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**

Program: M.Sc. 2016 onwards

COURSE ARTICULATION MATRIX (STUDY SCHEME: 2016 ONWARDS)

Subject	S Code	Semester	Credit	Duration (Hrs)	L T P	COs	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Electronic Spectra & Magnetic Properties of Transition Metal	MCHM1-101	1	4	45	4 0 0	CO1	Interpretation of electronic and magnetic properties.	1		2					
						CO2	Interpretation of molecular orbital diagrams of octahedral and tetrahedral diagramsfor various electronic properties.	1		2					
						CO3	Concepts of symmetry and group theory in solving chemical structural problems.	1		2					
						CO4	Use of character tables and application of group theory in spectroscopy. UNIT-I	1		1					

Subject	S Code	Semester	Credit	Duration (Hrs)	L T P	COs	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Organic reaction and mechanism –I	MCHM1-102	1	4	45	4 0 0	CO1	Various methods to determine the mechanisms of the reactions and different reaction intermediate involved	2			3			2	
						CO2	Mechanistic aspects in nucleophilic and electrophilic substitution.	1			3			2	
						CO3	Reaction mechanism and various factors affecting rate of free radical reactions	1			3			2	
						CO4	Reaction conditions, products formation and mechanisms of some named reactions	1			3			2	
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Thermodynamics	MCHM1-103	1	4	45	4 0 0	CO1	Acquire knowledge of classical thermodynamics and understanding thermodynamic phenomenon in a chemical system	2		1					
						CO2	Acquire knowledge of statistical thermodynamics and understanding thermodynamic properties in terms of partition functions	2							

						CO3	Acquire knowledge of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics	2							
						CO4	Acquire knowledge of theories of specific heat for solids	2		1					
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Computational Skills & Simulations in Chemistry	MCHM1-156	1	4	47	4 0 0	CO1	Advantages and principle of computer based calculation methods in chemistry	1						2	
						CO2	Fundamentals of various calculation methods viz: molecular mechanics, semi-empirical method and density-functional theory	1						2	
						CO3	Running calculation and model building using different algorithms in software packages, like Hyperchem, Gaussian	1						2	
						CO4	Quantum mechanical calculations in gaseous phase with GAMESS and Liquid simulations in BOSS	1						2	
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Polymer Chemistry	MCHM1-157	1	4	45	4 0 0	CO1	To impart knowledge about polymers and polymerization mechanism.						2		
						CO2	To understand the difference between crystalline and amorphous polymers.								3

						CO3	To familiarize polymer characterization with various spectroscopic techniques.		3						
						CO4	To learn molecular weight measurement by osmometry, mass spectrometry and Viscometry.				3				
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Group Theory	MCHM1-158	1	4	45	4 0 0	CO1	Symmetry elements and point groups.	1		2		1			
						CO2	Use of character table in spectroscopy	1		2		1			
						CO3	Electronic structure and energy levels.	1		2		2			
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Inorganic Chemistry Lab.-I	MCHM1-104	1	3		0 0 4	CO1	To develop basic understanding of various lab practices including safety measures.	1	2					3	
						CO2	To synthesize inorganic complexes and their characterization.	1	2					3	

ORGANO	**Subject**	Spectroscopy I			**Subject**	Organic Chemistry Lab-I			**Subject**
MCHMS1-	**S Code**	(MCHM1-206)			**S Code**	MCHM1-105			**S Code**
2	**Semester**	2			**Semester**	1			**Semester**
4	**Credit**	4			**Credit**	3			**Credit**
45	**Duration (Hrs)**	45			**Duration (Hrs)**				**Duration (Hrs)**
4 0 0	**L T P**	4 0 0			**L T P**	0 0 4			**L T P**
CO1	**COs**	CO3	CO2	CO1	**COs**	CO3	CO2	CO1	**COs**
Organometallic compounds and their nomenclature.	**Statement**	Importance of spectroscopy for structural elucidation.	Various spectroscopic techniques.	Selection rules, line width and broadening.	**Statement**	The students will acquire knowledge of Syntheses of various organic compounds and their structural analysis	The students will acquire knowledge of Different chromatographic techniques	The students will acquire knowledge of Distillation and separation	**Statement**
1	**PO1**	3	3	3	**PO1**	2	1	1	**PO1**
	PO2	1	1		**PO2**				**PO2**
	PO3	3	2	1	**PO3**	1	2	2	**PO3**
	PO4				**PO4**				**PO4**
	PO5	3	3	2	**PO5**				**PO5**
	PO6				**PO6**				**PO6**
	PO7				**PO7**	2			**PO7**
	PO8	1	1	1	**PO8**				**PO8**

						CO2	Bonding and reactivity of metal complexes	1							
						CO3	Role of organometallic complexes in organic syntheses.	1	2						
						CO4	Importance of catalyst in syntheses.	1	2		2	2		2	
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Organic reaction and mechanisms –II	MCHM1-208	2	4	45	4 0 0	CO1	Chemistry behind elimination, oxidation, reduction and Carbon-Carbon bond formation	2			3			1	
						CO2	Chemistry behind rearrangement reactions	2			3			1	
						CO3	Use of diverse reagents in organic synthesis	2			3			1	
						CO4	Concepts behind natural product synthesis	2			2			1	
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Seminar I	MCHM1-209	2	1		0 0 2	CO1	Be able to prepare power point presentation.				3		3		
						CO2	Be able to show and improve their presentation skills in the presence of audience.	1			3	1	3		

						CO3	Feel Confident and will be able to remove stage fear			1	1		3		
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
NANOCHEMISTRY	MCHM1-259	2	4	45	4 0 0	CO1	Introduction to the concept of nanochemistry and its classification and terminology.	1				3		3	
						CO2	Synthesis of nanomaterials by different routes and their characterization.Applications in biological and electronic systems.	1				2		3	
						CO3	Applications in biological and electronic systems	1							
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Bio – Organic Chemistry	MCHM1-260	2	4	45	4 0 0	CO1	The students will acquire knowledge of Relationship between organic chemistry and biochemistry.	1			1				
						CO2	The students will acquire knowledge of Kinetics and mechanism of enzyme catalysis.	2			2				
						CO3	The students will acquire knowledge of Determination of enantio- and diastereoselectivity using various analytical methods	2			2		1		

Bioinorganic chemistry		**Subject**	Analytical Chemistry				**Subject**
MCHM1-262		**S Code**	MCHM1-261				**S Code**
2		**Semester**	2				**Semester**
4		**Credit**	4				**Credit**
45		**Duration (Hrs)**	45				**Duration (Hrs)**
4 0 0		**L T P**	4 0 0				**L T P**
CO2	CO1	**COs**	CO4	CO3	CO2	CO1	**COs**
Metal complexation with various nucleic acids and their role in transcription of nucleic acids.	Structures, properties and transport mechanisms of enzymes in physiological systems	**Statement**	Acquire knowledge of electron microscopic techniques and their application	Acquire knowledge of thermogravimetric, electroanalytical, chromatographic methods of analysis	Acquire knowledge of significance of significant figures and data analysis	Acquire knowledge of basic concepts and importance of analytical chemistry	**Statement**
		PO1	2	2	2	2	**PO1**
		PO2					**PO2**
	2	**PO3**		1	1	1	**PO3**
3		**PO4**					**PO4**
		PO5	1	1		1	**PO5**
		PO6					**PO6**
		PO7					**PO7**
		PO8					**PO8**

						CO3	To understand structures, processes and chemical interactions of enzymes with metal ions in biological systems								3
Subject	**S Code**					**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Bio-physical Chemistry	MCHM1-263	2	4	45	4 0 0	CO1	Acquire knowledge of basic concepts and mechanism of enzyme catalyzed reactions	2						1	
						CO2	Acquire knowledge of interactions between various biomolecules	2						1	
						CO3	Acquire knowledge of thermodynamics of ADP and ATP syntheses	2							
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Asymmetric Synthesis	MCHM1-264	2	4	45	4 0 0	CO1	The students will acquire knowledge of Methods for inducing enantio- and diastereoselectivity	1			3				
						CO2	The students will acquire knowledge of Determination of enantio- and diastereoselectivity using various analytical methods	2			2		2		
						CO3	The students will acquire knowledge of Chemistry behind a range of asymmetric reactions	2			2				

Quantum	**Subject**	Spectroscopy II			**Subject**	Inorganic Chemistry Lab II		**Subject**
MCHM1-	**S Code**	MCHM1-311			**S Code**	MCHM1-210		**S Code**
3	**Semester**	3			**Semester**	2		**Semester**
4	**Credit**	4			**Credit**	2		**Credit**
45	**Duration (Hrs)**	45			**Duration (Hrs)**			**Duration (Hrs)**
4 0 0	**L T P**	4 0 0			**L T P**	0 0 2		**L T P**
CO1	**COs**	CO3	CO2	CO1	**COs**	CO2	CO1	**COs**
Schrodinger equation for a particle in a box and quantum chemical description.	**Statement**	Structural elucidation of molecules with UV, IR, NMR and mass spectroscopy.	Advanced NMR techniques like DEPT, INEPT.	Principle of NMR, spin-spin splitting and fluxionality in molecules.	**Statement**	To synthesize various inorganic complexes and their qualitative determination by UV, IR, NMR and ESR techniques.	To extend knowledge of use of standard laboratory equipment, modern instrumentation and classical techniques to carry out experiments.	**Statement**
2	**PO1**		1	3	**PO1**		1	**PO1**
	PO2	3			**PO2**		3	**PO2**
	PO3	3	3		**PO3**	2		**PO3**
	PO4				**PO4**			**PO4**
	PO5	1	1		**PO5**	2		**PO5**
2	**PO6**				**PO6**			**PO6**
	PO7				**PO7**	3		**PO7**
	PO8	1	1	1	**PO8**	1		**PO8**

						CO2	Electronic and Hamiltonian operators for molecules	2					2		
						CO3	Quantum chemical description of angular momentum and term symbols for a one and manyelectron systems	2					2		
						CO4	Born-Oppenheimer approximation, the Pauli principle, Hund's rules, Hückel theory and the variation principle	2					2		
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Heterocyclic chemistry	MCHM1-313	3	4	45	4 0 0	CO1	Be familiar with the structures of important classes of heterocyclic aromatic organic compounds,			3					
						CO2	Be able to classify simple heterocyclic aromatic compounds as electron deficient or electron rich and explain their reactivity based on these properties,				3				
						CO3	Be able to explain on a mechanistic level, reactions and synthesis of important electron deficient nitrogen containing heterocycles; pyridines, diazines and their benzo-condensed analogs,					2			
						CO4	Be able to explain on a mechanistic level, reactions and synthesis of important								2

							electron rich heterocycles; furans, pyrroles and thiophenes and 1,3-azoles, and benzo-condensed analogs.								
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Environmental Chemistry	MCHM1-365	3	4	45	4 0 0	CO1	Pollution and its effects on system and applications of green technologies.			2		1			
						CO2	Toxicity of heavy metals and their remediaions			2		2			
						CO3	Harmful effects of pesticides on soil and their removal from system.			2				3	
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Medicinal Chemistry	MCHM1-366	3	4	45	4 0 0	CO1	Different antimicrobial agents	1			2	1			
						CO2	Synthetic procedures for antimalarial drugs	1			2	1			
						CO3	Importance of CNS-stimulants and psychoactive drugs and diuretics.	1			2	1			

Physical	**Subject**	Organic Chemistry		**Subject**	Green Chemistry			**Subject**
MCHM 1-316	**S Code**	MCHM1-315		**S Code**	MCHM1-367			**S Code**
3	**Semester**	3		**Semester**	3			**Semester**
2	**Credit**	2		**Credit**	4			**Credit**
	Duration (Hrs)			**Duration (Hrs)**	45			**Duration (Hrs)**
0 0 4	**L T P**	0 0 4		**L T P**	4 0 0			**L T P**
CO1	**COs**	CO2	CO1	**COs**	CO3	CO2	CO1	**COs**
Acquire knowledge of surface adsorption phenomena while performing experiments	**Statement**	Purification and isolation of compounds.	Syntheses of various organic compounds.	**Statement**	The students will acquire knowledge of Generation and application of superoxide anions.	The students will acquire knowledge of Advantages of phase transfer catalyst and crown ethers in green reactions.	The students will acquire knowledge of Importance of ionic liquids in green syntheses.	**Statement**
	PO1	1	1	**PO1**	1	2	1	**PO1**
2	**PO2**			**PO2**				**PO2**
1	**PO3**	2	2	**PO3**				**PO3**
	PO4			**PO4**	2	2	2	**PO4**
	PO5			**PO5**	2	1		**PO5**
2	**PO6**			**PO6**				**PO6**
	PO7	3	3	**PO7**				**PO7**
	PO8			**PO8**				**PO8**

						CO2	Acquire knowledge of various physical parameters		2	1			2		
						CO3	Acquire knowledge of Conductivity related phenomena		2	1			2		
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Seminar II	MCHM1-314	2	1		0 0 2	CO1	Be able to prepare power point presentation.				3		3		
						CO2	Be able to show and improve their presentation skills in the presence of audience.	1			3	1	3		
						CO3	Feel Confident and will be able to remove stage fear			1	1		3		
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Photochemistry	MCHM1-417	4	4	45	4 0 0	CO1	Acquire basic knowledge on theoretical and applied photochemistry,			1					
						CO2	Overview basic photochemical reactions, photochemical reactions in imaging systems,				3				
						CO3	Handle silver halide photography, photodegradation and							3	

							photostabilization of materials,								
						CO4	To study some important applications of photochemistry.								
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Natural Products	MCHM1-418	4	4	45	4 0 0	CO1	Isolation, purification, identification and standardization of natural products	1		1	2			2	
						CO2	Structure elucidation of alkaloids, sterols and terpenoids,	1		1	2				
						CO3	Importance of vitamins, xanthophyll and carotenes	1			2				
Subject	**S Code**	**Semester**	**Credit**	**Duration (Hrs)**	**L T P**	**COs**	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
Physical Chemistry Lab.-II	MCHM1-419	4	2		0 0 4	CO1	Acquire knowledge of colligative properties and phase rule while performing experiments		2	1			2		
						CO2	Acquire knowledge of various physical parameters		2	1			2		

Advanced Lab II	**Subject**	Advanced Lab.-I		**Subject**	Term Paper			**Subject**
MCHM1-422	**S Code**	MCHM1-421		**S Code**	(MCHM1-420)			**S Code**
4	**Semester**	4			4			
4	**Credit**	4			4			
	Duration (Hrs)							
0 0 4	**L T P**	0 0 4			0 0 4			
CO1	**COs**	CO2	CO1	**COs**	CO3	CO2	CO1	**COs**
The students will acquire knowledge of Structure elucidation of unknown compounds via interpretation	**Statement**	Application of UV-Vis, FT-IR, Magnetic moment measurement, Conductivity measurements, NMR and Thermogravimetric analysis for characterization of coordination complexes	Preparation and purification of different inorganic complexes	**Statement**	3. Be able to write a review paper.	2. Will learn how to do the literature survey for a pre-defined topic.	1. Know about the various components of a research article.	**Statement**
1	**PO1**			**PO1**				**PO1**
	PO2	2	2	**PO2**		1		**PO2**
	PO3			**PO3**	1	1		**PO3**
2	**PO4**			**PO4**	3	1		**PO4**
	PO5			**PO5**	1	1		**PO5**
2	**PO6**	3	3	**PO6**	3	1		**PO6**
	PO7			**PO7**		1		**PO7**
	PO8			**PO8**	1			**PO8**

							of the spectra (NMR, IR, UV & MS).								
						CO2	The students will acquire knowledge of Various reactions conditions including modern coupling strategies and their implications	1			2			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)