St. Mary's College, Manarcaud

NAAC Accredited with 'B' Grade in 2016

(Affiliated to Mahatma Gandhi University, Kottayam)

PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

COURSE OUTCOMES

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Department of Chemistry

MSc Chemistry

PSO & CO

PSO No.	Program Specific Outcomes
PSO1	Demonstrate advanced knowledge of fundamental principles of Chemistry in the core areas of Organic, Inorganic, Physical and Theoretical Chemistry.
PSO2	Demonstrate advanced knowledge in multiple current areas of chemistry research such as Computational Chemistry, Spectroscopy, Organic Synthesis, Polymer Chemistry and Material Chemistry.
PSO3	Develop the knowledge of experimental techniques, theoretical concepts and acquire a broader understanding of research strategies, scientific thinking and data analysis
PSO4	Interpret research literature in his/her field of study and Conduct independent research under limited supervision within a research group and Communicate chemistry effectively, by using both oral and written skills.
PSO5	Analyze the methods of synthesis of various compounds and the mechanism of selected reactions

SEMESTER I

CH500101 ORGANOMETALLICS AND NUCLEAR CHEMISTRY

Programme	**M.Sc**
Semester	**I**
Course Type	**Theory**
Instructor(s)	**Dr.Shiby Susan Kuriakose, Marina Philip, Tony Francis**

CO	Course Outcomes	CL	PSO
1	To understand various aspects of organometallic compounds	**U**	1,2
2	To understand the application of organometallic compounds in catalysis reactions	**U,Ap**	2,5
3	To apply and analyse the functions of transition metal ions in biological systems	**Ap**	**3**
4	To apply and analyse the the applications of radioactive isotopes in various fields	**Ap**	**2,5**
5	To analyse the mechanism of selected catalytic organic reactions from the structure-bonding aspects.	An	5

Module	Course Description	Hours	CO
1.0	Organometallic compounds- synthesis,structure and bonding	**18**	
1.1	Organometallic compounds- synthesis,structure	2	1,2
1.2	Organometallic compounds- bonding	3	1,2
1.3	To understand haptonomenclature and different linear pi donor ligands	2	1,2
1.4	To recollect structure and bonding in organometallic compounds	3	1,2
1.5	To recollect simple and binuclear metal carbonyls	3	1,2
1.6	To recollect simple nitrosyls and cyanides	2	1,2
1.7	To understand isoelectronic and isolobal analogy	2	1,2
1.8	To understand IR spectral studies	1	1,2
2.0	**Reactions of organometallic compounds**	**9**	
2.1	To understand substitution, addition reactions	2	5
2.2	To understand insertion and elimination reactions	2	5
2.3	To understand fluxional isomeris	1	5
2.4	To understand fluxional isomerism of allyl system	**2**	**5**
2.5	To understand fluxional isomerism of cyclopentadienyl system	**2**	**5**
3.0	**Catalysis by Organometallic Compounds**	**18**	
3.1	Homogeneous and heterogeneous organometallic catalysis: Tolman catalytic loops, alkene hydrogenation using Wilkinson catalyst.	2	2,5
3.2	Reactions of carbon monoxide and hydrogen-the water gas shift reaction, the Fischer-Tropsch reaction (synthesis of gasoline).	2	2,5
3.3	Hydroformylation of olefins using cobalt and rhodium catalysts.	2	2,5

3.4	Polymerization by organometallic initiators and templates for chain propagation- Ziegler Natta catalysts,polymerisation by metallocene catalysts.	2	2,5
3.5	Carbonylation reactions: Monsanto acetic acid process, olefin hydroformylation- oxo process,carbonylation of alkenes and alkynes in the presence of a nucleophile- the Reppe reaction. Carbonylation of aryl halides in the presence of a nucleophile.	3	2,5
3.6	Olefin methathesis-synthesis gas based reactions, photodehydrogenation catalyst ("Platinum Pop").	1	2,5
3.7	Oxidation of olefins: Palladium catalysed oxidation of ethylene-the Wacker process,epoxidation of olefins, hydroxylation by metal-oxo complexes	1	2,5
3.8	Asymmetric catalysis- Asymmetric hydrogenation, isomerisation and epoxidation.	1	2,5
3.9	C-H activation and functionalization of alkanes and arenes: Radicaltype oxidation, hydroxylation, dehydrogenation, carbonylation and regioselective borylation of alkanes and cycloalkanes. Radicaltype reactions, electrophilic reactions, carbonylation and borylation of arenes.Insertion of alkenes and alkynes in the Ar-H bond.	2	2,5
3.10	Application of palladium catalysts in the formation of C-O and C-N bonds,oxidative coupling reactions of alkynes with other unsaturated fragments for the formation of cyclic and heterocylic compounds. The Dötz reaction.	2	2,5
4.0	**Bioinorganic Compounds**	**18**	
4.1	Essential and trace elements in biological systems, toxic effects of metals (Cd, Hg, Cr,Pb and As), structure and functions of biological membranes, mechanism of ion transport across membranes, sodium pump, ionophores, valinomycin. Phosphate esters in biology, Redox metalloenzymes, cytochromes-cytochrome P450.	**4**	**1,2**
4.2	Oxygen carriers and oxygen transport proteins:Structure and functions of haemoglobins and myoglobin,oxygen transport mechanism, cooperativity, Bohreffect. Structure and functions of haemerythrinsand haemocyanin.	**4**	**1,2**
4.3	Biochemistry of zinc and copper:Structure and functions of carbonic anhydrase, carboxypeptidase A and superoxide dismutase.	**4**	**1,2**
4.4	Other important metal containing biomolecules:Vitamin B_{12} and the vitamin B_{12} coenzymes, photosynthesis-chlorophyll a, PS I and PS II.	**3**	**1,2**
4.5	Role of calcium in muscle contraction, blood clotting mechanism and biological calcification. Metals in medicine-therapeutic applications of cis-platin, radioisotopes and MRI agents.	**3**	**1,2**
5.0	**Nuclear Chemistry**	**9**	
5.1	Nuclear Reactions:Q value and reaction threshold, reaction cross section, cross section and reaction rate, neutron capture cross section- variation of neutron capture cross section with energy (1/V law). Nuclear fission - fission fragments and mass distribution, fission yields, fission energy, fission cross section and threshold fission neutrons, nuclear fusion reactions and their applications.	**2**	**1,2**

5.2	Principles of counting technique:G.M. counter, proportional, ionization and scintillation counters,cloud chamber.	**2**	**1,2**
5.3	Synthesis of transuranic elements: Neptunium, Plutonium, Curium, Berkelium, Einsteinium, Mendelevium, Nobelium, Lawrencium	**2**	**1,2,5**
5.4	Analytical applications of radioisotopes-radiometric titrations, kinetics of exchange reactions, measurement of physical constants including diffusion constants, Radioanalysis, Neutron Activation Analysis, Prompt Gama Neutron Activation Analysis and Neutron Absorptiometry.	**2**	**1,2,3**
5.5	Radiation chemistry of water and aqueous solutions. Measurement of radiation doses.Relevance of radiation chemistry in biology, organic compounds and radiation polymerization	**1**	**1,2,3**

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1. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry Principles of Structure and Reactivity, 4th Edn., Harper Collins College Publishers,1993.

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4. P. Powell, Principles of Organometallic Chemistry, 2ndEdn., Chapman and Hall, 1988.

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6. B.D. Guptha, A.J Elias, Basic Organometallic Chemistry, Universities Press, 2010.

7. R.W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1984.

8. Sumit Bhaduri, Doble Mukesh, Homogeneous Catalysis: Mechanism and Industrial Applications, Wiley Interscience, 2000.

9. Astruc, D.; Organometallic Chemistry and Catalysis, Springer Verlag, 2007.

10. Robert H. Crabtree, The Organometallic Chemistry of the Transition Metals, 4thEdn., Wiley Interscience, 2005.

11. R. M. Roat-Malone, Bioinorganic Chemistry A Short Course, Wiley Interscience, 2007.

12. Robert R. Crichton, Biological Inorganic Chemistry A New Introduction to Molecular Structure and Function, Elsevier, 2012.

13. H.J. Arnikar, Essentials of Nuclear Chemistry, Wiley Eastern, 1982.

14. S.N. Goshal, Nuclear Physics, S. Chand and Company, 2006.

CH500102 STRUCTURAL AND MOLECULAR ORGANIC CHEMISTRY

Programme	**M.Sc**
Semester	**I**
Course Type	**Theory**
Instructors	**Dr. Sheela Chacko, Dr. Sholly Clair George**

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	To understand the basic concepts in organic chemistry	U	1
2	To describe and analyse the organic reactions by physical methods	An	1, 2,5
3	To understand and analyse photochemical reactions	C	1
4	Understand and analyse reactions based on stereochemical aspects and applications	AP	2,5
5	To acquaint the student with conformational aspects	Ap	3

Module	Course Description	Hrs	CO
1.0	Basic Concepts in Organic Chemistry	**18**	
1.1	Review of basic concepts in organic chemistry: Bonding, hybridisation, MO picture of butadiene and allyl systems.	2	1
1.2	Electron displacement effects: Inductive effect, electromeric effect, resonance effect, hyperconjugation, steric effect. Bonding weaker than covalent bonds.	3	1
1.3	Concept of aromaticity: Delocalization of electrons - Hückel's rule, criteria for aromaticity, examples of neutral and charged aromatic systems - annulenes. NMR as a tool ,carbon nanotubes and graphene	9	1
1.4	Mechanism of electrophilic and nucleophilic aromatic substitution reactions with examples. Arenium ion intermediates. SN1, SNAr, SRN1 and benzyne mechanisms	4	1
2.0	**Physical Organic Chemistry**	**9**	
2.1	Energy profiles. Kinetic versus thermodynamic control of product formation, Hammond postulate, kinetic isotope effects with examples. Linear free energy	5	2
2.2	Catalysis by acids,bases and nucleophiles with examples from acetal, cyanohydrin .Ester formation and hydrolysis reactions of esters-AAC2, AAC1, AAL1, BAC2and BAL1 mechanisms. Hard and soft acids, bases - HSAB principle and its applications (organic reactions only)	4	2
3.0	**Organic Photochemistry**	9	
3.1	Photoreactions of carbonyl compounds: Norrish reactions of ketones. Patterno-Buchi reaction. Barton (nitrite ester reaction); Di-π-methane and Photo Fries rearrangements, photochemistry of conjugated dienes (butadiene only),photochemistry of vision.	9	3

4.0	**Stereochemistry of Organic Compounds**	**18**	
4.1	Stereoisomerism: Definition based on symmetry and energy criteria, configuration and conformational stereoisomers,introduction to atrop isomerism	3	4
4.2	Center of chirality: Molecules with C, N, S based chiral centers, absolute configuration, enantiomers, racemic modifications, R and S nomenclature using Cahn-Ingold-Prelog rules, molecules with a chiral center and Cn, molecules with more than one center of chirality, definition of diastereoisomers, constitutionally symmetrical and unsymmetrical chiral molecules, erythro and threo nomenclature.	4	4
4.3	Axial, planar and helical chirality with examples, stereochemistry and absolute configuration of allenes, biphenyls and binaphthyls, ansa and cyclophanic compounds, spiranes, exo-cyclic alkylidene cycloalkanes.	4	4
4.4	Topicity and prostereoisomerism, topicity of ligands and faces as well as their nomenclature, NMR distinction of enantiotopic/diastereotopic ligands.	3	4
4.5	Geometrical isomerism: nomenclature, E-Z notation, methods of determination of geometrical isomers,interconversion of geometrical isomers	4	4
5.0	**Conformational Analysis**	**18**	
5.1	Conformational descriptors : Factors affecting conformational stability of molecules, conformational analysis of substituted ethanes, cyclohexane and its derivatives, decalins, adamantane, norbornane,sucrose and lactose.	6	5
5.2	Conformation and reactivity of elimination (dehalogenation, dehydrohalogenation, semipinacolic deamination and pyrolytic elimination - Saytzeff and Hofmann eliminations), substitution and oxidation of 2_o alcohols.	9	5
5.3	Chemical consequence of conformational equilibrium - Curtin Hammett principle.	3	5

References

1. R. Bruckner, Advanced Organic Chemistry: Reaction Mechanisms, Academic Press, 2002.

2. F.A. Carey, R.A. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms, 5thEdn., Springer, 2007.

3. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004.

4. T.H. Lowry, K.S. Richardson, Mechanism and Theory in Organic Chemistry, 2ndEdn., Harper & Row, 1981.

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6. D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, 3rdEdn., New Age Pub., 2010.

7. D.G. Morris, Stereochemistry, RSC, 2001.

8. E.L. Eliel, S.H. Wilen, Stereochemistry of Organic Compounds, John Wiley & Sons, 1994.

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11. K.K.R. Mukherjee, Fundamentals of Photochemistry, New Age Pub., 1978.

12. Jerry March, Advanced Organic Chemistry: Reactions, Mechanisms, and Structure

13. Nature Chemistry, Vol 10, 2018, pp 618 – 624

CH500103 QUANTUM CHEMISTRY AND GROUP THEORY

Programme	M.Sc. Chemistry
Semester	I
Course Type	Theory
Instructors	Tony Francis, Sholly Clair George

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Evaluate symmetry elements in a molecule and classify molecules into point groups and evaluate symmetry elements in a crystal and classify crystals into point groups	E	1, 3
2	Apply group theoretical rules to derive group multiplication tables, matrix representations, classes, character tables of point groups	Ap	1, 3
3	Apply group theory construction of symmetry adapted linear combination of atomic orbitals (SALCs) of molecules	An	1, 3
4	Understand and Familiarize with the main aspects of the historical development of quantum mechanics and understand the central concepts and principles in quantum mechanics	U	1, 3
5	Solve the Schrödinger equation for simple systems in one to three dimensions	Ap	1, 3
6	Understand the concepts of angular momentum and spin, as well as the rules for quantization and addition of these.	Ap	1,3

Module	Course Description	Hrs	CO
1.0	Group Theory and Applications in Chemical Bonding	**36**	
1.1	Symmetry Elements and Symmetric Operations	3	1
1.2	Determination of point groups	3	1
1.3	Symmetry in Crystals	5	1
1.4	Mathematical Groups and its properties	3	2
1.5	Group Multiplication Tables	**5**	2

1.6	Matrix Representation of elements	4	2
1.7	Reducible and Irreducible Representations	5	2
1.8	Application in Chemical bonding	8	6
2.0	**Quantum Mechanics and Applications**	**36**	
2.1	Historical background: Blackbody Radiation, Photoelectric effect, Compton effect, Hydrogen atom spectra, Matter waves	2	**4**
2.2	Operators: Linear operators, eigen functions and eigen values, commutation and non-commutation, construction of operators, normalization concept, Hermitian operators.	3	**4**
2.3	Postulates of quantum mechanics, time-independent and time-dependent Schrödinger equation.	3	**4**
2.4	Application of Schrödinger's Equations to Exactly solvable Model Problems: Translational motion-free particle in one-dimension.	2	**5**
2.5	Translation Motion: Particle on one-dimensional box with finite potential walls, Particle on one-dimensional box with infinite potential walls, Particle on three-dimensional box,	4	**5**
2.6	Rotational motion: Particle on a ring and its solution	2	**5**
2.7	Vibrational Motion: One dimensional harmonic oscillator, Hermite polynomials	4	**5**
2.8	Non-planar rigid rotor (or particle on a sphere) and their solutions, Legendre and associated Legendre equations, Legendre and associated Legendre polynomials. Spherical harmonics (imaginary and real forms)	4	**5**
2.9	Hydrogen-like Atoms: Schrodinger equation and its solutions, wave functions and energies of hydrogen-like atoms. Probabilities and radial distribution functions, atomic orbitals, degeneracy.	5	**5**
2.10	Quantization of angular momentum, quantum mechanical operators corresponding to angular momenta (Lx, Ly, Lz and L_2),	2	6
2.11	Commutation relations between these operators, shift operators, eigenvalues of angular momentum, Space Quantisation.	3	6
2.12	Spin: Spin orbitals, construction of spin orbitals from orbitals and spin functions.	2	6

References

1. I.N. Levine, Quantum Chemistry, 7thEdn., Pearson Education Inc., 2016.
2. P.W. Atkins, R.S. Friedman, Molecular Quantum Mechanics, 4th Edn., Oxford University Press, 2005.
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4. J.P. Lowe, K Peterson, Quantum Chemistry, 3rdEdn., Academic Press, 2006.
5. R. Anatharaman, Fundamentals of Quantum Chemistry, Macmillan India, 2001.
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14. S. Swarnalakshmi, T. Saroja, R.M. Ezhilarasi, A Simple Approach to Group Theory in Chemistry, Universities Press, 2008.
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18. K.Veera Reddy,Symmetry and Spectroscopy of molecules,New Age International (P) Ltd,1999

CH500104 THERMODYNAMICS, KINETIC THEORY AND STATISTICAL THERMODYNAMICS

Programme	**M.Sc. Chemistry**
Semester	**I**
Course Type	**Theory**
Instructures	**Philip Marina Philip, Tony Francis**

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Understand the basic concepts of classical and statistical thermodynamics	U	1
2	Analyze the macroscopic properties of matter using classical and statistical thermodynamics	An	1,3
3	Relate microscopic and macroscopic properties using classical and statistical thermodynamics	An	1,3
4	Calculate change in thermodynamic properties and absolute values of thermodynamic quantities and equilibrium constants	Ap	1,3
5	Understand the properties of gases	U	1

Module	Course description	Hrs	CO Nos
1.0	**Classical Thermodynamics**	18	
1.1	Variables, Extensive and intensive properties, equation for total differential, reciprocity characteristics, homogenous functions	2	1
1.2	Equations of state. Maxwell relations, irreversible processes.	2	1
1.3	Free energy functions, Gibbs Helmholtz equation	2	1
1.4	Partial molar quantities, chemical potential, determination of partial molar volume and enthalpy.	2	1
1.5	Fugacity, variation of fugacity with temperature and pressure	2	1,4
1.6	Gibbs Duhem Margules equation, Konovalov's first and second laws, free energy, enthalpy, entropy and volume.	2	1

1.7	Chemical affinity and thermodynamic functions, Vant Hoff reaction isochore and isotherm	2	1,2
1.8	Third law of thermodynamics, Nernst heat theorem	1	1
1.9	Three component systems, graphical represention, Solid – liquid equilibria, hydrate formation, liquid-liquid equilibria, partially miscible liquids.	3	1
2.0	**Kinetic Theory of Gases**	9	
2.1	Maxwell distribution of velocities, experimental verification	1	5
2.2	Most probable velocities, average and RMS velocities	2	5
2.3	Collision diameter, mean free path, frequency of collision	3	5
2.4	Law of corresponding states, transport properties of gases	3	5
3.0	**Statistical Thermodynamics**	27	
3.1	Permutation, probability, Stirlings approximation,phase space ensembles	5	1,2
3.2	Boltzman distribution law, partition function, partition function and thermodynamic functions, electronic, rotational, vibrational and translational	6	2,3
3.3	Thermodynamic functions and equilibrium constants Sackur Tetrode equation, residual entropy	5	1,2,3
3.4	Bosons and Fermions, Bose- Einstein statistics, B E condensation , liquid helium, BE distribution law, FD distribution, Comparison of three statistics	6	2,3
3.5	Heat capacity of solids, Einstein's theory, Debye theory	5	2,3

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SEMESTER II

CH500201 COORDINATION CHEMISTRY

Programme	M.Sc. Chemistry
Semester	II
Course Type	Theory
Instructors	Sheela Chacko, Tony Francis, Shiby Susan Kuriakose, Philip Marina Philip

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Classify various coordination compounds and sigma & pi bonding ligands	Ap	1
2	Explain different bonding aspects in coordination compounds	An	1
3	Investigate electronic, magnetic and spectral properties of coordination compounds	An	1,3
4	Propose structure to coordination compounds	C	1
5	Discuss the kinetics and mechanism of reactions of coordination compounds	U	1
6	Describe stereochemistry of coordination compounds	U	1,3
7	Summarize and compare different properties of lanthanides and actinides	U	1,3

Module	Course description	Hrs	CO Nos
1.0	**Structural Aspects and Bonding**	**18**	
1.1	Classification of complexes based on coordination numbers and geometries	2	1
1.2	Sigma and pi bonding ligands such as CO, NO, CN-, R3P, and Ar3P	2	1
1.3	Stability of complexes, thermodynamic aspects of complex formation-Irving William order of stability, chelate effect	2	2
1.4	Splitting of *d* orbitals in octahedral, tetrahedral, square planar, square pyramidal and triagonal bipyramidal fields, LFSE, *Dq* values	4	2
1.5	Jahn Teller (JT) effect.	2	2
1.6	Theoretical failure of crystal field theory, evidence of covaleny of metal ligand bond, nephelauxetic effect, ligand field theory	2	2
1.7	Molecular orbital theory M.O energy level diagrams for octahedral and tetrahedral complexes without and with π-bonding, experimental evidences for pi-bonding	4	2
2.0	**Spectral and Magnetic Properties of Metal Complexes**	**18**	
2.1	Electronic Spectra of complexes-Term symbols of *dn*system, Racah parameters, splitting of terms in weak and strong octahedral and tetrahedral fields	2	3
2.2	Correlation diagrams for *dn* and *d10-n*ions in octahedral and tetrahedral fields (qualitative approach).	2	3

2.3	*d-d* transition, selection rules for electronic transition-effect of spin orbit coupling and vibronic coupling.	2	3
2.4	Interpretation of electronic spectra of complexes-Orgel diagrams, demerits of Orgel diagrams	2	3
2.5	Tanabe-Sugano diagrams, calculation of *Dq*, *B* and β (Nephelauxetic ratio) values	2	3
2.6	Spectra of complexes with lower symmetries. Charge transfer spectra, luminescence spectra	3	3
2.7	Magnetic properties of complexes-paramagnetic and diamagnetic complexes, molar susceptibility, Gouy method for the determination of magnetic moment of complexes, spin only magnetic moment	2	3
3.0	**Kinetics and Mechanism of Reactions in Metal Complexes**	**18**	
3.1	Kinetics and mechanism of nucleophilic substation reactions in square planar complexes	3	4,5
3.2	Effect of leaving group and effect of ligands already present	3	4,5
3.3	Kinetics and substitution of octahedral substitution	3	4,5
3.4	Solvolytic reactions	1	5
3.5	Formation of chelates	1	5
3.6	Effect of H+ on the rates of substitution, metal assisted and ligand assisted dechelation	1	5
3.7	Electron transfer reactions: Outer sphere and inner sphere mechanism	3	5
4.0	**Stereochemistry of coordination compounds**	9	
4.1	Geometrical and optical isomerism in octahedral complexes	2	6
4.2	Resolution of optically active complexes, determination of absolute configuration of complexes by ORD and circular dichroism, stereoselectivity and conformation of chelate rings	3	6
4.3	Asymmetric synthesis catalyzed by coordination compounds	1	6
4.4	Linkage isomerism-electronic and steric factors affecting linkage isomerism	1	6
4.5	Symbiosis-hard and soft ligands, Prussian blue and related structures. Macrocycles-crown ethers.	2	6
5.0	**Coordination Chemistry of Lanthanoides and Actinoides**	9	
5.1	Term symbols for lanthanide ions, coordination complexes of lanthanides upto coordination No 12	2	7
5.2	Electronic spectra and Magnetic properties of lanthanoid complexes, Organometallic complexes of lanthanoids	2	7
5.3	General characteristics of actinoids, coordination complexes of the actinoids, sandwich complexes	2	7
5.4	Organometallic compounds of thorium and Uranium	1	7
5.5	Comparative account of coordination chemistry of lanthanoids and actinoids, spectra and magnetic properties	2	7

References

1. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry: A Comprehensive Text,

3rd Edn., Interscience,1972.

2. J.E. Huheey, E.A. Keiter, R.A. Keiter, Inorganic Chemistry Principles of Structure and Reactivity, 4thEdn., Pearson Education India, 2006.

3. K.F. Purcell, J.C. Kotz, Inorganic Chemistry, Holt-Saunders, 1977.

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6. R.S. Drago, Physical Methods in Chemistry, Saunders College, 1992.

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8. J.D. Lee, Concise Inorganic Chemistry, 4thEdn., Wiley-India, 2008

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10. G. A. Lawrance, Introduction to Coordination Chemistry, John Wiley & Sons Ltd, 2010.

11. C. E. Housecroft, A. G Sharpe, Inorganic Chemistry, Pearson, 2012.

CH 50 02 02 ORGANIC REACTION MECHANISMS

Programme	**M.Sc. Chemistry**
Semester	**II**
Course Type	**Theory**
Instructors	**Shiby Susan Kuriakose, Sholly Clair George**

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Explain metal and non metal based oxidations of alcohols and alkenes.	An	1
2	Explain catalytic hydrogenation and metal based reductions.	An	2
3	Illustrate Brook rearrangement, Tebbe olefination and various name reactions viz. Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction.	Ap	2
4	Discuss Metal mediated C-C and C-X Coupling reactions and Multicomponent reactions like Ugi reaction, Passerini reaction and Biginelli reaction.	E	2
5	Discuss Hydride transfer reagents, oxidation –reduction reactions of aluminium isopropoxide.	E	1
6	Ilustrate Synthesis of five and six membered rings, interconversions,and synthesis of heterocycles.	Ap	2
7	Decide the Protecting agents for various functional groups and to discuss peptide synthesis and SPPS	E	2
8	Design the synthesis pathway of target molecules by Retrosynthetic analysis.	C	2
9	Illustrate basic principles of biosynthesis and biominetic synthesis	U	5

Module	Course Description	Hrs	CO
1.0	**Review of Organic Reaction Mechanisms**	**9**	
1.1	Review of organic reaction mechanisms with special reference to nucleophilic and electrophilic substitution at aliphatic carbon (SN1, SN2, SNi, SE1, SE2), elimination (E1 and E2) and addition reactions (regioselectivity: Markovnikov's additioncarbocation mechanism, anti Markovnikov's addition-radical mechanism). Elimination vs substitution	5	1
1.2	A comprehensive study on the effect of substrate, reagent, leaving group, solvent and neighbouring group on nucleophilic substitution(SN2 and SN1) and elimination (E1 and E2) reactions.	4	1
2	**Chemistry of Carbanions**	**9**	
2.1	Formation, structure and stability of carbanions; Reactions of carbanions: C-X bond (X = C, O, N) formations through the intermediary of carbanions. Chemistry of enolates and enamines. Kinetic and Thermodynamic enolates- lithium and boron enolates in aldol and Michael reactions, alkylation and acylation of enolates.	4	1,2
2.2	Nucleophilic additions to carbonyls groups: Name reactions under carbanion chemistry-mechanism of Claisen, Dieckmann, Knoevenagel, Stobbe, Darzen and acyloin condensations, Shapiro reaction and Julia elimination. Favorski rearrangement.	3	2,3
2.3	Ylids: chemistry of phosphorous and sulphurylids - Wittig and related reactions, Peterson olefination.	2	2
3	**Chemistry of Carbocations**	**9**	
3.1	Formation, structure and stability of carbocations. Classical and non-classical carbocations.	3	2
3.2	C-X bond (X = C, O, N) formations through the intermediary of carbocations. Molecular rearrangements including Wagner-Meerwein, Pinacol-pinacolone, Semipinacol, Dienone-phenol and Benzilic acid rearrangements, Noyori annulation, Prins reaction.	3	2
3.3	C-C bond formation involving carbocations: Oxymercuration, Halolactonisation.	3	2
4	**Carbenes, Carbenoids, Nitrenes and Arynes**	**9**	
4.1	Structure of carbenes (singlet and triplet), generation of carbenes, addition and insertion reactions.	2	2
4.2	Reactions of carbenes such as Wolff rearrangement, Reimer-Tiemannreaction. Reactions of ylides by carbenoid decomposition	2	2
4.3	Structure, generation and reactions of nitrene and related electron deficient nitrene intermediates.	2	2
4.4	Hoffmann, Curtius, Lossen, Schmidt and Beckmann rearrangement reactions.	2	2
4.5	Arynes: Generation, structure, stability and reactions. Orientation effect - amination of haloarenes.	3	2
5	**Radical Reactions**	**9**	
5.1	Generation of radical intermediates and its (a) addition to alkenes, alkynes (inter andintramolecular) for C-C bond formation -Baldwin's rules (b) fragmentation andrearrangements - Hydroperoxide: formation, rearrangement and reactions. Autooxidation.		2
5.2	Name reactions involving radical intermediates: Barton deoxygenation and decarboxylation, McMurry coupling		2
`	**Chemistry of Carbonyl Compounds**	**9**	
6.1	Reactions of carbonyl compounds: Oxidation, reduction (Clemmensen and Wolf- Kishner), addition (addition of cyanide, ammonia, alcohol) reactions, Aldol condensation	4	3
6.2	Cannizzaro reaction, Addition of Grignard reagent. Structure and	5	3

	reactions of α, β- unsaturated carbonyl compounds involving electrophilic and nucleophilic addition - Michael addition, Mannich reaction, Robinson annulation.		
7	**Concerted Reactions**	**18**	
7.1	Classification :Electrocyclic, sigmatropic, cycloaddition, chelotropic, [illegible] reactions. Woodward Hoffmann rules - Frontier [illegible] symmetry correlation approaches - PMO method [illegible] cycloaddition reactions only).	5	4
	[illegible] reactions in organic synthesis such as [illegible] rearrangements. Diels-Alder and Ene reactions (with stereochemical aspects), dipolar cycloaddition (introductory).	5	4
7.3	Unimolecular pyrolytic elimnination reactions: Cheletropic elimination, decomposition of cyclic azo compounds, β-eliminations involving cyclic transition states such as N-oxides (Cope reaction), Acetates and Xanthates (Chugaeve reaction).	5	4
7.4	Problems based on the above topics	3	4

Programme	**M.Sc. Chemistry**
Semester	**II**
Course Type	**Theory**
Instructors	**Tony Francis, Sholly Clair George**

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CH500103 CHEMICAL BONDING AND COMPUTATIONAL CHEMISTRY

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Apply group theory to find out vibrational modes and predict IR and raman activity .	Ap	1, 3
2	Apply group theory to anlyse electronic spectra of polyatomic molecules using direct product terms.	Ap	1, 3
3	Determination of hybridization and hybrid functions in different molecules	Ap	1, 3
4	Understand relation of Group theory and optical activity	U	1, 3
5	Understand different approximation techniques used in molecular quantum mechanics	U	1, 3

6	Understand Quantum Mechanical and principles of Molecular Orbital theory, Hückel Molecular Orbital Theory, Valence bond theory and hybridization	U	1,3
7	Apply the concept of linear combination of atomic orbitals to produce Molecular Orbitals, Hückel Molecular Orbitals and hybrid orbitals to understand the molecular structure and geometry.	Ap	1,3
8	Identify and explain the main similarities and differences between computational approaches such as HF (Hartree-Fock), semi-empirical, DFT (Density Functional Theory) and force field methods.	Ap	1,2,3
9	Understand computational chemistry	U	1,3
10	Apply computational chemistry in molecules	Ap	1,3

Module	Course Description	Hrs	CO
1.0	**Application of Group Theory in Spectroscopy**	**18**	
1.1	Vibrational mode analysis using group theory taking H_2O,NH_3 and trans-N_2F_2 as examples using symmetry coordinates and internal coordinates method	3	1
1.2	method,prediction of IR and Raman activity,-rule of mutual exclusion,-redundant modes , out of plane modes.	3	1
1.3	Application in uv-visible spectroscopy,selection rules,orbital selection rules,transitions between non-degenerate states,	5	1
1.4	prediction of electronic transitions in C_2v,C_3v,C_4v,C_2h and C_4h using direct product terms	3	2
1.5	spin selection rules, relaxation in selection rules and distortion	**5**	2
1.6	Application in hybridization,determination of hybridization and hybrid functions in CH_4,BF_3 and PCl_5	6	2
1.7	Group theory and optical activity	3	2
2.0	**Approximation Methods in Quantum Mechanics**	**18**	
2.1	Many-body problem and the need of approximation methods, independent particle model. Variation method:Variation theorem with proof, illustration of variationtheorem using the trial function x(a-x) for particle in a 1D-box and using the trial function e-αr for the hydrogen atom, variation treatment for the ground state of helium atom.	5	**5**
2.2	Perturbation method, time-independent perturbation method (non-degenerate case only), first order correction to energy and wave function, illustration by application to particle in a 1D-box with slanted bottom, perturbation treatment of the ground state of the helium atom. Qualitative idea of Hellmann-Feynman theorem.	5	**5**
2.3	Hartree-Fock method,multi-electron atoms. Hartree-Fock equations (no derivation). The Fock operator, core hamiltonian, coulomb operator and exchange operator.	4	**6**
2.4	Qualitative treatment of Hartree-Fock Self-Consistent Field (HFSCF) method. Roothan's concept of basis functions, Slater type orbitals (STO) and Gaussian type orbitals (GTO), sketches of STO and GTO.	4	**6**
3.0	**Chemical Bonding**	**18**	
3.1	Schrödinger equation for molecules. Born-Oppenheimer approximation,valencebond (VB) theory, VB theory of H_2 molecule, singlet and triplet state functions (spin orbitals) of H_2.	4	**7**
3.2	Molecular Orbital (MO) theory, MO theory of H_2+ ion, MO theory of H_2 molecule, MO treatment of homonuclear diatomic molecules Li_2, Be_2, N_2, O_2 and F_2 and hetero nuclear diatomic molecules LiH, CO, NO and HF,bond order.	4	**7**
3.3	Correlation diagrams, non-crossing rule,spectroscopic term symbols for diatomic molecules,comparison of MO and VB theories.	4	**8**

3.4	Hybridization, quantum mechanical treatment of sp, sp^2 and sp^3 hybridisation. Semiempirical MO treatment of planar conjugated molecules, Hückel Molecular Orbital (HMO) theory of ethene, allyl systems, butadiene and benzene. Calculation of charge distributions, bond orders and free valency.	6	**8**
4.0	**Computational Quantum Chemistry**	**18**	
4.1	Introduction and scope of computational chemistry,potential energysurface,conformational search,global minimum, local minima, saddle points.	2	9
4.2	Ab initio methods: A review of Hartee-Fock method,selfconsistentfield (SCF)procedure. Roothan concept basis functions.Basis sets and its classification:Slater type and Gaussian type basis sets, minimal basis set, Pople style basis sets .Hartree-Fock limit. Post Hartree-Fock methods - introduction to Møller Plesset perturbation theory, configuration interaction, coupled cluster and semi empirical methods.	4	9
4.3	Introduction to Density Functional Theory (DFT) methods: Hohenberg-Kohntheorems,Kohn-Sham orbitals,exchange correlation functional,local densityapproximation,generalized gradient approximation,hybrid functionals (only the basic principles and terms need to be introduced).	3	
4.4	Comparison of ab initio, semi empirical and DFT methods.	2	9
4.5	Molecular geometry input:Cartesian coordinates and internal coordinates, Z matrix, Z-matrix of single atom, diatomic molecule, non-linear triatomic molecule, linear triatomic molecule, polyatomic molecules like ammonia, methane and ethane. General format of GAMESS / Firefly input file , single point energy calculation, geometry optimization, constrained optimization and frequency calculation. Koopmans' theorem.	4	10
4.6	Features of molecular mechanics force field-bond stretching, angle bending, torsional terms, non-bonded interactions and electrostatic interactions. Commonly used force fields- AMBER and CHARMM.	3	10

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2. P.W. Atkins, R.S. Friedman, Molecular Quantum Mechanics, 4thEdn., Oxford University Press, 2005.

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Chemical Applications, 2ndEdn., Wiley, 2000.

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Molecular Modeling: Principles and Applications, Springer, 2008.

19. A. Hinchliffe, Molecular Modelling for Beginners, 2ndEdn., John Wiley & Sons, 2008.

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21. D.C. Young, Computational Chemistry: A Practical Guide for Applying Techniques to RealWorld Problems, John Wiley & Sons, 2001.Softwares

A) Molecular Mechanics: Arguslab, Tinker, NAMD, DL-POLY, CHARMM, AMBER

B) Ab initio, semiempirical and dft:

1.Firefly / PC GAMESS available from http://classic.chem.msu.su/gran/gamess/

2.WINGAMESS available from http://www.msg.ameslab.gov/gamess/

C) Graphical User Interface (GUI):

1. Gabedit available from http://gabedit.sourceforge.net/

2.wxMacMolPlt available from http://www.scl.ameslab.gov/MacMolPlt

CH50 03 02 SPECTRSCOPIC METHODS IN CHEMISTRY

Programme	**MSc Chemistry**
Semester	**III**
Course type	**Theory**
Instructure	**Sheela Chacko**

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Learn the basic principles of uv-visible, chirooptical, vibrational, 1-D , 2-D NMR and Mass spectroscopy for the structure identification of organic compounds	An	1, 2,5
2	Analyze and interpret uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data of organic compounds	C	1
3	Evaluate various structural possibilities and arrive at the most logical structure of organic compounds by analysis and interpretation of uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data	AP	2,5
4	Identify the structure of organic compounds by analysis and interpretation of uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data.	Ap	3

Module	Course Description	Hrs	CO
1.0	**Ultraviolet-Visible and Chirooptical Spectroscopy**	**9**	
1.1	Energy levels and selection rules, Woodward-Fieser and Fieser-Kuhn rules.	2	1
1.2	Influence of substituent, ring size and strain on spectral characteristics. Solvent effect, Stereochemical effect, non-conjugated interactions.	2	1
1.3	Chiro-optical properties - ORD, CD, plane curves, Cotton effect, octant rule, axial haloketone rule, assignment of configuration of chiral molecules.	3	1
1.4	Problems based on the above topics	2	1
2.0	**Infrared Spectroscopy**	**9**	
2.1	Fundamental vibrations, characteristic regions of the spectrum (fingerprint and functional group regions), influence of substituent, ring size, hydrogen bonding, vibrational coupling	5	2

	and field effect on frequency, determination of stereochemistry by IR technique.		
2.2	IR spectra of C=C bonds (olefins and arenes) and C=O bonds.	4	2
2.3	Problems on spectral interpretation with examples.		
3.0	**Nuclear Magnetic Resonance Spectroscopy**	18	
3.1	Magnetic nucei with special reference to ^{1}Hand ^{13}C nucei., , Chemical shift and shielding/deshielding, factors affecting chemical shift, relaxation processes, chemical and magnetic non-equivalence, local diamagnetic shielding and magnetic anisotropy. ^{1}H and ^{13}C NMR scales.	3	3
3.2	Spin coupling:, , - AX, AX_2, AX_3, A_2X_3, AB, ABC, AMX type coupling, first order and non-first order spectra, Pascal's triangle coupling constant, mechanism of coupling, geminal, vicinal and long range coupling, , Karplus curve, quadrupole broadening and decoupling, , deceptive simplicity, virtual coupling, diastereomeric protons.	3	
3.3	^{13}C NMR: ^{13}C nucleus, natural abundance, sensitivity, ^{13}C chemical shift and structure correlation, proton coupled ^{13}C spectra, proton decoupled ^{13}C spectra, broad band decoupling, rotating frame of reference, mechanism of heteronuclear decoupling, cross polarization, NOE.	3	4
3.4	Simplification non-first order spectra to first order spectra: shift reagents, spin decoupling and double resonance, off resonance decoupling.	3	4
3.5	2D NMR and COSY, HOMOCOSY and HETEROCOSY – HETCOR and HMQC.	3	4
3.6	Polarization transfer, DEPT, selective Population Inversion, INEPT.	3	4
3.7	Problems on spectral interpretation with examples.		4
4.0	**Mass Spectrometry**	**9**	
4.1	Molecular ion: basic principles, ion production methods (EI). Soft ionization methods: SIMS, FAB, CA, MALDI, PD, Field Desorption, Electrospray Ionization., Fragmentation patterns-nitrogen and ring rules. McLafferty rearrangement and its applications. HRMS,MS-MS,GC-MS.	6	5
4.2	Problems on spectral Interpretation with examples.	3	5
5.0	Structural Elucidation Using SpectroscopicTechniques.	9	
	Identification of structures of unknown organic compounds based on the data from UV-Vis, IR, ^{1}H NMR and ^{13}C NMR spectroscopy (HRMS data or Molar mass or molecular formula may be given).	6	5
5.1	Interpretation of the given UV-Vis, IR and NMR spectra.	3	5

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Programme	**M.Sc. Chemistry**
Semester	**III**
Course Type	**Theory**
Instructors	**Shiby Susan Kuriakose, Tony Francis**

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SEMESTER III

CH 50 03 01 STRUCTURAL INORGANIC CHEMISTRY

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Summarize the knowledge in the advanced areas of solid state chemistry such as structure, reactions and phase transition in solids.	U	1,6
2	Relate the electrical, magnetic and optical properties of inorganic compound to its structures.	Ap	1,5
3	Analyze the synthesis, structure and bonding demonstrated by Inorganic Chains, Rings, Cage and Cluster compounds.	An	4

4	Recognize different types of organometallic polymers	U	2
5	Identify different synthesis methods for various solids,	U	5,6
6	Describe magnetic nanoparticles	U	5

Module	Course Description	Hrs	CO
1.0	**Solid State Chemistry**	**18**	
1.1	Structure of solids: Imperfections in solids- line defects and plane defects	2	1
1.2	Structure of the following compounds - Zinc blende, Wurtzite, Rutile, fluorite, antifluorite, Nickel Arsenide,	2	1
1.3	Structure of the following compounds ,Perosvskite and Ilmenite. Spinels,inverse spinel structures	2	1
1.4	Solid state reactions,diffusion coefficient, mechanisms, vacancy diffusion	2	1
1.5	Thermal decomposition of solid:Type I reactions, Type II reactions.	2	1
1.6	Phase transition in solids: Classification of phase transitions,first and second order phase transitions,martensitic transformations,	3	2
1.7	order-disorder transitions and spinodal decomposition,kinetics of phase transitions, sintering,	2	2
1.8	Growing single crystals-crystal growth from solution, growth from melt and vapour deposition technique.	3	2
2.0	**Electrical, Magnetic and Optical Properties**	**18**	
2.1	Free electron theory of solids. Band theory of solids: Applications to Transition metal compounds and compounds like NaCl, MgO and fullerenes. Energy bands-conductors and non-conductors,	3	2
2.2	Mechanism of intrinsic and extrinsic semiconductors. Mobility of charge carriers- Hall Effect (derivation required). Piezo electricity, pyroelectricity and ferro electricity- hysteresis.	3	2
2.3	Magnetic properties of transition metal oxides, garnets, spinels, ilmenites and perovskites, magnetoplumbites.	3	2
2.4	Photoconductivity, photovoltaic effects, luminescence,applications of optical properties-phosphors, solid state lasers and solar cells.	2	2

2.5	Conductivity of pure metals. Super conductivity-Type I and Type II superconductors, Meisner effect, BCS theory of superconductivity (derivation not required)-Cooper pairs.	2	2
2.6	High temperature superconductors, super conducting cuprates - YBaCu oxide system.	3	2
2.7	Josephson's Junction, conventional superconductors, organic superconductors, fullerenes, carbon nanotubes and graphenes.	2	2
3.0	**Inorganic Chains and Rings**	**9**	
3.1	Chains:Catenation, heterocatenation, silicones. Zeolites:Synthesis, structure and applications		3
3.2	isopoly acids of vanadium, molybdenum and tungsten, heteropoly acids of Mo and W,polythiazil-one dimensional conductors. Infinite metal chains	1	3
3.3	Rings,topological approach to boron hydrides, styx numbers.	1	3
3.4	Heterocyclic inorganic ring systems:Structure and bonding in phosphorous-sulphur and sulphur-nitrogen compounds..	2	3
3.5	Homocyclic inorganic ring systems:Structure and bonding in sulphur, selenium and phosphorous compounds	2	3
4.0	**Inorganic Cages and Clusters**	**9**	
4.1	Synthesis, structure and bonding of cage like structures of phosphorous. Boron cage Aluminium, indium and gallium clusters.	3	3
4.2	cages and clusters of germanium, tin and lead, cages and clusters of tellurium, Mercuride clusters in amalgams	3	3
4.3	Medical applications of boron clusters- nucleic acid precursors, DNA binders, application of C_2B_{10} for Drug Design, Nuclear receptor ligands bearing C_2B_{10}cages.	3	3
5.0	**Organometallic Polymers**	**9**	
5.1	Polymers with organometallic moieties as pendant groups, polymers with organometallic moieties in the main chain, condensation polymers based on ferrocene and on rigid rod polyynes, poly(ferrocenylsilane)s	3	4
5.2	applications of Poly(ferrocenylsilane)s and related polymers, applications of rigid-rod polyynes, polygermanes and polystannanes,	3	4
5.3	polymers prepared by ring opening polymerization, organometallic dendrimers	3	4
6	**Magnetic Nanoparticles and Synthesis of Solids**	**9**	
6.1	Synthesis of Solids: Nucleation, growth, epitaxy and topotaxy,methods for the synthesis of $MgAl_2O_4$, silica glass, indium tin oxide and their coatings, zeolites and alumina based abrasives	3	5
6.2	hydrothermal synthesis, intercalation and deintercalation,preparation of thin films, electrochemical methods, chemical vapour deposition. Synthesis of amorphous silica and diamond films, sputtering and laser ablation	3	5
6.3	Magnetic nanoparticles, superparamagnetism and thin films, applications of magnetic nanoparticles- data storage, Magnetic Resonance Imaging (MRI) and Contrast Enhancement using magnetic nanoparticles, biomedical applications of magnetic nanoparticles.	3	6

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Programme	**M.Sc. Chemistry**
Semester	**III**
Course Type	**Theory**
Instructors	**Shiby Susan Kuriakose, Sholly Clair George**

CH50 03 02 ORGANIC SYNTHESIS

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Explain metal and non metal based oxidations of alcohols and alkenes.	An	1
2	Explain catalytic hydrogenation and metal based reductions.	An	2
3	Illustrate Brook rearrangement, Tebbe olefination and various name reactions viz. Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction.	Ap	2
4	Discuss Metal mediated C-C and C-X Coupling reactions and Multicomponent reactions like Ugi reaction, Passerini reaction and Biginelli reaction.	E	2
5	Discuss Hydride transfer reagents, oxidation – reduction reactions of aluminium isopropoxide.	E	1
6	Ilustrate Synthesis of five and six membered rings, interconversions,and synthesis of heterocycles.	Ap	2
7	Decide the Protecting agents for various functional groups and to discuss peptide synthesis and SPPS	E	2
8	Design the synthesis pathway of target molecules by Retrosynthetic analysis.	C	2
9	Illustrate basic principles of biosynthesis and biominetic synthesis	U	5

Module	Course Description	Hrs	CO
1.0	**Organic Synthesis via Oxidation and Reduction**	**18**	
1.1	Survey of organic reactions with special reference to oxidation and reduction. Metal based and non-metal based oxidations of (a) alcohols to carbonyls [(Chromium-John's oxidation,Collin's oxidation,Sarrett oxidation),Manganese, aluminium and DMSO(Swernoxidation, Moffatt oxidation)] based reagents	3	1
1.2	(b) alkenes to epoxides (peroxides/per acids based)- Sharpless asymmetric epoxidation, Jacobsen epoxidation, Shi epoxidation	2	1
1.3	(c) alkenes to diols (Manganese and Osmium based)- Prevost reaction and Woodward modification	2	1
1.4	(d) alkenes to carbonyls with bond cleavage (Manganese based, ozonolysis)	2	1
1.5	(e) Alkenes to alcohols/carbonyls without bond cleavage- hydroboration-oxidation, Wacker oxidation, selenium based	2	1

	allylic oxidation. (f) ketones to ester/lactones- Baeyer-Villiger oxidation.		
1.6	(a) Catalytic hydrogenation (Heterogeneous: Palladium/Platinum/Rhodium and Nickel. Homogeneous: Wilkinson).	2	2
1.7	(b) Metal based reductions- Birch reduction, pinacol formation, acyloin formation (c) Enzymatic reduction using Baker's yeast.	2	2
2.0	**Modern Synthetic Methods**	**18**	
2.1	Baylis-Hillman reaction, Henry reaction, Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction. Brook rearrangement. Tebbe olefination.	6	3
2.2	Metal mediated C-C and C-X coupling reactions: Heck, Stille, Suzuki-Miyaura, Negishi, Sonogashira, Nozaki-Hiyama-Kishi, Buchwald-Hartwig, Ullmann and Glaser coupling reactions, Ugi reaction, Noyori reaction, Whol-Ziegler Reaction.Click reactions	9	4
2.3	Multicomponent reactions-Ugireaction,Passerini reaction and Biginelli reaction.	3	4
3.0	**Synthetic Reagents**	**9**	
3.1	Hydride transfer reagents from Group III and Group IV in reductions;-LiAlH4, DIBAL-H, Red-Al, NaBH4 and NaCNBH3, selectrides, trialkylsilanes and trialkyl stannane.	5	2
3.2	Aluminum isopropoxide (oxidation and reduction). Reagents such as NBS, DDQ and DCC. Gilmann reagent. DMAP-Borane, PCC, DEAD (Mitsunobu reaction).	4	5
4.0	**Construction of Carbocyclic and Heterocyclic Ring Systems**	**9**	
4.1	Synthesis of four, five and six-membered rings-Photochemical approaches for the synthesis of four membered rings-oxetanes and cyclobutanes, ketene cycloaddition (inter and intra molecular), Pauson-Khand reaction, Volhardt reaction, Bergman cyclization, Nazarovcyclization,cation-olefin cyclization and radical-olefin cyclization.	3	6
4.2	Inter-conversion of ring systems (contraction and expansion)-Demjenov reaction, Reformatsky reaction. Construction of macrocyclic rings-ring closing metathesis (Grubb's catalyst).	3	6
4.3	Formation of heterocyclic rings: 5-membered ring heterocyclic compounds with one or more than one hetero atom like N, S or O - pyrrole, furan, thiophene, imidazole, thiazole and oxazole.	3	6
5.0	**Protecting Group Chemistry**	**9**	
5.1	Protection and deprotection of hydroxy, carboxyl, carbonyl, and amino groups. Chemo and regio selective protection and deprotection. Illustration of protection and deprotection in synthesis	3	7
5.2	Protection and deprotection in peptide synthesis: common protecting groups used in peptide synthesis, protecting	4	7

	groups used in solution phase and solid phase peptide synthesis		
5.3	Functional equivalence and reactivity, Umpolung. Role of trimethyl silyl group in organic synthesis	2	5
6.0	**Retrosynthetic Analysis**	**9**	
6.1	Basic principles and terminology of retrosynthesis: synthesis of aromatic compounds, one group and two group C-X disconnections; one group C-C and two group C-C disconnections.	3	8
6.2	Amine and alkene synthesis: important strategies of retrosynthesis, functional group transposition, important functional group interconversions.	3	8

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2. F.A. Carey, R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 5thEdn., Springer, 2007.

3. S. Warren, P. Wyatt, Organic Synthesis: The Disconnection Approach, 2ndEdn., Wiley, 2008.

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CH010303 CHEMICAL KINETICS, SURFACE CHEMISTRY AND CRYSTALLOGRAPHY

Programme	M.Sc. Chemistry
Semester	III
Course Type	Theory
Instructors	Shiby Susan Kuriakose, Sholly Clair George

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.

1	Understand the fundamental concept of the kinetics of a reaction and its mechanism from various theories	U	1
2	Explain the thermodynamic parameters which are involved in the kinetics of a chemical reactions	An	1,3
3	Explain the effect of catalyst and its mechanism on the kinetics of a chemical reaction	An	1,3
4	Explain the fundamental concept of crystallography	Ap	1
5	Define the fundamental concept of surface reactions and various characterization methods	Ap	1,3

Module	Course description	Hrs	CO Nos
1.0	**Chemical Kinetics**	**27**	
1.1	Theories of reaction rates: Collision theory-steric factor, collision cross section, reaction cross section, steric factor, potential energy surfaces, early barrier, late barrier, Conventional transition state theory-Eyring equation. Thermodynamic formulation of the two theories. Contour plots, Thermodynamic formulation of the reaction rates. Significance of $\Delta G\neq$, $\Delta H\neq$ and $\Delta S\neq$. Volume of activation. Effect of pressure and volume on velocity of gas reactions	7	1,2
1.2	Lindemann-Hinshelwood mechanism, qualitative idea of RRKM theory, slater theory, chain reactions: free radical and chain reactions, decomposition of CH3OCH3, CH3CHO, steady state treatment, kinetics of H2-Cl2 and H2-Br2 reactions , Rice-Herzfeld mechanism, branching chains H2-O2, Semonov-Hinshelwood mechanism of explosive reactions, degree of branching, kinetics of step-growth,anionic and cationic polymerization reactions	6	1,2
1.3	Fast reactions: relaxation, flow and shock methods, flash photolysis, NMR and ESR methods of studying fast reactions	2	1,2
1.4	Reactions in solution: factors determining reaction rates in solutions, effect of dielectric constant and ionic strength, cage effect, Bronsted-Bjerrum equation, primary and secondary kinetic salt effect,	3	1,2
1.5	Acid-base catalysis: specific and general catalysis, Skrabal diagram, Bronsted catalysis law, prototropic and protolytic mechanism with examples, acidity function.	3	1,2,3
1.6	Enzyme catalysis and its mechanism, Michelis-Menten equation, effect of pH and temperature on enzyme catalysis	3	1,2,3
1.7	Introduction to oscillating chemical reactions: autocatalysis, Loka-Volterra mechanism, the brusselator, the oreganator, bistability.	3	1,2,3
2.0	**Surface Chemistry**	**27**	
2.1	Different types of surfaces, thermodynamics of surfaces, Gibbs adsorption equation and its verification, surfactants and micelles, surface pressure and surface potential and their measurements and interpretation	6	1,2,5
2.2	ESCA and Auger electron spectroscopy, scanning probe microscopy,AFM and STM, ion scattering, SEM and TEM in the study of surfaces, application of SERS.	3	1,2,5
2.3	Adsorption: The Langmuir theory, kinetic and statistical derivation, multilayer adsorption-BET theory, Use of	5	1,5

	Langmuir and BET isotherms for surface area determination. Application of Langmuir adsorption isotherm in surface catalysed reactions, the Eley-Rideal mechanism and the Langmuir-Hinshelwood mechanism, flash desorption		
2.4	Colloids: structure and stability, electrical double layer, zeta potential, electro-kinetic phenomena, sedimentation potential and streaming potential, Donnan membrane equilibrium	3	1,2,5
2.5	Macromolecules: Different averages, methods of molecular mass determination, osmotic, viscosity, sedimentation and light scattering methods	3	3,5
3.0	**Crystallography**	**18**	
3.1	Miller indices, point groups, translational symmetry, glide planes and screw axes, space groups, interplanar spacing and method of determining lattice types reciprocal lattices, methods of characterizing crystal structure, Xray diffraction and crystal growth techniques	10	4
3.2	Stucture factor: Atomic scattering factor, coordinate expression for structure factor, structure by Fourier synthesis	4	4
3.3	Liquid crystals: Mesomorphic state, types, examples and application of liquid crystals	4	4

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2. K.J. Laidler, Chemical kinetics, 3rdEdn., Harper & Row, 1987.

3. C. Kalidas , Chemical Kinetic Methods: Principles of Fast Reaction Techniques and Applications, New Age International, 2005.

4. J.W. Moore, R.G. Pearson, Kinetics and Mechanisms, John Wiley & Sons, 1981.

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CH50 03 04 SPECTRSCOPIC METHODS IN CHEMISTRY

Programme	**M.Sc. Chemistry**

Semester	**III**
Course Type	**Theory**
Instructors	**Sheela Chacko**

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Learn the basic principles of uv-visible, chirooptical, vibrational, 1-D , 2-D NMR and Mass spectroscopy for the structure identification of organic compounds	An	1, 2,5
2	Analyze and interpret uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data of organic compounds	C	1
3	Evaluate various structural possibilities and arrive at the most logical structure of organic compounds by analysis and interpretation of uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data	AP	2,5
4	Identify the structure of organic compounds by analysis and interpretation of uv-visible, chirooptical, vibrational, 1-D and 2-D NMR and Mass spectral data.	Ap	3

Module	Course Description	Hrs	CO
1.0	**Ultraviolet-Visible and Chirooptical Spectroscopy**	**9**	
1.1	Energy levels and selection rules, Woodward-Fieser and Fieser-Kuhn rules.	2	1
1.2	Influence of substituent, ring size and strain on spectral characteristics. Solvent effect, Stereochemical effect, non-conjugated interactions.	2	1
1.3	Chiro-optical properties - ORD, CD, plane curves, Cotton effect, octant rule, axial haloketone rule, assignment of configuration of chiral molecules.	3	1
1.4	Problems based on the above topics	2	1
2.0	**Infrared Spectroscopy**	**9**	
2.1	Fundamental vibrations, characteristic regions of the spectrum (fingerprint and functional group regions), influence of substituent, ring size, hydrogen bonding, vibrational coupling and field effect on frequency, determination of stereochemistry by IR technique.	5	2
2.2	IR spectra of C=C bonds (olefins and arenes) and C=O bonds.	4	2
2.3	Problems on spectral interpretation with examples.		
3.0	**Nuclear Magnetic Resonance Spectroscopy**	18	
3.1	Magnetic nucei with special reference to ^{1}Hand ^{13}C nucei., , Chemical shift and shielding/deshielding, factors affecting chemical shift, relaxation processes, chemical and magnetic non-equivalence, local diamagnetic shielding and magnetic anisotropy. ^{1}H and ^{13}C NMR scales.	3	3

3.2	Spin coupling:, , - AX, AX_2, AX_3, A_2X_3, AB, ABC, AMX type coupling, first order and non-first order spectra, Pascal's triangle coupling constant, mechanism of coupling, geminal, vicinal and long range coupling, , Karplus curve, quadrupole broadening and decoupling, , deceptive simplicity, virtual coupling, diastereomeric protons.	3	
3.3	^{13}C NMR: ^{13}C nucleus, natural abundance, sensitivity, ^{13}C chemical shift and structure correlation, proton coupled ^{13}C spectra, proton decoupled ^{13}C spectra, broad band decoupling, rotating frame of reference, mechanism of heteronuclear decoupling, cross polarization, NOE.	3	4
3.4	Simplification non-first order spectra to first order spectra: shift reagents, spin decoupling and double resonance, off resonance decoupling.	3	4
3.5	2D NMR and COSY, HOMOCOSY and HETEROCOSY – HETCOR and HMQC.	3	4
3.6	Polarization transfer, DEPT, selective Population Inversion, INEPT.	3	4
3.7	Problems on spectral interpretation with examples.		4
4.0	**Mass Spectrometry**	**9**	
4.1	Molecular ion: basic principles, ion production methods (EI). Soft ionization methods: SIMS, FAB, CA, MALDI, PD, Field Desorption, Electrospray Ionization., Fragmentation patterns-nitrogen and ring rules. McLafferty rearrangement and its applications. HRMS,MS-MS,GC-MS.	6	5
4.2	Problems on spectral Interpretation with examples.	3	5
5.0	Structural Elucidation Using SpectroscopicTechniques.	9	
	Identification of structures of unknown organic compounds based on the data from UV-Vis, IR, ^{1}H NMR and ^{13}C NMR spectroscopy (HRMS data or Molar mass or molecular formula may be given).	6	5
5.1	Interpretation of the given UV-Vis, IR and NMR spectra.	3	5

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2. F.A. Carey, R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 5thEdn., Springer, 2007.

3. S. Warren, P. Wyatt, Organic Synthesis: The Disconnection Approach, 2ndEdn., Wiley, 2008.

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10. R.O.C. Norman, J.M. Coxon, Principles of Organic Synthesis, 3rdEdn.,Chapmann and Hall, 1993.

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SEMESTER IV

CH80 0401 ADVANCED INORGANIC CHEMISTRY

Programme	**M.Sc**
Semester	**IV**
Course Type	**Thoery**
Instructors	**Tony Francis, Philip Marina Philip, Dr. Sheela Chacko**

CO	Course Outcomes	CL	PSO
1	Apply group theory to solve the problems in chemistry	**Ap**	1,3
2	To apply the knowledge of spectroscopy and photochemistry to solve the various problems in chemistry.	**Ap**	2
3	To understand the scientific revolutions of nanotechnology and to familiarize the classification of nanostructures and to know the applications of nanoparticles in technologically imperative fields.	**Ap**	**1,3**
4	To understand the chemistry of materials and metal organic frame works	**U**	**1,3**
5	To describe the chemistry of supramolecules	**An**	1

Module	Course Description	Hours	CO
1.0	**Applications of Group Theory**	**27**	
1.1	Transformation properties of atomic orbitals, hybridization schemes for sigma and pi bonding with examples, symmetry adapted linear combination of atomic orbitals in tetrahedral, octahedral and.	2	1
1.2	symmetry adapted linear combination of atomic orbitals in tetrahedral, octahedral complexes	2	1
1.3	sandwich complexes- ferrocene,formation of symmetry adapted group of ligand, MO diagrams	2	1
1.4	Ligand field theory,splitting of d orbitals in different environments using group theoretical considerations	2	1
1.5	construction of energy level diagrams	3	1
1.6	correlation diagrams, method of descending symmetry,	3	1
1.7	splitting terms for orbitals, energy levels, d-d transition-selection rules..	3	1
1.8	Determination of modes of vibrations in IR and Raman spectra using character tables in tetrahedral, octahedral and square planar complexes	1	1

2.0	**Inorganic Spectroscopic Methods (9 Hrs)**	**9 Hrs**	
2.1	Infrared and Raman Spectroscopy: Structural elucidation of coordination compounds containing the following molecules/ions as ligands-NH_3, H_2O, CO	**1**	**2**
2.2	Infrared and Raman Spectroscopy: Structural elucidation of coordination compounds containing the following molecules/ions as ligands-NO, OH^-, SO_4^{2-}, CN^-,	**1**	**2**
2.3	Infrared and Raman Spectroscopy: Structural elucidation of coordination compounds containing the following molecules/ions as ligands-, SCN^-, NO_2^- and X^- (X=halogen).	**1**	**2**
2.4	Use of isotopes in interpreting and assigning vibrational spectra.	**1**	**2**
2.5	Electron Paramagnetic Resonance Spectroscopy: EPR of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields	**1**	**2**
2.6	EPR: evaluation of g values and metal hyperfine coupling constants, electron-electron interactions, multiple resonance.	**1**	**2**
2.7	Mössbauer Spectroscopy: Applications of Mössbauer spectroscopy in the study of Fe(III) complexes	**1**	**2**
2.8	Compound Identification- the interhalogen compound $I_2Br_2Cl_4$, iron in very high oxidation states – Fe(V) and Fe(VI) nitride complexes.	**2**	**2**
3.0	**Inorganic Photochemistry**	**9 Hrs**	
3.1	Excited states in transition metal complexes:Intra-ligand excited states and metal-centred excited states.Photochemical reactions:Substitution and redox reactions of Cr(III), Co(III), Rh(III) and Ru(II) complexes	3	2
3.2	manganese-based photosystems for the conversion of water into oxygen, applications-synthesis and catalysis, chemical actinometry and photochromism, metal-metal multiple bonds, dissociative photochemistry, ligand loss.	3	2
3.3	Metal complex sensitizers,electron relay, semiconductor supported metal oxide systems, water photolysis, nitrogen fixation and CO_2 reduction, dinitrogen splitting.	3	2
4.0	**Nanomaterials**	**18**	
4.1	Inorganic nanomaterials: General introduction to nanomaterials,synthesis and applications of nanoparticles of gold, silver, rhodium, palladium and platinum	**2**	**3**
4.2	synthesis and applications of metal oxides of transition and non-transition elements-SiO_2, TiO_2, ZnO, Al_2O_3, iron oxides and mixed metal oxide nanomaterials,	**2**	**3**
4.3	non-oxide inorganic naomaterials, porous silicon nanomaterials-fabrication and chemical and biological sensing applications.	**2**	**3**
4.4	Characterisation of Nanomaterials: UV-visible, Raman, XRD, SEM, TEMand AFM techniques	**2**	**3**
4.5	Diversity in nanosystems: Self-assembled monolayers on gold-growth process and phase transition, gas phase clusters-formation, detection and analysis, quantum dots- preparation, characterization and applications,..	**2**	**3**
4.6	nanoshells-types of systems, characterization and application, inorganic nanotubes-synthetic strategies, structures, properties and applications	**2**	**3**
4.7	Nanocomposites- natural nanocomposites, polymer nanocomposites, metal and ceramic nanocomposites and clay nanocomposites	**2**	**3**

4.8	Evolving interfaces of nanotechnology:Nanobiotechnology, nano-biosensors, nanotechnology for manipulation of biomolecules-optical tweezers, dielectrophoresis, biochips, labs on chips, and integrated systems, nanocatalysts,	**2**	**3**
4.9	nanomedicines- importance of nanomaterials in the pharmaceutical industry and future possibilities for medical nanotechnology,	**1**	**3**
4.10	nanoparticles for medical imaging, nanoparticles for targeting cancer cells, nanoencapsulation for drug delivery to tumours	**1**	**3**
5.0	**Chemistry of Materials**	**9**	
5.1	Ceramic Structures:Mechanical properties, clay products, refractories- characterisation, properties and applications	**2**	**4**
5.2	non-silicon semiconductors as light emitting diodes, thermoelectric (TE) materials, applications of metals and alloys in hydrogen storage,	**3**	**4**
5.3	inorganic organic hybrid composites- sol-gel ceramics, fillers in elastomers, polymer- modified ceramics.	**2**	**4**
5.4	Synthetic strategies for inorganic material design: Direct Combination, low temperature techniques, combinatorial synthesis	**2**	**4**
6.0	**Metal Organic Frame Works**	**9**	**4**
6.1	Introduction, porous coordination polymers, frameworks with high surface area, Lewis acid frameworks, soft porous crystals	**3**	**4**
6.2	design of metal organic frameworks and design of functional metal organic frameworks by post-synthetic modification	**3**	**4**
6.3	Applications of metal organic frameworks- separation and purification of gases by MOFs, hydrogen storage, MOFs in the pharmaceutical world	**3**	**4**
7	**Inorganic Supramolecular Chemistry**	**9**	
7.1	Types of Supermolecules, examples of inorganic supermolecules, synthetic strategies for inorganic super molecules and coordination polymers, molecular polygons and tubes, molecular polyhedra.	**4**	**5**
7.2	Diamondoid networks, inorganic crystal engineering using hydrogen bonds, organometallic crystal engineering, supramolecular self-assembly caused by ionic interactions-hydrocarbyls, amides and phosphides.	**5**	**5**

References

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CH 80 04 02 ADVANCED ORGANIC CHEMISTRY

Programme	**M.Sc**
Semester	**IV**
Course Type	**Thoery**

Instructors	**Dr. Sholly Clair George, Philip Marina Philip, Dr. Sheela Chacko**

CO	Course Outcomes	CL	PSO
1	Identify Guests and Hosts	R	1,2
2	Describe Green Alternatives to Organic Synthesis	U	1,2
3	Design synthesis of adipic acid	**C**	**1,2,5**
4	Describe Biosynthesis and Biomimetic Synthesis	**U**	**2,3**
5	Understand Stereoselective Transformations	**U**	1,2,3
6	Understand Chemistry of Natural Products and Biomolecules	**U**	1,2,3
7	Discuss Medicinal chemistry	**U**	1.2.3
8	Discuss Dendrimers and dendritic polymers	**U**	1
9	Significance of Research Methodology of Chemistry	**E**	**1,4,5**

Module	Course Description	Hours	CO
1.0	**Molecular Recognition and Supramolecular Chemistry**	**18**	**1**
1.1	Introduction to supramolecular chemistry: Host, Guest, Host-Guest complex Lock and key principle. Preorganisation, Complementarity	3	1
1.2	Molecular recognition, forces involved in molecular recognition	3	1
1.3	Cation binding Hosts: Crown ethers, Lariat ethers, Podands, Cryptands, Spherands, Calixarenes	3	1
1.4	Anion binding hosts: Cyclophanes. A naturally occurring cyclic host: Cyclodextrin - industrial applications	3	1
1.5	Molecular clefts and tweezers. Macrocyclic polyamines – Nitrogen based cyclic hosts.	3	1
1.6	Naturally occurring Siderophores. Rhodopsin – A Supramolecular photonic device.	3	1
2.0	**Green Alternatives to Organic Synthesis** Introduction to Green Chemistry, atom economy	**9 Hrs**	**2**
2.1	Twelve principles of Green Chemistry, how to plan a green synthesis.	**1**	**2**
2.2	Green Solvents: Ionic liquids	**1**	**2**
2.3	supercritical CO_2, fluorous solvents, PEG	**1**	**2**
2.4	Microwave assisted organic synthesis : Principle, example.	**1**	**2**
2.5	Sonochemical synthesis : Principle, example	**1**	**2**
2.6	Green alternatives to organic synthesis: Thiamine catalyzed benzoin condensation	**1**	**2**
2.7	Montmorillonite K-10 catalysed Pinacol-Pinacolone rearrangement,	**1**	**2**
2.8	photochemical reduction of benzophenone to benzopinacol,	**1**	**2**
2.9	synthesis of adipic acid from cyclohexene synthesis of Ibuprofen	**1**	**2,3**
3.0	**Biosynthesis and Biomimetic Synthesis**	**9 Hrs**	
3.1	Basic principles of the biosynthesis of terpenes, steroids	1	4
3.2	Basic principles of the biosynthesis of alkaloids, carbohydrates	1	4
3.3	Basic principles of the biosynthesis proteins and nucleic acids	1	4
3.4	biosynthesis of cholesterol, α- terpineol, morphine,	2	4
3.5	glucose and phenyl alanine,biogenesis of isoprenoids and alkaloids,	2	4
3.6	biomimetic synthesis of progesterone (Johnson synthesis).	2	4
4.0	**Stereoselective Transformations**	**9 Hrs**	**6**
4.1	Assymmetric induction - chiral auxiliaries and chiral pool.	**3**	**6**
4.2	Enantioselective catalytic hydrogenation developed by Noyori and Knowels	**2**	**6**
4.3	Assymetric aldol condensation pioneered by Evans	**1**	**6**

4.4	Assymmetric Diels-Alder reactions	**2**	**6**
4.5	Enatioseletive synthesis of Corey lactone	**1**	**6**
5.0	**Chemistry of Natural Products and Biomolecules**	**18**	
5.1	Synthesis of camphor, atropine,	**2**	**6**
5.2	Synthesis of, papaverine,	**2**	**6**
5.3	Synthesis of β-carotene, testosterone	**2**	**6**
5.4	biosynthesis of PGE2 and PGF2α.	**2**	**6**
5.5	Structure of proteins, nucleic acids and methods for primary structure determination of peptides (N-terminal - Sanger's method and Edmond's method	**2**	**6**
5.6	C-terminal - Akabora method and carboxy peptidase method),	**2**	**6**
5.7	replication of DNA, flow of genetic information	**2**	**6**
5.8	protein biosynthesis, transcription and translation, genetic code, regulation of gene expression	**2**	**6**
5.9	DNA sequencing, The Human Genome Project	**1**	**6**
5.10	DNA profiling and the Polymerase Chain Reaction (PCR).	**1**	**6**
6.0	**Medicinal Chemistry and Drug Designing**	**9**	
6.1	Introduction to Drug design: Modelling techniques, receptor proteins, drug-receptor interaction, ,	**1**	**7**
6.2	drug action, drug selectivity	**1**	**7**
6.3	drug metabolism (Phase I and Phase II).	**1**	**7**
6.4	Mode of action of Warfarin (anticoagulant)		**7**
6.5	Mode of action of organic nitrates (anti-anginal drug),	**1**	**7**
6.6	Mode of action of Captoril (antihypertensive agent), Chloroquin (antimalarial drug	**1**	**7**
6.7	Antibiotics: Penicillins (SAR expected),	**1**	**7**
6.8	mode of action of chloramphenicol, tetracyclins and cephalosporins	**1**	**7**
6.9	mode of action of drugs for cancer (Methotrexate), AIDS (Zidovudin) and diabetes (Metformin).	**1**	**7**
7	**Advances in Polymer Chemistry** .	**9 Hrs**	
7.1	Conducting polymers, temperature resistant and.	**2**	**8**
7.2	flame retardant polymers, polymers for medical applications	**1**	**8**
7.3	Dendrimers and dendritic polymers: Terminology, classification of dendrimers	**1**	**8**
7.4	Methods of synthesis: convergent and divergent approaches,	**2**	**8**
7.5	applications of dendrimers.	**1**	**8**
7.6	Hyperbranched polymers: Definition, synthesis, applications.	**2**	**8**
8	**Research Methodology of Chemistry**	**9**	
8.1	The search of knowledge, purpose of research scientific methods	**1**	**9**
8.2	Role of theory, characteristics of research.	**1**	**9**
8.3	Types of research: Fundamental, applied, historical and experimental research Chemical literature: Primary, secondary and tertiary sources of literature	**1**	**9**
8.4	Classical and comprehensive reference Literature databases: ScienceDirect	**1**	**9**
8.5	SciFinder. Chemical Abstract.Scientific writing: Research reports, thesis, journal articles, books	**1**	**9**
8.6	Types of publications: articles, communications, reviews.	**2**	**9**
8.7	Important scientific and Chemistry Journals. Impact factor.	**2**	**9**

Reference

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15. V.K. Ahluwalia, Oxidation in Organic Synthesis, CRC Press, 2012.

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17. Jonathan W Steed & Jerry L Atwood, Supramolecular Chemistry, Wiley, 2nd Edition

18. Katsuhiko Ariga, Toyoki Kunitake, Supramolecular Chemistry – Fundamentals and Applications, Springer

CH 80 04 03 ADVANCED PHYSICAL CHEMISTRY

Programme	**M.Sc**
Semester	**IV**
Course Type	**Thoery**
Instructor(s)	**Dr.Shiby Susan Kuriakose, Dr. Sholly Clair George, Philip Marina Philip, Dr. Sheela Chacko**

CO	Course Outcomes	CL	PSO
1	Explain various aspects of photochemistry		1,3
2	Discuss Fluorescence Spectroscopy and understand The instrumentation	**E**	3
3	Explain mechanism of sensing, sensing techniques based on electron transfer,	**An**	**1,3**
4	Explain origin of spectra in AES	**An**	**1,3**
5	Design various Coulometric rections	C	1,3

6	Explain Thermodynamics of irreversible processes with simple examples	E	2

Module	Course Description	Hours	CO
1.0	**Photochemistry**	**18**	
1.1	Quantum yield, chemical actinometry, excimers and exciplexes, photosensitization, chemiluminescence,	2	1,3
1.2	bioluminescence,thermoluminescence,pulseradiolysis,hydrated electrons, photostationary state, dimerization of anthracene, ozone layer in the atmosphere.	2	1,3
1.3	Principle of utilization of solar energy: solar cells, types of solar cells-amorphous silicon solar cell	2	1,3
1.4	cadmium telluride solar cell, copper indium gallium selinide solar cell.	2	1,3
1.5	Quenching of fluorescence and its kinetics,	3	1,3
1.6	Stern-Volmer equation, concentration quenching, fluorescence and structure,	3	1,3
1.7	delayed fluorescence, E-type and P-type, effect of temperature on emissions, photochemistry of environment,	3	1,3
1.8	green house effect, two photon absorption spectroscopy, lasers in photochemical kinetics.	1	1,3
2.0	**Fluorescence Spectroscopy**	**9 Hrs**	
2.1	Instrumentation: light source, monochromator	**1**	1,3
2.2	optical filters, photomultiplier tube,	**1**	1,3
2.3	polarizers, fluorescence sensing,	**1**	1,3
2.4	mechanism of sensing, sensing techniques based on collisional quenching,	**1**	1,3
2.5	mechanism of sensing, sensing techniques based on energy transfer	**1**	1,3
2.6	mechanism of sensing, sensing techniques based on electron transfer,	**1**	1,3
2.7	examples of pH sensors	**1**	1,3
2.8	Novel fluorephores: long life time metal-ligand complexes	**2**	1,3
3.0	**Diffraction Methods and Atomic Spectroscopic Techniques**	**9 Hrs**	
3.1	Electron diffraction of gases, Wierl's equation, Neutron diffraction method,	1	3
3.2	Comparison of X-ray, electron and neutron diffraction methods.	1	3
3.3	Atomic absorption spectroscopy (AAS), principle of AAS, absorption of radiant energy by atoms	1	3
3.4	Classification of atomic spectroscopic methods, measurement of atomic absorption, instrumentation	2	3
3.5	Atomic emission spectroscopy (AES) advantages and disadvantages of AES	2	3,4
3.6	origin of spectra, principle and instrumentation.Flame emission spectroscopy (FES), flames and flame temperature,	2	3
3.7	spectra of metals in flame, instrumentation.	1	3
4.0	**Electrochemistry and Electromotive Force**	**27 Hrs**	
4.1	Theories of ions in solution, Drude and Nernst's electrostriction model and Born's model, Debye-Huckel theory, derivation of Debye-Huckel-Onsager equation, validity of DHO equation for aqueous and non aqueous solutions,	**3**	**1**
4.2	Debye-Falkenhagen effect, conductance with high potential gradients, activity and activity coefficients in electrolytic solutions, ionic strength, Debye-Huckel limiting law and its various forms,.	**3**	**1**

4.3	qualitative and quantitative tests of Debye-Huckel limiting equation, deviations from the DHLL, ion association, triple ions and conductance minima	**3**	**1**
4.4	Electrochemical cells, concentration cells and activity coefficient determination, liquid junction potential	**3**	**1**
4.5	evaluation of thermodynamic properties, the electrode double layer, electrode-electrolyte interface different models of double layer, theory of multilayer capacity	**3**	**1**
4.6	electro capillary, Lippmann equation, membrane potential Fuel cells- Theory and working of fuel cells	**3**	**1**
4.7	methanol fuel cell, H_2-O_2 fuel cell and solid oxide fuel cells.	**3**	**1**
4.8	Corrosion and methods of prevention, Pourbaix diagram and Evans diagrams.	**2**	**1**
4.9	Tafel equation and its significance,	**2**	**1**
4.10	Butler-Volmer equation for simple electron transfer reactions, transfer coefficient, exchange current density, rate constants.	**2**	**1**
5.0	**Electroanalytical Technique**	**18**	
5.1	Voltametry: Cyclic voltametry, ion selective electrodes, anodic stripping voltametry	**2**	**1**
5.2	Polarography-decomposition potential, residual current	**2**	**1**
5.3	migration current, supporting electrolyte, diffusion current,polarogram,	**2**	**1**
5.4	half wave potential, limiting current density, polarograph,explanation of polarographic waves	**2**	**1**
5.5	The dropping mercury electrode, advantages and limitations of DME, quantitative analysis- pilot ion procedure, standard addition methods, qualitative analysis-	**2**	**1**
5.6	determination of half wave potential of an ion, advantages of polarography.	**2**	**1**
5.7	Amperometric titrations: General principles of amperometry, instrumentation,	**2**	**1,3**
5.8	application of amperometry in the qualitative analysis of anions and cations in solution, merits and demerits of amperometric titrations.	**2**	**1,3**
5.9	Coulometry: Coulometer-Hydrogen Oxygen coulometers, silver coulometer, coulometric analysis with constant current, coulometric tritrations	**1**	**1,5**
5.10	application of coulometric titrations-neutralization titrations, complex formation titrations, redox titrations, advantages of coulometry	**1**	**1,5**
6.0	**Advanced Thermodynamics**	**9**	
6.1	Thermodynamics of irreversible processes with simple examples, general theory of non-equilibrium processes	**1**	**1,6**
6.2	entropy production, the phenomenological relations	**1**	**1,6**
6.3	principle of microscopic reversibility	**1**	**1,6**
6.4	Onsager reciprocal relations, thermal osmosis and thermoelectric phenomena	**1**	**1,6**
6.5	Bioenergetics, coupled reactions, ATP and its role in bioenergetics,	**1**	**1,6**
6.6	high energy bond	**1**	**1,6**
6.7	free energy and entropy change in ATP hydrolysis	**1**	**1,6**
6.8	thermodynamic aspects of metabolism	**1**	**1,6**
6.9	Respiration, glycolysis, biological redox reactions.	**1**	**1,6**

Reference:

1. K.K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, 2nd Edn., New AgeInternational,1986.

2. G. Aruldhas, Molecular structure and Spectroscopy, PHI Learning, 2007.

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Chemistry, 8th Edn., Saunders College Pub., 2007.

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21. R.K. Murray, D.K. Granner, P. A. Mayes, V.W. Rodwell, Harper's Biochemistry, Tata McGraw Hill, 1999.

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St. Mary's College, Manarcaud

BSc Chemistry

PSO & CO

PSO NO:	PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1	Understand fundamental concepts of inorganic organic physical environmental polymer and nano chemistry
PSO2	Identify and estimate inorganic chemicals using basic laboratory techniques
PSO3	Develop skills in synthesis separation and characterization of organic compounds using laboratory methods
PSO4	Develop skills in operating and interpreting various instruments and data used for physical and chemical experiments
PSO5	Understand recent developments and new areas of study and topics of relevance in the field of chemistry
PSO6	Understand the impact of chemicals on environment issue remedial measures human rights involved and legislation
PSO7	Associate the learned concepts to various industrial applications through industrial visits and projects
PSO8	Determine and solve basic quantum mechanical concepts
PSO9	Solve and calculate problems related to spectroscopy

Semester I

CH1CRT01 General & Analytical Chemistry

Programme	**B.Sc. Chemistry**
Semester	**I**
Course Type	**Theory**

Instructors	**Tony Francis, Sholly Clair George**

CO No.	***Expected Course Outcomes***	**Cognitive Level**	**PSO No.**
1	Describe about the methodology of Science in general and Chemistry in particular.	U	PSO-1
2	Explain the basic concepts of periodic table and the associated periodic properties.	U	PSO-1
3	Apply the concepts of periodic table and periodic properties	Ap	PSO-7
4	Discuss the various analytical tools in Chemistry	U	PSO-5
5	Describe various Chromatographic techniques	U	PSO-5
6	Evaluate analytical data	E	PSO-1

Module	Course Description	Hrs	CO.No.
1.0	**Methodology of Chemistry**	**7**	
1.1	Definition of Science. Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law.	2	1
1.2	Falsification of hypothesis - inductive and deductive reasoning- revision of scientific theories and laws.	1	1
1.3	Evolution of Chemistry-ancient speculation on the nature of matter. Early form of chemistry-alchemy, origin of modern chemistry.	1	1
1.4	Structure of chemical science: Scope, theory and experiment - branches of chemistry.	1	1
1.5	Role of chemistry as a central science connecting physics, biology and other branches of science	1	1
1.6	Interdisciplinary areas involving chemistry: Nanotechnology and biotechnology.	1	1
2.0	**Periodic Table and Periodic Properties**	**5**	
2.1	Modern periodic law – Long form periodic table. Diagonal relationship and anomalous behaviour of first element in a group.	1	2
2.2	Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity (electron gain enthalpy) – electronegativity.	2	3
2.3	Electronegativity scales: Pauling and Mullikan scales. Effective nuclear charge – Slater rule and its applications – polarising power.	2	3
3.0	**Analytical Methods in Chemistry**	**12**	
3.1	Molecular mass - mole concept – molar volume. Oxidation and reduction – oxidation number and valency – variable valency - equivalent mass.	1	4
3.2	Qualitative analysis: Applications of solubility product and common ion effect in the precipitation of cations. Principle of intergroup separation of cations. Interfering acid radicals and their elimination (oxalate, fluoride, borate and phosphate).	2	4
3.3	Titrimetric analysis - fundamental concepts. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and ppb.	2	4

3.4	Primary and secondary standards, quantitative dilution – problems.	1	4
3.5	Acid base titrations- titration curves – pH indicators. Redox titrations – titration curve – titrations involving MnO^{4-} and $Cr_2O_7^{2-}$ redox indicators.	2	4
3.6	Complexometric titrations – EDTA titrations - titration curves – metal ion indicators.	1	4
3.7	Gravimetric analysis: Unit operations in gravimetric analysis - illustrations using iron and barium estimation.	1	4
3.8	Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.	2	4
4.0	**Chromatographic Methods**	**7**	
4.1	Column Chromatography: Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.	2	5
4.2	Thin Layer Chromatography: Principle, choice of adsorbent and solvent, preparation of Chromatoplates, Rf-values, significance of Rf values.	2	5
4.3	Ion exchange chromatography: Principle and experimental techniques.	1	5
4.4	Gas Chromatography: Principle and experimental techniques	1	5
4.5	High Performance Liquid Chromatography (HPLC): Principle and experimental techniques.	1	
5.0	**Evaluation of Analytical Data**	**5**	
5.1	Units, significant digits, rounding, scientific and prefix notation, graphing of data.	1	6
5.2	Precision and accuracy-types of errors – ways of expressing precision – ways to reduce systematic errors - reporting analytical data.	2	6
5.3	Statistical treatment of analytical data – population and samples –Mean and standard deviation – distribution of random errors.	2	6

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8. R. Gopalan, *Inorganic Chemistry for Undergraduates*, Universities Press, Hyderabad, 2009.

9. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.

CO No.	*Expected Course Outcomes*	Cognitive Level	PSO No.
1	To understand the historical development of chemistry and theories of atomic structure	U	PSO-1
2	To understand different types of bond	U	PSO-1
3	To apply hybridization and VSEPER theory to different molecules	Ap	PSO-7
4	To apply Molecular orbital theory to simple molecules	Ap	PSO-5
5	To understand different intermolecular forces	U	PSO-5
6	To understand the general chemistry of s,p,d and f block elements	E	PSO-1

me B.Sc. Chemistry
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ors Tony Francis, Sholly Clair George

CH1CRT02 THEORETICAL AND INORGANIC CHEMISTY

Module	Course Description	Hrs	CO.No.
1.0	**Atomic Structure**	**6 hours**	
1.1	Introduction based on historical development (Dalton's atomic theory, Thomson's atom model Rutherford's atom model)	1	1
1.2	failure of classical physics – black body radiation - Planck's quantum hypothesis - photoelectric effect - generalization of quantum theory	1	1
1.3	Atomic spectra of hydrogen and hydrogen like atoms– Bohr theory of atom – Calculation of Bohr radius, velocity and energy of an electron - explanation of atomic spectra - limitations of Bohr theory - Sommerfeld modification.	1	1
1.4	Louis de Broglie's matter waves – wave-particle duality - electron diffraction - Heisenberg's uncertainty principle.	1	1
1.5	Schrödinger wave equation (derivation not expected), wave functions – significance of ψ and $\psi 2$ – atomic orbitals and concept of quantum numbers - shapes of orbitals (*s*, *p* and *d*)	1	1
1.6	Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle – electronic configuration of atoms.	1	1
2.0	**Chemical Bonding – I**	9hrs	
2.1	Introduction – Octet rule and its limitations.	1	2
2.2	Types of bonds: Ionic bond - factors favouring the formation of ionic bonds - lattice energy of ionic compounds - Born- Lande equation with derivation - solvation enthalpy and solubility of ionic compounds	2	2
2.3	Born-Haber cycle and its applications – properties of ionic compounds - polarisation of ions – Fajan's rule and its applications.	1	2
2.4	Covalent Bond: Valence Bond Theory and its limitations. Concept of resonance - resonance structures of borate, carbonate and nitrate ions.	2	2

2.5	Hybridization: Definition and characteristics – shape of molecules	1	3
2.6	VSEPR theory: Postulates - applications - shapes of molecules	1	3
2.7	Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure	1	3
3.0	**Chemical Bonding – II**	9hrs	
3.1	Covalent Bond: Molecular Orbital Theory – LCAO - bonding and anti-bonding molecular orbitals – bond order and its significance.	2	4
3.2	MO diagrams of homonuclear and heteronuclear diatomic moleculescomparison of bond length, magnetic behavior and bond energy of O2, O2+, O22+, O2- and O22-	2	4
3.3	Metallic Bond: free electron theory, valence bond theory and band theory (qualitative treatment only) - explanation of metallic properties based on these theories.	2	4
3.4	Intermolecular forces: Hydrogen bond - intra and inter molecular hydrogen bonds – effect on physical properties. Van der Waals forces, ion-dipole, dipole-dipole, ion-induced dipole, dipole-induced dipole and induced dipole-induced dipole interactions	3	5
4.0	**Chemistry of s and p Block Elements**	3hrs	
4.1	Periodicity in s-and p- block elements with respect to electronic configuration, atomic and ionic size, ionization energy and electro negativity. Inert pair effect.	3	6
5.0	**Chemistry of d and f Block Elements**	9hrs	
5.1	General characteristics of transition elements	1	6
5.2	Difference between first row and other two rows.	2	6
5.3	Preparation, properties, structure and uses of KMnO4 and K2Cr2O7.	2	6
5.4	*Lanthanides:* Electronic configuration and general characteristics – Occurrence of lanthanides	1	6

5.5	Isolation of lanthanides from monazite sand - Separation by ion exchange method.	2	6
5.6	Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides.	1	6

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1. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
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3. I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,
4. ManasChanda, *Atomic structure and Chemical bonding in Molecular Spectroscopy"* Tata McGraw Hill.
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SEMESTER III

CH3CRT03 Basic organic chemistry I

Programme	**B. Sc Chemistry**
Semester	**III**
Course Type	**Theory**
Instructor(s)	**Dr.Sheela Chacko, Dr. Sholly Clair George**

CO. No	Course Outcomes	CL	PSO
1	Understand the basic concepts of organic chemistry	**U**	**1**
2	Classification of organic compounds	**U**	**1**
3	Design the preparation of organic compounds	**C**	**3**
4	Discuss the reactions of organic compounds	**U**	**1**
5	Identify how stereochemistry affects a chemical reaction	**AP**	**1**
6	Recall organometallic compounds	**R**	**1**
7	Define Huckel's rule and applications	R	1
8	Infer the reactions of benzene and anthracene	U	1
9	Draw and Infer about structures in pericyclic reactions	AP	1

Module	Course Description	Hours	CO

1.0	**Unit 1: Fundamentals of Organic Chemistry**	**8**	
1.1	Classification and IUPAC system of nomenclature of common organic compounds (both aliphatic and aromatic).	**2**	**1,2**
1.2	Line diagram drawing. Factors affecting reaction mechanism. Polarity of bonds.	**1**	**1**
1.3	*Electronic displacements*: Inductive effect, electromeric effect, mesomeric effect, resonance and hyperconjugation. steric effects.	**1**	**1,4**
1.4	*Cleavage of bonds*: Homolysis and heterolysis with suitable examples. curly arrow rules, formal charges.	**1**	**1,4**
1.5	*Types of reagents*: Nucleophiles and electrophiles.	**1**	**1,4**
1.6	*Reactive intermediates*: Carbocations, carbanions, free radicals and carbenes – types, shape and relative stability.	**1**	**1.4**
1.7	*Types of organic reactions*: Addition, elimination, substitution, rearrangement and redox reactions (definition and one example each).	**1**	**1,3**
2.0	**Stereochemistry**	**15**	
2.1	Stereoisomerism – definition, classification.	**2**	**5**
2.2	*Optical isomerism*: Optical activity, specific rotation, concept of chirality (upto two carbon atoms).	**2**	**5**
2.3	Configuration. Enantiomerism, diastereomerism and meso compounds. Racemic mixture and methods of resolution. Asymmetric synthesis (partial and absolute). Threo and erythro; *d* and *l* designations; Cahn-Ingold-Prelog rules: R/ S notation (for upto 2 chiral carbon atoms).	**4**	**5**
2.4	*Geometrical isomerism: cis–trans, syn-anti* and E/Z nomenclature (for upto two C=C systems) with C.I.P rules. Methods of distinguishing geometrical isomers.	**2**	**5**
2.5	*Conformational analysis:* Conformational analysis with respect to ethane, butane and	**2**	**5**

	cyclohexane. Relative stability and energy diagrams.		
2.6	Inter conversion of Wedge formula, Newman, Sawhorse and Fischer projection formulae	**1**	**5**
2.7	Chair, boat and twist boat forms of cyclohexane with energy diagrams. Conformation of methyl cyclohexane	**1**	**5**
2.8	Origin of ring strain in cyclic systems. Baeyer's strain theory.	**1**	**5**
3.0	**Aliphatic Hydrocarbons and Alkyl Halides**	**12 hrs**	
3.1	*Alkanes:* Preparation - catalytic hydrogenation, Wurtz reaction, Wurtz-Fittig reaction, from Grignard reagent. Reactions - free radical substitution - halogenation.	**2**	**3,4**
3.2	*Alkenes:* Preparation - Elimination reactions - mechanism of E1 and E2 reactions. Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's and Hofmann's rules). Reactions - *cis*-addition (alkaline KMnO4) and *trans*-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition with mechanisms), Hydration, Ozonolysis.	**4**	**3.4**
3.3	*Alkynes:* Preparation - Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Reactions - Acidity of alkynes, formation of metal acetylides, alkylation of terminal alkynes and conversion into higher alkynes, addition of bromine and alkaline KMnO4.	**2**	**3.4**
3.4	*Alkyl Halides:* Preparation - From alkenes and alcohols. Reactions - Types of aliphatic nucleophilic substitution reactions - S 1and S 2 mechanisms with stereochemical aspects and effects of substrate structure, solvent, nucleophile and leaving group.	**2**	**3.4**
3.5	Organometallic compounds of Mg (*Grignard reagents*) – Formation, structure and important reactions/synthetic applications.	**2**	**6**

4.0	**Aromatic hydrocarbons and aryl halides**	**15 hrs**	
4.1	Aromaticity-basic concepts	2	7
4.2	Molecular orbital picture of benzene	2	8
4.3	Molecular orbital picture of anthracene	2	8
4.4	Substitution reactions of benzene	3	8
4.5	Aryl halides-Preparation and reactions	3	8
4.6	Benzyne mechanism	3	8
5.0	**Pericyclic Reactions**	**4 hrs**	
5.1	Classification – electrocyclic reactions	1	9
5.2	Cycloaddition- Reactions Diels-Alder reaction	2	9
5.3	Sigmatropic rearrangements	1	9

References

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons, 2014.
3. McMurry, J. *Organic Chemistry*, 7th ed. Cengage Learning, 2013.
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9. Kalsi, P. S. *Stereochemistry - Conformation and Mechanism*; New Age International, 2005.
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SEMESTER IV

CH4CRTO4 Organic chemistry II

Programme	**B. Sc Chemistry**
Semester	**IV**
Course Type	**Theory**
Instructor(s)	**Dr.Sheela Chacko, Dr. Sholly Clair George**

CO	Course Outcomes	CL	PSO

1	Understand the preparation properties and reactions of alcohols, phenols, ethers aldehydes and ketones	U	1
2	Design the preparation methods of carbonyl compounds	C	3
3	Explain the reactions of carbonyl compounds	U	1
4	Discuss the rearrangement reactions	U	1
5	Decide the effect of substituents on the reactivity of carboxylic acids	Ap	3
6	Summarise the general reactions of sulphonic acids	**U**	**3**
7	Recall the synthesis and reactivity of carboxylic acid derivatives	**U**	**3**

Module	Course Description	Hours	CO
1.0	**Alcohlos, Phenols and Ethers**	**16 hrs**	
1.1	Preparation - 1_, 2_ and 3_ alcohols using Grignard reagent, ester hydrolysis, reduction ofaldehydes, ketones, carboxylic acids and esters (Bouveault-Blanc reduction). Reactions - with sodium, HX (Lucas test), esterification, oxidation (with PCC, alkaline KMnO4, OsO4, acidic dichromate, conc. HNO3). Oppenauer oxidation (with mechanism). Ascent and descent of alcohol series	4	**1**
1.2	*Diols:* Preparation - hydroxylation of alkenes, hydrolysis of epoxides. Reactions - oxidative cleavage of diols using lead tetraacetate and periodic acid. Pinacol - Pinacolone rearrangement (with mechanism).	4	**1**
1.3	*Phenols:* Preparation -cumene hydroperoxide method, from diazonium salts. Reactions - Electrophilic substitution - nitration, halogenation and sulphonation. Reimer-Tiemannreaction and Fries rearrangement (with mechanisms). Preparation and uses of nitrophenols, picric acid, resorcinol and quinol.	4	**1**

1.4	*Ethers and Epoxides:* Preparation - ethersandepoxides - Williamson's ether synthesis. Reactions of ethers - cleavage with HI. Zeisel's method of estimation of alkoxy groups.Reactions of epoxides - with alcohols, ammonia derivatives and LiAlH4.	4	**1**
2.0	**Aldehydes and Ketones**	**20 hrs**	
2.1	Preparation, properties and reactions of formaldehye, acetaldehyde, acetone, benzaldehyde and benzophenone.Preparation - from alcohols, acid chlorides, esters and nitriles	4	3
2.2	Reactions - Structure of the carbonyl group and acidity of _-hydrogen. (i) Addition reactions - with HCN, ROH, NaHSO3, Grignard reagents and ammonia derivatives. Aldol, Claisen, Claisen-Schmidt, Knoevenagel and Benzoin condensations (with mechanisms).	4	4
2.3	Oxidation reactions - Tollen's and Fehling's tests, Iodoformtest, Baeyer-Villiger oxidation (with mechanism)	4	4
2.4	Reduction reactions - Clemmensen,Wolff-Kishner, Meerwein-Pondorff-Verley, LiAlH4, and NaBH4 reductions (with mechanisms)	4	4
2.5	Rearrangement reactions - Beckmann, and benzil-benzilic acid rearrangements (with mechanisms).	4	5
3.0	**Carboxylic Acids,Suiphonic Acids and their derivatives**	**18 hrs**	
3.1	*Carboxylic acids* (aliphatic and aromatic) Preparation - Oxidation of alcohols and aldehydes, hydrolysis of nitriles, side chain oxidation and carbonylation of grignard reagents. Acidic and alkaline hydrolysis of esters.	2	**5,7**
3.2	Reactions - structure of carboxylate ion, effect of substituents on acid strength. Ascent and descent of acid series. Reduction and decarboxylation reactions. Reactions with	4	**5,7**

	PCl5, PCl3 and SOCl2. Reaction with ammonia, esterification and halogentaion. Hell – Volhard Zelinsky reaction (with mechanism).		
3.3	*Carboxylic acid derivatives* (aliphatic) *Preparation* - acid chlorides, anhydrides, esters and amides from acids.Reactions - comparative study of nucleophilicity of acyl derivatives. Perkin condensation and Reformatsky reaction (with mechanisms).	4	**5.7**
3.4	*Dicarboxylic acids, hydroxy acids and unsaturated acids* Methods of formation, important reactions and uses of dicarboxylic acids, hydroxy acids and unsaturated acids like oxalic acid, malonic acid, adipic acid, phthalic acid, citric acid, salicylic acid, cinnamic acid, anthranilic acid, acrylic acid, maleic acid and fumaric acid	4	**5,7**
3.5	*Sulphonic acids and their derivatives* Preparation, reactions and uses of benzene sulphonic acid, benzene sulphonyl chloride and *ortho*- and *para*- toluene sulphonyl chlorides.	4	**5,7**

References

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, Wiley, 2014.
3. McMurry, J. *Organic Chemistry*, 7th ed. Cengage Learning, 2013.
4. Finar, I.L. *Organic Chemistry* (Vol. 1), Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
5. Carey, F.A., Giuliano, R.M. *Organic Chemistry*, 8th ed., Tata McGraw Hill,.2012
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10. Gupta, S.S. *Organic Chemistry*, Oxford University Press

Environment, Ecology, and human rights

Programme	**B Sc**
Semester	**V**
Course Type	**Theory**
Instructor(s)	**Tony Francis**

CO	Course Outcomes	CL	PSO
1	Understanding environmental studies and sustainable development	**U**	1,5,6
2	Different types of environmental resources	**U**	1,6
3	Infer about environmental problems	U	1,6
4	Describe environmental movements in India	U	1,6
5	Describe environmental hazards and risks and the social and economic ramifications	U	1,6
6	Familiarize with the major environmental problems its causes and potential solutions	U	1,6
7	Discuss the Toxicology and Toxicological Effects of Pollution	E	1,6
8	To understand what are human rights	U	1,6
9	To evaluate importance of United nations its organs and contributions UN made	**U**	**1,6**
10	To relate how human rights are internationally, nationally and in the states perspective	**R**	**1,6**

Module	Course description	Hours	CO
1.0	Introduction to environmental studies:natural resources	**10**	
1.1	Definition, scope and importance of environmental studies for sustainable development	1	1
1.2	Natural resources-classification and problems	1	1,3
1.3	Land resources- land degradation	1	
1.4	Mineral resources-uses and exploitation	1	1,3
1.5	Water resources-uses and problems	1	1,3
1.6	Forest resources-uses and problems	2	1,3
1.7	Food resources-problems and classification	1	1,3
1.8	Energy resources-classifications and uses	2	1,3
2.0	**Environment: Pollution and social issues**	**18**	
2.1	Fundamental issues of pollution and pollutant. Cause, effects and preventive measures of various types of pollutions-air, water, soil, marine, noise and thermal pollutions.	3	**1,3**
2.2	Nuclear energy as a source of energy and its hazards	1	**1,3**
2.3	Solid waste management, causes effects and control mechanism of urban and industrial wastes. Prevention of pollution: role of individual.	2	**1,3**
2.4	Disaster management mechanisms; disaster management of; floods, earthquakes,	4	**1,3**

	cyclone and landslides. Movement from unsustainable to sustainable development. Urban crisis related to energy. Water conservation, rain water harvesting, watershed management.		
2.5	Environmental ethics: Issues and possible solutions. Introduction to greenhouse gases, sources of the primary GHGs in Earths atmosphere. The lessor GHGs- nitrous oxide, Ozone and fluorinated gases	2	**1.3**
2.6	Carbon cycle, CO2 sources, Keeling curve and Natural sinks for CO2. Greenhouse effect, climate change, global warming. Acid rain, ozone layer depletion, role of CFCs, nuclear accidents.	2	**1,31**
2.7	Wasteland reclamation. Waste products Environment Protection Act, Air Act, Water Act, Wildlife protection Act, Forest conservation Act.	2	**1,3**
2.8	Issues involved in the enforcement of environmental legislation.	1	**1,3**
2.9	Introduction to the concept of green chemistry, atom economy and the twelve principles of green chemistry.	1	**1,3**
3.0	**Population and Environmental Issues**		
3.1	Maithusian theory-basic idea	2	1,3
3.2	Global challenges of population	2	1,3
3.3	Socio economic factors	2	1,3
3.4	Projects concerning population	3	1,3
3.5	Poverty scale and food crisis	3	1,3
3.6	Environmental movements in India	3	1,3
3.7	Environmental issues	3	1,3
4.0	**Ecological Chemistry**	**18**	
4.1	Definition of Ecological chemistry	1	**1**
4.2	Origin of chemical toxins, organisation of chemicals as xenobiotic, essential or non essential	1	**5**
4.3	Release of chemicals in the environment, transport, processes, classification of transformation processes, biotic and abiotic	2	**5**
4.4	Structure- activity relationship in degradation and biological degradation of organic chemicals.	1	**5**
4.5	Transformation processes including general, hydrolysis, oxidation reduction, photochemical degradation and	2	**5**

	phytodegradation, environmental fate determining processes		
4.6	Bioavailability, exposure of species to available fractions, uptake, metabolism, biomagnifications, distribution in organisms and subsequent toxic effects	3	**6**
4.7	Persistent organic pollutants, half lives, Kow, Kaw and Koa. Adverse effects of persistent chemicals. Twelve persistent organic pollutants	3	**7**
4.8	Behaviour of persistent pollutants identified by UNECE	3	**7**
4.9	Agency for toxic substance and disease Registry list, substance priority list	1	**7**
4.10	Restriction of Hazardous substances, MSDN, TSCA and banned chemicals list	1	**7**
5.0	**Human Rights**	**18**	
5.1	An introduction to human rights, meaning, concept and development – History of Human rights	**2**	**8**
5.2	Different generations of human rights- Universality of human rights	**1**	**8**
5.3	Basic International Human rights Documents – UDHR, ICCPR, ICESCR	**2**	**8**
5.4	Value dimensions of human rights	**1**	**8**
5.5	Role of UN secretariat, the economic and social council	**1**	**9**
5.6	The security council and human rights	**1**	**9**
5.7	Committee on the elimination of Racial discrimination, discrimination against women	**2**	**9**
5.8	Committee on Economic, Social, and Cultural Rights – The human rights committee	**1**	**9**
5.9	Appraisal of human rights regime	**1**	**9**
5.10	Human Rights in Indian Constitution, Fundamental rights. The constitutional context of human rights directive Principles of state policy and human rights, Human rights of women –children-minorities -prisoners	**3**	**10**
5.11	National human rights commission	**1**	**10**
5.12	State human rights commission	**1**	**10**
5.13	Human rights awareness in education	**1**	**10**

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1. H.O. Agarwal, *Implementation of Human Rights Covenants with Special Reference to India*,
2. P. Alston, *The United Nations and Human Rights*, Clarendon Press, London, 1995.
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15. Ian Brownlie, *Basic Documents Human Rights*
16. Jack Donelli, *Universal Human Rights in Theory and practice*
17. Upendra Baxi, *Future of Human Rights*
18. O P Dhiman, *Understanding Human Rights-An Overview*
19. D P Khanna, *Reforming Human Rights*
20. Chiranjivi J Nirmal, *Human Rights in India-Historical, social and political perspectives*
21. *Human Rights in Post-Colonial India,* Edited by Om Prakash Dwivedi and V G Julie Rajan

CH5CRT07 Physical chemistry I

Programme	**BSc CHEMISTRY**
Semester	**V**
Course Type	**Theory**
Instructor(s)	**Dr. Shiby Susan Kuriakose, Philip Marina Philip**

CO	Course Outcomes	CL	PSO

1	Understand kinetic theory of gases and deviations from ideal behaviour	**U**	**1**
2	Explain critical phenomena and velocity distribution.	**U**	**1**
3	Describe collision properties and properties of liquids.	**R**	**1**
4	Describe features of solid and liquid crystals	**U**	**1,5**
5	Identification of lattice planes.	**An**	**1**
6	Understand the features of semiconductors	**U**	**1,5**
7	Describe the process of adsorption of gases by solids.	**U**	**1**
8	Describe the properties and nature of colloids	**R**	**1**

Module	Course Description	Hours	CO
1.0	**GASEOUS STATE**	**12**	
1.1	Postulates of kinetic theory of gases, derivation and deviation from ideal behaviour	2	1
1.2	Compressibility factor and Van der Waals equation	1	1
1.3	Critical phenomena and Andrews isotherm of CO2	2	2
1.4	Critical constants	1	2
1.5	Virial equation and Boyle temperature	1	1,2
1.6	Maxwell distribution of velocities and energy	1	2
1.7	Most probable, RMS and average velocity	1	1,2
1.8	Collision properties	1	3
1.9	Mean free path and coefficient of viscosity	2	3
2.0	**LIQUID STATE**	**3**	
2.1	Intermolecular forces in liquids	1	3
2.2	Surface tension and viscosity	**2**	**3**
3.0	**SOLID STATE**	**12**	
3.1	Anisotropy, unit cells and crystal structure	1	6
3.2	Identification of lattice planes	1	6
3.3	Laws of crystallography	1	6
3.4	Miller indices	1	7
3.5	X ray diffraction, Bragg's Method	2	6
3.6	Analysis of powder pattern of NaCI and KCl	1	6
3.7	Structure of ionic compounds	2	6
3.8	Defects in crystals	1	6
3.9	Electrical conductivity and semiconductors	1	8
3.10	Liquid crystals	1	6
4.0	**SURFACE CHEMISTRY AND COLLOIDAL STATE**	**9**	
4.1	Adsorption-types, factors	**1**	**7**

4.2	Freundlich adsorption isotherm-Langmuir adsorption isotherm	**1**	**7**
4.3	BET theory-use of BET equation for the determination of surface area	**1**	**7**
4.4	Types of solution-true, colloidal and suspensions	**1**	**8**
4.5	Purification of colloids	**1**	**8**
4.6	Optical and electrical properties of colloids	**1**	**8**
4.7	Electrical double layer and zeta potential	**1**	**8**
4.8	Coagulation of colloids, Hardy-Schulz rule	**1**	**8**
4.9	Micelles, sedimentation and streaming potential	**1**	**8**

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2. R J Silby and R A Alberty, *"Physical Chemistry"*, John Wiley & Sons
3. F Daniels and A Alberty, *"Physical Chemistry"*, Wiley Eastern
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9. L V Azaroff, *"Introduction to Solids"*, McGraw Hill.
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12. Anthony R. West, *"Solid State Chemistry and its Applications"*, Wiley Eastern.

CH5CRT08 **Physical chemistry II**

Programme	**B.Sc Chemistry**
Semester	**V**
Course Type	**Theory**
Instructor(s)	**Dr. Sholly Clair George, Tony Francis**

CO	Course Outcomes	CL	PSO
1	Describe the failures of classical mechanics	U	1,8
2	Identify the dual nature of electrons	R	1,8
3	Solve and determine wave function	AP	1,9
4	Define operators, Eigen values and Eigen functions	R	1,9

5	Compute and calculate problems in spectroscopy	AP	1
6	Sketch the wave functions of Hydrogen atom	AP	1
7	Infer about quantum numbers	U	1
8	State and explain the postulates of quantum mechanics	R	1
9	Interpret the principle of different branches of spectroscopy	U	1

Module	Course Description	Hours	CO
1.0	**Quantum Mechanics**	**14**	
1.1	Classical mechanics-Concepts	1	1
1.2	Davission and Germer experiment	2	2
1.3	Postulates Of quantum Mechanics	1	1
1.4	Definition of Eigen operators	1	4
1.5	Application of Quantum mechanics	2	8
1.6	Quantum numbers and importance	2	7
1.7	Molecular orbital theory-Basic idea	2	6
1.8	Linear combination of atomic orbitals	2	6
1.9	Physical significance BMO and ABMO	1	3
2.0	**Molecular Spectroscopy -I**	**12**	
2.1	Introduction and selection rules	3	9
2.2	Rotational Spectroscopy-principle-selection rule	3	9
2.3	Vibrational Spectroscopy-principle-selection rule	3	9
2.4	Raman Spectroscopy-principle	3	9
3.0	**Molecular Spectroscopy -II**	**10**	
3.1	Electronic Spectroscopy-Principle-Selection rule	4	5,9
3.2	NMR Spectroscopy -Principle	1	5,9
3.3	Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling.	**2**	**5.9**
3.4	Electron Spin Resonance (ESR) spectroscopy: Principle, hyperfine structure,	**2**	**5.9**
3.5	ESR of simple radical - methyl radical.	**1**	**5,9**

References

1. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001

2. Mc Quarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books.

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CH5CRTO6 Organic chemistry III

Programme	**B. Sc Chemistry**
Semester	**V**
Course Type	**Theory**
Instructor(s)	**SSK, SC,LVK,DMT,NP**

CO	Course Outcomes	CL	PSO
1	Identify the structure of heterocyclic compounds	R	1,8
2	Describe the synthesis of heterocyclic compounds	U	1,8
3	Design the synthesis of nitrogen containing compounds	**C**	**3**
4	Explain the reactions of nitrogen containing compounds	**U**	**1**
5	Classify carbohydrates and understand its properties	**U**	**1**
6	Classify drugs and evaluate the applications	**E**	**5**
7	Discuss about dyes and polymers	**U**	**5**
8	Understand active methyline compounds	**U**	**1**
9	Significance of biodegradable polym**ers**	**E**	**6**

Module	Course Description	Hours	CO
1.0	Nitrogen Containing Compounds		
1.1	Methods of preparation of nitroalkanes and aromatic nitro compounds**.** Tautomerism of nitromethane. Formation of charge transfer complexes	**2**	**3**
1.2	Reduction products of nitrobenzene in acidic, neutral and alkaline media. Electrolytic reduction and selective reduction of polynitro compounds	**2**	**4**
1.3	Amines (aliphatic and aromatic): Preparation: From alkyl halides, Reduction of nitro	**2**	**3**

	compounds and nitriles, Reductive amination of aldehydes and ketones, Gabriel's phthalimide synthesis, Hofmann bromamide reaction (with mechanism).		
1.4	Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Schotten – Baumann Reaction (with mechanism). Electrophilic substitution reactions of aniline: Halogenation, nitration and sulphonation	**2**	**4**
1.5	Hinsberg test, with HNO2.Separation of a mixture of 1°, 2° and 3° amines using Hinsberg reagent. Quaternary amine salts as phase-transfer catalysts.	**2**	**4**
1.6	Stereochemistry of amines. Structural features affecting basicity of aliphatic and aromatic amines. Comparative study of aliphatic and aromatic amines	**2**	**4**
1.7	Diazonium salts: *Preparation:* From aromatic amines. *Reactions:* Structure and stability of benzene diazonium salts. Conversion to benzene, phenol, chloro, bromo, iodo and fluoro benzenes, nitro benzene and azo dyes. Mechanisms of Sandmeyer and Gatterman reactions. Schiemann and Gomberg reactions.	**3**	**3**
1.8	Preparation, structure and uses of Phenyl hydrazine, Diazomethane and Diazoacetic ester. Arndt –Eistert synthesis – Mechanism of Wolff rearrangement	**2**	**3**
2.0	**Heterocyclic Compounds**		
2.1	Classification and nomenclature. Structure and aromaticity of 5-membered and 6-membered rings containing one heteroatom.	2	1
2.2	Synthesis and reactions of: Furan, Thiophene Synthesis and reactions of Pyrrole (Paal Knorr synthesis and Knorr pyrrole synthesis), Pyridine (Hantzsch synthesis)	3	2
2.3	Synthesis and reactions of Indole(Fischer's indole synthesis), Quinoline (Skraup synthesis and Friedlander's synthesis) and	3	2

	Isoquinoline (Bischler-Napieralski reaction)		
3.0	**Active methylene compounds**		
3.1	Active Methylene Compounds Preparation: Ethyl acetoacetate by Claisen ester condensation. Keto-enol tautomerism	**2**	**8**
3.2	Synthetic uses of ethylacetoacetate, diethyl malonate and ethyl cyanoacetate (preparation of non-heteromolecules only). Alkylation of carbonyl compounds via enamines	**3**	**8**
4.0	**Carbohydrates**		
4.1	Classification of carbohydrates. Reducing and non-reducing sugars	**2**	**5**
4.2	General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose.	**2**	**5**
4.3	Chain lengthening and chain shortening of aldoses - Kiliani-Fischer synthesis and Wohl degradation. Interconversion of aldoses and ketoses	**2**	**5**
4.4	Linkage between monosaccharides. Structure of the disaccharides sucrose, maltose and cellobiose (excluding their structure elucidation). Reactions and uses of sucrose.	**2**	**5**
4.5	Artificial sugars (sweeteners) – sucralose. Structure of the polysaccharides starch and cellulose (excluding their structure elucidation). Industrial applications of cellulose.	**3**	**5**
5.0	**Drugs**		
5.1	Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics:	**2**	**6**

	Ampicillin and Chloramphenicaol, Sulpha drugs: Sulphanilamide,		
5.2	Antipyretics: Paracetamol, Analgesics: Aspirin and Ibuprofen, Antimalarials: Chloroquine, Antacids: Ranitidine, Anti-cancer drugs: Chlorambucil and Anti-HIV agents: Azidothymidine (Zidovudine).	**2**	**6**
5.3	Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples. Drug addiction and abuse. Prevention and treatment.	**1**	**6**
6.0	**Dyes**		
6.1	Theories of colour and chemical constitution. Classification of dyes – according to chemical constitution and method of application. Natural and synthetic dyes.	**2**	**7**
6.2	Synthesis and applications of: Azo dyes – Methyl orange; Triphenyl methane dyes - Malachite green and Rosaniline; Phthalein dyes **–** Phenolphthalein and Fluorescein; Indigoid dyes - Indigotin; Anthraquinoid dyes – Alizarin. Edible dyes (Food colours) with examples.	**2**	**7**
7.0	**Polymers**		
7.1	Introduction and classification. Polymerisation reactions - Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes.	**2**	**7**
7.2	Preparation and applications of plastics – thermosetting (Phenol-formaldehyde, Urea-formaldehyde, Polyurethane) and thermosoftening (Polythene, PVC); Fibres (acrylic, polyamide, polyester).	**2**	**7**

7.3	Synthetic rubbers – SBR, Nitrile rubber and Neoprene. Introduction to conducting polymers with examples. Environmental hazards and biodegradability of polymers. Recycling of plastics.	**2**	**9**

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1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
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7. John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.
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9. Pillai, C.N. *Organic Chemistry*, Universities Press, 2008.
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CH5OPT01 Chemistry in everyday life

Programme	**UG**
Semester	**5**
Course Type	**OPEN COURSE**
Instructor(s)	**Dr. Shiby Susan Kuriakose, Tony Francis**

CO	Course Outcomes	CL	PSO
1	Understand food additives	U	1
2	Explain Food safety act		2
3	Discuss different types of soaps and detergents	E	2
4	Explain various uses of different types of plastics and polymers	An	2
5	Understand different types of cosmetics	U	1
6	Explain different types of drugs and uses	An	2
7	Discuss different types of pesticides, fungicides and herbicides	E	1
8	Understand different types of nanoparticles	U	1

Module	Course Description	Hours	CO
1.0	**FOOD ADDITIVES**	**12**	
1.1	Preservatives food colours	2	1

1.2	Flavors	2	2
1.3	Leaventing agents	2	2
1.4	Toxicology	2	1
1.5	Food adulteration	2	1
1.6	Food safty and standards Act	2	1
2.0	**SOAPS AND DETERGENTS**	10	
2.1	Soaps, liquid soap TFM	2	3
2.2	Bathing bars, cleaning action of soap	2	3
2.3	Detergents	2	3
2.4	Common detergent additives	2	3
2.5	Environmental aspects	2	3
3.0	**COSMETICS**	**10**	
3.1	Introduction, types	2	5
3.2	Dental cosmetics, shampoo, hair dye	2	5
3.3	Skin products, cream, lotions	2	5
3.4	Lipsticks, perfumes, deodorants	2	5
3.5	Bath oil, shaving cream	1	5
3.6	Toxicology	1	5
4.0	**PLASTICS, PAPER AND DYES**	12	
4.1	Plastics and polymers	2	4
4.2	Polymerisation, uses	2	4
4.3	Biodegradable plastics, recycling of plastics	2	4
4.4	Paper-introduction, classifications	2	4
4.5	Paper manufacture	2	4
4.6	International recycling codes and symbols	1	4
4.7	Natural and synthetic dyes with examples	1	4
5.0	**DRUGS**	9	
5.1	Classifications, examples	3	4
5.2	Drug addiction and abuse	3	4
5.3	Preventation and treatment	3	4
6.0	**CHEMISTRY AND AGRICULTURE**	**12**	
6.1	Fertilizes-introduction, types	2	7
6.2	Excessive uses of fertilizers and impact on the environment	2	7
6.3	Bio fertilizers	2	7
6.4	Plant hormones	2	7
6.5	Pesticides-introductions, classifications	2	7
6.6	Excessive use of pesticides	1	7
6.7	Bio pesticides	1	7
7	**NANOMETERIALS**	7	
7.1	Terminology-scale of nanosyatems	2	8
7.2	Different types of nanoparticles	2	8
7.3	Applications	2	8
7.4	Toxicology of nanoparticles	1	8

Reference:

References:

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2. Shashi Chowla; *Engineering Chemistry*, Danpat Rai Publication.
3. B.K. Sharma; *Industrial Chemistry*. Goel Publishing House, Meerut, 2003.
4. C.N.R. Rao; *Understanding Chemistry*, Universities Press.
5. M.K. Jain and S.C. Sharma; *Modern Organic Chemistry*, Vishal Pub. Co., Jalandhar, 2009.
6. A.K. De; *Environmental Chemistry*, New Age International Ltd., New Delhi, 2006.
7. S.S. Dara; *A Textbook of Environmental Chemistry and Pollution Control*, S. Chand & Company Ltd.
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10. D. Sriram and P. Yogeeswari; *Medicinal Chemistry*, 2nd edn. Pearson, 2011.
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12. K.H.Buchel; *Chemistry of Pesticides*, John Wiley & Sons, New York, 1983.
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15. V.S.Muraleedharan, A. Subramania*; Nanoscience and Nanotechnology*, Ane Books, New Delhi, 2009.
16. K.J. Klabunde; *Nanoscale Materials in Chemistry*, Wiley.
17. Singh, K., *Chemistry in Daily Life;* Prentice Hall of India, New Delhi, 2008.

Course Code: CH6CRT10 Course Title: Organic chemistry IV Credits: 3 (54 hours)

Programme	**B. Sc Chemistry**
Semester	**VI**
Course Type	**Theory**
Instructor(s)	**Dr. Sheela Chacko**

CO	Course Outcomes	CL	PSO
1	Understand natural about Terpenoids and Alkaloids	U	1
2	Explain classification of lipids and their biological function	U	1
3	Understand the structure and functions of vitamins, hormones and steroids	U	1
4	Explain the methods of synthesis of amino acids	Ap	1
5	Understand about Nucleic acids and enzymes	U	1
6	Understand different types of photochemical reactions	U	1
7	Explain the basic concepts of UV, IR, NMR and Mass spectroscopy and supramolecular chemistry	U	1
8	Apply the concept of UV, IR, NMR and Mass spectroscopy to organic compounds	Ap	1

Module	Course Description	Hours	CO
1.0	**Natural Products**	**6**	
1.1	Terpenoids – Classification. Isoprene rule. Structure elucidation and uses of citral and geraniol. Natural rubber - structure, latex processing methods, vulcanisation, rubber compounding, mastication and uses.	3	1
1.2	Alkaloids - General methods of isolation. Classification. Physiological action and medicinal importance. Structure elucidation and synthesis of coniine, nicotine and piper	3	1
2.0	**Lipids**	**6**	
2.1	Introduction to lipids. Classification. Oils and fats: Biological functions. Extraction and refining. Common fatty acids present inoils and fats. Omega fatty acids. Trans fats and their effect. Hydrogenation, Rancidity. Acid value, Saponification value, Iodine value and RM value. Biological functions of waxes, phospholipids and glycolipids.	4	2
2.2	. Soaps - Types of soaps. Cleansing action of soaps. Synthetic detergents - Classification. Detergent additives. Comparison between soaps and detergents. Environmental aspects. ABS and LAS detergents	2	2
3.0	**Vitamins, Steroids and Hormones**	**6**	
3.1	Vitamins – Classification. Structure, biological functions and deficiency diseases of vitamins A, B1, B2, B3, B5, B6, C and D.	2	3
3.2	Steroids – Introduction. Diels' hydrocarbon. Structure and functions of cholesterol. Elementary idea of HDL and LDL.	2	3
3.3	Hormones – Introduction. Examples and biological functions of steroid hormones, peptide hormones and amine hormones (structure not required). Artificial hormones	2	3
4.0	**AminoAcids, Peptides, and Hormones**	**8**	
4.1	Classification of amino acids. Synthesis, ionic properties and reactions of _-amino acids. Zwitterion structure and Isoelectric point	2	4
4.2	Polypeptides. Synthesis of simple peptides (upto tripeptides) by N-protecting (benzyloxycarbonyl and *t*-butyloxycarbonyl) & C-activating groups.	2	4

	DCC method. Merrifield's solid phase peptide synthesis		
4.3	Classification of proteins. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of proteins. Terminal amino acid (by FDNB and Edman method) and C–terminal amino acid (by hydrazinolysis and with carboxypeptidase enzyme). Helical and sheet structures. Denaturation of proteins.	4	4
5.0	**Nucleic Acids**	**4**	
5.1	Components of Nucleic acids: Adenine, guanine, cytosine, thymine and uracil (structure only), other components of nucleic acids. Nucleosides and nucleotides(nomenclature), Structure of poly nucleotides;	2	5
5.2	Structure of DNA (Watson - Crick Model) and RNA. Biological functions of DNA and RNA - Replication and protein biosynthesis. Transcription and Translation. Genetic code.	2	5
6.0	**Enzymes**	**3**	
6.1	Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action, factors affecting enzyme action. Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action. Enzyme inhibition and their importance. Uses of enzymes.	3	5
7.0	**Supramolecular Chemistry**	**3**	
7.1	Introduction. Photochemical versus Thermal reactions.	1	7
7.2	Electronic excitation and fate of excited molecules, Jablonski diagram, Fluoresence and phosphorescence. Photosensitisation. Photochemical reactions	1	7
7.3	Norrish I and Norrish II type reactions of acyclic ketones, Paterno Buchi reaction and Photo Fries reaction	1	7
8.0	**Organic Photochemistry**	**4**	
8.1	Introduction. photochemical vs thermal reactions. Electronic excitation and fate excited molecules	1	6
8.2	Jabaloski diagram. Fluroscence and phosphorescence	1	6

8.3	Photosensensitisation, photochemical reactions: Norrish type1,and 2 reactions of acyclic ketones	1	6
8.4	Paterno Buchi reaction and photo Feries reaction(with mechanism)	1	6
9.0	**Organic Spectroscopy**	**14**	
9.1	UV Spectroscpy: Type of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption	2	7, 8
9.2	Application of Woodward Rules for calculation of λmax for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; conjugated dienes: alicyclic, homoannular and hetero annular;	2	7, 8
9.3	Extended conjugated systems(aldehydes, ketones and dienes);distinction between cis and trans isomers	2	7, 8
9.4	IR Spectroscopy: Fundamental and non fundamental molecular vibrations; IR absorption positions of O and N, containing functional groups; Effect of H-bonding, conjugation resonance and ring size on IR absorptions. Fingerprint region, and its significance; application in functional analysis.	3	7, 8
9.5	NMR Spectroscopy: Basic principles of proton Magnetic Resonance, chemical shift, factors influencing it; Spin – Spin coupling and coupling constant: Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.	3	7, 8
9.6	Application of IR,UV and NMR for identification of simple organic molecules.	1	8
9.7	Mass Spectroscopy: Introduction. EI ionization. Determination of molecular mass by MS(elementary idea only-fragmentation study not required).	1	7

References

1. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry*, 7th ed., W. H. Freeman.
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CH5CRT08 Physical chemistry III

Programme	**B. Sc Chemistry**
Semester	**VI**
Course Type	**Theory**
Instructor(s)	**Philip Marina Philip, Shiby Susan Kuriakose**

CO	Course Outcomes	CL	PSO
1			
2			
3			
4	Study the law of mass action and apply it in the case of reversible reactions	R	
5	Explain the factors affecting equilibrium constant	U	1
6	Explain the concepts of acids and bases	U	1
7	Study phase rule and explain its application to various one and two component systems.	Ap	1
8	Familiarize problems related to rate constants and half life	Ap	1
9	Understand about types of catalysis	U	1

Module	Course Description	Hours	CO
1.0	**Thermodynamics 1**	**15**	
1.1	Basic concepts-system, surroundings, Extensive intensive properties	2	
1.2	State function, path functions, types of process	1	
1.3	Zeroth Law of thermodynamics, Definition of internal energy and enthalpy	1	
1.4	Heat capacities at Cv and Cp, relationship between Cp and Cv	1	
1.5	First law of thermodynamics, Reversible process, maximum work	2	
1.6	Calculation of work, heat, internal energy and enthalpy change under reversible isothermal and adiabatic condition	2	
1.7	The Jule Thomson effect-derivation, sign and magnitude	1	
1.8	Inversion temperature, Liquefaction of gases	1	
1.9	Thermo chemistry-standard state, Enthalpies of formation, combustion and neutralization	2	
	Hess's Law and its applications,Kirchoff's eqation	2	

2.0	**Thermodynamics 1I**	**12**	
2.1	Second Law:limitations of first law-different statement of IInd law	2	
2.2	Thermodynamic scale of temperature, Carnot cycle and efficiency, Carnot theorem	2	
2.3	Concept of entropy-definition and physical significance	1	
2.4	Entropy as a function of pressure and temperature, entropy as a criteria of spontaneity and equilibrium	2	
2.5	Gibbs and Helmholtz free energies and their significances-criteria of equilibrium and spontaneity	1	
2.6	Gibbs and Helmholtz equation-dependence of temperature, volume and pressure	2	
2.7	Third law of thermodynamics-statement and determination of absolute entropies of substance	1	

3.0	**Chemical Equilibria**	**3**	
3.1	Law of mass action, Equilibrium constant, Relation between Kp, Kc and Kx, Van't Hoff reaction isotherm	2	
3.2	Temperature dependence of the Equilibrium constant,Van't Hoff equation, Pressure dependence of the equilibrium constant	1	
4.0	**Ionic Equilibria**	**8**	
4.1	Concepts of acids and bases, relative strength of acid base pairs, influence of solvents, Dissociation constants- acids, bases and polyprotic acids, Ostwalds dilution law.	3	
4.2	Degree of ionisation, ionization constant and ionic product water, pH	2	
4.3	Buffer solutions, Mechanism of buffer action, Henderson equation, Hydrolysis of salts, degree of hydrolysis and hydrolysis constant	3	
5.0	**Phase Equilibria**	**6**	
5.1	Phase rule, derivation, equilibrium between phases, conditions	1	
5.2	One component system- Water system, sulphur system, Two component system- Simple eutectic, Lead- Silver system	2	
5.3	Formation of compound with congruent melting point- Ferric chloride Water system.	2	
5.4	Formation of compounds with incongruent melting point Sodium sulphate – Water system	1	
6.0	**Chemical Kinetics**	**10**	

6.1	Rate equations for first order, second order and zero order	4	
6.2	Kinetics of complex reactions	3	
6.3	Homogeneous and heterogeneous catalysis	3	

References

1. R. P. Rastogi, R. R. Misra, *An Introduction to Chemical Thermodynamics*, 6th edn., Vikas Pub. Pvt. Ltd. (2003).
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3. K.K. Sharma, L.K. Sharma, *A Textbook of Physical Chemistry*, 4thedn, Vikas publishing House.
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10. S. Glasstone, *Thermodynamics for Chemists*, Affiliated East West Publishers.
11. G.S. Rush Brooke, *Statistical Mechanics*, Oxford University Press.
12. K. L. Kapoor, A *Textbook of Physical chemistry*, *Volumes 3*, Macmillan India Ltd.
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CH6CRT08 Physical chemistry III

Programme	**B. Sc Chemistry**
Semester	**VI**
Course Type	**Theory**
Instructor(s)	**Shiby Susan Kuriakose**

CO	Course Outcomes	CL	PSO
1	Understand different type of solutions and Colligative properties	U	1
2	Understand conductance of solution and its different aspects	U	1,5
3	Apply the acquired knowledge in the estimation of acids and bases	Ap	1,5
4	Explain different types of photochemical reactions	An	2
5	Explain the construction and the use of different types of electrodes	An	1,5
6	Explain different types of corrosion	An	1
7	Understand the principles of photochemistry	U	1
8	Understand different elements of symmetry and point groups	U	1

Module	Course Description	Hours	CO
1.0	**Solution**	**12**	

1.1	Introduction-Binary liquid solutions-Raoult's law-ideal and non ideal solutions.	2	1
1.2	Vapour pressure composition and temperature composition curves of ideal and non ideal binary liquid solutions	2	1
1.3	Fractional distillation of binary liquid liquid systems. CST	1	1
1.4	Solubility of gases in liquids Henry's law. Distribution of a solute between two solvents-Nernst distribution law.	1	1
1.5	Partial molar quanties-chemical potential, Gibbs Duhem equation	2	1
1.6	Colligative properties of dilute solutions, vapour pressure lowering, boiling point elevation and freezing point depression, molar mass determination-related questions	2	1
1.7	Osmotic pressure-law of osmotic pressure-reverse osmosis-purification of sea water	1	1
1.8	Abnormal molecular masses-Van't Hoff factor Degree of association and Degree of dissociation	1	1
2.0	**ELECTRICAL CONDUCTANCE**	**12**	
2.1	Introduction- Faraday's laws of electrolysis, electrochemical equivalent, and chemical equivalent-electrolytic conductivity, molar conductivity -	2	2
2.2	Variation of molar conductivity with concentration. Kohlrausch's law – applications.	1	2
2.3	Ionic mobility – relation with ion conductivity, influence of temperature on ion conductivity, ion	1	2
2.4	Conductivity, viscosity – Walden's rule, influence of dielectric constant of solvent on ion conductivity	1	2
2.5	Abnormal ion conductivity of hydrogen and hydroxyl ions.	1	2
2.6	Discharge of ions during electrolysis – Hittorf's theoretical device. Transport Numbers – determination by Hittorf's method and moving boundary method.	1	2
2.7	Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere, Asymmetry and electrophoretic effect, Debye-Hückel-Onsager equation (no derivation	1	2
2.8	Activity, mean ionic activity and mean ionic activity coefficients of electrolytes. Ionic strength of a solution, Debye-Hückel limiting law (no derivation).	2	2
2.9	Applications of conductance measurements – Determinations of degree of dissociation of weak electrolytes, ionic product of water, and solubility of sparingly soluble salts, coductometric titrations.	**2**	**2**
3.0	**ELECTROMOTIVE FORCE**	**15**	
3.1	Introduction - Galvanic cells, characteristics of reversible cells. Reversible electrodes –	2	5

	different types, electrode potential – electrochemical series. Representation of cells – emf of cell.		
3.2	Thermodynamics of reversible cells and reversible electrodes – Determination of ΔΔG, ΔH and Δ S of cell reaction. Emf and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and emf (Nernst equation).	3	5
3.3	Concentration cells – electrode concentration cell and electrolyte concentration cells. Types of electrolyte concentration cells – with transference and without transference	**2**	**5**
3.4	liquid junction potential. Fuel cells – the hydrogen-oxygen fuel cell. Applications of emf measurements	**2**	**5**
3.5	determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations, oxidation reduction indicators	**3**	**5**
3.6	Irreversible electrode processes – overvoltage. Corrosion of metals – forms of corrosion, corrosion monitoring and prevention methods	**3**	**5**
4.0	**Photochemistry**	**6**	
4.1	Laws of photochemistry-GROTHUS –Draper law, Stark Einstein Law	2	**2**
4.2	Jablonsky diagram-qualitative description of fluorescence, phosphorescence	1	**2**
4.3	Non radiative process, quenching of fluorescence	1	**2**
4.4	Quantum yield, example of law and high quantum yields, photochemical reactions	1	**2**
4.5	Photosensitised reactions, chemiluminescence, bioluminescence.	1	**2**
5	**Group Theory**	**9**	
5.1	Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element	3	**1,5**
5.2	Combination of symmetry elements, Shoenflies symbol, Point groups, C_2V, C_3V and D_3h, Group multiplication table of C_2V,	3	**1,5**
5.3	Determination of point groups of simple molecules like H_2O, NH_3 and BF_3	3	**1,5**

References

1. B. R. Puri, L. R. Sharma, M. S. Pathania, *Elements of Physical chemistry*, VishalPub. Co. Jalandhar.

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CH6CBT03 Soil and Agricultural Chemistry

Programme	**B. Sc Chemistry**
Semester	**VI**
Course Type	**Theory**
Instructor(s)	**Shiby Susan Kuriakose,**

CO	Course Outcomes	CL	PSO
1	Understand origin of soil	U	1
2	Discuss the physical properties of soil	U	1
3	Discuss the chemistry aspects of soil	Ap	5
4	Explain different types of plant nutrients	An	2
5	Explain different types of pesticides and herbicides	An	2

Module	Course Description	Hours	CO
1.0	**Origin of Soil**	**9**	
1.1	Definition of soil - origin - igneous - metamorphic and sedimentary rocks - rock systems .	2	1
1.2	Main components of soil- organic, inorganic, liquid and gaseous phase - minerals of importance with respect to industries and agriculture	2	1
1.3	Soil formation - weathering of rocks and minerals - physical, chemical and biological factors responsible for soil formation-soil forming processes .	2	1
1.4	Major soil groups of Kerala- methods of soil survey - remote sensing and soil mapping - soil resource management - use of satellite data for source inventory.	3	1
2.0	**Physical Properties of Soil**	**9**	
2.1	Physical properties of soil - soil texture and textural classification - pore space - bulk density, particle density.	1	2

2.2	Soil structure and soil colour - surface area - soil colloids – plasticity, shrinkage - flocculation and deflocculation	2	2
2.3	Soil air, soil temperature, their importance in plant growth.	2	2
2.4	Soil reaction - Ion exchange reaction- cation exchange - anion exchange .	2	2
2.5	Buffering capacity – hydrogen ion concentration - determination of pH values –Factors affecting soil pH - Soil pH and nutrient availability - Soil degradation - causes.	2	2
3.0	**Chemistry Aspects of Soil**	**9**	
3.1	Origin of problem soils, their properties- acid, alkali and saline soils .	1	3
3.2	Diagnosis – remediation of acid and salt affected soils - Methods of reclamation and after care .	2	3
3.3	Quality of irrigation water – causes for poor quality waters for irrigation, their effects in soils and crops.	2	3
3.4	Soil testing - concept, objectives and basis - soil sampling, collection processing, despatch of soil and water samples. soil organic matter - its decomposition and effect on soil fertility .	2	3
3.5	Source of organic matter in soil - maintenance and distribution - soil organism - their role - nitrification - denitrification, nitrogen fixation in soils - biological nitrogen fixation -microbial interrelationship in soil - microbes in pest and disease management - Bio-conversion of agricultural wastes.	2	3
4.0	**Plant Nutrients**	**18**	
4.1	Plant nutrients - macro and micro nutrients - their role in plant growth - sources- forms of nutrient absorbed by plants.	2	4
4.2	Factors affecting nutrient absorption - deficiency symptoms in plants .	2	4
4.3	Corrective measures - chemicals used for correcting nutritional deficiencies .	2	4
4.4	Nutrient requirement of crops, their availability, fixation and release of nutrients.	2	4
4.5	Fertilizers -classification of NPK fertilizers - sources - natural and synthetic - straight – complex.	2	4
4.6	Liquid fertilizers, their properties, use and relative efficiency .	2	4
4.7	Micro nutrient fertilizers, mixed fertilizers .	2	
4.8	Principle of fertilizers use - the efficient use of various fertilizers – integrated nutrient management	2	4
4.9	Biofertilizers - rhizobium, azospirillum, azetobacter - Blue green algae and azolla - production and quality control of bio-fertilizers.	2	4
5.0	**Pesticides, Fungicides and Herbicides**	**9**	
5.1	Pesticides: Definition – Classification – organic and inorganic pesticides – mechanism of action – Characteristics – Safe handling of pesticides .	2	5

5.2	Impact of pesticides on soil, plants and environment – Acts and Laws concerning the pesticides.	2	5
5.3	Fungicides: definition –classification – mechanism of action – sulfur, copper, mercury compounds, dithanes, dithiocarbamates.	2	5
5.4	Herbicides: definition – classification – mechanism of action – Arsenic and boron compounds – nitro compounds, chloro compounds, triazines, propionic acid derivatives, urea compounds. Acaricides – rodenticides – attractants – repellants – fumigants, defoliants.	3	5

References

1. Biswas, T. D. and Mukeherjee, S. K. Textbook of Soil Science, 1987
2. Daji, A.J. A Textbook of Soil Science, Asia Publishing House, Madras, 1970
3. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990
4. Hesse,P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.
5. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
6. Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi,

PRACTICALS SEMESTER V & VI

CH6CRP03 - QUALITATIVE INORGANIC ANALYSIS

Course	**Details**
Degree	BSc
Semester	V & VI
Course type	Practical
Instructors	

CO No.	***Expected Course Outcomes***	**Cognitive Level**	**PSO No.**
1	Identify various ions present in a given inorganic sample	U	PSO-2
2	Discuss and participate in the qualitative identification of ions present in water and soil	A	PSO-4
3	Describe confirmatory and spot tests for ions	R	PSO-1
4	Prepare reagents for qualitative inorganic analysis	U	PSO-1
5	Show techniques like precipitation and centrifugation	A	PSO-3
6	Identify and eliminate interfering anions in a given sample	An	PSO-3

7	Test and interpret the solubility of inorganic salts	An	PSO-3
8	Give a standard laboratory report	E	PSO-4
9	Work in as laboratory technician	C	PSO-4

Module	Course Description	Hrs	CO.No.
2.0	Qualitative inorganic analysis of Mixtures	54	
2.1	Study of the reactions of the following radicals with a view to their identification and confirmation. Ag^{+} , Hg_2^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+} , Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+} , Na^{+} , K^{+} , NH_4^{+} . CO_3^{2-} , S^{2-} , SO_4^{2-}, NO_3^{-}, F-, Cl-, Br- , BO_2^{-} , $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-} , PO_4^{3-} , AsO_3^{3-} , AsO_4^{3-} and CrO_4^{2-}	22	8
2.2	Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list without interfering radical and with one interfering radical by Semi- micro method only.	32	9

Reference

1. Vogel ‘A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis’: (Third Ed.) (ELBS)

2. G. Svehla, Text Book of Vogel's Macro and Semi-micro Inorganic Analysis, revised, Orient Longman.

3. V. V. Ramanujam, ‘Inorganic Semi micro Qualitative Analysis’, The National Publishing Co., Chennai,

4. W. G. Palmer ‘Experimental Inorganic Chemistry’, Cambridge.

CH6CRP04 - ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES

Course	Details
Degree	BSc
Semester	V & VI
Course type	Practical
Instructors	

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Devise new synthetic methodologies	C	PSO-4
2	Assess their idea about mechanisms to predict the outcome of reaction	E	PSO-1
3	Distinguish the category to which the reaction belong to	An	PSO-1

Module	Course Description	Hrs	CO.No.
1.0	**Organic Preparations**		
1.1	Oxidation (benzaldehyde to benzoic acid)	4	3,4,5
1.2	Hydrolysis (methyl salicylate or ethyl benzoate to the acid).	4	3,4,5
1.3	Nitration (*m*-dinitrobenzene and picric acid).	4	3,4,5
1.4	Halogenation (*p*-bromoacetanilide from acetanilide).	4	3,4,5
1.5	Acylation (Benzoylation of aniline, phenol, β-naphthol)	4	3,4,5
1.6	Esterification (benzoic acid ester)	4	3,4,5
1.7	Iodoform from acetone or ethyl methyl ketone.	4	3,4,5
1.8	Side chain oxidation (benzyl chloride to benzoic acid)	4	3,4,5
1.9	Claisen – Schmidt reaction: Dibenzal acetone from benzaldyde	4	3,4,5

References

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry,* 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th ed., Pearson Education, 2009.
3. Ahluwalia, V.K.; Aggarwal, R. *Comprehensive Practical Organic Chemistry – Preparation and Quantitative Analysis,* Universities Press, 2000.
4. Vishnoi, N.K. *Advanced Practical Organic Chemistry*, 3rd ed., Vikas Publishing House, New Delhi, 2010.

CH6CRP05 PHYSICAL CHEMISTRY PRACTICALS

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO3, NH4Cl
3. Heat of neutralization
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base, weak acid-strong base
6. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)
7. Determination of the surface tension of a liquid(Drop number method or Drop weight method)
8. Critical solution temperature of phenol-water system.
9. Effect of electrolytes on the CST of phenol-water system.
10. Molecular weight determination by Rast's method. (using naphthalene,camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. assolute.)
11. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
12. Potentiometric titration – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO_4^-
13. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
14. Determination of equivalence point of potentiometric and conductometric titrationsusing spreadsheet program.

References

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J.B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R.C. Das and B. Behra; 'Experiments in Physical Chemistry', Tata McGraw hill.
4. K.K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi
5. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry*,R. Chand & Co.: New Delhi (2011).

M.SC ZOOLOGY PROGRAM OUTCOMES AND COURSE

PO NO.	PROGRAM OUTCOMES
PO 1	Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms
PO 2	Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment
PO 3	Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
PO 4	Understands the complex evolutionary processes and behaviour of animals
PO 5	Correlates the physiological processes of animals and relationship of organ systems
PO 6	Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
PO 7	Understands about various concepts of genetics and its importance in human health
PO 8	Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties
PO 9	Apply the knowledge and understanding of Zoology to one's own life and work
PO10	Develops empathy and love towards the animals

PROGRAM SPECIFIC OUTCOMES

PSO NO.	PROGRAM SPECIFIC OUTCOMES
PSO 1	Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and environmental biology
PSO 2	Analyze the relationships among animals, plants and microbes
PSO 3	Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Biochemistry, Animal biotechnology, Immunology and research methodology
PSO 4	Understand the applications of biological sciences in environment
PSO 5	Gains knowledge about research methodologies, effective communication and skills of problem solving methods
PSO 6	Contributes the knowledge for Nation building.

Course	Details				
Code	ZL010101				
Title	Animal Diversity: Phylogenetic and Taxonomic Approaches				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/1				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	**Expected course outcome**	**Cognitive level**	**PSO No.**
CO 1	Describe general taxonomic rules on animal classification	U	1,4
CO 2	Understand the phylogenetic relationshipsamong the different groups of animals	U	1
CO 3	Classify various Phylum with taxonomic keys	Ap	4,2
CO 4	Provide the latest trend in animal taxonomy and phylogenetic systematic	C	5

Course	Details				
Code	ZL010102				
Title	Evolutionary Biology and Ethology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/1				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understand the evolution of different animals in different geographic period	U	1
CO 2	Expose students to the basics and advances in ethology, and generate an interest in The subject in order to understand the complexities of studying animal behavior on every level of the biological hierarchy Classify the different evolution styles.	Ap	4
CO 3	Describe the concept of relatedness and its connection to biological evolution	U	5
CO 4	Apply knowledge to new information and data, as well as the capacity to effectively communicate the principles of evolution and its application to human biology.	Ap	4

Course	Details				
Code	ZL010103				
Title	Biochemistry				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/1				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Generate an interest in the subject and help students explore the new developments in Biochemistry	Ap	4
CO 2	Understand the chemical nature of life and life process	U	1
CO 3	Understand interactions and interdependence of physiological and biochemical processes	C	2
CO 4	Understand the abnormal metabolism of biomolecules and the resultant diseases.	Ap	6

Course	Details				
Code	ZL010104				
Title	Bio statistics and research methodology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/1				
Type	Theory				
Credits	3	Hours/Week	3	Total hour	54

CO NO.	**Expected course outcome**	**Cognitive level**	**PSO No.**
CO 1	Impart concepts of statistics and research methodology, and create awareness about the gadgets, tools and accessories of biological research	C	3
CO 2	Improve analytical and critical thinking skills through problem solving and enable learners to effectively apply suitable statistical tests	Ap	4,2
CO 3	Understanding of scientific method, concepts and steps in research and application of various statistical methods in life science.	C	1
CO 4	equip learners to prepare research papers and project proposals	Ap	4,5

Course	Details				
Code	ZL010105				
Title	Animal Diversity: Evolutionary, Ethological and Biochemical methods &Approaches				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/1				
Type	Practical				
Credits	4	Hours/Week	10	Total hour	180

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understand the various methods in zoology for analysis of life processes	U	1
CO 2	Develop practical skill among learners	Ap,C	2,4,5
CO 3	Understand biochemical, statistical, evolutionary, physiological methods in various analysis	U,C	1,5
CO 4	Make scientific attitude as a learners as well as a researcher	C	5

Course	Details				
Code	ZL010201				
Title	Field ecology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/2				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Provide the knowledge of animal adaptations to a variety of environment	U	1
CO 2	Learn the different aspects of population and its interactions	U	1
CO 3	Understand the natural resources and manmade issues on environment and its management	Ap	4
CO 4	Understand the Biodiversity and conservation explore natural landscapes, species and ecosystems and acquires theories and practical methods in preserving environments and organisms.	U	1

Course	Details				
Code	ZL010202				
Title	Developmental biology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/2				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understand concepts and process in developmental biology	U	1
CO 2	understand and appreciate the genetic mechanisms and the unfolding of the same during development	U	1
CO 3	Expose the learner to the new developments in embryology and its relevance to Man	Ap	4
CO 4	Understand the various factors affecting development	C	1

Course	Details				
Code	ZL010203				
Title	Genetics and Bioinformatics				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/2				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	understand the principles and mechanism of inheritance	U	1
CO 2	study the fine structure of genetic material and molecular basis of hereditary transmission	Ap	4
CO 3	understand the role of genetics in evolution	U	1
CO 4	explore the emerging field of bioinformatics and to equip the students to take up bioinformatics studies	Ap	4

Course	Details				
Code	ZL010204				
Title	Microbiology and Biotechnology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/2				
Type	Theory				
Credits	3	Hours/Week	12	Total hour	54

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	provide an over view of the microbial world, its structure and function	U	1
CO 2	understand the modern biotechnology practices and approaches with an emphasis in technology application, medical, industrial, environmental and agricultural areas and nanomedicine	U,Ap	1,4,5
CO 3	Familiarize the students with public policy, biosafety, and intellectual property rights issues related to biotechnology	U	1

Course	Details				
Code	ZL010205				
Title	Diversity of Life: Ecological, Embryological, Hereditary and Microbial Methods and Approaches				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/2				
Type	Practical				
Credits	4	Hours/Week	10	Total hour	180

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understand the various methods in zoology for analysis of life processes	U	1
CO 2	Develop practical skill among learners	Ap,C	2,4,5
CO 3	Understand biochemical, statistical, evolutionary, physiological methods in various analysis	U,C	1,5
CO 4	Make scientific attitude as a learners as well as a researcher	C	5

Course	Details				
Code	ZL010301				
Title	Animal Physiology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/3				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	study and compare the functioning of organ systems across the animal world	Ap,U	1,4,5
CO 2	Understand over view of the comparative functioning of different systems in animals	U	1
CO 3	learn more about human physiology	Ap	5
CO 4	Understand the relation between biochemistry, environment animal physiology	U	1

Course	Details				
Code	ZL010302				
Title	Cell and Molecular Biology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/3				
Type	Theory				
Credits	4	Hours/Week	13	Total hour	72

CO NO.	**Expected course outcome**	**Cognitive level**	**PSO No.**
CO 1	study the structural and functional details of the basic unit of life at the molecular level	U	1
CO 2	motivate the learner to refresh and delve into the basics of cell biology	Ap,C	3,4,5
CO 3	Understand the new developments in molecular biology and its implications in human welfare	U,Ap	1,4

Course	Details				
Code	ZL010303				
Title	Biophysics, Instrumentation and Biological Techniques				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/3				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	72

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	understand the biological system and processes based on physical principles	U	1
CO 2	provide and insight on the tools and techniques of various instruments available for biochemical and biophysical studies	U,Ap,C	1,4,5
CO 3	Develop operational skills of different instruments required in Zoology	Ap	4
CO 4	Understanding of basic concepts of instrumentation such as cell fractactionation, homogenation and centrifugation	U	1

Course	Details				
Code	ZL010304				
Title	Immunology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/3				
Type	Theory				
Credits	3	Hours/Week	3	Total hour	54

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Provide an intensive and in-depth knowledge to the students in immunology	U	1
CO 2	understand the role of immunology in human health and well-being	U	1
CO 3	Understand new developments in immunology	U,C	1,5

Course	Details				
Code	ZL010305				
Title	Molecular, Physiological and Immunological Methods and Approaches in Biosciences				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/3				
Type	Practical				
Credits	4	Hours/Week	10	Total hour	180

CO NO.	**Expected course outcome**	**Cognitive level**	**PSO No.**
CO 1	Understand the various methods in zoology for analysis of life processes	U	1
CO 2	Develop practical skill among learners	Ap,C	2,4,5
CO 3	Understand biochemical, statistical, evolutionary, physiological methods in various analysis	U,C	1,5
CO 4	Make scientific attitude as a learners as well as a researcher	C	5

Course	Details
Code	ZL810401
Title	Environmental Science: Concepts and Approaches
Degree	Post graduation

Branches	Zoology				
Year/Semester	1/4				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	90

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	understanding on environment and influence of man on environment	U	1
CO 2	equip the students to use various tools and techniques for the study of environment	Ap, C	4,5

Course	Details				
Code	ZL810402				
Title	Environmental Pollution and Toxicology				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/4				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	90

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 3	Understand the various sources of pollution	U	1
CO 4	take up further studies and research in the field in pollution and toxicology	Ap, C	4,5
CO 3	Understand the way of reducing pollution	U,Ap	1,5

Course	Details
Code	ZL810403
Title	Environmental Management and Development
Degree	Post graduation

Branches	Zoology				
Year/Semester	1/4				
Type	Theory				
Credits	4	Hours/Week	4	Total hour	90

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understanding on environment and influence of man on environment	U	1
CO 2	Understand, think and evolve strategies for management and conservation of environment for sustaining life on earth	U	1
CO 3	Understand the needs of sustainable development	U,Ap	1,5
CO 4	Through Sustainable development fulfill National development	U,Ap	1,5

Course	Details				
Code	ZL810404				
Title	Practical : Environmental Science				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/4				
Type	Practical				
Credits	4	Hours/Week	4	Total hour	180

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Understand the various methods in zoology for analysis of life processes	U,C	1,4
CO 2	Develop practical skill among learners	Ap	5
CO 3	Understand biochemical, statistical, evolutionary, physiological methods in various analysis	Ap	5
CO 4	Make scientific attitude as a learners as well as a researcher	Ap,C	5,4

Course	Details				
Code	ZL010401				
Title	Project				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/4				
Type	Practical				
Credits	**5**	Hours/Week		Total hour	

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	Make research proposal in various field of life science	Ap,C	4,5
CO 2	Develop for tool data collection	U,Ap	1,5

CO 3	Learn fieldwork modalities	Ap	5
CO 4	Understand the process of data analysis	U	1
CO 5	Writing research report in scientific way	C	4,3

Course	Details				
Code	ZL010402				
Title	Viva				
Degree	Post graduation				
Branches	Zoology				
Year/Semester	1/4				
Type	Practical				
Credits	**2**	Hours/Week		Total hour	

CO NO.	Expected course outcome	Cognitive level	PSO No.
CO 1	To understand the knowledge of student after completing pg	1	U

PROGRAMME SPECIFIC OUTCOME

PSO No.	Intended Programme Specific Outcome(PSO)
	Upon completion of BSc. Zoology Degree Programmes, the graduates will be able to :

PSO -1	Develop a broad foundational knowledge regarding the faunal diversity, pattern of evolution, morphological features, adaptation, classification, molecular organization, and developmental aspects.
PSO-2	Understand the rich diversity of organisms, basic concepts in cell biology, biochemistry, developmental biology, genetics, evolution, microbiology, immunology, biotechnology, research methodology, statistics and physiology
PSO-3	Analyze the relationship between plants, animals, microbes and deal with the local national and global environmental issues in a sustainable manner by realizing the rights of an individual and also the need to conserve our biosphere
PSO-4	Generate innovative ideas for performing experiments in the areas of biochemistry, physiology, genetics, biotechnology, microbiology, immunology, developmental biology, bioinformatics, taxonomy, occupational zoology, ecology, , and research methodology.
PSO-5	Understand the application of biological sciences in aquaculture, apiculture, vermiculture and quail farming there by getting employed or impart skill for a source of additional income and self-employment
PSO-6	Use concepts, tools and techniques related to chemistry and botany to acquire knowledge and its application in zoology and the use of tools in information technology for doing activities related to zoology
PSO-7	Share social and environmental consciousness with their fellow citizens
PSO-8	Develop respect towards nature and nurture natural resources
PSO-9	Organize and deliver relevant applications of knowledge through effective written, verbal, graphical/ virtual communications and interact productively with people from diverse backgrounds

Course	**Details**
Code	ZY1CRT01
Title	General Perspectives in Science and Protistan Diversity
Degree	B.Sc
Branch	Zoology
Semester	I

CO No.	**Expected Course Outcomes**	**Cognitive level**	**PSO No.**

	Upon completion of the course, the students will be able to :		
1	Understand the various branches and scopes of Zoology and general taxonomic rule on classification	U	1
2	Examine the concepts of Taxonomy	Ap	1
3	Examine the levels of biodiversity through systematic classification	Ap	1
4	Discuss the diversity of protista and their significances	U	1
5	Analyse the medical significance of parasitic protists	An	2
6	Create an action plan for the local needs such as vector prevention and control during disease outbreak	C	2

Course	Details
Code	ZY1CRP01
Title	General Perspectives in Science and Protistan Diversity(P)
Degree	B.Sc
Branch	Zoology
Semester	I

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Apply classical keys for identification	Ap	1
2	Identify protozoans through microscopic or pictorial representations	U	1
3	Understand the basis of animal kingdom classification	U	1
4	Understand body parts of bird and dragonfly	U	1
5	Identify economically important protists	U	1

Course	Details
Code	ZY2CRT02
Title	Animal Diversity- Non Chordata
Degree	B.Sc
Branch	Zoology

Semester	II

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand different levels of biological diversity through systemic classification of invertebrate fauna	U	1
2	Describe and classify branch parazoa, with examples and salient features	U	1
3	Describe and classify phylum Coelentrata and Ctenophora along with their ecological and morphological significance	U	1
4	Create a concern regarding the conservation of coral reefs fauna	C	2
5	Classify coelomates and interpret general evolutionary relationships among and between these animal groups	Ap	1
6	Describe and classify phylum Platyhelminthes and identify the problems caused by parasitic forms	U	1
7	Describe and classify phylum Nemathelminthes and explain the pathogenic nematodes	U	1
8	Describe and classify phylum Annelida and explain the features of a living fossil in phylum Onychophora	U	1
9	Understand the anatomical features of non chordates through type study of phylum Arthropoda	U	1
10	Generate an understanding about minor phyla	U	1

Course	Details
Code	ZY2CRP02
Title	Animal Diversity- Non Chordata (P)
Degree	B.Sc
Branch	Zoology
Semester	II

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand, identify and classify the various groups of non chordates	Ap	1
2	Understand the evolutionary, adaptation and taxonomic significance of non chordates	U	1
3	Conduct dissection experiments to understand the anatomy of an organism	Ap	1
4	Illustrate the non chordate specimens to gain more knowledge	Ap	1

Course	Details
Code	ZY3CRT03
Title	Animal Diversity- Chordata
Degree	B.Sc
Branch	Zoology
Semester	III

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Explain the diversity and phylogeny of chordates	U	1
2	Understand the distinguishing characteristics and classification of the major vertebrate phyla	U	1
3	Understand the evolutionary importance of chordate groups	U	1
4	Compare the anatomy and complexity of two groups of chordata through type study	U	1
5	Classify coelomates and interpret general evolutionary relationships among and between these animal groups	Ap	1
6	Examine the local chordate diversity	C	1,2
7	Predict the classification category of given chordates based on morphological features	C	1
8	Generate understanding regarding the adaptations of aquatic mammals	U	1

Course	Details
Code	ZY3CRP03
Title	Animal Diversity- Chordata (P)
Degree	B.Sc
Branch	Zoology
Semester	III

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Make scientific drawings of specimens	U	1
2	Examine the anatomy, morphology and osteology of vertebrates	An	4
3	Apply taxonomic key to classify organisms	Ap	4

Course	Details
Code	ZY4CRT04
Title	Research Methodology, Biophysics and Biostatistics
Degree	B.Sc
Branch	Zoology
Semester	IV

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand the basic concepts of scientific method in research process	U	**2**
2	Develop skill in research communication and scientific documentation	C	**2**
3	Create awareness about laws and ethical values in biology	C	2
4	Realize the ethical issues related to animals as well as laws relevant in India to protect animals	U	3
5	Understand the basic concepts and techniques of animal rearing, collection and preservation	U	2
6	Analyse statistical methods in biological studies	An	2

Course	Details
Code	ZY4CRP04
Title	Research Methodology, Biophysics and Biostatistics (P)
Degree	B.Sc
Branch	Zoology
Semester	IV

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Conduct research work and research documentation	Ap	3
2	Apply suitable statistical methods to research studies	Ap	3
3	Understand the use microscopes as well as various equipments and instruments used in scientific studies	U	3
4	Conduct sampling, collection and preservation techniques	Ap	4
5	Compute statistical problems and representation of data using computer	Ap	3
6	Apply unit of measurements in chemical preparation	Ap	3

Course	Details
Code	ZY5CRT05
Title	Environmental Biology and Human Rights
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Identify various types of natural resources, human impact on these resources, their protection and common resource management practices	R	2
2	Understand theories and concepts of environmental science, ecosystems and its structural and functional aspects	U	2
3	Describe various aspects of environmental hazards, their causes, classification and impacts	E	2
4	Understand and appreciate various concepts and issues concerning biodiversity and conservation at local, regional and global level.	U	2
5	Develop management strategies and governmental action to mitigate environmental hazards	U	1
6	Analyse current situation in terms of human rights.	An	2
7	Create awareness on various environmental acts in India	C	2

Course	Details
Code	ZY5CRP05
Title	Environmental Biology and Human Rights (P)
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Analyse the different parameters of water and soil	An	4
2	Classify various ecosystem and animal interactions	Ap	4
3	Identify and count planktons in ecology	R	4
4	Create consciousness regarding biodiversity and nature	C	8

Course	Details
Code	ZY5CRT06
Title	Cell Biology and Genetics
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand the structure of cells and cell organelles in relation to the functional aspects	U	2
2	Understand basic concepts in genetics	U	**1,2**
3	Understand the mechanism of mitosis and meiosis and able to observe chromosomal arrangements during cell division.	|U	2
4	Identify the genetic defects and inborn errors of metabolism and take steps to prevent the same	U	2
5	Evaluate the significance of mutation	E	**3**
6	Create ideas about the application of genetics in human welfare	C	**3**

Course	Details
Code	ZY5CRP06
Title	Cell Biology and Genetics (P)
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Identify the structure of cell organelles, barr body, mitotic stages, blood cells and polytene chromosome	R	3
2	Conduct pedigree analysis and karyotyping	Ap	**2**
3	Prepare temporary whole mount and squash preparation of onion root tip	Ap	4
4	Familiarise |Mendalian genetics	Ap	4

Course	Details
Code	ZY5CRT07
Title	Evolution, Ethology and Zoogeography
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand the concept on the origin of life, theories on organic evolution and its evidences	U	3
2	Describe the concept of speciation, types and causes	U	3
3	Apply the principles of population genetics to study the progression of biological evolution	Ap	3
4	Understand the behaviour of animals and on the concept of learning	U	3
5	Develop the concept about the origin of continents, continental fauna, factors affecting animal distribution and zoogeographical realms	U	3
6	Create a mind set about application of population genetics and modern trends in evolutionary biology in establishing phylogeny studies	C	3

Course	Details
Code	ZY5CRP07
Title	Evolution, Ethology and Zoogeography (P)
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Identify zoogeographical realms, endemic species in each realm	U	4
2	Compare analogous and homologous organs and adaptive radiation	U	2
3	Understand the route of HMS Beagle	U	2
4	Examine the techniques to conduct learning experiments	An	2
5	Identify the stages of horse evolution	U	2
6	Identify behavioural patterns and use of phromones	U	2

Course	Details
Code	ZY5CRT08
Title	Human Physiology, Biochemistry and Endocrinology
Degree	B.Sc

Branch	Zoology
Semester	V

CO No.	**Expected Course Outcomes** **Upon completion of the course, the students will be able to :**	**Cognitive level**	**PSO No.**
1	Understand the importance of Physiology and branches of it.	U	2
2	Create an awareness on life style diseases by applying the concept of nutrition	C	2, 4
3	Understand the various organ systems, functions, normal metabolite levels and diseases	U	2, 4
4	Understand the physiology of muscle contraction	U	2
5	Understand nerve physiology and diseases associated with its function	U	2
6	Describe the structure and classification of major bio molecules	R	4
7	Understand biochemical reaction involved in enzymes action	U	4
8	Discuss the metabolism of different types of biomolecules	U	4
9	Create a general appreciation about the functioning of the organ system	C	2

Course	**Details**
Code	ZY5CRP08
Title	Human Physiology, Biochemistry and Endocrinology (P)
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Carry out experiments to determine haemoglobin content, RBC count and WBC count	An	4
2	Identify the principle and use of instruments	U	2
3	Conduct qualitative analysis to find the bio molecules in the sample provided	Ap	2, 4
4	Use chromatographic technique for separation of mixtures	Ap	2,4

Course	Details
Code	ZY5OPT01
Title	Vocational Zoology
Degree	B.Sc
Branch	Zoology
Semester	V

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Design and manage an aquarium	C	4
2	Construct an ornamental fish culture unit for self employment	C	4
3	Construct and maintain quail farming practices for self-employment	C	4

4	Apply the concept of vermicomposting to undertake waste management measures	Ap	4
5	Monitor and maintain meliponini culture and or apiculture as hobby or as a source of additional income	Ap	4

Course	**Details**
Code	ZY6CRT09
Title	Developmental Biology
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	**Expected Course Outcomes Upon completion of the course, the students will be able to :**	**Cognitive level**	**PSO No.**
1	Understand various stages involved in the developing embryo	U	2
2	Develop knowledge about various Techniques and tools of Embryology	C	1
3	Illustrate cleavage, blastulation and gastrulation	R	2
4	Apply the knowledge to collect various Biological data	Ap	4
5	Understanding the phenomenon of regeneration in animals	U	2
6	Create awareness on the impact of teratogens	C	2

Course	Details
Code	ZY6CRP09
Title	Developmental Biology(P)
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand various prenatal diagnostic procedures and technological application in human development	An	4
2	Carryout dissection to understand the reproductive organs	Ap	4
3	Examine the reproductive capacity of fish	Ap	4
4	Visualise the endocrine glands in brain and the effects of hormones on heartbeat of cockroach	An	4

Course	Details
Code	ZY6CRT10
Title	Microbiology and Immunology
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand structure, types replication and culture techniques of viruses	U	2
2	Understand disease caused by microorganisms and their transmission	U	2
3	Identify different types of organs and cells of immunity	U	2
4	Analyse immune mechanisms behind autoimmunity, hypersensitivity, immunodeficiency and transplantation rejection	An	2
5	Understanding about vaccins and recent trends in immunization	U	2

Course	**Details**
Code	ZY6CRP10
Title	Microbiology and Immunology(P)
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	**Expected Course Outcomes Upon completion of the course, the students will be able to :**	**Cognitive level**	**PSO No.**
1	Identify microorganisms using gram staining	An	4
2	Identify fungus using lactophenol cotton blue stain	U	4
3	Observe motility of bacteria using hanging drop method	U	4
4	Understand antibiotic sensitivity	U	4
5	Analyse the blood group of the sample provided	Ap	4
6	Understand primary and secondary lymphoid organs	U	4

Course	Details
Code	ZY6CRT11
Title	Biotechnology, Bioinformatics and Molecular Biology
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Understand the applications of biotechnology	U	2
2	Understand animal culture methods, application and potential hazards of biotechnology	U	2
3	Show the importance of acquiring different databases using bioinformatics tools	Ap	4
4	Understand antibiotic sensitivity	U	4
5	Analyse the blood group of the sample provided	Ap	4
6	Understand primary and secondary lymphoid organs	U	4

Course	Details
Code	ZY6CRP11
Title	Biotechnology, Bioinformatics and Molecular Biology(P)
Degree	B.Sc
Branch	Zoology

Semester	VI

CO No.	Expected Course Outcomes Upon completion of the course, the students will be able to :	Cognitive level	PSO No.
1	Familiarize the tools and techniques of bioinformatics	Ap	6
2	Perform isolation of genetic material	Ap	6
3	Understand structural organization and molecular composition of genetic material	U	2
4	Familiarise techniques involved in biotechnology	An	2

Course	Details
Code	ZY6CRT12
Title	Occupational Zoology
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	Expected Course Outcomes	Cognitive level	PSO No.

	Upon completion of the course, the students will be able to :		
1	Understand different species of honey bees and their social organization	U	4,5
2	Apply the concept of vermiculture for preparing a vermicompost unit and understand the role of earthworm in solid waste management	Ap	4,5
3	Construct an ornamental fish culture unit for self employment	Ap	5
4	Identify fish diseases, apiculture tools and equipments	R	5
5	Carry out qualitative test for honey adulteration	C	5
6.	Understand quail farming techniques	U	5

Course	**Details**
Code	ZY6CRP12
Title	Occupational Zoology (P)
Degree	B.Sc
Branch	Zoology
Semester	VI

CO No.	**Expected Course Outcomes** **Upon completion of the course, the students will be able to :**	**Cognitive level**	**PSO No.**
1	Identify the types of culturable fishes, ornamental fishes, earthworms, honey bees, shell fishes	Ap	5
2	Identify the principle and uses of various aquarium accessories	Ap	4,5

3	Carry out qualitative test for honey adulteration	Ap	5
4	Prepare artificial feed for aquarium fishes	Ap	5
5	Setting up of a miniature vermicomposting unit, ornamental fish tank	C	5

Department of Physics

PROGRAMME: BSc PHYSICS MODEL II APPLIYED ELECTRONICS

PSO No.	Programme Specific Outcomes(PSO)
PSO1	Understanding the basic concepts of Electronics, Optics, Environmental Science, Mathematical physics and Basic computer programming.
PSO2	Develop skills in various physical aspects
PSO3	Demonstrate knowledge of different aspects of physics and to apply this knowledge to analyse variety of physical phenomena.
PSO4	Use laboratory skills to take measurements in physics and analyse the measurements to draw valid conclusions.
PSO5	Use different techniques related to physics, mathematics and electronics to plan design, construct and modify devices using acquired knowledge.
PSO6	Oral and written scientific communications can think critically and work independently.

PSO7	Realise and develop an understanding of the impact of physics and science on society.
PSO8	Analyse physical problem and develop correct solutions using natural laws.
PSO9	Discover of physics concepts in other disciplines such as maths computer etc.

Programme outcomes and course outcomes

Under graduate Programme in Physics Model II Applied Electronics

Programme Outcomes of BSc Physics Model II programme :

PO No.	Programme outcomes
PO1	To enhance the student's academic abilities, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.
PO2	To define the basic laws involved in Physics
PO3	To understand the concepts and significance of the various physical phenomena.
PO4	To carry out experiments to understand the laws and concepts of Physics
PO5	To apply the theories learnt and the skills acquired to solve real time problems
PO6	To acquire a wide range of problem solving skills, both analytical and computational and to apply them.

SEMESTER I

METHODLOGY AND PERSPECTIVES OF PHYSICS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	Hours
1	Evaluate earlier experiments and observations on celestial mechanics, Optics, Electricity and Magnetism	U	1	4
2	Examine Contributions by the Great Scientists In Physics.	AN	3	5
3	Application of binary numbers in Computers.	AP	2,4	6
4	Application of vectors in Physics.	AP	6	6
5	Understand different co-ordinate systems.	U	2	6
6	Understand different types of errors.	U	5	5
7	Calculate errors in different computing methods	C	7	4
	Total hours	**36**		

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

AE1VOT01:PRINCIPLES OF ELECTRONIC COMPONENTS				36hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand resistor types, colour code	U	1	4
2	Potentiometers, rheostats checking resistors with Ohmmeter, Whesstone bridge	R, U	4	3
3	Basic ideas of inductance, series and parallel combination of inductors	R,U	2	3
4	Hay's and Maxwell's bridge	U		3
5	Capacitor types, series and parallel combinations, Q factor	U	5	8
6	Auto, Audio,IF, RF and Power transformers	U,A	1	4
7	Switches and relays	U	1	8
8	Display Devices	U,A	1	3

AE1VOT02: ELECTRONIC APPLICATIONS

Scope: This course is expected to provide knowledge of various electronic circuits and its application.

CO no	Expected course Outcome upon completion of this course, the students will be able to	Cognitive Level	PSO no	Class sessions
CO 1	Measuring Instruments	U	1	6
CO 2	Tuning Circuits	R	2	4
CO 3	FILTERS	U	1	2
CO 4	Basic of Time base Circuits	U	1	2
CO 5	Some Time base Circuits	R	1	4
CO 6	Transducers	R	1	6
CO 7	Optical Recording- CD	U	1	4
CO 8	PCB	Ap	5	2
CO 9	Soldering and Desoldering	Ap	5	6
	Total Hours			**36 hrs**

SECOND SEMESTER

PROPERTIES OF MATTER

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	Hours
1	Understand superposition of waves	U	1	4
2	Analyse the theory of oscillations	An	1	6
3	Define the basic concepts of angular velocity- angular acceleration- angular momentum	U	1	5
5	State parallel and perpendicular axes theorems	U	2	3
6	Calculate the moment of Inertia of different bodies	U	4	5
7	Analyse the basic concepts of elasticity	U,An	1,4	4
8	Evaluate factors affecting surface tension	U,E	4	5
9	Examine the basic principles of Mechanics and Properties of Matter	U	4	4
	Total hours	**36**		

AE2VOT03:BASICS OF POWERELECTRONICS				36hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand Types of FET, JFET, Operation of FET	U	1	6
2	JFET parameters, expression for Transconductance	R, U	1,4	8
3	MOSFET- types, working	R,U	2	7
4	MOSFET – circuit symbol, drain characteristics, N- channel and P- channel MOSFET	An	3	7
5	FET Amplifiers	U	5	8

AE2VOT04: POWER ELECTRONICS

Scope: This course is expected to provide a knowledge of various Power electronic circuits and its application.				
CO no	**Expected course Outcome upon completion of this course, the students will be able to**	**Cognitive Level**	**PSO no**	**Class sessions**
CO 1	Thyristors	R	1	2
CO 2	SCR	U	1	8
CO 3	TRIAC, DIAC	U	1	4
CO 4	UJT	U	1	4
CO 5	Silicon Controlled Switch	U	1	6
CO 6	Basic of Controlled Rectifiers	U	5	6
CO 7	Controlled Rectifier circuits	Ap	5	4
CO 8	Inverter	Ap	5	2
	Total Hours			**36 hrs**

THIRD SEMESTER

OPTICS AND PHOTONICS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Discuss the important and fascinating areas of interference with many experiments associated with it	R	3	8
2	Differentiate between Fraunhofer and Fresnel diffraction	AN	5	8
3	Apply skill to find the wavelength of spectral lines using Plane diffraction grating	C	7	8
4	Distinguish the methods of polarisation by reflection, refraction and scattering	AN	6	8
5	Explain the Brewsters law and Malus law	U	1,2	7
6	Describe the different types of lasers, its principle, properties of laser beam	U	1,2	8
7	Classify the different types of fibre	E	3	7
	Total hours	**54 hours**		

AV3VOT05:MICROPROCESSORS AND INTERFACING DEVICES				54hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand intel 8085, instruction cycle, timing diagram, instruction set of 8085	U	1	12
2	Addressing modes, status flags	R, U	4	10
3	Simple programs for data transfer and other mathematical operations	R	2	12

4	Data transfer schemes, interrupts of 8085	U,A		10
5	Programmable DMA controller intel 8257	U	5	3
6	Programmable interrupt controller intel 8259	U	1	3
7	Programmable peripheral interface intel 8255	U	1	4

AE3VOT06: COMMUNICATION ELECTRONICS Scope: This course is expected to provide knowledge of various communication systems and its working				
CO no	**Expected course Outcome upon completion of this course, the students will be able to**	**Cognitive Level**	**PSO no**	**Class sessions**
CO 1	Basic Communication Systems	R	1	6
CO 2	Radio waves	U	1	3
CO 3	Propagation of radio waves	U	1	9
CO 4	AM Modulation	U	1	4
CO 5	FM Modulation	U	1	3
CO 6	AM and FM Detectors	Ap	4	6
CO 7	Digital Pulse Modulation	U	1	2
CO 8	Super heterodyne AM and FM receiver	Ap	5	3
CO 9	Antenna	U	1	6
CO 10	RADAR	U	1	6
CO 11	Other communication systems	R	1	6
	Total Hours			**54 hrs**

FOURTH SEMESTER

SEMICONDUCTOR PHYSICS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Discuss basic idea of doping , p-n junction diode and its V-I characteristics using graphical and mathematical methods	U	1,2,3	10
2	Explain wave shaping circuits and voltage multipliers in electronics and its responses	AN	4,5	5
3	Illustrate various biasing circuits of a transistor	AN	4	8

4	Analyse various transistor amplifier circuits	AN	4	8
5	Design simple oscillator circuits	C	3	7
6	Apply the concept of feedback in operational amplifiers	AP	6	6
7	identify the need for modulation with AM techniques in detail	U	1,2	6

AV4VOT07: LINEAR INTEGRATED CIRCUITS				54hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand operations of Op-Amp	U	1	8
2	Inverting and non-inverting amplifier	R	4	8
3	Voltage follower	R,U	2	8
4	Summing and differential amplifier	U		8
5	Op-Amp applications- comparators, differentiator, integrator	U	5	8
6	Weinbridge oscillator, triangular wave oscillator	U	1	7
7	ICTimer (555)	U	1	7

AE4VOT08 APPLICATIONS OF MICROPROCESSORS

Scope: This course is expected to provide knowledge of architecture and applications of Microprocessors

CO no	**Expected course Outcome upon completion of this course, the students will be able to**	**Cognitive Level**	**PSO no**	**Class sessions**
CO 1	Applications of Intel 8085: 7 segment LED display – Temperature measurement and control	Ap	5	6
CO 2	Applications of Intel 8085:Stepper Motor –Traffic control – Generation of square wave or pulse using I/O Port.	Ap	5	6
CO 3	Basic of Micro Controller	U	1	10
CO 4	8051 Architecture	U	1	10
CO 5	8051 - Pindiagram	Ap	1	2
CO 6	8051 - memory	Ap	1	4
CO 7	8051 – Timer / counter	U	1	6
CO 8	8051 – I/O ports	U	1	4
CO 9	8051- Serial	U	1	4
CO 10	8051 - Interrupt	U	1	4
	Total Hours			**54 hrs**

FIFTH SEMESTER

PH5CRT06: CLASSICAL AND QUANTUM MECHANICS				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Identify the various types of constraints involved in motion of a system	U	1	5
2	Apply concept of constraints to represent certain dynamics	AP	3	4
3	Solve problems in classical dynamics,quantum mechanics	AP	3	5
4	Explain quantum mechanical phenomena such as photoelectric effect and Compton effect	AP	2	6
5	Explain how the wave nature of particle leads to the understanding of quantum mechanics.	U	2,3	5
6	Apply general formalism of quantum mechanics to various problems.	AP	6	4
7	To analyze quantum mechanical system by finding eigenvalues and eigenvectors	U	7	5
8	Define the probability density and the probability current density	AP	6	6
9	Compute the Ehrenfest theorem and its extension to three dimensions	AP	5	7

PH5CRT07: DIGITAL ELECTRONICS AND PROGRAMMING				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR gates	U	1	5
2	Describe the functionality and applications of logic circuits	U	2	6
3	Simplify circuits and Boolean expressions using the Boolean laws	AP	7	5
4	Explain the logic behind the operation of registers and counters	U	4	6
5	Design basic combinational andsequential logic circuits.	C	3	5
6	Use the methods of systematic reduction of Boolean algebra expressions including Karnaugh maps	AP	7	5
7	Outline the basic concepts of OOPs	U	4	3
8	List out the tokens used in C++ programming language	R	3	5
9	Explain aboutconditional statements and loops	U	5	3

10	Discuss the concept of object and classes	U	1	3
11	Design OOPs concepts through C++ programs for solving simple problems (sorting, matrix multiplication, Prime number, etc.) C 2 PSO-Program Specific outcome;	C	2	2

PH5CRT08: ENVIRONMENTAL PHYSICS AND HUMAN RIGHTS				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	72
1	Identify various types of natural resources, human impact on these resources, and common resource management practices	R	2	7
2	Develop skills and a commitment to act independently and collectively to sustain and enrich the environment	U	1	9
3	Understand the multidisciplinary nature, important theories and concepts of environmental science, ecosystems, natural resources and conservation	U	4	8
4	Describe environmental hazards and risks and the social and economic ramifications	E	5	8
5	Familiarize with the major environmental problems its causes and potential solutions	U	4	7

6	Explain Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy and different Renewable energy sources	AP	3	9
7	Identify the environmental aspects of solar energy resources. In Comparison with various conventional energy systems, their prospects and limitations.	AN	4	9
8	Identify issues and problems relating to the human rights.	U	6	8
9	Analyse country‟s situation or international situation in terms of human rights	AN	7	8
10	Create awareness on various environmental acts in India	C	7	9

PH5CRT05: ELECTRICITY AND ELECTRODYNAMICS				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	54
1	Define the fundamental concepts of Wattless current, choke coil, transformer on no load- skin effect.	R	1	9
2	Explain the theorems related to ideal voltage source and current source.	U	2	10
3	Explain the basics Thermocouple effects	U	4	8
4	Explain the Gauss‟s law, Poisson‟s and Laplace‟s equations .Lorentz Force law- Biot- Savart law, Faraday‟s law	U	6	7
5	Apply the principles of algebra and trigonometry to Gaussian surface and Amperian loop.	AP	4	7
6	Explain the Maxwell‟s equations, Continuity equations Poynting‟s theorem, Energy of electromagnetic waves	U	7	8

PH5OPT01: OUR UNIVERSE				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand early models of universe	U	1	5
2	Galaxies, Hubble’s classification	R, U	4	5
3	Big bang theory, Hubble’s law, Age of the universe	R,U	2	5
4	Stellar evolution, Chandrasekhar limit	U		6
5	Super nova, black hole	U	5	5
6	Cardinal points, equinoxes,	U,An	1	6
7	Diurnal motion of sun	U	1	6
8	Optical telescopes	U,A	1	6

9	Solar system, solar atmosphere	U,R	1	7
10	planets	R,An	3	5
11	Minor members of solar system	U	5	6
12	Universal law of gravitation	R	1	5
13	Earth's orbital motion- day-to –day changes and seasonal changes	U,An	2	5
	Total hours	**72**		

SIXTH SEMESTER

PH6CRT09: THERMAL AND STATISTICAL PHYSICS				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	State the laws of thermodynamics	R	3	6
2	Describe the working of heat engines such as Carnot engine,Petrol engine, Diesel engine.	U	5	7
3	Define the concept of entropy and explain its physical significance.	R	7	8
4	Explain Lees Disc experiment and can calculate the thermal conductivity by experimentally also	U	2,1	5
5	Derive Maxwells thermodynamic relations	AP	2	6
6	Explain the significance of Clausius-Clapeyron equation	U	1	5
7	Compute the thermodynamics of an ideal monoatomic gas	U	5	4
8	Derive Maxwell-Boltzmann,Bose-Einstien and FermiDirac distribution laws and compare the laws.	AP	3	3

PH6CRT11: NUCLEAR PHYSICS, PARTICLE PHYSICS AND ASTROPHYSICS				
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	54
1	Gain a clear picture of nuclear composition and various nuclear models.	R	1	10
2	Have a deep knowledge about Radio activity,nuclear Fission and Nuclear Fusion,the relevance of nuclear transformation.	U	4	11

3	Understand the working of nuclear detectors and counters,realize the importance of Cosmic rays and its effects on earth	R	2	12
4	Become familiar with nuclear particles and different particle accelerators. Student is expected to know the working of different accelerators.	U	5	12
5	Have Peripheral ideas about astronomy and astrophysics	AP	1	9

PH6CRT12: SOLID STATE PHYSICS				72 hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand basic crystal structure and compare various crystal systems, bonding in solids band theory,Bloch theorem	U	1	10
2	Understand basic properties of semiconductors and band structure of solids Fermi level of intrinsic and extrinsic semiconductors	R, U	4	10
3	Hall effect Direct and indirect bandgap semiconductors, principle of LED and photodiodes	R,A	2	8
4	Understanding the magnetic propertis of solids	U		8
5	Discuss Hall Effect and list its applications	U	5	8
6	Langavin's theory of dia and para magnetism	U	1	10
7	Meissner effect, type I and type II superconductors	U	1	8
8	Isotope effect, tunnelling, BCS theory, Cooper Pair	U	1	10

PH6CRT10: RELATIVITY AND SPECTROSCOPY				72hours
CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to	Cognitive Level	PSO No.	
1	Understand inertial and non-inertial frames, postulates of special theory of relativity,	U	3	6
2	Lorentz transformation	R	1,2	6
3	Spatial contraction, time dilation, equivalence of mass and energy	R	1,2	6
4	Atomic spectroscopy, absorption and emission of light by atoms, quantum theory	U	3	7
5	Early atom models	U	3,4	4

6	Quantum numbers, total angular momentum	R	1,2	4
7	Fine structure of sodium D lines, Zeeman effect	R	1	3
8	Paschen –Back effect	U	3	3
9	Molecular spectroscopy	R	3	7
10	Fluorescence and phosphorescence ,Raman effect, quantum theory	U	4	7
11	IR and Microwave spectroscopes	U	3	7
12	NMR Spectroscopy, Applications of NMR	R	1,2	6
13	ESR spectroscopy	U	3	6

PH6CBT01: INFORMATION TECHNOLOGY

Scope: To learn about the fascinating world of information technology and to use the tools available in Internet and the World Wide Web for a deep study of the subjects related to physics in better way by the students themselves.

CO no	**Expected course Outcome upon completion of this course, the students will be able to**	**Cognitive Level**	**PSO no**	**Class sessions**
CO 1	Basic of Information technology	U	1	3
CO 2	Computer Networks:basic, OSI model, TCP/IP model, topology	R	2	8
CO 3	THE INTERNET:IP	R	1	3
CO 4	THE INTERNET:other protocol	U	1	4
CO 5	Network Security and browsers	R	1	2
CO 6	HTML Programming	Ap	5	20
CO 7	Basic Idea of DBMS	U	1	10
CO 8	MS office, spreadsheet,powerpoint	Ap	5	4
	Total Hours			**54 hrs**

DEPARTMENT OF HISTORY

B.A History -MODEL – II (Vocational)

Archaeology and Museology

Programme Specific Outcomes

and

Course Outcomes

PROGRAMME SPECIFIC OUTCOMES

PSO1	Understand the basic skills that historians use in research.
PSO 2	Understand the basic skills that historians use in writing.
PSO 3	Understand the basic tools of historical analysis.
PSO 4	Students will understand the value of diversity and the need for its preservation.
PSO 5	Acquire a strong theoretical base to understand various issues and trends in the society at the local, national and global levels
PSO 6	Students will develop critical and analytical skill to evaluate competing interpretations and multiple narratives of the past
PSO 7	students will develop progressive and humanistic approaches on various problems plaguing Human society.
PSO 8	It enables an economic principal and trends in contemporary scenario
PSO 9	Understand the world based on cultural and social history
PSO 10	familiarized with basic techniques and methods in archaeological exploration and excavation as as preservation
PSO 11	Overall awareness about our own identities, gives us insight into present day problems and solutions, builds better citizenships in future.
PSO 12	Articulate the diversity of human experience including gender ,caste and ethnicity etc.,

SEMESTER – 1

Core course

HY1CRT01- Perspectives and Methodologies in Social Sciences

Sl.No.	Course Outcomes
CO1	Understand the basics of social science epistemologies and Methodologies
CO2	Understand the relevance of social science in solving contemporary issues at different levels
CO3	Understand the need for interdisciplinary and Multidisciplinary approaches of research
CO4	Contrast objectivity and subjectivity in Social Science in general and History in particular
CO5	Identify the nature and scope of history

Vocational

HY1VOT13 -Introduction to Archaeology

Sl.No.	Course Outcomes
CO1	Understand the basics of Definition, Aims and Scope Archaeology
CO2	Identify the Important archaeological findings and their significance
CO3	Understand the History of Archaeology world and Indian level
CO4	Brief Introduction to Archaeological Theories

Complimentary

EC 1/3CMT01-Principles of Economics

Sl.No.	Course Outcomes
CO1	Basic knowledge in basic Micro Economic Theory
CO2	Understand the theory of Demand and Supply
CO3	Evaluate Market Structure and market forms

Semester II

Core course

HY2CRT02-Understanding Early India: From Hunting Gatherers to Land Grant

Sl.No.	Course Outcomes
CO1	Compare Pre-historic, proto historic period and Early Historic period of Indian History
CO2	Discuss the role of Empire in Ancient India
CO3	Discuss the role of the Second urbanisation, and Mahajanapadas,
CO4	Evaluate the Heterodox sects in India
CO5	Critically evaluate the Indian Feudalism
CO6	Significance and determine the Developments in the field of Art and Architecture in ancient India

Vocational
HY 2VOT14 - Methods in Archaeology

Sl.No.	Course Outcomes

CO1	Basic knowledge in Exploration and Excavation Methods
CO2	Understand the Important of Archaeological Recording
CO3	Basic understanding Dating Methods
CO4	Conservation and preservation of Archaeological Remains

Complimentary
EC 2/4CMT02- Basic Economic Studies

Sl.No.	**Course Outcomes**
CO1	Basic understanding in Macro Economics
CO2	Understand General issues in Indian economy and Kerala Economy
CO3	Discuss the concepts of National income Methods of National income Accounting.
CO4	Understand the problem Inflation and Deflation in Economy

Semester III

Core course

HY3CRT03–Polity, Society and Economy in Pre Colonial Period

Sl.No.	Course Outcomes
CO1	**Understand Sources of Sultanate and Mughal periods**
CO2	**Evaluate Administration in the Medieval times**
CO3	**Compare the socio-economic cultural formations of the medieval period**
CO4	**Understand Regional Political Formations in South India**
CO5	**Understand the revenue administration in the Medieval time**

HY3CRT04-Cultural Trends in Pre Colonial Kerala

Sl.No.	Course Outcomes
CO1	Understand the geographical features in Kerala
CO2	Discuss the primary and secondary sources in Kerala history
CO3	Understand and examine the Early Settlements and Tamil heroic cultures In south india

CO4	Evaluate Age of perumals ,Swaroopams and Nadu divisions in ancient Kerala
CO5	Generalize Social , economic and culture life of pre modern Kerala

Vocational

HY 3VOT15 - Basics of Museology

Sl.No.	Course Outcomes
CO1	Introduction to Museology and Scope of Museum
CO2	Understand the collection , preservation and documentation of museum Objects
CO3	Understand the Research and Research facilities in museum
CO4	Understand the Educational activities by museum
CO5	Evaluate Various Types of Museums and New Museum Trends
CO6	Analyse Remains Act and Art Treasure Act in India

Semester IV

Core course

HY4C RT05- Making of the Modern Kerala

Sl.No.	Course Outcomes
CO1	Understand the European Colonization and effects
CO2	Evaluate the role of Missionaries-Printing, press and education
CO3	Discuss and summarize Socio-religious reform movements in modern Kerala
CO4	Under stand Early Political Movements in Kerala
CO5	Understand the political situation in Kerala since independence

HY4CRT06 - Researching the Past

SL.NO	Course Outcomes
CO1	Understand the Basics of historical Research and methodology
CO2	Determine the Synopsis and proposal Writing
CO3	Understand and identify Techniques of documentation
CO4	Understand the sources of historical writings

Vocational

HY 4VOT16 - Methods of Museology

SL.NO	Course Outcomes
CO1	Understand the Museum Administration
CO2	Understand the function and the role of Governing bodies, Committee and security
CO3	Financial Management of Museums-fund, funds raising, grant, sponsorship and income generation.
CO4	Planning and maintenance of Museum building, Lighting planning and programming of exhibition, Galleries terracotta, glass and metal
CO5	Conservation of organic material such as manuscript, paper, bone, wood and ivory

Semester V

Core course

HY5CRT 07-Inheritance and Departures in Historiography

SL.NO	Course Outcomes
CO1	Understand the History and Historiography
CO2	Understand Greek ,Roman,arabic , Church and Indian Historiography
CO3	Positivist Historiography and Marxian Materialism-
CO4	New trends in historiography- Annals and subaltern

HY5CRT 08-India: Nation in the Making

SL.NO	Course Outcomes
CO1	To develop an incisive understanding about the economic exploitation by the forces imperialism
CO2	Development and evolution of nationalism and national movement
CO3	Evolution of the constitution under British regime
CO4	Understanding the birth of a nation and attendant problems
CO5	Struggles against the empire from the margins
CO6	Dynamics and strategy of the national freedom struggle

HY5CRT 10- Environmental Studies and Human Rights in Historical Outline

SL.NO	Course Outcomes
CO1	Environmental Education encourages students to research, investigate how and why things happen
CO2	Understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues.
CO3	To develop the sense of awareness among the students about the environment
CO4	Identifying various problems and to help the students in realizing the inter relationship between man and environment and helps to protect the nature and natural resources.
CO5	acquiring the basic knowledge about environment and the social Norms that provide unity with environmental characteristics.
CO6	Understand the Environment and Human Rights in India

Vocational

HY 5VOT17 - Systems of Museology

SL.NO	Course Outcomes
CO1	To understand basics of museum, collection, documentation, exhibition, conservation and legislations relating to museums.
CO2	To understand the basic conservation of structures and monuments
CO3	To understand the significance of preservation of cultural heritage

Open course

HY5OCT01- Introducing Environmental History

SL.NO	Course Outcomes
CO1	Understand the Political, material and cultural dimensions of environmental History.
CO2	Understanding the Environmental Movements in India
CO3	Evaluate Industrial ecological impact and deforestation.
CO4	understand the European attitude towards environment- the European gaze- Imperial Agendas and exploitation of natural resources

Semester VI

Core course
HY6CRT 11–Making of Contemporary India

SL.NO	Course Outcomes
CO1	Understanding the problem of Partition and consequence
CO2	Evaluate Women's Reservation in contemporary India
CO3	Impact of Globalization and NEP
CO4	Evaluate the Migration and Rehabilitation-issue of refugees in India
CO5	Understanding the India's Foreign Policy evaluate the Planning Commission and Five Year Plans
CO6	Understand Decentralisation and Panchayati Raj
CO7	Evaluate Consolidation of Caste and Communal forces in Politics in India

HY6CRT12- Understanding Modern World

SL.NO	Course Outcomes
CO1	Understanding the growth of Colonialism and Imperialism in world ,
CO2	Evaluate World War I and its Impact
CO3	Understand Modern Revolutions in the world The Great Depression of 1929-33 and its impact on the world
CO4	Discuss the impact of Fascism and Nazism in Europe with reference of World War II
CO5	Evaluate Anti-Colonial Struggles in Asia, Africa and Latin America
CO6	Understand Cold War and the International Relations, Middle East crisis and Israel-Palestinian
CO 7	Transition Unipolar World to Multi-polarity

HY6CRT13- Capitalism and Colonialism

SL.NO	Course Outcomes
CO1	Traces the Emergence and development of capitalism in Europe and imperialist domination around the world
CO2	Processes and debates involved in the transition from feudalism to capitalism in Europe
CO3	Defining the colonies: surveys, census and ethnographies; administration Missionaries, Education and Health.
CO4	Evaluate the theories of imperialism- World System theories

Choice based core course

HY6CBT03 – Gender Studies

SL.NO	Course Outcomes
CO1	Explain the socio-historical constructions of sexual differences in society by Emphasizing the plural backgrounds.

CO2	To challenge the conventional social norms about male-female dichotomy and to conceive biological realities
CO3	To Establish that the very notion of gender difference is not natural but more of Economic, political and therefore power oriented.
CO4	Understand Social Construction of Gender - Concept of Sex and Gender
CO5	Understand Resistance and Sexual Liberation Movement

Vocational

HY 6VOT18 - Understanding Ancient Indian history through Archaeology

SL.NO	Course Outcomes
CO1	Explain the Sources of History on the basics of Literary and Archaeological
CO2	Analyse the Epigraphy and its important
CO3	Understand the reconstruction of history on the basics of epigraphy and Numismatics
CO4	Brief Introduction to Architecture in ancient India
CO5	Understand the Numismatics and relevance in History

Department of English
BA English

CORE COURSE	COURSE OUTCOME
Methodology of Literary Studies	1. The emergence of literature as a specific discipline within the humanities. 2. The tenets of what is now known as traditional approaches and also that of formalism 3. The questions raised by Cultural Studies and Feminism(s) 4. The issues of subalternity and regionality in the literary domain.

Introducing Language and Literature	1. The evolution and the differential traits of the English language till the present time. 2. The evolution of literature from antiquity to postmodern times. 3. The diversity of genres and techniques of representation and narration. 4.The links between literature and film as narrative expressions 5. The emergence of British and American Literature through diverse periods
Harmony of Prose	1. Understand varied prose styles of expression. 2. An awareness of eloquent expressions, brevity and aptness of voicing ideas in stylish language.
Symphony of Verse	1. An understanding of the representation of poetry in various periods of the English tradition. 2. An awareness of the emerging cultural and aesthetic expressions that poetry makes possible.
Modes of Fiction	1. Recognize the elements and different styles of fiction. 2.Trace the growth of English fiction. 3.Acquaint with British and Non British fictions. 1. Interpret texts with an awareness of and curiosity for other viewpoints. 2. Appreciate the novel as a form of literary expression. 3. Comprehend literal and figurative use of language. 4. Practice writing as a process of motivated inquiry.
Language and Lingustics	1. Understand and describe the historical development of the English language. 2. Comprehend the current theories and the nature of first and additional language acquisition. 3. Apply the tools of linguistics to analyze the sounds, words and sentences of a language.

	4. Describe different uses of language according to social context. 5. Recognize and combine diverse elements of the language programs of study into unified and coherent understanding of the discipline and its subjects of study. 6. Ability to compare and contrast language in terms of systematic differences in phonetics, phonology, morphology, syntax and semantics. 7. Develop proficiency in English language.
Acts on Stage	1.Familiar with the dramatic works and its playwrights 2.Identify the characteristics of dramatic works 3.Capable to appreciate and critique drama as an art form
Literary Criticism and Theory	1.Trace the advancement of literary criticism from the ancient times to the twentieth century. 2. Acquaint various literary theories and major theoretical schools. 3. Apprehend the chief strains of Indian literary criticism 4. Ability to analyse short poetical pieces critically.
Indian Writing in English	1.Illustrate the social, cultural and historical background of India based on the works of different Indian authors. 2.Identify the different issues people in India had gone through at various occasions of Indian diasporic history. 3.Recognize the cultural aesthetics which authors from different parts of India experienced. 4. Understand the different concerns that Indian English writers share, across boundaries
Environmental Science and Human Rights	1. Identify environmental issues by enhancing critical and creative thinking skills 2. Construct awareness about surroundings and need to protect environment 3. Arouse the feeling of positive attitude and compassion towards environment

	4. Construct an awareness of the vital importance of the vital importance of respecting human rights.
Postcolonial Literature	1. Getting familiar with the social, political, and cultural aspects of postcolonial societies. 2. Identify the characteristics of post colonial society 3. Understand the link between language, history and culture in a post colonial society
Women Writing	1. Understand texts from a feminist perspective 2. Analyse the patriarchal notions prevalent in society in connection with the literary texts 3. Understand the stereotypical notions against women and how women writing helps to overthrow such notions
American Literature	1. Acquaint with various literary movements in American Literature 2. Getting familiar with American Literary History 3. Understand the major writers and their renowned works in American Literature
Modern World Literature	1.It provides a vast picture of humanity across the world 2.It emerges as a platform on which poetics and politics fuse by defying regionalities and canonical assumptions 3.It also provides a platform for aesthetical and cultural collaboration between the different national dynamics 4.Associate ourselves with authors around the world through their works
Copy editing	1. Perceive an overall idea of copy editing. 2. Understand the fundamental principles of essay writing. 3. Identify various methods involved in essay writing 4. Recognize different proof-reading symbols and punctuations. 5. Write error free sentences and essays.

	6. Familiarize the process of book making and distribution.
English for Careers (Open Course)	1. Develop communicative skills for a career and function effectively in it. 2. Enhance academic and professional use of language. 3. Identify major patterns of effective presentation. 4. Acquaint with front office management and keeping public relations. 5. Develop interpersonal and interview skills

MA English

COURSES	COURSE OUTCOME
[EN010101] - Up Until Chaucer: Early Literatures in English	1. The student will be able to make sense of the major themes in Ancient and Medieval English literature as an expression of Anglo-Saxon culture and society as it emerges into a Britain-consciousness. 2. Understand the personal experiences of people living in a society very different from our own
[EN010102] -Literatures of the English Renaissance	1. Familiarise the students with the literature, thought and culture of the Renaissance period in England, a historical watershed marking the transition from the medieval to the modern. 2. Designed as a theoretical/critical reading of the era and the texts in the light of recent theoretical interventions like New Historicism and Cultural Materialism which had a special interest in Renaissance texts. 3. Instill a capacity to appreciate Renaissance writings bearing the stamp of radical changes in the outlook and ways of life.
[EN010103] -Literatures of the English Revolution/ Enlightenment	1. Familiarize the English literary texts which reflect the austere Puritan ideals of the late seventeenth century, the neoclassical vigour of the eighteenth century considerably influenced by the philosophy of the Enlightenment and the perspectival shift manifested in the transitional literature towards the end of this era. 2. Understand the late seventeenth and the eighteenth century literary scenario drawing upon the significant social and the political developments of the times.
[EN010104] -Nineteenth Century English Literatures	1. Familiarize students with the fundamental premises of the Romantic Movement and Victorian literature, their theoretical and

	ideological frameworks, and the major trends and offshoots across various genres. 2. Introduce the theoretical premises of the British Romantic Movement as well as the Victorian Age that chronologically follows the Romantic Era 3. Throws light on the historical significance of the Ode as a poetic form best suited to examine the subjective and individualistic imagination of the romantic poet
[EN010105] – Literary Criticism	1. Familiarize the students with the key concepts and texts of literary criticism ever since its emergence, and to provide theoretical familiarity with the range, approaches, and mechanics of critique. 2. Recognize the historical, political and aesthetic dimensions of the growth of literary criticism. Issues like canon formation, evolution of the genres, methods of literary analysis.
EN010201 Modernity and Modernisms	1. Recognize the literary trends of the early twentieth century in the context of the sensibility of literary modernism in the wake of the World War. 2. Introduce the changed literary perspectives in the twentieth century, along with the social, economic and political background.
EN010202 Postmodernism and Beyond	1. Acquaint the learners with the postmodern works of literature which defy categorisation and prove to be experimental in nature, subverting what is conventionally revered as the norm. 2. Familiarise the eclectic dimensions of postmodern thought as reflected in these literary works in which the boundaries that demarcate the different genres are often blurred. 3. Understand the underlying ideologies that nurture oppressive institutions
EN010203 American Literatures	1. Provide detailed information to the student regarding the processes and texts chiefly responsible for the evolution of American Literature as a separate branch possessing characteristic features which sets it apart from others. 2. Acquaint the students with some of the major conflicts, struggles and movements that are closely connected with the experiences of a group of people struggling to establish themselves as a nation.
EN010204 English Language History and Contemporary Linguistics	1. Familiarise the basic concepts of linguistics, the scientific study of language after initiating them into the history of English language. 2. Introduce the historical perspective of English language and its evolution.
EN010205 Thinking Theory	1. Introduce certain core aspects of what is currently designated as ‘literary theory’

	and also provide exposure to select current developments in this domain. 2.
EN010301 Reading India	1. Insight to the historical, cultural and literary heritage of India by acquainting the students with major movements and figures of Indian literature in English. 2. Understand the origin and growth of Indian writing in English especially in the colonial and post-colonial context.
EN010302 Post- Colonial Fiction	1. Introduce the discursive nature of colonialism, and the counter-discursive impulses of postcolonial theory, narratives and texts. 2. Address the consequences of European expansion and the creation and exploitation of the 'other' worlds, the course also addresses 'internal colonisations' of diverse kinds.
EN010303 Body, Text and Performance	1. Facilitate an understanding of the basic structural, thematic and theoretical patterns which govern the poetic process, especially in its relation to the performative or the theatrical. 2. Understand the aspects of power and powerlessness are constructed and performed have to be analyzed. One cannot disregard the cinematic medium in a study of performance.
EN010304 Literature and Gender	1. Understand the historic, thematic and cultural concerns that literature attempts against the backdrop of gender issues. 2. Interrogate the social stakes involved in being a woman and addresses the issue of Gender and Community Identity. 3. Address the problematic issues of Lesbian and Black identity and understand the issue of patriarchal oppression portrayed in various Indian languages over the decades.
EN010305 Ethics in/as Literature	1. Familiarise certain 'ethics' that narrative fiction has adopted across centuries, continents and languages. 2. Introduce the various ethical, formal choices that schools, influences and narrative devices have upheld so as to shape narrative fiction into its present expressive plurality.
[EN010401]-Cultural Studies	1. Introduce certain interpretive strategies commonly employed in Cultural Studies. 2. Understand interdisciplinary approaches to exploring how cultural processes and artifacts are produced, shaped, distributed, consumed, and responded to in diverse ways.
[EN010402]-Postcolonial Poetry	1. Introduce the diversity of poetry coming from the erstwhile colonies of the European Colonial Empires.

	2. See beyond the general discursive constellations, there are regional specifics that 'in a hybrid mode' negotiate issues of sovereignty, language, race, gender, identity and place.
[EN800402] Shakespeare Across Cultures	1. Recognize the timeless genius of Shakespeare across cultures, literatures and authors. 2. Understand the impact of Shakespeare at the theoretical and textual levels. 3. Familiarise the transfigurations of Shakespeare's plays as they were received in diverse cultures and the resonances and responses they evoked.
[EN820401] Modern European Fiction	1. Familiarize the evolution of European fiction over the latter half of the Nineteenth and early twentieth century. 2. Understand the major movements that shaped the growth of the European novel and the makers of European Fiction and to familiarize them with the writings of major novelists belonging to France, Germany, Russia, Greece, Italy and Austria spanning movements as varied as Realism, Existentialism, Naturalism and Postmodernism.
[EN830401] English Language Teaching (ELT)	1. Provide the fundamental techniques of teaching English language. 2. Expose the learner to various theories of ELT from the earliest to the modern. 3. To equip them with the methods and means of assessment and evaluation

Department of Mathematics

COURSE	DETAILS
COURSE CODE	MM1CMT01
COURSE TITLE	PARTIAL DIFFERENTIATION, MATRICES,TRIGONOMETRY AND NUMERICAL METHODS
TYPE	COMPLEMENTARY COURSE TO CHEMISTRY AND PHYSICS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:	CL	PSO No.
1	Recognize Functions of different variable and acquire knowledge in partial differentiation	Ap	
2	Get an idea about Rank, Transformation(Row/column) of Matrices, Able to find solutions of homogenous and non-homogeneous linear equations, Get an idea about Characterstic roots and vectors of a matrix and Cayley-Hamilton Theorem and application of theorem in different problems	Ap	
3	Learns the expansion using de Movier's theorem, in powers of sines and cosines, recognize hyperbolic and circular functions also learns the summation of different types of series	An	
4	Able to find solution of algebraic and transcendental equations using different methods	An	

COURSE	DETAILS
COURSE CODE	MM2CMT01
COURSE TITLE	INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS
TYPE	COMPLEMENTARY COURSE TO CHEMISTRY AND PHYSICS

CO No.	**Expected Course Outcomes Upon completion of this course, the students will be able to:**	**CL**	**PSO No.**
1	Evaluate the volumes of solids using cross-sections Evaluate the area of surfaces of revolution	E	
2	Calculate the length of an arc of a curve when whose equations are given in parametric and polar form	Ap	
3	Determine the area and volume by applying the techniques of double and triple integrals	Ap,E	
4	Identify different types of differential equations and solve them	U	
5	Obtain equations for surfaces and curves in three dimension	U	
6	Apply different methods to solve the equations of the form $dx/P = dy/Q = dz$ /R	Ap,E	
7	Form the partial differential equations by elimination of constants and elimination of functions	Ap,C	
8	Solve the partial differential equation using Lagrange's method	Ap,An,C	

COURSE	DETAILS
COURSE CODE	MM3CMT01
COURSE TITLE	VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA
TYPE	COMPLEMENTARY COURSE TO CHEMISTRY AND PHYSICS

CO No.	**Expected Course Outcomes Upon completion of this course, the students will be able to:**	**CL**	**PSO No.**
1	Getting an idea of curves in space and associated concepts	Ap	
2	Able to calculate directional derivatives and to find gradient vectors	Ap	
3	Understands the importance of line integral and will be able to identify where it can be applied and how it is evaluated	Ap,An	
4	Able to calculate surface area and surface integral	Ap,An	
5	Can interpret the concepts of work , potential function, circulation, flux etc mathematically by the help of greens theorem, stokes theorem	Ap,An	
6	Able to convert polar coordinates to Cartesian coordinates and learns the techniques to graphing equation in polar coordinates	Ap	
7	Identifies conic sections and their properties	U	
8	Get an understanding in basic concepts in group theory	R,U	

COURSE	DETAILS
COURSE CODE	MM4CMT01
COURSE TITLE	FOURIER SERIES,LAPLACE TRANSFORM AND COMPLEX ANALYSIS
TYPE	COMPLEMENTARY COURSE TO CHEMISTRY AND PHYSICS

CO No.	**Expected Course Outcomes Upon completion of this course, the students will be able to:**	**CL**	**PSO No.**
1	To represent periodic functions using Fourier series	U, Ap	
2	Get an idea of power series method to solve differential equations Familiar with Legendre equation and Legendre Polinomial	R, Ap	
3	Understands Laplace transforms	U, Ap	
4	Learns complex numbers and their properties	U, Ap	
5	Learns about analytic function and how to check analyticity based on Cauchy – Riemann equation	R, U, Ap	
6	To evaluate complex integral by various methods	R, An	
7	Knowing basic difference between real and complex calculus	U, Ap	

PSO-Program Specific outcome; CO-Course Outcome;CL- Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create