Vision, Mission and Core Values of the Vidyapeeth

VISION OF VIDYAPEETH

Traditionally believing that God is the Source of all Truth, Goodness and Beauty, Lingaya's Vidyapeeth, wishes to develop in students a wisdom that translates academic achievements into responsible citizenship, sincere professional service and a deep respect for life and beauty in God's Creation and Recreation.

MISSION OF VIDYAPEETH

- To impart knowledge and skills in the field of Engineering/ Technology, Management, Education, Science & Arts and related areas;
- To dedicate itself for improvement of social and economic status and enhancement of the quality of life for all;
- To strive for maximizing human welfare through education;
- To produce effective knowledge workers, practitioners and educators who will be guided by vision, compassion, knowledge, discipline, discovery with deep respect for human values;
- To provide an individual engineering and other professional COURSE experience for each student;
- To develop critical thinking, analytical ability and creative skills;
- To supplement the curricula, team work, leadership, communication skills, project management, social concerns and ethics and
- To establish interaction with industries for Technology, Research & Development.

In line with above vision and mission statements, Lingaya's Vidyapeeth has the following special characteristics:

- Lingaya's Vidyapeeth is an Institution for providing a student with opportunity for all round development and education with the aim of effective living as a good citizen.
- It has special strength in the field of Engineering and Technology with emphasis on practice and problem solving skills.
- Its activities and course curriculum concentrate on design, self-COURSE and research, which are the unique features of the Vidyapeeth.
- The primarily value of knowledge and skill imparted by Lingaya's Vidyapeeth resides in its utility in creating an infrastructure for the physical welfare of the general public, in sustaining good health of individual and the community.
- Lingaya's Vidyapeeth facilitates and promotes creativity and critical thinking capabilities in its students.
- The education in Lingaya's Vidyapeeth enhances the inherent capacity of a student with honesty, courage and fairness.

SCHOOL OF BASIC AND APPLIED SCIENCES LINGAYAS VIDYAPEETH

VISION OF SCHOOL

To be a School committed to promote Science and research exploration and education for attracting young talented students to contribute effectively in augmenting the national pool for scientific development who are responsible citizens and sincere professionals with the deep knowledge.

MISSION OF SCHOOL

1. To strive to maximize human welfare through the understanding the different phenomena of science with advance scientific development.
2. To develop and maintain state –of –the –art infrastructure and research facilities to enable create, apply and disseminate knowledge.
3. To create inter-disciplinary research environment and
4. To prepare students who are capable to take up their future educational and career challenges.

Vision and Mission of Department of Chemistry

School of Basic and Applied Sciences LV

VISION OF DEPARTMENT

To be a department dedicated to promoting multidisciplinary chemical science and research activities, as well as education for interesting young brilliant students, in order to efficiently contribute to augmenting the local and national pool of responsible people and genuine professionals with deep expertise.

MISSION OF DEPARTMENT

1. To encourage young minds and help them to explore their strengths in both theory and experimental work of chemical sciences
2. To prepare our graduate to understand the chemical analysis to apply in other disciplinary approach.
3. To explore applications of chemical sciences in engineering, medical sciences and engage in collaborative research in a multidisciplinary environment.
4. The Chemistry Department is dedicated to producing competitive and professional graduates in multi-area

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO-1: Graduate can need to develop and apply new skills and strategies in order to address issue that arise as outcomes of new technologies.

PEO-2: Graduate will have a wide range of opportunities to get employment at local and National level, and can work as analyst, research assistant in industry and government sector job.

PEO-3: Graduate students will be able to perform synthesis, separation, and interpretation based on advanced expertise and experience.

PEO-4: Graduates will be able to formulate, study, and examine scientifically real-life issues, as well as work in a multidisciplinary team with an ethical attitude.

Mapping of PEOs with Mission Statements

PEO Statements	Department Mission 1	Department Mission 2	Department Mission 3	Department Mission 4
PEO1	3	2	1	1
PEO2	1	2	3	2
PEO3	2	3	2	1
PEO4	2	1	2	3

PROGRAM OUTCOMES (PO'S)

PO-1: Identify and resolve complex scientific issues in national and local level.

PO-2: Analyze and interpret data using analytical instruments to investigate chemical problems.

PO-3: To solve chemical problems, choose, plan, and implement suitable experiment techniques, as well as instrumentation handling.

PO-4: Recognize and use contextual multidisciplinary information to evaluate societal, health, safety, and global problem that are important to research practices.

PO-5: Adopt scientific ideas about environmental use and long-term sustainability.

PO-6: Enhance skills for future employability through activities such as seminar, communication skills, industrial visit, and internship.

PO-7 Recall the chemistry courses that are available for competitive test.

PO-8: The students attain sound knowledge in the areas of organic, inorganic, physical, pharmaceutical chemistry and material for pursing higher education and research.

Mapping of Program Outcome with Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4
PO1	1	2	1	2
PO2	2	1	3	2
PO3	2	1	3	1
PO4	2	1	3	1
PO5	1	1	1	3
PO6	3	3	1	1
PO7	2	3	1	1
PO8	1	2	2	3

PSO1: To gain an understanding of various principles of organic, inorganic, and physical che mistry, as well as their biological implications and applications in everyday life.

PSO2: Chemistry for industries: planning, conducting experiment, and confidently handling equipment.

School of Basic and Applied Science

B.Sc (H) / Chemistry

Batch: 2018-2021

Semester: 1

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course: CC,AECC,SEC,DSE,GE	Course focus on Employability/ entrepreneurship /Skill Development
Year:1–Semester:1								
1	BCH-110	Inorganic Chemistry – I	3	1	**0**	4	CC	Course focus on Employability
2	BCH-114	Organic Chemistry – I	3	1	**0**	4	CC	Course focus on Employability
3	BCH-120/BZH-120	Physical Chemistry – I/Zoology	3	1	**0**	4	CC	Course focus on Employability
4	BMA-115	Calculus (Elective)	5	1	**0**	6	GE	Course focus on Employability
5	BEN-101	Communication Skill (English)	2	0	**0**	2	SEC	Skill Development
6	BCH-160	Inorganic Chemistry – I Lab	0	0	**4**	2	CC	Course focus on Employability
7	BCH-170/BZH-170	Physical Chemistry – I Lab/Zoology Lab	0	0	**4**	2	CC	Course focus on Employability
8	BCH-164	Organic Chemistry – I Lab	0	0	**4**	2	CC	Course focus on Employability
9.	PDP-101	Induction and Nurturing Hobby	0	0	**2**	1	**SEC**	Skill Development

Semester: 2

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course: CC,AECC,SEC,DSE,GE	Course focus on Employability/ entrepreneurship /Skill Development
Year:1 –Semester:2								
1	BCH-115	Physical Chemistry – II	3	1	**0**	4	CC	Course focus on Employability
2	BCH-121	Inorganic Chemistry –II	3	1	**0**	4	CC	Course focus on Employability
3	BCH-122	Organic Chemistry –II	3	1	**0**	4	CC	Course focus on Employability
4	BPH-125	Thermal Physics	3	1	**0**	4	GE	Course focus on Employability
5	CEA-101A	Environmental Science and Ecology	2	0	**0**	2	CC	Course focus on Employability
6	BCH-165	Physical Chemistry – II Lab	0	0	**4**	2	CC	Course focus on Employability
7	BPH-175	Thermal physics Lab	0	0	**4**	2	SEC	-
8	BCH-171	Inorganic Chemistry –II Lab	0	0	**4**	2	CC	Course focus on Employability
9	BCH-172	Organic Chemistry –II Lab	0	0	**4**	2	CC	Course focus on Employability
10	PDP-102	People Connect	1	0	**0**	1	-	Skill Development

Semester:3

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course: CC,AECC,SEC,DSE,GE	Course focus on Employability/entrepreneurship /Skill Development
Year:2 –Semester:3								
1	BCH-219	Physical Chemistry-III	3	1	**0**	4	CC	Course focus on Employability
2	BCH-221	Inorganic Chemistry –III	3	1	**0**	4	CC	Course focus on Employability
3	BCH-222	Organic Chemistry –III	3	1	**0**	4	AECC	Entrepreneurship
4	BMA-230/ 241	Differential Equation-I/ Elementary Mathematics	3	1	**0**	4	GE	Course focus on Employability
5	BCS-201	Computer for Chemists/Skill Based Subject –I	3	0	**0**	3	GE	Course focus on Employability
6	BA-272-A	Entrepreneurship	3	0	**0**	3	GE	Course focus on Employability
7	BCH-271	Inorganic Chemistry –III Lab	0	0	**4**	2	SEC	Skill Development
8	BCH-272	Organic Chemistry –III Lab	0	0	**4**	2	CC	Course focus on Employability
9	BCH-269	Physical Chemistry-III Lab	0	0	**4**	2	CC	Course focus on Employability
10	BCS-251	Computer for Chemist Lab	0	0	**2**	1	GE	Course focus on Employability
11.	PDP-201	Personality Development and grooming	0	0	**2**	1	-	Skill Development

Semester:4

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course: CC,AECC,SEC,DSE,GE	Course focus on Employability/ Entrepreneurship /Skill Development
Year:2 –Semester:4								
1	BCH-225	Organic Chemistry –IV	3	1	**0**	4	CC	Course focus on Employability
2	BCH-223	Physical Chemistry-IV	3	1	**0**	4	CC	Course focus on Employability
3	BCH-226	Analytical Chemistry / Discipline Specific Elective-I	3	1	**0**	4	CC	Course focus on Employability
4	BA-264A	Managerial Skill/ Skill Enhancementt Subject –II	3	0	**0**	3	GE	Course focus on Employability
5	BPH-224/ BMA-241A	Element of Modern Physics/ Elementary Mathematics -II	3 5	1 1	**0 0**	4	GE	Course focus on Employability
6	BPH-274	General Elective Lab – IV / Element of Modern Physics Lab	0	0	**4**	2	AECC	Entrepreneurship
7	BCH-275	Organic Chemistry –IV Lab	0	0	**4**	2	CC	Course focus on Employability
8	BCH-273	Physical Chemistry-IV Lab	0	0	**4**	2	CC	Course focus on Employability
9	BCH-276	Analytical Chemistry lab/ Discipline Specific Elective-I-Lab	0	0	**4**	4	CC	Course focus on Employability
10	PDP-202	Life skill	**2**	**0**	**0**	**1**	GE	Course focus on Employability

Semester:5

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course: CC,AEC C,SEC,D SE,GE	Course focus on Employability/E ntrepreneurship /Skill Development
Year:3 –Semester:5								
1	BCH-324	Inorganic Chemistry –IV	3	1	**0**	4	CC	Course focus on Employability
2	BCH-325	Organic Chemistry-V	3	1	**0**	4	CC	Course focus on Employability
3	BCH-321	Physical Chemistry-V	3	1	**0**	4	CC	Course focus on Employability
4	BCH-322	Spectroscopy & and Some Important Compounds/Dis cipline Specific Elective-II	3	1	**0**	4	CC	Course focus on Employability
5	BCH-371	Physical Chemistry-V Lab	0	0	**4**	2	CC	Course focus on Employability
6	PD P-301	Leadership and Entrepreneurship Development	2	0	**0**	2	CC	Course focus on Employability
7	BCH-374	Inorganic Chemistry –IV Lab	0	0	**4**	2	CC	Course focus on Employability
8	BCH-375	Organic Chemistry -V Lab	0	0	**4**	2	CC	Course focus on Employability
9	BCH-378	Workshop on Chemical Sciences	0	0	**4**	4	CC	Course focus on Employability

Semester:6

S.No	Subject Code	Subject	L	T	P	Credit	Type of Course : CC,AEC C,SEC, D SE,GE	Course focus on Employability/Entrepreneurship /Skill Development
Year:3 –Semester:6								
1	BCH-326	Discipline Specific Elective /Polymer Chemistry	3	1	**0**	4	CC	Course focus on Employability
2	BCH-327	Discipline Specific Elective-IV/ Fuel Chemistry	3	1	**0**	4	CC	Course focus on Employability Course focus on Employability
3	BCH-377	Project/ Dissertation/ Industrial	0	0	**6**	10	CC	Course focus on Employability

LINGAYA'S VIDYAPEETH

NACHUALI, JASANA ROAD, FARIDABAD

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)
BCH 110: INORGANIC CHEMISTRY-I

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. Here in this course we are trying to enlightening the student about the periodic properties ofmain group elements and role of periodic table in the field of inorganic chemistry.
2. Students can categories the elements in the groups on the basis similar chemical and physical behavior.

Course Outcomes:

1. After study of these five units student must aware with the atomic structure and role of Periodic table and their properties in the field of inorganic chemistry.
2. Student must also know the reasons and relationship between the elements situated into similar groups and similar periods.
3. Students also learn characteristic feature of different families of the element.
4. The student will gain knowledge of main group element chemistry.

UNIT-1: S & P BLOCK ELEMENT

Comparative study of the elements includes diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function.

Emphasis on comparative study of periodic properties of p-block elements (including diagonal relationship and excluding methods of preparation). Preparation and properties of some important compounds - sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate.

UNIT-2: CHEMISTRY OF NOBLE GASES

Occurrence and uses of noble gases; Chemical properties of noble gases with emphasis on their low chemical reactivity, chemistry of xenon, structure and bonding of fluorides, oxides and oxyflourides of xenon.

UNIT-3: BORON FAMILY

Oxide of boron (B_2O_3), Oxyacid of boron (H_3BO_3)-preparation, properties and uses. Preparation, properties and structure of diborane and borazine. Trihalides of boron-preparation, properties and relative strengths of trihalides of boron as Lewis acid.

UNIT-4: CARBON FAMILY

Catenation, carbides, fullerenes, fluorocarbons, silicates (structural aspects), silicones- general methods of preparations, properties and uses. Silicon tetrachloride, silicates, zeolites.

UNIT-5: NITROGEN & OXYGEN FAMILY

Oxides: structures of oxides of N, P. Oxyacids: structure and relative acid strengths of oxyacids of nitrogen and phosphorus. Structure of white, yellow and red phosphorus.Oxyacids of sulphur- structures and acidic strength of H_2O_2- structure, properties and uses. Preparation,

properties, structure and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl3, PCl5); Structures of oxides and oxoacids of nitrogen and

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
- Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
- Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	-	-	1	-	2	3	1	1
CO2	3	2	1	-	1	-	3	-	1	2
CO3	1	2	-	-	-	-	3	2	-	2
CO4	1	2	3	-	1	-	3	-	1	2

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)
BCH 120: PHYSICAL CHEMISTRY-I

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

To develop scientific curiosity about physical chemistry and to understand the concept of kinetics, conduction, gaseous state and its application.

Course Outcomes:

1. Relate the concepts of chemical kinetics and its application
2. Interrelate the study of conductance and electrochemistry.
3. Correlate the solid state of an element to its physical and chemical properties.
4. Student must learn the liquid and gaseous state in detail.

UNIT-1: CHEMICAL KINETICS

Rate of reaction, Rate equation, Factors influencing the rate of reaction- concentration, temperature, pressure, catalyst. Order of reaction, integrated rate expression for zero order, first order, second order reaction. Half-life period of a reaction, methods for determination of order of reaction.

Effect of temperature on the rate of reaction.

UNIT-2 ELECTROCHEMISTRY-I

Electrolytic conduction, factors affecting electrolytic conduction, specific conductance, molar conductance, equivalent conductance and relation among them, Arrhenius theory of ionization, Ostwald's dilution law, Debye-Huckel equation, Transport number, definition and determination of Hittorf's methods.

UNIT-3 SOLID STATE

Classification of solids, laws of crystallography- (i) Law of constancy of interfacial angles (ii) Laws of rationality of indices (iii) Law of symmetry

Definition of unit cell and space lattice, Bravais lattices, crystal system. X-ray diffraction by crystals, derivation of Bragg equation,

UNIT-4 LIQUID STATE

Structure of liquids, properties of liquids- surface tension, viscosity, vapor pressure, Refractive Index and Types of Crystals.

UNIT-5 GASEOUS STATE

Maxwell's distribution of velocities and energies(derivation excluded), average velocity and most probable velocity, collision diameter, collision number, collision frequency, deviation of real gases from ideal behavior, derivation of vander Waal's equation of state.

Reference Books:

- Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	-	2	1	-	2	3	1	1
CO2	2	2	1	3	1	-	3	2	2	-

CO3	1	2	-	-	-	2	1	3	-	2
CO4	1	2	3	-	1	-	3	-	1	2

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)
BCH 114: ORGANIC CHEMISTRY-I

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
Students must have knowledge of basic of organic chemistry by studying the hybridization and reaction intermediates to predict the reaction mechanism

Course Outcomes:
Students will gain:
1. Understanding of hybridization and geometry of atoms and the three-dimensional structure of organic molecules
2. Analyze reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry
3. Predict the mechanisms for organic reactions by knowing the nucleophiles, electrophiles, electronegativity, and resonance
4. Use their understanding of organic mechanisms to predict the outcome of reactions

UNIT-1 BASICS OF ORGANIC CHEMISTRY-I
Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.
Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

UNIT-2 BASICS OF ORGANIC CHEMISTRY-II
Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.
Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

UNIT-3 STEREOCHEMISTRY:
Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.
Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

UNIT-4 CHEMISTRY OF ALIPHATIC HYDROCARBONS
(i) A. Carbon-Carbon sigma bonds
Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

(ii) Carbon-Carbon pi bonds:
Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.
Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.
Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-5 CYCLOALKANES AND CONFORMATIONAL ANALYSIS
Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of

alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Reference Books:

- Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
- Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PSO1	PSO2
CO1	1	2	-	1	1	-	2	1	1	1
CO2	2	2	1	2	1	-	3	2	1	-
CO3	1	2	-	-	-	2	3	2	-	1
CO4	1	2	-	-	1	1	3	-	1	

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)
BMA-115: CALCULUS

L-4, T-0 P-0 **Credits –4** **Max Marks:** 75

Course Objectives:

1. Understand the major problems of differential and integral calculus.
2. Appreciate how calculus allows us to solve important practical problems in an optimal way.

Course Outcomes:

Upon completion of the course, the student will be able to:

1. Interpret a function from an algebraic, numerical, graphical and verbal perspective and extract information relevant to the phenomenon modeled by the function.
2. Calculate the limit of a function at a point numerically and algebraically using appropriate techniques including L'Hospital's rule.
3. Explain the relationship between the derivative of a function as a function.
4. Compare and contrast the ideas of continuity and differentiability.

UNIT-1: LIMIT & CONTINUITY *:* The real line and its geometrical representation; *e-δ* treatment of limit and continuity; Properties of limit and classification of discontinuities; Properties of continuous functions.

UNIT-2: DIFFERENTIABILITY: Successive differentiation; Leibnitz Theorem; Statement of Rolle's Theorem; Mean Value Theorem; Taylor and Maclaurin's Theorems; Indeterminate forms.

UNIT 3: APPLICATIONS OF DIFFERENTIATION*:* Asymptotes; Concavity, convexity and points of inflection; Curvature; Extrema; elementry curves, tangent and normal in parametric form; Polar Coordinates.

UNIT-4: PARTIAL DIFFERENTIATION: Limits and continuity of functions of two variables; Partial derivatives; Taylor's theorem and Maclaurin's Theorem for function of two variable; Maxima and minima for function of two variable.

UNIT-5: DOUBLE AND TRIPLE INTEGRALS; Change of order in double integrals. Application of Integration : length of a curve; Arc length as a parameter; Evoute & Envelope; Volumes and surface areas of solids of revolution.

Reference 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.
5Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Company, New Delhi.
6. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
7. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
8. H. Anton, I. Bivens and S. Davis, *Calculus,* 7th Ed., John Wiley and Sons (Asia) P. Ltd.,Singapore, 2002.

POs Cos	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	-	1	1	-	1	1	1	1
CO2	2	2	1	2	1	-	1	2	1	-
CO3	1	2	-	-	-	2	1	2	-	-
CO4	1	1	1	2	1	1	2	1	1	1

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)

BEN 101: Communication Skill-I

L-3, T-0 P-0 **Credits –3** **Max Marks: 75**

Course Objectives:

1. Will be able to integrate their ideas with those of others using summary, paraphrase, quotation, analysis, and synthesis of relevant sources.
2. Assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long COURSE.
3. Will be able to Document their work using appropriate conventions.

Course Outcomes:

1. Students should be able to apply critical and theoretical approaches to the reading and analysis of literary and cultural texts in multiple genres.
2. Students should be able to write analytically in a variety of formats, including essays, research papers, reflective writing, and critical reviews of secondary sources.
3. Students should be proficient in oral communication and writing.
4. Develop Coherence, Cohesion and Competence in Oral Discourse through Intelligible Pronunciation

UNIT 1: COMMUNICATION AND ITS ELEMENTS: An introduction to the need of communication competency; Role of vocabulary in effective communication**;** Word formation; A set of selected 50 synonyms, antonyms, homonyms & homophones; suffixes & prefixes

UNIT 2: LISTENING AND READING SKILLS: Listening comprehension & reading comprehension; Listening to recorded speeches, TV News and other audio materials to test listening comprehension with given exercises

UNIT 3: WRITING SKILLS: Ad Creation; Slogan making; Picture composition; Expanding hints, proverbs; Movie review.

UNIT 4: LETTER WRITING: Types of letter writing; Structure & Lay out; Leave application; Letter of enquiry & response with respect to educational & official matters; Informal letter expressing or discussing social or educational issues.

UNIT5: SPOKEN SKILLS: Introduction to oral communication; Importance of Pronunciation; Importance of phonetics; Usage of Phonetics; Types of Conversation; Strategies for effective conversation for social and official interaction; Developing conversation on topics of current importance. Soft Skills Non-verbal Importance of Body Language and its usage to communicate better.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	-	1	-	1	1	-	2	1	1	1
CO2	2	2	1	2	1	-	3	2	1	-
CO3	1	2	-	-	-	2	3	2	-	1
CO4	1	2	-	2	-	1	2	1	1	-

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)

BCH 160: INORGANIC CHEMISTRY-I LAB

L-0, T-0 P-2 **Credits –1** **Max Marks: 60**

Course Objectives
The objective of this course is to get the knowledge of quantitative analysis of various inorganic compounds
Course Outcomes:

1. The students can able to calibrate the apparatus and prepare solutions of different concentrations.
2. The students have the detailed knowledge of quantitative analysis of mixture of inorganic compounds.
3. Students will learn about the titration and volumetric analysis.

List of Experiments:

S.No	Experiment	Unit
1	**(A) Titrimetric Analysis** (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality of titrants	1-5
2	**(B) Acid-Base Titrations** (i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture. (iii) Estimation of free alkali present in different soaps/detergents	1
3	**(C) Oxidation-Reduction Titrimetry** (i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution. (ii) Estimation of oxalic acid and sodium oxalate in a given mixture. (iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.	1-5

Reference text:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	-	-	1	-	2	8	1	1
CO2	3	2	1	-	1	-	3	-	1	2
CO3	1	2	-	-	-	-	3	2	-	2

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)

YEAR:1, SEMESTER:1

BCH 170: PHYSICAL CHEMISTRY- LAB

L-0, T-0 P-2 **Credits –1** **Max Marks: 60**

Course Objectives:
The objective of this course is to get the knowledge of analysis of a compound for its physical properties
Course Outcomes:

1. The students can able to determine the viscosity of solutions of different concentrations.
2. The students have the detailed knowledge of determining the surface tension of compounds/solution.
3. Students will learn about the pH metry of strong acid and strong base.

List of Experiments

S.No	Experiment	Unit
1	**Surface tension measurements.** a. Determine the surface tension by (i) drop number (ii) drop weight method. b. Study the variation of surface tension of detergent solutions with concentration.	5
2	**Viscosity measurement using Ostwald's viscometer**. c. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature. d. Study the variation of viscosity of sucrose solution with the concentration of solute.	4
3	**Indexing of a given powder diffraction pattern of a cubic crystalline system.**	3
4	**pH metry** b. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. c. Preparation of buffer solutions of different pH i. Sodium acetate-acetic acid ii. Ammonium chloride-ammonium hydroxide	2

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

CO1	2	1	-	-	1	1	-	1	1	1
CO2	3	2	1	-	1	1	-	-	1	2
CO3	1	2	-	1	-	2	-	2	-	2

B.SC. HONS. (CHEMISTRY)
(FIRST SEMESTER)

YEAR:1, SEMESTER:1

BCH 164: ORGANIC CHEMISTRY- LAB

L-0, T-0 P-2 **Credits –1** **Max Marks: 60**

Course Objectives:
The objective of this course is to get the knowledge of analysis of an organic compound and separation of mixture

Course Outcomes:

1. The students can able to calibrate the apparatus and prepare solutions of different concentrations.
2. The students can able to determine the melting and boiling point of different organic compounds
3. The students have the detailed knowledge of determining the purification and crystallization of compounds/solution. Students will learn about the separation of compounds by chromatography.

List of Experiments

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
   a. Water
   b. Alcohol
   c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown 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, Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography
   a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
   b. Separation of a mixture of two sugars by ascending paper chromatography
   c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	-	-	1	1	-	1	1	1
CO2	3	2	1	-	1	1	-	-	1	2
CO3	1	2	-	1	-	2	-	2	-	2

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER
BCH 115: PHYSICAL CHEMISTRY

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
1. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.
2. To use solution thermodynamic concepts to compute phase & reaction equilibrium data and also aware the chemical equilibria and colligative properties of a solution

Course Outcomes:
Students will gain an understanding of:
1. The relationship between microscopic properties of molecules with macroscopic thermodynamic observables
2. The differences between classical and quantum mechanics
3. Students will estimate equilibrium conversion in reversible reactions at given pressure and temperature following rigorous thermodynamic method
4. The student will learn the chemical equilibria and colligative properties of a solution.

UNIT-1: Thermochemistry-I:
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

UNIT-2: Thermochemistry-II :
Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

UNIT-3: 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 in mixing of ideal gases.

UNIT-4: Chemical Equilibrium:
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p , K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

UNIT-5: Solutions and Colligative Properties:
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.

Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Reference Books

- Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.,* Oxford University Press (2011).
- Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
- Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
- Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-
CO4	1	2	1	-	1	-	3	2	1	-

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER
BCH 122: ORGANIC CHEMISTRY

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives
The present curriculum enhance the knowledge of organic chemistry of students; they should aware with alkenes, dienes their properties and chemical activity. Nomenclature of halide improves the knowledge of student in term of nomenclature and all.

Course Outcomes:
1. After finishing this curriculum students are able to differentiate between alkyl aryl and aldehyde.
2. Student aware the nomenclature of benzene derivatives
3. Student learn synthesis of naphthalene, and other poly nuclear hydrocarbons.
4. Here with this curriculum electrophilic and substitution reaction are define the properties of chemical compounds.

UNIT-1: ALKENES & DIENES
Nomenclature of alkenes, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides. Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.Chemical reactions of alkenes – mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration- oxidation, reduction, ozonolysis, hydration, hydroxylation and oxidation with KMnO4, polymerization of alkenes, substitution at allylic and vinylic positions of alkenes. Industrial application of ethylene and propene. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of butadiene, Chemical reactions – 1, 2 and 1, 4 additions (elecrophilic & free radical mechanisms), Diels –Alder reaction.

UNIT-2: ALKYNES
Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of elecrophilic and nucleophilic addition reactions, hydroboration – oxidation of alkynes, metal –ammonia reductions, oxidation and polymerization.

UNIT-3: ALKYL & ARYL HALIDES
Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams.
Methods of formation and reactions of aryl halides, the addition elimination and the elimination – addition mechanisms of nucleophilic aromatic substitution reactions.
Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

UNIT-4: ARENES AND AROMATICITY
Nomenclature of benzene derivatives: Aromatic nucleus and side chain, Structure of benzene: Molecular formula and Kekule structure Aromaticity: Huckel rule, aromatic ions, anti-aromatic, non -aromatic compounds.Aromatic electrophilic substitution – general pattern of the mechanism, mechanism of nitration, halogenations, sulphonation, and friedel – crafts reaction. Energy profile diagrams. Activating deactivating substituent, orientation and ortho/para ratio. Side chain reactions of benzene derivatives, Birch reduction. Methods of formation and chemical reactions of alkyl benzenes, alkyl benzenes and byphenyl.

UNIT-5: POLY NUCLEAR HYDROCARBONS
Haworth synthesis of naphthalein and phenanthene, Pschorr synthesis of phenanthrene, synthesis of anthracene involving Friedal craft acylation of benzene with phthalic anhydride

and Diels-Alder reaction between 1,3-butadiene and 1,4- naphthaquinone, reaction of naphthalene, anthracene and phenanthrene, relative reactivities at different positions and mechanism of electrophilic substitution reactions in naphthalene, anthracene and phenanthracene.

Reference Books:

- Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
- Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1
CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	1	2	1	-	1	-	2	1	1	-

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER
BCH 121: INORGANIC CHEMISTRY

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

The students can gain the knowledge of inorganic compounds have industrial application including metallurgy and polymers

Course Outcome:

Here in this course work we design for student to understand following objects:

1. Student would learn theory of acid and base in practical chemistry.
2. Student also easily understands the reason of corrosion and principle of metallurgy.
3. Oxidation reduction would help the student to determine the reaction activity of any chemicalcompound.
4. Students can learn the concept of inorganic polymers and their importance.

UNIT-1 ACID AND BASE:

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle

UNIT-2: 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. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

UNIT- 3 CORROSION AND ITS CONTROL

Types of Corrosion: Wet corrosion, dry corrosion, galvanic corrosion, water-line corrosion, differential aeration corrosion & stress corrosion, Factors effecting corrosion, Protection from corrosion: Barrier, sacrificial, cathodic and anodic protection.

UNIT-4 OXIDATION AND REDUCTION

Use of redox potential data - analysis of redox cycle, redox stability in water - Frost, Latinmer and Pourbaix diagrams, Principles involved in the extraction of elements.

UNIT-5 INORGANIC POLYMER

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1
CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	2	3	-	-	1	-	1	2	1	2

BPH-125:THERMAL PHYSICS

L-3, T-1 P-0 Credits–4 Max Marks: 100

Objectives:The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics and to use this knowledge to explore various applications.

Course outcomes:

CO1: Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.

CO2: Use the statistical physics methods, such as Boltzmann distribution, Gibbs distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems.

CO3: Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.

CO4: Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.

Unit I: Introduction to Thermodynamics (14 Lectures)

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Unit II: Second Law of Thermodynamics: (8 Lectures)

Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Unit III: Entropy (10 Lectures)

Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.

Unit IV: Maxwell's Thermodynamic Relations (10 Lectures)

Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Kinetic Theory of Gases:Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

UNIT V: Molecular collisions: (11 Lectures)

Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

Reference books:

- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	1	3	-	2	2	2	1	1
CO2	1	3	1	-	1	2	1	-
CO3	1	3	3	2	1	2	2	-
CO4	2	3	-	-	2	1	-	2

B.SC. HONS. (CHEMISTRY)

SECOND SEMESTER

CEA-101 A: ENVIRONMETAL SCIENCE AND ECOLOGY

L-2, T-0 P-0 Credits –2 Max Marks: 50

Course Objectives:

1. Environmental Studies is a multidisciplinary area, the issues of which everyoneshould know.
2. The aim of the course is to make everyone aware of environmental issues like continuing problems of pollution, loss of forest, solid waste disposal, and degradationof environment.
3. Issues like economic productivity and national security, global warming, the depletionof ozone layer and loss of biodiversity are other serious concerns before the mankind.

Course Outcomes:

On the completion of the course, students should be able to:

1. understand fundamental terms related to environment and aware of environmental problems;
2. Analyze the complexities of environmental problems and should know remedies available to them and implement them at their own level;
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Demonstrate proficiency in quantitative methods, qualitative analysis and critical thinking

UNIT 1.THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:

Basic definitions related to environment; Scope, vis-à-vis environmental science and environmental engineering; a uses of environmental degradation, atmospheric compositionand associated spheres, habitat and climate; objective, goals and principals involved in environmental education, environmental awareness, Environmental ethics, environmental organization and their involvement.

UNIT-2 NATURAL RESOURCES:

Renewable and non-renewable resources; forest resources, over-exploitation, and deforestation afforestation; water resources, impact of over-utilization of surface and ground water, floods, drought, conflicts over water, dams; mineral resources: dereliction of mines, environmental effects of extracting and using mineral resources; Food resources, modern agriculture and its impact, problem associated with fertilizer and pesticide, water logging, salinity ; energy resources, renewable, non-renewable energy sources, solar energy, wind energy, hydro energy, biomass energy, geothermal energy, nuclear energy and its associated hazards; land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT-3 ECOSYSTEMS:

Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids; characteristic features, structure and function of the following ecosystem -forest ecosystem, grassland ecosystem desert ecosystem and aquatic ecosystems.

UNIT-4 BIODIVERSITY AND ITS CONSERVATION:

Bio-geographical classification of India; biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity; value of biodiversity-consumptive use, productive use, social, ethical aesthetic and option values; threats to biodiversity; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT-5 ENVIRONMENTAL POLLUTION AND SOCIAL ISSUES:

Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution; solid waste management, e-waste management; disaster management –floods, earthquake, cyclone and landslides. Water conservation, rain water harvesting, watershed management; climate change, global warming, acid rain, ozone layer depletion; Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

Reference Book:

1. Agarwal, K.C., "Environmental Biology", 2nd Edition, Nidhi Publ. Ltd., Bikaner, 2001.
2. Bharucha Erach, "The Biodiversity of India", 2nd Edition, Mapin Publishing Pvt. Ltd., 2006.
3. Kaushik, Anubha, and Kaushik, C.P., "Perspectives in Environmental Studies", 4th Edition,
4. New Age International Publishers, 2004
5. Brunner R. C., "Hazardous Waste Incineration", 1st Edition McGraw Hill Inc., 1989.
6. Clark R.S., "Marine Pollution", 1st Edition Clanderson Press Oxford,1989
7. .Cunningham, W.P., Cooper, T.H. Gorhani, E. & Hepworth, M.T., Environmental Encyclopedia", 2nd Edition, Jaico Publ. House, 2001.
8. De, A. K., "Environmental Chemistry", 2nd Edition, Wiley Eastern, 1989
9. Jadhav, H. and Bhosale, V.M ., "Environmental Protection and Laws", 1st Edition,Himalaya Pub. House, Delhi, 1995.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1
CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	1	2	1	1	1	1	1	2	-	1

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER
BCH 172: ORGANIC CHEMISTRY- LAB II

L-0, T-0 P-2 **Credits –1** **Max Marks: 60**

Course Objectives
The objective of this course is to get the knowledge of analysis of an organic compound and separation of mixture
Course Outcomes:

1. The students can able to calibrate the apparatus and prepare solutions of different concentrations.
2. The students can able to determine the melting and boiling point of different organic compounds
3. The students have the detailed knowledge of determining the purification and crystallization of compounds/solution.Students will learn about the separation of compounds by chromatography.

List of Experiments

S. No	Experiment	Unit
1	Checking the calibration of the thermometer	3
2	4. Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-Water	1
3	Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)	1
4	Effect of impurities on the melting point – mixed melting point of two unknown organic compounds, Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)	1

5	Chromatography d. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography e. Separation of a mixture of two sugars by ascending paper chromatography f. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)	5

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER
BCH 171: INORGANIC CHEMISTRY-II LAB

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives
The objective of this course is to get the knowledge of gravimetric analysis of an inorganic compound, preparation of complexes and separation of salt mixture by chromatography

Course Outcomes:
1. The students can estimate the metal ions present in different inorganic compounds.
2. The students can synthesize inorganic coordination compounds or complexes.
3. The students have the detailed knowledge of separation of compounds by chromatography.

List of Experiments

S. No.	Experiment	Unit
1	**Gravimetric Analysis:** i. Estimation of nickel (II) usingDimethylglyoxime (DMG). ii. Estimation of copper as CuSCN iii. Estimation of iron as Fe_2O_3 byprecipitating iron as $Fe(OH)_3$. iv. Estimation of Al (III) by precipitatingwith oxine and weighing as $Al(oxine)_3$ (aluminium oxinate	1
2	**Inorganic Preparations:** i. Tetraamminecopper (II) sulphate,$[Cu(NH_3)_4]SO_4.H_2O$ ii. *Cis* and *trans* $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate(III) iii. Tetraamminecarbonatocobalt (III) ion iv. Potassium tris(oxalate)ferrate(III)	3
3	**Chromatography of metal ions** Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Fe (III) and Al (III)	2

Reference Book:
1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
SECOND SEMESTER

BCH 165: PHYSICAL CHEMISTRY- II LAB

L-0, T-0 P-2 **Credits –1** **Max Marks: 60**

Course Objectives

The objective of this course is to get the knowledge of analysis of thermodynamic parameters of a system

Course Outcomes:

1. The students can able to determine the heat capacity of different concentrations.
2. The students can able to calculate the ionization and hydration enthalpy of different compounds.
3. The students have the detailed knowledge of determining the basicity and solubility of compounds.

List of Experiments

S.No	Experiment	Unit
1	Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).	
2	Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.	
3	Calculation of the enthalpy of ionization of ethanoic acid.	
4	Determination of heat capacity of the calorimeter and integralenthalpy (endothermic and exothermic) solution of salts.	
5	Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for differentadditions of a base. Also calculate the enthalpy of neutralization of the first step.	
6	Determination of enthalpy of hydration of copper sulphate	
7	Study of the solubilityΔ of benzoic acid in water and determinationof H	

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-

BPH-175:THERMAL PHYSICS LAB

L-0, T-0 P-4 Credits–2 Max Marks: 100

Objective:The aim of this Lab is skill the students with various experiments involved in thermal physics.

Course outcomes:

CO1: Students will learn about thermal measurements.
CO2: understand the concept thermometer and variable resistance.
CO3: determination ofthermal conductivity of the materials.
CO4: understand the thermodynamics of materials.

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Note: Each student is required to perform at least seven experiments.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	1	2	2	1	1
CO2	3	3	1	-	1	2	1	-
CO3	1	3	-	1	1	2	2	2
CO4	2	3	-	1	2	1	-	-

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 222: ORGANIC CHEMISTRY- III

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. The present curriculum enhance the knowledge of organic chemistry of students; they should aware with alkenes, dienes their properties and chemical activity.
2. Benzene derivatives also plays an important role in organic chemistry to understand the students, it have their own importance.

Course Outcomes:

1. After finishing this curriculum students are able to differentiate between alkyl aryl and aldehyde.
2. Student aware the nomenclature of benzene derivatives
3. Student learn synthesis of naphthalene, and other poly nuclear hydrocarbons.
4. Here with this curriculum electrophilic and substitution reaction are define the properties of chemical compounds.

UNIT-1: ALCOHOLS

Monohydric alcohols—nomenclature, methods of formation by reduction of aldehydes, ketones, Carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols. Dihydric alcohols- nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.

UNIT-2: EPOXIDES

Synthesis of epoxides, acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

UNIT-3: PHENOLS

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions.

UNIT-4: CARBOXYLIC ACIDS

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids. Hydroxy acids: malic, tartaric andcitric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Industrial manufacture of acetic acid and benzoic acid (flow sheet diagram). Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

UNIT-5: CARBOXYLIC ACID DERIVATIVES

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides, relative stability of acyl derivatives. Physical properties, interconversion of acid

derivatives by nucleophilic acyl substitution, Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

Reference Books:

Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

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

Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	1	-	1	-	2	2	1	1
CO2	1	2	1	-	1	-	1	2	1	2
CO3	1	3	1	-	-	-	1	2	2	-
CO4	1	2	1	-	1	-	2	2	1	2

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 219: PHYSICAL CHEMISTRY- III

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. Here in this syllabus we start COURSE with aspects of electrochemistry and thermodynamics. It became easy to understand the aspect of thermodynamic behavior of chemical reaction and their direct indirect influence on chemical activity after the study.
2. Student also learn the theoryof phase equilibrium and their different aspect of forward and backward reactions.

Course Outcomes:

1. On finishing these modules of chemistry we are able to surface, electro and critical phenomenon.
2. It is also easy to understand thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le-Chatellier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.
3. Student may also able to understand the critical phenomenon
4. The students can determine the deviation of real gas from ideal behavior.

UNIT-1: THERMODYNAMICS

Definition of thermodynamics terms: system, surrounding, types of systems, intensive and extensive properties. State and path functions, Thermodynamic processes. Concept of heat and work. Zeroth Law of thermodynamics, first law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – joule – Thomson coefficient for ideal gas and real gas: and inversion temperature. Calculation of work done, heat, internal energy, enthalpy for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

UNIT-2: SURFACE CHEMISTRY

Adsorption by solids, Application of adsorption, Adsorption of gases by solids, Factors influencing the adsorption, Langmuir theory of adsorption, Adsorption from solution, Gibbs adsorption isotherm.

UNIT-3: DISTRIBUTION LAW

Nernst distribution law, conditions for the validity of Nernst distribution law, Derivation of molecular complexity from distribution law. Application of distribution law i.e. calculation of solubility of solute in solvent, determination of equilibrium constant from distribution law, distribution indicator, process of extraction and determination of degree of hydrolysis and study of complex ion formation, limitation of distribution law.

UNIT-4: ELECTROCHEMISTRY – II

Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity, temperature & pressure on it. Application of Kohlarausch's law in calculation of conductance of weak electrolytes at infinite dilution.

Application of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of sparingly soluble salts, conductance titrations. Definition of pH and pKa, Buffer action, Buffer mechanism of buffer action.

UNIT-5 GASEOUS STATE

Maxwell's distribution of velocities and energies(derivation excluded), average velocity and most probable velocity, collision diameter, collision number, collision frequency, deviation of real gases from ideal behavior, derivation of vander Waal's equation of state.

Reference Books:

Peter Atkins & Julio De Paula, *Physical Chemistry 9th Ed.,* Oxford University Press (2010).

- Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
- McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
- Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
- Ball, D. W. *Physical Chemistry* Cengage India (2012).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1
CO2	1	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	1	2	-	-	1	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 221: INORGANIC CHEMISTRY- III

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. Here in this course we are trying to enlightening the student about the role of transition elements in the field of inorganic chemistry.
2. Students can categories the elements in the groups on the basis similar chemical and physical behavior.

Course Outcomes:

1. After study of these five units student must aware with transition elements and their properties and applications in the field of inorganic chemistry.
2. Student must also know the reasons and relationship between the elements situated into similar groups and similar periods of 3d,4d and 5d transition series
3. Students also learn characteristic feature of different families of f-block elements
4. Students can learn the coordination and interhalogen compounds

UNIT-1: CHEMISTRY OF ELEMENTS OF IST TRANSITION SERIES:

Definition of transition elements, position in the periodic table, General characteristics & properties of Ist transition elements, Structures & properties of some compounds of transition elements– TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$

UNIT-2: CHEMISTRY OF ELEMENTS OF IIND & IIIRD TRANSITION SERIES:

General characteristics and properties of the IInd and IIIrd transition elements Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic radii, oxidation state, magnetic and Spectral properties and stereochemistry.

UNIT-3: LANTHANIDES:

Comparative study of lanthanide elements with respect to electronic configuration atomic and ionic radii, oxidation state and complex formation, lanthanide contraction. Separation of lanthanides. Application of lanthanide complexes.

UNIT-4: COORDINATION COMPOUNDS

Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

UNIT-5: HALOGEN FAMILY

Basic properties of halogen, interhalogens types properties, hydro and oxyacids of chlorine – structure and comparison of acid strength.

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
- Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
- Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-

Heinemann. 1997.
- Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
- Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.,* Pearson, 2010.
- Shriver & Atkins, *Inorganic Chemistry 5th Ed.*

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	1	1	1	-	2	2	1	1
CO2	1	3	1	-	1	-	1	2	2	1
CO3	1	3	-	1	-	-	1	2	-	2
CO4	1	3	-	1	-	-	2	2	-	2

B.SC. HONS. (CHEMISTRY)

THIRD SEMESTER

BMA-230: DIFFERENTIAL EQUATIONS-I

L-4, T-0 P-0 Credits –4 Max Marks: 75

Course Objectives:

1. Maintain a core of Mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.

COURSE OUTCOMES:

1. Students can perform abstract mathematical reasoning.
2. Students can identify and explain cases in which major results of one branch of mathematics rely nontrivially on results from another branch (e.g., the application of linear algebra to solving systems of differential equations).
3. Students will demonstrate their ability to solve problems in mathematics using appropriate technology.
4. Students will translating problems from one form to another, using various problem-solving strategies

UNIT 1: Geometrical meaning of a differential equation. Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form.

UNIT-2: Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous equation.

UNIT -3: Method of variations of parameters. Method of undetermined coefficients. Reduction of order of a differential equation. Linear differential equations of second order: Reduction to normal form.

UNIT-4: Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations.

UNIT-5: Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators x (d/dx) or t (d/dt) etc. Simultaneous equation of the form dx/P = dy/Q = dz/R. Total differential equations. Condition for Pdx + Qdy +Rdz = 0 to be exact. General method of solving Pdx + Qdy + Rdz = 0 by taking one variable constant.

Reference Books:

1. B.Rai & D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House Pvt. Ltd.

2. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	1	1	1	-	2	2	1	1
CO2	1	3	1	-	1	-	1	2	2	1
CO3	1	3	-	1	-	-	1	2	-	2
CO4	1	1	1	2	-	-	1	1	1	1

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BA-272-A: ENTREPRENEURSHIP DEVELOPMENT

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

It provides exposure to the students to the entrepreneurial cultural and industrial growth so as to prepare them to set up and manage their own small units.

Course Outcomes:

1. You understand different methods to assess the attractiveness of business opportunities.
2. The students solve a specific innovation challenge and apply their knowledge into actual actionthat creates value for others.
3. Creates a pre-understanding and a foundation for which the students can be tested in theoretical insight,understanding and critical thinking

UNIT I- INTRODUCTION: The Entrepreneur: Definition, Emergence of Entrepreneurial Class; Theories of Entrepreneurship.

UNIT 2 PROMOTION OF A VENTURE:

Opportunity Analysis; External Environmental Analysis Economic, Social and Technological; Competitive factors; Legal requirements of establishment of a new unit and Raising of Funds; Venture Capital Sources and Documentation Required.

UNIT 3 ENTREPRENEURIAL BEHAVIOUR:

Innovation and Entrepreneur; Entrepreneurial Behaviour and Psycho-theories, Social responsibility.Entrepreneurial Development Programmes (EDP): EDP, Their Role, Relevance and Achievements; Role of Government in Organizing EDP's Critical Evaluation.

UNIT 4 ROLE OF ENTREPRENEUR:

Role of an Entrepreneur in Economic Growth as an Innovator, Generation of Employment Opportunities, Complimenting and Supplementing Economic Growth, Bringing about Social Stability and Balanced Regional Development of Industries: Role in Export Promotion and Import Substitution, Forex Earnings.

Text Books:

1. Hisrich, Robert and Peters, Michael, (2002), Entrepreneurship, 5thEdition, McGrawHill Education.
2. Charantimani, (2006), Entrepreneurship Development and Small Business Enterprise, 1stedition, Pearson Education.

Reference Books:

1. Chandra, Ravi, (2003), Entrepreneurial Success: A Psychological Study, Sterling Publication Pvt. Ltd., New Delhi.
2. Balaraju, Theduri, (2004), Entrepreneurship Development: An Analytical Study, Akansha Publishing House, New Delhi.
3. David, Otes, (2004), A Guide to Entrepreneurship, Jaico Books Publishing House, Delhi.
4. Kaulgud, Aruna, (2003), Entrepreneurship Management, Vikas Publishing House, Delhi.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	1	1	1	-	2	2	1	1
CO2	1	2	1	-	1	-	1	2	2	1
CO3	1	3	-	1	-	-	1	2	-	2

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BMA-241: ELEMENTARY MATHEMATICS-I

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.
2. Students will demonstrate their ability to solve problems in mathematics using appropriate technology, translating problems from one form to another, using various problem-Solving Strategies.

Course Outcomes:

1. Students' can perform abstract mathematical reasoning.
2. Students' can identify and explain cases in which major results of one branch of mathematics rely nontrivially on results from another branch (e.g., the application of linear algebra to solving systems of differential equations).
3. Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties
4. Understand the basic methods of complex integration and its application in contour integration.

UNIT-1: SEQUENCE AND SERIES:

Arithmetic Progression (A.P.), Arithmetic Mean (A.M.), Geometric Progression (G.P.), general term of a G.P., sum of n terms of a G.P. Arithmetic and geometric series, infinite G.P. and its sum, geometric mean (G.M.). Relation between A.M. and G.M. Sumto n terms of the special series : $\sum n$, $\sum n^2$ and $\sum n^3$.

UNIT-2: MATRICES

Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices. Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2). (Here all matrices will have real entries).

UNIT-3: DETERMINANTS

Determinant of a square matrix (up to 3×3 matrices), properties of determinants, minors, cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

UNIT-4: DIFFERENTIATION

Differentiability, derivative of composite functions, chain rule, , derivative of implicit function. Concepts of exponential, logarithmic functions. Derivatives of $\log e^x$ and e^x. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives.

Rate of change, maxima and minima.Simple problems

UNIT-5: INTEGRALS

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts. Definite integrals as a limit of a sum. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and

evaluation of definite integrals. Applications in finding the area under simple curves

TEXT BOOKS/REFERENCE BOOKS:

1. R.D SHARMA FOR CLASS 11th AND 12TH MATHEMATICS
2. R.S. AGRAWAL FOR CLASS 12TH MATHEMATICS
3. PRADEEP'S REFERENCE BOOK FOR CLASS 11TH

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	1	1	1	-	2	2	1	1
CO2	1	3	1	-	1	-	1	2	2	1
CO3	1	2	-	-	-	1	-	1	-	1
CO4	1	1	-	1	1	1	1	1	-	2

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCS-201: COMPUTER FOR CHEMISTS

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:

1. Understand the principles of creating an effective web page including an in-depth consideration of information architecture.
2. Understand how to plan and conduct user research related to web usability.

Course Outcomes:

1. Develop and implement solutions to problems encountered in all phases of the design process.
2. Apply effective business practices and project management
3. An ability to analyze the local and global impact of computing on individuals, organizations, and society
4. A recognition of the need for and an ability to engage in continuing professional development

UNIT – 1: INTRODUCTION TO INTERNET

World Wide Web and concepts of website, web pages etc. Client – Server Architecture, The idea of hypertext and hyper media: how the web works: HTTP, HTML and URLs; how the browser works: MIME types, plug-ins and helper applications, standards, Introduction to HTML, XML, XHTML and the W3C.

UNIT –2 : HYPERTEXT MARKUP LANGUAGE

HTMLS: The anatomy of an HTML document; marking up for structure and style: basic page markup, ordered and unordered list, Structuring content with HTML using natural divisions, Marquee text with or without background with attributes, Working with Links Internal Links: Anchor Link, Email Link; embedding images, table creation: Table attributes Colspan, Rowspan, Table Border, Align, Valign, Table background image, Nesting tables, Frames and Nesting, iframes, forms, Semantic elements of HTMLS, Media tags in HTMLS.

UNIT – 3 : CASCADING STYLE SHEET

Introduction to Cascading Style Sheet: Selector, Declaration and declaration block. Types of CSS – Inline and Internal style specifications within HTML; external linked style specification using CSS, page and site design considerations. Types of Selector:Universal, Class and ID Selector, Building & Applying Class Selectors, ID Selector using Div Tags and span tag.

UNIT – 4 : CLIENT SIDE PROGRAMMING:

Introduction to JavaScript syntax: output, Comments, variables, functions, operators, conditions, switch, loop. Java1Script object model: Window, Location and History object model; HTML DOM: Introduction to DOM: methods, event handling, navigation, Forms validation.

UNIT – 5 : TESTING WEB APPLICATION

Introduction, Fundamentals, Terminology, Quality characteristics, test objectives, test levels, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing Load, stress

and continuous testing; Testing Security; Test automation; Benefits and drawbacks of automation testing.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	-	-	1	-	2	3	1	1
CO2	1	1	1	-	1	-	1	3	2	1
CO3	1	3	2	1	1	1	-	2	-	1
CO4	1	1	2	1	2	13	1	1	1	2

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
PDP 201: PDP

L-2, T-0 P-0 **Credits –2** **Max Marks: 55**

Course Objective:

To acquaint the students with the understanding of self-development through good inter-personal skills for effective social communication in order to succeed in maintaining relationships in professional and social environments.

Course Outcome

1. This module will also help at course group discussions and interview skills to enable employability and professional fit.
2. Student will able to self-development through good inter-personal skills for effective social communication
3. Able to communicate effectively with a range of audiences.

UNIT: 1. **SELF AWARNESS:** Development of our Self Image, Social Comparison, Significant others, Self Esteem, Self Confidence.
UNIT: 2. **ASSERTIVENESS & CONFIDENCE**: Assertiveness, Being Confident, Strategies to make Assertive NO Easier, Dealing with Emotions, Difference between being Aggressive and being Assertive.
UNIT: 3. **TEAM BUILDING & TEAM WORK**: The Team Concept, Elements of Team Work, Stages of Team Formation, Effective Team, Essential Building Blocks of Effective Teams, Team Player's Style, Team Tasks, Exercises.
UNIT: 4. **LEADERSHIP SKILLS:** Leadership Skills & Styles, Motivating People, Understanding Abilities, Delegating Tasks, Managing People, Overcoming Hurdles, Exercises.
UNIT: 5. **INTERVIEW SKILLS:** Why an Interview, The First Step to a Successful Interview, Resumes that make an impact, The Interview Process, The Interview Preparation Checklist, Interviewing Skills, Putting your Best Foot Forward, Common Interview Mistakes, One on One HR Interviews (two for each student).
UNIT: GROUP DISCUSSION SKILLS: Meaning of a GD, Types, Role of a Moderator, Do's and Don'ts, Mock GDs on General, Knowledge based and Abstract topics.
UNIT: 7. **THE ART OF CONVERSATION**: Skills to strike a Conversation, Sustaining Conversation, Communicating across Cultures, Conflict Management.

REFERENCE BOOKS

1. Haddon, F. Peter, "Mastering Personal and Interpersonal Skills", Viva Books Pvt. Ltd., 2003
2. Schuller, Robert H., "Tough Times Never Last But Tough People Do", Orient Paperbooks, 1988
3. Bolton, Robert, "People Skills", Touchstone Books, 1986
4. Jansaz, De Suzanne, " Interpersonal Skills in Organizations", 3rd Edition, McGraw-hill Education (Asia), 2009
5. Fontana, David, "Social Skills at Work", Universities Press, 2000
6. Burns, James Mac Gregor, "Leadership", Harper Perennial, 1982
7. Harris, Godfrey, "Art of Conversation", Jaico Publishing House, 2002

8. Ganguly, Anand,"Group Discussions and Interviews", Ramesh Publishing House, 2008

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	2	-	-	1	-	2	1	1	1
CO2	2	2	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	1	-	2

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 272: ORGANIC CHEMISTRY- II-LAB

L-0, T-0 P-3 **Credits –1** **Max Marks:60**

Course Objectives
The objective of this course is to get the knowledge of functional group analysis of an organic compound and other chemical reaction

Course Outcomes:

1. The students can able to calibrate the apparatus and prepare solutions for the functional group test.
2. The students can able to prepare amine or nitro group based organic compounds
3. The students have the detailed knowledge of amine based named reaction and reduction reaction by preparation of organic compounds.

List of Experiments

S. No	Experiment	Unit
1	Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.	3
2	Organic preparations: Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine)β and phenols (-naphthol, vanillin, salicylic acid) by any one method: a. Using conventional method. b. Using green approach	2
3	Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) andβ one of the following phenols (-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.	
4	Oxidation of ethanol/ isopropanol (Iodoform reaction)	2
5	Bromination of any one of the following: a. Acetanilide by conventional methods Acetanilide using green approach (Bromate-bromide method.	1
6	Nitration of any one of the following: b.Acetanilide/nitrobenzene by conventional method c.Salicylic acid by green approach (using ceric ammonium nitrate).	3
7	Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline	1
8	Reduction of *p*-nitrobenzaldehyde by sodium borohydride.	1
9	Hydrolysis of amides and esters.	3
10	Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde	3
11	*S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).	4

12	Aldol condensation using either conventional or green method.	3
13	Benzil-Benzilic acid rearrangement.	4

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
- Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 269: PHYSICAL CHEMISTRY- III-LAB

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives
The objective of this course is to get the knowledge of analysis of chemical (phase and ionic) equilibria parameters of a system
Course Outcomes:

1. The students can able to determine the critical solution temperature of different concentrations.
2. The students can able to calculate the degree of freedom by phase diagram of different eutectic system.
3. The students have the detailed knowledge of adsorption isotherms and kinetics of saponification.

List of Experiments

S. No	Experiment	Unit
1	Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it	1
2	II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: simple eutectic and congruently melting systems	1
3	Distribution of acetic/ benzoic acid between water and cyclohexane	1
4	Study the equilibrium of at least one of the following reactions by the distribution method: (i) $I_2(aq) + I^- \rightarrow I_3^-(aq)$ *(ii)* $Cu^{2+}(aq) + n NH \rightarrow Cu(NH_3)_n^{2+}$	2
5	Study the kinetics of the following reactions. 1. Initial rate method: Iodide-persulphate reaction 2. Integrated rate method: a. Acid hydrolysis of methyl acetate with hydrochloric acid. b. Saponification of ethyl acetate. 3. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.	3
6	Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.	4

Reference Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry*

8th Ed.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	2	3	2	-	-	-	1	3	-	-

B.SC. HONS. (CHEMISTRY)
THIRD SEMESTER
BCH 271: INORGANIC CHEMISTRY- II-LAB

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives

The objective of this course is to get the knowledge of iodimetric analysis of an inorganic compound and preparation of complexes.

Course Outcomes:

1. The students can estimate the metal ions present in different inorganic compounds by iodimetric titrations.
2. The students can synthesize inorganic coordination compounds or complexes.
3. The students have the detailed knowledge of prepared coordination compounds.

List of Experiments

S. No	Experiment	Unit
1	**(A) Iodo / Iodimetric Titrations** (i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically). (ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically (iii) Estimation of available chlorine in bleaching powder iodometrically.	1
2	**(B) Inorganic preparations** (i) Cuprous Chloride, Cu_2Cl_2 (ii) Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$ (iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.	5

Reference Books:

- Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS. 1978

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	2	3	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 223: PHYSICAL CHEMISTRY-IV

L-4, T-0 P-0 Credits –4 Max Marks: 75

Course Objectives:

1. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students.
2. To use solution thermodynamic concepts to compute phase & reaction equilibrium data.

Course Outcomes:

Students will gain an understanding of:

1. The relationship between microscopic properties of molecules with macroscopic thermodynamic observables
2. The differences between classical and quantum mechanics
3. The fundamentals of nuclear decay.
4. Students will estimate equilibrium conversion in reversible reactions at given pressure and temperature following rigorous thermodynamic method

UNIT-1 THERMODYNAMICS

Second law of thermodynamics. Need of the law, Concept of entropy, entropy as a state function of V and T, entropy as a function of P and T. Entropy change in physical processes. Entropy as criteria of Spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases, work function, Gibb's free energy function. Gibbs function (G) and Helmholtz function (A) as thermodynamic function. Criteria of spontaneity of reversible processes in terms of enthalpy change, entropy change, work function and free energy function. Variation of G and A with P, V and T. Gibb Helmholtz equation and its application, Third law of thermodynamics and its applications. Partial molar quantities. Chemical potential. Gibb's Duhem equation. Gibb's adsorption equation and its application.

UNIT-2 COLLOIDAL STATES

Colloids, classification of colloids, solids in liquids (sols) properties: Kinetic, optical and Electrical, stability of colloids, protective colloids, Hardy-schulze Rule, gold number, Emulsion types of emulsion and their preparation, Emulsifier. Gels (liquid in solids): Classification and properties, General application of colloids.

UNIT-3 CRITICAL PHENOMENON

Critical temperature**, critical** pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal's constants. Critical compressibility factor, the law of corresponding states. Liquefaction of gases.

UNIT-4 NUCLEAR CHEMISTRY:

Radioactivity, Properties of radiation, detection & measurement of radioactivity, types of radioactive decay, Group displacement law, rate of radioactive decay, half life, calculation of half life, radioactive dating, nuclear reactions: nuclear fission and nuclear fusion reaction. Nuclear binding energy.

UNIT-5 CHEMICAL BONDING:

Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their

limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

Reference Books:

- Atkins, P.W & Paula, J.D. *Physical Chemistry*, 9th Ed., Oxford University Press (2011).
- Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
- Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
- Barrow, G. M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).

- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
- Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	1	1	1	-	2	2	1	1
CO2	1	3	1	-	1	-	1	2	2	1
CO3	1	3	-	1	-	-	1	2	-	2
CO4	1	2	-	1	-	-	1	2	-	2

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B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 226: ANALYTICAL CHEMISTRY-III

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic and laboratory skills for the undergraduate students. They comprises of chemistry of soil, water, food products and cosmetics along with chromatography.

Course Outcomes:

1. The various topics of the syllabus are grouped under different units in order to bring forth the basic knowledge and importance of analytical chemistry and error measurements.
2. From this syllabus class will be able to understand about the chemistry of soil and water and their properties.
3. With this syllabus class will able to analyze the food products.
4. Students can identify and separate the mixture by chromatography and analyze the cosmetics.

UNIT-I INTRODUCTION:
Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

UNIT-II ANALYSIS OF SOIL & WATER:
Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample.

UNIT-III ANALYSIS OF FOOD PRODUCTS:
Nutritional value of foods, idea about food processing and food preservations and adulteration. a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. b. Analysis of preservatives and colouring matter.

UNIT-IV CHROMATOGRAPHY:
Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. a. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+). b. To compare paint samples by TLC method. Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

UNIT-V ANALYSIS OF COSMETICS:
Major and minor constituents and their function a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Reference Books:

- Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
- Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
- Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing

Company 1994.
- Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
- Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
- Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann,1997.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	1	1
CO2	1	3	1	-	1	3	1	2	1	2
CO3	2	3	-	1	1	-	1	2	2	-
CO4	2	3	-	1	1	-	2	3	2	-

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 225: ORGANIC CHEMISTRY-III

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
The objective of this course is to learn the organometallic reagents and heterocyclic compounds and their application in organic chemistry by knowing the synthesis mechanism.

Course Outcomes:

1. Student can learn the organometallic compounds that are used as reagents.
2. Student can gain the knowledge of synthesis, structure and bonding, properties and reactivity of main group organometallics (including Grignard reagents, organolithium reagents, organophosphorus compounds, etc).
3. The component of the course will aim to develop skills in the techniques of organotransition metal chemistry and organometallic catalysis.
4. Students can learn the organic synthesis via enolates and heterocyclic compounds.

UNIT-1: ORGANOMETALLIC COMPOUNDS

Reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions. Organo lead compounds: formation and chemical reactions. Organo cadmium compounds: formation and chemical reactions. Organo copper compounds: formation and chemical reactions

UNIT-2: ORGANOSULPHUR COMPOUNDS

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyl and aryl sulphonates.

UNIT-3: ORGANO PHOSPHORUS COMPOUNDS

Nomenclature, Trivalent phosphorus compounds - trialkyl and triaryl phosphine (method of formation and reactions), Pentavalent phosphorus compounds, organic phosphoranes, phosphorus ylides, wittig reaction. Biological role of phosphorus.

UNIT-4: HETEROCYCLIC COMPOUNDS

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six- membered heterocycles. Prepration and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT-5: ORGANIC SYNTHESIS *VIA* ENOLATES

Acidity of hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

Reference Books:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson

Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	2	1
CO2	2	3	1	-	1	2	1	2	1	2
CO3	1	3	1	-	-	-	1	2	2	-
CO4	1	2	2	-	-	-	1	2	2	-

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BA- 264A: MANAGERIAL SKILLS

L-4, T-0 P-0 **Credits –4** **Max Marks: 55**

Course Objectives:

1. The objective of this course is to develop a basic understanding about the management concepts as well as of human in various managerial processes in organization.
2. Will be able to learn strong working knowledge of ethics and professional responsibility.

Course Outcomes:

1. Manage the selection and initiation of individual projects and of portfolios ofprojects in the enterprise.
2. Demonstrate effective project execution and control techniques that result in successful projects.
3. Demonstrate the roles, skills and functions of management.
4. Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.

UNIT-1SKILL DEVELOPMENT

Writing Business Letter, Official letters, 7C's & 4'S in Communication , Report writing , Skills, Presentation Skills , Communication : Concept, Types , process, barriers, making Communication effective.

MANAGERIAL CREATIVITY- Business Process Re-engineering - Concept , Process, Redesign, BPR, experiences in Indian Industry , Total Quality Management(TQM) - Concept , Systems model of Quality, Deming's approach, TQM as a business Strategy .

UNIT-2 TECHNOLOGY LED DEVELOPMENT

Knowledge Management (KM)- What , why, how, of Knowledge Management , KM process , approach, strategies, tools. E-commerce- Ideology, methodology, classification by

application /nature of transactions , Driving Forces of EC, Impact of EC, Scope

UNIT-3 LEADERSHIP FOR MANAGERS

Concept, Traits, Styles, Types of leadership, Leadership for managers-varied case studies for identifying and imbibing leadership attributes.

Selling & Negotiation Skills-Types of Negotiation , Negotiation Strategies ,Selling skills – Selling to customers , Selling skills – Body language, Conceptual selling, Strategic selling

UNIT-4 CONFLICT MANAGEMENT

Conflict Management - Types of conflicts and Conflict Management, Coping strategies andConflict Management, Conflict Management Styles

UNIT-5 POSITIVE THINKING

Attitudes, Beliefs, Positive thinking – Martin Seligman's theory of Learned Helplessness, Learned Optimism, Case Studies and Presentations.

References

1.Stoner, Freeman , Gilbert Jr. : Management (Pearson education)

Kootz,O'Donnell , Weighrich : Essentials of Management

2.Michael , J. Stahl : Management -Total Quality in a global environment (Blackwell Business)

3.Newman , Warren and Summer : The Process of Management , Concept, Behaviour & Practice.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	2	1
CO2	1	3	1	-	1	2	1	2	1	2
CO3	1	3	1	-	-	-	1	2	2	-
CO4	2	2	1	-	2	1	1	2	2	2

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BMA-241 A : ELEMENTARY MATHEMATICS-II

L-4, T-0 P-0 **Credits –4** **Max Marks: 55**

CourseObjectives:

1. The ability to identify reflects upon, evaluate, integrate, and apply different typesof information and knowledge to form independent judgments.

Course Outcomes:

1. Apply mathematical concepts and principles to perform computations
2. Create, use and analyze graphical representations of mathematical relationships.
3. Able to assess and interpret complex situations, choose among several potentially appropriate mathematical methods of solution and persist in the face of difficulty
4. Analyze full and cogent solutions that include appropriate justification for their reasoning.

UNIT-1: PRINCIPLE OF MATHEMATICAL INDUCTION & BINOMIAL THEOREM

Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.
History, statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, General and middle term in binomial expansion, simple applications

UNIT-2: MATHEMATICAL REASONING

Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction, converse and contrapositive.

UNIT-3: STATISTICS & PROBABILITY

Measures of dispersion; Range, mean deviation, variance and standard deviation of ungrouped/grouped data. Random experiments; outcomes, sample spaces (set representation). Events; occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events. Conditional probability, multiplication theorem on probability. independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of random variable.

UNIT-4: VECTORS:

Vectors and scalars, magnitude and direction of a vector.Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors.

UNIT-5: LINEAR PROGRAMMING:

Introduction, related terminology such as constraints, objective function, optimization,

different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded and unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

TEXT BOOKS/REFERENCE BOOKS:

1. 12th NCERT Text Book
2. R.D SHARMA FOR CLASS 11th AND 12TH MATHEMATICS
3. R.S . AGRAWAL FOR CLASS 12TH MATHEMATICS
4. PRADEEP'S REFERENCE BOOK FOR CLASS 11TH

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	2	1
CO2	2	3	1	-	1	2	1	2	1	2
CO3	1	3	1	-	-	-	1	2	2	-
CO4	-	1	1	-	2	1	1	2	1	1

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BPH-224: ELEMENT OF MODERN PHYSICS

Course Objective:

1. Students will apply understanding and skill related to the principles and concepts of modern physics essential for graduate school and/or professional employment in the field.

Course Outcomes:

1. Understand and explain the differences between classical and quantum mechanics.
2. Solve Schrodinger equation for simple potentials.
3. Assess whether a solution to a given problem is physically reasonable.
4. Identify properties of the nucleus and other sub-atomic particles.

UNIT 1

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT 2

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude.

UNIT 3

Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension- across a step potential & rectangular potential barrier.

UNIT 4

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

UNIT 5

Mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.

TEXT BOOKS/REFERENCE BOOKS:

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Additional Books for Reference

- Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
- Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	2	1
CO2	1	3	1	-	1	2	1	2	1	2
CO3	1	2	1	-	-	-	1	2	2	-
CO4	1	2	1	-	-	-	3	2	2	1

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 275: ORGANIC CHEMISTRY-III LAB

L-0, T-0 P-3 **Credits –1** **Max**

Course Objectives

1. To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions

Course Outcomes

1. Use the scientific method to create, test, and evaluate a hypothesis
2. Engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents
3. Characterize organic molecules by physical and spectroscopic means, including mp, bp, IR, NMR, GC

List of Experiments

S. No.	Experiment	Unit
1	Detection of extra elements	1
2	Functional group test for nitro, amine and amide groups	1
3	Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)	1

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
- Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	1	-	1	-	2	3	1	1
CO2	2	3	1	-	1	-	2	3	1	-
CO3	1	3	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 273: PHYSICAL CHEMISTRY-IV LAB

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives
To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions

Course Outcomes
1. Reporting of experimental results (including error analysis) in a publication-style (journal paper)
2. Appreciation for modern problems and scientific controversies in physical chemistry
3. Key spectroscopic techniques including FTIR, UV-vis absorption, luminescence, laser methods

List of Experiments

S. No	Experiment	Unit
	Conductometry Determination of cell constant Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Mixture of strong acid and weak acidvs. strong base iv. Strong acid vs. dichromate vs.weak base	1
2	**Potentiometry** Perform the following potentiometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt	2

Reference Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003)

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

CO1	1	1	1	-	1	-	2	3	1	1
CO2	2	1	1	-	1	-	1	2	1	-
CO3	1	1	2	-	-	-	1	2	-	-

B.SC. HONS. (CHEMISTRY)
FOURTH SEMESTER
BCH 276: ANALYTICAL CHEMISTRY-LAB

L-0, T-0 P-3 **Credits –2** **Max Marks: 60**

Course Objectives
To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions

Course Outcomes
1. Apply principles and applications of modern chemical instrumentation, experimental design, and data analysis
2. Underlying chemical and physical of instrumental methods of analysis, including electronic and vibrational spectroscopy, reaction kinetics, chemical separation methods, and mass spectrometry
3. Formulating and solving problems in the laboratory

List of Experiments

S. No.	Experiment	Unit
1	To find out the dissolved oxygen present in water by DO meter	1
2	Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrates	4
3	To find out the total suspended solids in industrial water sample	5
4	Solvent Extractions: (i) To separate a mixture of Ni^{2+} & Fe^{3+} by complexing with DMG and extracting the Ni^{2+} in DMG complex using chloroform, and determine its concentration with spectrophotometry	3

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	1	-	1	-	2	2	2	1
CO2	1	1	2	-	1	-	2	2	1	-
CO3	1	1	2	-	-	-	1	2	-	1

ELEMENTS OF MODERN PHYSICS LAB
Subject Code: BPH-274

L-0, T-0 P-3 **Credits –2** **Max Marks: 60**

Course Objectives

To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions

Course Outcomes

1. Ability to calculate the decay rates and lifetime of radioactive decays like alpha, beta,
2. The students will get opportunity to perform experiments related to measurement of Planck's constant
3. Verification of the photoelectric effect and determination of the work Function of a Metal.

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	1	-	1	-	2	1	-	1
CO2	1	1	1	-	1	-	1	2	1	-
CO3	1	1	2	-	-	-	1	1	-	-

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 324: INORGANIC CHEMISTRY-IV

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
In order to study transition metals to understand the trends in properties and reactivity of the d-block elements, typical physical and chemical properties of the transition metals, identify simple compound classes for transition metals and describe their chemical properties.

Course Outcomes:
1. The students will be able to explain the fundamental concepts in coordination chemistry of transition metals.
2. The Students should be familiar with the basic knowledge of the non-aqueous solutions and applications of non-aqueous solvents in analytical chemistry.
3. The students will develop the ability of effective solving practical problem of analytical chemistry of non-aqueous solutions.
4. Students will be able to describe different quantitative methods of analysis of organic and inorganic substances.

. UNIT-1: THEORETICAL PRINCIPLES IN QUALITATIVE ANALYSIS:

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II

UNIT-2: REACTION KINETICS AND MECHANISM

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

UNIT-3: BIOINORGANIC CHEMISTRY

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

UNIT-4: ORGANOMETALLIC CHEMISTRY

Definition, Nature of Metal Carbon bond, classification of organometallic compounds by bond types viz. i) covalent ii) Ionic iii) Electron deficient, cluster compounds bond compounds including sandwich derivatives. Structure and bonding in Meta carbonyls, cyclopentadienyl derivative, metal-ethylenic, metal-acetylenic complexes, Applications of organometallic compounds as homogeneous catalysts in hydrogenation, hydroformylation, polymerization, oligomerization and metathesis reactions of alkenes
and alkynes (Ziegler - Natta polymerization of ethylene and propylene).

UNIT-5 ORGANOMETALLIC COMPOUNDS

VBT.π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.
Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium. Wacker Process, Synthetic gasoline (Fischer Tropsch reaction) Synthesis gas by metal carbonyl complexes.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	-	-	1	1	-	2	1	-
CO2	2	1	-	-	1	1	1	3	-	2
CO3	1	3	1	--	-	1	-	1	-	1
CO4	2	1	-	-	1	1	1	3	-	2

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 325: ORGANIC CHEMISTRY-V

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives:
1. Understand the structure and properties of oil and detergents.
2. Demonstrate some knowledge of the sources of and uses for inorganic and organic compounds in the practical world.

Course Outcomes:
1. To know the complete detailed structure of the composition of fat, oil and detergents.
2. Able to explain the relationship between starting materials, reagents and products arising from polymers
3. To understand the way in which bonds are made and broken to bring about product formation in these alkaloid based reactions
4. The student can learn the synthesis of dyes and drugs with examples.

UNIT-1: FATS, OIL AND DETERGENTS:
Occurrence, chemical composition and importance, hydrogenated oils, Rancidity, acid value, saponification and iodine numbers, difference between toilet and washing soaps, comparison of soap and detergents, classification and principle of cleansing action of detergents.

UNIT-2: POLYMERS:
Polymers, Classification on the basis of source, repeating units, sequences, method of polymerization, intermolecular interactions, atoms present. Mechanism of polymersisation. Synthesis of polymers: Nylon-6,6.; Perlon, Dacron, PAN, PVC. Natural rubber, synthetic rubber, vulcanization; Plastics; resins

UNIT-3: ALKALOIDS
Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure, Medicinal importance elucidation and synthesis of Nicotine, cocaine, atropine.

UNIT-4: DRUGS
Introduction, structure and use of methylene blue, Prontosil, use of pronyosil in synthesis of other sulpha drugs. Synthesis, structure and uses of sulphadiazine, mode of action of p-aminobenzenesulphonamide on bacteria.

UNIT-5: SYNTHETIC DYES
Color and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, and Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Reference Books:

- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
- Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV

Edition. W.H. Freeman and Co.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	1	-	-	-	2	2	1	-
CO2	2	1	2	1	-	1	2	1	1	1
CO3	1	3	1	-	1	-	1	2	-	2
CO4	2	3	1	-	1	-	2	2	-	2

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 321: PHYSICAL CHEMISTRY-V

L-4, T-0 P-0 **Credits –4** **Max Marks: 55**

Course Objectives
Understanding concept of quantization of energy, its application and principles learned in physical chemistry to area of photochemistry.

Course Outcomes:
1. Relate the concepts of quantum chemistry and its application
2. Interrelate the study of chemical bonding and nature of the atom
3. Correlate the atomic structure of an element to its physical properties by molecular spectroscopy.
4. Understand the concept of photochemistry and its application in day to day life.

UNIT-1: Quantum Chemistry
Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z- component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus.Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

UNIT-2: Chemical bonding:
Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

UNIT-3: Molecular Spectroscopy:
Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. 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.

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

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.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Unit-4: Photochemistry

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical eactions in biochemical processes, photostationary states, chemiluminescence.

Reference Books:

- Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
- House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
- Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
- Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1
CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	1	3	-	-	-	-	2	2	-	-

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 322: SPECTROSCOPY AND IMPORTANT ORGANIC COMPOUNDS (ELECTIVE)

Course Objectives

1. Deduce the structural formula of an unknown organic compound from spectroscopic or chemical data.
2. Able to understand the concept of natural product.
3. To understand the concept and difference between natural and synthetic rubber.

Course Outcomes:

1. Understanding the various ways organic chemical structures are depicted.
2. Drawing organic chemical structures from names.
3. Knowledge of the basic mechanisms of reactions involved in synthesis of carbohydrate and fabrics.
4. Apply the concept of spectroscopy.

UNIT-1:NMR SPECTROSCOPY: Principle of nuclear magnetic resonance,the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1, 1-dibromoethane, 1, 1, 2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde, acetophenone, *p*-anisidine and *p*-nitrotoluene. Simple problems on PMR spectroscopy for structure determination of organic compounds.

UNIT-2: MASS SPECTROSCOPY:

Introduction, instrumentation, mass spectrum, determination of molecular formula, parent peak and base peak, recognition of molecular ion peak, fragmentation pattern of alkanes, alkenes and benzene.

UNIT-3:CARBOHYDRATES: CLASSIFICATION AND NOMENCLATURE-

Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D (+)-glucose & D (-) fructose. Mechanism of mutarotation.

UNIT-4: CARBOHYDRATES : STRUCTURES OF RIBOSE AND DEOXYRIBOSE.:

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) involving structure determination.

UNIT-4 FABRICS:

Fabrics – natural and synthetic (acrylic, polyamido, polyester), Rubbers – Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers- natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	-	-	1	-	2	2	1	1

CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	-	-
CO4	1	2	-	-	-	1	2	2	-	-

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 374: INORGANIC CHEMISTRY-IV LAB

L-0, T-0 P-3 **Credits –2** **Max Marks: 60**

Course Objectives
The objective of this course is to get the knowledge of quantitative analysis of various inorganic techniques and experiments
Course Outcomes:

1. Student will understand common laboratory techniques including pH measurement, acid/base titrations, UV/Visible spectroscopy in both emission and absorption mode, calorimetry, and colorimetry.
2. Apply the use of the techniques mentioned above to solve chemical problems.
3. Study how to carry out self-directed experiment

List of Experiments

S. No	Experiment	Unit
1	Determination of acetic acid in commercial vinegar using NaOH	5
2	Determination of alkali content - antacid tablet using HCl	5
3	Estimation of calcium content in chalk as calcium oxalate by permanganometry	1
4	**Gravimetric Analysis** (i) Aluminium as oxinate (ii) Mg as $MgNH_4PO_4.6H_2O$ (i) Ba as $BaSO_4$	4
5	Synthesis of (a) Sodium hexa nitrito cobaltate (III) (b) Sodium ammonium hydrogen phosphate	1

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	-	-	1	-	2	2	1	1
CO2	3	2	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	2	1	2	2	2

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER
BCH 375: ORGANIC CHEMISTRY-V

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives:
The objective of this course is to get the knowledge of analysis of an organic compound and separation of mixture

Course Outcomes:
Students will gain an understanding of:

1. Planning and implementation of advanced organic reactions
2. Purification of molecules from reactions in a
3. Analyze detailed organic structures

List of Experiments

S. No	Experiment	Unit
1	Estimation of glycine by Sorenson's formalinmethod.	2
2	Study of the titration curve ofglycine	2
3	Estimation of proteins byLowry's method	2
4	Effect of temperature onthe action of salivary amylase. Study of the action of salivary amylaseon starch at	3
5	Saponification value of an oilor a fat	4
6	Determination of Iodinenumber of an oil/ fat	4
7	Isolation andcharacterization of DNAfrom onion/ cauliflower/peas.	1

Reference Books:

- Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
- Arthur, I. V. *Quantitative Organic Analysis,* Pearson.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	1	2	1	1	1	2	1	1
CO2	1	2	1	1	1	1	3	2	1	1
CO3	3	3	3	1	1	-	1	2	2	3

B.SC. HONS. (CHEMISTRY)
FIFTH SEMESTER

BCH 371: PHYSICAL CHEMISTRY-V LAB

L-0, T-0 P-3 **Credits –1** **Max Marks: 60**

Course Objectives:
The objective of this course is to get the knowledge of analysis of a compound for its physical properties
Course Outcomes:
Students will gain an understanding of:

1.Reporting of experimental results (including error analysis) in a publication-style (journal paper)
2.key spectroscopic techniques including FTIR, UV-vis absorption, luminescence, laser methods
3.the use of chemistry software programs to model energy potentials and vibrational levels of molecules.

S. No	Experiment	Unit
1	**UV/Visible spectroscopy** Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV). Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.	3
2	**Colourimetry**	3
	Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration	
	Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.	
	Study the kinetics of iodination of propanone in acidic medium.	
	Determine the dissociation constant of an indicator (phenolphthalein).	
	Analysis of the given vibration-rotation spectrum of HCl(g)	
	Determine the amount of iron present in a sample using 1,10-phenathroline.	

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

CO1	2	3	1	2	1	1	1	1	2	1
CO2	1	1	1	1	1	1	1	1	1	1
CO3	1	2	1	1	1	-	1	2	1	2

B.SC (HONS) CHEMISTRY
SIXTH SEMESTER
BCH 326: POLYMER CHEMISTRY

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

Course Objectives

The student can gain the knowledge of structure, physical and chemical properties and kinetics of polymeric materials in a broad aspect.

Course Outcomes:

1. Understand and perform the various polymerization techniques
2. Understand the various properties and kinetics of polymers.
3. Understand the nature structure of polymers and relationship between the lower and upper critical solution temperature.
4. Understand the properties, energy changes on mixing of polymer solution. Study the different natural and synthetic polymers present in this world.

UNIT 1: INTRODUCTION AND HISTORY OF POLYMERIC MATERIALS

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

UNIT 2: KINETICS OF POLYMERIZATION

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

UNIT 3: NATURE AND STRUCTURE OF POLYMERS

Structure Property relationships. Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometer, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

UNIT 4: POLYMER SOLUTION

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

UNIT 5: PROPERTIES OF POLYMERS

Physical, thermal, Flow & Mechanical Properties. Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride), poly(vinyl acetate), acrylic polymers, fluoro polymers, polyamides. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline].

List of Text Books:

- *Seymour's Polymer Chemistry,* Marcel Dekker, Inc.
- G. Odian: Principles of Polymerization, John Wiley.
- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.

List of Reference Books

- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	-	-	1	1	2	2	1	1
CO2	2	3	1	-	1	-	1	2	1	-
CO3	1	3	-	-	-	-	1	2	1	1
CO4	2	3	1	-	1	-	1	2	1	2

B.SC (HONS) CHEMISTRY
SIXTH SEMESTER
BCH 327: FUEL CHEMISTRY

L-4, T-0 P-0 **Credits –4** **Max Marks: 75**

FUEL CHEMISTRY (DEPARTMENTAL ELECTIVE)
SUBJECT CODE: BCH-327

Course Objectives:

1. Learn more about the energy-fuels-environment connection and prepare for making an intelligent contribution to the difficult energy policy choices inthe twenty-first century.
2. To know in detail about different kind of fuel and its efficiencies.

Course Outcomes:
Students should know following aspects after completion of course:

1. Energy use and the chemical processing aspects of energy production;
2. the chemical processes of fuel refining, conversion and utilization, including processes that can control air pollution;
3. the selection of equipment for efficient utilization of fuels and upgrading of fuels to maximize energy conversion and minimize the environmental impact of fuel utilization;
4. Applications of materials for purification of air and water and use of lubricants in different machines in industries.

UNIT-1: LUBRICANTS & LUBRICANTS

Introduction, Mechanism of lubrication: fluid film, boundary lubrication and extreme pressure lubricants, Classification of lubricants: Solid, semi-solid, liquid and emulsion, synthetic lubricants and additives for lubricants.

UNIT-2 PROPERTIES OF LUBRICANTS

Properties of lubricants: Flash & Fire point, Saponification number, Iodine value, Acid value , Viscosity and Viscosity index, Aniline point, Cloud point and pour point, Corrosive Tendency, Specific gravity, Volatility, oiliness, Emulsification, decomposition stability and carbon residue of lubricants

UNIT-3: COAL AS ENERGY RESOURCES

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value, Characteristics of good fuel, Comparison between solid, liquid and gaseous fuel, BOMB calorimeter, Coal, Classification of coal, Uses of coal in various industries, Selection of coal, analysis of coal, carbonization of coal. Pulverized coal and Metallurgical coal.

UNIT- 4 PETROLEUM

Petroleum, Cracking, Fractionation Distillation, Cracking: Thermal & Catalytic Cracking, Refining of gasoline, Synthetic petrol and methods of polymerization for synthetic petrol, Reforming: Thermal and Catalytic reforming, Knocking, Improvement in anti knocking properties.

UNIT-5: FUELS

Diesel Engine fuel, Kerosene & LPG as fuel, Non petroleum fuels, Natural gas, Coal gas, Oil gas

Water gas/ Blue gas, Non- conventional source of energy, Biomass, Biogas, Combustion, Analysis of fuel gas.

Reference Books:

- Fuels and fuel-additives. S.P. Srivastava & Jeno Hancsok. Willey.
- The chemistry of Hydrocarbon fuels. *Harold H. Schobert. Science Direct.*
- The chemistry and technology of petroleum. J.G. Speight.
- The chemistry and technology of coal. James Speight.

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	3	2	-	1	2	2	2	2	1
CO2	1	3	1	-	1	2	1	2	1	2
CO3	1	3	1	-	-	-	1	2	2	-
CO4	2	3	1	-	1	-	2	3	1	-

BCH-377: Project/Dissertation

(Semester VI)

L+T+P : **0+0+22**
Credits: : **11**
Contact hours : **52**

Description
Students are required to work on the allotted topic and must make a presentation in front of advisory committee and B.Sc. Students. Students are expected to provide latest facts and updated information by consulting latest editions of textbooks, reference books, monographs, and peer-reviewed national & international research journals.

S.No.	**Course details**
1.	Research work
2.	Seminar
3.	Evaluation by Research committee
4.	Research work by taking 52 credit hours