# MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY BATHINDA-151001 (PUNJAB), INDIA

*(A State University Estb. by Govt. of Punjab vide Punjab Act No. 5 of 2015 and Approved u/s 2(f) & 12 (B) of UGC; Member AIU)*

Department: **Chemistry**
MRSPTU

Program: B.Sc. (Hons.) Chemistry

## COURSE ARTICULATION MATRIX (STUDY SCHEME: 2019)

| Subject | S Code | Semester | Credit | Duration (Hrs) | L T P | COs | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INORGANIC CHEMISTRY-I | BCHMS1-101 | 1 | 4 | 60 | 4 0 0 | CO1 | Wave mechanics, atomic theories and shapes of orbitals | 1 | 2 | | | | | | |
| | | | | | | CO2 | Periodic table and various periodic properties | 1 | 2 | | | | | | |
| | | | | | | CO3 | Ionic bond, covalent bond, metallic bond and various weak chemical forces | 1 | 2 | | | | | | |
| | | | | | | CO4 | Redox reactions and applications of redox reactions | 1 | 2 | | | | | | |
| Physica l | BCHMS | 1 | 4 | 60 | 4 0 0 | CO1 | Acquire the knowledge of kinetic modular model of | 2 | | 1 | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | gases, behaviour of ideal and real gases | | | | | | | | |
| | | | | | | CO2 | Acquire the knowledge of concept of equilibrium, its types and the factors affecting the state of equilibrium | 2 | | 1 | | 1 | | | 1 |
| | | | | | | CO3 | Acquire the knowledge of different type of crystal systems, Bragg's law and Miller indices | 2 | | | | | | | |
| | | | | | | CO4 | Acquire the knowledge of comparison of the behaviour of ideal and real gases | 2 | | 1 | | | | | |
| Inorganic Chemistry Lab – I | BCHMS1-103 | 1 | 2 | 60 | 0 0 4 | CO1 | Preparation of solutions | 1 | 3 | | | | 2 | | |
| | | | | | | CO2 | Estimation of carbonates, bicarbonates and free alkalis in solution with acid base titrations | 1 | 3 | | | | 2 | | |
| | | | | | | CO3 | Estimation of Fe(II) and oxalic acid with oxidation reduction titrimetry | 1 | 3 | | | | 2 | | |
| Physical Chemistry Lab – I | BCHMS1-104 | 1 | 2 | 60 | 0 0 4 | CO1 | Acquire the knowledge of surface tension and viscosity measurement | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO2 | Acquire the knowledge of preparation of buffer solution | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of pH metric titrations | | 2 | | | | 1 | 1 | 1 |
| Organic Chemistry – | BCHMS1-201 | 2 | 4 | 60 | 4 0 0 | CO1 | Stereochemistry concepts | 1 | | 3 | 1 | | | | |
| | | | | | | CO2 | Reaction intermediates, electronic effects and types of reactions | 1 | | 3 | 1 | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO3 | Formation of carbon-carbon sigma and pi bonds | 1 | | 3 | 1 | | | | |
| | | | | | | CO4 | Conformational analysis of cycloalkanes | 1 | | 3 | 1 | | | | |
| | | | | | | CO5 | Aromaticity concepts | 1 | | 3 | 1 | | | | |
| Physical Chemistry – II | BCHMS1-202 | 2 | 4 | 60 | 4 0 0 | CO1 | Acquire the knowledge of systematic knowledge of concepts of thermodynamics and able to identify and describe energy exchange processes | 2 | | 1 | | | | | |
| | | | | | | CO2 | Acquire the knowledge of concept of chemical equilibrium, and the factors affecting the state of equilibrium | 2 | | 1 | | 1 | | | 1 |
| | | | | | | CO3 | Acquire the knowledge of variation of system properties with composition | 2 | | | | | | | |
| | | | | | | CO4 | Acquire the knowledge of solutions and their properties | 2 | | 1 | | 1 | | | 1 |
| Organic Chemistry Lab I | BCHMS1-203 | 2 | 2 | 60 | 0 0 4 | CO1 | Purification of organic compound using various solvent combinations | 1 | 3 | 1 | | | | | |
| | | | | | | CO2 | Determination of melting and boiling points of various organic compound | 1 | 3 | 1 | | | | | |
| | | | | | | CO3 | Chromatographic techniques | 1 | 3 | | | | | | |
| Physical Chemistry Lab II | BCHMS1-204 | 2 | 2 | 60 | 0 0 4 | CO1 | Acquire the knowledge of heat capacity and its calculations | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO2 | Acquire the knowledge of determination of enthalpy | | 2 | | | | 1 | 1 | 1 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO3 | Acquire the knowledge of handling calorimeter | | 2 | | | | 1 | 1 | 1 |
| Environment Sciences | BCHMA0-002 | 2 | 2 | 30 | 2 0 0 | CO1 | Multiple utility of Environment chemistry in the regions of Indutrial chemistry. | | 2 | | 3 | | 2 | | |
| | | | | | | CO2 | The general and specific approaches in Environment sciences establish a firm foundation for pursuing career. | | | | 1 | | 2 | | |
| | | | | | | CO3 | The conscious attribute towards environment and its issues. | | 2 | | 2 | | | | |
| | | | | | | CO4 | Acquire the fundamental knowledge of allied fields of science which will enable them to contribute effectively in the field of education. | | 2 | | | | 3 | | |
| Organic Chemistry II | BCHMS1-301 | 3 | 4 | 60 | 4 0 0 | CO1 | Students will acquire the knowledge of Chemistry of functional groups | 2 | | 2 | | | | | |
| | | | | | | CO2 | Students will acquire the knowledge of Reaction intermediates | 1 | | 2 | | | | | |
| | | | | | | CO3 | Students will acquire the knowledge of Mechanism of various reactions | 2 | | 2 | | | | | |
| | | | | | | CO4 | Students will acquire the knowledge of Preparation and properties of various functional group derivatives | 2 | | 3 | | | | | |
| Physical Chemist | BCHMS1 | 3 | 4 | 60 | 4 0 0 | CO1 | Acquire the knowledge of catalysis and its mechanism | 2 | | 1 | | 1 | | 1 | 1 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO2 | Acquire the knowledge of concept of chemical kinetics, including kinetics of complex reactions | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of theories and mechanism associated with rate of reactions | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO4 | Acquire the knowledge of concept of phase equilibria and its applications | 2 | | 1 | | 1 | | | |
| Organic Chemistry II – Lab | BCHMS1-303 | 3 | 2 | 60 | 0 0 4 | CO1 | After completion of course students will acquire the knowledge of Synthesis of organic compound using using chemical reactions | 1 | 3 | | 1 | | | | |
| | | | | | | CO2 | After completion of course students will acquire the knowledge of determination of melting and boiling points of synthesised organic compound | 2 | | | | | | | |
| | | | | | | CO3 | After completion of course students will acquire the knowledge of Functional group tests | 2 | | | 1 | | | | |
| Physical Chemistry Lab III | BCHMS1-304 | 3 | 2 | 60 | 0 0 4 | CO1 | Acquire the knowledge of drawing phase diagram and calculating various parameters associated with phase concept | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO2 | Acquire the knowledge of study of kinetics of a reaction practically | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of applying adsorption isotherm to study adsorption phenomena | | 2 | | | | 1 | 1 | 1 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemistry of Cosmetics and Perfumes BCHMD1- | BCHMD1-311 | 3 | 2 | 30 | 2 0 0 | CO1 | Cosmetics and its ingredients. | 3 | | | | | | | 1 |
| | | | | | | CO2 | Safety, efficacy testing and microbiological impacts of cosmetic products. | 3 | 1 | | | | | 2 | 1 |
| | | | | | | CO3 | Practical preparation of some cosmetics products. | 3 | 3 | | 1 | | 2 | | 1 |
| Green Methods in Chemistry | BCHMD1-312 | 3 | 2 | 30 | 2 0 0 | CO1 | The students will acquire knowledge of Principles of green chemistry | 2 | | | | | | 2 | |
| | | | | | | CO2 | The students will acquire knowledge of Application of green chemistry in industry | 1 | | | 2 | | | 3 | |
| Inorganic Chemistry II | BCHMS1-401 | 4 | 4 | 60 | 4 0 0 | CO1 | Metallurgy Principles and concepts behind acids and bases | 3 | | | 1 | | | | 1 |
| | | | | | | CO2 | Chemistry of s and p block elements | 3 | | | 1 | | | | 1 |
| | | | | | | CO3 | Noble gases and inorganic polymers | 3 | | | 1 | | | | 1 |
| Organic Chemistry-III | BCHMS1-402 | 4 | 4 | 60 | 4 0 0 | CO1 | Reactions of nitrogen containing functional groups | | | 2 | | 2 | | | 2 |
| | | | | | | CO2 | Structures, preparations and chemistry behind polynuclear and heterocyclic compounds | | | 1 | | | | | 2 |
| | | | | | | CO3 | Structural features, isolation, synthesis and medicinal properties of alkaloids | | | 1 | | 1 | | | 2 |
| | | | | | | CO4 | Classification, structure and synthesis of terpenes | | | | | 2 | | | 1 |
| Inorganic | BCHMS1 | 4 | 2 | 60 | 0 0 4 | CO1 | To understand the concepts behind Iodo/Iodimetric titrations | 1 | 2 | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO2 | To synthesize various inorganic compounds | 1 | 2 | | | | | | | |
| Organic Chemistry III Lab | BCHMS1-404 | 4 | 2 | 60 | 0 0 4 | CO1 | Detection techniques of extra elements | | 1 | | 2 | 3 | | | 1 |
| | | | | | | CO2 | Concepts of functional groups detection | | 3 | | | 3 | | | |
| | | | | | | CO3 | Quantitative analysis of organic molecules | | | | 3 | | | | 2 |
| Fuel Chemistry | BCMD1-411 | 4 | 2 | 30 | 2 0 0 | CO1 | Industrial applications of coal | 1 | 2 | | | | | | 2 |
| | | | | | | CO2 | Industrial uses and applications of petroleum | 1 | 3 | | | | | | 2 |
| | | | | | | CO3 | Properties and uses of lubricants | 1 | 3 | | | | | | 2 |
| Pharmaceutical Chemistry | BCHMD1-412 | 4 | 2 | 30 | 2 0 0 | CO1 | Synthetic methods used for the drug design and development | | | 1 | | 2 | | | |
| | | | | | | CO2 | Aerobic and anaerobic fermentation | | | 3 | 1 | 3 | | | |
| Inorganic Chemistry – III | BCHMS1-501 | 5 | 4 | 60 | 4 0 0 | CO1 | Coordination chemistry | 3 | 1 | | 1 | | | | 1 |
| | | | | | | CO2 | Concepts of chemistry of various transition elements | 3 | 1 | | 1 | | | | 1 |
| | | | | | | CO3 | Chemistry lanthanoids and actinoids | 3 | | | 1 | | | | 1 |
| | | | | | | CO 4 | Fundamentals of bioinorganic chemistry | 3 | | | 1 | | | 1 | 1 |
| Organic Chemistry – IV | BCHMS1-502 | 5 | 4 | 60 | 4 0 0 | CO1 | Basic concepts of nucleic acids | 1 | | 2 | 1 | | | | |
| | | | | | | CO2 | Concepts of chemistry of various amino acids, peptides and proteins | 1 | | 2 | 1 | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO3 | Enzymes chemistry and their mechanism of action | 1 | | 2 | 1 | | | | |
| | | | | | | CO4 | Fundamentals of energy in bio systems | 1 | | 2 | 1 | | | | |
| Physical Chemistry – IV | BCHMS1-503 | 5 | 4 | 60 | 4 0 0 | CO1 | Acquire the knowledge of basic concepts of conductance, related theories and applications of conductance measurements | 2 | | 1 | | | | | 1 |
| | | | | | | CO2 | Acquire the knowledge of concepts of electrochemistry | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of applications of EMF measurements | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO4 | Acquire the knowledge of fundamentals of electrical & magnetic properties of atoms and molecules | 2 | | 1 | | 1 | | 1 | 1 |
| Inorganic Chemistry III Lab | BCHMS1-504 | 5 | 2 | 60 | 0 0 4 | CO1 | Gravimetric analysis and estimation of different metals using the concept. | 2 | 3 | | 2 | | 3 | | |
| | | | | | | CO2 | Concepts of inorganic preparations | 2 | 3 | | 2 | | 3 | | |
| | | | | | | CO3 | Principles involved in chromatographic separations and by hand separation of metal ions | 2 | 3 | | 2 | | 3 | | |
| Organic Chemistry – IV Lab | BCHMS1-504 | 5 | 2 | 60 | 0 0 4 | CO1 | Estimation of amino acids and proteins | 1 | 3 | | | | | | |
| | | | | | | CO2 | Concepts of action of salivary amylase and effect of various parameters on its action | 1 | 3 | | 2 | | | | |
| | | | | | | CO3 | Calculation of physical parameters of oil and fat | 1 | 3 | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO4 | Procedures for synthesis of drugs and peptides | 1 | 3 | | 2 | | | | |
| Physical Chemistry IV Lab | BCHMS1-506 | 5 | 2 | 60 | 0 0 4 | CO1 | Acquire the knowledge of conductivity meter, calculation of various parameters and conductometric titrations | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO2 | Acquire the knowledge of Working of potentiometer and performance of potentiometric titrations | | 2 | | | | 1 | 1 | 1 |
| Instrumental Method of Analysis | BCHMD1-512 | 5 | 3 | 45 | 0 0 3 | CO1 | Acquire the knowledge of basic concepts of qualitative and quantitative aspects of analysis | 2 | | 1 | | | | 1 | 1 |
| | | | | | | CO2 | Acquire the knowledge of concepts of optical methods of analysis | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of basic concepts of thermal methods and electroanalytical methods of analysis | 2 | | 1 | | 1 | | 1 | 1 |
| | | | | | | CO4 | Acquire the knowledge of fundamentals of separation techniques | 2 | | 1 | | 1 | | 1 | 1 |
| Novel Inorganic Solids | BCHMD1-513 | 5 | 3 | 45 | 0 0 3 | CO1 | Basic concepts of synthesis and modification of inorganic solids | 1 | | | | | | | 3 |
| | | | | | | CO2 | Concepts of nanomaterials | 1 | | | | | | | 3 |
| | | | | | | CO3 | Basic concepts engineering materials for mechanical construction | 1 | | | | | | | 3 |
| | | | | | | CO4 | Fundamentals of composite materials and polymers | 1 | | | | | | | 3 |
| Instrumental | BCHMD- | 5 | 1 | 30 | 0 0 2 | CO1 | Acquire the knowledge of basic concepts of | | 2 | | | | 1 | 1 | 1 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | chromatographic separation of mixtures | | | | | | | | |
| | | | | | | CO2 | Acquire the knowledge of basic concept of extractions techniques | | 2 | | | | 1 | 1 | 1 |
| | | | | | | CO3 | Acquire the knowledge of working of UV/VIS spectrophometer, recording spectrogram and deducing various parameters using the data | | 2 | | | | 1 | 1 | 1 |
| Novel Inorganic Solids Lab | BCHMD1-516 | 5 | 1 | 30 | 0 0 2 | CO1 | Basic concepts of determination of cation exchange method and total difference of solids | | 2 | | | | | | 2 |
| | | | | | | CO2 | Basic concept of synthesis of hydrogels and nanoparticals | | 2 | | | | | | 3 |
| Physical Chemistry V | BCHMS1-601 | 6 | 4 | 60 | 4 0 0 | CO1 | Quantum chemistry with reference to particle in one dimensional box, Heisenberg uncertainty principle | 1 | | | | | 2 | | |
| | | | | | | CO2 | Qualitative treatment of hydrogen atom and hydrogen-like ions | 1 | | | | | 2 | | |
| | | | | | | CO3 | Principle and applications of spectroscopy | 1 | | | | | 2 | | 1 |
| | | | | | | CO4 | Laws of photochemistry, photochemical equilibrium, chemiluminescence | 1 | | | | | 2 | | |
| Inorganic Chemistry IV | BCHMS1-602 | 6 | 4 | 60 | 4 0 0 | CO1 | Solubility products, common ion effect. group reagents and interfering anions | 1 | | 2 | | | | | |
| | | | | | | CO2 | Preparation methods of organometallic compounds, p acceptor ligands and metal alkyls | 1 | | 2 | | 3 | | | |
| | | | | | | CO3 | Mechanism of substitution in square planar and octahedral complexes | 1 | | 2 | | 3 | | | |
| | | | | | | CO4 | Mechanism of various catalytic processes including | 1 | | 2 | | 3 | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | hydrogenation, Hydroformylation | | | | | | | | | |
| | | | | | | CO5 | Preparation methods and reactions of ferrocene | 1 | | 2 | | 3 | | | |
| Organic Chemistry V | BCHMS1-603 | 6 | 4 | 60 | 4 0 0 | CO1 | Solubility products, common ion effect. group reagents and interfering anions | 1 | | 2 | | | | | |
| | | | | | | CO2 | Preparation methods of organometallic compounds, p acceptor ligands and metal alkyls | 1 | | 2 | | 3 | | | |
| | | | | | | CO3 | Mechanism of substitution in square planar and octahedral complexes | 1 | | 2 | | 3 | | | |
| | | | | | | CO4 | Mechanism of various catalytic processes including hydrogenation, Hydroformylation | 1 | | 2 | | 3 | | | |
| | | | | | | CO5 | Preparation methods and reactions of ferrocene | 1 | | 2 | | 3 | | | |
| Physical Chemistry Lab V | BCHMS1-604 | 6 | 2 | 60 | 0 0 4 | CO1 | Spectroscopy techniques to find energy of transitions, reaction kinetics and dissociation constant | 1 | 2 | | | | 1 | | 1 |
| | | | | | | CO2 | Analysis of vibration spectrum | 1 | 2 | | | | 1 | | 1 |
| Inorganic Chemistry Lab | BCHMS1-605 | 6 | 2 | 60 | 0 0 4 | CO1 | Analysis of mixture for cations and anions | 1 | 3 | | | 1 | 2 | | |
| | | | | | | CO2 | Syntheses of inorganic complexes | 1 | 3 | | | 1 | 2 | | |
| Organic Chemistry | BCHMS1-606 | 6 | 2 | 60 | 0 0 4 | CO1 | The students will acquire knowledge of Analysis of unknown organic molecules | 1 | 2 | 1 | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO2 | The students will acquire knowledge of Structure elucidation of organic compounds by IR spectroscopy and NMR spectroscopy | 1 | 2 | | 2 | | | | |
| Polymer Chemistry | BCHMS1-611 | 6 | 3 | 45 | 3 0 0 | CO1 | Classification of polymers and polymerization mechanism. | | | 2 | | | | | |
| | | | | | | CO2 | Mechanism and kinetics of step growth | | | 3 | 1 | | | | |
| | | | | | | CO3 | Structure, properties and applications of polymers | | | 2 | 2 | | 2 | | |
| Molecular Modelling and Drug Design | BCHMD1-612 | 6 | 3 | 45 | 3 0 0 | CO1 | Coordinate Systems. Potential Energy Surfaces. Molecular Graphics | 1 | | | | | 1 | | 1 |
| | | | | | | CO2 | First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties | 1 | | | | | 1 | | 1 |
| | | | | | | CO3 | Molecular Dynamics using simple models, Metropolis method | 1 | | | | | 1 | | 1 |
| Inorganic Materials of Industrial Importance | BCHMD1-613 | 6 | 3 | 45 | 3 0 0 | CO1 | Types, classification and manufacturing process of glass, ceramics and cement | 1 | 2 | | | 2 | | | |
| | | | | | | CO2 | Classification of surface coatings paints and pigment formulation | 1 | 2 | | | 2 | | | |
| | | | | | | CO3 | Different types of fertilizers and their manufacturing processes | 1 | 2 | | | 2 | | | |
| | | | | | | CO4 | Classification of alloys, properties of different types of steel | 1 | 2 | | | 2 | | | |
| | | | | | | CO5 | Homogeneous and hetrerogeneous catalyst and their industrial applications | 1 | 2 | | | 2 | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Polymer chemistry lab | BCHMD1-614 | 6 | 1 | 30 | 0 0 2 | CO1 | Synthesis of different polymers | | | 2 | | | | | |
| | | | | | | CO2 | Molecular weight determination using viscometer | | | 2 | 3 | | | | |
| MOLECULA R | BCHMD1- | 6 | 1 | 30 | 0 0 2 | CO1 | The students will acquire knowledge one software (ChemSketch / ArgusLab (www.planaria-software.com)/ TINKER 6.2 (dasher.wustl.e | 1 | 2 | | | | 1 | | 1 |
| Inorganic materials of | BCHMD1-616 | 6 | 1 | 30 | 0 0 2 | CO1 | Different analytical techniques for analysis different materials | 1 | | | | | 3 | | 3 |
| | | | | | | CO2 | Preparation of buffer | 1 | | | | | 3 | | |

Enter Correction levels 1, 2 or 3 as defined below:

1. Slight (Low) - upto 30% 2. Moderate (Medium) – above 30% and upto70% 3. Substantial (High) – above 70%

So on…….. (1st semester to last semester)