Programme outcomes, Programme specific outcomes and course outcomes for all Programmes offered by the institution are stated and displayed on website and communicated to teachers and students

The program outcomes are achieved through curriculum that offers a number of mandatory courses as well as elective courses. Each course has defined course outcomes that are mapped to the program outcomes.

The linkage among program outcomes and course outcomes is shown in the following Table. The course outcomes are thus directly and quantitatively assessed, and are tied to the program outcomes as shown in the course syllabi. Therefore if the course outcomes are met, the program outcomes are met. In order to attain the correlation between course outcomes and POs, the following performa as per the following guidelines have been used during the introduction/revision of the course:

(i) Mark (*) if the subject matter meets a particular program outcome to a small extent only.
(ii) Mark (**) if the subject matter meets a particular program outcome to a reasonable extent.
(iii) Mark (***) if the subject matter meets a particular program outcome to a large extent.

The same is compiled and shown below:

FIRST SEMESTER

At the completion of the MSc. Chemistry program, the student will be able to:			
Program Outcome → / **Course Outcome**	Work in the pure, interdisciplinary and multidisciplinary areas of chemical sciences and its applications.	Analyse data obtained from sophisticated instruments (like UV-Vis, Fluorescence, FTIR, NMR, GCMS, HPLC, GCMS and TGA) for the structure determination and chemical analysis.	Apply green chemistry approach towards planning and execution of research in frontier areas of chemical sciences.
ANALYTICAL CHEMISTRY (PCY101)			
Principles of optical methods like AES, AAS, Plasma and Electric Discharge Spectroscopy, Spectrofluorimetry, Nephelometry and Turbidimetry	**	***	*
Potentiometric, Coulometric, and Voltametric methods of analysis.	**	***	*
Chromatographic Techniques and applications.	***	***	*
INORGANIC CHEMISTRY (PCY102)			
Chemistry of main group	***	***	*

elements, and synthesis and properties of few main group compounds.	**		
General properties and separation of lanthanides and actinides.	*** ***	***	*
Basics of nuclear chemistry and radio analytical techniques.	*** **	**	*
Stability of organometallic compounds and clusters, and their applications as industrial catalysts.	*** *	***	*
STEREOCHEMISTRY AND PHOTOCHEMISTRY (PCY103)			
Conformational analysis of cycloalkanes, reactivity, chirality, interconversion, resolution and asymmetric synthesis.	**	***	*
Aromaticity, nonaromaticity and antiaromaticity in carbocyclic and heterocyclic compounds.	***	**	*
Molecular orbital symmetry and possibility of thermally and photochemically pericyclic reactions.	**	**	*
Basics of photochemical reactions of alkenes, carbonyl and aromatic compounds.	**	***	*
THERMODYNAMICS AND CHEMICAL KINETICS (PCY201)			
Explain the spontaneity of a process and the conditions required for a spontaneous process.	**	**	***
Describe different methods to determine rate law and derive the rate law for various chemical reactions including fast reactions	**	**	***
Explain collision and activated complex theory and determination of activation parameters for a reaction and homogeneous catalysis	**	**	**
Explain importance of adsorption process, heterogeneous catalysis,	**	**	***

Langmuir, and BET model			
Describe the concept of colloidal material, classification, synthesis and their stability for many practical uses	**	**	***
CHEMISTRY LAB –I (PCY206)			
Set up the apparatus for the purification, isolation, synthesis and characterization of certain compounds	**	**	**
Quantify ions by volumetric and gravimetric analysis	**	**	**
Operate and apply various spectroscopic techniques for identification and quantification.	**	**	**
CHEMICAL BIOLOGY (for non-medical students) PCY107			
Molecular structure of proteins, DNA, RNA, Carbohydrates, Lipids and Vitamins.	**	***	**
Organization and working principles of various components present in living cell.	**	***	**

SECOND SEMESTER

MOLECULAR SPECTROSCOPY (PCY215)			
Explain the principle and instrumentation of microwave, infrared-vibration-rotation Raman and infra-red spectroscopy and interpret microwave, vibration-rotation Raman and infra-red spectra for chemical analysis	**	***	**
Explain the principle and instrumentation of electronic spectroscopy and analyze the electronic spectra of different species	*	**	**
Explain the principle and instrumentation of nuclear magnetic and electron spin resonance spectroscopy and apply the knowledge in characterizing the molecules	***	**	*

and also their use in medical diagnostics.			
Explain the principle, instrumentation, and application of Mössbauer spectroscopy to study bonding in iron derived complexes.	**	**	*
COORDINATION CHEMISTRY (PCY202)			
Explain the bonding in coordination complexes.	**	**	*
Interpretation of the electronic and magnetic properties.	**	**	*
Explain the formation and stability of the coordination complexes	**	**	*
Elucidate the kinetics and reaction mechanism of coordination complexes including redox reactions	**	**	*
ORGANIC REACTION MECHANISMS (PCY203)			
Mechanistic aspects in nucleophilic and electrophilic substitution.	**	**	**
Reaction conditions, products formation and mechanisms of some named reactions.	*	**	*
Mechanisms of addition reactions of C=C and C=O bonds and elimination reactions.	*	**	*
QUANTUM CHEMISTRY (PCY104)			
Explain Schrodinger equation for various quantum chemical models such as, particle in a box, harmonic oscillator, rigid rotor models and their quantum chemical description	**	***	***
Explain the operator algebra and their physical significance	**	**	*
Describe the electronic and Hamiltonian operators for H-like atoms and quantum chemical description of angular momentum and term symbols for a one and many-	***	**	**

electron systems			
Describe the approximation methods to solve the Schrodinger equation of many electron systems and their application for to describe the concept of bonding.	***	**	***
CHEMISTRY LAB –II (PCY209)			
Handle and use different organic and inorganic reagents.	**	**	***
Set up organic and inorganic reactions and characterize products using spectroscopic techniques.	**	***	**
Know the preparation, purification and characterization of different organic and inorganic compounds.	**	***	***
MEDICINAL AND PHARMACEUTICAL CHEMISTRY (PCY211)			
Drug designing and development, their SAR and QSAR	***	**	***
Mode of action of different drugs.	**	**	*
Role of drugs to inhibit the particular enzymes and treatment of disease	***	*	*

GREEN CHEMISTRY(PCY204)			
Concepts of green chemistry.	**	**	***
Applications of green chemistry for sustainable development	***	**	**
SUPRAMOLECULAR CHEMISTRY (PCY213)			
Molecular recognition and nature of bindings involved in biological systems	*	**	**
Structure of supramolecules of various types in solution and solid state	*	**	**
Applications of supramolecules in miniaturization of molecular devices	**	*	**
Molecular recognition and nature of bindings involved in biological systems	*	**	**
MATERIAL CHEMISTRY (PCYXXX)			
Describe Unit cells, lattice types, crystal system and point defects in solids	*	**	*
Explain X-ray and electron diffraction for crystal structure analysis	**	**	**
Explain electrical and magnetic properties of materials.	***	**	***
Elucidate the size-dependent physicochemical properties of nanomaterials	***	***	***

THIRD SEMESTER

SYMMETRY AND GROUP THEORY (PCY302)			
Concepts of symmetry and group theory in solving chemical structural problems	**	**	*
Explain molecular structure by the use of character tables and projection operator techniques	***	*	*
Application of symmetry	*	***	**

and group theory in IR spectroscopy			
CATALYSIS AND REAGENTS (PCY307)			
Use of transition metal based and other catalysts for different organic reactions.	***	**	*
use of reagents for different reaction transformations	**	*	**
Various reagents and their applications in industry.	**	*	**
INTERPRETATIVE SPECTROSCOPY (PCY308)			
IR range for functional groups, λ_{max} for polyenes and α, β-unsaturated carbonyl compounds.	***	**	***
Interpret cotton effect curves for obtaining absolute configuration of chiral molecules with chromophores.	**	**	*
Solve structural problems based on UV-Vis, IR, ^{1}HNMR, ^{13}CNMR and mass spectral data.	***	*	*
PHYSICAL AND ANALYTICAL CHEMISTRY LAB (PCY 309)			
To be familiar with experimental techniques for controlling chemical reactions	***	**	**
Measure various physical and chemical properties of materials and the kinetics of a chemical reaction	***	**	*
Record and interpret the UV-Vis and IR spectra for structural analysis and kinetic studies	**	***	**
Development of experimental skills on conductivity meter, potentiometer, pH meter and voltammeter for different applications	***	**	**

COMPUTATIONAL CHEMISTRY (PCYXXX)			
Run various quantum chemical and molecular dynamics software, such as Gaussian, ORCA, Gromacs/Amber	**	**	***

Explain chemical principles using computational modelling	***	**	***
Use those packages to solve different chemical and (bio)chemical problems	***	**	***
Analyze and interpret the outputs of these calculations to rationalize experimental outcomes or even making testable predictions	***	**	***
Use the molecular dynamics programs to explore the conformational changes of proteins with respect to time	***	**	***
REARRANGEMENTS AND RETROSYNTHESIS (PCY321)			
Mechanistic pathway of organic reactions.	*	**	**
Retrosynthetic approach to planning organic syntheses.	*	**	**
Conversion of different functional group via rearrangement reaction.	*	***	***
PHOTOPHYSICAL CHEMISTRY (PCY322)			
Photochemistry and photophysical principles.	**	**	**
Identification and characterization of transient intermediates by ultrafast modern techniques.	*	***	**
Theory of photoreaction.	*	**	**
application of photochemistry and photophysical principles on simple and macromolecules.	***	**	**

ENVIRONMENTAL CHEMISTRY (PCY XXX)			
Different concepts of atmosphere, stratospheric and tropospheric chemistry, photochemical smog, acid rain, atmospheric aerosols, global climate	**	**	***
Gases in hydrosphere, organic matter in water, humic material, metals in aqueous environment	**	**	**
Chemistry of colloids with	**	**	**

reference to environment			
Air pollution and its control	**	**	**
ORGANOMETALLIC CHEMISTRY (PCY XXX)			
Describe the structure and bonding in main group and transition metal organometallic compounds	**	**	*
Describe the reactivity and reaction mechanism of various organometallic compounds	**	***	*
Describe the multicentre bonding in different organotransition metal compounds	**	***	*
Apply the acquired knowledge to explain the catalysis by various transition metal-organic compounds	***	**	**
SEMINAR (SUMMER TRAINING/ INDUSTRIAL CASE STUDY)			
To expose the students with the working culture of industrial and academic research labs.	*	**	**

FOURTH SEMESTER

BIOINORGANIC AND BIOPHYSICAL CHEMISTRY (PCYXXX)			
Factors that govern the stability, folding, and dynamics of proteins.	***	***	**
Explain the kinetics, thermodynamics, and mechanism of protein folding and their implications in misfolding.	***	**	**
Describe the structure and biological functions of	***	**	**

proteins and explain the role of metals in biology			
Explain the roles of metals in medicinal chemistry and toxic effects of metals.	***	**	**
HETROCYCLIC CHEMISTRY AND NATURAL PRODUCTS (PCY401)			
Nomenclature of different heterocyclic compounds	**	*	*
Synthesis and reactivity of fused, six membered and smaller heterocyclic compounds.	**	*	*
Classification and importance of various natural products.	**	*	*
STATISTICAL THERMODYNAMICS (PCY XXX)			
Describe the various ensembles	*	*	*
correlate and differentiate Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics	**	*	*
explain the partition function and the derivation of thermodynamic properties in terms of molecular partition function	**	*	*
theories of specific heat for solids	**	**	*
INORGANIC SPECTROSCOPY (PCY XXX)			
Interpret IR and Raman spectrum of inorganic complexes and assign mode of binding for ambidentate ligands	*	***	*
Analyze the NQR data for chemical analysis	*	***	*
Interpret EPR spectrum of coordination complexes and obtain idea about oxidation state of metal ion and ligand field	*	***	*
Analyze the Mössbauer spectrum and obtain information about oxidation state as well as spin state of metal ion	**	***	*
Understand the principle and instrumentation of PES and analyze the spectra for	**	***	*

chemical analysis.			
DISSERTATION (PCY 491)			
To expose the students to the literature review	**	*	*
Designing and execution of the small reaction schemes	**	**	**
Project report/manuscript writing and presentation	***	*	**

Content Delivery Methods:
The following are the various other content delivery methods used to deliver the courses:

- Lecture along with discussions
- Quizzes
- Tutorials
- Demonstrations (Such as models, laboratory work, and Industrial visits)
- Home assignments
- Project work and report submission
- Presentations

Online Learning Resources: In addition to the syllabus mentioned in the curriculum, the students are encouraged to gain the knowledge through e-resources such as:

- **NPTEL** http://nptel.iitm.ac.in
- **Wikipedia** https://en.wikipedia.org
- **MIT Open Courseware** http://ocw.mit.edu/index.htm
- **RSC learning portal** http://www.rsc.org/learn-chemistry

The delivery methods are chosen appropriate to meet the Program Outcomes. The generalized mapping of the course delivery methods to the program outcomes is shown in table below:

At the completion of the MSc. Chemistry program, the student will be able to:			
Program Outcomes → / **Content delivery methods**	work in the pure, interdisciplinary and multidisciplinary areas of chemical sciences and its applications	analyse data obtained from sophisticated instruments (like UV-Vis, Fluorescence, FTIR, NMR, GCMS, HPLC, GCMS and TGA) for the structure determination and chemical analysis	apply green chemistry approach towards planning and execution of research in frontier areas of chemical sciences
Lecture along with discussions	*	*	*
Quizzes	*	*	*
Tutorials	*	*	*
Demonstrations (Such as models, laboratory work, and Industrial visits)	*	*	*
Home assignments	*	*	*
Project work and report submission	*	*	*
Presentations	*	*	*