

FIRST DEGREE PROGRAMME (B.Sc.) IN CHEMISTRY
UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

**Core Courses, Foundation Course II, Open Courses
and Elective Courses**

PROGRAMME SPECIFIC OUTCOMES (PSO) FOR FDP IN CHEMISTRY

Sl. No.	Upon completion of BSc. Degree programme in Chemistry, students	PSO No.
1	Develop scientific outlook scientific attitude and scientific temper	PSO1
2	Develop skill in experimenting , analyzing and interpreting data	PSO2
3	Develop research attitude and adopt scientific method of identifying, analyzing and solving research problems in an innovative way	PSO3
4	Apply physical and mathematical theories and principles in the context of chemical science	PSO4
5	Use chemistry related soft wares for drawing structure and plotting graphs	PSO5
6	Use instruments- potentiometer, conductometer, pH meter and colorimeter.	PSO6
7	Acquire skill in safe handling of chemicals including hazardous materials.	PSO7
8	Identify the ingredients in household chemicals, use them in a critical way	PSO8
9	Predict analytical procedures, compare experimental, theoretical and graphical methods of analysis	PSO9
10	Predict reaction mechanism in organic reactions	PSO10
11	Understand the terms, concepts, methods, principles and experimental techniques of physical, organic, inorganic and analytical chemistry	PSO11
12	Develop critical thinking and adopt healthier attitudes towards individual, community and culture through the course of Chemistry	PSO12
13	Become cautious about environmental aspects and impact of chemicals in soil, water and air and adopt ecofriendly approach in all frontiers of life	PSO13
14	Become responsible in consumption of natural resources and adopt measures for sustainable development.	PSO14
15	Visit Chemical factories and industries with scientific curiosity	PSO15
16	Develop writing skills and presentation skills using audio visual aids	PSO16
17	Compare and share knowledge in an interdisciplinary manner	PSO17
18	Inculcate spirit of originality, novelty, and necessity in scientific research	PSO18
19	Contribute to the academic and industrial requirements of the society	PSO19
20	Get motivated to higher studies - PG Degree in different branches of Chemistry, B.Ed. Degree in Physical Science and job opportunities in industrial and non -industrial sectors	PSO20
21	Adopt safer life skills in a human friendly and ecofriendly way	PSO21

COURSE OUTCOMES (CO)

Semester	I
Course	Core course-I
Course name	INORGANIC CHEMISTRY I
Course Code	CH 1141
Credit	2
Hours	36 hours
Lecture-Tutorial-Lab	2-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Discuss the course of development of structure of atom.	U	PSO1
2	Apply rules for filling electrons in classifying elements into s, p,d and f blocks	A	PSO10
3	Define various scales of electronegativities and their Applications	U	PSO10
4.	Define Effective nuclear charge and Slater's rules	U, A	PSO10
5	Discuss about diagonal relationship and anomalous behaviour of hydrogen and other first element in each group.	U	PSO4
6	Correlate and predict general properties of s and p block elements based on their electronic configuration.	A	PSO4
7	Realise applications of s and p block elements in sustainable and renewable energy sources.	A	PSO14
8	Define various concepts of acids and bases.	U	PSO11
9	Understand reactions in non-aqueous solvents.	U	PSO11
10	Realise various causes, effects and control measures of environmental pollution.	E	PSO13
11	Review national movements for environmental protection.	U, A	PSO21

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply, E-Evaluate

Semester	II
Course	Foundation course II
Course name	CHEMISTRY –ITS ORIGIN, METHODOLOGY AND IMPACTS
Course Code	CH 1221
Credit	2
Hours	36 hours
Lecture-Tutorial-Lab	2-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive level	PSO
1	Appreciate the development of scientific theories through years with specific examples	U	PSO1
2	Develop curiosity and scientific attitude towards the application of chemistry in daily life	C	PSO1
3	Outline a procedure for experimentation	A	PSO2
4	Appraise the current development in Chemistry	E	PSO1
5	Identify the common ingredients of house hold synthetic products	U	PSO8
6	Discriminate and classify chemicals used as drugs,explosives,	U	PSO7
7	Get motivated in visiting chemical Industries	E	PSO15
8	Adopt safety measures in handling chemicals	A	
9	Draw titration curves and explain theory of volumetric Titrations	A	PSO2/PSO3
10	Select suitable indicators for acid base titration knowing the theories of acid base titration and Indicators	A	PSO11
11	Develop computational skills	A	PSO5
12	Discuss separation techniques of filtration and chromatographic techniques	U	PSO3

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply, E-Evaluate, C-Create

Semester	III
Course	Core course-II
Course name	INORGANIC CHEMISTRY II
Course Code	CH 1341
Credit	3
Hours	54 hours
Lecture-Tutorial-Lab	3-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Understand various theories of chemical bonding and their limitations.	U	PSO4
2	Predict stability of atoms and the nature of bonding between atoms.	U, A	PSO4
3	Discuss various applications of intermolecular Interactions	U	PSO4
4.	Understand chemistry of glass, silicates and silicones	U	PSO7 PSO8
5	Discuss chemistry of Boron compounds, oxyacids and oxides of Phosphorous	U	PSO11
6	Understand refractory carbides, nitrides, borides and silicides.	U	PSO11
7	Describe various types of halogen compounds.	U	PSO3
8	Understand chemistry of noble gas	U	PSO3
9	Understand inorganic polymers and their applications.	U	PSO8
10	Distinguish between types of nuclear reactions.	U	PSO11
11	Describe measurement of radioactivity.	U	PSO2 PSO3
12	Discuss applications of radioactivity in various fields.	U	PSO3
13	Understand introductory concepts of nanochemistry	U, A	PSO18
14	Suggest methods of synthesizing nano materials.	U	PSO18
15	Appreciate the variety of applications of nanomaterials.	U, A	PSO18

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Semester	IV
Course	Core course-III
Course name	ORGANIC CHEMISTRY – I
Course Code	CH 1441
Credit	3
Hours	54 hours
Lecture-Tutorial-Lab	3-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Recall the fundamentals of organic chemistry.	R	PSO1
2	Apply the electron displacement effects to compare acidity, basicity and stability of organic compounds/intermediates.	A	PSO4
3	Judge the reaction mechanism of substitution and elimination on the basis of the structure of alkyl halides.	U	PSO10
4	Summarise the chemistry of reaction intermediates.	U	PSO10
5	Discuss optical, geometrical and conformational isomerism of organic compounds.	U	PSO11
6	Use CIP rules to predict the configuration of organic Compounds	A	PSO10
7	Differentiate photochemical and thermal reactions.	U	PSO11
8	Discuss theory of colour and constitution and the method of synthesis of dyes	U	PSO8
9	Explain aromaticity, orientation effect and mechanism of aromatic electrophilic substitution.	U	PSO10
10	Demonstrate the method of determination of reaction mechanism.	A	PSO10

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: R-Remember, U-Understand, A-Apply

Semester	V
Course	Core Course V
Course name	PHYSICAL CHEMISTRY I
Course Code	CH 1541
Credit	4
Hours	54 hours
Lecture	3-0-2

CO No.	COURSE OUTCOME		Cognitive level	PSO
	<i>Upon completion of this course, the students</i>			
1	Identify, compare and explain the properties and behaviour of ideal and real gases, knowing kinetic theory of gases and different types of molecular velocities and collision properties.	U	PSO11	
2	Perform numerical problems of gases under a set of Conditions	A	PSO2	
3	Differentiate between amorphous and crystalline solids, Understand anisotropy, symmetry and types of crystals, X-ray diffraction methods of study of crystal structure, identify the imperfections in crystals understand the physical aspects of surface tension and viscosity of liquids and the basics of liquid crystals and their applications	U	PSO11	
4	representation of lattice planes and calculation of interplanar spacing, draw the crystal structures of NaCl and CsCl	A	PSO9	
5	Recalling the basic concepts of solutions, concentration terms, Raoult's law and colligative properties	U	PSO9	
6	Determination of colligative properties and molecular mass of solute	E	PSO9	
7	Understand the working principle Electro-Chemical cells	U	PSO9	
8	Design and Determine the potentials of electrochemical Systems	E	PSO2	
9	Assess the nature of electrolytes in terms of dissociation and ionic conductance of electrolytes in terms of mobility of ions	E	PSO2	
10	Integrate the theory into practical applications of conductometric titrations	A	PSO3	

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply, E-Evaluate

Semester	V
Course	Core course-VI
Course name	INORGANIC CHEMISTRY III
Course Code	CH 1542
Credit	4
Hours	72 hours
Lecture-Tutorial-Lab	4-0-3

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Discuss the electronic configuration and related properties of transition elements and inner transition Elements	U	PSO11
2	Understand preparation of selected transition metal compounds,lanthanides and actinides	U, A	PSO11
3	Compare lanthanide and actinide contraction and their consequences.	U	PSO11
4.	Name coordination complexes,organometallics, discuss their properties and bonding	U	PSO11
5	Understand stability of complexes and factors affecting Stability	U	PSO3
6	Discribe isomerism in coordination compounds	U, A	PSO3
7	Discuss spectrochemical series, CFSE and their Consequences	U	PSO3
8	Correlate geometry , stability and Jahn Teller effect and its causes	A	PSO11
9	Discuss reaction mechanisms and applications of coordination compounds	U	PSO11
10	Name and Classify organometallic compounds	U	PSO3
11	Discuss preparation and properties and bonding of Carbonyls	U	PSO3
12	Identify the role of organometallic compounds in organic Synthesis	U	PSO10
13	Discuss the role of inorganic ions in biological systems and biochemistry of haemoglobin, myoglobin, cytochromes, iron sulphur proteins	U	PSO10
14	Discuss various bioinorganic processes like photosynthesis, working of sodium potassium pump, etc	U	PSO17
15	Discribe various aspects of metallurgy,and instrumental methods of analyses viz., spectrophotometric methods, thermal methods and tools available to measure Nanomaterials	U	PSO6

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Semester	V
Course	Core course-VII
Course name	ORGANIC CHEMISTRY II
Course Code	CH 1543
Credit	4
Hours	72 hours
Lecture-Tutorial-Lab	4-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Describe the preparation of hydroxy, carbonyl & amino compounds, carboxylic acids and organo Mg, Li & Zn compounds.	R	PSO10
2	Distinguish primary, secondary & tertiary alcohols and amines.	U	PSO10
3	Write reaction steps in ascending & descending of alcohol and aliphatic acid series, interconversion of aldose and ketose, chain lengthening and shortening of aldoses.	U	PSO11
4.	Explain the structure of glucose, fructose, sucrose, starch and cellulose.	U	PSO11
5	Predict the outcome and mechanism of simple organic reactions, using a basic understanding of the reactivity of functional groups	A	PSO10
6	Illustrate the use of organic reagents in synthesis.	A	PSO3 PSO10
7	Discuss fundamental principles of supramolecular and green chemistry	U	PSO13

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: R-Remember, U-Understand, A-Apply

Semester	VI
Course	Core course-X
Course name	PHYSICAL CHEMISTRY II
Course Code	CH 1641
Credit	4
Hours	72 hours
Lecture-Tutorial-Lab	4-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive level	PSO
1	Understand basic concepts of thermodynamics , spectroscopy and group theory	U	PSO11
2	Apply laws of thermodynamics in physical and chemical processes and real system	A	PSO1
3	Classify processes, properties and systems on a thermodynamic basis		PSO3
4	Discuss the second law of thermodynamics and Assess thermodynamic applications using second law of thermodynamics.	E, A	PSO3
5	Discuss basic concepts of statistical thermodynamics	U	PSO11
6	Solve numerical problems based on thermodynamics and Thermochemistry		PSO2
7	Understand the basics of spectroscopic techniques-Rotational, Vibrational and Raman Spectroscopy	U	PSO2
8	Compare NMR and ESR spectroscopy and their Applications	U	PSO3
9	Evaluate physical and chemical quantities using non-spectroscopic techniques.	U, E	PSO4
10	Identify the elements of symmetry and Determine the point groups of simple molecules	E	PSO11
11	Differentiate diamagnetism and paramagnetism, measurement of magnetic susceptibility	U	PSO11
12	Correlate dipole moment with geometry of molecules	R, U	PSO11

PSO-Programme Specific Outcome, CO-Course Outcome

Cognitive Level: R-Remember, U-Understand, A-Apply, E-Evaluate

Semester	VI
Course	Core course-XI
Course name	ORGANIC CHEMISTRY III
Course Code	CH 1642
Credit	4
Hours	72 hours
Lecture-Tutorial-Lab	3-0-2

CO No.	COURSE OUTCOMES <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Outline the chemistry of simple heterocyclic compounds	U	PSO10
2	Classify amino acids, proteins, nucleic acids, drugs, terpenes, vitamins, lipids and polymers.	U	PSO10
3	Discuss the synthesis of amino acids, peptides, drugs and polymers.	U	PSO9
4	Describe the isolation and structure of terpenes and alkaloids.	R	PSO10
5	Explain the mechanism and techniques of polymerisation.	U	PSO11
6	Discuss the principle of UV, IR, NMR and Mass spectroscopy.	U	PSO2
7	Interpret spectroscopic data to elucidate the structure of simple organic compounds.	A	PSO18
8	Use the simple organic reactions to elucidate the structure of quinoline, piperine and conine.	A	PSO18

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: R-Remember, U-Understand, A-Apply

Semester	VI
Course	Core course-XII
Course name	PHYSICAL CHEMISTRY III
Course Code	CH 1643
Credit	4
Hours	72 hours
Lecture-Tutorial-Lab	4-0-2

CO No.	COURSE OUTCOMES <i>Upon completion of this course, the students</i>	Cognitive Level	PSO
1	Recall the basic physical concepts in quantum mechanics, colloids, adsorption, Chemical Kinetics, catalysis, chemical and ionic equilibria, phase equilibria, binary liquid systems and photochemistry	R	PSO4
2	Understand the basic concepts involved in quantum mechanics, colloids, adsorption, Chemical Kinetics, catalysis, chemical and ionic equilibria, phase equilibria, binary liquid systems and photochemistry	U	PSO4
3	Derive and Interpret important theories and equations involved in physical chemistry	A	PSO10
4	Demonstrate the origin of quantum numbers by correlating the Cartesian and spherical polar coordinates of hydrogen atom.	A	PSO10
5	Identify and recognize the applications of various principles, equations and physical processes	U	PSO10
6	Perform calculations involving physical concepts and equations	A	PSO4
7	Analyze graphical representations (phase diagrams, two and three components, vapour pressure – composition and boiling point – composition, temperature-composition) present in physical chemistry.	A	PSO9
8	Understand terminology	U	PSO11
9	Understand the effects of external influence on various chemical processes	U	PSO1
10	Understand different laws and principles of physical chemistry	U	PSO3

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: R-Remember, U-Understand, A-Apply

LAB COURSES

(For all Lab courses scheme of ESE is decided by the board of examiners in each year)
Computer Lab for

Foundation Course II (CH 1221) SEMESTER II (No ESE)

Semester	II
Hours	2 hours/week
Lecture-Tutorial-Lab	0-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Get acquainted with Computer Lab based instruction on the use of computer and internet in learning.	U	PSO5
2	Use of educational softwares, information mining from internet and using INFLIBNET/NICNET, NPTEL and VIRTUAL LABS OF MHRD.	A	PSO5
3	Learn Word processing and document preparation. Use of Spread sheets in Data handling and presentation	U	PSO5
4	Develop skill in chemical structure drawing and visualization of molecules using chemistry softwares	U	PSO5

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Core Course-II
INORGANIC QUALITATIVE ANALYSIS

(ESE at IV Semester)

Time 3Hrs

Marks 80

Semester	I,III &IV
Course	Core Course-IV, Lab Course I
Course name	Inorganic Qualitative Analysis
Course Code	CH1442
Credit	2
Hours	2 hours/week
Lecture-Tutorial-Lab	0-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Obey Lab safety instructions, develop qualities of punctuality, regularity and scientific attitude, out look and scientific temper (GOOD LAB PRACTICES)	U	PSO1
2	Develop skill in safe handling of chemicals, take precaution against accidents and follow safety measures	A	PSO2/ PSO8
3	Use glass wares ,electric oven, burners and weighing balance	A	PSO1
4	Develop skill in observation , prediction and interpretation of reactions	A	PSO1
5	Detect solubility, and classify compounds according to their solubility	U	PSO3
6	Apply the principle of common ion effect and solubility	A	PSO1&
	product in the identification and separation of ions		PSO2
7	Develop skill in preparing and purifying inorganic complex compounds	A	
8	Use filtration and chromatographic techniques, vacuum pump and centrifugal pumps	U	PSO4

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

**Core Course-VIII
LAB COURSE II
INORGANIC VOLUMETRIC ANALYSIS
(ESE at V Semester)**

Time 3Hrs

Marks 80

Semester	V
Course	Core Course-VIII, Lab Course II
Course name	INORGANIC VOLUMETRIC ANALYSIS
Course Code	CH1544
Credit	3
Hours	5 hours/week (90Hrs)
Lecture-Tutorial-Lab	0-0-5

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Develop skill in selecting, primary and secondary standards	U	PSO1
2	Develop skill in weight calculation of primary standards weighing by electronic balance, making of solutions of definite strength (standard solutions)	A	PSO2 PSO8
3	Use sophisticated glass wares, calibrate apparatus and develop skill in keen observation , prediction and interpretation of results	A	PSO1
4	Perform volumetric titrations under acidimetry-alkalimetry, permanganometry, dichrometry, iodimetry-iodometry, cerimetry, argentometry and complexometry	A	
5	Compare the advantages and disadvantages of different volumetric techniques	U	
6	Practice Punctuality and regularity in doing experiments and submitting Lab records	A	

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

LAB COURSE III
PHYSICAL CHEMISTRY EXPERIMENTS
(ESE at V Semester)

Time 3Hrs

Marks 80

Instructions for use of computer softwares and programmes in the physical chemistry experiments

1. Computer software (Excel) is to be used for plotting graph or calculations.
2. Spread sheet program can be used for determining Equivalence point in potentiometric and conductometric titrations .
3. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
4. Plot scatter diagram (wherever applicable in physical experiments)

Semester	V
Course	Core Course-IX, Lab Course III
Course name	PHYSICAL CHEMISTRY EXPERIMENTS
Course Code	CH1545
Credit	2
Hours	4 hours/week (72Hrs)
Lecture-Tutorial-Lab	0-0-4

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Develop Scientific outlook and approach in applying principles of physical chemistry in chemical systems/reactions	U	PSO1
2	Use computational methods for plotting graph	A	PSO2/PSO8
3	Describe systematic procedures for physical experiments	U	PSO1
4	Acquire Instrumentation skill in using conductometer, potentiometer, refractometer, stalagmometer and Ostwald's viscometer.	U	PSO3
5	Compare theory with experimental findings	A	PSO1& PSO2
6	Practice Punctuality and regularity in doing experiments and submitting Lab records	A	

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

LAB COURSE IV ORGANIC CHEMISTRY EXPERIMENTS**(ESE at VI Semester)****Time 3Hrs****Marks 80**

Semester	VI
Course	Core Course-XIII, Lab Course IV
Course name	ORGANIC CHEMISTRY EXPERIMENTS
Course Code	CH1644
Credit	3
Hours	5 hours/week (90 Hrs)
Lecture-Tutorial-Lab	0-0-5

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Develop curiosity in systematically analyzing organic compounds	A	PSO1
2	Differentiate and identify organic compounds by their characteristic reactions towards standard reagents	U	PSO10
3	Confirm their findings by preparing solid derivatives, and thus understand reliability of experimental results	A	PSO2
4	Determine physical constants of organic compounds	A	PSO3
5	Separate organic compounds by TLC/paper/column chromatographic techniques	A	PSO3
6	Prepare soaps	A	PSO18
7	Apply the principles and techniques in organic chemistry, thereby developing skill in designing an experiment to synthesize and purify organic compounds	A	PSO18
8	Practice systematic scientific procedure and prepare adequate report of them	A	PSO16
9	Understand the chemistry behind organic reactions	A	PSO10

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

SEMSTER VI
Core Course-XIV

LAB COURSE V GRAVIMETRIC EXPERIMENTS

(ESE at VI Semester)

Semester	VI
Course	Core Course-XIV, Lab Course V
Course name	GRAVIMETRIC EXPERIMENTS
Course Code	CH1645
Credit	2
Hours	4 hours/week (72Hrs)
Lecture-Tutorial-Lab	0-0-4

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Understand precipitation techniques in quantitative context	U	PSO1
2	Appreciate the application of silica crucible and sintered crucible in gravimetry	A	PSO2 PSO8
3	Practice technique of making, diluting solutions on quantitative basis	A	PSO1
4	Realise the factors affecting precipitation/crystallisation	A	PSO1
5	Take precautionary measures in filtration , drying and incineration of precipitates	U	PSO3
6	Understand the principle of colorimetry to estimate Fe ³⁺ and ammonia	A	PSO1 & PSO2
7	Practice Punctuality and regularity in doing experiments and submitting Lab records	A	PSO18

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Semester	V-VI
Course	PROJECT COURSE
Course name	PROJECT
Course Code	CH1646
Credit	4
Marks	100 (No CE marks)
Lecture-Tutorial-Lab	0-0-2

CO No.	COURSE OUTCOME <i>Upon completion of this course, the students</i>	Cognitive Level	PSO No.
1	Develop an aptitude for research in chemistry	U,A	PSO1
2	Practice research methodology and literature search	A	
3	Critically choose appropriate research topic and presentation	A	PSO2 PSO8

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

OPEN COURSE FOR OTHER MAJORS

Semester	V
Course	Open Course
Course name	CHEMISTRY AND ITS APPLICATIONS
Course Code	CH 1551.1
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive level	PSO
1	Appreciate the history of evolution of science	U	PSO1
2	Develop curiosity and scientific attitude towards the application of chemistry in daily life	C	PSO1
3	Appraise the current development in Chemistry and contribution of chemistry for sustainable development	E	PSO1
4	Identify the common ingredients of house hold synthetic products	U	PSO 8
5	Classify chemicals according to their uses	U	PSO3
6	Critically choose cosmetics and cleansing agents for daily use	E	PSO15
7	Adopt safer and healthier life skills in harmony with nature	A	PSO21

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: C-Create, U-Understand, A-Apply, E-Evaluate

OPEN COURSE FOR OTHER MAJORS

Semester	V
Course	Open Course
Course name	FUNDAMENTALS OF CHEMISTRY AND ITS APPLICATION TO EVERYDAY LIFE
Course Code	CH 1551.2
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive Level	
1	Appreciate the evolution of Science and Chemistry and the early form of chemistry	U	PSO1
2	Understand the development of Chemistry as a discipline and the role of chemistry as a central science	U	PSO1
3	Discuss the fundamental properties of atom, structure of atom, classification of elements in to a periodic table	U	PSO3
4	Differentiate between simple molecules and giant molecules and the bonding nature	U	PSO11
5	Explain different types of bonding and predict stability	U	PSO4

PSO-Programme Specific Outcome, CO-Course Outcome

Cognitive Level: U-Understand

OPEN COURSE FOR OTHER MAJORS

Semester	V
Course	Open Course
Course name	ENVIRONMENTAL CHEMISTRY
Course Code	CH 1551.3
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive Level	PSO No.
1	Discuss the structure and composition of the atmosphere	U	PSO14
2	Identify, Realise and enlist the causes of pollution to water, soil and air	U	PSO14
3	Become aware of environmental issues and its effect to man and other living beings	U	PSO12
4	Review major environmental disasters and suggest controlling and preventive measures	U	PSO12
5	Discuss the laws of environmental protection	U	PSO21

PSO-Programme Specific Outcome, CO-Course Outcome

Cognitive Level: U-Understand

ELECTIVE COURSES

Semester	V1
Course	Elective Course
Course name	SUPRAMOLECULAR, NANO PARTICLES AND GREEN CHEMISTRY
Course Code	CH1651.1
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive Level	PSO No.
1	Become aware of pollution caused by industries	U	PSO13
2	Recognise the necessity of green approaches to protect nature	R	PSO14
3	Discuss about sustainable development and logical use of natural resources	U	PSO14
4	Motivated to more ecofriendly life style	A	PSO21
5	Realises the importance of microscale approaches and nano material research	U	PSO13 PSO21

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply, R-Remember

ELECTIVE COURSES

COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY

Semester	V1
Course	Elective Course
Course name	COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY
Course Code	CH1651.2
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive Level	PSO No.
1	Understand the use of Chemistry related softwares	U	PSO5
2	Discuss computational methods and combinatorial synthesis	U	PSO5
3	Classify reaction mechanism with suitable examples	U	PSO10
4	Understand the role of Thermodynamic functions in the study of Kinetics	U	PSO11
5	Correlate structure with reactivity	A	PSO11

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Semester	V1
Course	Elective Course
Course name	POLYMER CHEMISTRY
Course Code	CH1651.3
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME <i>Upon completion of this course, students</i>	Cognitive Level	PSO No.
1	Differentiate between Natural and synthetic polymers	U	PSO14
2	Understand polymerization process of monomeric units	U	PSO12
3	Critically analyse the advantages and disadvantages of polymers	A	PSO12
4	Analyse different Applications of Polymers	A	PSO4
5	Identify the properties of polymers.	U	PSO11
6	Realize the necessity of biodegradable substitutes for a sustainable development	U,A	PSO12 PSO12

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, A-Apply

Semester	V1
Course	Elective Course
Course name	BIO CHEMISTRY
Course Code	CH1651.4
Credit	2
Hours	54 hours
Lecture-Tutorial-Lab	2-0-0

CO No.	COURSE OUTCOME	Cognitive Level	PSO No.
	<i>Upon completion of this course, students</i>		
1	Recognise the constituents of blood and blood coagulation factors	R,U	PSO21
2	Become aware of the role of organs, in maintaining health	U	PSO21
3	Realise applications of Analytical techniques and instruments for biochemical studies	U	PSO9

PSO-Programme Specific Outcome, CO-Course Outcome
Cognitive Level: U-Understand, R-Remember

M.Sc. PROGRAMME IN BRANCH III – CHEMISTRY

PROGRAMME SPECIFIC OUTCOMES

- PSO 1 Develop a better understanding of the current chemical principles, methods and theories with the ability to critically analyse at an advanced level.
- PSO 2 Acquire solid knowledge of classical and modern experimental techniques and interpretation of results; thereby acquire the ability to plan and carry out independent projects.
- PSO 3 Develop the qualities of time management and organization, planning and executing experiments.
- PSO 4 Have a good level of awareness of the problems associated with health, safety and environment.
- PSO 5 Understand how chemistry relates to the real world and be able to communicate their understanding of chemical principles to a lay audience and as well apply the knowledge when situation warrants.
- PSO 6 Learn to search scientific literature and databases, extract and retrieve the required information and apply it in an appropriate manner.
- PSO 7 Demonstrate proficiency in undertaking individual and/or team-based laboratory investigations using appropriate apparatus and safe laboratory practices.
- PSO 8 Develop analytical solutions to a diversity of chemical problems identified from application contexts; critically analyse and interpret qualitative & quantitative chemical information's.
- PSO 9 Set the scene to make use of the wide range of career options open to chemistry graduates

COURSE OUTCOMES (CO)

SEMESTER I

CH 211 INORGANIC CHEMISTRY I

Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	employ crystal field theory in analysing the splitting of d orbitals in octahedral, tetragonal, square planar, tetrahedral, trigonalbipyramidal and square pyramidal fields, calculate Crystal Field Stabilization Energy and Interpret Octahedral Site Stabilization Energy.	Ap, An U	1
2.	apply Jahn-Teller theorem and demonstrate evidence for JT effect, static and dynamic JT effect.	Ap	1
3.	illustrate MOT for octahedral and tetrahedral complexes with and without pi bonds and construct MO diagrams.	An C	1
4.	critically evaluate data from a variety of analytical chemistry techniques and apply knowledge of the statistical analysis of data.	Ap, E	1, 2
5.	interpret complexometric titrations, redox titrations, gravimetric titrimetry and titrations in non-aqueous solvents.	E, U	1, 2
6.	apply TG, DTA and DSC in the study of metal complexes.	Ap, An	1, 2
7.	explain the functioning of the frontier materials in inorganic chemistry like Solid Electrolytes, Solid oxide fuel cells, Rechargeable battery materials, Molecular materials and fullerenes.	U	1, 4, 6
8.	explain the preparation, properties and structure of isopoly acids of Mo, W and V and heteropoly acids of Mo and W.	U	1
9.	explain preparation and properties of xenon fluorides, and noble gas compounds, aluminosilicates, zeolites and silicones and identify the importance of shape selectivity.	U	1
10.	identify the chemical processes occurring naturally in earth's atmospheric, aquatic and soil environments and evaluate the impacts of human perturbations to these processes.	An, E	4

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse, E–Evaluate,
C–Create

CH 212 ORGANIC CHEMISTRY I

Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	writedowntheIUPACnameofpolycyclic,spirocyclic and heterocyclic compounds and draw the structures from the IUPAC name of these compounds.	U	1
2.	determine R and S, P and M, E and Z configuration of compounds with chiral centres, biphenyls, allenes, spiranes and draw the configurations in dash and wedge formula, or zig – zag configurations.	E	1
3.	detectprochirality in a compound and explain relevance of prochirality.	U, An	1
4.	explain chiral centre, chiral axis and chiral planewith examples, stability of conformations, stereoselective and stereospecific reactions.	An, E	1
5.	calculate Cotton effect of a compound from its structure and configuration.	E	1
6.	explain different methods for generation of free radical and different types of free radical reactions- Predict the products in a free radicalreaction.	U, An	1
7.	describe different types mechanism of substitution, elimination, hydrolysis and additionreactions.	Ap	1
8.	differentiate the rate, mechanism and stereochemistry influenced by solvent, substrate structure, intermediate stability.	An	1
9.	predict the products or reactants or reagents in selected types of reactions.	U	1
10.	design the mechanism of selected reactions.	C	1

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, Ap–Apply, An–Analyse, E–Evaluate,

C–Create

CH 213 PHYSICAL CHEMISTRY I**Total 90 h**

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	outline the development of quantum mechanics and its tools and apply them in determining the wave functions and energies of moving particles.	U, Ap, An	1
2.	recognize the nature of adsorption and propose theories and choose theoretical and instrumental methods of measurements of surface property.	U, Ap, An	1
3.	understand theory and mechanism of catalytic action.	U	1
4.	correlate thermodynamic properties and apply them in systems.	U, Ap, An	1
5.	understand theories, mechanism and, kinetics of reactions and solve numerical problems.	U, Ap, An	1
6.	identify point groups and construct character table and predict hybridisation and spectral properties of molecules.	U, Ap, C	1

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse, C–Create

CH 214 INORGANIC CHEMISTRY PRACTICALS – I Total 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, E	3, 7, 8
2.	estimate volumetrically the concentration of Zn, Mg and Ni using EDTA and the volumetric estimation of Fe.	Ap, An	7, 8
3.	estimate volumetrically the hardness of water and concentration of Ca in water samples using EDTA.	Ap, An	7, 8
4.	estimate colorimetrically the concentration of Chromium – (using Diphenylcarbazide), Iron (using thioglycollic acid), Iron (using thiocyanate), Manganese (using potassium periodate), Nickel (using dimethyl glyoxime).	Ap, An	7, 8
5.	carry out the preparation of the metal complexes : Potassium trioxalatochromate(III), Tetraammonium copper (II) sulphate, Hexamminecobalt(III) chloride.	Ap	7, 8
6.	record the UV spectra, IR spectra, magnetic susceptibility, TG, DTA and XRD of the complexes prepared.	Ap, An	2, 7, 8

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, Ap–Apply, An–Analyse

CH 215 ORGANIC CHEMISTRY PRACTICALS – I Total 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, E	3, 7, 8
2.	determine the correct method for separation of a binary mixture and make the separated compounds in pure form.	An, E	2, 7, 8
3.	develop thin layer chromatogram of a compound and determine its purity.	C	2, 7, 8
4.	separate two compounds by column chromatography.	An	2, 7, 8
5.	utilize the synthetic procedures and reagents to convert a compound into another. Differentiate the products by spectroscopic methods.	An	2, 7, 8
6.	use green chemical principles in the synthesis.	Ap	2, 4
7.	solve GC MS and LC MS of a compound to ascertain purity and identity, apply the basic principles	Ap, E	2, 7

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, C–Create, Ap–Apply,

An–Analyse

CH 216 PHYSICAL CHEMISTRY PRACTICALS – ITotal 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, E	3, 7, 8
2.	construct the Freundlich and Langmuir isotherms for adsorption of acetic/oxalic acid on active charcoal/ alumina and determine the concentration of acetic/ oxalic acid	C, Ap, An	7, 8
3.	determine the rate constant, Arrhenius parameters, rate constant and concentration using kinetics	Ap	7, 8
4.	construct the phase diagram and determine the composition of an unknown mixture	Ap, An	7, 8
5.	construct the ternary phase diagram of acetic acid chloroform-water system and out the procedure in an unfamiliar situation to find out the composition of given homogeneous mixture.	C, Ap, An	7, 8
6.	construct the tie-line in the ternary phase diagram of acetic acid chloroform-water system	C, Ap, An	7, 8
7.	determine distribution coefficient using distribution law.	Ap	7, 8
8.	determine the equilibrium constant employing the distribution law.	Ap	7, 8
9.	determine the coordination number of Cu^{2+} in copper-ammonia complex.	Ap	7, 8
10.	determine K_f of solid solvent, molar mass of non-volatile solute, mass of solvent and composition of given solution	Ap, An	7, 8
11.	determine K_T of salt hydrate, molar mass of solute, mass of salt hydrate and composition of given solution.	Ap, An	7, 8
12.	determine surface tension and parachor of liquids.	Ap	7, 8
13.	ascertain the relationship between surface tension with concentration of a liquid and use this to find out the composition of given homogeneous mixture.	Ap, An	7, 8
14.	determine the concentration of given strong acid/alkali.	Ap, An	7, 8
15.	determine the heat of ionisation of acetic acid.	Ap, An	7, 8
16.	determine the heat of displacement of Cu^{2+} by Zn.	Ap, An	7, 8

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, C–Create, Ap–Apply, An–Analyse

SEMESTER II

CH 221 INORGANIC CHEMISTRY II Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	obtain the term symbols of d^n system and determine the splitting of terms in weak and strong octahedral and tetrahedral fields.	E	1
2.	explain the correlation diagrams for d^n and d^{10-n} ions in octahedral and tetrahedral fields and interprets electronic spectra of complexes.	U, E	1
3.	applies magnetic measurements in the determination of structure of transition metal complexes.	Ap	1
4.	relates crystalline structure to X-ray diffraction data and the reciprocal lattice and explains the diffraction methods	U	1
5.	explains crystal defects .	U	1
6.	elaborates the structure of selected compounds of AX , AX_2 , A_mX_2 , ABX_3 and spinels.	C	1
7.	explains the electronic structure of solids using free electron theory and band theory.	E	1
8.	understands the differences in semiconductor and dielectric materials and their electrical and optical properties	U, E	1
9.	explain the structure and reactions of S–N, P–N, B–N, S– P compounds and boron hydrides.	U, E	1
10.	analyse the topological approach to boron hydride structure and estimates styx numbers and apply Wade's rules in borane and carboranes.	Ap, An, E	1
11.	identify the electronic configurations and term symbols of lanthanides and actinides.	Ap	1
12.	sketches the shapes of f orbital and shows their splitting in cubic ligandfield.	U	1
13.	elaborates the importance of the beach sands of Kerala and their important components.	C	1

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, C–Create, Ap–Apply, An–Analyse

CH 222 ORGANIC CHEMISTRY II Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	discuss the fundamentals, operating principles and instrumentation of separation techniques.	R	1,
2.	differentiate the principle and applications of phase transfer catalysis with examples.	An	1
3.	describe the various methods of determining reaction mechanisms and basic thermodynamic principles of organic reactions.	U	1
4.	explain the Hammett parameters of reaction and design an experiment to confirm the mechanism of a reaction.	R, C	1
5.	identify different types of rearrangement reactions, determine the product of the reaction applying migratory aptitude, and reproduce the evidences for the mechanism of the reaction.	R, E	1
6.	understand that the outcomes of pericyclic reactions may be understood in terms of frontier orbital interactions, correlation diagram, Möbius and Hückel approach.	R	1
7.	recall and define the various types of pericyclic reaction; define such terms as 'conrotatory', 'suprafacial'.	R	1
8.	predict and rationalise the outcomes of pericyclic reactions including stereospecificity, regioselectivity, and stereoselectivity.	U	1
9.	state the synthetic importance of the above cycloaddition and rearrangement reactions, and give disconnections of target compounds corresponding to these reactions.	R	1
10.	describe the fate of excited molecule based on Jablonowski diagram, predict the course of an organic photochemical reaction and identify the product with the type of functional group.	R, An	1
11.	propose synthetic routes to a variety of molecules, starting from simple precursors with correct stereochemistry and reagents of selected reactions.	Ap	1

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, C–Create, Ap–Apply,

An–Analyse

CH 223 PHYSICAL CHEMISTRY IITotal 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	apply quantum mechanical principles in solving both real and imaginary spherical harmonics systems-multi electron systems and analyse spectral lines.	U, Ap, An	1
2.	describe and explain the physical and chemical principles that underlie molecular structure determination techniques like microwave, vibrational, Raman and electronic spectroscopy.	R, U	1
3.	predict likely spectral characteristics of given molecular species, and be able to rationalise those characteristics on the basis of structural and electronic arguments.	Ap, An	1
4.	acquire knowledge of basics of statistical mechanics and compare statistical methods.	U, Ap	1
5.	understand and apply of theories of heat capacity.	U, Ap	1
6.	understand theories of electrolytes and electrochemical reactions.	R, U, Ap, An	1
7.	ascertain the application of electrochemistry in industrial fields.	An	1
8.	understand the theories and applications behind various types of analytical techniques in electrochemistry.	U	1
9.	acquire skill in solving numerical problems.	Ap	1

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: R–Remember, U–Understanding, Ap–Apply, An–Analyse

SEMESTER III

CH 231 INORGANIC CHEMISTRY III

Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	demonstrate knowledge of advanced content in the areas of inorganic chemistry such as in organometallic compounds, bioinorganic compounds, spectroscopic methods in inorganic Chemistry and nuclear chemistry.	U	1
2.	examine the bonding in simple and polynuclear carbonyls with and without bridging and complexes with linear π donor ligands.	U, An	1
3.	explain the structure and bonding of ferrocene and dibenzenechromium with the help of MO theory.	U, An, C	1
4.	understand fundamental reaction types and mechanisms in organometallics and to employ them to understand selected catalytic processes in industry.	U, An, C	1
5.	contrasts the thermodynamic and kinetic stability of complexes, analyses the factors affecting stability of complexes and explains the methods of determining stability constants.	An, E	1
6.	classifies ligand substitution reactions and explains its kinetics and various mechanisms.	U, E	1
7.	analyze the chemical and physical properties of metal ions responsible for their biochemical action as well as the techniques frequently used in bioinorganic chemistry such as oxygen transport, e-transfer, communication, catalysis, transport, storage etc.	U, An	1
8.	explain the principles of spectroscopic methods employed in inorganic chemistry and their applications in the study of metal complexes.	An, E	1
9.	demonstrate a knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions, counting techniques.	R, U	1
10.	evaluate the role of nuclear chemistry to find the most suitable measures, administrative methods and industrial solutions to ensure sustainable use of the world's nuclear resources.	U, E, C	1, 4

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: R–Remember, U–Understanding, Ap–Apply, An–Analyse,

E–Evaluate, C–Create

CH 232 ORGANIC CHEMISTRY III Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	describe and explain the physical and chemical principles that underlie molecular structure determination techniques such as UV-visible, IR, mass and NMR spectroscopy.	U, An	1
2.	apply knowledge of molecular structure determination using UV-visible, IR, mass and NMR spectroscopic techniques to identify and/or characterise chemical compounds from experimental data.	Ap, An	1, 8
3.	calculate λ_{\max} of a compound, apply IR frequency table to determine the functional groups present in the molecule, interpret mass spectrum of compound from fragmentation.	U, Ap	1, 8
4.	predict likely spectral characteristics of given molecular species; solve the structures of unknown molecules using appropriate spectroscopic techniques.	U, Ap, An	1, 8
5.	devise a 2 D NMR of a compound based on learned principles and solve the structure of a compound based on NMR data.	C, Ap	1, 8
6.	discuss organic transformations with organometallic compounds and predict the products of these reactions.	U	1
7.	propose the retro synthetic pathways to a variety of molecules	U, Ap, C	1
8.	propose mechanisms for chemical reactions, given starting materials, reagents, conditions, and/or products.	U, Ap, C	1
9.	compare the reactions and mechanism and determine the products of a selected set of reactions; identify protecting group strategies.	Ap, E	1
10.	devise combinatorial method to create a library of compounds.	C	1, 6
11.	give examples of stereoselective, regioselective and chemoselective reductions and oxidations.	U	1

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse, E–Evaluate, C–Create

CH 233 PHYSICAL CHEMISTRY III Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	understand the theories of chemical bonding and their application with help of approximate methods predict the nature of orbitals and molecular spectra.	U, Ap, An	1
2.	compare MO and VBT.	An	1
3.	understand the properties of gases and liquids and the nature of the intermolecular forces in them.	U, Ap, An	1
4.	describe the principle behind the determination of surface tension and coefficient of viscosity.	U	1
5.	describe and explain the physical and chemical principles that underlie molecular structure determination techniques like NMR, ESR, Mossbauer, NQR and PES spectroscopy.	U, Ap, An	1
6.	judge the degrees of freedom of systems and understand theories of irreversible thermodynamic systems.	U, Ap, An, E	1
7.	understand the quantum mechanical and non-quantum mechanical methods in computational chemistry, potential energy surface and basis functions.	U, An	1
8.	write the Z matrix of simple molecules.	U, Ap	1
9.	acquire skill in solving numerical problems.	Ap	1

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, Ap–Apply, An–Analyse, E–Evaluate

CH 234 INORGANIC CHEMISTRY PRACTICALS – II Total 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, An	3, 7, 8
2.	estimate a simple mixture of ions (involving quantitative separation) by volumetric and gravimetric methods.	An	7, 8
3.	perform COD, BOD, DO, TDS analysis.	Ap, An	4, 7, 8
4.	predict likely spectral characteristics of given metal complexes solve the structures of unknown metal complexes using appropriate spectroscopic techniques and magnetic measurements .	Ap, An	6, 8
5.	analyse the XRD of simple substances.	An	8
6.	interpret TG and DTA curves.	An	8

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse

CH 235 ORGANIC CHEMISTRY PRACTICALS – II Total 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, An	3, 7, 8
2.	predict likely spectral characteristics of given molecular species; solve the structures of unknown molecules using appropriate spectroscopic techniques	Ap, An	6, 7, 8
3.	develop paper chromatogram of a compound and determine its purity	C	7, 8
4.	estimate quantitatively the Aniline, Phenol, glucose, Ascorbic acid and Aspirin in a sample	Ap	7, 8
5.	estimate colorimetrically paracetamol, protein and ascorbic acid	Ap	7, 8
6.	use green chemical principles in the synthesis	Ap	4, 7, 8

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse, C–Create

CH 236 PHYSICAL CHEMISTRY PRACTICALS – II Total 125 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
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1.	interpret data from an experiment, including the construction of appropriate graphs and the evaluation of errors.	U, E	3, 7, 8
2.	determine the strength of strong/ weak acids by conductometric titrations.	Ap	7, 8
3.	verify Onsager equation and Kohlraush's law conductometrically .	An, E	7, 8
4.	determine the activity and activity coefficient of electrolyte.	Ap, An	7, 8
5.	determine the concentration of a solution potentiometrically or pHmetrically.	Ap, An	7, 8
6.	employ spectrophotometry in determining unknown concentration.	Ap, An	7, 8
7.	determine the viscosity of liquid mixtures and use this in determining the concentration of a component in a mixture.	Ap, An	7, 8
8.	determine the concentration of a liquid mixture using a refractometer .	Ap, An	7, 8
9.	determine the unknown concentration of a given glucose solution.	Ap, An	7, 8

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, E–Evaluate, Ap–Apply, An–Analyse

SEMESTER IV

CH 241 CHEMISTRY OF ADVANCED MATERIALS

Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
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1.	understand dimensions, synthesis, physicochemical properties of nanomaterials and its applications.	U, Ap, An	1
2.	understand and apply characterization tools for analysing nano structures.	U, Ap, An	1
3.	outline and recognize the types of polymerization, kinetics and mechanisms.	U, Ap, An	1
4.	understand the stereochemical aspects and methods for the determination of molecular weights of polymers.	U, Ap, An	1
5.	discuss the synthesis and applications of selected classes of speciality polymers.	U, Ap, An	1, 5
6.	distinguish the types and important applications of smart materials.	U, Ap, An	1, 5

PSO–Programme Specific Outcome, CO–Course Outcome

Cognitive Level: U–Understanding, Ap–Apply, An–Analyse

CH 242 (a) INORGANIC CHEMISTRY IV Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	explain the schemes for σ and π bonding with examples.	U	1
2.	explain MO and Ligand field theory with the support of group theory and construct the MO diagram of octahedral complexes.	U, C	1
3.	apply character tables to find out the Infrared and Raman active modes for C_{2v} , C_{3v} and D_{4h} .	Ap, An	1
4.	assimilate the concepts of molecular recognition, self-assembly, dynamic combinatorial chemistry and supramolecular chirality, and be aware of the most important work in the field.	U	1
5.	understand the nature of bonding in metal atom clusters and distinguish Low nuclearity and High nuclearity carbonyl clusters.	U, An	1
6.	perform the electron counting schemes in cluster compounds.	Ap, An	1
7.	differentiate the different types of cluster molecules and understand their utility in catalysis.	An	1
8.	understand and explain the role of metal ions in biological systems and give examples for the use of metals in medicine.	U, An	1
9.	differentiate the defects arising due to deficiency and excess presence of metal ions in the body.	An	1
10.	explain the acid base concept in non aqueous media and identify the reactions taking place in selected non aqueous solvents.	An	1

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, C–Create, Ap–Apply, An–Analyse

CH 242 (b) ORGANIC CHEMISTRY IV**Total 90 h**

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	define secondary metabolites from plants and animals.	R	1
2.	explain the biosynthesis of terpenes and sterols, illustrate the structural elucidation and synthesis of natural products.	U, An	1
3.	list the forces involved in molecular recognition and recognize molecular receptors.	U	1
4.	quote molecular recognition events in biological systems.	U	1
5.	discuss the methods of creating combinatorial libraries and its processing to locate lead molecule.	U	1
6.	explain the various stages in drug development process, and outline the synthesis of paracetamol, phenobarbital, diazepam, sulphamethoxazole, benzylpenicillin, and chloramphenicol.	R, U, C	1
7.	construct a solid phase synthesis of tripeptide from any three aminoacids, explain protection, deprotection and automated synthesis of peptides and nucleotides.	U, C	1
8.	describe twelve principles green chemistry.	R	1, 4
9.	illustrate reactions in which green chemistry principles are applied and calculate atom economy.	Ap, An	1, 4

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: R–remember, U–Understanding, C–Create, Ap–Apply,

An–Analyse

CH 242 (c) PHYSICAL CHEMISTRY IV

Total 90 h

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	apply the group theory in the identification of IR and Raman active normal modes in molecules coming under various point groups such as C_{2v} , C_{3v} , C_{4v} , D_{3h} , Td and Oh.	Ap	1
2.	apply group theory in solving spectroscopic problems.	Ap	1
3.	solve the problems in Exactly solvable systems like Simple Harmonic Oscillator, rigid rotor and the Hydrogen atom.	Ap, An	1
4.	explain the approximation methods used in quantum mechanics	U	1
5.	illustrate trial wave functions for calculation of H atom and particle in a 1D box as examples.	U, Ap	1
6.	set up secular determinants	C	1
7.	explain the variation in the state of a system with time	U, An	1
8.	apply computational methods as potential tools for practicing chemistry	An	1
9	construction of Z-matrices of simple molecules H ₂ , H ₂ O, H ₂ O ₂ , H ₂ CO, CH ₃ CHO, CH ₄ , C ₂ H ₆ and with dummy atom, CO ₂ , NH ₃ , C ₆ H ₆ .	C	1
10.	explain the commonly using force fields (MM3, MMFF, AMBER and CHARMM) and Softwares.	Ap	1
11.	Compare Molecular Mechanics, Ab-initiomethod, Semi-empirical method and DFT method of computations.	E	1

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, C–Create, E– Evaluate, Ap–Apply

CH 243 (a) Dissertation

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	demonstrate an advanced theoretical and technical knowledge of chemistry as a creative endeavour; analyse, interpret and critically evaluate scientific information.	Ap, An	1
2.	present information, articulate arguments and conclusions, in a variety of modes, to audiences in their field of research.	E, C	5, 8
3.	as part of a team or individually, design, conduct, analyse and interpret results of an experiment, and effectively communicate these in written reports and other formats.	Ap, An	3, 7
4.	develop an understanding of the requirements to undertake independent research in a chemistry field.	U	6, 9
5.	demonstrate an understanding of the relationship between scientific research and the progress of new knowledge in a global scenario.	An	5, 6, 9

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, C–Create, E– Evaluate, Ap–Apply, An–Analyse

CH 243 (b) Visit to R & D Centre

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to</i>	Cognitive Level	PSO No.
1.	Understand the relevance of independent supervised research in a chemistry field and the need of well- developed judgement, adaptability and accountability as a practitioner or learner	U, An	2, 9

PSO–ProgrammeSpecificOutcome, CO–Course Outcome

CognitiveLevel: U–Understanding, An–Analyse

