



# MANONMANIAM SUNDARANAR UNIVERSITY -TIRUNELVELI UG PROGRAMMES



## OPEN AND DISTANCE LEARNING(ODL) PROGRAMMES

(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)

### B.Sc. Chemistry

Semester	Course	Title of the Course	Course Code	Course Type
<b>I</b>	Part I –Languages (Tamil)	Pothu Tamil – I - Tamil Ilakkiya Varalaru - I	J1TL11	Theory
	Part II – Languages (English)	General English–I	J2EN11	Theory
	Core I	General Chemistry ICCI	JMCH11	Theory
	Core II	Quantitative Inorganic Estimation (Titrimetry) and Inorganic Preparations	JMCHP1	Practical
	Generic Elective - I	Allied Chemistry for Physical Science I	JECHA1	Theory
	Generic Elective - II	Allied Chemistry Practical I- Volumetric Analysis	JECHP1	Practical
	Skill Enhancement –I	Food Chemistry	JSCH11	Theory
	Foundation Course		JFCH11	Theory

### 3. GENERAL CHEMISTRY-I

UNIT	CONTENT
<b>I</b>	<p><b>Atomic structure and Periodic trends :</b> History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom; The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De- Broglie wavelength- Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli' exclusion principle and Aufbau principle; Numerical problems involving the core concepts.</p>
<b>II</b>	<p><b>Introduction to Quantum mechanics :</b> Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wave functions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbital's -Probability density and significance of <math>\Psi</math> and <math>\Psi^2</math>.</p> <p><b>Modern Periodic Table</b></p> <p><b>Cause of periodicity;</b> Features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electro negativity - electro negativity scales, applications of electro negativity.</p> <p>Problems involving the core concepts</p>
<b>III</b>	<p><b>Structure and bonding – I</b></p> <p><b>Ionic bond</b></p> <p>Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarization – polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts.</p> <p><b>Covalent bond</b></p> <p>Shapes of orbitals, overlap of orbitals – <math>\sigma</math> and <math>\Pi</math> bonds; directed valency - hybridization; VSEPR theory - shapes of molecules of the type <math>AB_2</math>, <math>AB_3</math>, <math>AB_4</math>, <math>AB_5</math>, <math>AB_6</math> and <math>AB_7</math></p> <p>Partial ionic character of covalent bond-dipole moment, application to molecules of the type <math>A_2</math>, <math>AB</math>, <math>AB_2</math>, <math>AB_3</math>, <math>AB_4</math>; percentage ionic character- numerical problems based on calculation of percentage ionic character.</p>

IV	<p><b>Structure and bonding – II</b></p> <p>VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – <math>\text{CO}_2</math>, <math>\text{NO}_2</math>, <math>\text{CO}_3^{2-}</math>, <math>\text{NO}_3^-</math>; limitations of VBT;</p> <p>MO theory - bonding, antibonding and nonbonding <math>\text{H}_2</math>, <math>\text{C}_2</math>, <math>\text{O}_2</math>, <math>\text{O}_2^+</math>, <math>\text{O}_2^{2-}</math>, <math>\text{N}_2</math>, <math>\text{NO}</math>, <math>\text{HF}</math>, <math>\text{CO}</math>; <math>\text{CO}_2</math> magnetic characteristics, comparison of VB and MO theories.</p> <p>Coordinate bond: Definition, Formation of <math>\text{BF}_3</math>, <math>\text{NH}_3</math>, <math>\text{NH}_4^+</math>, <math>\text{H}_3\text{O}^+</math> properties</p> <p>Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors</p> <p>Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, special properties of water, ice, stability of DNA; Effects of chemical force, melting and boiling points</p>
V	<p><b>UNIT-V: Basic concepts in Organic Chemistry and Electronic effects</b></p> <p>Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects. Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, bond lengths; steric inhibition to resonance. Hyperconjugation - stability of alkenes, bond length, orienting effect of methyl group, dipole moment of aldehydes and nitromethane</p> <p>Types of organic reactions- addition, substitution, elimination and rearrangements.</p>
<b>Recommended Text</b>	
1.	Madan, R. D. and Sathya Prakash, <i>Modern Inorganic Chemistry</i> , 2 <sup>nd</sup> ed.; S.Chand and Company: New Delhi, 2003.
2.	Rao, C.N. R. University General Chemistry, Macmillan Publication: New Delhi, 2000.
3.	Puri, B. R. and Sharma, L. R. <i>Principles of Physical Chemistry</i> , 38 <sup>th</sup> ed.; Vishal Publishing Company: Jalandhar, 2002.
4.	Bruce, P. Y. and Prasad K. J. R. <i>Essential Organic Chemistry</i> , Pearson Education: New Delhi, 2008.
5.	Dash UN, Dharmarha OP, Soni P.L. Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi, 2016

#### 4. Quantitative Inorganic Estimation (Titrimetry) and Inorganic Preparations

UNIT	CONTENT
I	<p><b>Chemical Laboratory Safety in Academic Institutions:</b> Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal.</p> <p><b>Common Apparatus Used in Quantitative Estimation (Volumetric)</b></p> <p>Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand.</p> <p><b>Principle of Quantitative Estimation (Volumetric)</b> Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations; indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.</p>
II	<p><b>Quantitative Estimation(Volumetric) :</b> Preparation of standard solution, dilution from stock solution.</p> <p><b>Permanganometry :</b> Estimation of sodium oxalate using standard ferrous ammonium sulphate.</p> <p><b>Dichrometry :</b> Estimation of ferric alum using standard dichromate (external indicator) Estimation of ferric alum using standard dichromate (internal indicator).</p> <p><b>Iodometry:</b> Estimation of copper in copper sulphate using standard dichromate.</p> <p><b>Argentimetry:</b> Estimation of chloride in barium chloride using standard sodium chloride/Estimation of chloride in sodium chloride (Volhard's method).</p>

III	<b>Unit III Complexometry</b> Estimation of hardness of water using EDTA <b>Estimations :</b> Estimation of iron in iron tablets Estimation of ascorbic acid.
	<b>Preparation of Inorganic compounds-</b> Potash alum Tetraammine copper (II) sulphate Hexamminecobalt (III) chloride Mohr's Salt
<b>Recommended Text</b>	
1	Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. <i>Basic Principles of Practical Chemistry</i> , 2 <sup>nd</sup> ed.; Sultan Chand & Sons: New Delhi, 1997.
2	Nad, A. K.; Mahapatra, B.; Ghoshal, A.; <i>An advanced course in Practical Chemistry</i> , 3 <sup>rd</sup> ed.; New Central Book Agency: Kolkata, 2007.

## 5. ALLIED CHEMISTRY FOR PHYSICAL SCIENCES I

UNIT	CONTENT
I	<p><b>Chemical Bonding and Nuclear Chemistry</b></p> <p>Chemical Bonding: Molecular Orbital Theory-bonding, antibonding, and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes - carbon dating, rock dating and medicinal applications.</p>
II	<p><b>Industrial Chemistry</b></p> <p>Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.</p>
III	<p><b>Fundamental Concepts in Organic Chemistry</b></p> <p>Hybridization: Orbital overlap, hybridization and geometry of CH<sub>4</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>2</sub> and C<sub>6</sub>H<sub>6</sub>. Electronic effects: Inductive effect and consequences on K<sub>a</sub> and K<sub>b</sub> of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric- examples. Reaction mechanisms: Types of reactions–aromaticity (Huckel’s rule)- aromatic electrophilic substitution; nitration, halogenation, Friedel- Craft’s alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.</p>
IV	<p><b>Thermodynamics and Phase Equilibria</b> : Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot’s cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy. Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).</p>

V	<b>Analytical Chemistry</b> Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.
<b>Recommended Text</b>	
1	V.Veeraiyan, Text book of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2	S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3	S.ArunBahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, NewDelhi, twenty third edition, 2012.
4	P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan
5	Chand & sons, New Delhi, twenty ninth edition, 2007.

## 5A. ALLIED CHEMISTRY PRACTICAL FOR PHYSICAL SCIENCES I

<b>COURSE OUTLINE : VOLUMETRIC ANALYSIS</b>	
	<ol style="list-style-type: none"><li>1. Estimation of sodium hydroxide using standard sodium carbonate.</li><li>2. Estimation of hydrochloric acid using standard oxalic acid.</li><li>3. Estimation of ferrous sulphate using standard Mohr's salt.</li><li>4. Estimation of oxalic acid using standard ferrous sulphate.</li><li>5. Estimation of potassium permanganate using standard sodium hydroxide.</li><li>6. Estimation of magnesium using EDTA.</li><li>7. Estimation of ferrous ion using diphenyl amine as indicator.</li></ol>
<b>Recommended Text</b>	
V.Venkateswaran, R.Veerasingam, A.R.Kulandaivelu, Basic Principles of Practical Chemistry; Sultan Chand & sons, Second edition, 1997.	



## 6. FOOD CHEMISTRY

UNIT	CONTENT
I	<p><b>Food Adulteration</b></p> <p>Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals -Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.</p>
II	<p><b>Food Poison</b></p> <p>Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) -Chemical poisons - First aid for poison consumed victims.</p>
III	<p><b>Food Additives :</b> Food additives -artificial sweeteners – Saccharin - Cyclamate and tartaric acid Food flavours -esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents – preservatives -leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.</p>
IV	<p><b>Beverages :</b> Beverages-soft drinks-soda-fruit juices-alcoholic beverages-examples. Carbonation-addiction to alcohol–diseases of liver and social problems</p>
V	<p><b>Edible Oils :</b> Fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases-determination of iodine value, RMI value, saponification values and their significance.</p>
<b>Recommended Text</b>	
1	Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2	Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co. Publishers, second edition, 2006.
3	Food Chemistry, Dr. L. Rakesh Sharma, Evincepub publishing, 2022.
4	Food processing and preservation, G. Subbulakshmi, Shobha A Udipi, Padmini S Ghugre, New age international publishers, second edition, 2021.

## 7. FOUNDATION COURSE

UNIT	CONTENT
I	<p><b>Structure of atom and periodic classification of Elements and properties.</b> Atom structure-Fundamental particles-Atomic mass- Atomic number – Isotopes –Isobars – Isotones – Orbitals-Quantum number and their significance. Shapes of s,p and d orbitals- Rules governing electronic configuration in various its atomic orbitals. Periodic table-periodic laws (Mendeleev and Mosley)- Classification of elements into s,p, d and f-blocks .Metals-Non metals-Periodic properties-Concept, Variation and factors affecting various periodic properties-Inert pair effect.</p>
II	<p><b>Chemical Bonding :</b> Definition- Types of chemical bond-Ionic bond- Ion polarization - Dipole moment and Percentage of ionic character-Covalent bond-Definition –Postulates of Valence bond theory and Concept of hybridization (<math>sp</math>, <math>sp^2</math>, <math>sp^3</math>, <math>sp^3d</math>, <math>sp^3d^2</math>, <math>dsp^2</math>, <math>d^2sp^3</math>) –Magnetic properties – Paramagnetic – Diamagnetic-Ferromagnetic. Co-ordinate covalent bond-Definition –Examples-Co-ordination compounds (basic concepts only).</p>
III	<p><b>Nomenclature and Isomerism in Organic compounds:</b> Carbon compounds- Uniqueness of carbons- Classification of hydrocarbons - IUPAC Nomenclature of Organic compounds Isomerism: Structural and Stereoisomerism Structural Isomerism: Chain isomerism, Functional isomerism, Positional isomerism and Meta isomerism. Stereoisomerism: Geometrical and Optical isomerism-Chiral molecule- Enantiomers - Diastereomers- Meso compounds - Racemic mixture.</p>
IV	<p><b>States of Matter :</b></p> <p><b>Gaseous state:</b> Kinetic theory of gases- Ideal and Non-ideal gases- Ideal gas equation- Deviation of ideal gas from ideal behavior -vander Waal's equation and Liquification of gases.</p> <p><b>Liquids :</b> Intermolecular forces, Vapour pressure and Boiling point of liquid - Surface tension –Viscosity- Factors affecting surface tension and viscosity.</p> <p><b>Solids:</b> Definition - Characteristics of solids- Amorphous and Crystalline solids - Space lattice and unit cells - Close packed structure of solids-Radius ratio rule.</p>

<b>v</b>	<p><b>Introduction to Spectroscopy :</b>          Electromagnetic radiation- General characteristics of Wave – Wavelength – Frequency – Amplitude – Wave number - Electromagnetic spectrum- Absorption and Emission spectrum- Quantization of Energy level - Selection rule - Intensity of the Spectral lines – Width of Spectral lines. Types of spectroscopy: Microwave spectroscopy, Infrared spectroscopy, UV-Visible spectroscopy, Nuclear Magnetic Resonance spectroscopy, Electron spin resonance spectroscopy.</p>
<b>Recommended Text</b>	
1	B.R Puri, L.R.Sharma, K.C. Kalia, Principles of Inorganic chemistry, Milestone Publishers and Distributors, New Delhi, 2012.
2	B.R. Puri and L.R.Sharma, 38 <sup>th</sup> edition, Vishal Publishing company, Jalendar 2002.
3	K.S, Tewari, S.N. Mehrothra and N.K.Vishnoi, Text book of Organic Chemistry, 2 <sup>nd</sup> edition Vikas publishing House, New Delhi, 1998.