GURU KASHI UNIVERSITY

Master of Science in Chemistry

Session : 2022-23

Department of Chemistry

PROGRAMME LEARNING OUTCOMES

- Programme enables the learner to determine molecular structure by using UV, IR and NMR.
- Helps in solving the reaction mechanisms and assign the final product.
- Targets to improve the skills of students in the organic research area.
- Learners are able to synthesize Natural products and drugs by using proper mechanisms.
- Helps to determine the aromaticity of different compounds.
- Enables the learners to solve the reaction mechanism and assign the final product.
- Strengthens the knowledge of the importance of ions in daily life.
- Learners are competent to diagnose the problems relevant to Inorganic ions and their complexes in biophysical entities.
- Learners develop skills to demonstrate knowledge and understanding in scientific management principles and apply those to one's own work as a member and leader of a team to managing projects in multidisciplinary environments.
- Enables the learners to function effectively as an individual independently and as a member or leader in diverse teams and in multidisciplinary settings.

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Programme Structure

Semester: I						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**Credits**
MCH101	Inorganic Chemistry-I	Core Course	4	0	0	4
MCH102	Organic Chemistry-I	Core Course	4	0	0	4
MCH103	Physical Chemistry-I	Core Course	4	0	0	4
MCH104	Analytical Chemistry	Core Course	4	0	0	4
MCH105	Inorganic Chemistry-I Lab	Skill Based	0	0	4	2
MCH106	Organic Chemistry-I Lab	Skill Based	0	0	4	2
MCH107	Community Service	Community Outreach	0	0	4	2
MCH199	MOOC	Compulsory Foundation	-	-	-	-
Value Added Course (For other Discipline also)						
MCH108	Teaching Methodology	VAC	2	0	0	2
MCH109	Organizational Management	Ability Enhancement Course	1	0	0	1
Total			**19**	**0**	**12**	**25**

Semester: II						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**Credits**
MCH201	Organic Chemistry-II	Core Course	4	0	0	4
MCH202	Physical Chemistry-II	Core Course	4	0	0	4
MCH203	Inorganic Chemistry-II	Core Course	4	0	0	4

MCH204	Inorganic Chemistry-II Lab	Skill Based	0	0	4	2
MCH205	Organic Chemistry-II Lab	Skill Based	0	0	4	2
MCH206	Industrial Chemistry	Skill Based	0	0	2	1
Discipline Elective –I (Any one of the following)						
MCH207	Mathematics for Chemists	Discipline Elective	3	0	0	3
MCH208	Organometallic Chemistry					
MCH209	Organic Spectroscopy					
MCH210	Biology for Chemists					
Discipline Elective –II (Any one of the following)						
MCH211	Chemistry of Cosmetics & Perfumes	Discipline Elective	3	0	0	3
MCH212	Pesticide Chemistry					
MCH213	Fuel Chemistry					
Total			**18**	**0**	**10**	**23**

Semester: III						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**Credits**
MCH301	Heterocyclic Chemistry	Core Course	4	0	0	4
MCH302	Applications of Spectroscopy	Core Course	4	0	0	4
MCH303	Organic Synthesis	Core Course	4	0	0	4
MCH304	Physical Chemistry-II Lab	Skill Based	0	0	4	2
MCH305	Physical Chemistry-III Lab	Skill Based	0	0	4	2

MCH306	Basics of Research Methodology	Compulsory Foundation	4	0	0	4
Discipline Elective –III (Any one of the following)						
MCH307	Environmental Chemistry	Discipline Elective	3	0	0	3
MCH308	Polymer Chemistry					
MCH309	Chemistry of Main Group Elements, Theories of Acids and Bases					
MCH310	Biophysical Chemistry					
xxx		Open Elective	2	0	0	2
MCH399	MOOC					
Total			**21**	**0**	**8**	**25**
Open Elective Courses (For other Departments)						
MCH311	Thermodynamics	IDC	2	0	0	2
MCH312	Computer Fundamentals and Programming	IDC	2	0	0	2
MCH313	Green Chemistry	IDC	2	0	0	2
MCH314	Analytical Clinical Biochemistry	IDC	2	0	0	2

Semester: IV						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**Credits**
MCH401	Women and Children Empowerment	Community Outreach	0	0	4	2
MCH402	Dissertation	Research Skill Based	NA	NA	NA	20
MCH403	Human Values and Professional Ethics	Value Added Course	2	0	0	2
Total			**0**	**0**	**4**	**24**
Grand Total			**58**	**0**	**34**	**97**

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]

   Continuous Assessment 1: [10 Marks]

   Continuous Assessment 2: [10 Marks]

   Continuous Assessment 3: [05 Marks]

B. Attendance (5 Marks)

C. Mid Semester Test-1: [30 Marks]

D. Mid Semester Test-1: [20 Marks]

E. End Term Exam : [20 Marks]

Evaluation Criteria for other courses has been given separately with the respective courses

SEMESTER-I

Course Title: Inorganic Chemistry-I

Course Code: MCH101

L	T	P	Credits
4	0	0	4

Course Outcomes

On the completion of the course the students will be able to

1. Understand the mechanism in transition metal complexes, Born Haber cycle to calculate lattice energy.
2. Gains knowledge of metal complexes in biological systems.
3. Understand the common themes running through ionic, covalent and metallic descriptions of Chemical bonding.
4. Learn to explain splitting orbitals which helps to explain properties of complexes.

Course Content

UNIT I **15 hours**

The ionic bond, covalent bond, the variation method, ground state energy of hydrogen atom, thesecular quations, the molecular orbital theory, electron distribution in hydrogen molecule ion, symmetric and antisymmetric energy states, the classical interaction energy,resonance contribution of ionic terms, sp^3 hybridisation, three centered bond, Linnetts doublet-quartet approach, the Pauli's exclusion principle.

UNIT II **14 hours**

Pi Bonding Ligand Complexes: Pi Acid Ligands CO as prototype, other pi acid ligands-isocyanide ligands, dinitrogen,the CS ligands, the NO ligands, Theories of Bonding in Transition Metal complexes– QualitativeApproach:: Qualitative introduction to the molecular orbital theory, complexes with no pi bonding, complexes with pi-bonding, the crystal field & ligand field

theories, orbital splitting and magnetic properties, the angular overlap model.

UNIT III **16 hours**

Structural and Thermodynamic Consequences of Partly Filled- shells

Ionic radii, Jahn - Teller effects, thermodynamic effects of d-orbital splitting, magnetic properties of chemical compounds, origin of magnetic behavior, magnetic susceptibility and types of magnetic behavior: diamagnetism, paramagnetism, ferromagnetism: types of paramagnetic behavior: Large multiplet separation, smallmultiplet separations, spin only, heavy atoms, high spin-low spin crossovers. Spectral properties. Russel- Saunder's term, election rules, breakdown of selection rules, bandwidths & shapes, energy level diagrams and- d complex spectra, Orgel diagrams-weak fields, charge-transfer spectra.

UNIT IV **15 hours**

Bioinorganic chemistry

Introduction,the biochemistry of Iron:ironstorage and transport ferritin,transferrin,bacterial iron transport,hemoglobin and myoglobin,nature of the heme-dioxygen binding,other natural oxygen carriers - hemerythrins, iron - sulfur proteins. Nitrogenases, miscellaneous other elements:vanadium,chromium&nickel metal ions and chelates in chemotherapy,synthetic metal chelates as an microbialagents,lithium and mental health,gold and its compounds, metal complexes as an chelation therapy.

Transaction Mode Quiz, E-Team Teaching, Group Discussion, Demonstration

SUGGESTED READINGS

- Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M., & Grimes, R. (2016). *Advanced inorganic chemistry* (Vol. 6, p. 1455). New York: Wiley.
- Shriver, D. F., Atkins, P. W., & Langford, C. H. (2019). Inorganic chemistry.
- Hughes, M. N. (1981). *The inorganic chemistry of biological processes* 2nd edn. *FEBSLETTERS.*.
- Rajapandian, V., Haseena, S., Palanisamy, K., & Indumathy, R. (2019). DOCKING STUDIES OF COBALT (III)-TERPYRIDYL COMPLEXES WITH DNA. *International Journal of Chemical and Molecular Engineering*.

SEMESTER-I

Course Title: Organic Chemistry-I
Course Code: MCH102

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Distinguish between type of addition, elimination and substitution reaction which helps in performing organic industrial preparation.
2. Learn classical and non-classical carbocation, NGP by pi and sigma bonds.
3. Distinguish between type of addition, elimination and substitution reaction which helps in performing organic industrial preparation.
4. Learn SN1 and SN2 Mechanism and stereochemistry.

Course Content

UNIT I **17 hours**

1. Recall Reactive Intermediate:

(i) Carbocation: Generation, Structure, Stability, Application of NMR spectroscopy in the detection of Carbocation, allylic and benzyllic carbocations. Stereochemistry and reactions.Non classical carbocations:Phenoniumion, norbornyl system, explaination based on rearrangement.

(ii) Carbanions: Generation, Structure, stability, stereochemistry, Tautomerism, Prototropy and general reactions.

(iii) Carbenes: Formation, Structure, Singlet & Triplet carbene, Stereochemsitry and reactions.

(iv) Nitrenes: Formation, Structure Singlet & Triplet nitrene, Stereochemsitry and reactions.

(v) Arynes:Formation,Structureandreactions.

(vi) Freeradicals:Formation,Structure,Stability,Stereo-chemistryandreactions.

2. Reaction of Free Radicals:

(i) Polymerization

(ii) Halogenation: Chlorination, bromination, Bromination by NBS, Iodination, Fluorination, Polar effects in halogenation.

(iii) Addition Reactions: Free radical addition of HBr, thiols and halogens.

(iv) Auto-oxidation

(v) Rearrangements

UNIT II **15 hours**

1. Nature of Bonding in Organic Molecules

(i) Introduction to fullerenes

(ii) Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's Rule, anti-aromaticity, homo-aromaticity, PMO-approach.

(iii) Bonding weaker than Covalent:

Addition compounds, Crown ether complexes and Cryptands, inclusion compounds, Cyclodextrins, Catenanes and rotaxane.

2. Techniques used for determination of reaction mechanism (Non-kineticmethod):

Use of optical, Stereochemical anisotopic techniques.

Reaction studies from identification of products,

trapping of intermediate, cross over experiments, use of catalyst

UNIT III **13 hours**

Elimination Reactions:

a) E_2, E_1 and E_1CB mechanism, Stereochemistry Productratio, Orientationofdoublebond, HofmanRule, SaytzeffRule. Factors Governing E_2 & E_1 Mechanism. Eliminationversus substitution. Dehalogenation byzinc

b) Aromatic Elimination: Benzenes, Nucleophillic aromatic substitution, addition elimination.

UNIT IV **15 hours**

1. **Pericyclic Reactions:**
   Molecular Orbital symmetry, Frontier Orbitals of ethylene, 1, 3- butadiene, 1, 3, 5- hexatrience and allyl system. Classification of Pericyclic reactions. Woodward-Hoffman rule, correlation diagrams. FMO and PMO approach.
2. **Electrocyclic reactions -** conrotatory and disrotatory motions 4n, 4n+2 and allyl systems. **Cycloadditions -** antarafacial and suprafacial additions 4S+2S systems and 2S+2S additions ofalkene.
3. **Sigmatropic rearrangement -** suprafacial and antarafacial shift involving hydrogen carbon moieties. [1,3], [1,5], [1,7] [3,3] and [5,5]-sigmatropic rearrangement, Claisen and Cope rearrangement reactions.

Transaction Mode Open Talk, Question, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Samec, J. S., &Bäckvall, J. E. (2002). Ruthenium-Catalyzed Transfer Hydrogenation of Imines by Propan-2-ol in Benzene. *Chemistry–A European Journal*.
- Carey, F. A., &Sundberg, R. J. (2007). *Advanced organic chemistry: part A: structure and mechanisms*. Springer Science & Business Media.
- Sykes, P. (1986). *A guidebook to mechanism in organic chemistry*. Pearson EducationIndia.
- Ingold, C. K. (1953). Structure and mechanism in organic chemistry.
- Pursell, D. P. (2009). Adapting to student learning styles: Engaging students with cell phone technology in organic chemistry instruction. *Journal of chemical education*.
- Norman, R., &Coxon, J. M. (2017). *Principles of organic synthesis*. Routledge.
- Mukherji, S. M., & Singh, S. P. (1984). *Reaction mechanism in organic chemistry*. Macmillan

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SEMESTER-I

Course Title: Physical Chemistry-I

Course Code: MCH103

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the completion of the course, the students will be able to

1. Learn the thermodynamic description of exact, inexact differential and state function.
2. Know the qualitative properties of solution, the depression in freezing point,
3. Know the statistical thermodynamics and various partition functions
4. Evaluate conductivity measurements and titrations curve which are vital in electroanalytical activities.

Course Contents

UNIT I **12 hours**

Thermodynamics

Brief review of concepts involve in first and second law of thermodynamics, Entropy, free energy and chemical equilibrium. Thermodynamic equation of state. Maxwell relations.

Non-ideal systems: Excess functions for non-ideal systems. Activity and activity coefficients and their determination. Concept of fugacity and its experimental determination. Partial molar properties and their determination.

UNIT II **18 hours**

Statistical Thermodynamics

General introduction: Phase space, microstates, macro states, thermos dynamic probability. Brief introduction to different types of statistics. Ensemble concept. Canonical,

grand canonical and micro canonical ensembles. Sterling approximation, Maxwell Boltzmann distribution law, introduction of partition functions.

UNIT III **13 hours**

Electrochemistry

1. Ion-solvent interactions: Born model of ion-solvent interactions, Structural models of ion- solvent interactions. Experimental determination of salt-solvent interactions. Relative heats of salvation of ions in the hydrogen scale.
2. Ion-ion interactions: Debye-Hackle theory of ion-ion interactions. Verification of Debye
   Hackle limiting law. Activity coefficients at moderate concentrations and higher concentrations. Activity coefficients as a function of ion-ion and ion-solvent interactions. Mean activity coefficient and their experimental determination.

UNIT IV **17 hours**

1. **Debye-Huckel-Onsager theory.** Modification of Debye-Huckel-Onsager equation. Ionic conductances. Ion-association and ion-pair formation. Ion-triplets in electrolyte solutions. Ion-triplets and conductance.
2. **Electrical double layer;** Electrical field interfaces & their structure, Electro catalysis, Kinetics of electrode process/reactions.
3. **Corrosion of Metals:** Classification of corrosion processes, theories of corrosion process, passivation of metals. Corrosion monitoring and methods of corrosion prevention.

Transaction Mode Question, Cooperative Teaching, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Bockris, J. O. M., Reddy, A. K., &Gamboa-Aldeco, M.

(2019). Electrodics. *Modern Electrochemistry 2A: Fundamentals of Electrodics*.

- Bockris, J. O. M., & Khan, S. U. (2016). *Quantum electrochemistry*. Springer Science &Business Media..

- Glasstone, S. (2018). *An introduction to electrochemistry*. Read Books Ltd.

- Aston, J. G., Aston, J. G., & Fritz, J. J. (2015). *Thermodynamics and statisticalthermodynamics*. Wiley

SEMESTER-I

Course Title: Analytical Chemistry

Course Code: MCH104

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students willbe able to

1. Determine the pH of soild samples.
2. Analyze the preservatives and colouring matter
3. Identify the adulterants in some common food items like coffee powder.
4. Know the nutritional value of foods, idea about food processing and foodpreservations and adulteration.

Course Content

UNIT I **17 hours**

1. **Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.
2. **Analysis of soil:** Composition of soil, Concept of pH and pH measurement,

   Complexometric titrations, Chelation, Chelating agents, use of indicators

   Determination of pH of soil samples.

   Estimation of Calcium and Magnesium ions as Calcium carbonate by Complexometrictitration.

3. **Analysis of water:** Definition of pure water, sources responsible for contaminating water,water sampling methods, water purificationmethods.
   a. Determination of pH, acidity and alkalinity of a watersample.
   b. Determination of dissolved oxygen (DO) of a watersample.
4. **Analysis of food products:** Nutritional value of foods, idea about food processing and foodpreservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder,asafoetida, chilli powder, turmeric powder, coriander powder and pulses,etc.

b. Analysis of preservatives and colouringmatter.

UNIT II **13hours**

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc , Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+). b. To compare paint samples by TLC method.Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

UNIT III **16 hours**

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride,sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zincoxide and Calcium carbonate by complexometrictitration.

UNIT IV
14hours

1. **Suggested Applications (Any one)**:
   a. To study the use of phenolphthalein in trapcases.
   b. To analyze arsonaccelerants.
   c. To carry out analysis of gasoline.

2. **Suggested Instrumental demonstrations:**
   a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flamephotometry.
   b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
   c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks.

Transaction Mode Team Teaching,Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. (1988). Instrumentalmethods of analysis.
- Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of instrumental analysis*. Cengage learning.
- Skoog, D. A., West, D. M., & Holler, F. J. (1994). *Analytical chemistry: anintroduction*.
- Harris, D. C. (2010). *Quantitative chemical analysis*. Macmillan.
- Day, R. A., & Underwood, A. L. (1991). *Quantitative analysis* (Vol. 27). NJ: Prentice

SEMESTER-I

Course Title: Inorganic Chemistry-I Lab

Course Code: MCH105

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES:

On the successful completion of the course, the students will be able to

1. Understand the methods involved in analytical studies.
2. Learn chromatographic techniques that help in separation of amino acids and their presence in unknown sample can be determined.
3. Understand qualitative and quantitative methods of analysis which are helpful in future Research studies.
4. Do estimation studies that are important both in medical studies as well as in forensic studies.

Course Contents

PREPARATION AND ESTIMATIONS

1. Preparation of Tris-thioureacuprous chloride
2. Estimation of Cu, and Chloride.
3. Preparation of Hexathioureaplumbousnitrate $Pb.6CS(NH_2)_2(NO_3)_2$.
4. Estimation of cobalt.
5. Preparation of Tin tetraiodide.
6. Estimation of Sn.
7. Preparation of $K_3[Fe(C_2O_4)_3]$.
8. Estimation of iron.
9. Preparation of $Hg[Co(NCS)_4]$
10. Simultaneous estimation of Hg and Co.
11. Preparation of $(NH_3)_2Hg\ Cl_2$.
12. Estimation of Hg.
14. Preparation of $K_3[Cr(C_2O_4)_3]$
15. Estimation of Cr and oxalate.
16. Spectrophotometric Estimation of
    (a) tin with toluene 3,4-dithiol (dithiol)
    (b) Chromium with diphenyl carbazide.
17. Chromatographic separation of ions.
    (a) Paper chromatography.
    (b) Thin layer chromatography.
    (c) Column chromatography.

Transaction Mode Team Teaching, open talk, E-Team Teaching,Group Discussion

SUGGESTED READINGS

- Vogel, A. I., Mendham, J., Denney, R. C., Barnes, J. D., & Thomas, M. (2009). *Vogel's Quantitative Chemical Analysis*. Pearson

SEMESTER-I

Course Title: Organic Chemistry-I Lab

Course Code: MCH106

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Perform Name reaction essential for synthesis of Organic Compounds.
2. Gain knowledge to purify organic compounds.
3. Understands to detect unknown compounds through Spectral studies.
4. Perform solvent extraction essential for Organic Synthesis.

Course Contents

1. Qualitative Organic Analysis

Separation and purification of components of binary mixture (Solid/solid, solid/liquid and

liquid/liquid) on the basis of solubility behavior and solvent extraction and their identification and conformation by chemical tests and preparation of suitable derivative. Preparative TLC separation for IR and PMR spectral studies of the respective component.

2. Organic Synthesis

Benzoylation : Hippuric acid

Oxidation : Adipic acid/p-Nitrobenzoic acid Aldol condensation : Dibenzalacetone/Cinnamic acid Sandmeyer's reaction : p-Chlorotoluene

Benzfused Heterocycles : Benzimidazole

Cannizzaro's reaction : p-Chlorobenzaldehyde as substrate

Friedel Crafts reaction :S-Benzoylpropionic acid

Aromatic electrophilic

substitution : p-Nitroaniline / p-Iodoaniline

The products may be characterized by spectral techniques.

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching, Role Play

SUGGESTED READINGS

- Khurana, J. M., & Sharma, P. (2004). Chemoselective reduction of α, β-unsaturated aldehydes, ketones, carboxylic acids, and esters with nickel boride in methanol– water. *Bulletin of the Chemical Society of Japan*.

- Singh, S. I., &Prabha, S. (2008). Synthesis and characterization of series of promising decontaminants for organophosphorus compounds. *Oriental Journal of Chemistry*

SEMESTER-I

Course Title: Community Service

Course Code: MCH107

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On successful completion of the course, the students will be able to:

1. Develop networking skills. (The action or process of interacting with others to exchange information and develop professional or social contacts.)
2. Define the role and function of the civil society organizations in addressing the welfare needs of the deprived and disadvantaged sections of the society.
3. Recognize the socio-economic conditions of the urban poor and the importance ofurbanization.
4. Identify the government response in terms of policies to address the needs of the urban poor.

Course Content

UNIT I **06 hours**

Defining the Urban Poor Introduction to Service Learning (SL)-Concept- History & Dynamics of SL through Common, Classroom & Thematic Orientation. Understanding the Urban Poor.

Understanding the process of Urbanization-Urban Social Problems-Slums,Types of Slums- Urban Poor-Understanding Urban Power Structure and identifying the resources of the community (Community Mapping) and Modules for the community Service.

UNIT II **09 hours**

Community learning - Application of academic knowledge through service learning activities Basic English – Importance of Education – Child rights - Special Coaching – Easy English to all – basic

computer skill – Communication skill -Govt. Schemes – Alcoholism and substance addiction – Pros and cons of Social Media - Understanding various schemes related to urban poor - Creating livelihood opportunities – Basic App (inmobile). Saving Schemes - Govt. Schemes (women belonged to marginalized)

UNIT III **07 hours**

Rights of Women, children and others – marketing - Entrepreneurial skills & Schemes - Creating livelihood opportunities – Access to digital money (ATM, E-corner etc.,) Rights of Elders and Persons with disabilities – Understanding various schemes related to social security schemes. Self -Hygiene - Testing the purity of water - Safe drinking water - Environmental degradation - Communicable and non-communicable diseases – Alcoholism
and substance abuse – Addiction – Healthy food habits – health fitness – Waste management
- Documentary of social issues.

UNIT IV **07 hours**

Program Planning and Implementation Community Program Planning: Orientation on community program – Event process (Identifying the issues, Need based analysis on specific issues, Invitation, Pamphlets, Inviting participants, Content designing, identifying & Selection of tools, venue arrangements, tapping the resources and etc).

Identifying the stakeholders (hospitals, Civil Society Organizations) – Budgeting Communication / Liasoning (among learners, with community, support of experts / guests) and follow-ups - Implementation of the planned activity, reporting, reflection. Awareness / advocacy for an issue identified and build capacity to carry out that awareness and advocacy programme.

Transaction Mode Brain Storming, Blogs, Open Talk, Antakshri

SUGGESTED READINGS

1. BediYashpal (2018) *Handbook of Preventive and community Medicine* Pragya SharmaEditor
2. PatilRamagonda Asha (2022) *Community Organization and Development*PHI Learning

SEMESTER-I

Course Title: Teaching Methodology

Course Code: MCH108

L	T	P	Credits
2	0	0	2

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Develop knowledge, Understanding and an insight of the various underlying concepts ofLearning.
2. Differentiate and establish a relationship between various Learning methods and techniques.
3. Prepare and evaluate of different curricular materials, specific subject and teacher guide.
4. Discuss and assess the different educational structure and system and the changing socio- cultural environment in context to education

Course Content

UNIT I **08 hours**

Fundamental elements in teaching – Levels of learning - Planning a course: trips and tips – Planning a class: no detail is too small – Experimental methods

UNIT II **07 hours**

Enhancing the conversation: audiovisual tools and techniques – Executive education: contributing to organizational competitive advantage.

UNIT III **03 hours**

Counseling students – Evaluating students: the twin tasks of certification and development

UNIT IV **08 hours**

Teaching evaluations: feedback that can help and hurt –

Research presentations – Managingyourself and your time.

Transaction Mode Project Based Learning, Panel Discussion, E-Team Teaching, Group Discussion

SUGGESTED READINGS:-

- James G.S. Clawson, Mark E. Haskins,(2006) *Teaching Management*, Cambridge University Press, First Edition.
- Enamul Hoque , (2016), *50 METHODS OF TEACHING*, University of English and Foreign Language
- Rohit Vaidwan (2021),*Teaching Methodology:* Adhayan Mantra Publication
- Rohit Vaidwan (2022),*Teaching aptitude and Methodology:* Adhayan Mantra Publication

SEMESTER-I

Course Title: Organisational Management

Course Code: MCH109

L	T	P	Credits
1	0	0	1

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Help students to develop confidence to face interviews and to groom them for workplace.
2. Develop their individual ability, strengthening their employability.
3. Equip himself/herself to get in to grips with its new realities.
4. Provides a range of new challenges, all of which call for graduates to display accountability, professionalism and credibility

Course Content

UNIT I **05 hours**

SpeakingActivities- Group Discussion, Mock Interview, Extempore, Declamation, and Presentation.

Writing SkillsActivity-Business letter, Cover Letter and Resume writing

UNIT II **03 hours**

Reading Activity- Reading comprehension exercises from competitive tests.

Listening Skills Activity- Listening to comprehend.

UNIT III **03 hours**

Personality Development Activity-SWOT Analysis, Grooming and Work Ethics

UNIT IV **04 hours**

Vocabulary Enhancement Activity- Exercises on Synonyms& Antonyms, One word substitution Grammar Activity- Exercises based on Narration, Change of voice and errors.

Transaction Mode Role Play, Dialouge, Open Talk,Group Discussion

SUGGESTED READINGS:-

- Sanjay Kumar&PushpLata , (2014) *Communication Skills*, Oxford University Press.
- Barron's Vocabulary Builder(2013) *Educational Series*, Bright Publishers
- Wren & Martin,(2009) *High School Grammar*, S.Chand& Company
- Dr. T. KalyanaChakravarthi& Dr. T. LathaChakravarthi, (2012) *Soft Skills for Managers*, Bizant

SEMESTER-II

Course Title: Organic Chemistry-II

Course Code: MCH201

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Study the stereochemistry of six member ring.
2. Learn the stereochemistry of rings other than six members. Understand fused bridge and Caged rings.
3. Study the various name reaction with examples helpful in Organic synthesis.
4. Gain insight of metal hydrides and functional group.

Course Content

UNIT I **14 hours**

Stereochemistry

(a) Stereoisomerism: Introduction and different types of stereoisomers. Fischer, Newman and saw horse representations for organic Molecules.

Optical Isomerism: Requirement for a compound to be optically active, compounds with one asymmetric center. Dissymmetry as a cause of optical activity. Compounds with two asymmetric centers. Racemic Modification Racemization: Thermal, anionic, cationic, free radical, epimerization, Mutarotation Racemic compounds, mixtures and solid solutions.

(b) Disastereo isomerism: Resolution of acids, bases, amino acids, alcohols, aldehydes and ketones, Absolute and Relative configuation, Different systems of rotation.

Assymetric induction, methods of determining the configuration. Cram's Rule and Prelog's Rule.

UNIT II **14 hours**

Conformation Isomerism: Meaning of conformation, Conformation and reactivity in alicyclic compounds. Conformation and Physical properties, dipole moment, NMR, IR and X-rays, conformational effects on stability and reactivity. Ionic elimination. Intra molecular rearrangement, neighboring group participation. Elimination. Pyrolysis of acetate, and amine oxide. Relation of conformation to reactivity. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes).

Systems: Conformational studies in Cyclohexane; mono and disubstituted Cyclohexane. Its stability and reactivity. Energy determination in chair and boat form. Studies in fused systems

UNIT III **16 hours**

(a) **Geometrical Isomerism:** Nomenclature (E & Z) Nature of geometrical isomerism and determination of Configuration Curtin Relative stability and interconversion of Geometrical isomers.

(b) **Addition to carbon – carbon multiple bond:**

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and freeradicals. Orientation and reactivity. Hydrogenation of double and triple bond, hydrogenation of aromatic

rings.

UNIT IV **16 hours**

a) **Hydroboration,** Michael-reaction, Mechanism of metal hydride reduction of carbonyl compounds and other functional groups

b) **Wolf Kishner reduction**; Clemmenson reduction, Wittig's Reaction. Addition of Grignard's reagent

c) **Mechanism of condensation reactions involving enolates** – Aldol, knoevengel, Claisen, Mannich, Perkin reactions, Hydrolysis of esters and amides.

Transaction Mode Open Talk, Question, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Kalsi, P. S. (2007). *Spectroscopy of organic compounds*. New age international.
- Chandrasekhar, S. (1987). Product stability in kinetically-controlled organic reactions. *Chemical Society Reviews*.

SEMESTER-II

Course Title: Physical Chemistry-II

Course Code: MCH202

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Know the Eigen function, Eigen value, operator and postulates of quantum mechanics.
2. Learn two and three dimensional box, mechanics of particle.
3. Study the steady state approximation Michaels- mention mechanism, lindemann- hinshelwood mechanism, chain reaction rate determining steps and consecutive elementary reactions.
4. Study the energy of activation and second order reaction essentially required for variety of reactions needed for industrial purposes.

Course Content

UNIT I **17 hours**

Introduction to exact quantum mechanical result

Fundamental concepts of quantum mechanics, Hermitian, unitary and linear operators, postulates of quantum mechanics. Setting up of operators for different observables, Discussion of solution of Schrodinger equation to some model systems

Hydrogen and hydrogen like atoms

Solution of Schrodinger equation for hydrogen and hydrogen like atoms, representation of probability functions and plots of s & p orbitles.

Approximate Methods

The variation principle, perturbation theory (first order and non degenerate), applications of variation method and

perturbation theory to the helium atom.

UNIT II **13 hours**

Angular Momentum

Ordinary angular momentum, the quantum mechanical operators for angular momentum. Eigen function and eigen values of angular momentum using ladder operators, addition of angular momentum.

Electronic Structure of Atom

Electronic states of complex atoms, anti-symmetry and Pauli's exclusion principle, Hartree method, Russel Saunder's terms and coupling schemes,

Molecular Orbital Theory

Huckel Theory of conjugated systems, bond order and charge density calculation, applications of Huckel molecular orbital theory to 1,3-butadiene & cyclohexadiene. Introduction to extended Huckel theory.

UNIT III **16 hours**

Chemical Kinetics

1. Theories of reaction rates : Number of bimolecular collisions and derivation of rate constant from it, steric factor & its calculation, factors determining effectiveness of collisions.
2. Theories of unimorecular gaseous reactions.
3. Fast reactions : Study of fast reactions by stopped flow technique, relaxation methods, magnetic resonance technique.
4. Thermodynamic treatment of reaction rates : free energy of activation, heat of activation and its relationship with various kinds of activation energies,

relationship between steric factor and entropy of activation.

UNIT IV **14 hours**

1. Kinetics in solution : Primary and secondary salt effects, effect of polarity and nature of solvent on rate of reaction.
2. Complex reactions : Types of complex reactions, parallel first order reactions producing a common product, parallel higher order reactions, reactions approaching equilibrium, consecutive reactions, oscillating reactions, electron transfer reactions
3. Enzyme catalysis & its applications, Michaelis-Menten mechanism for enzyme catalysis.

Transaction Mode Team Teaching, Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Peter Atkins, P., & De Paula, J. (2014). *Atkins' physical chemistry*. OUP Oxford.
- Murray, J. S., & Sen, K. (Eds.). (1996). *Molecular electrostatic potentials: concepts and applications*. Elsevier.
- Benson, S. W. (1960*). Foundations of chemical kinetics*..
- Chandra, A. K. (1994). *Introductory quantum chemistry*. Tata McGraw-Hill Education.
- Pye, C. C. (2004). Intuitive solution to quantum harmonic oscillator at infinity. *Journal of chemical education*.
- Kauzmann, W. (2013). *Quantum chemistry: an introduction*. Elsevier.

- Eyring, H., Walter, J., & Kimball, G. E. (1944). Quantum chemistry (p. 214). New York: Wiley.

SEMESTER-II

Course Title: Inorganic Chemistry-II

Course Code: MCH203

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Know the preparation and properties of transition metal carbonyls.
2. Learn concept of symmetry elements in molecules
3. Learn molecular orbital and its orientation.
4. Understand symmetry operations that help to perform 3 d operations on molecules of practicalimportance.

Course Content

UNIT I **14 hours**

Chemistry of Main Group Elements

Group I A to IV A Group Elements

Hydrogen: transition metal hydrides, the group IA elements - organometallic compounds of alkali - metals, the group II A - organo-beryllium and organo-magnesium compounds, the group, III A elements, **metal clusters**, car boranes and other hetro-boranes, organoboron compounds, organaluminum compounds, the group IV A element - compounds with C-N bonds, zeolites.

UNIT II **17 hours**

Chemistry of Main Group Elements

Group V A to VIII A Group Elements

The group V A elements - types of Covalence in nitrogen, stereochemistry, dinitrogen and nitrogen compounds as ligands, ammonia and amines, group VI A elements - chemical properties of dioxygen, singlet oxygen, dioxygen super Oxo and per Oxo ligands. The group VII A elements the charge — transfer complexes of halogens, pseudo halogens, the group VIII A elements — the chemistry of xenon and radon

UNIT III **16 hours**

Group Theory

Order, classes of group, representation of a group, point symmetry group, representation of group by matrices**.** Separation of d orbitals under influence of octahedral, tetrahedral, sq. planar and trigonal bipyramid symmetry, the separation of P, D ,F etc. free ion terms into symmetry labelled electric field terms under the influence of octahedral field.

UNIT IV **13 hours**

Applications of Group Theory

Suitable metal orbitals and ligand or orbitals combination to form molecular orbitals in coordination complexes O_h, T_d& square planar complexes, electronically allowed transitions, selection rules or fundamentals, overtones and combinations in vibrational spectroscopy — the symmetry symbols for normal modes of vibrations., Fermi resonance.

Transaction Mode Quiz, E-Team Teaching, Group Discussion, Demonstration

SUGGESTED READINGS

- Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M., & Grimes, R. (2018).
- *Advanced inorganic chemistry* (Vol. 6, p. 1455). New York: Wiley.
- Shriver, D. F., Atkins, P. W., & Langford, C. H. (1999). *Inorganic chemistry*.
- Hughes, M. N. (2011). *The inorganic chemistry of biologicalprocesses* 2nd edn. FEBSLETTERS..

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SEMESTER-II

Course Title: Inorganic Chemistry-II Lab

Course Code: MCH204

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Learn principles of titrimetric important in performing titrations.
2. Understand methods to perform redox titrations.
3. Learn to handle explosive and corrosive chemicals.
4. Understand preparation of standards, minimizing errors in experiments and enhancing accuracy and precision.

Course Content

1. INTRODUCTION TO QUANTITATIVE ANALYSIS: Introduction – types of quantitative analyses – theory of significant figures – error analysis –principles of chemical balances (double-pan and single-pan) – apparatus used in titrimetric analysis – handling of chemical balances and other apparatus – concept of molecular weight, formula weight, equivalent weight – concentrations of solutions – molarity, formality, normality and weight percentage.

2 . GENERAL PRINCIPLES OF TITRIMETRY: Principle of titrimetric – primary and secondary standards – preparing standard solutions –standardising the secondary standard solutions

– types of titrimetric analyses – principal reactions – concepts of acids, bases, oxidants, reductants

– theory of indicators – calculations for strengths of solutions and the amounts of substances in solutions.

3. LABORATORY HYGIENE AND SAFETY: Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals. Simple first aid procedures for accidents involving acids, alkalis, bromine, burns and cut by glass. Threshold vapour concentration

- safe limits. Waste disposal.

4. COMPLEXOMETRIC TITRATIONS: Determination of calcium in the presence of magnesium using EGTA as titrant. Determination of the total hardness (permanent and temporary) of water. Determination of calcium in the presence of barium using CDTA as titrant.

5. REDOX TITRATION:

(a) Determination of chlorate, preparation of 0.1M cerium (IV) sulphate solution.

(b) Determination of copper, determination of dissolved oxygen.

(c) Determination of hydrogen sulphide.

(d) Determination of antimony & arsenic.

6. ELECTRO ANALYTICAL TECHNIQUES-PH METRIC, CONDUCTOMETRIC AND AMPEROMETRIC TITRATION:

Representative acid-base and redox titrations.

7. COLORIMETRY AND SPECTROPHOTOMETRY:

(a) Determination of λ_{max} the absorption curve and concentration of a substance.

(b) Simultaneous spectrophotometric determination (chromium and manganese).

(c) Spectrophotometric determination of pK value of an indicator.

(d) Determination of copper (II) with EDTA

(e) Determination of iron (III) with EDTA.

8. ATOMIC ABSORPTION SPECTROSCOPY:

(a) Determination of cations by AAS

(b) Determination of magnesium and calcium in tap water

(c) Determination of trace elements in contaminated soil

(d) Determination of vanadium in lubricating oil, determination of trace lead in a ferrous alloy.

Transaction Mode Team Teaching, Open talk, E-Team Teaching,Group Discussion

SUGGESTED READINGS

- Vogel, A. I., Mendham, J., Denney, R. C., Barnes, J. D., & Thomas, M. (2009). *Vogel's Quantitative Chemical Analysis*. Pearson

SEMESTER-II

Course Title: Organic Chemistry-II Lab

Course Code: MCH205

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Learn qualitative organic analysis experimentally.
2. Understand solubility behavior and extraction required for identification and preparation.
3. Gain knowledge about characterization by spectral techniques
4. Learn mechanism of reaction experimentally.

Course content

1. QUALITATIVE ORGANIC ANALYSIS:

Separation and purification of components of binary mixture (Solid/solid, solid/liquid and liquid/liquid) on the basis of solubility behaviour and solvent extraction and their identification and conformation by chemical tests and preparation of suitable derivative. Preparative TLC separation for IR and PMR spectral studies of the respective component.

2. ORGANIC SYNTHESIS:

Oxidation : Adipic acid/p-Nitrobenzoic acid

Aldol condensation : Dibenzalacetone/Cinnamic acid

Sandmeyer's reaction : p-Chlorotoluene

Benzfused Heterocycles : Benzimidazole

Cannizzaro's reaction : p-Chlorobenzaldehyde as substrate Friedel Crafts reaction : S-Benzoylpropionic acid Aromatic electrophilic

substitution : p-Nitroaniline / p-Iodoaniline

The products may be characterized by spectral techniques.

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching,

Role Play

SUGGESTED READINGS

- Furniss, B. S. (1989). *Vogel's textbook of practical organic chemistry*. Pearson Education India.
- Mann, F. G., & Saunders, B. C. (1975). *Practical organic chemistry*. Orient Blackswan.0

SEMESTER-II

Course Title: Industrial Chemistry

Course Code: MCH206

L	T	P	Credits
0	0	2	1

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Gain knowledge about water purification methods.
2. Cope up with environmental issues.
3. Learn large scale production of various gases.
4. Gain knowledge of different types of Chemicals.

Course Content

UNIT I **08 hours**

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, Sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

UNIT II **07 hours**

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and Sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution.

Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Methods of estimation of CO, NOx, Sox and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of Sulphur from coal. Control of particulates.

UNIT III **06 hours**

Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management

Biocatalysis

Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

UNIT IV **09 hours**

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants

(primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.
Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

Transaction Mode Open Talk, Question, E-Team Teaching, Group Discussion

SUGGESTED READINGS

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- R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley
- Publishers, New Delhi.
- J. A. Kent: Riegel's*Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New
- Delhi.
- K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
- S.E. Manahan, *Environmental Chemistry*, CRC Press (2015).

SEMESTER-II

Course Title: Mathematics for Chemists

Course Code: MCH207

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On the successful completion of this course, the students will be able to

1. Students learn analysis of multivariable functions, continuity and differentiability.

2. Solve applied problems using right triangles trigonometry.
3. Enables the student to perform mathematical simulations required in technical Operations.
4. Learn mathematical observations for experimental purposes.

Course Content

UNIT I **13 hours**

Vectors and Matrix Algebra

Addition and multiplication, determinants (upto4th order) inverse, adjoin and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitical; skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non- homogeneous, linear equations and conditions for the solution, linear dependence and independenc e. Clayey Hamilton theorem, matrix Eigen values and Eigen vectors.

UNIT II **11 hours**

Trigonometry

Values of trigonometric functions for different angles, trigonometric functions of sum and Differences of angles, addition and subtraction formulae.

UNIT III **11 hours**

Calculus

Differential Calculus: Functions, continuity and differentiability, rules for differentiation,

applications of differential calculus including maxima and minima. Functions of several variables, partial differentiation, Euler's theorem co-ordinate transformations (e.g. Cartesian tospherical polar).

UNIT IV **10 hours**

Permutation and Probability

Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the kinetic theory of gases, curve fitting (including least square fit) with a general polynomial fit.

Transaction Mode Team Teaching,Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Steiner, E. (2018). *The chemistry maths book*. Oxford University Press..
- Doggett, G., & Sutcliffe, B. T. (2015). *Mathematics for chemistry*. Prentice Hall.
- Barrante, J. R. (2016). *Applied mathematics for physical chemistry*. Waveland Press.
- Tebbutt, P. (1994). *Basic mathematics for chemists*. Wiley.

SEMESTER-II

Course Title:	Organometallic Chemistry	**L**	**T**	**P**	**Credits**
Course Code:	MCH208	3	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Understand the classification of organometallic compounds on the basis of bond type
2. Gains knowledge of hapticity of organic ligands.
3. Analyze the Mechanism of substitution in octahedral complexes.
4. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition)

Course Content

UNIT I **13 hours**

Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

UNIT II **11 hours**

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

UNIT III **10 hours**

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene,Reaction Kinetics and Mechanism Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

UNIT IV **11 hours**

Catalysis by Organometallic Compounds Study of the following industrial processes and their mechanism: 1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Hydroformylation (Co salts) 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) 5. Synthesis gas by metal carbonyl complexes

Transaction Mode Team Teaching, Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M., & Grimes, R. (2018). *Advanced inorganic chemistry* (Vol. 6, p. 1455). New York: Wiley.
- Shriver, D. F., Atkins, P. W., & Langford, C. H. (1999). *Inorganic chemistry*.
- Hughes, M. N. (2011). *The inorganic chemistry of biologicalprocesses* 2nd edn. FEBS LETTERS

SEMESTER-II

Course Title:	Organic Spectroscopy	**L**	**T**	**P**	**Credits**
Course Code:	MCH209	3	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Analyze fundamental and non-fundamental molecular vibrations.
2. Gains knowledge of hapticity of organic ligands.
3. Analyze the types of electronic transitions, λmax.
4. Understand the distinction between cis and trans isomers

Course Content

UNIT I **13 hours**

General principles

Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

UNIT II **10 hours**

IR Spectroscopy:

Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance;

application in functional group analysis.

UNIT III **11 hours**

NMR Spectroscopy:

Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds.

UNIT IV **11 hours**

Applications of IR, UV and NMR for identification of simple organic molecule

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching, Role Play

SUGGESTED READINGS

- Ingold, C. K. (1953). Structure and mechanism in organic chemistry.
- Pursell, D. P. (2009). Adapting to student learning styles: Engaging students with cell phone technology in organic chemistry instruction. *Journal of chemical education*.
- Norman, R., &Coxon, J. M. (2017). *Principles of organic synthesis*. Routledge.
- Mukherji, S. M., & Singh, S. P. (1984). *Reaction mechanism in organic chemistry*. Macmillan

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SEMESTER-II

Course Title: Biology for Chemists

Course Code: MCH210

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Gain knowledge about cell and its functions.
2. Understand ultra-structure of cell wall, plasma membrane and organelles.
3. Acquire knowledge of Food chain and food web in ecosystem.
4. Relevant to hereditary and genetic issues.

Course Content

UNIT I
11hours

Cell Structure, Functions and divisions

Structure of prokaryotic. & eukaryotic cells, Intercellular organelles and their functions, Comparison of plant and animal cells. Overview of metabolic process-catabolism and Anabolism. ATP- the Biological energy currency. Cell divisions tags of mitosis & meiosis. Significance of cell division and fertilization.

UNIT II **10**

hours

Carbohydrates

Mono saccharine, structure & functions Structural poly saccharine. Structural Polysaccharine- cellulose and chitin. Storage Polysaccharides-starch and glycogen. Lipids

Fatty acids, essential fatty acids, structure and function. Storage lipids. Biological membranes and transport. Fluid

mosaic model of membrane structure.

UNIT III **13 hours**

Structure of Proteins

Amino acids, essential and non-essential, Primary structure –peptide chain. Secondary structure of proteins, for case response before holding of secondary structure- αhelix, zbeta sheets

UNIT IV **11 hours**

Enzymes

1. Enzymes as biological catalyst and mode of their action.
2. Structure of Nucleic Acids

Structure of ribonucleic acids (RNA) and dioxin ribonucleic acids (DNA), Replication of DNA: The chemical basis of heredity and over view of replication of DNA, protein synthesis &Genetic Code, transcription, translation and genetic code, chemical synthesis of mono,di,tri nucleotide.

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching, Role Play

SUGGESTED READINGS

- Nelson, D. L., Lininger, A. L., & Cox, M. M. (2018). *Lininger principles of biochemistry*. Macmillan.

- Berg, J. M., Tymoczko, J. L., &Stryer, L. (2016). Biochemistry WH Freeman and Company. *New York*.

- Vella, F. (1993). Principles of biochemistry by HR Horton, LA Moran, RS Ochs, JD Rawn and KG Scrimgeour. pp 675. Neil Patterson Publishers, Prentice Hall Inc.

SEMESTER-II

Course Title:	Chemistry of Cosmetics &Perfumes	**L**	**T**	**P**	**Credits**
Course Code:	MCH211	3	0	0	3

COURSE OUTCOMES

On successful completion of this course, the students willbe able to

1. Prepare Cosmetic Products.
2. Identify artificial flavors.
3. Make lipstick of required choice.
4. Learn the composition of natural essential oils and their uses.

Course Content

UNIT I **10 hours**

Preparation and uses of the following:

Hair dye, hair spray, shampoo.

UNIT II **10 hours**

Preparation and uses of the following:

Face and body lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams).

UNIT III **13 hours**

Preparation and uses of the following:

Antiperspirants and artificial flavours. Essential oils and theirimportance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oileucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

UNIT IV **12 hours**

Preparation and uses of the following:

Nail polish and nail polish remover, hair remover Cream

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching,Role Play

SUGGESTED READINGS

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut(199

SEMESTER-II

Course Title: Pesticide Chemistry

Course Code: MCH212

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Synthesize useful pesticides.
2. Prepare of simple organophosphates.
3. Calculate alkalinity of various pesticides.
4. Identify adverse effect of pesticides.

Course Content

UNIT I **10**

hours

General introduction to pesticides (natural and synthetic), benefits and adverse effects.

UNIT II **12 hours**

Changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides.

UNIT III **10 hours**

Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuranand carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

UNIT IV **13 hours**

Preparation of simple organophosphates, phosphonates and thiophosphates and Calculate acidity/alkalinity in given sample of pesticide formulations as perBIS specifications.

Transaction Mode Open Talk, Flip Teaching, Cooperative Teaching,Role Play

SUGGESTED READINGS

- Cremlyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, NewYork, 1978.

SEMESTER-II

Course Title: Fuel Chemistry

Course Code: MCH213

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On successful completion of the course, the students will be able to

1. Classify different types of fuel and their utility in daily life
2. Calculate Calorific Value of Fuels.
3. Prepare different Petrochemicals.
4. Demonstrate different properties of lubrricants

Course Content

UNIT I **13 hours**

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal:Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of

coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar,uses ofcoal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification(Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

UNIT II **10 hours**

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking),Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derivedfrom biomass), fuel from waste, synthetic fuels (gaseous

and liquids), clean fuels.

UNIT III **11hours**

Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

UNIT IV **11hours**

Lubricants*:* Classification of lubricants, lubricating oils (conducting and non-conducting)Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Transaction Mode Open Talk, Question, E-Team Teaching, Group Discussion

SUGGESTED READINGS

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- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (2010).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (2016).

SEMESTER-III

Course Title: Heterocyclic Chemistry

Course Code: MCH301

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Study of heterocyclic chemistry: Five and six members heterocyclic with one or twohetero atoms.
2. Understand condensed five and six member's heterocyclic
3. Study the synthesis, reactivity, aromatic character and importance of heterocyclic compounds essential for medicinal purposes.
4. Learn structure of small ring heterocyclic members

Course Content

UNIT I **17 hours**

1. **Nomenclature of Heterocycles**
   Systematic nomenclature (Hantzsch-widman System) for monocyclic fused and bridged hetrocycles
2. **Aromatic Heterocycles**
   General chemical behaviour of aromatic heterocycles classification (structural type) criteria of aromaticity (bond length ring current and chemical shift in H NMR- Spectra), Diamagnetic susceptibility exaltations.

UNIT II **13 hours**

Non- aromatic Heterocycles

Strain-bond angle and torsional strains and their conseqences in small ring heterocycles.

Conformation of six-membered heterocycles with reference to molecular Geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects-anomeric and related effects Attractive interactions-hydrogen

bonding and intermolecular nucleophilic-electrophilic interactions

UNIT III **16 hours**

1. **Heterocyclic synthesis**

   Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition Reactions.

2. **Small Ring Heterocycles**

   Three- membered and four-membered heterocycles-synthesis and reactions of aziridinesoxiranes, thiiranes, azetidines, oxetanes and thietanes

UNIT IV **14 hours**

1. **Benzo-Fused Five-Memberd Heterocycles**

   Synthesis and reaction including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

2. **Six-Membered Heterocycles**

   One Heteroatom Synthesis and reactions of pyrylium salt and pyrones and their comparison with Pyridinium&thiopyrylium salt and Pyridones synthesis and reactions of Quinolizinium and benzopyrylium salt coumarins and chromones**.**

Transaction Mode Quiz, E-Team Teaching, Group Discussion, Demonstration

SUGGESTED READINGS

- Johne, S. (1982). Search for pharmaceutically interesting quinolone derivatives: efforts andresults (1969–1980).
- *Progress in Drug Research/Fortschritte der Arzneimittelforschung/Progrès des recherchespharmaceutiques*.
- Sainsbury, M. (Ed.). (1992). Aliphatic Compounds: Monocarboxylic Derivatives of *AliphaticHydrocarbons, Their Analogues and Derivative*s. Elsevier.
- Acheson, R. M., & Jones, B. J. (1970). Addition reactions

of heterocyclic compounds. Part XLII the mechanism of the thermal rearrangement of tetraethyl 7, 9-dimethyl-9a H- quinolizine-1, 2, 3, 4-tetracarboxylate to the 4 H-isomer. *Journal of the Chemical Society C:Organic*.

- Katritzky, A. R., & Rees, C. W. (1984). *Comprehensive heterocyclic chemistry*. PergamumPress.
- Moore, J. W., & Pearson, R. G. (2011). *Kinetics and mechanism*. John Wiley & Sons.
- Peter Atkins, P., & De Paula, J. (2014). *Atkins' physical chemistry*. OUP Oxford.
- Murray, J. S., & Sen, K. (Eds.). (1996). *Molecular electrostatic potentials: concepts and applications*. Elsevier.
- Chandra, A. K. (1994). *Introductory quantum chemistry*. Tata McGraw-Hill Education.
- Kauzmann, W. (2015). *Quantum chemistry: an introduction*. Elsevier.

SEMESTER-III

Course Title:	Applications of Spectroscopy
Course Code:	MCH302

L	**T**	**P**	**Credits**
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Understand the factors affecting UV-absorption spectra, Interpret IR- spectra on basic values of IR-frequencies.
2. Discuss the problem of UV, IR and NMR
3. Learn the molecular spectroscopy, Raman, Electronic and Mossbauer and its application.
4. Polarographic technique helps to perform electroanalytical required in qualitative and quantitative economic activities.

Course Content

UNIT I **15 hours**

1. **INTRODUCTION**: Characterization of electromagnetic radiation, the quantization of energy. Regions of the spectrum, representation of the spectrum. Basic elements of practical spectroscopy, Fourier transform spectroscopy, computer averaging, stimulated emission.

2. **MICROWAVE SPECTROSCOPY:** The rotation of the molecules, rotational spectra, diatomic molecules, polyatomic molecules, techniques and instrumentation, chemical analysis by microwave spectroscopy.

UNIT II **15 hours**

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:

H-NMR spectroscopy: Introduction, chemical shift, shielding and equivalence, nuclear

magnetic resonance spectrometer, spin- spin splitting rule, coupling constant, protons on oxygen, nitrogen and Sulphur. Quadrupole broadening and decoupling. The effect of solvent on chemical shift, chemical shift reagent, chiral resolving agents. Determining absolute and relative configurations via NMR, nuclear overhauser effect.

UNIT III **17 hours**

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INFRA-RED AND RAMAN SPECTROSCOPY: Introduction, the vibrating diatomic molecule, the diatomic vibrating rotator. The vibration-rotation spectrum of carbon monoxide. The interaction of rotations and vibrations. The vibrations of polyatomic molecules, the influence of rotation on the spectra of polyatomic molecules. Analysis by infrared techniques – identity by finger printing and functional groups, techniques and instrumentation.

UNIT IV **13 hours**

ELECTRONIC SPECTROSCOPY: Ultraviolet and visible spectroscopy, Beer Lambert Law, Electronic transitions Principles of absorption spectroscopy, the chromophore concept, solvent effects,

Woodward-Fieser rules. Applications of electronic spectroscopy.

Stereochemical factors. Absorption spectra for charge-transfer complexesanalysis. Polarography and ICPMS.

Transaction Mode Question, Cooperative Teaching, E-Team Teaching, Group Discussion

SUGGESTED READINGS

.

- Pang, P., Lai, Y., Zhang, Y., Wang, H., Conlan, X. A., Barrow, C. J., & Yang, W. (2020). Recent advancement of biosensor technology for the detection of microcystin-LR. *Bulletin of the Chemical Society of Japan*.
- Silverstein, R. M., & Webster, F. X. (2013). Spectroscopic Identification of Organic Compound 6thed John Wiley and Sons. *Inc. New York*.
- Sarangi, A. K., Mahapatra, B. B., & Sethy, S. K. (2018). Synthesis and characterization of tetranuclear metal complexes with an octadentate azodye ligand. *Chemistry Africa*.
- Drago, R. S. (2011). *Physical methods in inorganic chemistry*.

SEMESTER-III

Course Title:	Organic Synthesis	**L**	**T**	**P**	**Credits**
Course Code:	MCH303	4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Study the various name reaction with examples.
2. Learn the mechanism of rearrangement reaction, use synthetic reagent of oxidation and reduction for solving the problems.
3. Study the design of organic synthesis, protection deportation of hydroxyl, amino carboxyl, ketenes and aldehyde vital for industrial organic synthesis.
4. Understand structure, reactivity and preparation of poly nuclear and macro ringcompounds.

Course Content

UNIT I **17 hours**

Rearrangments

General mechanistic considerations – nature of migration, migratory aptitude, memory effects. A

detailed study of the following rearrangements: Pinacol-pinacolone, Wagner-Merwein, Demjanov, Benzil- Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius,Schmidt, Baeyer- Villiger, Shapiro reaction.

UNIT II **13 hours**

Polynuclear Compounds & Macro-Ring Compounds

Introduction of aromatic character of Linear and non-Linear-ortho-fused

polynuclear hydrocarbons, ortho-and peri-fused polynuclear

hydrocarbons. General method of preparation and reactions of indene, fluorine, anthracene and phenanthrene. Modern methods of synthesis of macro ring compounds-civiton and muscone.

UNIT III **16 hours**

Reagents in Organic Synthesis

Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium dimethylcuprate,lithiumdisopropylamide (LDA) dicyclohexylcarbodimide.

UNIT IV **14 hours**

Oxidising and Reducing agents

1,3-Dithiane (reactivity umpolung),trimethylsilyl iodide, tri-n-butyltinhybride, Woodward and prevost hydroxylation, osmium tetroxide,DDQ, selenium dioxide, phase transfer catalysts, crown ethers, Peterson's synthesis and Wilkinson's catalyst.

Transaction Mode Team Teaching, Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Joule, J. A., Mills, K., & Smith, G. F. (2020). *Heterocyclic chemistry*. CRC Press.
- Firme, C. L. (2019). *Introductory organic chemistry and hydrocarbons: a physical chemistry approach*. Crc Press.
- Wilcock, A. A. (2006). *An occupational perspective of health*. Slack Incorporated.

SEMESTER-III

Course Title: Physical Chemistry-II Lab
Course Code: MCH304

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On the successful completion of the course, the students willbe able to

1. Performance of potentiometric analysis helps in learning analytical skills.
2. Concentration of unknown compounds determined and established through hexperiments.
3. Experimental determination of laws established.
4. Working through instruments of physical chemistry helps to ascertain established facts thereby imparting practical knowhow of Course.

Course Content

Determine the specific rotation of an optically active compound.

(1) Study the kinetics of inversion of cane sugar bypolarimetry.

(2) Estimate the strength of the strong acid and the weak acid in a mixture by conductometric titration.

(3) Determine the rate constant of saponification of methyl acetate conductometrically at room temperature.

(4) Determine the ionization constant (Ka) of a weak acid by conductometric method at room temperature and find the equivalent conductance at infinite dilution (Λo) of a weak acid by graphical extrapolation (Verification of Ostwald's dilutionlaw).

(5) Potentiometrically estimate the strength of Mohr's salt with the help of a standard potassium dichromate solution. Find the E0, Fe3+ / Fe2+ using graphicalmethods.

(6) Potentiometrically estimate the strength of AgNO3

solution with a standard KCl solution. Determine the solubility product (Ksp) of AgCl at roomtemperature.

(7) Estimate the strength of a weak acid (monobasic/dibasic) pH-metrically. Find pKa of this acid at room temperature using a graphicalprocedure.

(8) Study the kinetics of the reaction (KI + K2S2O8) by colorimetric method and determine the rate constant of the reaction at room temperature.

(9) Test the validity of Lambert-Beer's law for KMnO4 solution. Construct similarly the calibration curve for K2Cr2O7 solution and hence determine the concentration of an unknown K2Cr2O7 solution.

(10) Study the kinetics of iodination of acetone in presence of acid. Hence find out the order withrespect to iodine/acetone/acid.

(11) Determine the critical solution temperature of phenol-water system.

(12) Determine the solubility product (Ksp) of PbI2 and verification of Debye-Hückel limitinglaw.

(13) Determination of E0 of quinhydrone electrode.

Transaction Mode Team Teaching, Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- Berry, R.S. & Rice, S.A. (2009).J. *Ross physical chemistry*.
- Peter Atkins, P., & De Paula, J. (2014). *Atkins' physical chemistry*. OUP Oxford.
- Dunne, T. G. (1987). Physical Chemistry, (Levine, Ira N).
- Cengel, Y. A. (2015). *Introduction to thermodynamics and heat transfer* (Vol. 846). New York: McGraw-Hill.
- Glasstone, S. (2011). *An introduction to electrochemistry*. Read Books Ltd.
- Bockris, J. O. M., Reddy, A. K., & Gamboa-Adelco, M. E. (Eds.). (2006). *Modern Electrochemistry1, 2A, and 2B*. Springer US.

SEMESTER-III

Course Title: Physical Chemistry-III Lab

Course Code: MCH305

L	T	P	Credits
0	0	4	2

COURSE OUTCOMES

On the successful completion of the course, the students willbe able to

1. Practical determination of values of physical quantities provides know how.
2. Operational know how of state of the art instruments helps in future industrial laboratory activities.
3. Electro analytical experiments helps in performing experimental activities.
4. Student learns to derive rate constants that were taught in theoretical class, thereby develops coherence between the two.

Course Content

1. To determine the Molecular weight of given polymer by viscosity method.
2. To find out the value of coefficient of expansion for the given liquid with the help of Pyknometer.
3. To determine the atomic Parachors of C, H & O.
4. To compare the cleansing powers of two samples of detergents by surface tension method.
5. To determine the interfacial tension between two immiscible solvents.
6. To determine therate constant of the hydrolysis of ethyl acetate catalyzed by an acid and also find out

the half-life period of their action.

7. To determine the order of saponification of ethyl acetate with sodium hydroxide.

8. Tofindoutthemolarrefractivitiesofhomolog ousseriesofalcohols&alsofindoutthe atomic refractivities of C&H.

9. To find out the molar refractivity of the given solid.

10. To study the adsorption of acetic acid on activated charcoal & prove the validity of Freundlich Adsorption Isotherm.

11. To find out the molecular weight of benzoic acid in benzene cryoscopically & hence find out its degree of association.

12. To find out the degree of hydrolysis of sodium acetate cryoscopically.

13. To determine the density of given liquids with the help of Pyknometer.

Transaction Mode Team Teaching, Open talk, E-Team Teaching, Group Discussion

SUGGESTED READINGS

- James, A. M., & Prichard, F. E. (2014). *Practical physical chemistry* (pp. 19-26). New York: Longman.
- Reetha, C., Aravindakshan, K. K., & Janardanan, C. (2012). Bismuth selective antimony (III) silicate inorganic ion-exchanger.

SEMESTER-III

Course Title: Basics of Research Methodology

Course Code: MCH306

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Learn the handling of hazardous chemicals and methods of storage.
2. Identify disposable explosive and their verification and segregation.
3. Explain the data obtain during investigation and their further analysis.
4. Understand fundamentals of circuits and their designs.

Course Content

UNIT I **13 hours**

Chemical Safety and Ethical Handling of Chemicals:
Safe working procedure and protective environment, protective apparel, emergency Procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, Procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, Procedure for laboratory disposal of explosives, identification, verification and segregation of Laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

UNIT II **17 hours**

Data Analysis
The Investigative Approach: Making and Recording

Measurements. SI Units and their use. Scientific method and design of experiments.

UNIT III **13 hours**

Analysis and Presentation of Data*:* Descriptive statistics. Choosing and using statistical tests.

Chemo metrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, *r* and its use. Basic aspects of multiple linear regression analysis.

UNIT IV **17 hours**

Electronics

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments. Elementary aspects of digital electronics.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks,E team Teaching

Suggested Readings:-

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2015)

Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.

- Hibbert, D. B. & Gooding, J. J. (2016) *Data analysis for chemistry*. Oxford University Press.
- Topping, J. (2011) *Errors of observation and their treatment.* Fourth Ed., Chapman Hall, London.
- Harris, D. C. *Quantitative chemical analysis*. 6th Ed., Freeman (2017) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis.* Cambridge Univ. Press (2015) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992. OSU safety manual 1.01.

SEMESTER-III

Course Title: Environmental Chemistry

Course Code: MCH307

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Understand atmospheric general circulation and the basic principles of physical and Applied climatology and climate change.
2. Solve combustion problems and calculates amount of pollutants emitted.
3. Describe methods for evaluating the hazards associated with environmental exposures to toxicants.
4. BOD and COD explained and taught experimentally necessary for obtaining values essential in industries releasing toxic wastes.

Course Content

UNIT I **11 hours**

Commonly used terms, environmental segments, **n**atural cycles of environment, environmental chemistry of water, water pollution, water treatment operations, advanced waste water treatment.

Analysis of major and minor constituents in water, potable and industrial water, dissolved oxygen demand (COD), Biological oxygen demand (BOD).

UNIT II **10 hours**

Special features of forensic analysis: Sampling, Sample storage, classification of prisons, lethal dose, significance of LD 50 and LC 50.

UNIT III **10 hours**

The atmosphere and atmospheric chemistry, air pollutants, organic air pollutants, atmospheric analysis of gases, atmospheric analysis of particulates, soil formation, soil properties, analysis of soil sediments and biological specifications.

UNIT IV **13 hours**

Toxicological chemistry, toxicology of some organic compounds, reactions and rate of hazardous wastes, hazardous waste reduction and minimization and physical methods treatment of hazardous waste, chemical methods of treatment of hazardous waste.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks, E team Teaching

Suggested Readings:-

- De Anil, K. (2013). *Environmental chemistry*. New Age International.
- Fifield, F. W., & Haines, P. J. (Eds.). (2010). *Environmental analytical chemistry*. Wiley-Blackwell.
- Pabby, A. K., Rizvi, S. S., & Requena, A. M. S. (2008). *Handbook of membrane separations: chemical, pharmaceutical, food, and biotechnological applications*. CRC press.
- Aznar-Sánchez, J. A., García-Gómez, J. J., Velasco-Muñoz, J. F., & Carretero-Gómez, A. (2018). Mining waste and its sustainable management: Advances in worldwide research. *Minerals*.
- Rao, C. S. (2007). *Environmental pollution control engineering*. New Age International.

SEMESTER-III

Course Title: Polymer Chemistry

Course Code: MCH308

L	T	P	Credits
3	0	0	3

Course Outcomes

On the successful completion of the course, the students will be able to

1. Distinguish between addition and condensation polymers.
2. Calculate average degree of polymerization.
3. Determine of molecular weight of polymers.
4. Analyse Physical, thermal, Flow & Mechanical Properties of different polymers.

Course Content

UNIT I **10 hours**

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

UNIT II **13 hours**

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers- Structure Property relationships.

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution

UNIT III **11 hours**

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

UNIT IV **10 hours**

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related 50 polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac),

polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Transaction Mode Collaborative teaching, Group Discussion, Ted talks,E team Teaching

Suggested Readings:-

- Seymour's Polymer Chemistry, Marcel Dekker, Inc.
- G. Odian: Principles of Polymerization, John Wiley.
- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

SEMESTER-III

Course Title: Chemistry of Main Group Elements, Theories of Acids and Bases

Course Code: MCH309

L	T	P	Credits
4	0	0	4

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Characterize the Basic concepts of operators like Solution of algebraic and transcendental equations: Bisection method, False position method, Fixed-point iteration method,
2. Solve problems using Newton forward formula and Newton backward formula and its convergence.
3. Derive Gauss's formula and Stirling's formula using Newton forward formula and Newton backward formula.
4. Calculate Simpson's 1/3, 3/8 rules using trapezoidal rule and evaluate the summation of series finite difference techniques

Course Content

UNIT I **15 hours**

Acids and Bases

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of

metal oxides using carbon and carbon monoxide as reducing agents.

Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.

UNIT II **15 hours**

***s*- and *p*-Block Elements**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale).

General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature.

Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S

Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals.

Solutions of alkali metals in liquid ammonia and their properties.

Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals. Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable:

Diborane and concept of multicentre bonding, hydrides of

Groups 13 (EH3), 14, 15, 16 and 17.

UNIT III **17 hours**

Halides and oxo halides of P and S (PCl3, PCl5, SOCl2 and SO2Cl2) Interhalogen compounds.Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF2, XeF4 and XeF6, bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory

UNIT IV **13 hours**

Inorganic Polymers

Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in (NPCl2)3.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks,E team Teaching

Suggested Readings:-

- 1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. C*oncepts and Models in Inorganic Chemistry,* John Wiley & Sons.
- Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
- Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
- Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.

SEMESTER-III

Course Title: Biophysical Chemistry

Course Code: MCH310

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students willbe able to

1. Account for structures and functions of biological membrane, as well as model systems and relevant methods.
2. Describe how anabolic and catabolic processes are coupled to energetic from ATP hydrolysis
3. Identify enzymes involved in metabolic pathways.
4. Explain biosensors and their industrial applications.

Course Content

UNIT I **12 hours**

BIOENERGETICS: Standard free energy, entropy and chemical potential change in biochemical reactions. The effect of temperature and pH Oxidation, reduction reaction and hydrolytic reactions in biological system, (electron-transfer reactions), hydrolysis of ATP,synthesis of ATP from ADP .

UNIT II **13 hours**

PROPERTIES OF WATE Ionic product of water and its measurements. Importance of water in biological system with special reference to the maintenance of the native structure of biological molecules. Types of bonding in biological molecules. Biological relevance of pH and pKa proteins and nucleic acids.

Buffers, pH value of various bio-entities, buffer action, buffer capacity and their importance in biological systems. Isoelectric points for amino acids.

UNIT III **12 hours**

BIOPOLYMER INTERACTIONS

Forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction. Thermodynamics of biopolymers.Vant's Hoff's law of osmotic pressure, Theory of osmotic pressure and semipermiability. Significance of osmosis in biology.

UNIT IV **08 hours**

TRANSPORT OF ION: Ion transport through cell membrane, nurve conduction.

BIOSENSORS Definition, types, sensors for environmental, medical, food safety and biosecurity applications.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks,E team Teaching

Suggested Readings:-

- Timberlake, K. C., &Orgill, M. (2009). Chemistry: An introduction to general, organic, and biological chemistry. Pearson/Prentice Hall.
- Wurst, F. M., Alexson, S., Wolfersdorf, M., Bechtel, G., Forster, S., Alling, C. & Pragst, F. (2004). Concentration of fatty acid ethyl esters in hair of alcoholics: comparison to other biological state markers and self reported-ethanol intake. Alcohol and Alcoholism.
- Champe, P. C., Harvey, R. A., & Ferrier, D. R. (2005). Biochemistry.

SEMESTER-III

Course Title: Thermodynamics

Course Code: MCH311

L	T	P	Credits
2	0	0	2

COURSE OUTCOMES

On the successful completion of the course, the students willbe able to

1. Calculate entropy change for reversible and irreversible processes.
2. Analyze the variation of S, G, A with T, V, P.
3. Learn about Intensive and extensive variables; state and path functions
4. Recall all facts about Free energy change and spontaneity

Course Content

UNIT I **08 hours**

Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Change in thermodynamic functions in mixing of ideal gases.

UNIT II **07 hours**

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy,

bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

UNIT III **09 hours**

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P;

UNIT IV **06 hours**

Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell 17 relations; thermodynamic equation of state. Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks, E team Teaching

Suggested Readings:-

1. Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann,

M., & Grimes, R. (2018).
Advanced inorganic chemistry (Vol. 6, p. 1455). New York: Wiley.
2. Shriver, D. F., Atkins, P. W., & Langford, C. H. (1999). *Inorganic chemistry*.
3. Hughes, M. N. (2011). *The inorganic chemistry of biologicalprocesses* 2nd edn. FEBSLETTERS..

SEMESTER-III

Course Title: Computer Fundamentals and Programming

Course Code: MCH312

L	T	P	Credits
2	0	0	2

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Analysis of software and hardware used to solve problems in scientific context.
2. Illustrate the flow chart and design an algorithm for a given problem and to develop IC programme using operators necessary for Simulation research.
3. Ability to define and manage data structure based on problem Course domain.
4. Problem solving methods helps to gain practical insight of theoretical aspects.

Course Content

UNIT I **08 hours**

Computer organization: Hardware, Software, Programming languages with special reference to BASIC, Fortran and C.

Binary representation: Binary numbers, Conversion of decimal to binary and binary to decimal, Idea of Octal and hexa-decimal numbers.

Problem solving: Problem analysis, Algorithm development, Program Coding, Program Compilation and execution.

UNIT II **07 hours**

Introduction to C: Historical development of C, The C character set, Constants, variables and keywords, Types of C constants and variables, C keywords.

C instructions : Type declaration instruction, Arithmetic instructions, Integer and float conversion,Typeconversioninassignment,Hierarchyofoperations, Writingofafirstprogram inC,ControlInstructionsinC.Simpleproblemswithsequentialstructure.

UNIT III **08 hours**

Decision and control structure : The if statement, The if-else statement, The nested if-else statement, Use and hierarchy of logical operators, Conditional operators.

Loop control structure: The while loop, The for loop, Nesting of loops, The do-while loop, Break and continue statements.

Case control studies : Decision using switch, The go to statement, Simple problems with Selective and repetitive structures.

UNIT IV **07 hours**

Functions: What is function, why use functions, Passing values between a functions, Role offunctions.

Advanced features of functions: Function declaration and prototypes, Call by values and call by reference, An introduction to pointer, Pointer notion.

Arryas : What are arrays, Initialization of arrays.

Transaction Mode Collaborative teaching, Group Discussion,

Ted talks, E team Teaching

Suggested Readings:-

1. Kanetkar, Y. (2019). *Data Structures through C: Learn the fundamentals of Data Structures through C*. Bpb Publications.
2. Wright, G. R., & Stevens, W. R. (2015). *TCP/IP Illustrated, Volume 2 (paperback): The Implementation*. Addison-Wesley Professional.
3. Ghoshdastidar, P. S., Kumar, N., & Chhabra, R. P. (2012). Computer Simulation of Heat Transfer During Dry Process Cement Production in a Rotary Kiln. In *International Heat Transfer Conference Digital Library*. Begel House Inc.

SEMESTER-III

Course Title: Green Chemistry

Course Code: MCH313

L	T	P	Credits
2	0	0	2

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Understand the basic principal of green chemistry and their contemporary importance.
2. Design and develop less hazardous and environmental friendly chemicals.
3. Cope with the less eco-friendly discharge from chemical reactions.
4. Achieve a deep insight into the mechanism of solventless reactions.

Course Content

UNIT I **08 hours**

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the

goals of Green Chemistry

UNIT II **07 hours**

Principles of Green Chemistry and Designing a Chemical synthesis

Twelve principles of Green Chemistry with their explanations and examples and special Emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ by products maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
- Prevention/ minimization of hazardous/ toxic products reducing toxicity.
- Risk = (function) hazard × exposure; waste or pollution prevention hierarchy.
- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use Of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; Catalysis and green chemistry, comparison of heterogeneous and homogeneous Catalysis, biocatalysts, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, Principle of ISD “What you

don't have cannot harm you", greener alternative to

- Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer Route to cyclohexane) subdivision of ISD, minimization, simplification, substitution, Moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the Generation of hazardous substances in chemical processes.

UNIT III **07 hours**

Examples of Green Synthesis/ Reactions and some real world cases

- Green Synthesis of the following compounds: Adipic acid, catechol, disodium Imino diacetate (alternative to Stracke synthesis)
- Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic
- acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents
- Diels-Alder reaction and Decarboxylation reaction
- Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic Alternative to Iodine)
- Surfactants for carbon dioxide – replacing smog producing and ozone depleting Solvents with CO2 for precision cleaning and dry cleaning of garments.
- Designing of Environmentally safe marine anti foulant.
- Right fit pigment: synthetic azo pigments to replace toxic organic and inorganic Pigments.
- Healthier Fats and oil by Green Chemistry: Enzymatic Inter esterification for Production of no Trans-Fats and Oils
- Development of Fully Recyclable Carpet: Cradle to Cradle

Carpeting

UNIT IV **08 hours**

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green Chemistry; Proliferation of solvent less reactions; co crystal controlled solid state synthesis (C2S3); Green chemistry in sustainable development.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks, E team Teaching

Suggested Readings:-

- Ahluwalia, V.K. &Kidwai, M.R.(2015).*New Trends in Green Chemistry*, AnamalayaPublishers
- Matlack, A.S.(2011)*Introduction to Green Chemistry*, Marcel Dekker.
- Cann, M.C. &Connely, M.E. (2012).*Real-World cases in Green Chemistry*, American Chemical Society, Washington.
- Ryan, M.A. & Tinnesand, M.(2015)*Introduction to Green Chemistry*, American ChemicalSociety, Washington

SEMESTER-III

Course Title: Analytical Clinical Biochemistry

Course Code: MCH314

L	T	P	Credits
2	0	0	2

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Understand the basic composition of naturally occurring biomolecules.
2. Learn the structure and function of carbohydrates, proteins, lipids and enzymes.
3. Acknowledge the importance of genetic materials and their structure.
4. Achieve diagnostic approach of various diseases through the analysis of blood/ urine.

Course Content

UNIT I **08 hours**

Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins:

Review of concepts studied in the core course:

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency ofenergy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.

Isolation and characterization of polysaccharides.

Proteins*:* Classification, biological importance; Primary and secondary and tertiary structures Of proteins: α-helix and β-pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereo specificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysts: Importance in

"Green Chemistry" and Chemical Industry.

UNIT II **07 hours**

Lipids: Classification. Biological importance of triglycerides and phosphoglycerates and Cholesterol; Lipid membrane, Liposomes and their biological functions and underlying Applications.

Lipoproteins: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.

Structure of DNA (Watson - Crick Model) and RNA, Genetic Code, Biological roles of DNA And RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzymeInhibition.

UNIT III **07 hours**

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and Preservation of samples. Anemia, Regulation, estimation and interpretation of data for blood Sugar, urea, creatinine, cholesterol and bilirubin.

UNIT IV **08 hours**

Urine: Collection and preservation of samples. 6. Formation of urine. Composition and Estimation of constituents of normal and pathological urine.

Transaction Mode Collaborative teaching, Group Discussion, Ted talks, E team Teaching

Suggested Readings:-

- Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2015).
- Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons,2010.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2012.
- Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHILearning.
- Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman, 2015

SEMESTER-IV

Course Title:	Women and Children Empowerment	**L**	**T**	**P**	**Credits**
Course Code:	MCH401	0	0	4	2

COURSE OUTCOMES

On the successful completion of the course, the students will be able to

1. Analyze key issues affecting women through a transnational feminist perspective, including immigration, education, maternal health and gender-based violence.
2. Comprehend the value of locally-generated social change arising from and working within the culture of local communities.
3. Demonstrate knowledge about the ways that women throughout the world are resisting gender oppression and organizing to reshape their own communities.
4. Recognize key women activists who have received global recognition for their contributions.

Course Content

UNIT I

Gender and Feminism, Gender, gender equality and patriarchy. Feminism and Struggle for women's equality throughout the world: West and Asia.

UNIT II

Status of Women: Historical Perspective, Status and Position of Women in History: Women in Ancient, Vedic and Post Vedic period, Status of women in pre-independence period and Social Reforms before and after independence.

UNIT III

Women, Society and Human Rights, Universal Declaration of Human Rights and Human Rights Commission, Gender issue

and Indian Constitution, Struggles for Gender Equality: Society,reforms and laws in India.

UNIT IV

Status of Women in Punjab, Status of women in Punjab: History with particular reference to Sikh Scriptures, Status of women in Punjab: Contemporary Issues.

Transaction Mode Collaborative teaching, Field Study, Group Discussion, Ted talks, E team Teaching

Suggested Readings:-

- Amy S. Wharton. (2005). "*The Sociology of Gender: An Introduction to Theory and Research*". (Key Themes in Sociology) Blackwell Publishing, UK, Indian Reprint, Kilaso Books, New Delhi.
- Devaki Jain and Pam Rajput (Ed). (2003). "*Narratives from the Women's Studies FamilyRecreating Knowledge*, Sage, and New Delhi.
- Bharathi Ray, (Ed). "*Women of India: Colonial and post-colonial periods of History of Sciences and Philosophy in India Civilization"*, Vol, IX part 3, Sage, New Delhi, 2005.
- Kamal K.Misra, Janet Huber Lowry, (Ed). "*Recent Studies on Indian Women*", Rawat Pub. Jaipur
- Malini Bhattacharya (2005)"Women and Globalization, Tulika Books in Association of School of Women's Studies", Jadapur University, New Delhi.

SEMESTER-IV

Course Title: Dissertation

Course Code: MCH402

L	T	P	Credits
0	0	0	20

Guidelines for Course Evaluation Criteria

A report on research regarding Dissertation on the research area of interest/ expert areas of supervisor will be submitted by all the PG students under the supervision of the supervisor allocated from department research committee. The progress of the dissertation will initially be monitored by the Supervisor Finally; the submitted report will be evaluated by the evaluation committee. A presentation will be given by the student before the examiner and then the final submission of Dissertation will be done by the candidate.