

Sardar Patel University Mandi

District Mandi -175001 (HP) India

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(Established Under H.P. Legislative Assembly Act 03 of 2022)



Syllabus for M.Sc. Industrial Chemistry

2 Years (CBCS)

Session 2022-23 Onwards

**Faculty of Physical Sciences
Sardar Patel University Mandi (HP)**

SARDAR PATEL UNIVERSITY, MANDI-175001

FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. Industrial Chemistry

Session: 2022-24



**DEPARTMENT OF INDUSTRIAL
CHEMISTRY**

SARDAR PATEL UNIVERSITY MANDI-175001

HIMACHAL PRADESH


07-12-2023

A Detailed Scheme and Course Contents of the Syllabus for M.Sc. Industrial Chemistry Spread Over Four Semesters (I-IV) For Session 2023-24.

Sr. No.	Course No.	Title	Course Type	Teaching hour per weak	Credit	Max. Marks (Theory+Internal Assessment)	Total Marks
Semester-I							
1	MIC-101	Inorganic Reagent and Chemistry	CPT	4	4	80+20	100
2	MIC-102	Organic synthesis and Chirotechnology	CPT	4	4	80+20	100
3	MIC-103	Fundamental Physical Chemistry	CPT	4	4	80+20	100
4	MIC-104	Mathematics for Chemists and Applications of computer in Chemistry	AEC	3	3	60+15	75
5	MIC-105	Environment Pollution and Monitoring Techniques	AEC	3	3	60+15	75
6	MIC-106	Industrial Internship and seminar*	PRC*	10 Day	1	15+10	25
7	MIC-107	Inorganic Chemistry Practical based on MIC-101	CPP	6	2	40+10	50
8	MIC-108	Organic Chemistry Practical based on MIC-102	CPP	6	2	40+10	50
9	MIC-109	Physical Chemistry Practical based on MIC-103	CPP	6	2	40+10	50
				36	25		625
Semester-II							
1	MIC-201	Spectroscopy of Organic Compounds	CPT	4	4	80+20	100
2	MIC-202	Advanced Analytical Chemistry	CPT	4	4	80+20	100
3	MIC-203	Mechanism and kinetics of Polymers	CPT	4	4	80+20	100
4	MIC-204	Fundamental of Medicinal Chemistry	CPT	3	3	60+15	75
5	MIC-205	Industrial Internship and seminar*	PRC*	10 Day	1	15+10	25
6	MIC-206	Instrumental Methods of Analysis Practical based on MIC 202	CPP	6	2	40+10	50
7	MIC-207	Polymer Chemistry Practical based on MIC 203	CPP	6	2	40+10	50
8	MIC-208	Cheminformatics and Drug Design Practical based on MIC-204	CPP	6	2	40+10	50
				33	22		550
Semester-III							
1	MIC-301	Natural Products	CPT	4	4	80+20	100
2	MIC-302	Agrochemical Chemistry	CPT	4	4	80+20	100
3	MIC-303	Organic Synthesis	CPT	4	4	80+20	100
4	MIC-304	Medicinal Chemistry	CPT	4	4	80+20	100
5	MIC-305	Industrial Internship and seminar*	PRC*	10 Day	1	15+10	25

6	MIC-306	Natural Products Practical	CPP	6	2	40+10	50
7	MIC-307	Agrochemical Chemistry Practical	CPP	6	2	40+10	50
8	MIC-308	Organic Synthesis Practical	CPP	6	2	40+10	50
				34	23		575
Semester-IV							
1	MIC-401	Physical Chemistry	CPT	6	4	80+20	100
2	MIC-402	Fuel and Energy Technology	CPT	6	4	80+20	100
3	MIC-403	IPR, Quality control and assurance	AEC	2	2	40+10	50
4	MIC-404	Industrial training and report	PRC	3 months	6	150	150
5	MIC-405	Seminar	AEC		4	50	50
				14	20		450
*Industrial Internship of 10 days is mandatory for every student and will be evaluated according to the written report submission and seminar.							

1. The abbreviation use in the above course type are as follows:

Core Paper Theory = CPT

Core Paper Practical = CPP

Ability Enhancement Courses = AEC

Skill Enhancement Courses = SEC

Project Report Course = PRC

2. Examination time for each paper will be three hours (except Industrial Internship and seminar*).

3. Industrial Training of 3 Months is mandatory for every student in 4th semester. (Evaluation will be done as per rubrics).

4. For internal assessment (IA), following criteria will be implemented with regards to the award of internal assessment:

I. Internal assessment of 20 % marks will be added to each paper.

II. These marks will split as following: (a) 5 marks for attendance. The weightages to attendance will be as: upto 75% with condonation from competent authority as per provision under ordinance-ZERO. Without condonation upto 75%-ONE Marks, 76-80%-TWO Marks, 81-85% THREE Marks, 86-90%-FOUR Marks, and above 91%-FIVE Marks. (b) The award of 15 Marks would be based on the performance of class test, and this test will consist of both subjective as well as objective type questions.

9. Total Marks of all four semesters:

Semester	Credit	Marks
Semester-I	25	625
Semester-II	22	550
Semester-III	23	575
Semester-IV	20	450
Total	90	2200

Semester-I

Semester-I
(Course MIC- 101)

Credit: 4

Inorganic Chemistry

Syllabus

Lectures: 60

Unit-1 Non-Aqueous Solvents:

Factors justifying the need of Non-Aqueous solution Chemistry and failure of water as a Solvent. Solution chemistry of Sulphuric acid: Physical properties, Ionic self-dehydration in H_2SO_4 , high electrical conductance in spite of high viscosity, Chemistry of H_2SO_4 as an acid, as a dehydrating agent, as an oxidizing agent, as a medium to carry out acid-base neutralization reaction and as a differentiating solvent. Liquid BrF_3 : Physical properties, solubilities in BrF_3 , self-ionization, acid base neutralization reactions, solvolytic reactions and formation of transition metal fluorides.

Unit-2 Organometallics

Introduction, Transition metal alkyls, metal-alkenyls and metal-alkynyls and aryls- routes of synthesis, Reactions of metal-carbon bonded compounds-homolytic cleavage, reductive elimination, electrophilic cleavage, insertion, β -metal hydrogen elimination, α -abstraction or α -elimination. Transition metal to carbon multiple-bonded compounds-carbonyls, nitrosyls, metal-dinitrogen, metal alkyls, metal-carbene complexes.

Unit-3 Inorganic Hydrides and reagents

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

Chelating Reagents: Role of following reagents in analytical chemistry

- (a) Dimethylglyoxime and EDTA
- (b) 8-Hydroxyquinoline and 1,10 Phenanthroline

Unit-4 Molecular Symmetry and Group Theory

Symmetry elements and operations, Group theory- Concept of a group, definition of point group. Assignment of point groups to molecules, Group multiplication tables for C_{2v} and C_{3v} point groups. Matrix representations of symmetry operations, reducible and irreducible representations. Character tables, Applications of group theory: a) to determine symmetry of molecular orbitals of BF_3 , B_2H_6 ; b) to determine IR active and Raman active lines in molecules with C_{2v} , C_{3v} , D_{4h} and T_d point groups.

Unit-5 Nuclear Chemistry

Nuclear Structure: Stability of nuclei, packing fraction, n/p ratio, nuclear potential, binding energy and exchange forces, shell model and liquid drop model; decay of radio nuclei, rate of decay; determination of half-life period; modes of decay: alpha, beta, gamma and orbital electron capture; Nuclear reactions, Nuclear fusion (sun's atmosphere, hydrogen bomb) and Nuclear fission (plutonium bomb), Q value.

Books Recommended

1. J. E. Huheey, R. L. Keiter and A. L. Keiter, Inorganic Chemistry, 4th edition. Addison Wesley,
2. H. S. Ray and A. Ghosh. Principles of Extractive Metallurgy, New Age International.
3. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley, 1991.
4. R. C. Mehrotra and A. Singh, Organometallic Chemistry, New Age International, 1999.
5. F. A. Cotton: Chemical Applications of Group theory, Wiley, New York, 1993.
6. G. L. Miessler and D. A. Tarr; Inorganic Chemistry, 3rd edn. Pearson Education Inc.
7. C. Bodsworth; Metallurgy and metallurgical engineering series, CBS, 1988.
8. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, Butterman-Helmman, 2005.

Organic synthesis and Chirotechnology

Syllabus

Lectures: 60

Unit-1 Reaction Mechanism

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

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

Unit-2 Aliphatic Nucleophilic Substitution

Aliphatic Nucleophilic Substitution: Reactivity effect of substrate structure, leaving group and nucleophile. The SN_2 , SN_1 , mixed SN_1 and SN_2 , SET mechanisms & SN_i mechanism. The neighboring group mechanism, neighboring group participation by π and σ bonds, anchimeric assistance. Non-classical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements-Wagner-Meerwein, Pinacol-Pinacolone and Demjanov ring expansion and ring contraction. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Esterification of carboxylic acid, transesterification, Phase-transfer catalysis, and ultrasound, ambident nucleophile, regioselectivity.

Unit-3 Aromatic Nucleophilic Substitution

Aromatic nucleophilic substitution: A general introduction to different mechanisms of aromatic substitution SN_{Ar} , AN and aryne, Von Richter rearrangement, Sommet, Hauser rearrangement, Smiles rearrangement. Radical substitution Mechanism: Reaction at sp^3 and sp^2 carbon, hydroxylation at aromatic carbon by means of Fenton's reagent, oxidation of aldehydes to carboxylic acids, formation of cyclic ethers with $Pb(OAc)_4$, Reed reaction, Sandmeyer reaction, Kolbe reaction and Hunsdiecker reaction.

Unit-4 Addition Elimination Reaction

Addition Elimination Mechanisms: (a) Addition to carbon multiple bonds-Addition reactions involving electrophiles, nucleophiles and free radicals (b) Addition to carbon hetero atom multiple bonds: Mannich reaction: LAH reductions of Carbonyl compounds acids, esters, nitrites, addition of Grignard reagents, Reformatsky reaction, Tollen's reaction, Wittig reaction (c) Elimination reactions: Stereochemistry of eliminations in acyclic and cyclic systems, orientation in eliminations - Saytzeff and Hoffmann elimination.

Unit-5 Chirotechnology

Concept of chirality, optical isomerism, D, L-; R, S- designations, geometrical isomerism and E, Z designations, Stereoselective and stereospecific reactions, Racemisation, mechanism of racemisation, resolution of racemic mixtures, methods of determination of enantiomeric excess, Use of α -amino acids in the synthesis of benzodiazepines, carbohydrates in the synthesis of swainsonine (D-mannose) and tomolal (mannitol). Synthesis and applications of oxazaborolidines, IPC2BH, (S)-BINAP-DIAMINE and (R)-BINAL-H. Use of (R,R)- DIPAMP, (R,R)-DIOP, S-PBMgCl, (+) and (-)-DET.

Books Recommended

1. J. March, Advanced Organic Chemistry-Reactions, mechanisms & structure, (Wiley, NY) 2000.
2. P. Sykes, A guide book of mechanisms in Organic Chemistry, (Orient- Longman) 1985.
3. R.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, (Plenum, New York) 1990.
4. Tewari, Vishnoi and Mehrotra, A Text book of Organic Chemistry, (Vikas, New Delhi) 1998.
5. Audrey Miller, Philippa H. Solomon: Writing Reaction Mechanisms in Organic Chemistry, Elsevier Science & Technology Books.
6. S.H. Pine, Organic Chemistry 4th Edition (McGraw-Hill, London) 1987.
7. R.P. Narein, Modern Concepts of Advanced Organic Chemistry, (Vikas, Delhi) 1997.
8. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw-Hill.

(Course MIC-103)

Credit: 4

Fundamental Physical Chemistry

Syllabus

Lectures: 60

Unit-1 Thermodynamics

Terminology, Laws of thermodynamics, Carnot cycle, Carnot theorem, Free energy change and work function, Entropy evaluation, Criteria for reversible and irreversible processes, Thermodynamics of mixing. Theory and determination of Chemical Potential, variation of chemical potential with temperature and pressure. Enthalpy changes in chemical reaction, Kirchoff's equation, Flame and explosion temperature, Hess's law of constant heat summation, Measuring enthalpy of combustion.

Unit-2 Chemical kinetics

A brief review of basic concepts and terminologies in reaction kinetics. Rate law and factors effecting rate law. Steady state approximation. Complex reactions: activated complex theory, parallel, consecutive and chain reaction thermal ($H_2 - Br_2$) and photochemical $H_2 - Cl_2$ reactions, Rice Herzfeld mechanism for dissociation of ethane.

Unit-3 Surface Chemistry

Adsorption: Definition, thermodynamics of adsorption, Langmuir adsorption isotherm, Langmuir constant and Gibbs energy of adsorption, Langmuir adsorption with lateral interaction, BET adsorption isotherm, adsorption on heterogeneous surface.

Surfactants: Micelles and Emulsions: Surfactants, types of micelles, Ostwald ripening, critical micelle concentration, thermodynamics of micellization, structure of surfactants, aggregates, biological membranes, microemulsion, inverse microemulsion formation and stabilization.

Unit-4 Ionic equilibria

Ostwald dilution law, concepts of acids and bases, hard soft acids and bases, ionization constants of acids and bases, ionization of water, ionic product of water, the pH scale, common ion effect, buffer solutions, hydrolysis of salts, acid-base indicators and titrations, the solubility product.

Unit-5 Introduction and Applications of electrochemistry

Electrochemistry Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Types of electrodes. General concepts of brine electrolysis, modern technological developments, chlorine cell technologies, production of potassium hydroxide, Standard electrode potential. Electrochemical series. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode.

Self-study topics: Chemical potential and free energy.; potential energy surfaces, Electrochemistry of corrosion, Electrochemistry of synthesis reactions.

Books recommended

1. S Glasstone, Thermodynamics for Chemists, East-west Editon, New Delhi, 2003
2. Hareesh Mehra, Chemical Kinetics-, Alfa publishing, New Delhi, 2006.
3. Jain and Jain, Engineering Chemistry, Danpat Rai Publishers.
4. DR Crow, Principles & Applications of Electrochemistry, 3rd Edn. Chapman & Hall, 1987.
5. Klotz, Rosenbeg, Chemical Thermodynamics-Basic Theory and Methods, 4th Edn. Benjamin, 1986.
6. K J Laidler, Chemical Kinetics, Pearson Education.
7. J.O.M. Bockries and A.K.N.Reddy, Modern Electrochemistry, Vol I, IIA & IIB (1998).
8. Peltcher, Industrial electrochemistry.

Mathematics for Chemists & Application of Computer in Chemistry

Syllabus

Lectures: 45

Mathematics for Chemists

Unit-1 Differential calculus

Differential calculus: functions of single and several variables, partial derivatives, the total derivative, maxima and minima theorem, and simple examples related to chemistry. Vectors: representation and simple properties of vectors (addition and subtraction) vector addition by method of triangles, resolution of vectors. Scalar product of vector. Concept of normalization, orthogonality and complete set of unit vectors.

Unit-2 Integral calculus

Integral calculus: general and special methods of integration, geometric interpretation of integral, evaluation of definite and some standard integrals related to chemistry. The significance of 'exponential' equations. Differential equations: simple differential equations, separable variables, homogeneous equations, exact equations, linear equations, and equations of first and second order. Application to simple chemistry problems.

Unit-3 Matrices and Determinants

Matrices and Determinants: Definition of matrix, types of matrices (row, column, null, square, diagonal). Matrix algebra: addition, subtraction, and multiplication by a number, matrix multiplication. Transpose and adjoint of matrix, elementary transformation, representation and applications to solutions of linear equations. Application to simple chemistry problems.

Application of Computer in Chemistry

Unit-4 Chemistry and FORTRAN Programming

Chemistry and FORTRAN Programming: Introductory FORTRAN concepts, character set, constant variables, data types, subscripted variables, and FORTRAN functions. Data transfer and program execution control: Introduction, format specification for READ and WRITE statements, format commands, control commands and transfer commands.

Unit-5 Arrays and repetitive computation

Arrays and repetitive computation; Introduction, arrays arrange storage, dimension statement, do control, Nested do – loop continue statement, implied do. Sub – programme (functions and sub – routines): Introduction, sub programme, functions in FORTRAN, function arguments, subroutines, save variable function vs. subroutine programme.

Books Recommended:

1. Mathematical Preparation for Physical Chemistry: F. Daniel
2. Mathematical Methods for Science Students: G. Stephemen
3. Applied Mathematics for Physical Chemistry: T.R. Barrante
4. Fortran 77 & 90: V. Rajaraman
5. Computer in Chemistry: K.V. Raman

(Course MIC-105)

Credit: 3

Environment Pollution and Monitoring Techniques

Syllabus

Lectures: 45

Unit-1 Water pollution

Water pollution, categories of pollutants, sources of water pollution, Nature Types of water pollutants: Elemental pollutants, Heavy metals, Metalloids, Inorganic species, Algal nutrients and eutrophication, organic pollutants, radionuclides in the aquatic environment.

Unit-2 Water Treatment

Municipal water treatment, Industrial wastewater treatment, Sewage treatment, Removal of calcium, iron, and manganese from water, water disinfection, Unit operations: Screening, sedimentation and floating, filtration, mixing, equalization, Flow proportioning, Drying and Incineration, freezing, foaming, dialysis and osmosis, adsorption, gas transfer, Elutriation.; Unit processes: pH Correction, Coagulation, oxidation and reduction, aerobic and anaerobic processes.

Unit-3 Methods of Wastewater treatment

Physical Methods. Reverse Osmosis, electro dialysis, membrane filtrate, Chemical methods: Carbonates, Hydroxides, Sulphides, Biological methods: Biodegradable materials and removal of pollutants by microorganisms, BOD and its measurement, activated sludge process.

Unit-4 Measurement and monitoring of Air pollution

Photochemical smog, atmospheric aerosols, Ambient air sampling: elements of sampling system, sampling systems for gaseous pollutants: sampling systems for particulate pollutants: Behaviour of Particles at Sampling Inlets, Passive sampling systems, sampler siting requirements, sampling for air toxics.

Unit-5 Air pollutants analysis and measurements

Analysis and measurements of gaseous pollutants: Carbon-monoxide (CO), ozone (O₃), nitrogen-dioxide (NO₂), sulphur-dioxide (SO₂), non-methane volatile organic compounds, laboratory analysis of air pollutant samples, semi-volatile organic compounds.

Books Recommended

- I. S.E. Manahan, Environmental Chemistry, 7th edition, CRC Press LLC, 2008.
- II. A.K. De, Environmental Chemistry, Wiley Eastern.
- III. V K Ahluwalia, Environmental chemistry, Anne Books India, 2008.
- IV. R.D. Braum, Introduction to Instrumental Analysis
- V. S.P. Mahajan: Pollution control in process Industries (MH)
- VI. K.S. Ramlho: Introduction to waste water treatment process (A.P)
- VII. M.J. Hammar: Water and waste water Technology (J.W)

(Course MIC-106)

Credit: 2

Industrial Internship and seminar

Syllabus

Industrial Training/visit of 10 days is mandatory for every student. Evaluation will be done as per the written report submission and seminar.

(Course MIC-107)

Credit: 2

Inorganic Chemistry Practical

Syllabus

1. Bromatometric titrations

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

2. Complexometric titrations

- (i) Estimation of magnesium, copper and zinc using EDTA titrations.
- (ii) Determination of nickel in nickel salts both by direct titration and back titration with EDTA.
- (iii) Alkalimetric titrations with EDTA

3. Mixture Analysis

- (i) Cu(II) + Mg(II): Cu (gravimetrically) as CuSCN and Mg (volumetrically) using EDTA.
- (ii) Cu(II) + Ni(II): Cu (gravimetrically) as CuSCN and Ni (volumetrically) using EDTA.
- (iii) Cu(II) + Ni(II)+Zn: Cu (volumetrically) using hypo solution, Ni (gravimetrically) with DMG and Zn (complexometrically) using EDTA.

4. Sample Analysis

- (i) Determination of available NPK in soil and Fertilizer analysis.
- (ii) Determination of hardness of water.
- (iii) Determination of Oxygen in hydrogen peroxide.
- (iv) Determination of Phosphoric acid in commercial phosphoric acid.
- (v) Determination of Boric acid in borax.
- (vi) Determination of available chlorine in bleaching powder and residual chlorine in water samples.
- (vii) Determination of phosphates in detergents.
- (viii) Analysis of Ores (Dolomite, Pyrolusite) and alloys (Coin, Brass, Bronze).

5. Colorimetric analysis

- (i) Determination of composition of complexes: a) Job's method: Fe-1, 10-phenanthroline complex.
- (ii) Determination of composition of complexes a) Slope ratio method: Cu ethylenediamine.
- (iii) Determination of Iron present in sulpha- drugs; colorimetrically
- (iv) Estimation of iron in cement by colorimetrically.

Books Recommended

- I. Svehla, G., Sivasankar B., 2013, Vogel's Q Svehla, G., Sivasankar B., 2013, Vogel's Qualitative Inorganic Analysis, 7th Edition, Pearson.
- II. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., 1978, Vogel's Textbook of Quantitative
- III. Inorganic Analysis (revised); 4th ed., Orient Longman.
- IV. Mendham J., R. C., Denney J. D., Barnes and Thomas M., Vogel's Textbook of Quantitative Analysis, Pearson, Ed. 2006.
- V. Vogel, A I; Tatchell A R; Furnis, B S; Hannaford, A J and Smith, PWG. 1989. Vogel's Text Book of Practical Inorganic Chemistry, 5th Edition, Pubs: ELBS.
- VI. Marr G. and Rocket B. W., Practical Inorganic Chemistry, University Science Books, Ed. 1999.
- VII. Pass G. and Sutcliffe H., Practical Inorganic Chemistry, Chapman and Hall, London, Ed. 1968

(Course MIC-108)

Credit: 2

Organic Chemistry Practical

Syllabus

Organic Synthesis

1. Reduction of camphor using NaBH_4
2. Prepare oxime from cyclohexanone
3. Prepare caprolactam from cyclohexanone oxime
4. Prepare Fluorescein from Resorcinol
5. Prepare Eosin from Fluorescein
6. Preparation of Acetophenone phenyl hydrazine
7. To synthesize 2-phenyl indole from Acetophenone phenyl hydrazine (two steps).
8. Preparation of Resorpiophenone
9. To synthesize 7-Hydroxy 3-methyl Flavone by Baker Venkatraman method from Resorpiophenone (two steps).
10. Preparation of 7-Hydroxy-4-methylcoumarin (Umbelliferone), Pechmann reaction

Books Recommended

- I. Harwood, L.M., and Moody, C.J., Experimental Organic Chemistry, 1st edition, Blackwell Scientific Publishers, 1989.
- II. Vogel, A.I., Text Book of Practical Organic Chemistry, ELBS, 5th edition, Longman Group Ltd., 1989.
- III. Mann, F.G., and Saunders, B.C., Practical Organic Chemistry, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1981.
- IV. Tewari, K.S., Vishnoi, N.K. and Mehrotra, S.N., A Textbook of Organic Chemistry, 2nd edition, Vikas Publishing House, 1976.
- V. Leonard, J., Lygo, B., Advanced Practical Organic Chemistry, J. Leonard, B. Lygo, Chapman and Hall, 1995.

Physical Chemistry Practical

Syllabus

Thermochemistry

1. Determination of specific heat of liquids and solutions by calorimetry.
2. To determine the heats of neutralization of two acids, e.g., HCl and CH₃COOH and hence their relative strength.
3. To determine the integral heat of solution of a salt at two concentrations and hence the integral heat of dilution.

Kinetics Studies

4. Determine the rate constant of hydrolysis of an ester such as methyl acetate catalysed by an acid, say 0.5M HCl. Determine also the energy of activation of the reaction.
5. Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide (saponification of an ester).
6. Study the kinetics of depolymerisation of diacetone alcohol catalysed by sodium hydroxide using a dilatometer.

Adsorption and distribution coefficient studies

7. Investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal, and examine the validity of classical and Langmuir's adsorption isotherms.
8. Determine the distribution coefficient of iodine between an organic liquid such as carbon tetrachloride, carbon disulphide, kerosene etc. and water at a given temperature (or room temperature).
9. Determine the equilibrium constant of the reaction $KI + I_2 \rightleftharpoons KI_3$ by distribution method.
10. Determine the formula of the complex ion formed between the cupric ion and ammonia (cuprammonium ion) by distribution method.

Conductometric measurements

11. Determination of cell constant, limiting molar conductance of simple electrolytes in water, verification of Ostwald, dilution law for weak acetic acid.
12. Surface tension measurements: Surface tension of pure solvents, analysis of mixtures of two miscible solvents, verification of Gibbs' Thomson rule of surface tension.

Books Recommended

- I. B. P. Levitt, Findlay's Practical Physical Chemistry, Longman, London.
- II. James and Prichard, Experiments in Physical Chemistry.
- III. Yadav, Advanced Practical Physical Chemistry, 1989.
- IV. J. C. Ghosh, Experiments in Physical Chemistry, Bharathi Bhavan, 1974
- V. B.D. Khosla, V.C. Garg, Adarsh Gulati, Physical Chemistry, 1975

SEMESTER-II

Characterization techniques of compounds

Syllabus

Lectures: 60

Unit-1 UV-visible and fluorescence Spectroscopy

UV-visible Spectroscopy: Basic principles, Beer-Lambert law, deviation from Beer-Lambert's Law. types of electronic transitions. Franck - Condon principles, ground and excited electronic states of diatomic molecules. Chromophores, auxochromes, electronic spectra of polyatomic molecules. Instrumentation and application. Factors affecting the positions of UV bands. Photometric Titrations curves, Woodward-Fisher rules. Application of UV Spectroscopy in the structural study of organic molecules.

Molecular Fluorescence Spectroscopy:- Theory, relaxation processes, relationship between excitation spectra and fluorescence spectra, effect of concentration on fluorescence intensity, instrumentation

Unit-2 NMR Spectroscopy

Magnetic properties of nuclei, theory and measurement techniques, NMR spectrometer, chemical shift and its measurements, factors affecting chemical shift, spin-spin coupling, coupling constant, Shielding and deshielding, spin decoupling; effects of chemical exchange, solvent effects and Nuclear Overhauser Effect. Experimental techniques (CW and FT). Brief introduction of C-13 NMR.

Unit-3 Infrared Spectroscopy

Theory of IR absorption, Types of IR vibrations, Observed number of modes of vibrations, Intensity of absorption bands, application of infrared spectroscopy in functional group identification. Characteristic vibrational frequencies of common functional groups (alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, ketones, aldehydes, esters, amides and acids). Factors affecting vibrational frequencies and band shapes (Vibrational Coupling, Electrical effects: Resonance, Inductive effects, Ring strain)

Unit-4 Mössbauer and NQR Spectroscopy

Mössbauer Spectroscopy: Introduction, Principle, Conditions for Mössbauer Spectroscopy, Parameters from Mössbauer Spectra- Isomer shift, Electric Quadrupole Interactions, Magnetic Interactions, MB instrumentation, Applications of MB spectroscopy in structural determination of

a) Low spin Fe(II) and Fe(III) Complexes- Ferrocyanides, Ferricyanides, Prussian Blue.

b) Iron carbonyls. $\text{Fe}(\text{CO})_5$, $\text{Fe}_2(\text{CO})_9$ and $\text{Fe}_3(\text{CO})_{12}$

Nuclear Quadrupole Resonance Spectroscopy: Basic concepts of NQR (Nuclear electric quadrupole moment, Electric field gradient, Energy levels and NQR frequencies), Effect of magnetic field on spectra, Relationship between electric field gradient and molecular structure.

Unit-5 Electron Spin Resonance Spectroscopy

Electron Spin Resonance Spectroscopy:- Introduction, Similarities between ESR and NMR, Behaviour of a free electron in an external Magnetic Field, Basic Principle of an Electron Spin Resonance Spectrometer, Presentation of the spectrum, Hyperfine coupling in Isotropic Systems (methyl, benzene and Naphthalene radicals). Factors affecting the magnitude of g-values. Zero field splitting and Kramer's Degeneracy, Line width in solid state ESR, Double resonance technique in E.S.R.

Books recommended

- I. Pavia, D.L., "Spectroscopy", 4th Ed., Cengage, 2012.
- II. Sharma, Y.R., Elementary Organic Spectroscopy – Principles and Chemical Applications, S.Chand, 1992.
- III. Kalsi, P.S., Spectroscopy of Organic Compounds, 6th Edition, New age International Publishers, 2008.
- IV. Banwell, C.N., Fundamentals of molecular Spectroscopy, 3rd ed., TMH, New Delhi, 1983.
- V. Kemp, W., Organic Spectroscopy, 3rd Ed., MacMillan, 1994.
- VI. Dyer, C.R., Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1965.
- VII. Williams, D. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", 6th Ed., McGraw Hill Education (India) Private Limited.
- VIII. Silverstein, P.M., Spectroscopic Identification of Organic Compounds, F. X. Webster, 7th ed., Wiley & Sons, 2005.

IX. Drago, R.S., Physical methods in inorganic chemistry, 2015.
(Course MIC-202)

Credit: 4

Advanced Analytical Chemistry

Syllabus

Lectures: 60

Unit-1 Quantitative Analysis

Accuracy, Precision, Standard deviation, Classification of errors and their sources, minimization of errors, Significant figures, Criteria for rejection of data, Q-test, F-test, *t*-test, Control chart, Sampling methods, Sampling error, Standard reference materials.

Unit-2 Solvent Extraction and separation techniques

Partition law and its limitations, distribution ratio, separation factor, factors influencing extraction, multiple extractions. Extraction of metal chelates. Determination of molecular weight, molecular weight distribution, Brief idea of High-performance liquid chromatography (HPLC) and Gas Chromatography (GC): Mechanism of separation, theory and technique, instrumentation, Analysis of the purity of monomers, additives.

Unit-3 Spectroscopic techniques of analysis

Theory of flame photometer, intensities of spectral lines, selection of optimal working conditions, applications of flame photometry to quantitative analysis. The Theory of Atomic Absorption Spectroscopy (AAS), Origin of atomic spectra, line width effects in atomic absorption, instrumentation and its application, Atomic emission spectroscopy (AES) and the detailed description of the techniques of inductively coupled plasma AES (ICP-AES) and its instrumentation. Chemical and spectral interferences encountered in both techniques and how to overcome them. Basic principle of electron microscopy; specimen preparation, instruments, working and applications of scanning electron microscope (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM), contact angle measurements.

Unit-4 Thermal techniques of analysis

Basic principle, instrumentation, working and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC).

Unit-5 Mass Spectrometry

Mass Spectrometry - Introduction, ion production – EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McCafferty rearrangement. Nitrogen rule. High-resolution mass spectrometry.

Books recommended

- I. Willard, H.H., Merritt Jr. L., Dean, J.A. and Settle, F.A., Instrumental Methods of Analysis, CBS3. Christian, G.D., Analytical Chemistry, Wiley (2007) 6th ed.
- II. Skoog, P.T., Holler, D.A., Crouch, F.J., Thomson, S.R., Principles of Instrumental Analysis, Learning (2007).
- III. Khopkar, S.M., Basic Concepts of Analytical Chemistry, Wiley Eastern
- IV. Skoog, Holder, Nieman, Principles of Instrumental Analysis Fifth edition, Thomson Books, 1998.
- V. Haines, J., Thermal Methods of Analysis, Principles, Application and Problems, Blackie Academic and Professional, 1994.
- VI. Braithwaite, A., and Smith, F.J., Chromatographic Methods, 5th ed. Blackie Academic and Professional, London, 1996.
- VII. Pescock, R.L., Shields, L.D., Cairns, T., Mc William Modern Methods of Chemical Analysis, 2nd Edition (1976), John Wiley, New York
- VIII. Wendlandt, W.W., Thermal methods of analysis.

Mechanism and kinetics of Polymers

Syllabus

Lectures: 60

Identification and Analysis of Polymers

Unit-1

Concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, Solubility and swelling; **Thermoplastics** - melting point, density, viscosity, melt flow index, K-value. moisture analysis, particle size, apparent density, **Thermosets** - spiral flow test, cup flow test, gel time and peak exothermic temperature. Resins - acid value, hydroxyl value, isocyanate index, epoxy equivalent

Unit-2

Mechanisms of Polymerization

Mechanism of Addition polymerization, condensation polymerization, Ring opening polymerization, stereoselective polymerization, electrochemical polymerization. solid state polymer and kinetic chain length.

Unit-3

Ionic Chain Polymerization

Cationic polymerization: - Initiation- protonic acids, Lewis acids, other initiators, Propagation, Termination- chain transfer to monomer, spontaneous termination, combination with counter ion, chain transfer to polymer, other transfer and termination reactions, kinetics

Anionic polymerization: - Initiation- nucleophilic initiators, electron transfer, Propagation, Termination- polymerization without termination, termination by impurities and deliberately added transfer agents, spontaneous termination, Kinetics. Comparison between cationic, anionic & radical polymerization.

Unit-4

Copolymerization

Importance of chain copolymerization, Types of copolymers, Copolymer composition, Methods of determination of reactivity ratios, Reactivity ratio and copolymerization behavior, Radical copolymerization, Rates of copolymerization.

Unit-5

Thermodynamics of polymers solutions

Criteria of polymer solubility, solubility parameter, solution viscosity, Flory - Huggins theory. Entropy of mixing, enthalpy of mixing, thermodynamics of dissolution of polymers and their structures. Dilute solution theory based on excluded molar volume, Theta temperature.

Books Recommended

- I. Principles of polymer chemistry – P.J. Flory.-Encyclopedias- 672 pages.1995
- II. Macromolecules in solution – H.merawetz. interscience. N.Y.1965
- III. Principles of polymerization – G. Odian.-John Wiley & sons, Inc 2004.
- IV. Polymer colloids, A comprehensive Introduction: Rober M. Fitch –Springer 1971 (Academic Press)

(Course MIC-204)

Credit: 3

Fundamentals of Medicinal Chemistry

Syllabus

Lectures: 45

Unit-1 Computer Assisted Virtual screening design

Structure Based Virtual Screening- Protein Ligand Docking, Scoring Functions for Protein Ligand docking, Practical aspects of structure based Virtual Screening; Prediction of ADMET Properties, 2 D and 3D data searching. Chemical databases, Role of computers in Chemical Research.

Unit-2 Prediction of Properties of Compounds

Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Cheminformatics in Drug Design.

Unit-3 Drug Design, Drug-Target Interactions

Development of new drugs, procedures followed in drug design, concept of lead Compound and lead modification, Screening of NPs (Isolation and purification, structural determination), concepts of prodrugs and soft drugs, structure-activity relationship (SAR) factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial, consideration. Quantitative Structure Activity Relationship (QSAR) with special reference to antimalarials, antibiotics, anticholinergics and CNS active drugs. Concepts of drugs receptors. Elementary treatment of drug receptors. Elementary treatment of drug receptor interactions. Concepts of LD50 and ED50, Ec50, MIC, Natural product as a lead. Isolation & characterization of natural lead.

Unit-4 Pharmacokinetics

Pharmacokinetics: Introduction to drug absorption, Disposition, Elimination using pharmacokinetics, Important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

Unit-5 Pharmacodynamics

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

Books recommended

- I. Wilson and Gisvold's, Text Book of organic Medicinal & Pharmaceutical Chemistry, (2004)
- II. Thomas, G. Fundamentals of medicinal chemistry. John Wiley & Sons.2004.
- III. Burger's, Medicinal Chemistry & Drug Discovery, Vol-1(Chapter-9 & Ch-14),Ed.M.E.Wolff, JohnWiley, 1995
- IV. Goodman and Gilman's, pharmacological Basis of Therapeutics, McGraw-Hill, 1996.
- V. Silverman, R.B., The Organic Chemistry of Drug Design and Drug Action, Academic Press, 2014
- VI. Lednicer, D., Strategies for Organic Drug Synthesis and Design, John Wiely, 2009.
- VII. GrahamL. Patrik, An introduction to Medicinal Chemistry-, Oxford University Press, 3rd edition, 2005.
- VIII. Berry, I.R.,& Nash, R.A., Pharmaceutical Process Validation, Academic Press, London, 3rdEdition, 2003.

(Course MIC-205)

Credit: 2

Industrial Internship and seminar

Syllabus

Industrial Training/visit of 10 days is mandatory for every student. Evaluation will be done as per the written report submission and seminar.

(Course MIC-206)

Instrumental Methods of chemical analysis Practical

Credit: 2

Syllabus

Spectrophotometers: Instrumentation and Applications

1. Investigate several characteristics of a commercial spectrophotometer and compare different cuvette materials.
2. Determination of chlorophyll in olive oil by UV-Visible and Fluorescence
3. Spectroscopy
4. Determination of caffeine and benzoic acid in a soft drink.
5. To study the excitation and emission spectra for the fluorescent dye fluorescein and study the effect of concentration and instrumental bandwidth on the fluorescent signal.

Gas Chromatography

6. Analysis of a Liquid Organic Mixture by Gas Chromatography
7. Examine the phosphoric acid catalyzed dehydration of 2-methylcyclohexanol using Gas chromatography.
8. To study the effect of column gas flow rate and temperature on the separation of a BTEX mixture (mixtures of benzene, toluene, and the three xylene isomers, all of which are aromatic hydrocarbons.)

Cyclovoltammetry

9. Determine the redox potential of potassium ferricyanide and calculate the diffusion coefficient of potassium ferricyanide.
10. Cyclic Voltammetric Study of ferrocyanide/ferricyanide Redox Couple.
11. To study the redox processes and solvent hydrogen bonding effects in 2,3,5,6-tetramethyl-1,4-benzoquinone

Books Recommended

- I. L.M., Harwood, and C.J., Moody, Experimental Organic Chemistry, 1st edition, Blackwell Scientific Publishers, 1989.
- II. A.I., Vogel, Text Book of Practical Organic Chemistry, ELBS, 5th edition, Longman Group Ltd., 1989.
- III. F.G., Mann, and B.C., Saunders, Practical Organic Chemistry, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1981.
- IV. K.S., Tewari, N.K. Vishnoi, and S.N., Mehrotra, A Textbook of Organic Chemistry, 2nd edition, Vikas Publishing House, 1976.
- V. J., Leonard, B., Lygo, Advanced Practical Organic Chemistry, J. Leonard, B. Lygo, Chapman and Hall, 1995. Assessment Pattern - internal and External

(Course MIC-207)

Credit: 2

Polymer Chemistry Practical

Syllabus

Polymer synthesis

1. Condensation polymerization of amino caproic acid to prepare Nylon-6.
2. Polyamide formation via diamine and diacid chloride monomer through step growth polymerization at Room temperature.
3. Synthesis of conducting polymers

Polymer Characterisation-I

4. Determination of percentage of NCO groups in a polymer sample.
5. Determination of saponification value in a polymer sample.
6. Determination of acid value in a polymer sample.

Polymer Characterisation-II

7. Determination of molar mass of Nylon or any other amide by end group analysis.
8. Determination of number average molecular weight of a polymer by hydroxyl end group analysis.
9. Determination of viscosity average molecular weight of polystyrene in toluene by dilute solution viscosity method.
10. Determination of glass transition temperature of a polymer sample
- 11.

Books Recommended

- I. G., Svehla, B., Sivasankar 2013, Vogel's Qualitative Inorganic Analysis, 7th Edition, Pearson.
- II. S M A Ashraf, Laboratory Manual of Polymers; I K International Publishing, Vol 1.
- III. B. P. Levitt Findlay's Practical Physical Chemistry, , Longman, London.
- IV. James and Prichard. Experiments in Physical Chemistry.
- V. Yadav, Advanced Practical Physical Chemistry, 1989.

(Course MIC-208)
Cheminformatics and Drug Design Practical

Credit: 2

Syllabus

Molecular representations and chemical databases

1. Practical session for chemical structure representation and storage in special file formats (SMILES, WLN, sd and mol).
2. Importance of 3D structures and method of generation from 1D & 2D representations.
3. A brief introduction to building molecular databases with special emphasis on retrieval using structure input.

Chemical Databases and Data Mining

4. Chemical Databases and Data Mining: Cambridge Structural Database CCDC CSD; Crystallographic Open Database COD; Protein Data Bank PDB Ligand Explorer; Chemspider; Other Data Bases
5. Quantitative Structure Activity/Property/Toxicity Relationship Studies
6. Substructure/Exact/similar structure based searching

Computer-Aided Drug Design

7. Computer-Aided Drug Design Tools (Molecular Modeling Tools; Structural Homology modeling Tools; Docking Tools and Screening Tools; Other tools)
8. Pharmacophore hypothesis and searching.
9. Docking studies (Rigid, Flexible & library based).
10. Design and analysis of focused combinatorial library.

Books Recommended

- I. Andrew R. Leach, Valerie J. Gillet, Cluwer, Introduction to Cheminformatics, Academic Publisher, Netherlands, 2003.
- II. Lisa B. English (Editor), Combinatorial Library Methods and Protocols, Humana Press Inc, Volume: 201, 2002.
- III. Frank Jensen, Introduction to Computational Chemistry, Wiley Publisher, Second Edition, 2006
- IV. Johann Gasteiger (Editor), Thomas Engel (Editor), Chemoinformatics: A Textbook, Wiley Publisher ISBN: 978-3-527-30681-7, 2003.
- V. Rajarshi Guha (Editor), Andreas Bender (Editor), Computational Approaches in Cheminformatics and Bioinformatics Wiley-Blackwell, 2012.
- VI. Fan Li, Developing Chemical Information Systems: An Object-Oriented Approach Using enterprise JAVA, John Wiley & Sons, 2006.

SEMESTER-III

Semester-III
(Course MIC-301)

Credit: 4

Natural Products

Syllabus

Lectures: 60

Unit- 1 Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, biosynthesis and synthesis of the following representative molecules: Monoterpenoids: Citral, α -terpeneol, menthol (monocyclic). Sesquiterpenoids: Farnesol (acyclic), zingiberene (monocyclic), santonin (bicyclic), General methods of structure determination of Carotenes: β carotene.

Unit- 2 Alkaloids and Steroids

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

Unit- 3 Carbohydrates

Types of naturally occurring sugars: Deoxy-sugars, amino sugars, branched chain sugars. General methods of structure and ring size determination with particular reference to maltose, lactose, sucrose, pectin, starch and cellulose, photosynthesis of carbohydrates.

Unit-4 Amino acid, peptides and proteins

General methods of peptide synthesis, sequence determination, Purines and nucleic acid, Chemistry of uric acid, adenine, protein synthesis.

Unit-5 Vitamins

A general study, detailed study of chemistry of thiamine (Vitamin B1), Ascorbic acid (Vitamin C), Pantothenic acid, biological importance of vitamins.

Books recommended:

1. Natural Products- Chemistry and Biological Significance, J. Mann, R.S. Davidson, J. B. Hobbs, D.V. Banthrope and J. B. Harborne, Longman, Essex.
2. Organic Chemistry Vol. II, I.L. Finar, ELBS.
3. Stereo selective synthesis- A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants From the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.
6. New Trends in Natural Product Chemistry, Atta-ur-Rahman M. I. Choudhary, Harwood Academic Publishers.

(Course MIC-302)

Credit: 4

Agrochemical Chemistry

Syllabus

Lectures: 60

Unit-1 Agrochemicals and Pests

Introduction, Classification and Role of agrochemicals in agriculture. Pests: Introduction and Types of pests, Pest control: Natural and applied control [Physical, mechanical, cultural, biological, genetic, regulatory, chemical controls], Integrated pest management, Attractants, Repellents and Pheromones,

Unit-2 Pesticides-I

Pesticides: Introduction, Classification of pesticides based on mode of action, according to target species and chemical nature, Toxicity of pesticides, Formulation of pesticides-Dry formulation: Dusts, granules, wettable powders, seed disinfectants, liquid formulations: Emulsions, suspensions, etc.

Herbicides: Introduction and chemistry of Aromatic acid herbicides: 2,4-D, 2, 4-DB, 2, 4-DES, MCPB, 2, 4, 5-T. N-dimethylureas: Monuron, diuron, and sulfonylureas.

Unit-3 Pesticides-II

Fungicides: General introduction, structure and chemistry of Inorganic fungicides- Sulphur, Lime sulphur, copper sulphate, copper oxychloride, cuprous oxide, mercurous chloride. Dithiocarbamates: Ziram, Ferbam, Thiram, Nabam, Zineb, Maneb, Quinones: Chloranil. Benzimidazole: Carbendazim, Thiabendazole.

Rodenticides: Hydroxycoumarin, Dicoumarin, Warfarin, Zinc-phosphide and bromodiolone

Unit-4 Pesticides-III

Insecticides: Inorganic insecticides- Arsenic insecticides, Paris green, fluoro insecticides. Insecticides of plant origin-Nicotine, nornicotine, Pyrethroids, rotenoids, allethrin. Structure, and mode of action of Chlorinated hydrocarbons (DDT, DDD, BHC, Chlordane, Heptachlor, Aldrin, Dieldrin, Endrin, Endosulfan), Organophosphorus Insecticides (Dichlorovos, Naledphosphinon), and Carbamate Insecticides (Carbaryl, Isolan, Mesurool, Zectran, Baygon).

Unit-5 Fertilizers

Fertilisers: Introduction, Essential plant Nutrients, Classification of Essential Nutrients, Primary Nutrients, Secondary Nutrients, Micronutrients, Macronutrients, Classification of Fertilizers- Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures.

Manufacture and general properties of Fertilizer products: Nitrogenous Fertilizers: Ammonium Nitrate, Calcium Ammonium Nitrate, Urea; **Phosphatic Fertilizers:** Ground Rock Phosphate, Single Superphosphate, Triple Superphosphate; **Potassic Fertilizers:** Potassium Chloride (Muriate of Potash), Potassium Sulphate (Sulphate of Potash), Potassium Nitrate; **Complex Fertilizers:** Ammonium Phosphates, Di-Ammonium Phosphate (DAP), Nitro phosphates, Urea Ammonium Phosphates, NPK Complex Fertilizers,

Books recommended:

1. Melnikov N.N., Chemistry of Pesticides, Pubs: Springer-Verlag, New York, 1971.
2. Panda, H; The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides with Formulae & Processes; NIIR Project Consultancy Services, 2003
3. N.K. Roy, Chemistry of pesticides.
4. K.A. Hussel, Chemistry of pesticides.
5. R. Cremlyn, Pesticides:preparation and mode of action.
6. M.B. Green, G.S.Hartley West: Chemicals for crop protection and pest managements (pergamon)
7. K.H. Buchel, Chemistry of Pesticides.
8. U. S. Sree Ramulu , Chemistry of Insecticides and Fungicides, Oxford and IBM Pub., 1979
9. Van Wade. Velkenburg, Pesticides Formulations, 1973.
10. Gunter and Zweig, Analytical Methods of Pesticides and Plant Growth Regulators and Food Additives, Vol. I-IV, 1968.
11. K. S. Yawalkar, J. P. Agrawal, S. Bokde, Manures and Fertilizers , 1967.
12. G. H. Collings, Commercial Fertilizers , 2002.

13. S. B. Chattopadhyay, Principles and procedures of plant protection. Oxford & IBH Publishing Company, Pvt. Limited; 1991.

Semester-III
(Course MIC-303)

Credit: 4

Organic Synthesis

Syllabus

Lectures: 60

Unit- 1 Organic Reagents

Reagents in organic synthesis: Wilkinson catalyst, Lithium dialkylcuprates (Gilman's reagents), Lithium diisopropylamide (LDA), 1,3-Dithiane (Umpolung) Dicyclohexylcarbodiimide (DCC), and Trimethylsilyliodide, DDQ, SeO₂, Baker yeast, Tri-n-butyltinhydride, Nickel tetracarbonyl, Trimethylchlorosilane, Grubbs Catalysts.

Unit- 2 Oxidations

Introduction, Different oxidative process. Aromatization of six membered ring, dehydrogenation yielding C-C double bond, Oxidation of alcohols, Oxidation involving C-C double bond, Oxidative cleavage of ketones, aldehydes and alcohols, double bonds and aromatic rings, Ozonolysis, Oxidative decarboxylation, Bisdecarboxylation, Oxidation of methylene to carbonyl, Oxidation of olefines to aldehydes and ketones

Unit- 3 Reductions

Introduction, Different reductive processes. Reduction of carbonyl to methylene in aldehydes and ketones, Reduction of nitro compounds and oximes, Reductive coupling, Bimolecular reduction of aldehydes or ketones to alkenes, metal hydride reduction, Acyloin ester condensation, Cannizzaro reaction, Tishchenko reaction, Willgerodt reaction.

Unit- 4 Rearrangements

General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Backmann, Hofmann, Curtius, Schmidt, Benzidine, Baeyer-Villiger, Shapiro reaction, Wittig rearrangement and Steven's rearrangement.

Unit- 5 Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5 hexatrienes and allyl system. Classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions: conrotatory and disrotatory motions, 4n and 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and chelotropic reactions. Sigmatropic rearrangements-Suprafacial and Antarafacial shifts of H, sigmatropic shifts involving carbon moieties, Claisen, Cope and aza-Cope rearrangements, Ene reaction.

Books Recommended:

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis- Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
3. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions, H.O. House, W. A. Benjamin.
5. Advanced Organic Chemistry-Reactions Mechanisms and Structure, J. March, Wiley.
6. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blakie Academic and Professional.
7. Advanced Organic Chemistry Part-B, F.A. Carey and R. J. Sundburg, Plenum Press.
8. Organometallic Chemistry-A Unified Approach, R.C. Mehrotra, A. Singh.

Semester-III
(Course MIC-304)

Credit: 4

Medicinal Chemistry

Syllabus

Lectures: 60

Unit- 1

Antibiotics and Antiinfective Drugs: Antibiotics: Historic development in the structural modifications of Penicillin antibiotics. Structure, SAR and biological action of antibiotics. Examples: penicillin: penicillin-G, penicillin-V, ampicillin, amoxicillin, chloramphenicol, cephalosporin, tetracycline and streptomycin. Sulfonamides: Structure, SAR and mode of action of sulfonamides, sulfonamide inhibition and probable mechanisms of bacterial resistance to sulfonamides. Examples: sulfadiazine, sulfafurazole, Acetyl Sulfafurazole, Sulfaguanidine, Dapsone, Introduction and general mode of action of Local antiinfective drugs, Examples: sulphonamides, furazolidone, ciprofloxacin, norfloxacin, chloroquine.

Unit- 2

Psychoactive Drugs: Introduction, neurotransmitters-receptor interaction, CNS depressants and stimulants. SAR and Mode of action, Central Nervous System Depressant: **General anaesthetics, Sedatives & Hypnotics:** Barbiturates and Benzodiazepines. Anticonvulsants: Barbiturates, Oxazolindiones, Succinimides, Phenacemide and Benzodiazepines.

Unit- 3

Psychotropic Drugs: The neuroleptics (Phenothiazines and butyrophenones), antidepressants (Monoamine oxidases inhibitors and Tricyclic antidepressants) and anti-anxiety agents (Benzodiazepines). **Central Nervous System Stimulants:** Strychnine, Purines, Phenylethylamine, analeptics, Indole ethylamine derivatives.

Unit- 4

Therapeutic Agents, SAR and Their mode of Action: Antineoplastic Agents: Cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Biological action of mechlorethamine, cyclophosphamide, melphalan, uracil, and 6-mercaptopurine.

Unit- 5

Cardiovascular Drugs: Antihypertensive and hypotensive drugs, antiarrhythmic agents, vasopressor drug, Direct acting arteriolar dilators. Biological action of methyl dopa, propranolol, amyl nitrate, verapamil, Atenolol.

Diuretics: Mercurial diuretic, Non mercurial diuretics (Thiazides, carbonic-anhydrase inhibitors, xanthine derivatives, pyrimidine diuretics and osmotic diuretics)

Books Recommended:

1. An Introduction to Medicinal Chemistry, Graham L. Patrick.
2. Medicinal Chemistry: Principles and Practice Edited by F.D. King.
3. Textbook of Organic Medicinal and Pharmaceutical Chemistry, Edited by Charles O. Wilson, et al.
4. Introduction to Medicinal Chemistry, Alex Gringuage.
5. Principles of Medicinal Chemistry, William O. Foye, Thomas L. Lemice and David A. Williams.
6. Introduction to Drug Design, S.S. Pandeya and J. R. Dimmock, New Age International.
7. Burger's Medicinal Chemistry and Drug Discovery, Vol-1 Ed. M.E. Wolff, John Wiley.
8. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
9. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
10. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.

Semester-III
(Course MIC-306)
Natural Products Practical

Time: 6 Hours/week
Syllabus

Credit: 2
Max. Marks: 50

1. Extraction of Organic Compounds from Natural Sources:
 - a) Isolation of Caffeine from tea leaves.
 - b) Casein from milk (the students are required to try some typical color reactions of proteins).
 - c) Lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported).
 - d) Isolation of diosgenin from Fenugreek seeds (Methi seeds).
 - e) Lycopene from tomatoes and β - carotene from carrots.
2. Extraction of essential oils.
3. Determination of lactose in normal cow's milk.
4. **TLC and Paper Chromatography:** Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Books Recommended:

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C.Heath.
3. Systematic Qualitative Organic Analysis, H.Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H.Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
6. Laboratory Experiments in Organic Chemistry, R. Adams, J. R. Johnson and C. F. Wilcox. The Macmillan Limited, London.

Semester-III
(Course MIC-307)
Agrochemical Chemistry Practical

Time: 6 Hours/week

Credit: 2

Syllabus

Max. Marks: 50

A. Analysis of Pesticides:

1. To estimate amount of Copper from Copper Fungicides.
2. To estimate amount of sulphur from given Sulphur Fungicides.
3. Estimation of nitro group by stannous chloride method.
4. Estimation of Simazine by colorimetric method.
5. Estimation of Ziram by hydrolysis method.

B. Analysis of Fertilizers:

1. Determination of amount of Nitrogen from given fertilizer sample.
2. Estimation of Calcium from superphosphate sample.
3. Analysis of organic manures.
 - a) Moisture content.
 - b) Organic matter and ash content.
4. Determination of available NPK in soil and Fertilizer samples.
5. Determination the percentage of phosphorus present in terms of P_2O_5 from a fertilizer sample volumetrically.

C. Soil and water analysis:

1. Determination of salinity of given soil sample conductometrically.
2. Estimation of amount of phosphorous from given soil sample colorimetrically.
3. Determination of concentration of sulphate ions from water samples.
4. Determination of total Sulphur in soil sample.
5. Determination of apparent specific gravity or bulk density, particle density or true density of the soil, water holding capacity of the soil.
6. Analysis of chalcopyrite, magnetite and ilmenite.
7. Determination of fluoride in drinking water by spectrophotometry and ion selective electrodes.

D. Preparation of agrochemicals:

1. 2- Naphthoxy acetic acid.
2. Chlorophenoxy acetic acid.
3. Maleic hydrazide.
4. Phthallyl hydrazide.
5. Dimethyl phthalate.
6. Coumarin.
7. Dithiocarbamate pesticides.

Books Recommended:

1. A Text book of Quantitative Inorganic Analysis, A.I. Vogel, ELBS, 1978.
2. Standard Method for the Examination of Water and Waste Water, APHA, AWWA and WPCF, Washington DC, 1989.
3. Quantitative Chemical Analysis, I. M. Kolthof and E.P. Sandell, McMillan, 1980.
4. Environmental Chemistry, I. Williams, Wiley, 2001.
5. Comprehensive Analytical Chemistry, Lobinski and Marczenko, Vol.30, Elsevier, 1996.
6. Physicochemical Experiments, J. Rose.
7. Vogel's Text Book of Quantitative Chemical Analysis(5th Ed), G.H.Jeffrey, J.Bassette, J.Mendham and R.C.Denny, Longman, 1999.
8. Methods of pesticides analysis- U. S. Sree Ramulu, Oxford- IBH

Semester-III
(Course MIC-308)
Organic Synthesis Practical

Time: 6 Hours/week
Syllabus

Credit: 2
Max. Marks: 50

A. Quantitative Analysis:

1. Determination of the percentage/ number of hydroxyl groups in an organic compound by acetylation method.
2. Estimation of amines/ phenols using bromate – bromide solution/ acetylation method.
3. Determination of iodine and saponification values of an oil sample.
4. Determination of DO, COD and BOD of water sample.

B. Multistep Synthesis:

1. Cannizzaro reaction: 4-chlorobenzaldehyde as substrate.
2. Benzilic Acid Rearrangement: Benzaldehyde → Benzoin → Benzil → Benzilic acid.
3. Hofmann bromamide Rearrangement: Phthalic anhydride → Phthalimide → Anthranilic acid
4. Beckmann Rearrangement: Benzene → Benzophenone → Benzophenone oxime → Benzanilide.
5. Skraup Synthesis: Preparation of quinoline from aniline.
6. Synthesis using Phase Transfer Catalysis: Alkylation of diethyl malonate or ethyl acetoacetate and an alkyl halide.
7. Synthesis of p- nitro aniline and any other reaction as per requirement.

C. TLC and column chromatography.

All the students must submit the recrystallised product along with yield, melting point and R_f value for all the stages of preparation.

Books Recommended:

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

SEMESTER-IV

Semester-IV
(Course MIC-401)

Credit: 4

Physical Chemistry

Syllabus

Lectures: 60

Unit- 1

Colloidal State: Classification of colloids, charge and stability of colloidal dispersions, Hardy-Schulze Law, gold number, electrical properties of colloids, electrical double layer and its structure, Stern's theory of double layer, zeta-potential, electrophoresis and electro-osmosis, emulsions and their classification, emulsifiers, gels and their classification.

Unit- 2

Operators in quantum mechanics: Introduction to angular momentum, Eigen values and eigen functions, Hermitian operator, Postulates of quantum mechanics, Time dependent and time independent Schrodinger wave equations, Some analytically soluble problems (complete solutions) of particle in a one and three dimensional box, harmonic – oscillator, the rigid rotor, the hydrogen atom and the quantum mechanical tunnelling.

Unit- 3

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

Unit- 4

Electrochemistry: Quantitative treatment of Debye - Hückel and Debye-Hückel-Onsagar (D-H-O) theory of conductance of electrolyte solution their limitations and modifications, Pair-wise association of ions (Bjerrum and Fuoss treatment), Determination of association constant (KA) from Debye – Huckel Limiting Law, Extended Debye – Huckel Law, Qualitative treatment of ion – solvent interactions (ion solvation).

Unit- 5

Statistical Thermodynamics: Basic Terminology: probability, phase space, micro and macro states, thermodynamic probability, statistical weight, assembly, ensemble, The most probable distribution: Maxwell-Boltzmann distribution, quantum statistics: The Bose- Einstein statistics and Fermi- Dirac Statistics, Thermodynamic probability (W) for the three types of statistics, Lagrange's undetermined multipliers, Stirling's approximation, Molecular partition function and its importance.

Books Recommended:

1. Physical Chemistry of Surfaces: A.W. Admson
2. Foundation of Colloid Science Vol. I and II: R.J. Hunter
3. Physical Chemistry: P.W. Atkins
4. Principal of Physical Chemistry: P.S. Pathania

Semester-IV
(Course MIC-402)

Credit: 4

Fuel and Energy Technology

Syllabus

Lectures: 60

Unit-1 Fuels

Types and properties of solid, liquid and gaseous fuels; Solid Fuels: Origin, classification and analysis of coal; gasification; oxidation; hydrogenation and liquefaction of coal; solid fuel handling and storage. Liquid Fuels: Origin and classification and properties of petroleum, liquid fuels from other sources; storage and handling of liquid fuels. Gaseous Fuels: Natural gases, methane from coal mines, manufactured gases, producer gas, water gas, refinery gas, LPG; cleaning, purification and handling of gaseous fuel compounds.

Unit-2 Fuel Cells and Fuels

Fuel Cell: Basics, difference between batteries and fuel cells, components of fuel cells, principle of working of fuel cell, performance characteristics of fuel cells, fuel cell types: alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, problems with fuel cells, applications of fuel cells.

Nuclear Fuel: Basic principles, elements of nuclear power plant, nuclear reactor and fuels, advantage and disadvantages of nuclear power plants.

Hydrogen Fuel: Its merit as a fuel; production, applications and storage methods

Unit-3 Renewable Energy Sources and Devices

Solar Energy: solar collectors, solar energy storage system, solar photovoltaic cell, solar hydrogen energy, solar pumps, heaters, dryers, cookers and refrigerators.

Wind Energy: Basic principle and conversions, site selection, wind mills, application and safety system, environmental aspects, wind energy conversion system.

Unit-4 Energy from Biomass

Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy farming.

Unit-5 Ocean Energy

Tidal energy, origin and nature of tidal energy and its limitations, Ocean Wave Energy: wave energy conversion devices, ocean thermal energy, Principles of ocean thermal energy conversion OTEC.

Books Recommended:

1. Robert Curley, Fossil Fuels (Energy: Past, Present, and Future) Rosen Education Service, 2011.
2. Julie Richards, Fossil Fuels Benchmark Books, 2009.
3. Andrew Solway, Hydrogen Fuel (Energy for the Future and Global Warming), Gareth Stevens Publishing, 2007.
4. Christopher A. Simon, Lanham, Maryland, Alternative Energy: Political, Economic, and Social Feasibility Maryland: Rowman & Littlefield, 2006.
5. Ghazi A. Karim, Fuels, Energy, and the Environment, CRC Press, 2012.
6. S. Basheer Ahmed, Nuclear Fuel and Energy Policy, 1979.
7. Donald L. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, 1998.

Semester-IV
(Course MIC-403)

Credit: 2

IPR, Quality control and assurance

Syllabus

Lectures: 30

Unit-1

Concept and fundamentals of IPR, need and economic importance of IPR, detail description of various IP Properties (Patents, Trademarks, Copyrights, Geographical Indications Industrial Designs and Trade secrets), IPR with emphasis on patent regime, factors affecting IP protection, penalties for violation or infringement, trade related aspects of IPR, concepts behind World Trade Organization (WTO), General Agreement on Tariffs and Trade (GATT), General Agreement on Trade in Services (GATS), Trade-Related Aspects of Intellectual Property Rights (TRIPS), Trade-Related Investment Measures (TRIMs).

Unit-II

Patents and Drafting Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure.

Government standards like Agmark, Bureau of Indian Standards (BIS) Hallmark, Indian Standards Index (ISI), Indian Pharmacopoeia (IP), an introduction to International Organization for Standardization (ISO), US Food and Drug Administration (USFDA), ICH Guidelines, Food and Agriculture Organization (FAO), Food Safety and Standards Authority of India (FSSAI).

Unit-III

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Filing and Drafting the Copyrights.

Trademarks and Trading licences Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Trading licence importance of exports and imports in trading.

Unit-IV

Concept of quality and quality control, nature of variability's, design of QC laboratory for chemical, instrumental and microbiological laboratories, standardization of reagents, labeling of reagents, control samples, data generation and storage, QC documentation, LIMS sampling techniques, sampling plans, steps to improve quality with reference to ISO and total quality management (TQM), total quality control (TQC), six sigma, preparation of control charts, sampling, inspection, cost reduction & quality improvement.

Unit-V

Concepts of quality assurance (QA), philosophy of GMP and cGMP, preparation of audit, conducting audit, audit analysis, audit report and audit follow up, premises: location, design, plant layout, construction, maintenance of sterilized areas, control of contamination.

Books Recommended:

1. Rimmer, M. (2008). Intellectual property and biotechnology: biological inventions. Edward Elgar Publishing.
2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
3. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
4. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>
5. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
6. Ramakrishna, Basic principles and acquisition of Intellectual Property Rights, CIPRA, NSLIU 2005.
7. P.M. Bhandari, Handbook of Small Scale Industry.
8. The Trade marks Act 1999 (Bare Act with short comments)-Universal Law Publishing Co. Ltd. 2005.
9. The Patents Act, 1970 (Bare Act with short comments) - as amended by Patents (Amendment) Rules 2006 w.e.f. 5-5-2006. Commercial law publishers (India) Pvt. Ltd. 2006.
10. Thomas T Gordon and Arthur S Cookfair, Patent Fundamentals for Scientist and Engineers, CRC Press.

Semester-IV
(Course MIC-404)
Industrial Training and Project Report

Time: 3 months

Credit: 6

Syllabus

Max. Marks: 150

Each candidate has to undergo three months of industrial training and produce a detailed project report on the work performed by him/her in the industry.

Semester-IV
(Course MIC-405)
Seminar

Time: 30 min

Credit: 4

Syllabus

Max. Marks: 50

Every candidate will have to deliver a seminar of 20-30 minutes duration on the project work performed in industry which will be chosen by him / her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three-member committee (one coordinator and two teachers) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate.

- (i) Content
- (ii) Expression
- (iii) Presentation
- (iv) Depth of the subject matter and answers to the questions.

22-23
3rd/4th

Chemistry Spread Over Four Semesters (I-IV) For Session 2022-23 and Onwards

Sr. No.	Course No.	Title	Course Type	Teaching hour per week	Credit	Max. Marks (Theory+ Internal Assessment)	Total Marks
Semester-I							
1	MIC-101	Inorganic Reagent and Chemistry	CPT	4	4	80+20	100
2	MIC-102	Organic synthesis and Chirotechnology	CPT	4	4	80+20	100
3	MIC-103	Fundamental Physical Chemistry	CPT	4	4	80+20	100
4	MIC-104	Mathematics for Chemists and Applications of computer in Chemistry	AEC	3	3	60+15	75
5	MIC-105	Environment Pollution and Monitoring Techniques	AEC	3	3	60+15	75
6	MIC-106	Industrial Internship and seminar*	PRC*	10 Day	1	15+10	25
7	MIC-107	Inorganic Chemistry Practical based on MIC-101	CPP	6	2	40+10	50
8	MIC-108	Organic Chemistry Practical based on MIC-102	CPP	6	2	40+10	50
9	MIC-109	Physical Chemistry Practical based on MIC-103	CPP	6	2	40+10	50
				36	25		625
Semester-II							
1	MIC-201	Spectroscopy of Organic Compounds	CPT	4	4	80+20	100
2	MIC-202	Advanced Analytical Chemistry	CPT	4	4	80+20	100
3	MIC-203	Mechanism and kinetics of Polymers	CPT	4	4	80+20	100
4	MIC-204	Fundamental of Medicine Chemistry	CPT	3	3	60+15	75
5	MIC-205	Industrial Internship and seminar*	PRC*	10 Day	1	15+10	25
6	MIC-206	Instrumental Methods of Analysis Practical based on MIC-202	CPP	6	2	40+10	50
7	MIC-207	Polymer Chemistry Practical based on MIC-203	CPP	6	2	40+10	50
8	MIC-208	Cheminformatics and Drug Design Practical based on MIC-204	CPP	6	2	40+10	50
				33	22		550

*Industrial Internship of 10 days is mandatory for every student and will be evaluated according to the written report submission and seminar.

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SARDAR PATEL UNIVERSITY, MANDI

FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. Industrial Chemistry

Session: 2022-23 and onwards



Dr. Lakshmi Sen
[Signature]

[Signature]
Dr. Manish Sharma
Asstt. Prf. in Botany
SPU, Mandi

[Signature]
Dr. Neelam Dule
Assistant Prof
in Zoology
SPU Mandi (H.P.)

DEPARTMENT OF
INDUSTRIAL CHEMISTRY

SARDAR PATEL UNIVERSITY MANDI-175001

HIMACHAL PRADESH

[Signature]
[Signature]
02-05-2023

[Signature]
Dr. Anand Kumar
Associa Prof Physics

[Signature]
Dr. Karan Gupta
Associate Prof.

[Signature]
29/9/22

Bachelor in Hotel Management Four-year syllabus– Total Credits 183

Students of Bachelor in Hotel management Course will undergo the course of Studies of four years duration, which will be run on semester basis. The course curriculum of B.H.M is subject to change with the addition of fourth year. The course will comprise 8 semesters viz. Semester I to VIII. After successful completion of the course, students will be awarded a degree in Bachelor in Hotel Management of H.P. University.

BHM Course Curriculum

The course will be spread over eight semesters

Semester 1	Total Marks=100			Credits
Course	Theory	Internal Assessment	Practical	
BHM-101: Front Office Operations	50	30	20	4
BHM-102: Hotel Housekeeping I	50	30	20	4
BHM-103: Basic Food & Beverage Service	50	30	20	4
BHM-104: Basic Food and Beverage Production	50	30	20	4
BHM-105: Food Microbiology and Nutrition	70	30	---	4
BHM-106: Communication and Soft Skills	70	30	---	2
BHm-107: Practical		30	70 (Including Demonstration, Viva Voce, Food Production, F& B Service)	2
Semester 1: Total Credits				24

Semester II	Total Marks=100			Credits
Course	Theory	Internal Assessment	Practical	
BHM-201: Hotel Housekeeping II	50	30	20	4
BHM-202: Fundamental of Tourism & Tourism Products	70	30	--	4
BHM-203: Food & Beverage Service Operation –I	50	30	20	4
BHM-204: Food & Beverage Production –I	50	30	20	4
BHM-205: Hotel Engineering	70	30	----	4
BHM-206: Basics of Computers	50	30	20	4
BHm-207: Practical		30	70- (Including Demonstration, Viva Voce, Housekeeping, Front Office, Computers)	2
ENVS2AECC02-Environment Studies	100	00	--	-----
Semester II: Total Credits				26