SHIVAJI UNIVERSITY, KOLHAPUR

DEAPRTMENT OF CHEMISTRY

Academic Year 2018-2019

PART – A

Name of Department: Department of Chemistry

Department Vision: Engender Human Resource to Lead the Competitive Science World for Nation Building

Department Mission: Impart most advanced scientific knowledge and training to the students so that genuine researchers and skilled scientists of world standard will be made available for the advancement of national science and technology programs as well as to cater the needs of industrial and pharma sectors

Name of Program: M.Sc. Inorganic Chemistry

Program Outcomes (POs)

PO1: Students will have a thorough knowledge in the fundamentals and application of modern chemical and scientific theories including those in all branches of Chemical sciences.

PO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

PO3: Students will be able to use the evidence based comparative chemistry approach for synthesis and analysis of the chemical compounds.

PO4: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO5: Students will be able to clearly communicate the results of scientific task in oral and written formats. Students will be able to function as a member of an interdisciplinary problem solving team.

PO6: Students will be able to explain the role of Inorganic Chemistry for addressing social, economic, and environmental problems.

Program Specific Outcomes (PSOs)

PSO1: The students will be able to get global level research opportunities to pursue Ph.D programme, targeted approach of competitive Exams such as CSIR – NET/GATE/SET, discipline specific competitive exams conducted by service commission, etc.

PSO2: The students will be able to get employment opportunities in various industries like petrochemicals, metallurgical, materials and pharmaceutical, etc.

PSO3: Understands the background of Inorganic reaction mechanisms, complex chemical structures, and instrumental methods of chemical analysis, separation techniques and analytical methods of general purpose.

PSO4: Gains complete knowledge about all fundamental aspects of all the elements of chemistry.

Part B

Syllabus Structure: Annexure – I

Semester-wise courses, their COs and Mapping Matrices

Semester: I

Courses:

CH-1.1 (Inorganic Chemistry – I)

CH-1.2 (Organic Chemistry – I)

CH-1.3 (Physical Chemistry – I)

CH-1.4 (Analytical Chemistry – I)

PCH-1.1 (Practical – I)

PCH-1.2 (Practical – II)

CH-1.1 (Inorganic Chemistry – I)

Course Outcomes (COs)

CO1: Students will be able to explain the basic chemistry of transition metals and its compounds, spectroscopic characteristics of such compounds, nomenclature, reactions and applications.

CO2: Students will obtain knowledge about Preparation, structure, physical and chemical properties of metal carbonyls of transition metals.

CO3: Students will be able to understand the all aspects of synthesis, bonding, structure and reactivity of organometallic compounds and their applications in homogenous catalysis.

CO4: Student will be able determine the stability of the complexes and will be able to explain the nuclear stability and reactions.

COs – POs & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	3	3	3	1	2
CO2	2	2	3	2	2	3	3	2	3	3
CO3	3	3	3	2	2	2	3	1	3	3
CO4	3	2	3	1	1	1	3	2	2	2
Total	11	9	12	7	8	9	12	8	9	10
Average	2.8	2.2	3	1.8	2	2.2	3	2	2.2	2.5

CH-1.2 (Organic Chemistry – I)

Course Outcomes (COs)

CO1: Students will able to differentiate between various organic reactive intermediates.

CO2: Students can recognize, classify, explain, and apply fundamental organic reactions.

CO3: Students will have ability to distinguish between different kinds of isomers.

CO4: Course will develop interest in writing and finding mechanisms of new reactions.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	2	2	3	3	3	3	3	2	2
CO4	3	1	2	3	3	3	3	3	2	3
Total	12	9	10	12	12	12	12	12	8	9
Average	3	2.2	2.5	3	3	3	3	3	2	2.2

CH-1.3 (Physical Chemistry – I)

After completing this course, students will be able to understand basic principles of thermodynamics and statistical mechanics required to learn more advanced topics like quantum statistics and molecular dynamic simulation methods.

Course Outcomes (COs)

CO1: Students will be able to understand basic principles of thermodynamics and statistical mechanics

CO2: Able to learn advanced topics like quantum statistics and molecular dynamic simulation methods.

CO3: Develop abilities to understand how to estimate and analyze the physicochemical properties of condensed and gas phase materials.

CO3: Able to utilize spectral data to estimate molecular thermodynamic properties through partition function calculations.

CO4: Understand properties of detergents and colloidal materials

CO5: Learns the principles and techniques to understand gas and liquid adsorptions on solid surfaces

CO6: Can learn spectral techniques to study surface adsorption phenomena.

CO7: Learn principles and techniques for estimation of average molecular weight of a polymer or biological macromolecules

CO8: Develop abilities to characterize polymers through understanding theories of virial coefficients, concepts of glass transition temperatures, etc.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3	3	3	2	2	3	1
CO2	2	2	1	3	2	3	1	2	1	2
CO3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	2	3	3	2	1	2	2	2
CO5	3	1	0	3	3	1	1	1	3	1
CO6	3	3	1	3	3	1	2	1	3	1
CO7	3	3	1	3	3	3	1	2	3	2
CO8	3	3	0	3	3	2	1	2	3	2
Total	23	20	8	24	23	18	12	15	21	14
Average	2.9	2.5	1	3	2.9	2.2	1.5	1.9	2.6	1.7

CH.1.4: Analytical Chemistry-I

Course Outcomes (COs)

CO1:Students would acquire the knowledge about the fundamentals of Analytical Chemistry including the sampling, sample pretreatment, basic techniques, methods and data handling, processing and statistical analysis of the same.

CO2: Students would acquire the knowledge and understand the scope of Analytical Chemistry spanning various fields. The students will learn fundamentals of qualitative analysis using conventional techniques

CO3: Students will learn the chromatographic techniques, choice of chromatographic techniques and tuning of the chromatographic technique as per the need based on the samples to deal with, learn electroanalytical techniques and computation chemistry which would

groom them for alternative analytical strategies which form one of the important components of analytical chemistry.

CO4:Students will learn about referring to the standard reference books and infer information from the same. Analytical case study problems would be discussed to familiarize with the scope and advantages of Analytical Chemistry.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	2	2	3	3	3	3	3	2	2
CO4	3	1	2	3	3	3	3	3	2	3
Total	12	9	10	12	12	12	12	12	8	9
Average	3	2.2	2.5	3	3	3	3	3	2	2.2

PCH-1.1 (Practical – I)

Course Outcomes (COs)

CO1: Ability in professional sampling and sample treatment before actual analysis

CO2:Ability to treat and evaluate the results of analysis

CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory

CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)

COs – POs & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	2	3	3	3
CO2	2	3	3	2	3	3	3	3	3	2
CO3	2	2	2	2	3	3	1	3	3	3
CO4	2	3	3	2	3	3	2	3	3	3
Total	8	11	11	8	12	12	8	12	12	11

Average	2	3	3	2	3	3	2	3	3	3

PCH-1.2 (Practical – I)

Course Outcomes (COs)

CO1: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc.

CO2: Determine the rate constants of various first order and second order reactions

CO3: Determine the redox potential of a system, relative strength of acid etc using potentiometer, conductometer

CO4: Know the formation of alloys like Brass, Bronze, phase diagram for binary and ternary systems studied in details like a composition, critical temperature, etc

CO5:Validity of Freundlich adsorption isotherms to remove toxic material such as dye, acetic acid, and other industrial effluents

Cos – Pos & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

CO1	2	3	3	2	3	3	2	3	2	3	3	3
CO2	2	3	3	2	3	3	2	2	3	3	3	2
CO3	2	2	2	2	3	3	3	2	1	3	3	3
CO4	2	3	3	2	3	3	3	2	2	3	3	3
CO5	2	2	2	1	2	1	2	1	2	2	1	2
Total	10	13	13	9	14	13	12	10	10	14	13	13
Average	2	2.6	2.6	1.8	2.8	2.6	2.4	2	2	2.8	2.6	2.6

Semester: II

Courses:

CH-2.1 (Inorganic Chemistry – II)

CH-2.2 (Organic Chemistry – II)

CH-2.3 (Physical Chemistry – II)

CH-2.4 (Analytical Chemistry – II)

PCH-2.1 (Practical – III)

PCH-2.2 (Practical – IV)

CH-2.1 (Inorganic Chemistry – II)

Course Outcomes (COs)

CO1: Students will get the knowledge of the basic chemistry of non-transition elements and their compounds, synthesis and structural features, and applications.

CO2: To be able to explain the structures of inorganic compounds based on different theories. Student will understand the chemistry of various types of solvents.

CO3: Be well versed with the knowledge about the chemistry of Lanthanides and Actinides with respect to occurrence, separation, compounds and applications.

CO4**:**To understand the three dimensional structures of solid-state materials of industrial importance and to get the knowledge of bio-inorganic Chemistry.

COs – POs & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	3	3	1	3	2
CO2	3	1	3	3	2	3	2	2	3	3
CO3	2	2	2	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	1	3	3	2
Total	11	8	11	12	11	12	9	8	12	10
Average	3	2	3	3	3	3	2	2	3	3

CH-2.2 (Organic Chemistry – II)

Course Outcomes (COs)

CO1: Illustration of modern synthetic methods and applications of reagents.

CO2: Provide knowledge of different organometallic compounds and various coupling reactions.

CO3: Understand principle and applications of protection and deprotection of various functional groups.

CO4: It will elaborate to understand the concept of chemoselectivity, regioselectivity and enantioselectivity.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	1	2
CO2	3	3	2	3	3	3	3	2	2	2
CO3	3	2	2	3	2	3	3	3	2	2
CO4	3	1	2	3	3	3	3	3	2	2
Total	12	9	9	12	12	12	12	11	7	8
Average	3	2.2	2.2	3	3	3	3	2.7	1.7	2

CH2.3 (Physical Chemistry – II)

Students will learn the fundamentals of quantum mechanics and how to solve the Schrodinger wave equation for some simple systems as well as derive selection rules for such systems. Knowledge gained through this course will help students to learn more advanced topics in quantum mechanics and hence becomes the basis or essential requirement for the course "Advanced Quantum Chemistry"

Course Outcomes (COs)

CO1: Students will learn basics of quantum mechanics.

CO2: Knowledge of the course will form the basis or essential requirement for the course "Advanced Quantum Chemistry"

CO3: Able to understand selection rules and to predict the electronic spectra of conjugated organic molecules.

CO4: Able to study photochemical and photophysical phenomena

CO5: Capable of qualitative and quantitative analysis of various ingredients from industrial, food and pharma samples using techniques of emission spectroscopy.

CO6: Capable of understand the electrochemical aspects of materials, ionic processes and electrochemical sensors, battery materials and characterizations etc.

CO7: Able to study electrokinetic effects and their applications in the field of protein separation, characterization etc.

CO8: Understanding the molecular dynamics through kinetic studies. Applications to explore reaction pathways, protein-ligand binding rates, etc. will help to understand life governing processes.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	3	3	2	3	2	3	3
CO2	3	2	1	3	3	2	3	2	3	3
CO3	3	3	1	3	3	0	3	1	3	3
CO4	3	3	0	3	3	3	2	2	3	2
CO5	2	3	0	3	3	3	2	0	2	1
CO6	2	3	3	2	3	0	3	1	2	1
CO7	3	3	3	3	1	2	1	1	2	2
CO8	3	2	1	3	2	3	1	3	2	3
Total	22	22	10	23	21	15	18	12	20	18
Average	2.7	2.7	1.2	2.9	2.6	1.9	2.2	1.5	2.5	2.2

CH.2.4: Analytical Chemistry-II

Course Outcomes (COs)

CO1: Students will acquire the knowledge of spectroscopic tools/instruments used in chemical analysis and interpretation of the data. The scope and limitations of the spectroscopic tools would be discussed so that the students learn about the type of samples which could be analyzed by these tools offering choices among the spectroscopic tools.

CO2: Students will learn about the simple and advanced instruments used for analysis like NMR, MS, AAS, ICP and thermal analysis (TGA, DTA, DSC etc.) techniques spanning wide variety of samples to be considered for analysis.

CO3:Students will learn about the instrumentation, sample preparation and handling of sample, analysis and data interpretation and structural elucidation.

CO4: Learning about different instruments will give them idea about appropriate choice of the instrument for analysis based on the source and type of analyte(s) in the sample under consideration.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	1	2
CO2	3	3	2	3	3	3	3	2	2	2
CO3	3	2	2	3	2	3	3	3	2	2
CO4	3	1	2	3	3	3	3	3	2	2
Total	12	9	10	12	12	12	12	12	8	9
Average	3	2.2	2.5	3	3	3	3	3	2	2.2

PCH-2.1 (Practical – III)

Course Outcomes (COs)

CO1: Students developed for precise sample solution preparation and sample treatment before actual analysis.

CO2:Students can be able to perform the calculations and error analysis

CO3: Develop understanding of basic chemical processes and deciding methods of analysis.

CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, high end thermometers, refractometer, pH meter etc.)

COs – POs & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	2	3	3	3
CO2	2	3	3	2	3	3	3	3	3	2
CO3	2	2	2	2	3	3	2	3	3	3
CO4	2	3	3	2	3	3	2	3	3	3
Total	8	11	11	8	12	12	9	12	12	11
Average	2	3	3	2	3	3	2.2	3	3	3

PCH-2.2 (Practical – IV)

Course Outcomes (COs)

CO1: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc.

CO2: Determine the unknown concentration and thermodynamic parameters using conductometer

CO3: Student will explore how to estimate order of reaction and the catalysis

CO4: students can estimate refractive index and molecular weights of species.

CO5:Students can understand the estimation of equilibrium properties like redox potential, phase diagram etc

Cos – Pos & PSOs mapping matrix (1-Low, 2-Medium, 3-High, 0-No correlation)

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	2	3	3	3
CO2	2	3	3	2	3	3	3	3	3	2
CO3	2	2	2	2	3	3	1	3	3	3
CO4	2	3	3	2	3	3	2	3	3	3
CO5	2	2	2	2	2	2	2	2	1	2
Total	10	13	13	10	14	14	10	14	13	13
Average	2	2.6	2.6	2	2.8	2.8	2	2.8	2.6	2.6

Semester III

Courses:

ICH-3.1 (Inorganic Chemical Spectroscopy)

ICH-3.2 (Coordination Chemistry – I)

ICH -3.3 (Nuclear Chemistry)

ICH -3.4 (a) (Organometallic and Bioinorganic Chemistry)
ICH -3.4 (b) (Selected Topics in Inorganic Chemistry)
ICH -V (Practical Course – V)

ICH -VI (Practical Course – VI)

PCH-3.1 (Inorganic Chemical Spectroscopy)

Course Outcomes (COs)

CO1: At the end the student should be able to: Recognize symmetry elements in a molecule; State the point group a molecule belongs to; Combine matrices and set up matrix for transformations and acquisition of a theoretical support which underlies much of spectroscopy.

CO2: Able to describe molecular vibration with the interaction of matter with light, Explain the basic concepts in IR and Raman Spectroscopy, Examines IR and Raman spectroscopy and molecular structure determination by the simple molecules.

CO3: Students will be able to identify, describe and explain the function of the several components of a mass spectrometer and predict the fragmentation patterns expected.

CO4: The ability to investigate and determine the local structure of typical elements in inorganic compounds and able to explain the surface composition and chemical nature of the surface elements.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	1	2	3	2	1	3	3	3	3
CO4	3	1	3	3	2	1	3	3	3	3
Total	12	8	11	12	10	8	12	11	10	11
Average	3	2	3	3	2	2	3	3	3	3

ICH-3.2 (Coordination Chemistry – I)

Course Outcomes (COs)

CO1: To be able to describe and explain the bonding in d-metal complexes using crystal field and ligand field theories and calculate the crystal field stabilization energy and its role in stabilizing the complexes.

CO2: At the end of the course students should be able to interpret simple electronic spectra and predict both position and intensity based on Orgel/Tanabe-Sugano diagrams and explain the spectroscopic properties of transition metal complexes.

CO3: Students should be able to estimate the spin-only magnetic moment for given complex and predict the nature of magnetic properties.

CO4**:**Students will be able to explain the reactivity and stabilities of ternary complexes and their reactions.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	2	3	3	2	3
CO2	3	2	3	3	3	2	3	3	2	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	3	2	3	3	3	2	3	3	2	3
Total	12	9	11	12	12	8	12	12	9	12
Average	3	2	3	3	3	2	3	3	2	3

ICH- 3.3(Nuclear Chemistry)

Course Outcomes (COs)

CO1: Students will be able to different modes of radioactive decay and also theories of radioactive decay.

CO2: Students will be able to explain the nuclear structure and stability using various models.

CO3: Students will get basic knowledge of nuclear reactions, mechanism and energy calculations.

CO4**:**At the end students should be able to describe the fundamentals of nuclear reactors, isotopic chemistry, and the applications of radioactivity.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	3	3	3	1	1	3
CO2	3	1	3	3	3	3	3	2	1	3
CO3	3	1	3	3	3	3	3	2	1	3
CO4	3	1	3	3	2	3	3	1	1	3
Total	12	4	12	12	12	12	12	6	4	12
Average	3	1	3	3	3	3	3	2	1	3

ICH-3.4 (A) (Organometallic and Bioinorganic Chemistry)

Course Outcomes (COs)

CO1: After successful completion of the course the students should be able to explain the synthesis, structure, bonding, properties and reactivity of Alkyls and Aryls of Transition Metals.

CO2: After successful completion of the course the students should be able to explain the synthesis, structure, bonding, properties and reactivity of Compounds of Transition Metal –Carbon with Multiple bonds.

CO3: Students should be able to describe the role of metals in medicines, deficiency disorders of metals and use of platinum, gold and lithium compounds in the treatment of cancer, arthritis and psycho drugs, respectively.

CO4**:**At the end of the course student should be able to explain the natural proteins that carry dioxygen in various animals, the role of myoglobin and hemoglobin in carrying dioxygen in mammals and other non-heme proteins for oxygen uptake.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	2	3	2	3	3
CO2	3	3	3	3	3	2	3	2	3	3
CO3	3	3	3	3	3	2	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	3
Total	12	12	12	12	12	9	12	8	12	12
Average	3	3	3	3	3	2	3	2	3	3

ICH-3.4 (B) (Selected Topics in Inorganic Chemistry)

Course Outcomes (COs)

CO1:Students will learn about the basic principles of catalysis.

CO2:Students will get knowledge about the coordination polymers.

CO3:After completion of the course students will be able to learn about the non-conventional sources of energy.

CO4:Students will be able to understand the supra-molecular chemistry and the principles of it.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	1	2
CO2	3	2	2	2	3	3	3	2	2	3
CO3	2	3	2	2	3	3	3	2	2	3
CO4	3	3	2	3	3	3	3	2	3	3
Total	11	11	9	10	12	12	12	9	8	11
Average	3	3	2	2	3	3	3	2	2	3

PRACTICAL COURSES

Practical ICHP – V

Course Outcomes (COs)

CO1: Ability in professional sampling and sample treatment before actual analysis
CO2: Ability to treat and evaluate the results of analysis
CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory
CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

Pos→ Cos ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	3	3	3	3
CO2	2	3	3	2	3	3	3	3	3	2
CO3	2	2	2	2	3	3	3	3	3	3
CO4	2	3	3	2	3	3	3	3	3	3
Total	8	11	11	8	12	12	12	12	12	11
Average	2	3	3	2	3	3	3	3	3	3

Practical ICHP – VI

Course Outcomes (COs)

CO1: Ability in professional sampling and sample treatment before actual analysis
CO2: Ability to treat and evaluate the results of analysis

CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory

CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)**COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)**

POs→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	3	3	3	3
CO2	2	3	3	2	3	3	3	3	3	2
CO3	2	2	2	2	3	3	3	3	3	3
CO4	2	3	3	2	3	3	3	3	3	3
Total	8	11	11	8	12	12	12	12	12	11
Average	2	3	3	2	3	3	3	3	3	3

Semester – IV

Courses:

ICH-4.1 (Instrumental Techniques)

ICH-4.2 (Coordination Chemistry-II)

ICH-4.3 (Chemistry Of Inorganic Materials)

ICH-4.4 (A) (Energy And Environmental Chemistry)
ICH-4.4 (B) (Radiation Chemistry)

ICHP-VII (Practical Course – VII)

ICHP-VIII (Practical Course – VIII)

ICH4.1 (Instrumental Techniques)

Course Outcome (COs)

CO1: Students will obtain knowledge of the working principles involved for selective analytical methods and the fundamental basics of the instrumentation including electronic spectroscopy and diffraction techniques.

CO2: Students will understand the advanced methods involved in determination of the quality and quantity of chemical substances in given compounds.

CO3: At the end of the course students will learn the interpretation of the experimental data obtained using various techniques and instruments for laboratory analysis carried out for quality assurance.

CO4**:**Students will be able to demonstrate the use of complementary analytical techniques to define the system/materials more precisely. To know the recent advancements in the instrumental methods of temperature programmed analysis.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	2	3	3	2	3
CO2	3	3	3	3	3	2	3	3	2	3
CO3	3	3	2	3	3	2	3	3	2	3
CO4	3	3	2	3	3	2	3	3	2	3
Total	12	12	10	12	12	8	12	12	8	12
Average	3	3	2	3	3	2	3	3	2	3

ICH-4.2 (Coordination Chemistry-II)

COs

CO1: After successful completion of the course students will be able to familiar with various reactions of transition metal complexes and will be able to predict the mechanism involved using direct and indirect evidences.

CO2: At the end students will be able to explain the cis-effect, trans-effect, and mechanism of electron transfer reactions.

CO3: Students will be able to explain the photochemistry of transition metal complexes.

CO4: Students will be able to describe the industrial applications of transition metals as catalysts.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	2	3	3	2	3
CO2	3	2	3	3	3	2	3	3	2	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	3	2	3	3	3	2	3	3	2	3
Total	12	9	11	12	12	8	12	12	9	12
Average	3	2	3	3	3	2	3	3	2	3

ICH- 4.3 (Chemistry of Inorganic Materials)

COs

CO1: At the end of the course students should be able to explain the bonding and structures of the solid state materials.

CO2: After completion of this course students will be able to explain the various defects present in the solid-state materials and their impact on electronic and structural properties of the same.

CO3: Students will be able to explain the various synthesis methods and advanced instrumentation tools used for characterization of nano-materials.

CO4: At the end students will be able to explain the optical, magnetic and structural properties of the nanomaterials and will be able to explain their applications in various industrial fields such as Electronic devices, Energy generation and storage, Automobiles, Sports and toys, Textile Industries, Cosmetics Production, etc.**COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)**

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	1	2
CO2	3	1	2	2	3	3	3	2	2	3
CO3	3	3	2	3	3	3	3	2	2	3
CO4	3	2	3	3	3	3	3	2	3	3
Total	12	9	10	11	12	12	12	9	8	11
Average	3	2	2	3	3	3	3	2	2	3

ICH-4.4 (A) (Energy and Environmental Chemistry)

COs

CO1: At the end, students will be able to: Learn basic concepts of solid waste management, beginning from source generation to waste disposal.

CO2: Students should be able to-Characterize the solid waste in terms of hazardous waste components; impact of waste management on health and environment; understand steps towards solid waste management-waste reduction at source, materials and resource recovery/recycling, treatment and disposal techniques.

CO3: After completion of the course student will be able to explain the advanced energy conversion devices such as Fuel cells, and the various techniques involves in the production of Hydrogen (future fuel).

CO4**:**Students will be able to demonstrate the reactions involved in the advanced energy storage devices, can predict the theoretical energy storage capacities of such devices, understand the chemistry of various batteries.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	3	3	3	2	2	3
CO2	3	1	3	3	2	3	3	3	2	3
CO3	3	1	3	3	2	3	3	3	3	3
CO4	3	1	3	3	2	3	2	3	2	3
Total	12	4	12	12	9	12	11	11	9	12
Average	3	1	3	3	2	3	3	3	2	3

ICH-4.4 (B) (Radiation Chemistry)

Cos

CO1: The students will obtain knowledge about the isotopes and health hazards of radiation.

CO2: Students will earn knowledge about the separation of radionuclides.

CO3:Students will be able to understand the role of tracers in designing a reaction mechanism of certain reactions.

CO 4: After successful completion of the course student will have knowledge about the detection and measurement of radioactivity.

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	2	3	3
CO5	11	11	12	10	12	9	12	8	11	12
Total	3	3	3	2	3	2	3	2	3	3
Average	3	3	3	3	3	3	3	2	3	3

Practical ICHP – VII

Course Outcomes (COs)

CO1: Ability in professional sampling and sample treatment before actual analysis

CO2: Ability to treat and evaluate the results of analysis

CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory

CO4**:**Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	2	3	3	3
CO2	3	3	3	2	3	3	3	3	3	2
CO3	3	2	2	2	3	3	3	3	3	3

CO4	3	3	3	2	3	3	3	3	3	3
Total	12	11	11	8	12	12	11	12	12	11
Average	3	3	3	2	3	3	3	3	3	3

PracticalICHP – VIII

Course Outcomes (COs)

Course Outcomes (COs)

CO1: Ability in professional sampling and sample treatment before actual analysis

CO2: Ability to treat and evaluate the results of analysis

CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory

CO4**:**Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)

COs – POs& PSOs mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

POs→ COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	2	3	3	3
CO2	3	3	3	2	3	3	3	3	3	2
CO3	3	2	2	2	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3
Total	12	11	11	8	12	12	11	12	12	11
Average	3	3	3	2	3	3	3	3	3	3

COPO Mapping Matrix for All Courses

Course ID	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CH-1.1	Inorganic Chemistry – I	2.8	2.2	3	1.8	2	2.2	3	2	2.2	2.5
CH-1.2	Organic Chemistry – I	3	2.2	2.5	3	3	3	3	3	2	2.2
CH-1.3	Physical Chemistry – I	2.9	2.5	1	3	2.9	2.2	1.5	1.9	2.6	1.7
CH-1.4	Analytical Chemistry – I	3	2.2	2.5	3	3	3	3	3	2	2.2
PCP-1.1	Practical – I	2	3	3	2	3	3	2	3	3	3
PCH-1.2	Practical – II	2	2.6	2.6	1.8	2.8	2.6	2	2.8	2.6	2.6
CH-2.1	Inorganic Chemistry – II	3	2	3	3	3	3	2	2	3	3
CH-2.2	Organic Chemistry – II	3	2.2	2.2	3	3	3	3	2.7	1.7	2
CH-2.3	Physical Chemistry – II	2.7	2.7	1.2	2.9	2.6	1.9	2.2	1.5	2.5	2.2
CH-2.4	Analytical Chemistry – II	3	2.2	2.5	3	3	3	3	3	2	2.2
PCP-2.1	Practical – III	2	3	3	2	3	3	2.2	3	3	3
PCH-2.2	Practical – IV	2	2.6	2.6	2	2.8	2.8	2	2.8	2.6	2.6
PCH-3.1	Inorganic Chemical Spectroscopy	3	2	3	3	2	2	3	3	3	3
PCH-3.2	Coordination Chemistry-I	3	2	3	3	3	2	3	3	2	3
PCH-3.3	Nuclear Chemistry	3	1	3	3	3	3	3	2	1	3
PCH-3.4 (A)	Organometallic and Bioinorganic Chemistry	3	3	3	3	3	2	3	2	3	3

PCH-3.4 (B)	Selected Topics in Inorganic Chemistry										
PCHP-V	Practical Course – V	2	3	3	2	3	3	3	3	3	3
PCHP-VI	Practical Course – VI	2	3	3	2	3	3	3	3	3	3
PCH-4.1	Instrumental Techniques	3	3	2	3	3	2	3	3	2	3
PCH-4.2	Coordination Chemistry-II	3	2	3	3	3	2	3	3	2	3
PCH-4.3	Chemistry Of Inorganic Materials	3	2	2	3	3	3	3	2	2	3
PCH-4.4 (A)	Energy And Environmental Chemistry	3	1	3	3	2	3	3	3	2	3
PCH-4.4 (B)	Radiation Chemistry										
PCHP-VII	Practical Course – VII	3	3	3	2	3	3	3	3	3	3
PCHP-VIII	Practical Course – VIII	3	3	3	2	3	3	3	3	3	3
	Total										

Correlations between contribution of Each Course for fulfillment of POs and PSOs are defined using numbers: 0 – No correlation; 1 – Small Correlation; 2 – Large Correlation and 3 – Full Correlation