IEC UNIVERSITY

DEPARTMENT OF CHEMISTRY

SYLLABUS

MASTER OF SCIENCES

IN

CHEMISTRY

SCHOOL OF APPLIED AND BASIC SCIENCES

I.E.C UNIVERSITY, BADDI, SOLAN

HIMACHAL PRADESH,

PIN-174103, INDIA

M.Sc. (Chemistry) Two Years Programme Curricula												
First Semester			Periods			Evaluation Scheme					Sub. Total	Credits
						Internal				External		
S. No.	Sub Code	Subject	L	T	P	MST	CA	P	Total			
1	MCH-101	Inorganic Chemistry -I	4	1	0	40	20	0	60	40	100	4.5
2	MCH-102	Organic Chemistry - I	4	1	0	40	20	0	60	40	100	4.5
3	MCH - 103	Physical Chemistry -I	4	1	0	40	20	0	60	40	100	4.5
4	MCH-104/ MCH-105	Basic Mathematics*/ Remedial Biology*	4	0	0	40	20	0	60	40	100	4
5	MCH - 151 P	Inorganic Chemistry Lab I	0	0	4	0	0	30	30	20	50	2
6	MCH - 152 P	Organic Chemistry Lab I	0	0	4	0	0	30	30	20	50	2
7	MCH - 153 P	Physical Chemistry Lab-I	0	0	4	0	0	30	30	20	50	2
Total			16	3	12	160	80	90	320	220	550	23.5

*Mathematics for medical stream students and Biology for Non-Medical stream students.

M.Sc. (Chemistry) Two Years Programme Curricula												
Second Semester			Periods			Evaluation Scheme					Sub. Total	Credits
						Internal				External		
S. No	Sub Code	Subject	L	T	P	MST	CA	P	Total			
1	MCH-201	Inorganic Chemistry -II	4	1	0	40	20	0	60	40	100	4.5
2	MCH-202	Organic Chemistry - II	4	1	0	40	20	0	60	40	100	4.5
3	MCH - 203	Physical Chemistry - II	4	1	0	40	20	0	60	40	100	4.5
4	MCH-204	Computer Programming Theory	4	0	0	40	20	0	60	40	100	3
5	MCH - 251 P	Inorganic Chemistry Lab II	0	0	4	0	0	30	30	20	50	2
6	MCH - 252 P	Organic Chemistry Lab II	0	0	4	0	0	30	30	20	50	2
7	MCH - 253 P	Physical Chemistry Lab-II	0	0	4	0	0	30	30	20	50	2
8	MCH - 254 P	Computer-Lab	0	0	4	0	0	30	30	20	50	2
Total			16	3	16	160	80	120	360	240	600	24.5

M.Sc. (Chemistry) Two Years Programme Curricula												
Third Semester			Periods			Evaluation Scheme					Sub. Total	Credits
						Internal				External		
S. No.	Sub Code	Subject	L	T	P	MST	CA	P	Total			
1	MCH-301	Inorganic Chemistry -III	4	1	0	40	20	0	60	40	100	4.5
2	MCH-302	Organic Chemistry - III	4	1	0	40	20	0	60	40	100	4.5
3	MCH - 303	Physical Chemistry - III	4	1	0	40	20	0	60	40	100	4.5
4	MCH-304	Chemistry of Materials	4	0	0	40	20	0	60	40	100	4
5	MCH-305	Seminar	0	0	0	0	0	0	100	0	100	1
6	MCH - 351 P	Inorganic Chemistry Lab III	0	0	4	0	0	30	30	20	50	2
7	MCH - 352 P	Organic Chemistry Lab III	0	0	4	0	0	30	30	20	50	2
8	MCH - 353 P	Physical Chemistry Lab-III	0	0	4	0	0	30	30	20	50	2
Total			16	3	12	160	80	90	430	220	650	24.5

M.Sc. (Chemistry) Two Years Programme Curricula												
Disciplinary specialization subject will be chosen either by adopting combination: A(Inorganic Chemistry) or B (Organic Chemistry) or C Physical Chemistry												
Fourth Semester			Periods			Evaluation Scheme					Sub. Total	Credits
						Internal				Ext.		
S. No	Sub Code	Subject	L	T	P	MST	CA	P	Total			
1	*	Elective (Disciplinary specific)	4	1	0	40	20	0	60	40	100	4.5
2	*	Elective (Disciplinary specific)	4	1	0	40	20	0	60	40	100	4.5
5	MCH-403	Dissertation	0	0	15	0	0	0	50	50	100	12
Total			8	2	15	80	40	0	170	130	300	21

Note: L = Lecture, T = Tutorial, P = Practical, CA= Class assessment, MST = Mid Semester Test, Ext. = External.

S.No	Disciplinary specialization		Code
A	**Inorganic Chemistry**		
	1	Advanced Organometallics*	MCH -401E-I
	2	Inorganic photochemistry & Polymeric* compounds	MCH-402E-I
B	**Organic Chemistry**		
	1.	Medicinal Chemistry*	MCH-401E-O
	2.	Natural Products*	MCH -402E-O
C	**Physical Chemistry**		
	1	Advanced Quantum Chemistry*	MCH -401E-P
	2	Solid State Chemistry*	MCH -402E-P

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FORM.Sc. FIRST YEAR *(SEMESTER-I and II)*

MSc Chemistry 1st Year			
Semester-I	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-101	Course Title: Inorganic chemistry-1		
Max Marks: 60+40	Time: 3H		

***Instruction*:** Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks

UNIT-I

Group theory: The concept of group, Symmetry elements and symmetry operations, Assignmentof point groups to Inorganic molecules, Some general rules for multiplications of symmetryoperations, Multiplication tables for water and ammonia, Representations (matrices, matrixrepresentations for C_2V and C_3V point groups irreducible representations), Character and charactertables for C_2V and C_3V point groups. Applications of group theory to chemical bonding (hybridorbitals for σ-bonding in different geometries and hybrid orbitals for π-bonding. Symmetries ofmolecular orbitals in BF_3, C_2H_4 and B_2H_6.

UNIT-II

Application of Group Theory in Vibrational Spectroscopy: A brief idea about Infrared andRaman scattering spectroscopy. Vibrational modes as basis of group representations w.r.t. SO_2,
$POCl_3$, $PtCl_4^{2-}$ and RuO_4. Mutual exclusion principle, Classification of vibrational modes (i.e. Stretching and angle deformation vibrations w.r.t. SO_2, $POCl_3$ and $PtCl_4^{2-}$.

UNIT-III

Non-Aqueous Solvents: Factors justifying the need of Non Aqueous solution Chemistry andfailure of water as a Solvent. Solution chemistry of Sulphuric acid: Physical properties, Ionic self
dehydration in H2SO4, high electrical conductance in spite of high viscosity, Chemistry of H_2SO_4as an acid, as an dehydrating agent, as an oxidizing agent, as an medium to carry out acid-baseneutralization reaction and as a differentiating solvent. Liquid BrF_3: Physical properties,solubilities in BrF_3, self ionization, acid base neutralization reactions, solvolytic reactions andformation of transition metal fluorides. Chemistry of Molten salts as Non-Aqueous Solvents:Solvent properties, solution of metals, complex formation, Unreactivity of molten salts, Lowtemperature molten salts.

UNIT-IV

Inorganic Hydrides: Classification, preparation, bonding and their applications. Transition metalcompounds with bonds to hydrogen, carbonyl hydrides and hydride anions. Classification, nomenclature, Wade's Rules, preparation, structure and bonding in boron hydrides(boranes),carboranes, metalloboranes and metallocarboranes.

Books Recommended:

1. Chemical applications of Group Theory – F.A.Cotton
2. Inorganic Chemistry – Durrant and Durrant
3. Symmetry in Chemistry- Jaffe and Orchin
4. Non-aqueous solvents – H.Sisler
5. Non-aqueous solvents – T.C.Waddington
6. Non-aqueous solvents – Logowsky
7. Advanced Inorganic Chemistry:Cotton&Wilkinson,VthEdn.
8. Concise course in Inorganic Chemistry- J.D.Lee
9. Nature of Chemical Bond – L. Pauling
10. Chemistry of Elements – Greenwood and Earnshaw
11. Inorganic Chemistry – T. Moeller
12. Inorganic Chemistry – J.E.Huheey 3rd Edn.
13. Topics in Current Chemistry (Inorganic/Bio-Chemistry)–Vol. 64

MSc Chemistry 1st Year			
Semester-I	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-102	Course Title: Organic chemistry-1		
Max Marks: 60+40	Time: 3H		

***Instruction*:** Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Nature of Bonding in Organic Molecules: Delocalized Chemical Bonding: Kinds of moleculeswith delocalized bond, cross- conjugation, resonance, pπ-dπ bonding (ylides). Aromaticity: othersystems containing aromatic sextet, Aromatic systems with electron number other than six. Huckelrule, other aromatic compounds, hyperconjugation. **Supramolecular chemistry:** Introduction,Bonding other than covalent bond. Addition compounds, Crown ether complexes and Cryptands,Inclusion compounds, Cyclodextrins, Catenanes and Rotaxenes and their applications.

UNIT-II

Stereochemistry: Conformational analysis of cycloalkanes, decalins, effect of conformation onreactivity in acylic and cyclohexane systems. Stericstrain due to unavoidable crowding. Elementsof symmetry: chirality, molecules with more than one chiral center, threo and erythro isomers,methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces,Optical activity due to chiral planes, Optical activity in the absence of chiral carbon (biphenyls,allenes and spiranes), chirality due to helical shape. Asymmetric Synthesis: Principle andcategories with specific examples of asymmetric synthesis including newer methods involvingenzymatic and catalytic reactions, enantio and diastereoselective synthesis. StereoselectiveReactions: Cyclopropanation, hydroboration, catalytic hydrogenation, and metal ammonireduction, stereoselective synthesis of (-) ephedrine and (+) φ- ephedrine. Stereospecific Reactions: Elimination of 2,3- dibromobutanedensyl chloride(1,2-diphenyl-1-chloroethane), SN_2 reactionsat chiral carbon.

UNIT-III

Reaction Mechanism: Structure and Reactivity: Thermodynamic and kinetic requirements,Kinetic and Thermodynamic control, Hammonds postulate, Curtin-Hammett principle. Potential
energy diagrams, transition states and intermediates.

Effect of structure on reactivity: resonance and field effects, steric effect. Quantitative treatment:Hammett equation and linear free energy relationship, Substituent and reaction constants, Taftequation. Methods: determining reaction mechanism.

UNIT-IV

(A) Aliphatic Nucleophilic Substitution: The SN_2, SN_1, mixed SN_1 and SN_2, SET mechanisms &SNi mechanism. The neighboring group mechanism, neighboring group participation by π and σbonds, anchimeric assistance. Non-classical carbocations, phenonium ions, norbornyl system,common carbocation rearrangements-Wagner-Meerwein, Pinacol-Pinacolone and Demjanov ring
expansion and ring contraction. Nucleophilic substitution at an allylic, aliphatic trigonal and avinylic carbon. Esterification of carboxylic acid, transesterification, transetherification andpreparation of inorganic esters. Phase-transfer catalysis, and ultrasound, ambident nucleophile,regioselectivity.

(B) Aliphatic Electrophilic Substitution: Bimolecular mechanisms- SE_2 and SEi. The SE1mechanism, electrophilic substitution accompanied by double bond shifts, halogenations of aldehydes, ketones, acids and acyl halides. Effect of substrates, leaving group and thesolvent system on reactivity. Aliphatic diazonium coupling, Acylation at aliphatic carbon,alkylation of alkene, Stork-enamine reactions

(C) Free radical reactions: Types of free radical reactions, free radical substitutionmechanism, mechanism at an aromatic substrate, neighboring group assistance,Reactivity in aliphatic and aromatic substrates at a bridgehead and attacking radicals.Effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes tocarboxylic acids, auto oxidation, coupling of alkynes and arylation of aromaticcompounds by diazonium salts. Gomberg Bachmann reaction, Sandmeyer reaction,Hoffmann -Loffler- Freytag reaction, Hunsdiecker reaction.

Books Recommended:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic andProfessional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

MSc Chemistry 1st Year			
Semester-I	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-103	Course Title: Physical chemistry-1		
Max Marks: 60+40	Time: 3H		

***Instruction*:** Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT – I

Spectroscopy – I: Theory of nuclear magnetic resonance NMR phenomenon, the chemical shiftand its measurement. The fine structure (spin – spin coupling). Factors influencing chemical – shiftand spin – spin coupling. Relaxation phenomena in NMR: spin – spinand spin – lattice relaxation processes. Line –width and rate processes. The nuclear Overhausereffect. An introduction to Fourier Transform NMR (FTNMR).

Theory of Electron Spin Resonance(ESR) phenomenon. Fine and hyperfine structure of ESR. Zero – field splitting of ESR signal.Mapping of charge density on molecule (McConnell relation). Mossbaur spectroscopy: a brief introduction (isomer – shift, quadrupole interaction and magnetic hyperfine interaction).

UNIT - II

Spectroscopy – II: Rotational and vibrational spectra. Moment of inertia and rotational spectra ofrigid and non – rigid diatomic molecules. Vibrational excitation effect.. Rotational spectra of symmetric - top molecules. Stark effect. Vibrational energy of diatomic molecules. Anharmonicoscillator, overtones and hot bands. Diatomic vibrator – rotator (P, Q and R – branches of diatomicvibrator – rotator). Rotational – vibrational spectra of symmetric – top molecules. RamanSpectroscopy: qualitative quantum theory of Raman scattering. Rotational

Raman spectra of linearand symmetric – top molecules. Vibrational Raman spectra and mutual exclusion principle.

UNIT - III

Kinetics of complex reactions: Reversible / opposing reactions, consecutive / successivereactions, simultaneous side / parallel reactions, chain / free radical reactions viz. thermal (H_2 –Br_2) and photochemical H_2–Cl_2) reactions. Rice – Herzfeld mechanism of dissociation of organicmolecules viz. dissociation of ethane, decomposition of acetaldehyde as 3/2 or ½ order reactions.Kinetics of polymerization (molecular and free radical mechanisms). Reaction rates and chemicalequilibrium, principle of microscopic reversibility, activation energy and activated complex.

UNIT - IV

Theories of reaction rates: Collision,The kinetic theory of collisions, transition state theory, comparison ofcollisions and transition state theories in simple gas reactions, steric factor, Lindmans theory of unimolecularreaction, the thermodynamic formulation of reaction rates.

Surface Reactions: Mechanism of surface reactions, unimolecular and bimolecularsurface reactions, Langmuir – Hinshelwood mechanism for gases only.

Books Recommended:

1. Chemical Kinetics : K.J. Laidler
2. Kinetics and Mechanism of Reaction Rates: A.Frost and G. Pearson.
3. Modern Chemical Kinetics: H. Eyring
4. Theories of Reaction Rates: K.J. Laidler, H. Eyring and S. Glasston
5. Fast Reactions: J.N. Bradly
6. Fast Reactions in Solutions: Caldin
7. Basic Principles of Spectroscopy: R. Chang
8. NMR and Chemistry: J.W. Akit
9. Introduction to Molecular Spectroscopy: G.M. Barrow
10. Physical Chemistry: P.W. Atkins
11. Fundamentals of Molecular Spectroscopy: C.N. Banwell

MSc Chemistry 1st Year			
Semester-I	**L**	**T**	**C**
	4	0	4
Course Code: MCH-104	Course Title: Basic Mathematics		
Max Marks: 60+40	Time: 3H		

***Instruction*:** Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage

of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

1. **Equations Reducible to Quadratic Equations:** Quadratic equations, Nature of roots, Method ofsolving a quadratic equation and equations reducible to quadratic equations.**(5 Hrs)**
2. **Determinants:** Determinants, Properties of determinants, application of determinants in solving asystem of simultaneous linear equations, solution of non-homogenous system by Cramer's rule.**(5 Hrs)**
3. **Matrices:** Matrices, Types of matrices, Addition of matrices, Subtraction and multiplication ofmatrices, Transpose of matrix, Adjoint of matrix, Inverse of matrix, Unit matrix, solution of systems of linear equations by matrix method.**(6 Hrs)**
4. **Functions, Limit and Continuity:** Type of functions, domain and range of a function, limit of afunction, properties of limits, evaluation of limit of a function, continuity of a function at a point, Types of Discontinuity.**(6 Hrs)**
5. **Differentiation:** Definition of Derivatives, formation of Derivatives, Law of derivatives, Deltamethod, chain rule, repeated derivatives, derivative of implicit functions and explicit functions. **(6 Hrs)**
6. **Integration:** Integration, Graphical representation, Integration of algebraic Functions, logarithmicand exponential functions, integration of functions using substitution method, Integration by parts and partial fractions.(**6 Hrs)**
7. **Trigonometry:** Measurement of angles, trigonometric ratios, Trigonometric functions of standardangles, Trigonometric ratios of complementary angles and supplementary angles, allied angles, compound angles, multiple and sub-multiple angles; Conditional identities. **(6 Hrs)**

Books Recommended

Note: Recent editions of the following books to be referred

1. Schaum's Differential Equations. Singapore: McGraw Hill.
2. Grewal BS. Higher Engineering Mathematics. New Delhi: Khanna Publishers.

MSc Chemistry 1st Year			
Semester-I	**L**	**T**	**C**
	4	0	4
Course Code: MCH-105	Course Title: Remedial Biology		
Max Marks: 60+40	Time: 3H		

***Instruction*:** Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage

of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Cell structure and function: Overview of metabolic processes (catabolic and anabolic), energy transfer processes, role and significance of ATP (the biological energy currency). Introductory idea of metabolism of proteins and lipids, biosynthesis of proteins and glycerides.

UNIT-II

Nucleic acids: Chemical constitution of nucleic acids: chemical structure of nitrogenous bases in DNA & RNA, base pairing, Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The Chemical basis for heredity, transcription, translation and genetic code. Chemical synthesis of mono and tri-nucleoside.

UNIT-III

Introduction to photosynthesis: various plant pigments, Chemical structure of chlorophyll, Photo-system I & II, role of electron transport chain in photosynthesis,

UNIT-IV

Enzymes: Definition, classification on the basis of chemical composition & functions, mode of action of enzymes (Lock and key hypothesis), Cofactors, vitamins and Hormones (brief introduction including definition, classification on the basis of chemical composition and functions).

Books Recommended:

1. Principles of Biochemistry –A.L.Lehringer
2. Introduction to Chemistry of Life-H.J.DeBay
3. Outlines of Biochemistry-Conn and Stumpf.

MSc Chemistry 2nd Year			
Semester-II	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-201	Course Title: Inorganic Chemistry-II		
Max Marks: 60+40	Time: 3H		

Instructions:Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Metal-Ligand Bonding-I: Recapitulation of Crystal Field Theory including splitting of *d*-orbitalsin different environments, Factors affecting the magnitude of crystal field splitting, structuraleffects (ionic radii, Jahn-Teller effect), Thermodynamic effects of crystal field theory (ligation,hydration and lattice energy), Limitations of crystal field theory, Adjusted Crystal Field Theory(ACFT), Evidences for Metal-Ligand overlap in complexes, *Molecular Orbital Theory* foroctahedral, tetrahedral and square planar complexes (excluding mathematical treatment)

UNIT-II

Atomic Spectroscopy: Energy levels in an atom, coupling of orbital angular momenta, coupling of spin angular momenta, spin orbit coupling, spin orbit coupling p^2case, Determining the GroundState Terms-Hund's Rule, Hole formulation (derivation of the Term Symbol for a closed sub-shell,derivation of the terms for a d^2configuration), Calculation of the number of the microstates.

UNIT-III

Electronic Spectra-I: Splitting of spectroscopic terms (*s,p,d.f* and *g,h,i*), d^1-d^9 systems in weakfields (excluding mathematics), strong field configurations, transitions from weak to strong crystalfields.

Electronic Spectra-II: Correlation diagrams (d^1-d^9) in O_h and T_d environments spin-cross over incoordination compounds. Tanabe Sugano diagrams, Orgel diagrams, evaluation of B,C and βparameters.

UNIT-IV

Magnetochemistry: Origin of Magnetic moment, factors determining paramagnetism, pplication ofmagnetochemistry in co-ordination chemistry (spin only moment, Russell Saunder's coupling,quenching of orbital angular moment, orbital contribution to a magnetic moment) in spin free andspin paired octahedral and tetrahedral complexes. Magnetic susceptibility (diamagnetic,paramagnetic), magnetic moments from magnetic susceptibilities, Van Vlecks formula formagnetic susceptibility, temperature dependence of magnetic susceptibility.

Books Recommended:

1 Advanced Inorganic Chemistry – Cotton and Wilkinson
2 Coordination Chemistry- Experimental Methods – K.Burger
3 Theoretical Inorganic Chemistry – Day and Selbin
4 Magnetochemistry – R.L.Carlin
5 Comprehensive Coordination Chemistry – Wilkinson, Gillars and McCleverty.
6 Inorganic Electronic Spectroscopy – A.B.P.Lever
7 Concise Inorganic Chemistry – J.D.Lee
8 Introduction to Ligand Fields – B.N.Figgis
9 Physical Methods in Inorganic Chemistry-R.S.Drago
10 Introduction to Magnetochemistry – A.Earnshaw, Academic Press.

MSc Chemistry 2nd Year			
Semester-II	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-202	Course Title: Organic Chemistry-II		
Max Marks: 60+40	Time: 3H		

(ORGANIC CHEMISTRY-II)

Paper: MCH -202 (L:4, T:1, 4.5 credits) Max marks (60+40) Time 3 hours

Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

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UNIT – I

(A) Aromatic Electrophilic Substitution: Arenium ion mechanism, orientation and reactivity,energy profile diagrams, The ortho/para ratio, ipso attack, orientation in other ring systems.Quantitative treatment of reactivity in substrates and electrophiles, Diazonium coupling, Vilsmeirreaction, Scholl reaction, Amination reaction, Fries rearrangement, Reversal of Friedel Craftalkylation, Decarboxylation of aromatic acids.

(B) Aromatic Nucleophilic Substitution: SNAr, SN_1, benzyne and SRN_1 mechanism. Reactivity,effect of substrate structure, leaving group and attacking nucleophile, Von Richter, Sommelet-Hauser, and Smiles rearrangements, Ullman reaction, Ziegler alkylation, Schiemann reaction.

UNIT-II

Common Organic Reactions and Their Mechanisms: Perkin condensation, Michael reaction,Robinson annulation, Diekmann reaction, Stobbe condensation, Mannich reaction, Knoevenagelcondensation, Benzoin condensation, Witting reaction, Hydroboration, Hydrocarboxylation, Esterhydrolysis, Epoxidation.

Reagents in Organic Synthesis: Synthesis and applications of BF_3, NBS, Diazomethane, Lead tetra-acetate, Osmium tetraoxide, Woodward Prevorst hydroxylation reagent, $LiAlH_4$, Grignard reagent, organozinc and organolithium reagent.

UNIT-III

Elimination Reactions: Discussion of E1, E2, E1cB and E2C Mechanisms and orientation,Reactivity: Effects of substrate structures, attacking base, leaving group and medium. Ciselimination, elimination in cyclic systems, eclipsing effects, Pyrolytic eliminations, cleavage ofquaternary ammonium hydroxides, Fragmentations: γ-Amino and γ-hydroxy halides,decarboxylation of β-hydroxycarboxlic acid and β-lactones.

UNIT-IV

Pericyclic Reaction: Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene,1,3,5 hexatrienes and allyl system. Classification of pericyclic reactions, Woodward-Hoffmanncorrelation diagrams. FMO and PMO approach. Electrocyclic reactions: conrotatory anddisrotatory motions, 4n and 4n+2 and allyl systems. Cycloadditions- antarafacial and suprafacialadditions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions andchelotropic reactions. Sigmatropic rearrangements-Suprafacial and Antarafacial shifts of H,sigmatropic shifts involving carbon moieties, Claisen, Cope and aza-Cope rearrangements, Enereaction.

Books recommended:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic andProfessional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

MSc Chemistry 1st Year			
Semester-II	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-203	Course Title: Physical Chemistry-II		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT – I

Thermodynamics

Thermodynamics, laws of thermodynamics. Gibb's and Helmholtz free energy functions and theirsignificance. Partial molar properties. Free energy change with temperatureand pressure. Entropy. Gibb's and Helmholtz equation. Fugacity and activity and their variation withtemperature and pressure. Graphical method for the determination of fugacity.Law of chemical equilibrium and its application.Chemical equilibrium constant and its temperaturedependence.

Clausius and Clapeyron equation

UNIT – II

Chemical potential in case of ideal gases

Colligative properties and determination of colligative properties (depression in freezing point,elevation in boiling point and relative lowering of vapour pressure). Determination of molecularweight of non – volatile solutes from colligative properties. Relationship between relative loweringof vapour pressure and osmotic pressure. Van't Hoff factor.

Nernst heat theorem. Thermodynamicderivation of phase rule and its application to two component systems. Distribution law, itsthermodynamic derivation and application. Zeroth law of thermodynamics.

UNIT – III

Surface Chemistry and Micelles

Adsorption. Surface tension, capillary action, pressure difference across curved surface(Laplace eqn), vapour pressure of droplets, (Kelvin eqn), Gibb's adsorption isotherm, estimation of surface area (BET eqn), surface films on liquids (electro kinetic phenomenon), catalytic activity at surfaces. Surface active agents, classification of surface active agents, micellisation, hydrophobic interactions, critical micellar concentration, factors affecting CMC of surfactants, counter ions binding to micelles, thermodynamics of micellization-phase separation & mass action models, solubilization, microemulsion, reverse micelles

UNIT –IV

Electrochemistry:

Corrosion of metals, causes and types of corrosion, Inhibition of corrosion(electrochemical, inhibitor, and coating methods).Electrochemical theories of corrosion.Kinetics of corrosion. Determination of activity of solutes. Derivation of Debye – Huckel Limiting Law. solvation number.Energy conduction. Ion–ion interactions (ion–association).

Books Recommended:

1. Thermodynamics for Chemists: S. Glasstone
2. Physical Chemistry: G.M. Barrow
3. Non – equilibrium Thermodynamics: C. Kalidas
4. Non – equilibrium Thermodynamics: I. Prigogene
5. Electrochemistry: S. Glasstone
6. Electrochemistry: P.H. Reiger
7. Thermodynamics; R.C. Srivastava, S.K. Saha and A.K. Jain
8. Modern Electrochemistry Vol. I: J.O'M Bockris and A.K.N. Reddy

MSc Chemistry1st Year			
Semester-II	**L**	**T**	**C**
	3	0	3
Course Code: MCH-204	Course Title: Computer Programing Theory		
Max Marks: 60+40	Time: 3H		

UNIT-I

Overview of C: History of C, Importance of C, Structure of a C Program.

Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant.

Input/output: Unformatted & formatted I/O function in C, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts().

UNIT-II

Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associatively.

UNIT-III

Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement.

Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement.

UNIT-IV

Functions: Definition, prototype, passing parameters, recursion.

Storage classes in C: auto, extern, register and static storage class, their scope, storage, & lifetime.

UNIT-V

Arrays: Definition, types, initialization, processing an array, passing arrays to functions, Strings & arrays.

TEXT BOOKS

1. Gottfried, Byron S., Programming with C, Tata McGraw Hill
2. Balagurusamy, E., Programming in ANSI C, 4E, Tata McGraw-Hill

REFERENCE BOOKS

1. Jeri R. Hanly& Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley.
2. YashwantKanetker, Let us C, BPB.
3. Rajaraman, V., Computer Programming in C, PHI.
4. YashwantKanetker, Working with C, BPB.

MSc Chemistry2nd Year			
Semester-III	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-301	Course Title: Inorganic Chemistry-III		
Max Marks: 60+40	Time: 3H		

Instructions: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Metal π Complexes: Preparation, reactions, structures and bonding in carbonyl, nitrosyl,phosphine and related complexes, structural evidences from vibrational spectra, bonding andimportant reactions of metal carbonyls. Structure and bonding in metal cyanides, stabilization ofunusual oxidation states of transition metals.

UNIT-II

Introductory Analytical Chemistry: ***Data Analysis–*** Types and sources of errors, propagationoferrors, detection and minimization of various types of errors. Accuracy and precision, average andstandard deviation, variance, its analysis and confidence interval, tests of significance (*F*-test, *t*-testand paired t-test), criteria for the rejection of analytical data (4d rule, 2.5d rule, Q-test, averagedeviation and standard deviation), and least-square analysis.
Food and Drug Analysis- General methods for proximate and mineral analysis in food (moisture,ash, crude fiber, nitrogen (proteins) and minerals (iron, calcium, potassium, sodium andphosphorus). Discussion of official (pharmacopea) methods for the determination of followingdrugs as such: (i) Analgin/oxyphenbutazone, (ii) chloramphenicol and related nitro compounds,(iii) chloroquinine,(iv) phenylbutazone, (v) salicylic acid and (vi) sulphonamides.

UNIT-III

Photoelectron Spectroscopy: Basic principle, photoionization process, ionization energies,Koopman's theorem, ESCA, photoelectron spectra of simple molecules, (N_2, O_2 and F_2)Photoelectron spectra for the isoelectronic sequence Ne, HF, H_2O, NH_3 and CH_4, chemicalinformation from ESCA, Auger electron spectroscopy – basic idea.

UNIT-IV

Lanthanides and Actinides:- Spectral and magnetic properties, comparison of Inner transition andtransition metals, Trans-uranium elements (formation and colour of ions in aqueous solution),usesof lanthanide compounds as shift reagents, periodicity of trans-lawrencium elements.

Books Recommended:

1. Advanced Inorganic Chemistry – Cotton and Wilkinson
2. Fundamentals of Analytical Chemistry – Skoog and West
3. Quantitative Inorganic Analysis – Vogel
4. Chemistry of the Elements – Greenwood and Earnshaw
5. Nuclear Chemistry-U.C.Dash
6. Nuclear Chemistry – B.G.Harvey
7. Nuclear Chemistry – Arnikar
8. Techniques in Inorganic Chemistry Vol. II (Nuclear Chemistry-Johnson and Others).
9. Modern Aspects of Inorganic Chemistry-H.J.Emeleus and A.G.Sharpe
10. Inorganic Chemistry, 4th Edition, - J.E.Huheey, E.A.Keiter and R.L.Keiter.
11. Analytical Chemistry-G.D.Christian
12. Chemical Structure and Bonding- Dekock and Gray
13. The Organometallic Chemistry of Transition metals: R.H. Crabtree.
14. Electronic absorption spectroscopy and related techniques: D.N. Sathyanarayan

MSc Chemistry 2nd Year			
Semester-III	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-302	Course Title: Organic Chemistry-III		
Max Marks: 60+40	Time: 3H		

Instructions: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT–1

Spectroscopy:

(A) Ultra Violet and Visible Spectroscopy: Electronic transitions (185-800 nm), Beer-LambertLaw, Effect of solvent on electronic transitions, Ultra Violet bands of carbonyl compounds,unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules forconjugated dienes and carbonyl compounds, Ultra- Violet spectra of aromatic and heterocycliccompounds. Steric effect in biphenyls. Applications of UV- visible spectroscopy in organicchemistry.

(B) Infrared Spectroscopy: Instrumentation and sample handling, Characteristic vibrationalfrequencies of common organic compounds. Effect of hydrogen bonding and solvent effect onvibrational frequencies, overtones, combination bands and Fermi resonance. Introduction toRaman spectroscopy. Applications of IR and Raman Spectroscopy in organic chemistry.

UNIT-II

Nuclear Magnetic Resonance (NMR) Spectroscopy: General introduction, chemical shift,spin-spininteraction, shielding mechanism, chemical shift values and correlation of protons present

indifferent groups in organic compounds. chemical exchange, effect of deuteration, complex spin-spininteraction between two, three, four and five nuclei, virtual coupling. Stereochemistry,hindered rotation, Karplus- relationship of coupling constant with dihedral angle. Simplification ofcomplex spectra-nuclear magnetic double resonance, spin tickling, INDOR, contact shift reagents,solvent effects. Fourier transform technique, Nuclear Overhauser Effect (NOE). Introduction toresonance of other nuclei –F, P, Principle and introduction to C-13 NMR, 2-D and 3-D NMR,Applications of NMR in organic chemistry.

UNIT-III

Mass Spectrometry: Introduction, ion production—EI, CI, FD and FAB, factors affectingfragmentation, ion analysis, and ion abundance. Mass spectral fragmentation of organiccompounds, common functional groups, Molecular ion peak, Meta-stable peak, McLaffertyrearrangement. Nitrogen Rule. High-resolution mass spectrometry. Examples of mass spectralfragmentation of organic compounds with respect to their structure determination. Introduction tonegative ion Mass spectrometry, TOF-MALDI. Problems based upon IR, UV, NMR and mass
spectroscopy.

UNIT- IV

Photochemistry – I: Introduction and Basic principles of photochemistry. Interaction ofelectromagnetic radiations with matter. Types of excitations, fate of excited molecules, quantumyield, transfer of excitation energy, actinometry. Photochemistry of alkenes: cis-transisomerization, dimerization of alkenes, photochemistry of conjugated olefins, photo-oxidation of
alkenes and polyenes. Photochemistry of Aromatic compounds: Isomerization, addition andsubstitution, photo-reduction of aromatic hydrocarbons

Photochemistry – II: Photochemistry of Carbonyl compounds: Norrish Type I and II,Intermolecular and Intramolecular hydrogen abstraction, Paterno-Buchi reaction, α and β-cleavagereactions of cyclic and acyclic carbonyl compounds, Formation of oxetane and cyclobutane fromα, β unsaturated ketones, Photo-reduction of carbonyl compounds, Photo-rearrangement of enones,dienones, epoxyketones, Photo Fries rearrangement.

Books Recommended:

1. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G.C.Bassler andT.C.Morrill, John Wiley.
3. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry, D.H. Williams,I. Fleming, Tata McGraw-Hill.
6. Organic spectroscopy by Jagmohan
7. Organic spectroscopy by W. Kemp.
8. Fundamentals of Photochemistry, K.K.Rohtagi - Mukherji, Wiley-Eastern.
9. Essentials of Molecular Photochemistry, A. Gilbert andJ.Baggot, Blackwell Scientific Publication.

10. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
11. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
12. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
13. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
14. Organic Photochemistry Vol.I, II, III. Ed. Orville L. Chapman.
15. Organic Photochemistry, Ed. Robert O. Kan.

MSc Chemistry 2nd Year			
Semester-III	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-303	Course Title: Physical Chemistry-III		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT – I

Statistical Thermodynamics

Types of statistics: Maxwell-Boltzmann distribution, Bose-Einstein's, Fermi-Dirac statistics, Molecular partition function for an ideal gas, types of partition functions, nuclear, electronic translational and vibrational partition function

UNIT – II

Photochemistry

Photophysical processes of electronically excited molecules (Jablonski Diagram). Franck-Condon principle. Kinetics of Excimer and exciplex formation. Energy transfer from electronically excited molecules (Stern – Volmer mechanism). E- type and P- type delayed fluorescence.

UNIT – III

Basic Quantum Chemistry

Operators in quantum mechanics. Eignvalues and eignfunctions. Hermitian operator and its application. Postulates of quantum mechanics, Schreodinger wave equatuion and its formulation as an eign value problem. The uncertainty principle. Quantum mechanical treatment of translational motion of a particle, particle in one and three dimensional boxes, harmonic – oscillator, rigid rotator and hydrogen atom. Graphical presentation of orbitals (s, p and d), radial and angular probability distribution plots.

UNIT – IV

Macromolecules

Types of polymers, regular and irregular polymers, synthesis of polymers by chain and step reactions, physical properties of solid polymers (crystallinity, plasticity and elasticity), vulcanization of rubbers, molecular mass determination by osmometry, viscometer, light scattering and ultracentrifuge methods, number and mass average molecular masses, polymer solutions, factors affecting the solubility of polymers , conducting polymers, doping of polymers, mechanism of conduction, polarones and bipolarons

Books Recommended:

1. Physical Chemistry: Puri, Sharma &Pathania
2. Theoretical Chemistry by S. Glasston
3. Statistical Chemistry by I. Prigogine
4. Quantum Chemistry An Introduction: H.L. Strauss
5. Introductory Quantum Chemistry: A.K. Chandra
6. Quantum Chemistry: A. Mcquarrie
7. Quantum Chemistry: I.N. Levine

MSc Chemistry 2nd Year			
Semester-III	**L**	**T**	**C**
	4	0	4
Course Code: MCH-304	Course Title: Chemistry of Materials		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I **(11 Lectures)**

Introduction: History; scope and perspectives of nano-chemistry Synthesis and Stabilization of Nanoparticlesa: Chemical Reduction; Reactions in Micelles, Emulsions, and Dendrimers; Photochemical and Radiation Chemical Reduction; Cryochemical Synthesis: Physical Methods:Particles of Various Shapes and Films.

UNIT-II

Experimental Techniques: Electron Microscopy: Transmission electron microscopy: Probe Microscopy: Probe Microscopy: Diffraction Techniques X-ray diffraction, Neutron diffraction :Miscellaneous Techniques, Comparison of Spectral Techniques Used for Elemental Analysis Size Effects in Nanochemistry; Melting Point; Optical Spectra; Kinetic Peculiarities of Chemical Processes on the ; Surface of Nanoparticles; Thermodynamic Features of Nanoparticles

UNIT-II **(12 Lectures)**

Magnetic Materials

Introduction, structure and classification, hard and soft ferrites, synthesis of ferrites by various methods (precursor and combustion method), characterization of ferrites by Mossbauer

spectroscopy, significance of hysteresis loop and saturation magnetization inferrites, magnetic properties of ferrites, applications of ferrites., Superparamagnetic materials, Paramagnetic materials

UNIT-IV **(8 Lectures)**

Organic Materials

Types and Properties, Methods of Preparation and separation of carbon nanotubes, applications of fullerenes, CNTs and grapheme, Organic semiconductors – photo physical processes, thermal and photo generation of carriers; Aromatic hydrocarbons, phthalocynins- anthracene mechanisms; excitons and polarons, Conduction polymers- polyacetylenes, polyanilines and polyvinylidenes- preparation and Applications

Books Suggested:

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
2. Material Science and Engineering, An Introduction, W.D. Callister, Wiley. 12

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-401E-O	Course Title: Medicinal Chemistry		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Drug Design: Development of new drugs, procedures followed in drug design, concepts of leadcompound and lead modification, concepts of prodrugs and soft drugs, structure-activityrelationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterismbioisosterism,spatial considerations. Theories of drug activity: occupancy theory, rate theory, inducedfit theory. Quantitative structure activity relationship. History and development of QSAR.Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-Chemicalparameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Free-Wilsonanalysis, Hansch analysis relationships between Free-Wilson and Hansch analysis.

UNIT-II

Pharmacokinetics and Pharmacodynamics: Pharmacokinetics: Introduction to drug absorption,disposition, elimination using pharmacokinetics. Important pharmacokinetic parameters indefining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drugdevelopment process.

Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzymeinhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics,biotransformation. Significance of drug metabolism in medicinal chemistry.

UNIT-III

Antibiotics and Antiinfective Drugs: Antibiotics: Structure, SAR and biological action ofantibiotics. Examples: penicillin: penicillin G, penicillin V, ampicillin, amoxycillin,chloramphenicol, cephalosporin, tetracycline and streptomycin.Sufonanmides: Structure, SAR and mode of action of sulfonamides, sulfonamide inhibition andprobable mechanisms of bacterial resistance to sulfonamides. Examples: sulfodiazine,sulfofurazole, acetyl sulfafurazole, Sulfagnanidine, Phthalylsulfoacetamide, Mafenide.Sulphonamide related compounds Dapsone. Local antiinfective drugs: Introduction and generalmode of action. Examples: sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin,chloroquin and primaquin

UNIT-IV

Psychoactive Drugs: Introduction, neurotransmitters, CNS depressants and stimulants. SAR and Mode of actions. Central Nervous System Depressant: General anaesthetics.Sedatives & Hypnotics: Barbiturates and Benzodiazepines.Anticonvulsants: Barbiturates, Oxazolidinediones, Succinimides, Phenacemide andBenzodiazepines.Psycotropic Drugs: The neuroleptics (Phenothiazines and butyrophenones), antidepressants(Monoamine oxidases inhibitors and Tricyclic antidepressants) and anti-anxiety agents(Benzodiazepines).Central Nervous System Stimulants: Strychnine, Purines, Phenylethylamine, analeptics, Indoleethylamine derivatives,

Books Recommended:

1. The Inorganic Chemistry of Biological processes - M.N.Hughes.
2. Bio Inorganic Chemistry - Robert Wittay
3. An Introduction to Biochemcial Reaction Mechanism - James N.Lowe and Lloyalt Ingraham.
4. Physical Chemistry of Macromolecules: S.F.Sun
5. The Enzyme Molecules: W. Ferdinand

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-402E-O	Course Title: Natural Product		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks

Unit-I **(15 Lectures)**

Terpenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, biosynthesis and synthesis of the followingrepresentative molecules: Monoterpenoids: Citral, geraniol (acyclic), α-terpeneol, menthol(monocyclic). Sesquiterpenoids: Farnesol (acyclic), zingiberene (monocyclic), santonin(bicyclic), Diterpenoids: Phytol and abietic acid.

UNIT- II **(15 Lectures)**

Carotenoids and Xanthophylls: General methods of structure determination of Carotenes: β-carotene, α- carotene, γ- carotene, lycopene and vitamin A. Xanthophylls: Spirilloxanthin, Capsorubin, Fucoxanthin. Carotenoid acids (Apocarotenoids): Bixin and Crocetin. Bio synthesis of carotenoids

Plant Pigments: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Anthocyanins (Cyanin and pelargonidin), polyphenols: Flavones (chrysin), Flavonols (quercitin) and isoflavones (daidzein) coumarin, Quinones (lapachol), Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

UNIT-III **(15 Lecture)**

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring,role of alkaloids in plants. Structure, synthesis and biosynthesis of the following: Ephedrine,Coniine, Nicotine, Atropine, Quinine and Morphine.

UNIT-IV **(15 Lectures)**

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Androsterone, Testosterone, Estrone, Progestrone. Biosynthesis of steroids

Books Recommended:

1. Finar, I.L. *Organic Chemistry,* Vol. 2, 5th edition, ELBS, 1975.

2. Hostettmann, Kurt; Gupta, M.P.; Marston, *A. Chemistry, Biological andPharmacological Properties of Medicinal Plants from the Americas,* Harwood Academic Publishers, CRC Press 1999.

3. Rohm, B.A. *Introduction to Flavonoids*, Harwood Academic Publishers.

4. Dev, Sukh*Insecticides of Natural Origin*, CRC Press 1997.

5. Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B. *Natural Products: Chemistry and Biological Significance*, Longman, Essex1994

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-401E-I	Course Title: Advance Organometallics		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I

Organometallic Compounds of transition elements: Types of ligands and their classifications inorganometallic compounds, 16 and 18 electron rule and its limitations. Hapto-nomenclature,synthesis, structure and bonding aspects of following organometallic compounds with carbon- π
donor ligands
a) Two electron donor (olefin and acetylenic complexes of transition metals)
b) Three electron donor (π-allyl complexes of transition metals)
c) Four electron donor (butadiene and cyclobutadiene complexes of transition metals)
d) Five electron donor (cyclopentadienyl complexes of transition metals – metalloceneswith special emphasis to ferrocenes)
e) Six electron donor [Benzene (arene) complex]Fluxional and dynamic equillibria in compounds such as η2-olefin, η3- allyl and dienylcomplexes.

UNIT-II

Homogeneous Transition metal catalysis: General considerations, Reason for selecting transitionmetals in catalysis (bonding ability, ligand effects, variability of oxidation state and coordinationnumber), basic concept of catalysis (molecular activation by coordination and addition), proximityinteraction (insertion/inter-ligand migration and elimination, rearrangement). Phase transfercatalysis. Homogeneous hydrogenation of unsaturated compounds (alkenes, alkynes, aldehydesand ketones). Asymmetric hydrogenation.

UNIT-III

Some important homogeneous catalytic reactions:- Ziegler Natta polymerization of ethyleneand propylene, oligomerisation of alkenes by aluminumalkyl, Wackers acetaldehyde synthesis,hydroformylation of unsaturated compounds using cobalt and rhodium complexes, Monsantoacetic acid synthesis, carboxylation reactions of alkenes and alkynes using nickel carbonyl andpalladium complexes. Carbonylation of alkynes (acetylene) using nickel carbonyls or Palladiumcomplexes.

UNIT-IV

Metal-metal bonding in carbonyl and halide clusters:- Polyhedral model of metal clusters,effect of electronic configuration and coordination number, Structures of metal carbonyl clusters ofthree atoms $M_3(CO)_{12}$ (M=Fe, Ru&Os), Four metal atoms (tetrahedra) $[M_4(CO)_{12}$ {M= Co, Rh&Ir}] and octahedron of type $M_6(CO)_{16}$ [M= Co & Rh], and halide derivatives of Rhenium (III)triangles, metal carbonyls involving bridged-terminal exchange and scrambling of CO group.

Transition Metal-Carbon multiple bonded compounds:-Metal carbenes and carbines (preparation, reactions, structure and bonding considerations). Biological applications andenvironmental aspects of organometallic compounds, Organometallic compounds in medicine,agriculture and industry.

Books Recommended:

1. Principles of organometallic compounds – Powell

2. Organometallic chemistry (an Introduction) – Perkin and Pollar
3. Organometallic chemistry – Parison
4. Advanced Inorganic Chemistry – Cotton and Wilkinson
5. Organometallic Chemistry-R.C.Mehrotra
6. Organometallic compounds of Transition Metal-Crabtree
7. Chemistry of the Elements – Greenwood and Earnshaw
8. Inorganic Chemistry – J.E.Huheey
9. Homogeneous transition metal catalysis – Christopher Masters
10. Homogeneous Catalysis – Parshall
11. Principles and Application of HomogeneousCatalysis – Nakamura and Tsutsui
12. Progress in Inorganic Chemistry Vol. 15 – Lipard. (Transition metal clusters – R.B.King)
13. Organotransition metal chemistry by S.G.Davis, Pergamon press 1982.
14. Principles and applications of organotransition metal chemistry by Ccollmen and Hegden

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-402E-I	Course Title: Inorganic photochemistry & Polymeric compounds		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT-I **(17 Lectures)**

Inorganic Photochemistry : Basic principles, Basic photochemical processes, Kashia's rule, Thexi state, Photochemical behaviour of transition metal complexes, charge transfer spectra of crystalline and gaseous alkali halides, photochemical reactions of coordination compounds, oxidation-reduction reactions, Photo substitution reactions, Adamson's rules and photosubstitution reactions of cobalt(III) complexes i.e. $[Co(NH_3)_5X]^{2+}$, $[Co(en)_3]^{3+}$.

UNIT-II **(14 Lectures)**

Inorganic Reactions and Mechanism: Substitution reactions in octahedral complexes, acid hydrolysis reactions, base hydrolysis and anation reactions, substitution reaction.Theories of trans-effect, labile and inert complexes.

UNIT-III **(13 Lectures)**

Polymeric Inorganic Compounds: General chemical aspects (synthesis, properties and structure) of phosphazenes, borazines, silicones, and condensed phosphates.

UNIT-IV **(16 Lectures)**

Stability of Coordination Compounds – Stability constants, stepwise formation constants, overall formation constants, relationship between stepwise and overall formation constants, difference between thermodynamic and kinetic stability. Determination of stability constants by:

(i) Spectrophotometric methods (Job's method, Mole ratio and slope ratiomethod).

(ii) Bjerrum's method

Factors affecting the stability constants (with special reference to metal and ligand ions).

1. Cotton, F. A. and Wilkinson, G. *Advanced InorganicChemistry*, John Wiley and Sons Ltd. 2006.
2. Moeller, T.*Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1983.
3. Lee, J.D.*Concise Inorganic Chemistry*,Wiley, India Edition, 2009.
4. Figgis, B.N.*Introduction to Ligand Fields*, Wiley VCH, 2000.
5. Basolo, F. and Pearson, R. G. *Inorganic Reaction Mechanism*, McGraw-Hill, 1965.

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-401E-P	Course Title: Advanced Quantum Chemistry		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks.

UNIT - I

Time – independent perturbation theory for non – degenerate states (first order correction toenergy and wave function), and its application to particle in a one – dimensional box, ground statehelium atom (without spin consideration) and perturbed harmonic – oscillator. Variational method:theory and application to ground state hydrogen and helium atoms and one – dimensionaloscillator.

UNIT - II

Theory of time – dependent quantum approximation technique. Fermi Golden Rule. Radiation – Matter interaction (induced emission and absorption of radiation). Einstein's transitionprobabilities. Determination of selection rules in respect of rigid rotation and harmonic – oscillatorapproximation.

UNIT - III

Quantum – mechanical of multielectron atoms: Hartree self – consistent method. Hartree – Fockself – Consistent (HFSCF) method. Rootham's method. Correlation energy (CE) and configurationinteraction (CI). Koopmann'stheorm. Basic idea of Density Functional Theory (DFT): Kohn –Sham equation.

UNIT –IV

Quantum – mechanical treatment of diatomic molecules: The Born Oppenheimer approximationand its formulation. The valence – bond treatment of a hydrogen molecule. Heitler – Londontreatment and ionic contribution. Molecular Orbital Theory (MOT) of H_2^+. MOT withconfiguration interaction (CI). Hybridization (sp, sp^2 and sp^3) from a quantum – mechnical view – point. The Huckel –Molecular Orbital Theory (HMOT) for conjugated hydrocarbons and cyclic conjugated systems.Huckel calculations for ethylene, allyl systems, cyclobutadiene and benzene. Calculation ofelectron density, charge distribution and bond orders.

Books Recommended:

1. Quantum Chemistry An Introduction: H.L. Strauss
2. ntroductory Quantum Chemistry: A.K. Chandra
3. Quantum Chemistry: D.A. McQuarri
4. Quantum Chemistry: I.N. Levine
5. Molecular Quantum Mechanics: P.W. Atkins
6. Elementary Quantum Chemistry: F.L. Pilar
7. Introductory Quantum Chemistry: S.R. LaPaglia
8. Fundamental Quantum Chemistry: T.E. Peacock

MSc Chemistry 2nd Year			
Semester-IV	**L**	**T**	**C**
	4	1	4.5
Course Code: MCH-402E-P	Course Title: Solid State Chemsitry		
Max Marks: 60+40	Time: 3H		

Instruction: Section (A) is compulsory contain 15 question carrying weight of 2 marks each. Section (B) will contain 8 questions. Candidate will attempt any 5 questions, carrying weightage of 8 marks each. Section (C) will contain 4 questions. Candidates will attempt any 2 questions each carrying a weight age of 15 marks

UNIT - I

X- ray diffraction

XRD, Bragg equation, experimental methods, the rotating crystal and the powder (the Debye-Scherrer) techniques, XRD pattern for cubic system and tungsten crystal, visual method, radial distribution method andapplications. Electron diffraction (Wierl equation), Neutron diffraction, Application to structure modification and magnetic compounds. Example of one difractogram: interpretation partical size, d-spacing.

UNIT - II

Bonding in crystals: Types of crystals, Characteristics structures of ionic crystals, Free electron model of metals, symmetry in crystal system, Imperfections: Point defects (Schottky and Frankel defects). Thermodynamic derivation of thesedefects. Miller indices, Born-Lande equation and

Born Haber cycle,Indexing of powder and crystal photographs. Determination of Bravais lattice,point group and space group. Determination of space group with examples.

UNIT - III

Properties of crystals: Electrical properties of metals; conductors and non – conductors,conductivity in pure metals. Hall Effect. Thermal properties: Theories of specific heat. Electricalproperties of semiconductors: Band theory, intrinsic and extrinsic semiconductors. Electrons and
holes. Temperature dependence and mobility of charge carriers. Optical properties: Absorptionspectrum, photoconductivity, photovoltaic effect and luminescence. Refraction Birefringence andcolor centre. Dielectric properties: Piezoelectricity, Rerro electricity, Ionic conductivity and
Electric breakdown. Interpretation of Tauc plot for direct and indirect band gap semiconductors.

UNIT – IV

Superconductivity: Experimental survey, occurrence of superconductivity, destruction ofsuperconductivity by magnetic fields (Meissner effect). Thermodynamic effects ofsuperconducting species (entropy, thermal conductivity and energy gap). Quantum tunnling. London equation. BCS theory of superconductivity.
Solid State Reactions: General principles: experimental procedures, kinetics of solid statereactions, vapour phase transport methods, interaction or ion exchange reaction, electrochemicalreduction methods.

Books Recommended:

1. Introduction to Solids: Azaroff
2. Solid State Chemistry and its applications: West
3. Solid State Chemistry: Charkrabarty
4. Solid State Chemistry: N.B. Hannay
5. Solid State Physics: Kiittal

PRATICALS

(INORGANIC CHEMISTRY PRACTICAL-I)

Paper: MCH-151 P (P:4, T:0, 2 credits)Max marks (30+20)Time 3 hours

1. Volumetric Analysis:

(a) **Potassium iodate titrations**: Determination of iodide, hydrazine, antimony(III)and arsenic(III)

(b) Potassium bromate titrations

i) Determination of antimony (III) and arsenic (III) Direct Method)
ii) Determination of aluminium, cobalt and zinc (by oxine method)

(c) EDTA titrations

i) Determination of copper, nickel, magnesium
ii) Back titration
iii) Alkalimetric titration
iv) Titration of mixtures using masking and demasking agents
v) Determination of hardness of water

2. Commercial Analysis:

i) Determination of available chlorine in bleaching powder
ii) Determination of Oxygen in hydrogen peroxide.
iii) Determination of Phosphoric acid in commercial phosphoric acid.
iv) Determination of Boric acid in borax.
v) Determination of metals: copper in copper oxychloride and zinc in zinebfungicides.

(ORGANIC CHEMISTRY PRACTICAL-I)

Paper: MCH -152 P **(P:4, T:0, 2credits)**
Max marks (30+20)Time 3 hours

Qualitative Analysis: Separation, purification and identification of binary mixture of organiccompounds by

i) chemical tests
ii) TLC
iii) Column chromatography and
iv) IR spectroscopy.

Books Recommended:

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, PrenticeHall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C.Heath.
3. Systematic Qualitative Organic Analysis, H.Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H.Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

(PHYSICAL CHEMISTRY PRACTICAL-I)

Paper: MCH -153 P (P:4, T:0, 2credits) Max marks (30+20)Time 3 hours

1. Refractive Index (RI) Measurements: Refractive index (RI) measurements of puresolvents, analysis of mixtures of two miscible solvents, molar and atomic refractiondetermination, polarizability of liquids.

2. Conductometric Measurements: Determination of cell constant, limiting molarconductance of simple electrolytes in water, verification of Ostwald, dilution law for weekacetic acid.

3. Surface Tension Measurements: Surface tension of pure solvents, analysis of mixturesof two miscible solvents, verification of Gibb's Thomson Rule of surface tension.

4. Partition – Coefficient: Determination of partition – coefficient for I_2 between water andCCl_4 and for benzoic acid between water and benzene.

Books Recommended:

1. Senior Practical Physical Chemistry: B.D. Khosla, V.C. Garg and A. Khosla
2. Experimental Physical Chemistry: V. Athawale and P. Mathur.
3. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
4. Practical in Physical Chemistry: P.S. Sindhu

PRACTICALS

(INORGANIC CHEMISTRY PRACTICAL-II)

Paper: MCH -251 P **(P:4, T:0, 2credits)**
Max marks (30+20)Time 3 hours

1. Analysis of mixtures by gravimetric and volumetric methods from the mixturesolutions:
i. Copper- Nickel
ii. Copper -Magnesium
iii. Copper-Zinc
iv. Iron-Magnesium
v. Silver-Zinc
vi. Copper-Nickel-Zinc
vii. Fe(II)-Fe(III)

2. Green methods of Preparation of the following:
(i) Bis(acetylacetonato)copper(II)
(ii) Tris(acetylacetonato)iron(III)
(iii) Tris(acetylacetonato)manganese(III)
(iv) trisethylenediaminenickel(II)chloride
(v) Potassiumdiaquooxalatochromate(III)
(vi) Vanadylacetonateie oxy-bis-(acetylacetonato) Vanadium (IV)

Books Recommended:
1. A text Book of Quantitative Inorganic Analysis: A.I.Vogal.
2. Applied Analytical Chemistry: Vermani.
3. Commercial Methods of Analysis: Shell &Biffen

(ORGANIC CHEMISTRY PRACTICAL-II)

Paper: MCH -252 P **(P:4, T:0, 2credits) Max marks (30+20)Time 3 hours**

(A) Organic Synthesis: Acetylation: - Acetylation of cholesterol and separation of cholesteryl acetateby column chromatography. Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.Grignard reaction: Synthesis of triphenyl methanol from benzoic acid. Aldol condensation:Dibenzal acetone from benzaldehyde. Sandmeyer reaction: p-chlorotoluene from p-toluidine.Acetoacetic ester condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E condensation.Preparation of iodoform from acetone (Haloform reaction). Preparation of polystyrene, anthranilicacid, fluorosceine-eosin, and methyl orange

(B) Paper Chromatography: Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Books Recommended:

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, PrenticeHall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C.Heath.
3. Systematic Qualitative Organic Analysis, H.Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H.Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

(PHYSICAL CHEMISTRY PRACTICAL-II)

Paper: MCH-253 P **(P:4, T:0, 2credits) Max marks (30+20)Time 3 hours**

1. **Adsorption Measurements:** Verification of Freundlich adsorption isotherm for I_2, acetic acid and oxalic acid on charcoal.

2. **Colloidal Solution:** Preparation of sol solution of arsenic sulphide and estimation of flocculation value for NaCl, KCl, $BaCl_2$, $AlCl_3$.

3. **Thermochemistry:** Determination of water equivalent of thermos flask, and estimation of heat of neutralization for strong acid strong base, weak acid strong base or vice – versa, heat of hydration and solution of salts.

4. **Kinetic Measurement:** Kinetics of Hydrolysis of methylacetate and ethylacetate in the presence of HCl.

5. Determination of % Loss on dryness (LOD) of given compound $KMnO_4$, MNO_2, $K_2Cr_2O_7$.

Books Recommended:

1. Senior Practical Physical Chemistry: B.D. Khosla, V.C. Garg and A. Khosla
2. Experimental Physical Chemistry: V. Athawale and P. Mathur.

3. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
4. Practical in Physical Chemistry: P.S. Sindhu

SEMESTER III
(INORGANIC CHEMISTRY PRACTICAL-III)

Paper: MCH -351 P**(P:4, T:0, 2credits) Max marks 30+20**
Time 3 hours

1. Analysis of the given sample (Ores)/Both Qualitative and Quantitative Dolomite,Pyrolusite, Galena.

2. Analysis of the given alloys: Coin, Gunmetal, Brass and Bronze.

3. To prepare a pure and dry sample of the following compounds:
1. Potassium tris(oxalato)aluminate(III)
2. Sodium hexa(nitro)cobaltate(III)
3. Potassium tris(oxalato)cobaltate(III)
4. Hexa(ammine)cobalt (III)chloride
5. Tetrapyridinecopper(II)persulphate
6. Dinitrotetrapyridinenickel(II)
7. Lead tetraacetate
8. Mercury (tetraisothiocyanato)cobaltate(II).
and characterize them by the following techniques:

i) Elemental analysis
ii) Molar conductance values
iii) I.R. Spectral interpretation
iv)Thermal analysis
v) UV-Visible Spectra

Books Recommended:
1. A Text Book of Qualitative Inorganic Analysis – A.I. Vogel

SEMESTER III
(ORGANIC CHEMISTRY PRACTICAL-III)

Paper: MCH -352 P **(P:4, T:0, 2credits)**
Max marks (30+20)Time 3 hours

A. Quantitative Analysis: Determination of the percentage/ number of hydroxyl groups in anorganic compound by acetylation method. Estimation of amines/ phenols using bromate – bromide solution/ acetylation method. Determination of iodine and sponification values ofan oil sample. Determination of DO, COD and BOD of water sample.

B. Multistep Synthesis: Cannizzaro reaction: 4-chlorobenzaldehyde as substrate. BenzilicAcid Rearrangement: Benzaldehyde à BenzoinàBenzilàBenzilic acid. HofmannbromamideRearrangement: Phthalic anhydride-à PhthalimideàAnthranilic acidBeckmann Rearrangement: BenzeneàBenzophenone-à BenzophenoneoximeàBenzanilide. Skraup Synthesis: Preparation of quinoline from aniline. Synthesisusing Phase Transfer Catalysis: Alkylation of diethyl malonate or ethyl acetoacetate and analkyl halide.
(C) Extraction of Organic Compounds from Natural Sources: Isolation of Caffeine from tea Leaves, casein from milk (the students are required to try some typical color reactions of proteins),lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported).lycopene from tomatoes and β- carotene from carrots.

Books Recommended:
1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller,Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C.Heath.
3. Systematic Qualitative Organic Analysis, H.Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H.Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

SEMESTER III
(PHYSICAL CHEMISTRY PRACTICAL-III)

Paper: MCH 353 P **(P:4, T:0, 2credits)**
Max marks (30+20) Time 3 hours

1. **Solubility Measurements:** Heat of solution of electrolytes by solubility measurements.

2. **Heat of transfer Measurements:** Heat of transfer for benzoic acid between benzene andwater and I_2 between CCl_4 and water.

3. **Conductometric Measurements:** Precipitation titration ($AgNO_3$ – KCl), acid – baseneutralization titration, determination of relative strength of acids in the given mixtures,solubility of sparingly soluble salt.

4. **Construction of Phase Diagram:** Phase diagram for liquids, (benzene and methanol, ----)and phase diagram for solids, (benzoic acid and cinnamic acid, benzoic acid andnaphthalene and acetamide and salicylic acid).

5. Colorimetric Measurements: Verification of Beer – Lambert's law for aqueous solutionsof $KMnO_4$, $K_2Cr_2O_7$ and $CuSO_4$ and construction of calibration plot to estimate theunknown concentration.

6. **Kinetic Measurement:** Saponification of ethylacetate by NaOH solution.
7. Determination of direct and indirect Band Gap by using Tauc relation.