Ramakrishna Mission
Vivekananda Centenary College, Rahara

DEPARTMENT OF CHEMISTRY

Programme Outcomes, Programme Specific Outcomes, Course Objectives and Course Outcomes of the SYLLABUS FOR B.Sc. HONOURS WITH CHEMISTRY

CHOICE BASED CREDIT SYSTEM (CBCS)

2017

Principal
Ramakrishna Mission
Vivekananda Centenary College
Rahara, Kolkata-700 118

Ramakrishna Mission Vivekananda Centenary College
Rahara
Kolkata - 118

PROGRAMME OUTCOMES (POs)

PO Numbers	PROGRAMME OUTCOMES	COGNITIVE LEVEL
PO 1:	Recognize the scientific tempers and attitudes, which in turn can prove to be beneficial for the society since the scientific developments can make a nation or society to grow at a rapid pace.	R
PO 2:	Understand scientific knowledge and exchange ideas with other stakeholders; make people aware about sustainable utilization of resources with ethical approach.	U
PO 3:	Understand and apply the issues of environmental contexts and sustainable development as a basic interdisciplinary concern.	U, Ap
PO 4:	Create the ability to perform experiments and to analyse & interpret the obtained accurate results and thus gain the ability to solve problems, to involve in critical, independent, and creative thinking.	C
PO 5:	Possess expertise to apply and formulate ideas which will provide them competitive advantage in pursuing higher studies from India or abroad; and seek jobs in academia, research or industries.	Ap, C
PO 6:	Assemble the acquired in-depth knowledge of applied subjects towards the inculcation of professional and employment skills so that students can make a career and become an entrepreneur in diverse fields.	C

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PO Numbers	PROGRAMME SPECIFIC OUTCOMES	COGNITIVE LEVEL
PSO 1:	Remember and understand the fundamental concepts of organic, inorganic, physical and analytical chemistry.	R, U
PSO 2:	Analyse and apply the principles of analysis **and** hands on training of different advanced and commonly used analytical equipment for qualitative, quantitative and synthetic laboratory exercises	An, Ap
PSO 3:	Apply the principles of chemistry in the fields of industry, agriculture, medicine and environment	Ap
PSO 4:	Be able to apply the knowledge of the scientific concepts learnt to develop novel research ideas in chemistry	C
PSO 5:	Be able to combine the theoretical and practical knowledge for entrepreneurship, research and development and societal benefits	C

COURSE STRUCTURE

(BSC HONOURS WITH CHEMISTRY)

SEMESTERWISE DISTRIBUTION OF COURSES

SEMESTER	COURSE	COURSE NAME	CREDITS
SEMESTER-1	UGCHEMAECC01	English Communications/ Environmental Science	2
	UGCHEMCC01	Organic Chemistry-I + Organic Chemistry-I Lab	4+2
	UGCHEMCC02	Physical Chemistry-I + Physical Chemistry-I Lab	4+2
	GE-1	Generic Elective Theory + Practical	4+2
SEMESTER-2	UGCHEMAECC02	English Communications/ Environmental Science	2
	UGCHEMCC03	Inorganic Chemistry-I + Inorganic Chemistry-I Lab	4+2
	UGCHEMCC04	Organic Chemistry-II + Organic Chemistry-II Lab	4+2
	GE-2	Generic Elective Theory + Practical	4+2
SEMESTER-3	UGCHEMCC05	Physical Chemistry-II + Physical Chemistry-II Lab	4+2
	UGCHEMCC06	Inorganic Chemistry-II + Inorganic Chemistry-II Lab	4+2
	UGCHEMCC07	Organic Chemistry-III + Organic Chemistry-III Lab	4+2
	UGCHEMSEC01	Skill Enhancement Course-1	2
	GE-3	Generic Elective Theory + Practical	4+2
SEMESTER-4	UGCHEMCC08	Physical Chemistry-III + Physical Chemistry-III Lab	4+2
	UGCHEMCC09	Inorganic Chemistry-III + Inorganic Chemistry-III Lab	4+2
	UGCHEMCC10	Organic Chemistry-IV + Organic Chemistry-IV Lab	4+2
	UGCHEMSEC02	Skill Enhancement Course-2	2
	GE-4	Generic Elective Theory + Practical	4+2
SEMESTER-5	UGCHEMCC11	Inorganic Chemistry-IV+ Inorganic Chemistry-IV Lab	4+2
	UGCHEMCC12	Organic Chemistry-V + Organic Chemistry-V Lab	4+2
	UGCHEMDSE01	DSE-1 Theory + Practical	4+2
	DSE-2	DSE-2 Theory + Practical	4+2
SEMESTER-6	UGCHEMCC13	Inorganic Chemistry-V + Inorganic Chemistry-V Lab	4+2
	UGCHEMCC14	Physical Chemistry-IV + Physical Chemistry-IV Lab	4+2
	DSE-3	DSE-3 Theory + Practical	4+2
	DSE-4	Theory + Practical	4+2
TOTAL CREDITS			140

SEMESTER – 1		
Course name	CHEMISTRY -CC01: ORGANIC CHEMISTRY-01	
Course code	UGCHEMCC01	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding different types of interactions present in molecules
2. Understanding and applying VB and MO theories
3. Understanding and analysing Reactivity of different organic molecules
4. Evaluating actual shape of a molecule
5. Remembering and applying different terminologies and their application in the higher field of chemistry
6. Understanding and applying asymmetric synthesis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1	Analyse different types of chemical forces and interactions to predict the structure-activity relationships of different organic molecules	PO 2	PSO 4	An
CO 2	Apply the knowledge of VBT and MOT to discuss structure of molecules	PO 2	PSO 4	Ap, C
CO 3	Apply the knowledge addition reactions in alkenes and alkynes in organic synthesis	PO 2	PSO 3	Ap
CO 4	Analyse and apply the concept of crystallisation and purification of organic compounds	PO 1	PSO 2	An, Ap
CO 5	Evaluate boiling and melting points of unknown organic compounds	PO 2	PSO 2	E
CO 6	Apply the concept of asymmetric synthesis to design novel organic molecules	PO 4	PSO 5	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 1		
Course name	CHEMISTRY -CC02: PHYSICAL CHEMISTRY-01	
Course code	UGCHEMCC02	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Kinetic model of an ideal gas
2. Theoretical basis of Equipartition principle and its limitation
3. Understanding thermodynamic principles for a system performing mechanical work and applying the laws of thermodynamics
4. Analysing how fast a chemical reaction can occur under certain physical conditions
5. Understanding and analysing role of catalysts and biocatalyst (e.g., enzymes, etc.) in a catalyzed reaction
6. Evaluating numerical problems and experimentally determine the order, rate and activation energy of a chemical reaction

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1	Explain the theories of kinetic model of an ideal gas	PO 2	PSO 1	U
CO 2	Analyse and explain theoretical basis of Equipartition principle and its limitation	PO 2	PSO 3	An, E
CO 3	Apply the concepts of thermodynamics in different chemical reactions	PO 2	PSO 3	Ap
CO 4	Analyse how fast a chemical reaction can occur under certain physical conditions and what are the specific roles of different parameters affecting the speed or rate of any chemical reaction.	PO 2	PSO 4	R, An
CO 5	Analyse role of catalysts and biocatalyst (e.g., enzymes, etc.) in a catalyzed reaction and design new catalysts	PO 2	PSO 3	An, C
CO 6	Analyse and apply the theoretical knowledge to do the different thermodynamic and kinetic based experiments	PO 1	PSO 4	An, Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 2		
Course name	CHEMISTRY -CC03: INORGANIC CHEMISTRY-01	
Course code	UGCHEMCC03	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the structure of atom
2. Periodic table and understand the periodic variation of different atomic and ionic properties
3. Understanding the acid-base behaviour of different organic and inorganic compounds
4. pH of acids and bases, buffer solution and their applications in respective areas
5. Understanding the redox behaviour of different substances
6. Applications of redox chemistry in different promising areas, like, solar cell, fuel cell, supercapacitors, batteries etc.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the classical and quantum mechanical ideas to analyze different numerical problems	PO 2	PSO 2	Ap, An
CO 2	Recall the periodic table and explain the periodic variation of different periodic properties	PO 2	PSO 1	R, U
CO 3	Explain and analyse acid-base behaviour of different organic and inorganic compounds	PO 2	PSO 3	U, An
CO 4	Evaluate and apply the mathematical ideas based on pH in acid base reaction system	PO 2	PSO 4	E, Ap
CO 5	Apply the redox chemistry to design advanced materials like, solar cell, fuel cell, supercapacitors, batteries etc.	PO 5	PSO 4	Ap, C
CO 6	Analyse and apply the concept of pH and redox potential in respective quantitative analysis	PO 3	PSO 2	An, Ap

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SEMESTER – 2		
Course name	CHEMISTRY – CC04: ORGANIC CHEMISTRY-02	
Course code	UGCHEMCC04	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding chirality and applying the knowledge in enzymatic reactions
2. Understanding the fundamental principles of different spectroscopy and applying the knowledge in characterizing different aspects of molecules
3. Reactivity of different organic molecules, as well as, mechanism of different organic reactions
4. Applying the above concepts in the synthesis of different important organic compounds.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of stereochemistry in different enzymatic reactions	PO 2	PSO 3	Ap
CO 2	Apply the fundamental principles of different spectroscopy to solve spectroscopic aspects of molecules	PO 3	PSO 2	Ap, C
CO 3	Interpret reactivity of different organic molecules, and justify the mechanism of different organic reactions	PO 2	PSO 1	E
CO 4	Apply the fundamental concepts learnt to design different important organic compounds.	PO 2	PSO 4	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 3		
Course name	CHEMISTRY -CC05: PHYSICAL CHEMISTRY-02	
Course code	UGCHEMCC05	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding basic laws governing the adsorption, different adsorption isotherms and applying the knowledge in analysing the function of heterogeneous catalysts
2. Understanding the concepts of chemical equilibrium and applying the thermodynamic laws to explain chemical equilibrium
3. Understanding and applying Le Chatelier principle
4. Understanding the basic and fundamental concepts classical and quantum mechanics
5. Applying the concepts of quantum mechanics in different quantum mechanical system, such as particle in a box, simple harmonic oscillator, rigid rotor and one-electron system like hydrogen atom.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain the basic laws governing the adsorption, different adsorption isotherms and apply the knowledge to analyze the role of heterogeneous catalysts	PO 2	PSO 3	U, An, Ap
CO 2	Apply the concepts and principles of chemical equilibrium in analyzing chemical reactions	PO 3	PSO 3	An, Ap
CO 3	Summerize the basic and fundamental concepts classical and quantum mechanics and evaluate different quantum mechanical problems	PO 4	PSO 2	U, E
CO 4	Apply the knowledge of physical chemistry to estimate different parameters in practical experiments	PO 5	PSO 2	Ap, C

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SEMESTER – 3		
Course name	CHEMISTRY -CC06: INORGANIC CHEMISTRY-02	
Course code	UGCHEMCC06	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding concepts, theories and parameters related to bonding
2. Applying the knowledge of bonding in explaining the structure and properties of molecules and ions
3. Understanding the factors determining nuclear stability and applying the knowledge in different nuclear reactions
4. Understanding and applying nuclear models
5. Applying the concepts of radioactivity in power generation, age determination etc.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Demonstrate the concepts, theories and parameters related to ionic, covalent, metallic and H-bonding	PO 1	PSO 1	U
CO 2	Apply the knowledge of bonding in explaining the structures, interactions and reactions of molecules and ions	PO 2	PSO 3	Ap
CO 3	Elaborate the concept of radioactivity in promising fields like, nuclear power generation, radiation therapy etc.	PO 2	PSO 3	C
CO 4	Apply the knowledge of volumetric and gravimetric analysis in different chemical reactions	PO 2	PSO 2	Ap

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SEMESTER – 3		
Course name	CHEMISTRY -CC07: ORGANIC CHEMISTRY-03	
Course code	UGCHEMCC07	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the reactivity of carbonyl and related organic compounds
2. Understanding and applying the concepts of reaction mechanism in organic synthesis
3. Understanding the fundamental principles of different spectroscopies
4. Applying the concepts of spectroscopy in evaluating different aspects of molecules
5. Understanding the reactivity of organometallic compounds in organic synthesis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain and illustrate the reactivity of carbonyl and related organic compounds	PO 2	PSO 3	U
CO 2	Interpret the concepts of reaction mechanism in organic synthesis	PO 1	PSO 4	U, E
CO 3	Apply the fundamental principles of different spectroscopies and solve different spectrochemical data	PO 2	PSO 2	Ap, C
CO 4	Explain and interpret the reactivity of organometallic compounds in organic synthesis	PO 2	PSO 3	U, E
CO 5	Apply the concepts of synthesis in organic preparation	PO 2	PSO 3	Ap

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SEMESTER - 3		
Course name	CHEMISTRY -CC08: PHYSICAL CHEMISTRY-03	
Course code	UGCHEMCC08	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the activity and activity coefficient of various ionic species present in the solution
2. Understanding various electrode processes; different types of electrodes
3. Derivation of Nernst equation using laws of Thermodynamics
4. Historical chronology leading to the development of Quantum Mechanics and understanding different fundamental theories of Quantum Mechanics
5. Understanding and applying Schrodinger's wave equation (time-independent), and several other mathematical techniques to determine the physical property of different models.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Compare and explain the activity and activity coefficient of various ionic species present in the solution	PO 2	PSO 1	U, E
CO 2	Classify different types of electrodes and electrode processes	PO 1	PSO 3	U, An
CO 3	Demonstrate Nernst equation using laws of Thermodynamics and solve numerical problems	PO 1	PSO 4	U, C
CO 4	Recall historical chronology leading to the development of Quantum Mechanics and explain different fundamental theories of Quantum Mechanics	PO 1	PSO 1	R, E
CO 5	Interpret and illustrate Schrodinger's wave equation (time-independent), and several other mathematical techniques to determine the physical property of different models	PO 2	PSO 4	U, E

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SEMESTER – 4		
Course name	CHEMISTRY CC09: INORGANIC CHEMISTRY-03	
Course code	UGCHEMCC09	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Extraction and purification of metals based on redox potential
2. Understanding the chemistry of various compounds of the s-block and p-block elements
3. Understanding and applying several industrially important compounds
4. Understanding the basic theories of coordination bonding and coordination chemistry
5. Demonstrating isomerism in coordination compounds in different geometrical shapes

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the principles of extraction and purification of metals based on redox potential	PO 2	PSO 1	U
CO 2	Explain and illustrate the chemistry of various compounds of the s-block and p-block elements	PO 2	PSO 3	U, E
CO 3	Discuss the basic theories of coordination bonding and coordination chemistry	PO 1	PSO 4	C
CO 4	Solve new research problems based on the knowledge on isomerism	PO 4	PSO 1	C
CO 5	Plan and design novel research ideas based on inorganic synthesis	PO 5	PSO 4	Ap, C

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SEMESTER – 4		
Course name	CHEMISTRY -CC10: ORGANIC CHEMISTRY-04	
Course code	UGCHEMCC10	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Preparation and reactivity of nitrogen based organic compounds
2. Understanding and applying the concept of retro synthesis and asymmetric synthesis
3. The mechanism of different organic rearrangement reactions
4. Understanding the mechanism, stereochemistry, regioselectivity in case of electrocyclic reactions, cycloaddition reactions and sigmatropic reactions.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the preparation and explain the reactivity of nitrogen based organic compounds	PO 2	PSO 2	U, E
CO 2	Apply the concept of retro synthesis and asymmetric synthesis to design new target	PO 3	PSO 4	Ap, C
CO 3	Solve and interpret the mechanism of different new organic rearrangement reactions	PO 5	PSO 4	E, C
CO 4	Apply the knowledge of pericyclic reactions to solve new related problems	PO 1	PSO 4	Ap, C
CO 5	Quantitatively estimate composition of different organic compounds	PO 2	PSO 2	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 5		
Course name	CHEMISTRY -CC11: INORGANIC CHEMISTRY-04	
Course code	UGCHEMCCXI	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The elementary idea on crystal field theory
2. The colour, magnetic properties and chemical potentials of coordination compounds of transition metals
3. The colour, magnetic properties and chemical potentials of coordination compounds of lanthanoids and actinoids
4. Understanding the chemistry of semimicro qualitative analysis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of crystal field theory and its related aspects to discuss the chemistry of coordination compounds	PO 2	PSO 1	Ap, C
CO 2	Explain the colour, magnetic properties and chemical potentials of novel coordination compounds	PO 2	PSO 4	E
CO 3	Explain the colour, magnetic properties and chemical potentials of coordination compounds of lanthanoids and actinoids	PO 2	PSO 4	E
CO 4	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 3	PSO 3	E, C

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SEMESTER – 5		
Course name	CHEMISTRY -CC12: ORGANIC CHEMISTRY-05	
Course code	UGCHEMCC12	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Different heterocyclic compounds of different sizes especially 5 and 6-membered heterocycles.
2. The synthesis and reactions of different heterocycles.
3. Understanding the key biological roles of heterocycles
4. Understanding the chemistry of carbohydrate, amino acids, peptides, proteins and nucleic acids including the functions of DNAs and RNAs
5. Chemical methods for sequencing biopolymers

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Classify and summarize heterocyclic compounds of different sizes especially 5 and 6-membered heterocycles	PO 1	PSO 1	Ap, An
CO 2	Apply the concepts of synthesis and reactions of heterocycles in designing novel drug molecules	PO 3	PSO 4	Ap, C
CO 3	Demonstrate the key biological functions of heterocycles	PO 1	PSO 3	U
CO 4	Illustrate and interpret the chemistry of carbohydrate, amino acids, peptides, proteins and nucleic acids	PO 2	PSO 4	E, C
CO 5	Apply the chromatographic techniques in separation of organic mixtures	PO 3	PSO 2	Ap

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SEMESTER – 6		
Course name	CHEMISTRY -CC13: INORGANIC CHEMISTRY-05	
Course code	UGCHEMCC13	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The role of metal ions in biological systems
2. The structures, functions of metalloproteins and metalloenzymes
3. Understanding the mechanism of redox reactions in biological systems, photosynthesis and chelation therapy
4. Understanding the structure, bonding and reactivity of organometallic complexes
5. Applications of organometallic complexes in catalysis
6. Understanding the thermodynamic and kinetic aspects of inorganic reaction mechanism

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Evaluate the role of metal ions in biological systems	PO 1	PSO 1	E
CO 2	Apply the knowledge of redox reactions in biological systems in designing model biological systems	PO 3	PSO 4	Ap, C
CO 3	Illustrate the structure, bonding and reactivity of new organometallic complexes and apply the concept in designing novel organometallic catalyst	PO 2	PSO 3	U, C
CO 4	Make use of the knowledge of inorganic reaction mechanism to explain new reactions	PO 3	PSO 4	Ap, E
CO 5	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 4	PSO 3	E, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 6		
Course name	CHEMISTRY -CC14: PHYSICAL CHEMISTRY-04	
Course code	UGCHEMCC13	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the fundamental principles of rotational, vibrational, NMR and ESR spectroscopy
2. Applications of spectroscopic techniques in chemistry
3. Illustrating the concepts of photochemistry
4. Understanding the basics of different surface phenomena like, surface tension, adsorption etc.
5. Understanding different physicochemical phenomena of colloid chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of spectroscopy in solving related problems in chemistry	PO 3	PSO 2	Ap, C
CO 2	Apply the concepts of photochemistry to interpret different photochemical reactions	PO 3	PSO 2	Ap, E
CO 3	Apply the concepts of surface tension, adsorption etc. to analyse different surface phenomena	PO 3	PSO 3	Ap, An
CO 4	Designing new formulations for cosmetics, surfactants, medicines utilizing the concepts of colloid chemistry	PO 4	PSO 4	Ap, E
CO 5	Apply the knowledge of surface properties to determine the related parameters	PO 2	PSO 2	Ap, E

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DISCIPLINE SPECIFIC ELECTVES (DSE)

Course name	DSE01: Advanced Physical Chemistry	
Course code	UGCHEMDSE01	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding structural parameters of ionic solids
2. Classifications of different lattice systems and lattice parameters
3. Understanding statistical thermodynamics
4. Third law of thermodynamics and its related topics
5. Understanding basic polymer chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain and illustrate the structural features of different ionic solids based on crystallography	PO 2	PSO 1	U, E
CO 2	Classify and discuss the lattice systems and lattice parameters newly synthesized crystalline materials	PO 2	PSO 4	U, C
CO 3	Apply statistical thermodynamics to solve new related problems	PO 3	PSO 4	Ap, C
CO 4	Apply third law of thermodynamics to interpret related systems	PO 4	PSO 1	Ap, E
CO 5	Design new polymer for advanced applications	PO 4	PSO 4	C
CO 6	Develop computer programs based on numerical methods for applications in chemistry	PO 6	PSO 4	C

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Course name	DSE02: Analytical Methods in Chemistry	
Course code	UGCHEMDSE2	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding analysis of analytical data based on statistical treatment
2. Basic principles on instrumentation techniques for optical method of analysis
3. Fundamental concepts of analytical chemistry involving qualitative and quantitative analysis
4. Applying the techniques for quantitative analysis of elements in different samples
5. Understanding the basic concepts on chromatography

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Analyse analytical data based on statistical treatment	PO 2	PSO 1	An
CO 2	Apply the knowledge on instrumentation techniques for optical method of analysis to solve related analytical problems	PO 3	PSO 4	Ap, C
CO 3	Apply the different analytical techniques to estimate industrial samples quantitatively	PO 2	PSO 4	Ap, C
CO 4	Adapt the chromatographic separation techniques in research and development areas of both industry and academia	PO 4	PSO 1	C
CO 5	Analyse samples spectrophotometrically and interpret the data	PO 2	PSO 4	An, E
CO 6	Apply the titrimetric methods of analysis in analysing geochemical samples	PO 2	PSO 4	Ap, An

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Course name	DSE03: Green Chemistry	
Course code	UGCHEMDSE03	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding green chemistry and its scope and limitations
2. Twelve fundamental principles of green chemistry
3. Designing a Green Synthesis using these principles
4. Applications of green chemistry in real world cases
5. Combinatorial chemistry and sustainable development of green chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Select green chemistry-based methods for synthesis	PO 2	PSO 1	An
CO 2	Apply the fundamental principles of green chemistry design new experiments	PO 3	PSO 4	Ap, C
CO 3	Apply the green chemistry techniques to maximize environmental benefits	PO 4	PSO 4	Ap, C
CO 4	Plan new green methodologies for applications in real world systems	PO 4	PSO 1	Ap, C
CO 5	Apply the concept of combinatorial chemistry in formulations of new drug molecules	PO 2	PSO 4	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	DSE04: Inorganic Materials of Industrial Importance	
Course code	UGCHEMDSE04	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding chemistry of glass, ceramics and cements
2. Classification, preparation and composition of glass, ceramics and cements
3. Understanding preparation, chemical composition and applications of fertilizers
4. Understanding basics theories, synthesis and applications of nanomaterials
5. Composition, properties and applications of different composite materials and conducting polymers

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Demonstrate and compare the chemistry of glass, ceramics and cements	PO 2	PSO 1	U, E
CO 2	Design novel glass and ceramic materials for advanced applications	PO 5	PSO 4	C
CO 3	Design new methods for synthesis and applications of novel nanomaterials	PO 4	PSO 2	Ap, C
CO 4	Design novel composite materials and conducting polymers in advanced versatile fields	PO 5	PSO 3	C
CO 5	Analyse commercial fertilizer samples and formulate new fertilizers	PO 2	PSO 3	An, C
CO 6	Develop new nano scale materials for advanced applications	PO 6	PSO 4	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	DSE05: Industrial Chemicals and Environment	
Course code	UGCHEMDSE05	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding large scale production, storage and hazards in handling of the gases
2. Manufacture, application, analysis and hazards in handling industrial chemicals
3. Understanding causes and effects of environmental pollution
4. Procedures of industrial waste management
5. Available natural sources of energy and nuclear pollution

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Take part in large scale production, storage and hazards in handling of industrial gases	PO 2	PSO 3	An
CO 2	Develop new methodologies for manufacturing and safe handling of industrial chemicals	PO 3	PSO 4	C
CO 3	Develop strategies to minimize environmental pollution	PO 4	PSO 3	C
CO 4	Plan to manage industrial waste to maximize environmental and economical benefits	PO 4	PSO 4	C
CO 5	Propose conserving natural sources of energy and design alternate energy resources	PO 5	PSO 4	C
CO 6	Determine parameters related to environmental pollution	PO 2	PSO 2	E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SKILL ENHANCEMENT COURSES (SEC)

Course name	CHEMISTRY SEC-1: Pharmaceutical Chemistry	
Course code	UGCHEMSEC1	Credits: 2, Full Marks: 50
Number of lectures required: 60		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the procedure to design and develop new drug molecules
2. Basic retrosynthetic approach for target drug molecule
3. Synthetic methodologies for different classes of drugs
4. Different aerobic and non-aerobic fermentation procedure for synthesis
5. Large scale production of different drugs

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the procedure to design and develop new drug molecules	PO 2	PSO 4	U, C
CO 2	Plan retrosynthetic approach to target new drug molecule	PO 4	PSO 3	Ap, C
CO 3	Develop and analyse different classes of drug molecules	PO 5	PSO 4	E, C
CO 4	Apply aerobic and non-aerobic fermentation procedure for developing new drugs	PO 6	PSO 3	Ap, C
CO 5	Take part in large scale production of different drugs	PO 5	PSO 4	An

Course name	CHEMISTRY SEC-2: FUEL CHEMISTRY	
Course code	UGCHEMSEC2	Credits: 4, Full Marks: 50
Number of lectures required: 60		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding renewable and non-renewable sources of energy
2. Composition, carbonization and uses of coal
3. Refining of crude petroleum and applications of different petroleum products
4. Understanding different industrial procedure, like, fractional distillation, thermal cracking, reforming etc.
5. Different types of lubricant

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Select renewable and non-renewable sources of energy	PO 3	PSO 1	E
CO 2	Apply carbonization of coal to maximize its calorific value	PO 4	PSO 3	Ap, C
CO 3	Refine crude petroleum and formulate different petroleum products	PO 6	PSO 3	C
CO 4	Take part in different industrial procedures like, fractional distillation, thermal cracking, reforming etc.	PO 4	PSO 3	An
CO 5	Develop different types of lubricant as per user requirement	PO 5	PSO 4	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

GENERIC ELECTIVES (CHEMISTRY)

Course name	CHEMISTRY GE-1	
Course code	UGCHEMGE1	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Physical properties of liquid, like, surface tension, viscosity etc.
2. Definition of thermodynamic terms and first law of thermodynamics
3. Composition of atomic nucleus, laws of radioactivity and decay kinetics
4. Understanding factors responsible for stability of organic compounds and organic reactions
5. Understanding basic stereochemistry of organic molecules
6. Understanding different types of interactions and bonding between atoms and ions

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain different physical properties of liquid, like, surface tension, viscosity etc.	PO 2	PSO 2	E
CO 2	Define different thermodynamic terms and apply first law of thermodynamics in chemical reactions	PO 3	PSO 2	R, Ap
CO 3	Choose correct reaction pathway or stable product utilizing the related concepts and theories	PO 2	PSO 2	Ap, C
CO 4	Interpret basic stereochemistry of organic molecules	PO 1	PSO 1	E
CO 5	Estimate the metal ions quantitatively in an unknown sample	PO 4	PSO 4	C

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Course name	CHEMISTRY GE-2	
Course code	UGCHEMGE2	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Phase equilibrium for one component systems
2. Kinetics and related factors of chemical reactions
3. Laws of photochemistry and different theories of acid-base
4. Classification, preparation and properties of colloids
5. Reactions of carboxylic acids, carbohydrates and amino-acids
6. Theories, stereochemistry and IUPAC nomenclature of coordination compounds

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Analyse how fast a chemical reaction can occur under certain physical conditions and what are the specific roles of different parameters affecting the speed or rate of any chemical reaction.	PO 2	PSO 4	R, An
CO 2	Apply laws of photochemistry to explain different photochemical reactions	PO 3	PSO 1	U, Ap
CO 3	Design new drug molecule utilizing the concepts of carbohydrate and proteins	PO 5	PSO 4	Ap, C
CO 4	Interpret theories, stereochemistry and IUPAC nomenclature of coordination compounds	PO 1	PSO 1	E
CO 5	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 4	PSO 2	E, C

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Course name	CHEMISTRY GE-3	
Course code	UGCHEMGE3	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Principles of thermochemistry
2. Different factors and equations related to salt hydrolysis
3. Application of solubility product principle in different chemical reactions
4. Preparation and reactions of different aromatic hydrocarbons
5. Preparation and reactions of alcohols, phenols, ethers, esters etc.
6. Preparation and reactions of aliphatic and aromatic carbonyl compounds

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the theories of thermochemistry in different chemical reactions	PO 2	PSO 1	Ap
CO 2	Solve various related problems utilizing the concepts and equations of salt hydrolysis	PO 3	PSO 1	Ap, C
CO 3	Explain different chemical reactions considering solubility product principle	PO 2	PSO 2	E
CO 4	Design new chemical reactions of aromatic hydrocarbon applying the preparation and reactions of them	PO 5	PSO 4	Ap, C
CO 5	Explain different organic reactions of alcohols, phenols, ethers, esters	PO 2	PSO 2	E
CO 6	Determine physical parameters, like, pH, enthalpy, heat capacity of chemical compound or reaction	PO 2	PSO 3	E

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Course name	CHEMISTRY GE-4	
Course code	UGCHEMGE4	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The elementary idea on crystal field theory
2. The colour, magnetic properties and chemical potentials of coordination compounds of transition metals
3. Kinetic model of an ideal gas
4. Theoretical basis of Equipartition principle and its limitation
5. Evaluating numerical problems and experimentally determine the order, rate and activation energy of a chemical reaction
6. Classifications of different lattice systems and lattice parameters

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of crystal field theory and its related aspects to discuss the chemistry of coordination compounds	PO 3	PSO 1	Ap, C
CO 2	Explain the colour, magnetic properties and chemical potentials of novel coordination compounds	PO 2	PSO 4	E
CO 3	Explain the theories of kinetic model of an ideal gas	PO 1	PSO 1	U
CO 4	Analyse and explain theoretical basis of Equipartition principle and its limitation	PO 2	PSO 3	An, E
CO 5	Explain and illustrate the structural features of different ionic solids based on crystallography	PO 2	PSO 1	U, E

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ABILITY ENHANCEMENT COMPULSORY COURSES (AECC)

Course name	English for Communication	
Course code	UGCHEMAECC01	Credits: 2, Full Marks: 50
Number of lectures required: 30		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Demonstrate mastery of the discipline by detailing the development and current practices of Listening, Speaking, Reading and Writing as Language skills.
2. Conduct research that engages and responds to diverse audiences of scholars, students, and community members.
3. Demonstrate values and ethics in all activities

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Enhance their English language proficiency in the aspects of reading, writing, listening and speaking	PO 3	PSO 1	Ap, C
CO 2	Develop academic literacy required for undergraduate learning, further studies and research	PO 2	PSO 2	E
CO 3	Apply the requisite communicative skills and strategiesto future careers	PO 1	PSO 2	U
CO 4	Gain an insight into cultural literacy and cross-cultural awareness and engage in self-directed English languagelearning	PO 2	PSO 5	An, E
CO 5	Be responsible and ethical English users	PO 2	PSO 1	U, E

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Course name	Environmental Sciences	
Course code	UGCHEMAECC02	Credits: 2, Full Marks: 50
Number of lectures required: 30		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Remembers and understands the concept, components and function of natural resources andecosystems.
2. Understand and evaluate the Cause, effects and control measures of various environmentalpollutants.
3. Understand the basic idea about the disasters and its management.
4. Understand and apply the knowledge about the social, environmental issues and environmental legislation.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes:	PO Addressed	PSOs Addressed	Cognitive Level
CO 1:	Define and demonstrate the concept, components andfunction of natural resources and ecosystems.	PO1	PSO 3	R, U
CO 2:	Define, illustrate and analyse the cause, effects and control measures of various environmental pollutants.	PO 3	PSO 3	R, U, An
CO 3:	Demonstrate the basic idea about the disasters and itsmanagement.	PO 3	PSO 3	U
CO 4:	Illustrate and apply the knowledge about the social, environmental issues and environmental legislation.	PO 4	PSO 3	U, Ap
CO 5:	Define, demonstrate and evaluate the impact of human population on the Environment	PO 6	PSO 3	R, U, E

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Ramakrishna Mission Vivekananda Centenary College ★ Rahara Kolkata - 118

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DEPARTMENT OF CHEMISTRY

PROGRAMME OUTCOMES, PROGRAMME SPECIFIC OUTCOMES, COURSE OBJECTIVES AND COURSE OUTCOMES OF THE SYLLABUS FOR B.SC. HONOURS WITH CHEMISTRY

CHOICE BASED CREDIT SYSTEM (CBCS)

2020

Ramakrishna Mission Vivekananda Centenary College
Rahara
Kolkata - 118

Principal
Ramakrishna Mission
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Rahara, Kolkata-700 118

PROGRAMME OUTCOMES (POs)

PO Numbers	PROGRAMME OUTCOMES	COGNITIVE LEVEL
PO 1:	Recognize the scientific tempers and attitudes, which in turn can prove to be beneficial for the society since the scientific developments can make a nation or society to grow at a rapid pace.	R
PO 2:	Understand scientific knowledge and exchange ideas with other stakeholders; make people aware about sustainable utilization of resources with ethical approach.	U
PO 3:	Understand and apply the issues of environmental contexts and sustainable development as a basic interdisciplinary concern.	U, Ap
PO 4:	Create the ability to perform experiments and to analyse & interpret the obtained accurate results and thus gain the ability to solve problems, to involve in critical, independent, and creative thinking.	C
PO 5:	Possess expertise to apply and formulate ideas which will provide them competitive advantage in pursuing higher studies from India or abroad; and seek jobs in academia, research or industries.	Ap, C
PO 6:	Assemble the acquired in-depth knowledge of applied subjects towards the inculcation of professional and employment skills so that students can make a career and become an entrepreneur in diverse fields.	C

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PO Numbers	PROGRAMME SPECIFIC OUTCOMES	COGNITIVE LEVEL
PSO 1:	Remember and understand the fundamental concepts of organic, inorganic, physical and analytical chemistry.	R, U
PSO 2:	Analyse and apply the principles of analysis **and** hands on training of different advanced and commonly used analytical equipment for qualitative, quantitative and synthetic laboratory exercises	An, Ap
PSO 3:	Apply the principles of chemistry in the fields of industry, agriculture, medicine and environment	Ap
PSO 4:	Be able to apply the knowledge of the scientific concepts learnt to develop novel research ideas in chemistry	C
PSO 5:	Be able to combine the theoretical and practical knowledge for entrepreneurship, research and development and societal benefits	C

COURSE STRUCTURE

(BSC HONOURS WITH CHEMISTRY)

SEMESTERWISE DISTRIBUTION OF COURSES

SEMESTER	COURSE	COURSE NAME	CREDITS
SEMESTER-1	UGCHEMAECC01	English Communications/ Environmental Science	2
	UGCHEMCC01	Organic Chemistry-I + Organic Chemistry-I Lab	4+2
	UGCHEMCC02	Physical Chemistry-I + Physical Chemistry-I Lab	4+2
	GE-1	Generic Elective Theory + Practical	4+2
SEMESTER-2	UGCHEMAECC02	English Communications/ Environmental Science	2
	UGCHEMCC03	Inorganic Chemistry-I + Inorganic Chemistry-I Lab	4+2
	UGCHEMCC04	Organic Chemistry-II + Organic Chemistry-II Lab	4+2
	GE-2	Generic Elective Theory + Practical	4+2
SEMESTER-3	UGCHEMCC05	Physical Chemistry-II + Physical Chemistry-II Lab	4+2
	UGCHEMCC06	Inorganic Chemistry-II + Inorganic Chemistry-II Lab	4+2
	UGCHEMCC07	Organic Chemistry-III + Organic Chemistry-III Lab	4+2
	UGCHEMSEC01	Skill Enhancement Course-1	2
	GE-3	Generic Elective Theory + Practical	4+2
SEMESTER-4	UGCHEMCC08	Physical Chemistry-III + Physical Chemistry-III Lab	4+2
	UGCHEMCC09	Inorganic Chemistry-III + Inorganic Chemistry-III Lab	4+2
	UGCHEMCC10	Organic Chemistry-IV + Organic Chemistry-IV Lab	4+2
	UGCHEMSEC02	Skill Enhancement Course-2	2
	GE-4	Generic Elective Theory + Practical	4+2
SEMESTER-5	UGCHEMCC11	Inorganic Chemistry-IV+ Inorganic Chemistry-IV Lab	4+2
	UGCHEMCC12	Organic Chemistry-V + Organic Chemistry-V Lab	4+2
	UGCHEMDSE01	DSE-1 Theory + Practical	4+2
	DSE-2	DSE-2 Theory + Practical	4+2
SEMESTER-6	UGCHEMCC13	Inorganic Chemistry-V + Inorganic Chemistry-V Lab	4+2
	UGCHEMCC14	Physical Chemistry-IV + Physical Chemistry-IV Lab	4+2
	DSE-3	DSE-3 Theory + Practical	4+2
	DSE-4	Theory + Practical	4+2
TOTAL CREDITS			140

SEMESTER – 1		
Course name	CHEMISTRY -CC01: ORGANIC CHEMISTRY-01	
Course code	UGCHEMCC01	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding different types of interactions present in molecules
2. Understanding and applying VB and MO theories
3. Understanding and analysing Reactivity of different organic molecules
4. Evaluating actual shape of a molecule
5. Remembering and applying different terminologies and their application in the higher field of chemistry
6. Understanding and applying asymmetric synthesis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1	Analyse different types of chemical forces and interactions to predict the structure-activity relationships of different organic molecules	PO 2	PSO 4	An
CO 2	Apply the knowledge of VBT and MOT to discuss structure of molecules	PO 2	PSO 4	Ap, C
CO 3	Apply the knowledge addition reactions in alkenes and alkynes in organic synthesis	PO 2	PSO 3	Ap
CO 4	Analyse and apply the concept of crystallisation and purification of organic compounds	PO 1	PSO 2	An, Ap
CO 5	Evaluate boiling and melting points of unknown organic compounds	PO 2	PSO 2	E
CO 6	Apply the concept of asymmetric synthesis to design novel organic molecules	PO 4	PSO 5	Ap, C

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SEMESTER – 1		
Course name	CHEMISTRY -CC02: PHYSICAL CHEMISTRY-01	
Course code	UGCHEMCC02	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Kinetic model of an ideal gas
2. Theoretical basis of Equipartition principle and its limitation
3. Understanding thermodynamic principles for a system performing mechanical work and applying the laws of thermodynamics
4. Analysing how fast a chemical reaction can occur under certain physical conditions
5. Understanding and analysing role of catalysts and biocatalyst (e.g., enzymes, etc.) in a catalyzed reaction
6. Evaluating numerical problems and experimentally determine the order, rate and activation energy of a chemical reaction

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1	Explain the theories of kinetic model of an ideal gas	PO 2	PSO 1	U
CO 2	Analyse and explain theoretical basis of Equipartition principle and its limitation	PO 2	PSO 3	An, E
CO 3	Apply the concepts of thermodynamics in different chemical reactions	PO 2	PSO 3	Ap
CO 4	Analyse how fast a chemical reaction can occur under certain physical conditions and what are the specific roles of different parameters affecting the speed or rate of any chemical reaction.	PO 2	PSO 4	R, An
CO 5	Analyse role of catalysts and biocatalyst (e.g., enzymes, etc.) in a catalyzed reaction and design new catalysts	PO 2	PSO 3	An, C
CO 6	Analyse and apply the theoretical knowledge to do the different thermodynamic and kinetic based experiments	PO 1	PSO 4	An, Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 2		
Course name	CHEMISTRY -CC03: INORGANIC CHEMISTRY-01	
Course code	UGCHEMCC03	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the structure of atom
2. Periodic table and understand the periodic variation of different atomic and ionic properties
3. Understanding the acid-base behaviour of different organic and inorganic compounds
4. pH of acids and bases, buffer solution and their applications in respective areas
5. Understanding the redox behaviour of different substances
6. Applications of redox chemistry in different promising areas, like, solar cell, fuel cell, supercapacitors, batteries etc.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the classical and quantum mechanical ideas to analyze different numerical problems	PO 2	PSO 2	Ap, An
CO 2	Recall the periodic table and explain the periodic variation of different periodic properties	PO 2	PSO 1	R, U
CO 3	Explain and analyse acid-base behaviour of different organic and inorganic compounds	PO 2	PSO 3	U, An
CO 4	Evaluate and apply the mathematical ideas based on pH in acid base reaction system	PO 2	PSO 4	E, Ap
CO 5	Apply the redox chemistry to design advanced materials like, solar cell, fuel cell, supercapacitors, batteries etc.	PO 5	PSO 4	Ap, C
CO 6	Analyse and apply the concept of pH and redox potential in respective quantitative analysis	PO 3	PSO 2	An, Ap

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SEMESTER – 2		
Course name	CHEMISTRY – CC04: ORGANIC CHEMISTRY-02	
Course code	UGCHEMCC04	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding chirality and applying the knowledge in enzymatic reactions
2. Understanding the fundamental principles of different spectroscopy and applying the knowledge in characterizing different aspects of molecules
3. Reactivity of different organic molecules, as well as, mechanism of different organic reactions
4. Applying the above concepts in the synthesis of different important organic compounds.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of stereochemistry in different enzymatic reactions	PO 2	PSO 3	Ap
CO 2	Apply the fundamental principles of different spectroscopy to solve spectroscopic aspects of molecules	PO 3	PSO 2	Ap, C
CO 3	Interpret reactivity of different organic molecules, and justify the mechanism of different organic reactions	PO 2	PSO 1	E
CO 4	Apply the fundamental concepts learnt to design different important organic compounds.	PO 2	PSO 4	Ap, C

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SEMESTER – 3		
Course name	CHEMISTRY -CC05: PHYSICAL CHEMISTRY-02	
Course code	UGCHEMCC05	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding basic laws governing the adsorption, different adsorption isotherms and applying the knowledge in analysing the function of heterogeneous catalysts
2. Understanding the concepts of chemical equilibrium and applying the thermodynamic laws to explain chemical equilibrium
3. Understanding and applying Le Chatelier principle
4. Understanding the basic and fundamental concepts classical and quantum mechanics
5. Applying the concepts of quantum mechanics in different quantum mechanical system, such as particle in a box, simple harmonic oscillator, rigid rotor and one-electron system like hydrogen atom.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain the basic laws governing the adsorption, different adsorption isotherms and apply the knowledge to analyze the role of heterogeneous catalysts	PO 2	PSO 3	U, An, Ap
CO 2	Apply the concepts and principles of chemical equilibrium in analyzing chemical reactions	PO 3	PSO 3	An, Ap
CO 3	Summerize the basic and fundamental concepts classical and quantum mechanics and evaluate different quantum mechanical problems	PO 4	PSO 2	U, E
CO 4	Apply the knowledge of physical chemistry to estimate different parameters in practical experiments	PO 5	PSO 2	Ap, C

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SEMESTER – 3		
Course name	CHEMISTRY -CC06: INORGANIC CHEMISTRY-02	
Course code	UGCHEMCC06	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding concepts, theories and parameters related to bonding
2. Applying the knowledge of bonding in explaining the structure and properties of molecules and ions
3. Understanding the factors determining nuclear stability and applying the knowledge in different nuclear reactions
4. Understanding and applying nuclear models
5. Applying the concepts of radioactivity in power generation, age determination etc.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Demonstrate the concepts, theories and parameters related to ionic, covalent, metallic and H-bonding	PO 1	PSO 1	U
CO 2	Apply the knowledge of bonding in explaining the structures, interactions and reactions of molecules and ions	PO 2	PSO 3	Ap
CO 3	Elaborate the concept of radioactivity in promising fields like, nuclear power generation, radiation therapy etc.	PO 2	PSO 3	C
CO 4	Apply the knowledge of volumetric and gravimetric analysis in different chemical reactions	PO 2	PSO 2	Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 3		
Course name	CHEMISTRY -CC07: ORGANIC CHEMISTRY-03	
Course code	UGCHEMCC07	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the reactivity of carbonyl and related organic compounds
2. Understanding and applying the concepts of reaction mechanism in organic synthesis
3. Understanding the fundamental principles of different spectroscopies
4. Applying the concepts of spectroscopy in evaluating different aspects of molecules
5. Understanding the reactivity of organometallic compounds in organic synthesis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain and illustrate the reactivity of carbonyl and related organic compounds	PO 2	PSO 3	U
CO 2	Interpret the concepts of reaction mechanism in organic synthesis	PO 1	PSO 4	U, E
CO 3	Apply the fundamental principles of different spectroscopies and solve different spectrochemical data	PO 2	PSO 2	Ap, C
CO 4	Explain and interpret the reactivity of organometallic compounds in organic synthesis	PO 2	PSO 3	U, E
CO 5	Apply the concepts of synthesis in organic preparation	PO 2	PSO 3	Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 3		
Course name	CHEMISTRY -CC08: PHYSICAL CHEMISTRY-03	
Course code	UGCHEMCC08	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the activity and activity coefficient of various ionic species present in the solution
2. Understanding various electrode processes; different types of electrodes
3. Derivation of Nernst equation using laws of Thermodynamics
4. Historical chronology leading to the development of Quantum Mechanics and understanding different fundamental theories of Quantum Mechanics
5. Understanding and applying Schrodinger's wave equation (time-independent), and several other mathematical techniques to determine the physical property of different models.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Compare and explain the activity and activity coefficient of various ionic species present in the solution	PO 2	PSO 1	U, E
CO 2	Classify different types of electrodes and electrode processes	PO 1	PSO 3	U, An
CO 3	Demonstrate Nernst equation using laws of Thermodynamics and solve numerical problems	PO 1	PSO 4	U, C
CO 4	Recall historical chronology leading to the development of Quantum Mechanics and explain different fundamental theories of Quantum Mechanics	PO 1	PSO 1	R, E
CO 5	Interpret and illustrate Schrodinger's wave equation (time-independent), and several other mathematical techniques to determine the physical property of different models	PO 2	PSO 4	U, E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4		
Course name	CHEMISTRY CC09: INORGANIC CHEMISTRY-03	
Course code	UGCHEMCC09	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Extraction and purification of metals based on redox potential
2. Understanding the chemistry of various compounds of the s-block and p-block elements
3. Understanding and applying several industrially important compounds
4. Understanding the basic theories of coordination bonding and coordination chemistry
5. Demonstrating isomerism in coordination compounds in different geometrical shapes

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the principles of extraction and purification of metals based on redox potential	PO 2	PSO 1	U
CO 2	Explain and illustrate the chemistry of various compounds of the s-block and p-block elements	PO 2	PSO 3	U, E
CO 3	Discuss the basic theories of coordination bonding and coordination chemistry	PO 1	PSO 4	C
CO 4	Solve new research problems based on the knowledge on isomerism	PO 4	PSO 1	C
CO 5	Plan and design novel research ideas based on inorganic synthesis	PO 5	PSO 4	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4		
Course name	CHEMISTRY -CC10: ORGANIC CHEMISTRY-04	
Course code	UGCHEMCC10	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Preparation and reactivity of nitrogen based organic compounds
2. Understanding and applying the concept of retro synthesis and asymmetric synthesis
3. The mechanism of different organic rearrangement reactions
4. Understanding the mechanism, stereochemistry, regioselectivity in case of electrocyclic reactions, cycloaddition reactions and sigmatropic reactions.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the preparation and explain the reactivity of nitrogen based organic compounds	PO 2	PSO 2	U, E
CO 2	Apply the concept of retro synthesis and asymmetric synthesis to design new target	PO 3	PSO 4	Ap, C
CO 3	Solve and interpret the mechanism of different new organic rearrangement reactions	PO 5	PSO 4	E, C
CO 4	Apply the knowledge of pericyclic reactions to solve new related problems	PO 1	PSO 4	Ap, C
CO 5	Quantitatively estimate composition of different organic compounds	PO 2	PSO 2	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 5		
Course name	CHEMISTRY -CC11: INORGANIC CHEMISTRY-04	
Course code	UGCHEMCCXI	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The elementary idea on crystal field theory
2. The colour, magnetic properties and chemical potentials of coordination compounds of transition metals
3. The colour, magnetic properties and chemical potentials of coordination compounds of lanthanoids and actinoids
4. Understanding the chemistry of semimicro qualitative analysis

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of crystal field theory and its related aspects to discuss the chemistry of coordination compounds	PO 2	PSO 1	Ap, C
CO 2	Explain the colour, magnetic properties and chemical potentials of novel coordination compounds	PO 2	PSO 4	E
CO 3	Explain the colour, magnetic properties and chemical potentials of coordination compounds of lanthanoids and actinoids	PO 2	PSO 4	E
CO 4	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 3	PSO 3	E, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 5		
Course name	CHEMISTRY -CC12: ORGANIC CHEMISTRY-05	
Course code	UGCHEMCC12	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Different heterocyclic compounds of different sizes especially 5 and 6-membered heterocycles.
2. The synthesis and reactions of different heterocycles.
3. Understanding the key biological roles of heterocycles
4. Understanding the chemistry of carbohydrate, amino acids, peptides, proteins and nucleic acids including the functions of DNAs and RNAs
5. Chemical methods for sequencing biopolymers

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Classify and summarize heterocyclic compounds of different sizes especially 5 and 6-membered heterocycles	PO 1	PSO 1	Ap, An
CO 2	Apply the concepts of synthesis and reactions of heterocycles in designing novel drug molecules	PO 3	PSO 4	Ap, C
CO 3	Demonstrate the key biological functions of heterocycles	PO 1	PSO 3	U
CO 4	Illustrate and interpret the chemistry of carbohydrate, amino acids, peptides, proteins and nucleic acids	PO 2	PSO 4	E, C
CO 5	Apply the chromatographic techniques in separation of organic mixtures	PO 3	PSO 2	Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 6		
Course name	CHEMISTRY -CC13: INORGANIC CHEMISTRY-05	
Course code	UGCHEMCC13	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The role of metal ions in biological systems
2. The structures, functions of metalloproteins and metalloenzymes
3. Understanding the mechanism of redox reactions in biological systems, photosynthesis and chelation therapy
4. Understanding the structure, bonding and reactivity of organometallic complexes
5. Applications of organometallic complexes in catalysis
6. Understanding the thermodynamic and kinetic aspects of inorganic reaction mechanism

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Evaluate the role of metal ions in biological systems	PO 1	PSO 1	E
CO 2	Apply the knowledge of redox reactions in biological systems in designing model biological systems	PO 3	PSO 4	Ap, C
CO 3	Illustrate the structure, bonding and reactivity of new organometallic complexes and apply the concept in designing novel organometallic catalyst	PO 2	PSO 3	U, C
CO 4	Make use of the knowledge of inorganic reaction mechanism to explain new reactions	PO 3	PSO 4	Ap, E
CO 5	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 4	PSO 3	E, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 6		
Course name	CHEMISTRY -CC14: PHYSICAL CHEMISTRY-04	
Course code	UGCHEMCC13	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the fundamental principles of rotational, vibrational, NMR and ESR spectroscopy
2. Applications of spectroscopic techniques in chemistry
3. Illustrating the concepts of photochemistry
4. Understanding the basics of different surface phenomena like, surface tension, adsorption etc.
5. Understanding different physicochemical phenomena of colloid chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of spectroscopy in solving related problems in chemistry	PO 3	PSO 2	Ap, C
CO 2	Apply the concepts of photochemistry to interpret different photochemical reactions	PO 3	PSO 2	Ap, E
CO 3	Apply the concepts of surface tension, adsorption etc. to analyse different surface phenomena	PO 3	PSO 3	Ap, An
CO 4	Designing new formulations for cosmetics, surfactants, medicines utilizing the concepts of colloid chemistry	PO 4	PSO 4	Ap, E
CO 5	Apply the knowledge of surface properties to determine the related parameters	PO 2	PSO 2	Ap, E

R= Remembering, U = Understanding; An = Analysing, Ap = Applying, E = Evaluating, C = Create

DISCIPLINE SPECIFIC ELECTVES (DSE)

Course name	DSE01: Advanced Physical Chemistry	
Course code	UGCHEMDSE01	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding structural parameters of ionic solids
2. Classifications of different lattice systems and lattice parameters
3. Understanding statistical thermodynamics
4. Third law of thermodynamics and its related topics
5. Understanding basic polymer chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain and illustrate the structural features of different ionic solids based on crystallography	PO 2	PSO 1	U, E
CO 2	Classify and discuss the lattice systems and lattice parameters newly synthesized crystalline materials	PO 2	PSO 4	U, C
CO 3	Apply statistical thermodynamics to solve new related problems	PO 3	PSO 4	Ap, C
CO 4	Apply third law of thermodynamics to interpret related systems	PO 4	PSO 1	Ap, E
CO 5	Design new polymer for advanced applications	PO 4	PSO 4	C
CO 6	Develop computer programs based on numerical methods for applications in chemistry	PO 6	PSO 4	C

R= Remembering, U = Understanding; An = Analysing, Ap = Applying, E = Evaluating, C = Create

Course name	DSE02: Analytical Methods in Chemistry	
Course code	UGCHEMDSE2	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding analysis of analytical data based on statistical treatment
2. Basic principles on instrumentation techniques for optical method of analysis
3. Fundamental concepts of analytical chemistry involving qualitative and quantitative analysis
4. Applying the techniques for quantitative analysis of elements in different samples
5. Understanding the basic concepts on chromatography

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Analyse analytical data based on statistical treatment	PO 2	PSO 1	An
CO 2	Apply the knowledge on instrumentation techniques for optical method of analysis to solve related analytical problems	PO 3	PSO 4	Ap, C
CO 3	Apply the different analytical techniques to estimate industrial samples quantitatively	PO 2	PSO 4	Ap, C
CO 4	Adapt the chromatographic separation techniques in research and development areas of both industry and academia	PO 4	PSO 1	C
CO 5	Analyse samples spectrophotometrically and interpret the data	PO 2	PSO 4	An, E
CO 6	Apply the titrimetric methods of analysis in analysing geochemical samples	PO 2	PSO 4	Ap, An

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	DSE03: Green Chemistry	
Course code	UGCHEMDSE03	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding green chemistry and its scope and limitations
2. Twelve fundamental principles of green chemistry
3. Designing a Green Synthesis using these principles
4. Applications of green chemistry in real world cases
5. Combinatorial chemistry and sustainable development of green chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Select green chemistry-based methods for synthesis	PO 2	PSO 1	An
CO 2	Apply the fundamental principles of green chemistry design new experiments	PO 3	PSO 4	Ap, C
CO 3	Apply the green chemistry techniques to maximize environmental benefits	PO 4	PSO 4	Ap, C
CO 4	Plan new green methodologies for applications in real world systems	PO 4	PSO 1	Ap, C
CO 5	Apply the concept of combinatorial chemistry in formulations of new drug molecules	PO 2	PSO 4	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	DSE04: Inorganic Materials of Industrial Importance	
Course code	UGCHEMDSE04	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding chemistry of glass, ceramics and cements
2. Classification, preparation and composition of glass, ceramics and cements
3. Understanding preparation, chemical composition and applications of fertilizers
4. Understanding basics theories, synthesis and applications of nanomaterials
5. Composition, properties and applications of different composite materials and conducting polymers

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Demonstrate and compare the chemistry of glass, ceramics and cements	PO 2	PSO 1	U, E
CO 2	Design novel glass and ceramic materials for advanced applications	PO 5	PSO 4	C
CO 3	Design new methods for synthesis and applications of novel nanomaterials	PO 4	PSO 2	Ap, C
CO 4	Design novel composite materials and conducting polymers in advanced versatile fields	PO 5	PSO 3	C
CO 5	Analyse commercial fertilizer samples and formulate new fertilizers	PO 2	PSO 3	An, C
CO 6	Develop new nano scale materials for advanced applications	PO 6	PSO 4	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	DSE05: Industrial Chemicals and Environment	
Course code	UGCHEMDSE05	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding large scale production, storage and hazards in handling of the gases
2. Manufacture, application, analysis and hazards in handling industrial chemicals
3. Understanding causes and effects of environmental pollution
4. Procedures of industrial waste management
5. Available natural sources of energy and nuclear pollution

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Take part in large scale production, storage and hazards in handling of industrial gases	PO 2	PSO 3	An
CO 2	Develop new methodologies for manufacturing and safe handling of industrial chemicals	PO 3	PSO 4	C
CO 3	Develop strategies to minimize environmental pollution	PO 4	PSO 3	C
CO 4	Plan to manage industrial waste to maximize environmental and economical benefits	PO 4	PSO 4	C
CO 5	Propose conserving natural sources of energy and design alternate energy resources	PO 5	PSO 4	C
CO 6	Determine parameters related to environmental pollution	PO 2	PSO 2	E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SKILL ENHANCEMENT COURSES (SEC)

Course name	CHEMISTRY SEC-1: Pharmaceutical Chemistry	
Course code	UGCHEMSEC1	Credits: 2, Full Marks: 50
Number of lectures required: 60		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the procedure to design and develop new drug molecules
2. Basic retrosynthetic approach for target drug molecule
3. Synthetic methodologies for different classes of drugs
4. Different aerobic and non-aerobic fermentation procedure for synthesis
5. Large scale production of different drugs

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Outline the procedure to design and develop new drug molecules	PO 2	PSO 4	U, C
CO 2	Plan retrosynthetic approach to target new drug molecule	PO 4	PSO 3	Ap, C
CO 3	Develop and analyse different classes of drug molecules	PO 5	PSO 4	E, C
CO 4	Apply aerobic and non-aerobic fermentation procedure for developing new drugs	PO 6	PSO 3	Ap, C
CO 5	Take part in large scale production of different drugs	PO 5	PSO 4	An

Course name	CHEMISTRY SEC-2: FUEL CHEMISTRY	
Course code	UGCHEMSEC2	Credits: 4, Full Marks: 50
Number of lectures required: 60		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding renewable and non-renewable sources of energy
2. Composition, carbonization and uses of coal
3. Refining of crude petroleum and applications of different petroleum products
4. Understanding different industrial procedure, like, fractional distillation, thermal cracking, reforming etc.
5. Different types of lubricant

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Select renewable and non-renewable sources of energy	PO 3	PSO 1	E
CO 2	Apply carbonization of coal to maximize its calorific value	PO 4	PSO 3	Ap, C
CO 3	Refine crude petroleum and formulate different petroleum products	PO 6	PSO 3	C
CO 4	Take part in different industrial procedures like, fractional distillation, thermal cracking, reforming etc.	PO 4	PSO 3	An
CO 5	Develop different types of lubricant as per user requirement	PO 5	PSO 4	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

GENERIC ELECTIVES (CHEMISTRY)

Course name	CHEMISTRY GE-1	
Course code	UGCHEMGE1	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Physical properties of liquid, like, surface tension, viscosity etc.
2. Definition of thermodynamic terms and first law of thermodynamics
3. Composition of atomic nucleus, laws of radioactivity and decay kinetics
4. Understanding factors responsible for stability of organic compounds and organic reactions
5. Understanding basic stereochemistry of organic molecules
6. Understanding different types of interactions and bonding between atoms and ions

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Explain different physical properties of liquid, like, surface tension, viscosity etc.	PO 2	PSO 2	E
CO 2	Define different thermodynamic terms and apply first law of thermodynamics in chemical reactions	PO 3	PSO 2	R, Ap
CO 3	Choose correct reaction pathway or stable product utilizing the related concepts and theories	PO 2	PSO 2	Ap, C
CO 4	Interpret basic stereochemistry of organic molecules	PO 1	PSO 1	E
CO 5	Estimate the metal ions quantitatively in an unknown sample	PO 4	PSO 4	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	CHEMISTRY GE-2	
Course code	UGCHEMGE2	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Phase equilibrium for one component systems
2. Kinetics and related factors of chemical reactions
3. Laws of photochemistry and different theories of acid-base
4. Classification, preparation and properties of colloids
5. Reactions of carboxylic acids, carbohydrates and amino-acids
6. Theories, stereochemistry and IUPAC nomenclature of coordination compounds

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Analyse how fast a chemical reaction can occur under certain physical conditions and what are the specific roles of different parameters affecting the speed or rate of any chemical reaction.	PO 2	PSO 4	R, An
CO 2	Apply laws of photochemistry to explain different photochemical reactions	PO 3	PSO 1	U, Ap
CO 3	Design new drug molecule utilizing the concepts of carbohydrate and proteins	PO 5	PSO 4	Ap, C
CO 4	Interpret theories, stereochemistry and IUPAC nomenclature of coordination compounds	PO 1	PSO 1	E
CO 5	Elaborate the principles of semimicro qualitative analysis to determine the presence of different elements in test samples	PO 4	PSO 2	E, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	CHEMISTRY GE-3	
Course code	UGCHEMGE3	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Principles of thermochemistry
2. Different factors and equations related to salt hydrolysis
3. Application of solubility product principle in different chemical reactions
4. Preparation and reactions of different aromatic hydrocarbons
5. Preparation and reactions of alcohols, phenols, ethers, esters etc.
6. Preparation and reactions of aliphatic and aromatic carbonyl compounds

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the theories of thermochemistry in different chemical reactions	PO 2	PSO 1	Ap
CO 2	Solve various related problems utilizing the concepts and equations of salt hydrolysis	PO 3	PSO 1	Ap, C
CO 3	Explain different chemical reactions considering solubility product principle	PO 2	PSO 2	E
CO 4	Design new chemical reactions of aromatic hydrocarbon applying the preparation and reactions of them	PO 5	PSO 4	Ap, C
CO 5	Explain different organic reactions of alcohols, phenols, ethers, esters	PO 2	PSO 2	E
CO 6	Determine physical parameters, like, pH, enthalpy, heat capacity of chemical compound or reaction	PO 2	PSO 3	E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	CHEMISTRY GE-4	
Course code	UGCHEMGE4	Credits: 6, Full Marks: 100
Number of lectures required: 120		
Marks Distribution (100)	Theory: Endsem (50) + Midsem (10) + Attendance (05) Practical: Experiment (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. The elementary idea on crystal field theory
2. The colour, magnetic properties and chemical potentials of coordination compounds of transition metals
3. Kinetic model of an ideal gas
4. Theoretical basis of Equipartition principle and its limitation
5. Evaluating numerical problems and experimentally determine the order, rate and activation energy of a chemical reaction
6. Classifications of different lattice systems and lattice parameters

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Apply the knowledge of crystal field theory and its related aspects to discuss the chemistry of coordination compounds	PO 3	PSO 1	Ap, C
CO 2	Explain the colour, magnetic properties and chemical potentials of novel coordination compounds	PO 2	PSO 4	E
CO 3	Explain the theories of kinetic model of an ideal gas	PO 1	PSO 1	U
CO 4	Analyse and explain theoretical basis of Equipartition principle and its limitation	PO 2	PSO 3	An, E
CO 5	Explain and illustrate the structural features of different ionic solids based on crystallography	PO 2	PSO 1	U, E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC)

Course name	English for Communication	
Course code	UGCHEMAECC01	Credits: 2, Full Marks: 50
Number of lectures required: 30		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Demonstrate mastery of the discipline by detailing the development and current practices of Listening, Speaking, Reading and Writing as Language skills.
2. Conduct research that engages and responds to diverse audiences of scholars, students, and community members.
3. Demonstrate values and ethics in all activities

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs addressed	PSOs addressed	Cognitive Level
CO 1	Enhance their English language proficiency in the aspects of reading, writing, listening and speaking	PO 3	PSO 1	Ap, C
CO 2	Develop academic literacy required for undergraduate learning, further studies and research	PO 2	PSO 2	E
CO 3	Apply the requisite communicative skills and strategiesto future careers	PO 1	PSO 2	U
CO 4	Gain an insight into cultural literacy and cross-cultural awareness and engage in self-directed English languagelearning	PO 2	PSO 5	An, E
CO 5	Be responsible and ethical English users	PO 2	PSO 1	U, E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

Course name	Environmental Sciences	
Course code	UGCHEMAECC02	Credits: 2, Full Marks: 50
Number of lectures required: 30		

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Remembers and understands the concept, components and function of natural resources andecosystems.
2. Understand and evaluate the Cause, effects and control measures of various environmentalpollutants.
3. Understand the basic idea about the disasters and its management.
4. Understand and apply the knowledge about the social, environmental issues and environmental legislation.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes:	PO Addressed	PSOs Addressed	Cognitive Level
CO 1:	Define and demonstrate the concept, components andfunction of natural resources and ecosystems.	PO1	PSO 3	R, U
CO 2:	Define, illustrate and analyse the cause, effects and control measures of various environmental pollutants.	PO 3	PSO 3	R, U, An
CO 3:	Demonstrate the basic idea about the disasters and itsmanagement.	PO 3	PSO 3	U
CO 4:	Illustrate and apply the knowledge about the social, environmental issues and environmental legislation.	PO 4	PSO 3	U, Ap
CO 5:	Define, demonstrate and evaluate the impact of human population on the Environment	PO 6	PSO 3	R, U, E

R= remembering, U = understanding, Ap = applying, An = analysing, E = evaluating, and C = creating

Ramakrishna Mission Vivekananda Centenary College ★ Rahara Kolkata - 118

Principal
Ramakrishna Mission
Vivekananda Centenary College
Rahara, Kolkata-700 118

Ramakrishna Mission Vivekananda Centenary College

Rahara, Kolkata-700118

DEPARTMENT OF CHEMISTRY

Programme Outcomes, Programme Specific Outcomes, Course Objectives and Course Outcomes of the Syllabus for M.Sc. in Chemistry

CHOICE BASED CREDIT SYSTEM (CBCS)

2018

Ramakrishna Mission Vivekananda Centenary College
Rahara
Kolkata - 118

Principal
Ramakrishna Mission
Vivekananda Centenary College
Rahara, Kolkata-700 118

PROGRAMME OUTCOMES (POs)

PO No.	PROGRAMME OUTCOMES	Cognitive Level
PO 1:	Outline and demonstrate the basic concepts by acquiring a comprehensiveknowledge in the newer emerging field of knowledge.	R, U
PO 2:	Perform experiments, analyse & interpret the obtained accurate results and thusgain the ability to solve problems.	Ap, An, E
PO 3:	Apply and evaluate the basic ideas to their thoughts, actions, and interventionsfor the societal benefits through the development of entrepreneurships.	Ap, E
PO 4:	Develop the ability to involve in critical, independent, and inventive thinking forthe engagement in research and development on the emerging topics.	C

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PROGRAMME SPECIFIC OUTCOMES (PSOs)

PO No.	PROGRAMME SPECIFIC OUTCOMES	Cognitive Level
PSO 1:	Recall the fundamental concepts and understand the advanced concepts of organic inorganic and physical chemistry	R, U
PSO 2:	Apply the concepts of chemistry in carrying out different laboratory-based experiments	Ap
PSO 3:	Apply the theoretical and practical knowledge gained in entrepreneurship, research and development and different eras of society	Ap
PSO 4:	Build their own career in good academic as well as industrial position and crack different examination like NET, GATE, SET etc.	C
PSO 5:	Design new methodologies to develop novel materials in their future research in academia, agriculture and industry for the betterment of society	C

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COURSE STRUCTURE

(MSC CHEMISTRY)

COURSE TYPE	TOTAL PAPERS	CREDIT	TOTAL CREDIT
MCT	9	05	45
MCP	9	03	27
SCC	1	04	04
OE'	1	04	04
ME	2	04	08
OT	2	06+02	08
SOC	4	01	04

#Students can also achieve the credit from SWAYAM online courses (https://swayam.gov.in/) as per order by UGC.

ABBREVIATIONS USED:

MCT: Main Course Theory

MCP: Main Course Practical

SCC: Special Core Course

OE: Open Elective

ME: Major Elective

OT: Others

SOC: Skill Oriented Course

SEMESTERWISE DISTRIBUTION OF COURSES

Semester	Course Code	Course Title	Credit	Class (hr)/Week
Semester-1	PGCHEMMCT01	Inorganic Chemistry -1	05	05
	PGCHEMMCT02	Organic Chemistry- 1	05	05
	PGCHEMMCT03	Physical Chemistry-1	05	05
	PGCHEMMCP01	Inorganic Chemistry Practical -1	03	03
	PGCHEMMCP02	Organic Chemistry Practical- 1	03	03
	PGCHEMMCP03	Physical Chemistry Practical-1	03	03
	PGSOC01	Yoga	01	01
Semester-2	PGCHEMMCT04	Inorganic Chemistry-2	05	05
	PGCHEMMCT05	Organic Chemistry -2	05	05
	PGCHEMMCT06	Physical Chemistry-2	05	05
	PGCHEMMCP04	Inorganic Chemistry Practical -2	03	03
	PGCHEMMCP05	Organic Chemistry Practical- 2	03	03
	PGCHEMMCP06	Physical Chemistry Practical-2	03	03
	PGSOC02	Communicative English	01	01
Semester-3	PGCHEMMCT07	Inorganic Chemistry -3	05	05
	PGCHEMMCT08	Organic Chemistry- 3	05	05
	PGCHEMMCP07	Inorganic Chemistry Practical -3	03	03
	PGCHEMMCP08	Organic Chemistry Practical- 3	03	03
	PGCHEMSCC	Interdisciplinary Adv. Chemistry	04	04
	PGCHEMOE01/ PGCHEMOE02	Open Elective 01/ Open Elective 02	04	04
	PGSOC03	VECC	01	01
Semester-4	PGCHEMMCT09	Physical Chemistry-3	05	05
	PGCHEMMCP09	Physical Chemistry Practical-3	03	03
	PGCHEMME01/ PGCHEMME03/ PGCHEMME05	Advanced Organic Chemistry-1/ Advanced Inorganic Chemistry-1/ Advanced Physical Chemistry-1	04	04
	PGCHEMME02/ PGCHEMME04/ PGCHEMME06	Advanced Organic Chemistry-2/ Advanced Inorganic Chemistry-2/ Advanced Physical Chemistry-2	04	04
	PGSOC04	Computer for Chemists	01	01
	PGCHEMOT01	Project & Presentation	06	-
	PGCHEMOT02	Grand Viva and Seminar	02	-

SEMESTER – 1	
CHEMISTRY -MCT01: INORGANIC CHEMISTRY-1	
PGCHEMMCT01	Credits: 5
Number of lectures required: 60	
MCT01: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding different symmetry elements and symmetry operations
2. Applying the concept of group theory in different aspects of molecules
3. The advanced concepts on crystal field theory
4. The colour, magnetic properties and chemical potentials of coordination compounds of transition metals
5. Basic principle of inorganic analysis and different instrumentation techniques

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Evaluate symmetry properties of different molecules	PO 3	PSO 1	E
CO 2:	Apply the knowledge of crystal field theory and its related aspects to discuss the chemistry of coordination compounds	PO 1	PSO 3	Ap, C
CO 3:	Apply the concepts on crystal field theory to explain colour, magnetic properties and chemical potentials of coordination compounds of transition metals	PO 1	PSO 4	Ap, E
CO 4:	Basic principle of inorganic analysis and different instrumentation techniques	PO 3	PSO 3	An, Ap

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SEMESTER – 1	
CHEMISTRY -MCT02: ORGANIC CHEMISTRY-1	
PGCHEMMCT02	Credits: 5
Number of lectures required: 60	
MCT02: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Different organic synthetic strategies based on retrosynthetic approach
2. Reactivity of different organometallic compounds
3. Conformational analysis of cyclohexane and related compounds
4. Synthesis and structure elucidation of different terpenoids

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs Addressed	Cognitive Level
CO 1:	Explain the conformation of new sugar molecules utilizing the concepts of stereochemistry for cyclic compounds	PO 1	PSO 2	E
CO 2:	Apply the reactivity of organometallic compounds in different reactions	PO 3	PSO 3	Ap
CO 3:	Evaluate structure of different natural products	PO 2	PSO 2	E
CO 4:	Design new molecules via retrosynthetic approach	PO 4	PSO 5	C

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SEMESTER – 1	
CHEMISTRY -MCT03: PHYSICAL CHEMISTRY-I	
PGCHEMMCT03	Credits: 5
Number of lectures required: 60	
MCT03: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding thermodynamic principles for a system performing mechanical work and applying the laws of thermodynamics
2. Analysing how fast a chemical reaction can occur under certain physical conditions
3. Rates and mechanisms of photochemical, chain and oscillatory reactions
4. Different models related to structure of atom

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Recall the thermodynamic principles and applying the laws of thermodynamics in different chemical reactions	PO 1	PSO 2	R, Ap
CO 2:	Analyse how fast a chemical reaction can occur under certain physical conditions	PO 2	PSO 3	An
CO 3:	Explain rates and mechanisms of photochemical, chain and oscillatory reactions	PO 3	PSO 3	E
CO 4:	Apply the classical and quantum mechanical ideas to analyze different numerical problems	PO 2	PSO 3	Ap, An

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SEMESTER – 1	
CHEMISTRY -MCP01: INORGANIC CHEMISTRY PRACTICAL-I	
PGCHEMMCP01	Credits: 5
Number of lectures required: 60	
MCP01: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Quantitative estimation of metal ion spectrophotometrically
2. Spectrophotometric estimation of metal ion in a binary mixture
3. Estimations based on ion-exchange separation, acid-base, complexometric and argentometric titrations
4. Analysis of ternary and quaternary mixture

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Estimate metal ion quantitatively based on spectrophotometry	PO 2	PSO 2	C
CO 2:	Estimate metal ions in a binary mixture spectrophotometrically	PO 3	PSO 5	C
CO 3:	Estimate metal ions based on ion-exchange separation, acid-base, complexometric and argentometric titrations	PO 3	PSO 5	C
CO 4:	Analyse ternary and quaternary mixture to estimate each component present in the mixture	PO 3	PSO 5	An, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 1	
CHEMISTRY -MCP02: ORGANIC CHEMISTRY PRACTICAL-I	
PGCHEMMCP02	Credits: 5
Number of lectures required: 60	
MCP02: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Identification of unknown organic compound (solid and liquid) by qualitative tests
2. Application of chromatographic and or spectroscopic techniques in the identification of single organic compound
3. Separation, purification and identification of organic compounds in binary mixtures (two solids, one solid + one liquid)
4. Proper utilization of TLC, PC, column chromatography, chemical tests, UV-, IR- spectral measurements in the identification, separation and purification of organic compounds

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Identify unknown organic compound (solid and liquid) by qualitative tests	PO 2	PSO 2	Ap
CO 2:	Apply chromatographic and or spectroscopic techniques to analyze single organic compound	PO 3	PSO 3	Ap, An
CO 3:	Predict, separate, and purify organic compounds in binary mixtures (two solids, one solid + one liquid)	PO 4	PSO 5	C
CO 4:	Analyze organic compounds by proper application of TLC, PC, column chromatography, chemical tests.	PO 2	PSO 2	An, Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 1	
CHEMISTRY -MCP03: PHYSICAL CHEMISTRY PRACTICAL-I	
PGCHEMMCP03	Credits: 3
Number of lectures required: 60	
MCP03: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Determination of critical solution temperature of two component systems
2. Construction of phase diagram of three component systems
3. Surface adsorption behaviour of heterogeneous systems
4. Kinetics of chemical reactions of different orders
5. Determination of rate laws of different chemical reactions

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Determine of critical solution temperature of two component systems	PO 2	PSO 2	E
CO 2:	Construct phase diagram of three component systems	PO 2	PSO 5	C
CO 3:	Analyze surface adsorption behaviour of heterogeneous systems	PO 2	PSO 3	An
CO 4:	Measure kinetics of chemical reactions of different orders	PO 2	PSO 3	E

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SEMESTER - 1	
SOC 1: Yoga	
PGSOC01	Credits: 1
Number of lectures required: 20	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Attainment of general awareness about health
2. Management life style of students' life
3. Increase of concentration
4. Improvement the decision-making capacity
5. Build up confidence in their life

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes:	POs Addressed	PSOs Addressed	Cognitive Level
CO 1:	Attainment of general awareness about health	PO 1	PSO 1	R, U, Ap
CO 2:	Management life style of students' life	PO 3	PSO 3	R, Ap
CO 3:	Increase of concentration	PO 3	PSO 3	An, Ap
CO 4:	Improvement the decision-making capacity	PO 3	PSO 3	U, C

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SEMESTER – 2	
CHEMISTRY -MCT04: INORGANIC CHEMISTRY -2	
PGCHEMMCT04	Credits: 5
Number of lectures required: 60	
MCT04: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Structure elucidation of boranes, metal clusters and metal carbonyl clusters employing Wade's rule and related theories
2. Supramolecular ligands and their applications in coordination chemistry
3. Electronic configuration, oxidation states, aqueous, redox and complex chemistry, spectral and magnetic properties of compounds of d and f block elements
4. Structure, bonding and reactions of different organometallic complexes
5. Structure elucidation of organometallic clusters employing Wade's rule and TVE count

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply Wade's rule and related theories to determine structure of boranes, metal clusters and metal carbonyl clusters	PO 1	PSO 1	Ap, E
CO 2:	Classify supramolecular ligands and discuss their applications in coordination chemistry	PO 1	PSO 3	An, C
CO 3:	Explain electronic configuration, oxidation states, aqueous, redox and complex chemistry, spectral and magnetic properties of compounds of d and f block elements	PO 2	PSO 5	E
CO 4:	Design new organometallic complexes and evaluate their structure, bonding and reactions	PO 2	PSO 5	E, C

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SEMESTER – 2	
CHEMISTRY -MCT05: ORGANIC CHEMISTRY -2	
PGCHEMMCT05	Credits: 5
Number of lectures required: 60	
MCT05: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Qualitative M.O. approach and Huckel's theory to explain bonding in organic molecules
2. Application of heterocycles in organic synthesis
3. Understanding the basic principles of photochemistry
4. Understanding the mechanism, stereochemistry, regioselectivity in case of electrocyclic reactions, cycloaddition reactions and sigmatropic reactions.
5. Elementary idea about ene reactions, 1,3-dipolar cycloaddition and rearrangement in ylide systems through simple and illustrative example

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply qualitative M.O. approach and Huckel's theory to explain bonding in organic molecules	PO 1	PSO 1	Ap, E
CO 2:	Apply the principles of heterocycles in organic synthesis to design functional organic molecules	PO 2	PSO 5	Ap, C
CO 3:	Apply the principles of photochemistry to design new photochemical reaction	PO 2	PSO 5	Ap, C
CO 4:	Explain the mechanism, stereochemistry, regioselectivity in case of electrocyclic reactions, cycloaddition reactions and sigmatropic reactions.	PO 2	PSO 3	E

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SEMESTER – 2	
CHEMISTRY -MCT06: PHYSICAL CHEMISTRY -2	
PGCHEMMCT06	Credits: 5
Number of lectures required: 60	
MCT06: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding the basic and fundamental concepts classical and quantum mechanics
2. Applying the theories of quantum mechanics in different quantum mechanical systems
3. Understanding the fundamental principles of rotational, vibrational, and Raman spectroscopy
4. Understanding the basic principles of electrochemistry and electrode reactions
5. Understanding electrode kinetics and electro-catalysis.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Recall the fundamental theories and equations of classical and quantum mechanics to apply in solving problems	PO 1	PSO 3	R, Ap, C
CO 2:	Apply the fundamental principles of rotational, vibrational, and Raman spectroscopy in molecular characterizations	PO 3	PSO 2	Ap
CO 3:	Apply the basic principles of electrochemistry to analyze different electrode reactions	PO 1	PSO 3	Ap
CO 4:	Develop new electrocatalysts and electrode materials for applications in energy related research	PO 2	PSO 5	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 2	
CHEMISTRY -MCP04: INORGANIC CHEMISTRY PRACTICAL -2	
PGCHEMMCP04	Credits: 5
Number of lectures required: 60	
MCP04: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Basic principles of Semi-Micro Qualitative Inorganic Analysis of Complex Inorganic Mixtures
2. Reactions of the different cations and anions in solutions
3. Group separations of metal ions based on solubility product principle
4. Treatment of aqua-regia insoluble residue

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply basic principles of semi-micro qualitative inorganic analysis to analyze different industrial samples	PO 2	PSO 2	Ap, An
CO 2:	Apply the basic principles of semi-micro qualitative inorganic analysis to identify different rare elements in soil and industrial samples	PO 2	PSO 3	Ap, An
CO 3:	Develop new analytical methods of separation of metal ions from their mixture	PO 3	PSO 5	C
CO 4:	Analyze the presence of metal ions in different insoluble geochemical residue	PO 2	PSO 5	An

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SEMESTER – 2	
CHEMISTRY -MCP05: ORGANIC CHEMISTRY PRACTICAL -2	
PGCHEMMCP05	Credits: 5
Number of lectures required: 60	
MCP05: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Synthesis of organic compounds employing different types of organic reactions
2. Work-up procedure and purification of the reaction product
3. Determination of m.p. and b.p. of the reaction product
4. Characterization of the prepared compounds by different spectroscopic and chromatographic techniques

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Design new methodologies for synthesising new organic compounds	PO 2	PSO 3	C
CO 2:	Develop new techniques for work-up and purification of new organic compounds	PO 2	PSO 5	C
CO 3:	Elaborate the synthesis knowledge to develop novel drug molecules	PO 4	PSO 5	C
CO 4:	Apply the spectroscopic and chromatographic techniques for characterization	PO 3	PSO 3	Ap

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SEMESTER – 2	
CHEMISTRY -MCP06: PHYSICAL CHEMISTRY PRACTICAL -2	
PGCHEMMCP06	Credits: 5
Number of lectures required: 60	
MCP06: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Determination of physical parameters like, strength, concentration, CMC etc. by conductometry
2. Determination of physical parameters like, concentration, electrode potentials, pH etc. by potentiometry and pH-metry
3. Kinetic studies by colorimetric methods
4. Polarimetric determination of rate constant of reactions, like, inversion of sucrose mutarotation of glucose

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Determine physical parameters like, strength, concentration, CMC etc. by conductometric methods	PO 1	PSO 2	E
CO 2:	Determine physical parameters like, concentration, electrode potentials, pH etc. by potentiometry and pH-metry	PO 1	PSO 2	C
CO 3:	Apply the colorimetric methods to determine the rate constant of related reaction	PO 3	PSO 3	Ap
CO 4:	Determine the rate constant of reactions, like, inversion of sucrose mutarotation of glucose by polarimeter	PO 2	PSO 2	E

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SEMESTER – 2	
PGSOC02: Communicative English	
SOC 2	Credits: 1
Number of lectures required: 60	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Demonstrate mastery of the discipline by detailing the development and current practices of Listening, Speaking, Reading and Writing as Language skills.
2. Conduct research that engages and responds to diverse audiences of scholars, students, and community members.
3. Demonstrate values and ethics in all activities

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes:	POs Addressed	PSOs Addressed	Cognitive Level
CO 1:	Enhance their English language proficiency in the aspects of reading, writing, listening and speaking.	PO 3	PSO 3	U, Ap
CO 2:	Develop academic literacy required for undergraduate learning, further studies and research	PO 3	PSO 3	C
CO 3:	Apply the requisite communicative skills and strategies to future careers	PO 3	PSO 3	Ap
CO 4:	Gain an insight into cultural literacy and cross-cultural awareness and engage in self-directed english language learning	PO 3	PSO 3	Ap, C

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SEMESTER - 3	
CHEMISTRY -MCT07: INORGANIC CHEMISTRY-2	
PGCHEMMCT07	Credits: 5
Number of lectures required: 60	
MCT07: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Techniques of Chemical Separation based on chromatography, and solvent extraction methods
2. Understanding environmental parameters and their corelations
3. Causes of environmental pollution and remedies
4. Essential and trace elements in the biological systems, their roles and reactions
5. Biological processes of electron transfer, transport and storage of oxygen

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the techniques of chromatography, and solvent extraction methods in the separation of organic compounds	PO 2	PSO 2	An
CO 2:	Analyze environmental parameters and identify their corelations	PO 2	PSO 3	Ap, An
CO 3:	Evaluate the causes of different environmental pollution and design remedies to resolve it	PO 3	PSO 3	E, C
CO 4:	Interpret the importance of essential and trace elements in the biological systems, their roles and reactions	PO 1	PSO 5	E

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SEMESTER – 3	
CHEMISTRY -MCT08: ORGANIC CHEMISTRY-2	
PGCHEMMCT08	Credits: 5
Number of lectures required: 60	
MCT08: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Structure and properties of different important biomolecules
2. Structure, reactivity and roles of different enzymes
3. Different organometallic reactions
4. Catalysis involving different organometallic complexes
6. Fundamental theories of green chemistry and combinatorial chemistry

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Explain structure and properties of different important biomolecules and enzymes	PO 2	PSO 3	E
CO 2:	Understand the mechanism of different organometallic reactions	PO 2	PSO 3	Ap, C
CO 3:	Design new organometallic complexes for catalysis	PO 2	PSO 5	C
CO 4:	Apply the fundamental knowledge of green chemistry and combinatorial chemistry for sustainable development	PO 1	PSO 3	Ap

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SEMESTER – 3	
CHEMISTRY -MCP07: INORGANIC CHEMISTRY PRACTICAL-3	
PGCHEMMCP07	Credits: 5
Number of lectures required: 60	
MCP07: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Preparation of different inorganic double salts, and complex salts
2. Optimization of reaction parameters and solvent to maximize the product yield
3. Work-up procedure and purification of the reaction product
4. Characterization of the prepared compounds by different spectroscopic techniques and magnetic moment measurements

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the knowledge of inorganic synthesis for preparation of novel inorganic compounds	PO 2	PSO 2	Ap
CO 2:	Develop new methodologies for work-up and purification of the reaction product	PO 2	PSO 5	C
CO 3:	Analyse qualitatively and quantitatively new inorganic compounds	PO 3	PSO 3	An
CO 4:	Interpret the spectroscopic and magnetic moment results to characterize the prepared compounds	PO 2	PSO 3	E

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SEMESTER – 3	
CHEMISTRY -MCP08: ORGANIC CHEMISTRY PRACTICAL-3	
PGCHEMMCP08	Credits: 5
Number of lectures required: 60	
MCP08: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Estimation of drugs, such as, paracetamol / aspirin, ascorbic acid (vitamin-C), isoniazide
2. Semi micro-quantitative estimation of nitrogen in organic samples
3. Determination of DO, COD, BOD and hardness of water sample
4. UV-VIS-spectrophotometric estimations of amino acids, proteins, carbohydrates etc.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Estimate different drugs such as, paracetamol / aspirin, ascorbic acid (vitamin-C), isoniazide quantitatively	PO 2	PSO 5	C
CO 2:	Quantitatively estimate nitrogen in soil and fertilizers	PO 2	PSO 5	C
CO 3:	Determine DO, COD, BOD and hardness of water sample of different natural sources	PO 2	PSO 5	E
CO 4:	Apply spectrophotometric and titrimetric techniques to estimate iron, phosphate, halides in water samples	PO 4	PSO 5	Ap, C

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SEMESTER – 3	
CHEMISTRY -SCC: INTERDISCIPLINARY ADVANCED CHEMISTRY	
PGCHEMSCC	Credits: 4
Number of lectures required: 60	
SCC : Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Instrumental methods like UV-VIS, IR, ORD-CD, Mass, NMR spectroscopy
2. Instrumental methods like electronic, ESR, NQR, MB, PES spectroscopy
3. Instrumental methods like X-Ray, electron and neutron diffraction techniques

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the instrumental techniques like UV-VIS, IR, ORD-CD, Mass, NMR spectroscopy to analyze chemical samples	PO 3	PSO 3	An
CO 2:	Apply the instrumental techniques like electronic, ESR, NQR, MB, PES spectroscopy to analyze new chemical samples	PO 3	PSO 3	Ap, C
CO 3:	Apply the instrumental techniques like X-Ray, electron and neutron diffraction techniques to analyze chemical samples	PO 3	PSO 5	Ap
CO 4:	Design new reactions and characterize the product applying the different instrumentation techniques	PO 3	PSO 5	Ap, C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 3	
CHEMISTRY -OE01: OPEN ELECTIVE-01	
PGCHEMOE01	Credits: 4
Number of lectures required: 60	
OE01:	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Principles of molecular association and organization in enzymes, nucleic acids, membranes, micelles and vesicles
2. Synthesis and characterization of different supramolecules
3. Principles of gene synthesis, regulation of protein biosynthesis, synthetic receptors.
4. Supramolecular devices and nanotechnology

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the principles of molecular association and organization to explain the chemical interactions in enzymes, nucleic acids, membranes, micelles and vesicles	PO 2	PSO 3	Ap, E
CO 2:	Design novel supramolecules for advanced applications	PO 4	PSO 5	Ap, C
CO 3:	Apply the principles of gene synthesis, regulation of protein biosynthesis, synthetic receptors to explain related systems	PO 3	PSO 3	Ap, E
CO 4:	Design new supramolecular devices for versatile applications	PO 4	PSO 5	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 3	
CHEMISTRY -OE02: OPEN ELECTIVE-02	
PGCHEMOE02	Credits: 4
Number of lectures required: 60	
OE02:	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Different types of drugs, drug – receptor interactions, and mechanisms of drug actions.
2. SAR and QSAR with special reference to antimalarials, antibiotics, anticholenergic and CNS – active drugs
3. Different established and new generation antibiotics
4. Activity of different vitamins

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Understand types of drugs, drug – receptor interactions, and mechanisms of drug actions.	PO 1	PSO 1	U
CO 2:	Apply the mechanism of drug actions to design new drug molecules	PO 3	PSO 5	Ap, C
CO 3:	Design next generation antibiotics	PO 3	PSO 5	Ap
CO 4:	Analyze the activity of different vitamins in biological systems	PO 2	PSO 2	An

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 3	
SOC 3: Value Education and Indian Culture	
PGSOC03	Credits: 1
Number of lectures required: 20	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Attain awareness about daily routine, self-evaluation & Integral Personality Development
2. Understand the educational needs, the Power of thoughts and the Science of Peace
3. Understand the relation: Values and enlightened citizenship
4. Attain awareness about the Indian Practice and Culture

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Define, demonstrate and apply the daily routine, self- evaluation & Integral Personality Development	PO 1	PSO 3	R, U, Ap
CO 2:	Learn, and apply the Power of thoughts & the Scienceof Peace	PO 4	PSO 3	U, Ap
CO 3:	Demonstrate the relation: Values and enlightenedcitizenship	PO 4	PSO 3	U
CO 4:	Discuss the awareness about the Indian Practice andCulture	PO 4	PSO 3	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -MCT09: PHYSICAL CHEMISTRY-3	
PGCHEMMCT09	Credits: 5
Number of lectures required: 60	
MCT09: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Symmetry elements, symmetry operations and fundamentals of group theory
2. CFT and MO approaches for explaining bonding and chemical reactions
3. Crystal structures, crystal defects and electronic properties of solids
4. Fundamentals of biophysical chemistry and its applications

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Recall the fundamentals of group theory to explain the related problems	PO 1	PSO 1	R, E
CO 2:	Apply the CFT and MO concepts to explain the bonding and molecular properties	PO 2	PSO 3	Ap, E
CO 3:	Evaluate the crystal structures, crystal defects and electronic properties of new crystalline solids	PO 3	PSO 5	E
CO 4:	Apply the concepts of biophysical chemistry in different enzymatic reactions	PO 3	PSO 2	Ap

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -MCP09: PHYSICAL CHEMISTRY-3	
PGCHEMMCP09	Credits: 5
Number of lectures required: 60	
MCP09: Practical (30) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Understanding application of viscometric method in determination of molecular radius of a molecule, molecular weight of polymer.
2. Understanding and analysing different aspects of kinetic study of chemical reactions.
3. Understanding and analysing experimental data to determination of order, rate constant, variation of rate constant with ionic strength, etc.
4. Understanding and application of spectrophotometric method in determination of composition of metal – ligand complex and hands-on experience in using UV-Visible spetroscope.

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Determine molecular weight of polymer by viscometric method	PO 2	PSO 2	E
CO 2:	Analyse different aspects of kinetic study of chemical reactions.	PO 2	PSO 2	An
CO 3:	Analyse experimental data to determine of order, rate constant, variation of rate constant with ionic strength, etc.	PO 2	PSO 2	An, E
CO 4:	Apply spectrophotometric method to determine of composition of metal – ligand complex and hands-on experience in using UV-Visible spetroscope.	PO 4	PSO 5	Ap, E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -ME01: ADVANCED INORGANIC CHEMISTRY-1	
PGCHEMME01	Credits: 4
Number of lectures required: 60	
ME01: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Stability constants of metal ligand complexes and their determination by different methods
2. Factors affecting the stability of complex in solution
3. Bioinorganic chemistry of human iron metabolism
4. Nuclear reactions and application of radioactive techniques

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Determine stability constants of metal ligand complexes	PO 2	PSO 3	E
CO 2:	Analyse the factors affecting the stability of complex in solution	PO 2	PSO 3	An
CO 3:	Understand the mechanism of redox enzymes, vitamins and coenzymes and apply the concept to explain different biological phenomenon	PO 2	PSO 3	U, Ap, E
CO 4:	Develop new nuclear medicine and radiation technique in the medical field	PO 4	PSO 5	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -ME02: ADVANCED INORGANIC CHEMISTRY-2	
PGCHEMME02	Credits: 4
Number of lectures required: 60	
ME02: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Synthesis, structure and bonding features, technical applications of different inorganic polymers
2. Understanding the mechanism of substitution, electron transfer and photochemical reactions of transition metal complexes
3. Determination of magnetic susceptibility of magnetic materials by different methods
4. Magnetic behaviour of Lanthanides and actinides

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Design new inorganic polymer for with versatile application	PO 4	PSO 5	C
CO 2:	Explain the mechanism of substitution, electron transfer and photochemical reactions of transition metal complexes	PO 3	PSO 3	E
CO 3:	Determine the magnetic susceptibility of materials by different methods	PO 2	PSO 3	E
CO 4:	Apply different laws and equations of magnetochemistry to explain related systems	PO 3	PSO 4	Ap, E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER - 4	
CHEMISTRY -ME03: ADVANCED ORGANIC CHEMISTRY-1	
PGCHEMME03	Credits: 5
Number of lectures required: 60	
ME03: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Applications of different spectroscopic techniques in organic synthesis
2. Applications of mass, UV-VIS, IR and NMR spectroscopy to simple structural and mechanistic problems
3. Stereoselective and stereospecific synthesis of organic molecules
4. Enantio- and diastereo- selective synthesis
5. Introductory course on molecular mechanics computations

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply different NMR techniques in the structure elucidation of newly synthesized organic molecules	PO 3	PSO 3	Ap
CO 2:	Apply mass, UV-VIS, IR and NMR spectroscopy to evaluate simple structural molecules	PO 3	PSO 5	Ap, E
CO 3:	Design new organic molecules following stereoselective and stereospecific synthesis	PO 4	PSO 5	C
CO 4:	Design new organic molecules following enantio- and diastereo- selective synthesis	PO 4	PSO 5	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -ME04: ADVANCED ORGANIC CHEMISTRY-2	
PGCHEMME04	Credits: 5
Number of lectures required: 60	
ME04: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Biosynthesis of nucleosides, proteins and folic acid
2. Structure, types and chemistry of sugars
3. Synthesis and reactions of hetero aromatic rings containing one/two hetero atom
4. Chemical synthesis, bio-synthesis, chiral synthesis of different natural products

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Design new synthetic strategy for functional biomolecules	PO 4	PSO 5	C
CO 2:	Apply the knowledge of carbohydrate chemistry in the synthesis of new drug molecules	PO 2	PSO 2	Ap
CO 3:	Develop new drug molecules with hetero aromatic rings containing one/two hetero atom	PO 4	PSO 5	C
CO 4:	Apply the knowledge for isolation of different natural products	PO 3	PSO 3	Ap

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SEMESTER – 4	
CHEMISTRY -ME05: ADVANCED PHYSICAL CHEMISTRY-1	
PGCHEMME05	Credits: 5
Number of lectures required: 60	
ME05: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Ensemble, its classification, partition function, BE and FD distribution formula
2. Non-Equilibrium Thermodynamics and statistical formulation of chemical kinetics reaction dynamics
3. Classification of polymers and polymerization reactions
4. Kinetics and mechanism of polymerization, thermodynamics of polymer solution

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the knowledge to classify the real systems into different statistical models	PO 2	PSO 2	U, Ap
CO 2:	Solve problems related to the non-equilibrium thermodynamics and applications of statistical formulation of problems related to chemical kinetics reaction dynamics	PO 4	PSO 4	Ap, C
CO 3:	Understand different polymerization reactions and design new functional polymers	PO 3	PSO 3	U, C
CO 4:	Compare the kinetics and various mechanisms of polymerization	PO 2	PSO 3	E

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
CHEMISTRY -ME06: ADVANCED PHYSICAL CHEMISTRY-2	
PGCHEMME06	Credits: 4
Number of lectures required: 60	
ME06: Endsem (50) + Midsem (10) + Attendance (05)	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Different surface phenomena and their spectroscopic characterizations
2. Dielectric behaviour of molecules and related theoretical equations
3. n-dimensional vector space, matrix representation of operators and many electron Hamiltonian
4. Variation Method and Perturbation theory

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Apply the knowledge of surface phenomena including heterogeneous catalysis and their physicochemical characterizations	PO 3	PSO 3	Ap
CO 2:	Interpret the dielectric behaviour of molecules and related theoretical equations from molecular level	PO 2	PSO 3	E
CO 3:	Apply n-dimensional vector space model to solve many electrons Hamiltonian	PO 2	PSO 3	Ap, C
CO 4:	Apply variation method and perturbation theory to explain degenerate and non-degenerate systems	PO 1	PSO 1	An, Ap

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SEMESTER – 4	
PGCHEMSOC: Computer for Chemists	
PGSOC04	Credits: 1
Number of lectures required: 20	

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Drawing 2D and 3D plots from different experimental data
2. Analysis of data and plots
3. Drawing of different chemical structures and reaction schemes

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Interpret different 2D and 3D plots	PO 3	PSO 5	E
CO 2:	Analyze data and plots	PO 2	PSO 5	An
CO 3:	Construct new chemical structures and reaction schemes	PO 2	PSO 5	C

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SEMESTER – 4	
CHEMOT01: Project & Presentation	
PGCHEMOT01	Credits: 6

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Identify the research problem
1. Literature review on the proposed research problem
2. Experimentation and analysis of experimental data
3. Preparation of report and presentation

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Choose new research problems	PO 3	PSO 3	Ap
CO 2:	Design new reactions/materials	PO 4	PSO 5	C
CO 3:	Analyze the properties of the materials	PO 2	PSO 3	An
CO 4:	Compile the experimental and theoretical data and build the project report	PO 2	PSO 3	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

SEMESTER – 4	
PGCHEMOT02: Grand Viva and Seminar	
PGCHEMOT02	Credits: 6

Course Objectives:

At the end of studying this course a student will acquire knowledge on:

1. Preparation of seminar reports
2. Presentation of seminar in front of experts
3. How to defend the viva

Course Outcomes:

After completion of this course the student will be able to

CO No.	Course Outcomes	POs Addressed	PSOs addressed	Cognitive Level
CO 1:	Compose seminar report and presentation	PO 2	PSO 3	Ap
CO 2:	Take part in lectures, presentation and debates	PO 2	PSO 3	An
CO 3:	Develop own scientific understanding and self-confidence to face interviews	PO 4	PSO 5	C

R = Remembering, U = Understanding, Ap = Applying, An = Analysing, E = Evaluating, C = Creating

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