SYLLABUS

MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

UG - COURSES – AFFILIATED COLLEGES

Course Structure for **B.Sc CHEMISTRY**

(Choice Based Credit System)

(with effect from the academic year 2017- 2018 onwards)

Semester-VI				
Part	Subject Status	Subject Title	Subject Code	Credit
III	Core Paper IX	Inorganic Chemistry – III	SMCH61	4
	Core Paper X	Organic Chemistry - IV	SMCH62	4
	Core Paper XI	Physical Chemistry – IV	SMCH63	4
	Major Elective – III	Nano Chemistry	SECH6B	4
	Major Practical VII	Gravimetric Estimation & Organic Preparation	SMCHP7	2
	Major Project	Major Project	SMCH6P	7

Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. **Scheme for internal Assessment**:
Maximum marks for written test: **20 marks**
3 internal tests, each of **I hour** duration shall be conducted every semester.
To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks.

The break up for internal assessment shall be:
Written test- 20 marks; Assignment -5 marks Total - 25 marks

B. Scheme of External Examination
3 hrs. examination at the end of the semester
A – Part : 1 mark question two - from each unit
B – Part : 5 marks question one - from each unit
C – Part : 8 marks question one - from each unit

- **Conversion of Marks into Grade Points and Letter Grades**

S.No	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	AA	-	Absent

- **Cumulative Grade Point Average (CGPA)**

$$\mathbf{CGPA} = \frac{\mathbf{\Sigma\,(GP \times C)}}{\mathbf{\Sigma C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

- **Classification**
  a) First Class with Distinction : CGPA $\geq$ 7.5*****
  b) First Class : CGPA $\geq$ 6.0
  c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
  d) Third Class : CGPA $<$ 5.0

INORGANIC CHEMISTRY – III

Objectives

To study the theories in coordination chemistry To study the chemistry of metal carbonyls To understand the role of metal ions in biological systems To study the basic principles of photoinorganic chemistry

UNIT - I
COORDINATION CHEMISTRY-I

Introduction: IUPAC nomenclature, Ligands- monodentate, bidentate, and polydentate ligands; coordination sphere; coordination number; nomenclature of mononuclear and dinuclear complexes. Structural and stereoisomerism in tetrahedral, square planar and octahedral complexes.Valance Bond theory – applications of valance bond theory to tetrahedral, square planar and octahedral complexes- Merits and limitations of VB theory.

UNIT – II
COORDINATION CHEMISTRY II

Crystal field theory - splitting of d-orbitals in octahedral and tetrahedral complexes - factors affecting the magnitude of crystal field splitting - effects of crystal field splitting - spectrochemical series - applications of CFT - magnetic properties and spectra of transition metal complexes - crystal field stabilization energy and their uses - limitations of CFT - effective atomic number rule - stability of complexes - step-wise and overall stability constants - factors affecting the stability of complexes - determination of stability constants.

UNIT – III
CO-ORDINATION CHEMISTRY III

Labile and inert complexes - ligand substitution reactions in octahadral complexes: aquation, base hydrolysis and anation reactions - substitution reactions in square planner complexes - Trans effect - theories of trans effect - mechanism of substitution reactions - redox reactions: inner-sphere and outer-sphere electron transfer reactions.

UNIT - IV
ORGANOMETALLIC CHEMISTRY

Introduction–History, Nomenclature of organometallic compounds, EAN rule and 18 electron rule. Structure and nature of M-L bond in metal carbonyls - metal nitrosyls. preparation of organo metallic compounds of Mg, Zn, Li, Cu, P, B, Ti, Fe and Co Wilkinson‘s catalyst and alkene hydrogenation, hydroformylation, Mansanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.

UNIT - V

Inorganic photochemistry

Electronic transitions in metal complexes : selection rules - metal-centered and charge-transfer transitions - properties of excited states - bimolecular quenching and energy transfer - photochemical pathways : substitutional, reduction-oxidation and isomerisation processes - photosubsitution reactions of Cr(III) complexes - Adamson's rules - photoredox reactions of Co(III) complexes - photoismerisation in Pt(II) complexes. Photochemical conversion and storage of solar energy : photolytic cleavage of water into H2 and O2 - photoelectrochemical devices : photogalvanic cells and semiconductor based photovoltaic cells.

Text books :

1. J.D. Lee, *Concise Inorganic Chemistry* 5th Ed., Blackwell Science Ltd.,
2. James E. Huheey, Elien A. Keiter and Richard L. Keiter, *Inorganic Chemistry : Principles Structure and Reactivity,* 4th Ed., Harper College Publisher.

Reference books :

1. F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Marilo and Manfred Bochman, *Advanced Inorganic Chemistry,* 6th Ed., Wiley Interscience Publication.
2. Fred Basolo and Ralph G. Pearson, *Mechanisms of Inorganic Reactions : A study of metal complexes in solution,* 2nd Ed., John wiley and sons, Inc.,
3. David E. Fenton, *Biocoordination Chemistry,* Ist Ed., Oxford Science Publications.
4. Ivano Bertini, Harry B Gray, Stephen J Lippard, Joan Selverstone Valentine, *Bioinorganic Chemistry,* 1st Ed., Viva Books Pvt. Ltd.,
5. J.K. Rohatgi - Mukherjee, *Fundamentals of Photochemistry* - Wiley Eastern Revised Ed.,
6. *Journal of Chemical Education,* Vol.60, No.10, October 1983.
7. A.W. Adamson and P.D. Fleischauer, (Editors) *Concepts of Inorganic photochemistry,* John wiley and sons, New York, 1975.

ORGANIC CHEMISTRY - IV

Objectives

- To learn about natural products
- To understand chemistry of aromatic compounds
- To study spectroscopy

UNIT-I
CARBOHYDARATES

Classification-Monosaccharides- constitution of glucose and fructose. Reactions of glucose and fructose – Osazone formation, Mutarotation and its mechanism, cyclic structure, pyronose and furanose forms. Epimerisation-Chain lengthening and shortening of aldoses. Interconversions of aldoses and ketoses. Disaccharides- sucrose- reactions and structure. Polysaccharides – starch and cellulose (elucidation of structure not necessary).

UNIT-II
PHENOLS, AROMATIC ALDEHYDES, KETONES AND ACIDS

Phenols

Acidic character of phenols- effect of substituents on acidity of phenols - Mechanisms of Kolbe‘s reaction and Riemer-Tiemen reaction. Preparation of cresols, catechol, resorcinol, quinol and euginol.

Aldehydes and ketones

Preparation and uses of cinnamaldehyde. Coumarin, vanillin, Michler‘s ketone, p-benzoquinone-Quinone mono oxime tautomerism. Mechanism of Cannizaro reaction, benzoin condensation, Perkin reaction, Claisen reaction, Knovenagel reaction,Gattermann aldehyde synthesis and Houben –Hoesch synthesis.

Aromatic acids

Ortho effect, preparation of mandelic acid, cinnamic acid and anthranilic acid. Preparation and uses of benzene-1,2- dicarboxylic acid, benzene-1,3- dicarboxylic acid and 1,4- dicarboxylic acid.

UNIT III
REARRANGEMENTS

Rearrangement to electron-deficient carbon – 1,2 shift (Wagner-Meerwein rearrangement, pinacol rearrangement,Wolff rearrangement in Arndt-Eistert synthesis, benzil-benzilic acid rearrangement).

Aromatic rearrangements from oxygen to ring carbon (Fries rearrangement, Claisen rearrangement and benzidine rearrangement).

Rearrangement to electron-deficient nitrogen (Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Curtius rearrangement).

Rearrangement to electron-deficient oxygen (Baeyer-Villiger oxidation, hydroperoxide rearrangement,cumene hydroperoxide-phenol rearrangement), Dakin reaction.

UNIT IV
TERPENOIDS AND ALKALOIDS

Terpenes and terpenoids - classification - isoprene rule. Elucidation of structure and synthesis of citral , limonene, menthol, α-terpineol and camphor. Alkaloids: Introduction, classification and general methods for the determination of structure. Structural elucidation and synthesis of conine,piperine and nicotine

UNIT-V
ORGANIC SPECTROSCOPY

UV spectroscopy - chromophore – auxochrome – blue shift, red shift – hypochromic shift, hyperchromic shift – applications for studying functional groups,cis-trans isomerism and nature of double bonds- Woodward-Fischer rules as applied to conjugated enes and alpha and beta unsaturated ketones. IR spectroscopy– characteristics of IR absorption frequencies – intermolecular and intramolecular hydrogen bonding – functional group detection. NMR Spectroscopy - interpretation of NMR spectra of simple organic compounds such as acetone, anisole, benzaldehyde, isobutene, mesitylene, 1-chloropropane, ethyl methyl ketone, benzyl alcohol, and propionic acid.

Text Books

1. K.S. Tewari, N.K. Vishil, S.N. Mehotra – A text book of org. chem – 1st edition, Vikas Publishing House Pvt Ltd., 2001, New Delhi.
2. P.L. Soni, Text Book of Organic chemistry, Sultans Chand, 1991, New Delhi,

Reference Books

1. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
2. Gurdeep Chatwal, Reaction mechanisms and reagents in organic chemistry
3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House,2002.
4. Gurdeep Chatwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House,2002
5. Y.R. Sharma, O.P. Vig, Elementary organic absorption spectroscopy – 1st edition, Goel Pulishers, 1997, Meerut
6. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI Limited, New Delhi, 1992.
7. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley and Sons, New York,1992.
8. S. H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 1987.

PHYSICAL CHEMISTRY –IV

Objectives

- To learn about basic concepts in spectroscopy
- To understand chemical equilibrium and phase equilibrium
- To study nano chemistry

UNIT - I
SPECTROSCOPY -II

Raman spectroscopy: Principle - Rayleigh and Raman scattering - Stokes and Anti-stokes lines - differences between IR and Raman spectroscopy - mutual exclusion principle – selection rule - applications.

NMR spectroscopy: Theory of NMR, modes of nuclear spin-relaxation process - shielding effect, hyperfine splitting, coupling constants, - chemical shift - factors affecting chemical shift - internal standard, δ and τ scale - applications of NMR and limitations of NMR.

ESR spectroscopy: principle - energy level splitting - presentation of ESR spectrum for methyl and benzene radicals, deuterium - applications Mass spectroscopy: basic principles of mass spectrum - molecular peak - base peak - isotopic peak - meta stable peak - types of fragmentation - factors influencing the fragmentation - Mc-Lefferty rearrangement - applications

UNIT – II
CHEMICAL KINETICS

Rate of reaction-Measuring rates of reaction-expressing reaction rates-factors influencing rate-rate constant-Rate laws, Stoichiometry, order and molecularity of reactions- First order, second order, third order and zero order reactions and example. Characteristics of I,II,III and Zero order reactions. Determination of order of reactions-expression for rate constant of first and second order reaction-derivation. Effect of temperature on rate constant. The activation energy - determination of Arrhenius frequency factor and energy of activation-The collision theory of reaction rates and its limitation. Lindemann theory of unimolecular reactions-The theory of Absolute reaction rate Comparison of the collision theory with the Absolute reaction rate theory.

UNIT – III
IONIC EQUILIBRIA

The Ostwald‘s dilution law-experimental verification-limitations-acids and bases-Lewis concept-dissociation of weak acids and weak bases-dissociation of water-pH scale-common ion effect- its applications-buffer solution-different types-calculation of pH value of buffer solution. Hydrolysis of salts - salts of weak acids & strong base, salts of weak base and strong acids, salts of weak acid and weak base - determination of degree of hydrolysis. Acid-base indicators- acid-base titration and use of indicators. Solubility product - Application of solubility product principle

UNIT-IV
PHASE EQUILIBRIA

Phase rule - phase, component, degree of freedom - thermodynamic derivation of phase rule, One-component system: Phase diagrams of Water and sulphur systems. Two component system: (i) Simple eutectic: Lead-silver system and potassium iodide-water system. (ii) Formation of compound with congruent melting point: Magnesium – zinc system and ferric chloride – water system. Distribution Law-Statement and thermodynamic derivation-association of the solute in one of the solvents- dissociation of the solute in one of the solvents-applications of the distribution law-solvent extraction.

UNIT – V
NANOCHEMISTRY

Definition - size dependent properties: magnetic, electrical and optical properties – quantum dots – metal oxides and metal nano particles - ceramic nano particles Synthesis of nanomaterials - bottom-up and top-down approaches - thin film deposition - catalytic assisted growth - chemical vapour deposition - sol gel method - chemical reduction Fullerenes - carbon nanotubes - single walled and multi walled nano tubes – structures - carbon nanofibre – nanocomposites. Applications of nanoscience and nanotechnology.

Text books :

1. Principles of Physical Chemistry - B.R. Puri and Sharma - Shobanlal Nagin Chand & Co.,
2. Text Book of Physical Chemistry - P.L. Soni - Sultan Chand.

Reference books :

1. Elements of physical chemistry - Glasstone and Lewis - Macmillan.
2. Physical chemistry - G.W. Castellan - Narosa publishing house.
3. Universal General Chemistry, C.N.R. Rao, Macmillan.
4. Nano: The Essentials Understanding Nano Science and Nanotechnology. T. Pradeep -. Tata Mc Graw-Hill Publishing Company Ltd. New Dehli.
5. Introduction to Nano technology, Charles P Poole Jr. & Frank J Owens, Wiley Interscience
6. Kemp, W. Organic Spectroscopy
7. Jag Mohan Organic Spectroscopy 8. Chemical Kinetics-K. J. Laidler, Tata McGraw Hill Publishing Company, NewDelhi

GREEN CHEMISTRY

Objectives

- To introduce the basics and need for Green Chemistry
- To understand the principles and designing a green synthesis of selected compounds
- To make the students familiar with the usage of green solvents and green catalysts in chemical reactions.
- To learn the principles of the microwave and ultrasound assisted reactions.

UNIT- I

Introduction to green chemistry

Definition – need for green chemistry – scope of green chemistry. Concept of atom economy – yield – mass intensity and atom economy. Calculation of atom economy, mass intensity, mass productivity and carbon efficiency. Different types of reactions and atom economy - addition, substitution, elimination and rearrangements. Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diasterioselectivity.

UNIT- II

Green solvent

Super critical fluids – Introduction – extraction of super critical fluids – solvents of super critical fluid– advantages and applications. Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide - advantages and applications. Chemical reactions in supercritical water and Near – Critical Water (NCW)- Region. Extracting natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation lonic liquid as green solvent : Introduction – synthesis of ionic liquids - acidic ionic liquid and neutral ionic liquids – applications in organic synthesis. Green reagents : Dimethyl carbonate and Polymer supported reagents.

UNIT- III

Green catalyst

Catalysis over view : acid catalyst - basic catalyst – oxidation catalyst – polymer supported catalyst- photosensitized super acid catalyst and Tetra

Amido Macrocylic Ligand (TAML) catalyst. Biocatalyst : microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst. Development of mesoporous supports by liquid crystal templating – neutral templating methods- heterogeneous catalyst – solid supported catalyst.

UNIT- IV

Green synthesis

Green synthesis of the following compounds -Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibruprofen and Paracetamol Microwave assisted reactions in water – Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols Microwave assisted reactions in organic solvents – Esterification, Fries rearrangement, Clasien Rearrangement, Diels-Alder Reaction and Decarboxylation. Ultra sound assisted reactions – Esterification, Saponification, alkylation , oxidation, reduction, coupling reactions and Cannizaro reactions.

UNIT -V

Green reactions invloving basic principle of green chemistry.

Twleve principle of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents. Combinatorial green chemistry – green chemistry in sustainable developments. Importance of Green chemistry in day to day life, versatile bleaching agents and analgeric drugs.

Text Books

1. V.K.Ahluwallia &M.R Kidwai ―New Trends in Green Chemistry‖, Anamalaya Publishers (2005)
2. P.T.Anaster &J.K.Warnerr ― Oxford Green Chemistry,Theory and Practical‖,University Press(1998)

Reference Books

1. A.S. Matlack,‘‘ Introduction to Green Chemistry‖-Marcel Deckkar (2001)
2. V.K.Ahhluwallia,―GreenChemistryEnvironnmentallyBenign Reaction‖Ane Books Pvt.Ltd. New Delhi (2009)
3 Rashmi Sannghi &MM Srivastava, ―Green Chemistry Environment Friendly Alternatives.‖ Narosa Publishing House Pvt Ltd, New Delhi (2009)

NANO CHEMISTRY

Objectives

- To give an insight into the basics of nanochemistry.
- To understand the difference between bulk material and nanomaterial and learn the synthesis, application and fabrication of nanostructure.
- To study the importance of nanocatalyst, nanocomposites and fibers.
- To make the students familiar with the characterization and applications of nanomaterials.

UNIT- I

Introduction to Nano chemistry.

Definition: nanoscience – nanotechnology – nanochemistry – significance of nanoscale - factors responsible for special properties of nanomaterials.

Nanomaterials: Different types of nanomaterials and structures- quantum wells – quantum wires – quantum dots – nanoclusters – nanocrystals – nanowires and nanotubes. Feynman‘s Prophecy– manufacturing of nanomateris - top-down and bottom-up approaches.

UNIT-II

Synthesis of nano particles.

Introduction – orientation of nanoparticles – synthesis of nanoparticles. Physical methods: laser ablation, physical vapour deposition (PVD) and solvated metal atom dispersion (SMAD). Chemical methods: thermolysis, sonochemical method, reduction methods, phase-transfer processes and biosynthesis of nanoparticles. Synthesis of nanosized semiconductors: precipitation methods and thermal decomposition of complex precursors. Synthesis of ceramics: physical methods, gas condensation method, laser method, chemical methods and sol-gel synthesis.

UNIT –III

Nanocatalyst and carbon based nanomaterials

Inroduction – fundamentals of catalysis – adsorption of a molecule on a catalyst surface, adsorption theory- Langmuir adsorption isotherm. Surface reactions – synthesis – synthesis requirements, example of a conventional synthetic technique, non traditional methods for preparing nanocatalyst. Characterization of nanocatalyst : overview - bulk characterization technique and surface characterization technique Carbon nanomaterials : structure and properties of graphite, diamond and fullerenes.

UNIT-IV

Nanocomposites and fibers.

Introduction - Background - types of composite materials - The nano perspective. Physical and chemical properties of materials – mechanical properties, thermal properties, electronic properties and chemical properties. Natural

nanocomposities - Skin of the sea cucumber and hard natural nanocomposites. Carbon fibers and nanotubes – Types of fibers, Whiskers and nanotubes – synthesis of fibers and nanotubes - chemical modification and applications of carbon nanotube. Metal and Ceramic nanocomposites - Metal nanocomposites, inorganic nanofibers and concrete. Clay nanocomposite materials -polypropylene clay nanocomposite , mont morillonite clay nanocomposite and halloysite nanotube claycomposites.

UNIT-V

Characterization and applications of nanomaterials.

Types of characterization methods – Electron probe method- Scanning electron microscopy – Transmission electron microscopy, Spectroscopyic Methods, - UV – Visible adsorption and emission spectroscopy, Infra Red and Raman spectroscopy and X-ray diffraction methods. Current applications: sunscreens and cosmetics – nano medicine, drug delivery and cancer drugs – food and drinks, textiles, chemical industry and electronic devices. Short term applications - paints – fuel cells – displays – batteries – fuel additives and catalysts. Long term applications- composites – lubricants – magnetic materials – medical implants – machinable ceramics – water purification and military battle suits.

Text Books

1. Geoffrey A. Ozin and Andre C. Arsenault, ―Nanochemistry: A chemical approach to nanomaterials‖, RSC publishing, (2005), U.K.
2. Hari Singh Nalwa, ―Nanostructured Materials and Nanotechnology‖, Academic Press, New York,(2002).

Reference Books

1. C.N.R. Rao, A. Muller and A.K. Cheetham, ―The Chemistry of Nanomaterials, Volume I & II‖, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).
2. Kenneth J. Klabunde, ―Nanoscale Materials in Chemistry‖, Wiley-Interscience‖, New York,(2001).
3. Gabor L.Hornyak, Harry F. Tibbals, Joydeep Dutta and John J Moore . ―Inroduction to Nanoscience and Nanotechnology‖ CRC Press ,Taylor and Francis group London Newyork.