PRIST
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UNIVERSITY
NAAC ACCREDITED
THANJAVUR – 613 403 - TAMIL NADU

SCHOOL OF ARTS OF SCIENCE

DEPARTMENT OF CHEMISTRY

M.Sc CHEMISTRY CURRICULUM

REGULATION 2020

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THANJAVUR – 613 403 - TAMILNADU

SCHOOL OF ARTS AND SCIENCE

DEPARTMENT OF CHEMISTRY

M.Sc CHEMISTRY – REGULATION 2020

COURSE STRUCTURE

M.Sc. Graduate Attributes

- Domain knowledge
- Investigative
- Critical thinking
- Resourceful and Responsible
- Effective Communication
- Ethical and Moral values

M.Sc. Programme Educational Objective – PEO

- PEO1-To demonstrate broad knowledge of descriptive Chemistry.
- PEO2-To impart the basic analytical and technical skills to work effectively in the various fields of chemistry.
- PE03- To motivate critical thinking and analysis skills to solve complex chemical problems, e.g., analysis of data, synthetic logic, spectroscopy, structure and modeling, team-based problem solving, etc.
- PEO4-To demonstrate an ability to conduct experiments in the above sub-disciplines with mastery of appropriate techniques and proficiency using core chemical instrumentation and modeling methods.
- PEO5-To demonstrate the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
- PEO6-To develop skills in quantitative modeling of static and dynamic chemical systems.
- PEO7-To develop laboratory competence in relating chemical structure to spectroscopic phenomena.

- PEO8-To demonstrate the ability to synthesize, separate and characterize compounds using published reactions, protocols, standard laboratory equipment, and modern instrumentation.

M.Sc Pragramme Outcome –PO

- PO1-Think critically and analyze chemical problems.
- PO2-Present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
- PO3-Work effectively and safely in a laboratory environment.
- PO4-Use technologies/instrumentation to gather and analyze data.
- PO5-Work in teams as well as independently.
- PO6-Apply modern methods of analysis to chemical systems in a laboratory setting.

M.Sc Course -C

- C1-Organic Chemistry-I
- C2-Inorganic Chemistry-I
- C3-Physical Chemistry-I
- C4-Research Led Seminar
- C5-Organic Chemistry-II
- C6-Inorganic Chemistry-II
- C7-Physical Chemistry-II
- C8-Research Methodology
- C9-Participation in Bounded Research
- C10-Organic Chemistry-III
- C11-Inorganic Chemistry-III
- C12-Physical Chemistry-III
- C13- Participation in Scaffold Research
- C14-Project Work

M.Sc Curriculum Mapping

Programme Educational Objectives Vs Programme Outcome

Programme Outcome-PO Programme Educational Outcome - PEO	PO1	PO2	PO3	PO4	PO5	PO6
PE01	✓					
PE02						
PE03		✓				
PE04			✓			
PE05						
PE06					✓	
PE07				✓		
PE08						✓

M.Sc Curriculum Mapping
Programme Outcome vs Courses Outcome

Programme Outcome-PO Courses Outcome-CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			*	*		*
CO2		*		*	*	*
CO3	*	*			*	
CO4			*	*		*
CO5			*	*		*
CO6		*		*	*	*
CO7	*	*			*	
CO8		*	*		*	
CO9	*	*			*	*
CO10		*	*	*		*
CO11		*		*	*	
CO12	*	*		*	*	
CO13		*	*	*	*	
CO14		*	*	*	*	*

M.Sc. CHEMISTRY SYLLABUS – REGULATION 2020

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DEPARTMENT OF CHEMISTRY
M.Sc CHEMISTRY – REGULATION 2020
COURSE STRUCTURE

SEMESTER - I					
COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
20214SEC11	Organic Chemistry-I	5	0	0	4
20214SEC12	Inorganic Chemistry-I	5	0	0	4
20214SEC13	Physical Chemistry-I	5	0	0	4
20214SEC14L	Organic Chemistry Lab-I	0	0	5	2
20214SEC15L	Inorganic Chemistry Lab-I	0	0	5	2
20214DSC16_	Discipline Specific Elective-I	5	0	0	4
20214RLC17	Research Led Seminar	-	-	-	1
	Total	**20**	**-**	**10**	**21**
SEMESTER - II					
20214SEC21	Organic Chemistry-II	4	0	0	4
20214SEC22	Inorganic Chemistry-II	4	0	0	4
20214SEC23	Physical Chemistry-II	4	0	0	4
20214SEC24L	Organic Chemistry Lab-II	0	0	5	2
20214SEC25L	Inorganic Chemistry Lab-II	0	0	5	2
20214DSC26_	Discipline Specific Elective-II	5	0	0	4
20214RMC27	Research Methodology	3	0	0	2
20214BRC28	Participation in Bounded Research	-	-	-	2
	Total	**20**	**-**	**10**	**24**
SEMESTER - III					
20214SEC31	Organic Chemistry-III	5	0	0	5
20214SEC32	Inorganic Chemistry-III	5	0	0	5
19214DSC35_	Discipline Specific Elective-III	5	0	0	4

20214SEC33L	Physical Chemistry Lab-I	-	0	5	3
20214SEC34L	Physical Chemistry Lab-II	-	0	5	3
202_ _ OEC36	Open Elective	4	0	0	2
19214SRC37	Participation in Scaffold Research (Design and Societal Project)	-	-	-	2
	Total	**19**	**0**	**10**	**24**
SEMESTER - IV					
20214SEC41	Physical Chemistry-III	6	1	0	6
20214SEC32	Industrial Chemistry	6	1	0	5
19214DSC43_	Discipline Specific Elective-III	5	0	0	4
20214PRW44	Project	-	-	-	10
20214PEE	Programme Exit Examination	-	-	-	2
	Total	**17**	**2**	**0**	**27**
	Total Credits of this Program				**96**

DISCIPLINE SPECIFIC ELECTIVE COURSES –I

Semester	Elective No.	Course Code	Course Title
I	I	20214DSC16A	a) Environmental Chemistry
		20214DSC16B	b) Supramolecular Chemistry

DISCIPLINE SPECIFIC ELECTIVE COURSES –II

Semester	Elective No.	Course Code	Course Title
II	II	20214DSC26A	a) Special Topics in Chemistry
		20214DSC26B	b) Macromolecules as Engineering Materials.

DISCIPLINE SPECIFIC ELECTIVE COURSES –III

Semester	Elective No.	Course Code	Course Title
III	III	20214DSC35A	a) Medicinal Chemistry
		20214DSC35B	b) Green Organic Synthesis: Principles and Applications

DISCIPLINE SPECIFIC ELECTIVE COURSES –IV

Semester	Elective No.	Course Code	Course Title
IV	IV	20214DSC43A	a) Nano Chemistry
		20214DSC43B	b) Material Chemistry

OPEN ELECTIVE COURSES

Semester	Course Code	Course Title
III	20211OEC	Writing for the Media
	20212OEC	Applicable Mathematical Techniques
	20213OEC	Biomedical Instrumentation
	20215OEC	Herbal Medicines
	20220OEC	M-Marketing
	20261OEC	Financial Service
	20280OEC	Counselling and Psychology

CREDIT DISTRIBUTION

SEMESTER	SEC	GEC	DSE	RESEARCH	OTHERS	TOTAL
I	16	-	04	01		**21**
II	16	-	04	04		**24**
III	16	02	04	02		**24**
IV	11	-	04	10	02	**27**
TOTAL	**59**	**02**	**16**	**17**	**02**	**96**

SEMESTER – I

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC11	Organic Chemistry – I	5	0	0	4

Aim:

- To acquaint students with learning Organic Chemistry.

Objective:

- To sensitize students to learn Important components of Organic Chemistry.

Outcome:

Having successfully completed this module you will be able to:

- Recognise many functional groups and their reactivity
- Set up glassware and apparatus to conduct experiments in Organic Chemistry.
- Interpret data from a range of physical techniques to characterise Organic componds.
- Present the results of a practical investigation in a concise manner.
- Recognise many fundamental bond forming reactions and how to apply them in synthesis

Unit - I

Bonding, Structure & Aromaticity

Hybridization with reference to carbon compounds-Shapes of simple organic molecules-bond angle and bond length in organic molecules. Electronegativity of atoms and groups. Dipole moments of molecules-Applications of dipole moment to study the properties of organic molecules. Polarity of solvents. Hydrogen bonding-Inter and Intramolecular hydrogen bonding. E**lectronic Effects**-Inductive, resonance and hyperconjucative effects and their influence-rules of resonance. Tautomerism. Steric effects. Aromatic character-Huckel's rule and applications-Craig's rule and applications-Consequences of aromaticity – non-alteration in bond length-

Resonance energy from heat of hydrogenation, heat of combustion and Huckel's MO calculation, antiaromatic compounds.

Unit - II

Essentials of Organic Stereochemistry

Principles of symmetry-concept of chirality. Molecular symmetry and chirality. Newmann, Sawhorse, Fischer and Wedge representations and their interconversions. Types of molecules exhibiting optical activity. Configurational nomenclatures of acyclic and cyclic molecules: *cis-trans* and *E,Z* – and *D*, *L*; *R*, *S*; erythro and threo; *syn* and *anti*; *endo* and *exo*. Stereochemistry of molecules with axial chirality-atropisomerism – biphenyls-allenes, spiranes and analogues. Helicity and chirality. Topocity and prostereoisomerism- Diastereotopic ligands and faces. Resolution – methods of Resolution. Conformations six membered ring systems and their optical activity. Quantitative correlation between conformation and reactivity- Winstein-Eliel equation

Unit - III

Reactive Intermediates Methods of Determining Reaction Mechanisms

Carbocations, Carbanions, Carbenes and Nitrenes – Generation and stability of reactive intermediates. Correlation of reactivity with structure of reactive intermediates. Free radicals – Configurations – Identification by chemical and spectral methods – Free radical halogenation - NBS. Types of reactions: Homolytic and Heterolytic cleavages of bonds. Thermodynamic and kinetic aspects, Hammond’s postulate, isotope effects. Energy profile diagrams –

Intermediate versus transition state, Product analysis and its importance, Crossover experiments, Kinetic methods, Stereochemical studies, Isotopic and substituent effects

Unit - IV

Nucleophilic Substitutions in Aliphatic and Aromatic Substrates

SN1 and SN2 mechanisms-effect of substrate structure, leaving group, attacking nucleophile and solvent polarity-neighbouring group participation-substitution at vinylic and allylic carbons and reactivity. Ambient nucleophiles and substrates. Hydrolysis of esters-mechanisms. Selected reactions-Von-Braun, Dieckmann, Williamson. SNAr mechanism- SN1 (Aromatic) mechanism with evidences - Benzyne mechanism - Effect of substrate structure, leaving group, attacking nucleophile and solvent.

Unit -V

Heterocycles

Nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur. Synthesis, reactivity and applications of the following heterocycles: Pyrazoles, Oxazoles, Pyridazines, Pyrimidine and Pyrazines.

REFERENCES

1. March J, *Advanced Organic Chemistry*, Fourth Edition, John-Wiley and Sons, New York (1992).

2. Sykes P, *Guide Book to Mechanism in Organic Chemistry*, Sixth Edition, ELBS with Longmann (1997).

3. Eliel E L, *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill Publishing Company, New Delhi (1998).

4. Finar, I.L, *Organic Chemistry Volume* 2, Sixth Edition, ELBS with Longmann, Singapore (1997).

5. Nasipuri D, *Stereochemistry of Carbon Compounds*, Second Edition, New-Age International Publishers, New Delhi (1996).

6..Kalsi P.S, *Stereochemistry – Conformation and mechanism*. Wiley Eastern Limited.

7. Kalsi P.S., *Stereochemistry and mechanism through solved problems*. Second New Age Iunternational Publishers.

8. Nasipuri D., *Stereochemistry of Organic Compounds*., New Age International Publishers.

9. Mukherji S.M. and Singh S.P., *Organic Reaction Mechanism*, Macmillan India.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC12	Inorganic Chemistry – I	5	0	0	4

Aim:

- To acquaint students with learning Inorganic Chemistry

Objective:

- To learn Important Concepts of Inorganic Chemistry

Outcome:

- Having successfully completed this module you will be able to:
- .
- Present the results of a practical investigation in a concise manner.
- Recognise many fundamental bond forming reactions and how to apply them in synthesis

Unit - I

18 electron rule - EAN rule - theories of coordination compounds - valence bond theory - crystal field theory - splitting of d orbitals in different symmetries - crystal field stabilization energy - factors affecting the magnitude of 10 Dq - evidence for crystal field stabilization - spectrochemical series - site selection in spinels - tetragonal distortion from octahedral symmetry - Jahn-Teller distortion - molecular orbital theory - octahedral complexes - tetrahedral and square planar complexes - pi bonding and molecular orbital theory - experimental evidence for pi bonding.

Unit - II

Term states of dn ions - electronic spectra of coordination compounds - selection rules - band intensities and band widths - energy level diagrams of Orgel and Tanabe - Sugano - spectra of Ti^{3+}, V^{3+}, Ni^{2+}, Cr^{3+}, Co^{2+}, Cr^{2+} and Fe^{2+} - calculation of 10Dq and B for V^{3+} (oct) and Ni^{2+} (oct) complexes.

Magnetic properties of coordination compounds - change in magnetic properties of complexes in terms of spin orbit coupling - temperature independent paramagnetism - spin cross over phenomena.

Unit - III

Substitution reactions in square planar complexes - the rate law for nucleophilic substitution in a square planar complex - the trans effect - theories of trans effect - mechanism of nucleophilic substitution in square planar complexes - kinetics of octahedral substitution - ligand field effects and reaction rates - mechanism of substitution in octahedral complexes - reaction rates influenced by acid and bases - racemization and isomerization - mechanisms of redox reactions - outer sphere mechanisms - excited state

outer sphere electron transfer reactions - inner sphere mechanisms - mixed valent complexes.

Unit - IV

Structure of coordination compounds with reference to the existence of various coordination numbers - complexes with coordination number two - complexes with coordination number three - complexes with coordination number four - tetrahedral and square planar complexes - complexes with coordination number five - regular trigonal bipyramidal and square pyramidal - site preference in trigonal bipyramidal complexes - site preference in square planar complexes - isomerism in five coordinate complexes - coordination number six - distortion from perfect octahedral symmerty - trigonal prism - geometrical isomerism in octahedral complexes - coordination number seven and eight.

Unit - V

Inorganic chains - rings - cages and clusters - catenation - heterocatenation - intercalation chemistry - one dimensional conductor - isopolyanions - heteropolyanions - borazines - phosphazenes - phosphazene polymers - ring compounds of sulphur and nitrogen - homocyclic inorganic systems - cages - boron cage compounds - metal clusters - dinuclear clusters - trinuclear clusters - tetranuclear clusters - hexanuclear clusters - structural prediction of organometallic clusters.

References

1. Inorganic Chemistry - Principles of structure and reactivity, Fourth Edition J. E. Huheey, E. A. Keiter and R. L. Keiter - Addition Wesley Publishing Co, NY, 1993.
2. Advanced Inorganic Chemistry - F. A. Cotton and G. Wilkinson
3. Mechanism of Inorganic reactions - F. Basolo and R. G. Pearson
4. Inorganic Chemistry - R. B. Heslop and P. L. Robinson
5. Introduction to Ligand Fields - B. N. Figgis - Wiley Eastern Ltd, New Delhi, 1976.

6. Inorganic Chemistry - Keith F.Purcell and John C.Kotz,, Saunders Golden Sunburst Series, W.B.Saunders Company, Philadelphia, 1977.
7. Inorganic Chemistry - Shriver, Atkins and Longford, ELBS, 1994.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC13	Physical Chemistry – I	5	0	0	4

Aim:

- The aim of this course is to provide a core for future studies in chemistry and aspects of Physical Chemistry .

Objective:

- To learn the importance of Physical Chemistry.

Outcome:

- Having successfully completed this module you will be able to:
- Determine rate constants and half-life for 0, 1st and 2nd order reactions from experimental datasets.
- Understand and apply the Boltzman distribution and its effect on the observed spectraintegrate most functions encountered in chemical practice.
- Solve separable first-order ordinary differential equations.

UNIT -I

Classical Mechanics

Symmetry of space and its relation to conservation laws-Conservation theorems - conservation of linear momentum, angular momentum and energy-Equations of motion - Newtonian, Lagrangian, Hamiltonian-Definition of classical mechanics, quantum mechanics and relativistic

mechanics- Assumptions of classical mechanics. Classical wave equation-Conversion of classical wave equation into Schroedinger wave equation-Failure of Classical mechanics-Black body radiation-Photoelectric effect-Heat capacity of substances-Hydrogen atom spectrum.

UNIT- II

Mathematics for Quantum Chemistry

Functions - definition, classification-Linearly dependent and independent functions, odd and even functions-Inner product - normalization - orthogonality - ortho normal functions-Kronecker delta - Eigen functions - need for normalization. Operators - Linear, angular momentum, energy operators-Linear and non-linear operators. Hermitian operators and their properties- Proof for Hermicity of linear, angular, position and Hamiltonian operators-Commutator of operators-Commutation relation among angular momentum operators Lx, Ly, Lz- Vectors - vector space - Euclidean space, Hermitian space, Hilbert space.

UNIT - III

Basic Quantum Chemistry

Wave - particle dualism-Compton effect-Uncertainty principle and its applications- Postulates of quantum mechanics-Setting up Schrodinger wave equation and solving for particle in a 1D and 3D box, Harmonic oscillator, Rigid rotor, Hydrogen atom-Hydrogen atomic orbitals-Analytical and graphical representations-Radial probability distribution function-Orthogonality of 1s, 2s, 2p orbitals- Many electron atom – one electron orbital and one electron potential, Pauli’s exclusion principle, Slater’s determinant.

UNIT -IV

Fundamentals of Statistical Thermodynamics

Permutations and combinations-Combinatory rule – probability theorems. Microstates, macrostates-Methods of counting microstates of distinguishable and indistinguishable particles-Heat capacity of solids-Einstein and Debye models-Maxwell-Boltzmann statistics-Phase space-Thermodynamic probability-Statistical equilibrium. Derivation of M.B. statistics-Relationship between entropy and probability-Statistical meaning of third law of thermodynamics.

UNIT -V

Applications of Statistical Thermodynamics

Partition functions -Translational, rotational and vibrational partition functions of diatomic molecules-Translational, rotational and vibrational partition functions of poly atomic molecules-Electronic partition function-Derivation of thermodynamic quantities E, S, A, H, G, K and Cp, Cv using partition function-Sackur-Tetrode equation- Quantum statistics. Bose Einstein statistics-Behaviour of helium at low temperature-Fermi Dirac statistics.

REFERENCES:

1. Prasad R.K. Quantum Chemistry, I Edition, New Delhi, Wiley Eastern Ltd, (1992) - Unit 1, 2, 3

2. Anderson J. M. Mathematics of Quantum Chemistry, I Edition, Massachusetts, W.A.Benjamine Inc. (1966)- Unit 2

3. Kuriakose. J.C. and Rajaram J.C. Thermodynamics Jalandar Shoban Lal Co., (1996)- Unit 4, 5

4. Gupta and Kumar Classical Mechanics – Unit 1

COURSE CODE	COURSE TITLE	L	T	P	C

20214SEC14L	Organic Chemistry Lab – I	0	0	5	3

Aims: The organic laboratory class consists of a series of experiments designed to be completed in either one or two sessions. A written report discussing notable features of each experiment and the significance of the data is to be carried out each week. The course is designed to illustrate and reinforce concepts covered in the lecturebased part of the course. The students will be introduced to key synthetic techniques and will regularly employ spectroscopic techniques to examine the outcome of experiments.

Objectives: To perform seven experiments that have been divided into 3 topics:
Functional group interconversions, carbon-carbon bond formation / enolate chemistry, and electrophilic aromatic substitution. To take part in spectroscopy workshops that will demonstrate further topics in spectroscopy and the use of spectroscopic techniques in the characterisation of organic compounds. To learn new synthetic techniques: distillation under reduced pressure, reactions involving continuous removal of water and preparative chromatography. To gain experience in the identification and characterisation of unknown products using 1H NMR spectroscopy, ^{13}C NMR spectroscopy, IR spectroscopy and mass spectrometry. To introduce the concept of multi-step organic synthesis.

ORGANIC CHEMISTRY LAB – I

Qualitative analysis of an organic mixture containing two components.

a) Pilot separation

b) Bulk separation

c) Analysis

d) Derivatization

Preparation of Organic compounds (Single stage)

a) Glucose pentaacetate from glucose(acetylation)

b) Resorcetophenone from resorcinol (acetylation)

c) Benzophenoneoxime from benzophenone (addition)

d) *p*-Benzoquinone from hydroquinone (oxidation)

e) Phenyl-azo-2-napthol from aniline(diazotization).

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC15L	Inorganic Chemistry Lab – I	0	0	5	3

Aims:

The inorganic laboratory class consists of a series of experiments designed to be completed in either one or two sessions. A written report discussing notable features of each experiment and the significance of the data is to be carried out each week. The course is designed to illustrate and reinforce concepts covered in the lecture-based part of the course. To equip students with the basic skills and expertise required to carry out careful and precise procedures in the modern practical chemistry laboratory whilst providing experiments that illustrate and support the lecture course. To train students in

the art of good scientific report writing and in the use of spectroscopic techniques for the structural elucidation of inorganic compounds. To encourage student to become more aware of the risks and hazards associated with careful laboratory work and to assess risks and methods for minimizing them.

Objectives:

Analytical Experiments:

(1) To be familiar with the use of pipettes, burettes and analytical balances. To be able to transfer quantitatively liquids and solids.

(2) To be familiar with the techniques of gravimetric analysis, complexometric titration, colorimetry and atomic absorption spectrometry for the analysis of inorganic compounds. (3) To learn about gases in the environment and how to analyse for concentrations of gas components via spectrophotometry and IR spectroscopy. In modern analytical chemistry instrumental methods are replacing traditional titration and gravimetric methods. Nevertheless, a good grasp of the basic techniques is essential in all forms of instrumental analysis.

Among these techniques are:

(a) the ability to make up a standard solution

(b) the ability to make careful measurements

(c) an appreciation of errors and significant figures.

INORGANIC CHEMISTRY LAB – I

1. Titrimetry: Complexometric titrations involving estimations of calcium, magnesium, nickel, zinc and hardness of water.

2. Quantitative analysis: Quantitative analysis involving volumetric and gravimetric estimations of at least four mixtures of cations.

3. Preparation of inorganic complexes: About six preparations involving different techniques selected from the following.

(i) Potassium tris(oxalato)aluminate

(ii) Nickel ammonium sulphate

(iii) Tris(thiourea)copper(I) chloride

(iv) Potassium tris(oxalato)ferrate

(v) Hexamminecobalt(III) chloride

(vi) Ammonium hexachloro stannate(IV)

(vii) Tetrammine copper(II) sulphate

(viii) Cis and trans bis(glycinate) copper.

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC16A	Discipline Specific Elective - I Environmental Chemistry	5	0	0	4

Aim: To learn the important of Environmental Chemistry.

Objective:

- Creating the awareness about environmental problems among people.
- Imparting basic knowledge about the environment and its Ancillary problems.
- Developing an attitude of concern for the environment.
- Motivating public to participate in environment protection and environment improvement.
- Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
- Striving to attain harmony with Nature.

Outcomes:

Students who graduate with a major in environmental science will be able to:

- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale;
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment;
- Demonstrate ecology knowledge of a complex relationship between predators, prey, and the plant community;
- Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues; and
- Understand how politics and management have ecological consequences.

UNIT – I

Pollution

Environmental pollution - structure of atmosphere - biogeological cycles - oxygen - nitrogen – carbon – phosphorous – sulphur - biodistribution of elements - air pollutions - reactions in atmosphere - primary pollutants - air quality standards - analysis of CO, nitrogen oxides, sulphur oxides, hydrocarbons and particulate matter - particulate pollution - control methods - vechicular pollution - green house effect and global warming - climatic changes – ozone - photochemical smog - acid rain - sampling - monitoring – control.

UNIT – II

Water Pollution

Hydrosphere: Water pollution - hyrological cycle - chemical composition - sea water composition - water quality criteria for domestic and industrial uses - BIS and WHO standards - ground water pollution - surface water pollution - lake and river water - eutrophication - marine pollution - water pollutants - biodgradeability of detergents – pestisides - endosulfan and related case studies.

UNIT – III

Water Treatment

Principles of water and waste water treatment - aerobic and anaerobic treatment - industrial waste water treatment - heavy metal pollution - hard water - softening - purification of water for drinking purposes - water treatment for industrial use - electrodialysis - reverse osmosis - other purification methods - chemical speciation of elements.

UNIT – IV

Water Analysis

Color - odor - conductivity - TDS - pH - acidity - alkalinity - chloride - residual chlorine - hardness - trace metal analysis - elemental analysis - ammonia - nitrite - nitrate - fluoride - sulphide - phosphate - phenols - surfactants - BOD - COD - DO - TOC - nondispersive IR spectroscopy - anode stripping - ICP - AES - Chromatography - ion selective electrodes - neutron activation analysis.

UNIT – V

Soil Pollution:

Soil humus - soil fertility - inorganic and organic components in soil - acid - base and ion exchange reactions in soils - micro and macro nutrients - wastes and pollutants in soil - introduction to geochemistry - solid waste management - treatment and recycling soil analysis - radioactive pollution - disposal of radioactive waste.

REFERENCES:

1. H. Kaur, Environmental Chemistry, 6th Edn, Pragathi Prakashan, Meerut, 2011.
2. K.H.Mancy and W,.J.Weber Jr. Wiley, Analysis of Industrial Waste Water, Interescience New York, 1971.
3. L.W. Moore and E. A. Moore, Environmental Chemistry, McGraw Hill Publication, New York, 2002.
4. S. M. Khopkar, Environmental Pollution Analysis, New Age International (P) Ltd, 1993.

5. Colid Baird. Environmental Chemistry, W. H. Freemand and Company, 1995.

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC16B	Discipline Specific Elective - I Supramolecular Chemistry	5	0	0	4

Aim:

- To focuses on non-covalent bonding interactions of molecule.

Objective:

- To explain the chemical reactions and molecular rearrangements of non-covalent bond molecules.
- To forces include hydrogen bonding ,metal coordination, van der waals forces, pi-pi interactions and electrostatic effects.

Outcome:

- Understand the reactivity of non-covalent bonding molecules.
- Develop the interaction and nature of organic solvents to others.

UNIT- I

Definition of supramolecular chemistry: Nature of binding interactions in supramolecular structures: ion-ion, ion-dipole, dipole-dipole, hydrogen bonding, cation-π, anion- π, π- π, and van der Waals interactions.

UNIT -II

Synthesis and structure of crown ethers: lariat ethers, podands, cryptands, spherands,

calixarenes, cyclodextrins, cyclophanes, cryptophanes, carcerands and hemicarcerands.

UNIT- III

Host-Guest interactions: pre-organization and complimentarity, lock and key analogy. Binding of cationic, anionic, ion pair and neutral guest molecules.

Crystal engineering: role of H-bonding and other weak interactions.

UNIT- IV

Self-assembly molecules: design, synthesis and properties of the molecules, self

assembling by H-bonding, metal-ligand interactions and other weak interactions,

metallomacrocycles, catenanes, rotaxanes, helicates and knots.

UNIT -V

Molecular devices: molecular electronic devices, molecular wires, molecular rectifiers,

molecular switches, molecular logic.

Relevance of supramolecular chemistry to mimic biological systems: cyclodextrins as enzyme mimics, ion channel mimics, supramolecular catalysis.

REFERENCES:

1. J. -M. Lehn; Supramolecular Chemistry-Concepts and Perspectives (Wiley-VCH, 1995).

2. D. Beer, P. A. Gale, D. K. Smith; Supramolecular Chemistry (Oxford University Press, 1999)

3. W. Steed and J. L. Atwood; Supramolecular Chemistry (Wiley, 2000)

SEMESTER - II

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC21	Organic Chemistry - II	4	0	0	4

Aim:

- To acquaint students with learning Organic Chemistry

Objective:

- To sensitize students to learn Important components of Organic Chemistry

Outcome:

- Having successfully completed this module you will be able to:
- Gaining knowledge about Carbon –Carbon Double bonda
- About rearrangements
- Interpret data from a range of physical techniques to characterise Organic componds.
- Present the results of a practical investigation in a concise manner.
- Recognise many fundamental bond forming reactions and how to apply them in synthesis.

UNIT- I

Addition to Carbon–Carbon Multiple Bonds

Electrophilic and nucleophilic additions, addition to conjugated systems, orientation and reactivity, addition of halogen and nitrosyl chloride to olefins, hydration of olefins and acetylenes, hydroboration, hydroxylation epoxidatoin , Michael addition, 1.3 dipolar addition, Diels-Alder reaction.

UNIT- II

Addition to Carbon–Hetero Atom Multiple Bonds

Mechanism and reactivity, Mannich, Stobbe, Darzen-Glycidic ester condensation, Benzoin condensation, Peterson olefination (Silyl Witting reaction), Strecker synthesis, Witting, Witting Horner, Perkin, Thorpe, Ritter, Prins reactions.

UNIT -III

Elimination Reactions

E_1,E_2,E_1CB mechanisms, Orientation of the double bond, Hofmann and Saytzeff rule, competition between elimination and substitution, dehydration and dehydrohaloganation reactions. Stereochemistry of E_2 eliminations in cyclohexane ring systems, mechanism of pyrolytic eliminations, Chugaev reaction and Cope elimination.

UNIT - IV

Molecular Rearrangements

A detailed study of the mechanism of the following rearrangements: Nucleophilic. Electrophilic and Freeradical rearrangements-memory effects, Migratory aptitudes, Pinacol-Pinacolone. Oppener-Wagner-Meerwin, Demyanov, Dienone-Phenol, Favorski, Baeyer-Villiger, Wolff, Stevens and Von-Richter (a few examples in each rearrangement are to be studied), rearrangements involving nitrenes- Hofmann, Curtius, Lossen, and Beckmann.

UNIT –V

Oxidation and Reduction

Study of the following oxidation reaction with mechanism: Oxidation of alcohols by CrO_3 - DMSO. DMSO in combination with DCC; acetic anhydride and oxylyl chloride, oxidation of aryl methane, allylic oxidation of olefins, oxidative cleavage of glycols, oxidative cleavage of double bonds by ozonolysis., NBS Oxidation.

Study of the following reduction reactions with mechanism: Reduction of carbonyl compounds by hydrides, selectivity in reduction of 4-ter-butylcyclohexanone using selenides, Clemmenson and Wolff-Kishner reductions, Birch reduction, MPV reduction.

References:

1. Advanced Organic Chemistry – Reactions, Mechanisms and Structure, Fourth Edition, Jerry March. John Wiley Sons (1992)
2. Organic Chemistry, Francis A. Carey. Third Edition, The McGraw-Hill Companies. Inc.
3. Organic Chemistry, Hjendrickson, Cram and Hammond, Third Edition, McGraw-Hill Book Company.
4. Organic Reactions and Mechanisms, P.S.Kalsi, Second Edition, New Age International Publishers.
5. Stereochemistry – of Carbon Compounds, Emest L. Eliel.T.M.H Edition, Tata MeGraw-Hill Publishing Company.
6. Stereochemistry – Conformation and mechanism. P.S.Kalsi, Wiley Eastern Limited.
7. Stereochemistry and mechanism through solved problems, P.S.Kalsi, Second Edition, New Age international Publishers.

8. Stereochemistry of Organic Compounds D.Nasipuri, New Age International Publishers.
9. Reation mechanism in Organic Chemistry. S.M.Mukherji and S.P.Singh,Macmillan.
10. Organic Chemistry R.T.Morrison and R.N.Boyd, Prentice-Hall.
11. Principles of Organic Synthesis, R.O.C Nomman, 2nd Edition, Chapman and Hall.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC22	Inorganic Chemistry - II	4	0	0	4

Aim:

- To acquaint students with learning Inorganic Chemistry

Objective:

- To learn Important Concepts of Inorganic Chemistry

Outcome:

- Having successfully completed this module you will be able to:
- .
- Present the results of a practical investigation in a concise manner.
- Recognise Nuclear chemistryand transition Elements

UNIT- I

Nuclear Chemistry:

Radioactive decay and equilibrium, Nuclear reactions; Q value, cross sections, types of reactions, Chemical effects of nuclear transformations; fission and fusion, fusion products and fission yields. Radioactive techniques; tracer technique, neutron activation analysis, counting techniques such as G.M. ionization ands proportional counter.

UNIT - II

Chemistry of Non-transition Elements:

General discussion on the properties of the no transition element special features of individual elements; synthesis, properties and structure of their halides and oxides, polymorphism of carbon, phosphorus and sulphur.

Synthesis, properties and structure of boarnes, carbonates, borazines, silicates carbides, silicons, phosphazenes, sulphur-nitrogen compounds; peroxo compounds of boron, carbon and sulphur; oxy acids of nitrogen, phosphrous, sulphur and halogens, interhalgens pseudochalides and noble gas compounds.

UNIT- III

Chemistry of Transition Elements:

Coordination chemistry of transition metal ions; stability constants of complexes and their determination; stabilization of unusual oxidatrion states. Stereochemistry of coordination compounds. Ligandfield theory, splitting of d-orbital in low-symmetry environments. , John – Teller effect : interpretation of electronic spectra including charge transfer spectra; spectrochemical series , nephelauxetic series Magnetism; Dia, para; ferro- and antiferromagnetism, quenching of orbitial angular moment, spinorbit coupling, inorganic reaction mechanisms; substitution reactions, tarns effect and electron transfer reactions.

UNIT - IV

Chemistry of Lanthanides and Actinides:

Spectral and magnetic properties ; Use of lanthanide compounds as shift reagents molecules metal clusters, Spin crossover in coordinating Photo chemical reaction of chromium and ruthenium complexes. Fluxional compounds.

UNIT -V

Organometallic Chemistry of Transition Elements:

Synthesis, structure and bonding, organ metallic reagents in organic synthesis and in homogeneous catalytic reaction (hydrogenation, hydroformaylation, isomerisation and polymerization); pi-acid metal complexes, activation of small molecules by coordination.

References:

1. Badie E.Duglas and Danl H.McDaniel. Concepts and Models in Inorganic Chemistry, Indian Edition, 1970, Oxford and IBH Publishing Co., New Delhi.
2. J.D.Lee, A.New Concise Inorganic Chemistry , 4th Edition, ELBS, 1995
3. G.Friedlander, J.W. Kennedy and J.M.Miller, Nuclear and Radiochemistry
4. Keith F.Purchell and John. C.Kotz, Inorganic Chemistry, Saunders Golden Sunburst Series, W.B.Sauners Company, Philadelphia.
5. Cotton and Wilkinson, Advanced Inorganic Chemistry, 5th Edition, John Wiley & Sons, New York
6. W.Kain and B.Schwederski, Bioinorganic Chemistry, Inorganic Elements in the Chemistry of life, John Wiley and Sons, New York.
7. James E.Huheey, Ellen A.Keiter and Richard L.Keitre, Inorganic Chemistry; Principles of Structure and Reactivity, 4th Edition, Addison – Wesley, New York, (Unit – I)
8. Shriver and Atkins, Inorganic Chemistry, III Edition Oxford, 1999, India Gopsons Pvt.Ltd, A – 14 sector Noida.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC23	Physical Chemistry - II	4	0	0	4

Aim:

- The aim of this course is to provide a core for future studies in chemistry and aspects of Physical Chemistry.

Objective:

- To learn the importance of Physical Chemistry.

Outcomes:

- Having successfully completed this module you will be able to:
- Learning various concepts of Surface Phenomenon and Spectroscopy.
-

UNIT - I

Surface Phenomena:

Adsorption and free energy reaction at inter –phase-physisorption and chemisorption-potential energy diagram-Lennand –Jones Plot-Langmuir,BET isotherm-Gibbs & Freundlich's adsorption isotherms.

Role of surfaces in catalysis- Semiconductor catalysis-n and p type surfaces-kinetics of surface reactions involving adsorbed species-Langmuir-Hinshelwood mechanism of biomolecular reaction- Langmuir-Rideal mechanism of biomolecularr reaction- Rideal-Eley mechanism.

UNIT- II

Partition Functions:

Calculation of thermodynamic probability of a system –difference between thermodynamics and statistical probability-definition of micro and macro states – different methods of counting macro states-distingiusable and indistinguishable particles classical statistics-derivation of Maxwell-Boltzman Distribution law.

Transational ,rotational.vibrational,electronic-calculation of enthalpy internal energy,entropy and other thermodynamic functions – applications of partition functions to monoatomic and diatomic molecules.

UNIT - III

Spectroscopy:

Microwave Spectroscopy - Theory of linear, symmetric top and asymmetric top molecules.

IR Spectroscopy - Vibrational spectra- selection rules-harmonic and unharmonic oscillator- (fundamental absorption, first and second overtones, hot bands etc)-rotation, vibration spectra of diatomic molecules-influence of rotation on the spectra of poly atomic molecules- FT- IR spectrometry.

UNIT- IV

Raman Spectroscopy: Raman's effect – elastic and inelastic scattering-selection rules-pure rotational Raman spectra(linear, spherical top, symmetric top and asymmetric top molecules)-vibrational Raman's spectra-polarisation of lights and Raman effect-comparision of IR and Raman spectra –simple molecules-mutual exclusion principle-fermi resonance-Laser Raman's Spectroscopy (LRS).

UNIT-V

Group Theory: Elements of group theory- properties of subgroup –classes – group multiplication table –isomorphism groups –symmetry element and symmetry operations –inter relation among symmetry operation-generations- points group of molecules- matrix representation theory – construction of character tables- reducible and irreducible representations – MOs for systems like ethylene, butadiene, monocyclic and aromatic compounds.

References:

1. F.A.Cotton ,"Chemical Applications of Group Theory", 2nd ed., Wiley (1981).
2. R.L.Flowry, Jr,Symmentry Groups –Prentice Hall,New Jersy (1980)
3. B.E.Douglas and C.A.Hollingsworth, Symmentry in bonding and spectra- An Introduction,Academic Press Nal(1985)
4. K.Veera Reddy," Symmentry and spectroscopy of molecules", New Age International (p) Limted, Publishers,New Delhi.

5. A.K.Chandra, Introductory quantum Chemistry, 4th ed., Tata McGraw Hill(1994)
6. R.K.Prasad, quantum Chemistry, 2nd ed., New Age International Publishers(2000)
7. S.Glasstone, Introduction to Thearitical Chemistry, Affilated East-West press
8. C.N.Banwell,Fundamentals of Molecular spectroscopy, Tata McGraw Hill(1993)
9. G.M.Barrow , Introduction to Molecular spectroscopy, International McGraw Hill student edition(1984)
10. R.Chang,Basic principles of spectroscopy, McGraw Hill pub.Limited
11. J.D.GrayBeal, Molecular spectroscopy, McGraw Hill International edition(1988)
12. F.W.Sears "Thermodynamics, Kinetic Theory of gases and statistical mechanics", 2nd ed., Addision Wesley(1972)
13. S.Glasstone,"Thoeritical Chemistry", Affilated East-West press

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC24L	Organic Chemistry Lab - II	0	0	5	3

Aims: The organic laboratory class consists of a series of experiments designed to complete in either one or two sessions. A written export discussing notable features of each experiment and the significance of the data is to be carried out each week. The course is designed to illustrate and reinforce concepts covered in the lecture based part of the course. The students will be introduced to key synthetic techniques and will regularly employ spectroscopic techniques to examine the outcome of experiments.

Objectives: To perform seven experiments that have been divided into 3 topics:
Functional group interconversions, carbon-carbon bond formation / enolate chemistry, and electrophilic aromatic substitution. To take part in

spectroscopy workshops that will demonstrate further topics in spectroscopy and the use of spectroscopic techniques in the
characterisation of organic compounds. To learn new synthetic techniques: distillation under reduced pressure, reactions involving continuous removal of water and preparative chromatography. To gain experience in the identification and characterisation of unknown products using ^{1}H NMR spectroscopy, ^{13}C NMR spectroscopy, IR spectroscopy and mass spectrometry. To introduce the concept of multi-step organic synthesis.

ORGANIC CHEMISTRY LAB – II

Qualitative analysis of Organic Compounds:

Estimation of

a) Phenol

b) Aniline

c) Ketone

d) Glucose

Preparation of Organic Compounds (Double stage)

a) p-bromoacetanilide from aniline (acetylation & bromination)

b) 1,3,5- tribromobenzene from aniline (bromination, diazotization & hydroxylation)

c) p-nitroaniline from acetanilide (nitration & hydrolysis)

d) p-aminobenzoic acid from para- nitrotoluence, (oxidation & reduction).

COURSE CODE	COURSE TITLE	L	T	P	C

20214SEC25L	Inorganic Chemistry Lab - II	0	0	5	3

Aims:

The inorganic laboratory class consists of a series of experiments designed to be completed in either one or two sessions. A written report discussing notable features of each experiment and the significance of the data is to be carried out each week. The course is designed to illustrate and reinforce concepts covered in the lecture-based part of the course. To equip students with the basic skills and expertise required to carry out careful and precise procedures in the modern practical chemistry laboratory whilst providing experiments that illustrate and support the lecture course. To train students in

the art of good scientific report writing and in the use of spectroscopic techniques for the structural elucidation of inorganic compounds. To encourage student to become more aware of the risks and hazards associated with careful laboratory work and to assess risks and methods for minimizing them.

Objectives:

Analytical Experiments:

(1) To be familiar with the use of pipettes, burettes and analytical balances. To be able to transfer quantitatively liquids and solids.

(2) To be familiar with the techniques of gravimetric analysis, complexometric titration, colorimetry and atomic absorption spectrometry for the analysis of inorganic compounds. (3) To learn about gases in the environment and how to analyse for concentrations of gas components via spectrophotometry and IR spectroscopy. In modern analytical chemistry instrumental methods are replacing traditional titration and gravimetric methods. Nevertheless, a good grasp of the basic techniques is essential in all forms of instrumental analysis.

Among these techniques are:

(a) the ability to make up a standard solution

(b) the ability to make careful measurements

(c) an appreciation of errors and significant figures.

1. Qualitative analysis: Qualitative analysis employing semi-micro methods and spot tests of mixtures of common cations and ions of the following less familiar elements. Molybdenum, tungsten, selenium, tellurium, cerium, thorium, titanium, zirconium, vanadium, uranium and lithium.

2. Colorimetry: Colorimetric estimations of copper, nickel, iron and chromium using

photoelectric colorimeter.

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC26A	Discipline Specific Elective - II Special Topics in Chemistry	5	0	0	4

Aim:

- The aim of this course is to provide a core for future studies in chemistry and aspects of Industrial Chemistry .

Objective:

- To learn the importance of Industrial Chemistry.

Outcomes:

- Having successfully completed this module you will be able to:
- Learning various concepts of industries using Chemicals.

Unit – I

Water conditioning for chemical factories – reuse – methods of conditioning – Demineralisation – Precipitation – Desalting – Industrial and Sewage waste water treatment. Vegetable oils – Refining of edible oils – Solvent extraction – Processing of animal fat – Hydrogenation – Interesterification - Manufacture of soap and detergents . Biodegradability of surfactants – Methods.

Unit – II

Pulp and paper industries – Sulphite, Sulphate, soda, ground wood pulp for paper – Manufacture of paper – Speciality paper – Paper stock – Structural Boards. Plastics – Manufacture – Resin – Manufacturing process – Condensation polymerization – Manufacture of laminates and other derivatives – Hexamethylene tetramine plastics – Vinyl esters.

UNIT – III

Basic ideas – Flow charts – Chemical Conversion – Batch Versus Continuous processing – Design – Chemical Process control and economics – Market evaluation – Plant location – Management for productivity and Creativity – Research & Development and its role in Chemical industries.

Unit – IV

Rubber industries – Natural rubber – Synthetic rubber – Monomer production – Synthetic rubber polymerization – Butadiene – Styrene copolymers – Butadiene acrylonitrile copolymer – Neoprene – Thiokol – Silicon Rubber – Butyl rubber – Urethane rubber – Rubber processing-chemicals – Rubber compounding – Rubber fabrication – Latex compound-reclaimed rubber- Rubber derivatives.

UNIT – V

Industrial and military explosives – Manufacture – Pyrotechniques – Manufacture of safety matches.Colour photography – Theory – material and process – special applications of photography.

REFERENCES:

1. Chemical process Industries – Norrish Shreve, R. and Joseph A. Brink Jr. McGraw Hill, Industrial Book Company, London.
2. Production and Properties of Industrial Chemicals – Brain A.C.S Reinhold – New York.
3. Fermentation Industries – Burgh, A., Interscience, New York.

4. Hand Book of Technology and Engineering – Gilbert, J., Van Nostrand Reinhold, London.
5. Rubber Hand Book – Rubber Manufacturers association – New York.
6. Petroleum Products Hand Book, Guthrie V., McGraw Hill, Tokyo.

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC26B	Discipline Specific Elective - II Macromolecules as Engineering Materials	5	0	0	4

Aim:

- To study about the macromolecules as engineering materials in various fields.

Objective:

- To develop the concept and reactivity of macromolecules.

Outcome:

- Develop the knowledge of characterization and its applications of macromolecules.

UNIT - I

Concepts - Small molecules to macromolecules. Definitions and nomenclature. Classification of polymers, types of polymerizations (chain growth, step growth and living), molecular weights and distribution.

UNIT- II

Study on physical methods of determining molecular weights and distribution.

Synthesis of macromolecules – thermodynamics and kinetics of chain polymerization with reference to industrially important polymers such as polyethylene, polypropylene, polystyrene, polyvinyl chloride.

UNIT- III

Thermodynamics and kinetics of step polymerization with reference to specialty polymers such as PET, Nylon, PC, and PU. Step growth polymerizations involving crosslinking (gelation) or formation of insoluble

polymer mass. Determination of polymer structure via IR and NMR spectroscopies.

UNIT - IV

Characterization of polymer structure in the solid state – Characteristics of Amorphous and semicrystalline polymers. Viscoelasticity. Glass transition temperature and elementary theories of glass transition. Rubber elasticity and thermodynamic theory of rubber elasticity.

UNIT -V

Applications – Engineering and specialty polymers, high performance fibres (Kevlar), Composite materials (BMC and SMC), conducting plastics. Polymers for separation science, biomedical devices, electronics and photonics.

REFERENCES:

1. Polymer Science and Technology, by Joel R. Fried, Prentice Hall of India Pvt. Ltd.
1999.

2. Textbook of Polymer Science, by Fred W. Billmeyer Jr. Fourth Edition, 1999, Wiley-
Interscience, Ney York.

3.Principle of Polymerization, by George Odian, Fourth Edition, 1999, Wiley-
Interscience, Ney York.

4. Polymer Science, by V. R. Gowarikar, N. V. Viswanathan and S. Jayadev, Halsted
Press (John Wiley & Sons), New York.

COURSE CODE	COURSE TITLE	L	T	P	C
20214RMC27	Research Methodology	3	-	-	2

Aim:

To give an exposure to development of research questions and the various statistical methods suitable to address them through available literature, with basic computational operators.

Objective:

To understand the approaches towards and constraints in good research.

To identify various statistical tools used in research methodology

To appreciate and compose the manuscript for publication

To train in basic computational and software skills for research in physical and chemical sciences.

Outcome:

Ability to develop research questions and the various research strategies, and compile research results in terms of journal manuscripts.

PREREQUISITES:

Research Methodology course in UG level or equivalent knowledge.

UNIT I:

Introduction to Research Methodology

Objectives of research – Types of research – Significance of research. Research methods versus methodology – Research and scientific method – Criteria of good research – Problems encountered by researchers in India.

UNIT II:

Database and Literature Survey

Articles – Thesis – Journals – Patents – Primary sources of journals and patents – Secondary sources – Listing of titles – Abstracts – Chemical Abstract Service – Reviews – Monographs – Literature search.

UNIT III:

Data Analysis and Chemical Packages

Precision and accuracy – Reliability – Determinate and random errors – Distribution of random errors – Normal distribution curve – Statistical treatment of finite samples – t test and F test (ANOVA) co -variance (ANCOVA) correlation and multiple regression analysis – Chemical Packages – ChemDraw – ChemSketch – ISIS draw – Origin.

UNIT IV:

Thesis and Paper writing

Conventions in writing – General format – Page and chapter format – Use of quotations and footnotes – Preparations of tables and figures – References – Appendices.

UNIT V:

Laboratory Safety

Basic laboratory guidelines – safety equipment – Leaking compressed gas cylinders – electrical safety. Fire – fire extinguishers. Laboratory injuries and treatment. Chemical spills – Mercury and Biohazardous – clean up procedure - Accident management - Disposal of chemicals and glass wares.

References:

1. C. R. Kothari, Research Methodology, New Age International Publishers. New Delhi, 2004.

2. R.A Day and A.L. Underwood, Quantitative analysis, Prentice Hall, 1999.

3. D.G Peters, J.M. Hayes and G.M. Hefige, A brief introduction to Modern chemical analysis.

4. R. Gopalan, Thesis writing, Vijay Nicole Imprints Private Ltd., 2005.

5. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry,

Sultan Chand and Sons, New Delhi, 2005.

6. E. Balagurusamy, Numerical methods, Tata McGraw-Hill

7. S.S. Sastry, Introductory Methods of Numerical analysis, PHI, N.Delhi

SEMESTER - III

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC31	Organic Chemistry - III	5	0	0	5

Aim:

- To acquaint students with learning Organic Chemistry

Objective:

- To sensitize students to learn Important components of Organic Chemistry

Outcome:

- Having successfully completed this module you will be able to:
- Gaining knowledge organic Synthesis.

Unit I

Reagents in Organic Synthesis:

Use of the following reagents in organic synthesis and functional group transformations, complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium diazopropylamine (LDA), 1,3-dithiane, trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, Peterson's synthesis, Wilkinson's catalyst, baker yeast.

Unit II

Photochemistry:

Cis-trans isomerism, Paterno-Buchi reaction, Norrish type I and II reactions. Photoreduction of ketones, di-pimethane rearrangement, photochemistry of arenes.

Unit III

Pericyclic Reactions:

Selection rules and stereochemistry of electrocyclic reactions, cycloaddition, and sigmatropic shifts, Sommlet, Hauser, Cope and Claisen rearrangements.

Unit IV

Selective Organic Name Reactions:

Favorski, Mannich, Stork-Enamine reactions, Sharpless asymmetric epoxidation, Ene reaction, Barton reaction, Hoffmann-Loffler-Freytag reaction, Shapiro, Chichibabin and Bayer-Villiger reactions.

Unit V

Spectroscopy:

Applications of Mass, UV-VIS, IR and NMR spectroscopy for structural elucidation of organic molecules.

References:

(1) R.K. Bansal, Organic reaction mechanisms, New Age International, 1996.

(2) F.A. Carey and R.J. Sunberg, Advanced Organic Chemistry.

(3) W. Carruthers, Some Modern Methods in Organic Synthesis, Cambridge, 1971.

(4) E.J. Corey, Reactions and Reagents in Organic Synthesis, VCH, 1988.

(5) I.L.Finar, Organic Chemistry, Vol. II, ELBS, 1977.

(6) C. H. Depuy and O.S. Chapman, Elements of Organic Photochemistry, Prentice Hall, 1975.

(7) D. Dyer, Application of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1978.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC32	Inorganic Chemistry - III	5	0	0	5

Aim:

- To acquaint students with learning Inorganic Chemistry

Objective:

- To learn Important Concepts of Inorganic Chemistry

Outcome:

- Having successfully completed this module you will be able to:
- .Recognise Analytical Techniques and Spectroscopy.

UNIT – I

Topics in Analytical Chemistry:

Adsorption partition, exclusion electrochromatography, solvent extraction and ion exchange methods. Application of atomic and molecular absorption and emission spectroscopy in quantitative analysis. Light scattering techniques including nephelometry.Raman Spoectroscopy: Electroanalytical techniques; voltammetry, cyclic voltammetry, polarography, amperometry coulometry and conductometry. Ion-elective electrodes, anodic stripping voltammetry, TGA, DTA, DSC and online analyzer.

UNIT –II

Electronic Spectroscopy:

Electronic confoguration, terms states and microstates, derivation of term symbols (p^2, d^2) and arranging the various terms according to their energies. Spectroscopic terms – effect of inter electronic repulsion and spin – orbit coupling – Racah parameters B and C-R-S coupling and JJ coupling. Selection rules and the breakdown of selection rules- group theoretical explanation. Ground states of free ions for $d^{''}$ systems- Oh and Td systems and the corresponding energy level disgrams- mixing of orbitals. Orgel

diagram – charcteristics – prediction and assignment of transitions for d" weak filed cases. Tanane- Sugano diagrams- characteristics – predication and assignment of transition for weak field and strong filed – d" systems band intensity, band widths – band shapes – factors affecting these – distortion and spin-orbit coupling calculation of B and 10q for simple octahedral complexes of Co and Ni.

UNIT –III

IR and Raman Spectroscopy:

Combined uses of IR and Raman spectroscopy in the structural elucidation of simple molecules like H_2O,ClF_3, NO_3, ClO_3. Effect of co-ordination on legend vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate nitrate, sulphate and dimethylsulphoxide. Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding, geometry and number of C-O stretching vibrations (group theoretical treatment).

UNIT – IV

NMR Spectroscopy:

Chemical shifts and coupling constants (spin-spin coupling involving different nuclei ^{1}H, ^{31}P & ^{13}C) interpretation and applications to inorganic compounds. Effects of Quadrapole nuclei (^{1}H, ^{10}B, ^{11}B) on the ^{1}H NMR spectrum. NBR paramagnetic molecules - isotopic shifts, contact and pseudocontact interactions- lanthanide shift reagents. Stereochemistry of non-rigid molecules, satellite spectra – Applications of ^{31}P,^{13}C and ^{1}H NMR of inorganic molecules.

UNIT – V

EPR Spectroscopy:

Basic principles – characteristics of 'g' – hyperfine splitting - selection rules- hyperfine splitting on various structure – bis (salicilyldiaminecopper(II) – factors affecting the magnitude of the 'g' values

of transition metal ions – dependence on spin – orbit coupling crystal filed. Three conditions (I) spin-orbit coupling crystal filed (ii) strength of the crystal filed effects, (iii) very large crystal filed. Ni(II) octahedral complex- Cu^{2+} in a tetragonal – field. Zero–field splitting and signal- effecting spins mixing of saturated zero field splitting. Line widths in solid state EPR – spin – lattice – spin – spin relaxation – exchange processes. Effect of disortion – T, Ag, Eg. ground terms – g (parallel), g (perpendicular), g (average) $\alpha^2\beta^2$ and G parameters from EPR and information obtained from them.

References:

1. A.I. Vogel, Quantitative Inorganic Analysis, 3rd Ed., ELBS Longman, London.
2. R.S. Drago, Physical Methods in Inorganic Chemistry, 3rd ed., Wiley Eastern Company.
3. R.S Drago, Physical Methods in Chemistry, W.B. Saunders Company, Thinadelphia, London.
4. P.J. Wheatley, The Determination of Molecular Structure.
5. E.A.V. Ebsworth, Structural Methods in Inorganic Chemistry, 3rd Ed., ELBS, Great Britain, 1987.
6. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 3rd Ed., Mc-Graw Hill, 1983, New Delhi.
7. G.H.H. Stout and L.H. Jenson, X-ray Structure Determination, a Practical Guide.
8. G. Barrow, Introduction to Molecular Spectroscopy, Mc-Graw Hill, New York, 1964
9. P.K. Ghosh, Introduction to Photoelectron Spectroscopy, John Wiley, New York (1989).
10. W.Kemp, NMR in Chemistry – A Multinuclear Introduction, McMillan, 1986.
11. C.D. Becker, High Resolution NMR – Theory and Applications, Academic Press, 2nd Ed., 1980.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC33L	Physical Chemistry Lab -I	0	0	5	3

Aims: The physical laboratory class consists of a series of experiments designed to be completed in either one or two sessions. The laboratory is designed to illustrate and reinforce concepts covered in the lecture based part of the course. The students will be introduced to a number of spectroscopic and analytical techniques.

Objectives: To perform eight experiments covering analytical chemistry, catalysis, diffraction, IR spectroscopy, kinetics and thermodynamics

1. Kinetics – Acid hydrolysis of Esters - Comparison of strengths of acids.
2. Kinetics – Acid hydrolysis of Esters – Determination of Energy of Activation (E_a)
3. Kinetics – Saponification of Ester - Determination of Energy of Activation (E_a) by conductometry
4. Kinetics – Persulphate – Iodine Reaction - Determination of order,effect of ionic strength on rate constant
5. Distribution Law – Study of Iodine – Iodide equilibrium
6. Distribution law –Study of Association of Benzoic acid in Benzene.
7. Adsorption –Oxalic acid /Acetic acid on charcoal using Freundlich Isotherm.
8. Conductometry –Determination of dissociation constant of weak acids
9. Acid - alkali titrations
10. Displacement titrations
11. Precipitation titrations

12. Solubility product of sparingly soluble silver salts.

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC34L	Physical Chemistry Lab -II	0	0	5	3

Aims: The physical laboratory class consists of a series of experiments designed to be completed in either one or two sessions. The laboratory is designed to illustrate and reinforce concepts covered in the lecture based part of the course. The students will be introduced to a number of spectroscopic and analytical techniques.

Objectives: To perform eight experiments covering analytical chemistry, catalysis, diffraction, IR spectroscopy, kinetics and thermodynamics

1. Determination of molecular weight of substances by cryoscopy
2. Determination of molecular weight of substances by Transition Temperature method
3. Determination of molecular weight of substances by Rast method
4. Determination of Critical Solution Temperature (CST) of phenol – water system and effect of impurity on CST
5. Study of phase diagram of two components forming simple eutectic
6. Study of phase diagram of two components forming a compound.
7. Study of phase Diagram of three components (Acetic acid, Benzene and water)
8. Potentiometric titration's –Acid alkali titration
9. Precipitation titration's
10. Redox titration's
11. Determination of dissociation constant of weak acids.
12. Determination of solubility of silver salts
13. Determination of activity and activity co-efficient of ions

References:

1. Finlays "Practical physical chemistry "Revised and edited by B.pLevitt 9th ed,London 1985
2. J.N.Gurtur and R.Kapoor,'Advaced Experimental Chemistry" Vol.1.chand &co Ltd., New Delhi

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC35A	Discipline Specific Elective - III Medicinal Chemistry	5	0	0	4

Aim:

- The aim of this course is to provide a core for future studies and aspects of MedicinalChemistry.

Objective:

- To learn the importance of Medicinal Chemistry.

Outcomes:

- Having successfully completed this module you will be able to:
- Learning various concepts of Drugs.
- Learning various concepts in medicinal Chemistry.

UNIT- I

General Introduction

Introduction to medicinal chemistry, general mechanism of drug action on lipids, carbohydrates, proteins and nuleic acids, drug metabolism and inactivation, receptor structure and sites, drug discovery development, design and delivery systems, gene therapy and drug resistance.

UNIT - II

Drugs

Drugs based on structure or pharmacological basis with examples, synthesis of important drugs such as α - methyl dopa, chloramphenicol griseofulvin, cephelosphorins and nystatin. Molecular modeling, conformational analysis, qualitative and quantitative structure activity relationships.

UNIT - III

Antibiotics

Mechanism of action of lactam antibiotics and non lactam anti biotics, antiviral agents, chemistry, stereochemistry, biosynthesis and degradation of penicillins - An account of semisynthetic penicillins - acid resistant, penicillinase resistant and broad spectrum semisynthetic penicillins.

UNIT- IV

DNA Interactions

DNA-protein interaction and DNA-drug interaction. Introduction to rational approach to drug design, physical and chemical factors associated with biological activities, mechanism of drug action.

UNIT V

Enzyme Reactions: Nomenclature and classification of enzymes, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors. Enzyme kinetics, Michaleis-Menten and Lineweaver-Burk plots.

References:

1. G. L. Patrick, Introduction to Medicinal Chemistry, Oxford Univeristy Press, 2001.

2. I. Wilson, Giswald and F. Doerge, Text Book of Organic Medicinal and Pharmaceutical Chemistry, J.B. Lippincott Company, Philadelphia, 1971.

3. A. Burger, Medicinal Chemistry, Wiley Interscience, New York, Vol. I and II, 1970.

4. Bentley and Driver's Text Book of Pharmaceutical Chemistry revised by L.M.

Artherden, Oxford University Press, London, 1977.

5. A. Gringauz, Introduction to Medicinal Chemistry, How Drugs Act and Why?, John

Wiley and Sons, 1997.

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC35B	Discipline Specific Elective - III Green Organic Synthesis: Principles and Applications	5	0	0	4

Aim:

- To develop the study about green organic synthesis and its principles.

Objective:

- To explain the awareness about soil and water pollution in environment.

Outcome:

- Develop the advanced techniques to reduce chemical waste pollution.

UNIT- I

Green Chemistry: Definition, need for Green chemistry, evolution of Green Chemistry, principles of Green Chemistry.

UNIT - II

Classification of organic reactions under Green chemistry principles: a) Atom economic and non-toxic byproduct reactions: rearrangements, addition reaction, condensations, cascade strategies under catalysis, b) atom

uneconomic reactions: substitutions, eliminations, Wittig reactions, degradation reactions.

UNIT - III

Green Strategies and techniques for Organic Synthesis: use of Microwave, Sonochemsitry, Ball mill technique, electrochemical reactions, photochemical reactions.

UNIT- IV

Catalysis: Principles of various catalysis techniques in terms of Green Organic Synthesis i) Homogeneous, ii) Heterogeneous, iii) bio (enzyme) catalysis, iv) catalysis with nontoxic metals (Ca, Fe, Co, etc.), v) solid supported catalysis, vi) metal free/organocatalysis, vii) Visible light catalysis viii) phase transfer catalysis Alternative/Green Solvents for Organic Synthesis i) Water, ii) Ionic liquids, iii) Supercritical liquids (SCL), iv) Poly(ethylene glycol) (PEG), v) Fluorous biphasic Solvents.

UNIT- V

Comparison of greenness of solvents. Understanding the role/effect of these solvents on organic reactions. Solvent Free Organic Synthesis. Reactions at Room Temperature, Applications of the Green strategies in Organic Synthesis. Comparing organic reactions under classical conditions and Green conditions.

REFERENCES:

1. Green Chemistry: An introductory text by Mike Lancaster, RSC publishing, 2nd Edition, 2010.

2. Green Chemistry: Theory and Practice by Paul T. Anastas and John C. Warner, Oxford University Press, Oxford, 1998.

3. Green Chemistry: Environment Friendly Alternatives by Rashmi Sanghi and M M Srivastava, Narosa Publishing House, Delhi, 2003.

Course Code	Course Title	L	T	P	C
20111OEC	Open Elective - Journalism	4	0	0	2

Aim :

- To acquaint with the basic knowledge of journalism so that it may enthuse the students to become journalists.

Objective:

- To instill in the minds of students the different aspects of journalism
- To understand the different kinds of news
- To learn the qualities and duties of a reporter, editor and sub editor
- To familiarize with the style and features of the different sections in a newspaper

Outcome:

- Become a journalist

UNIT- I

Journalism – Definition, Qualities of a journalist, Forms of journalism, Role and elements, Ethics of Journalism, Press

UNIT- II

News – Definition, Kinds, Elements, Sources

UNIT- III

Reporters, Qualities, types

UNIT- IV

The Editor and the Sub Editor-qualities, types, editorial department,

UNIT –V

Language of Journalism, Style
Qualities of a Writer
Writing a News story, Opinion Pieces, Reviews, Headlines, Editorials, articles, middle, features, column

References:-

Journalism -Susan
Professional Journalism - John Hogenberg
News Writing and Reporting - M.James Neal (Surjeet Publication)
Professional Journalism -M.V Komath
The Journalist's Handbook -M.V Komath
Mass Communication & Journalism - D.S Mehta

Course code	Course Title	L	T	P	C
20112OEC	Open Elective**:** Development of Mathematics Skills	4	0	0	2

Aim:

- To understand the concepts from the five branches of mathematics

Objectives

- Knowledge and understanding are fundamental to study mathematics and form the base from which to explore concepts and develop problem-solving skills. Through knowledge and understanding students develop mathematical reasoning to make deductions and solve problems.
- To develop student's ability to apply both conventional and creative techniques to the solution of mathematical problems

Outcomes

- Know and demonstrate understanding of the concepts from the five branches of mathematics (Operations Research, Set Theory, Statistics, Matrices and Business mathematics)
- Use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts
- Select and apply general rules correctly to solve problems including those in real-life contexts.

Unit I

Simple interest and compound interest

Unit II

Sinking fund – discounting – trade discount – quantity discount – cash discount

Unit III

Set theory – Series

Unit IV

Matrices – Determinants

Unit V

Assignment problems

References

P.A.Navanitham, Business Mathematics & Statistics
Kanti Swarup, P.K.Gupta and Manmohan, "Operations Research"

Course Code	Course Title	L	T	P	C
20113GEC	Open Elective- Instrumentation	4	0	0	2

Aim:

- Making and analyzing measurements is the primary task of the experimental physicist. This includes designing experiments. Most experimental work, whether in bench-top situations, or using complex instruments. To many physicists this can be as interesting and involving as the basic physics one is trying to do.

Objectives:

- The use of instruments is of course not confined to physicists and this kind of experience is valuable in many situations which many students will encounter after graduation.
- A good physicist will bring a critical mind aiming to understand not only the result of an investigation but the primary reasons for the behavior of the data. Understand that there are finite limits to our ability to make good measurements, and why.

Outcomes:

- Appreciate important practical aspects of theoretical knowledge: how important components work, when to impedance match, non-ideal behaviour of op-amps etc.
- Acquire a sound understanding of the role of noise in measurement systems and know how to apply noise reduction techniques.
- Be able to apply Fourier and Laplace transforms to analyse the behaviour and stability of complex systems.

UNIT – I: Introduction

Potentiometer - calibration of volt meter and ammeter, measurement of resistance, Principles of network theorems – Thevenin's and Norton's theorem – Bridges : AC bridges – Maxwell, Owen, Schering and De Sauty's bridges – Wien bridges.

UNIT – II: Electronic Instruments – I

Basic characteristics of instruments – resolution – sensitivity - Audio frequency oscillator, Conversion of galvanometer into voltmeter and ammeter – resistance meter - Amplified D.C. meter – Chopper stabilized amplifier – A.C. Voltmeter using
rectifiers – Electronic multimeter – Differential voltmeter – Digital voltmeters –
Component measuring instruments (quantitative studies)

UNIT – III: Electronic Instruments – Ii

Signal conditioning systems – DC and AC carrier systems – Instrumentation
amplifiers – Vibrating capacitor amplifier – Analog to digital data and sampling – A/D and D/A convertor (successive approximation, ladder and dual slope converseons).

Unit IV – Recording Devices

Recorders necessity – Recording requirements – Analog recorders – Graphic recorders – strip chart recorders – Galvanometer types recorders – Null type recorders.

Unit V – CRO

CRO – Construction and action – Beam transit time and frequency limitations –
Measurement of potential, current, resistance, phase and frequency – Special purpose oscilloscopes – Sampling storage oscilloscope.

Books for Study

Electronic Instrumentation and Measurement techniques – W.D. Cooper and A.D. Helfrick – PHI – Third edn. – 1989

Books for Reference:

A Course In Electrical And Electronic Measurements and Instrumentation – A.K.
Sawhmey – Dhanpat Rai and Sons – 1990.

Electronic Measurements And Instrumentation – Oliver Cage – McGraw Hill –1975.

Course Code	Course Title	L	T	P	C
20114OEC	Open Elective-Food and Adulteration	4	0	0	2

Aim:

- To introduce students to food safety and standardization act and quality control of foods.

Objectives:

- To educate about common food adulterants and their detection.
- To impart knowledge in the legislatory aspects of adulteration.
- To educate about standards and composition of foods and role of consumer.

Outcomes:

- The students will have knowledge about different processing and preservation methods and principles involved.

Unit-I Introduction to Food Chemistry

Introduction to Food Chemistry- Water (Structure of water and ice, Physical constants of water, Types of water, Water activity) Composition of Food- Carbohydrates, Proteins, Lipids, Vitamins & Minerals.

Unit- II Food Pigments

Introduction- classification, types of food pigments- chlorophyll, carotenoids, anthocyanins, flavanoids.

Unit – III Food Preservation

Introduction - Importance, principle and Types.
High and low temperatures preservation - Pasteurization - Sterilization- Canning- Freezing- Refrigeration.

Unit – IV Food Additives

introduction- antioxidants, sequestrants, preservatives, nutrient supplement, emulsifiers, stabilizers and thickening agents, bleaching and maturing agent,

sweeteners, humectants and anti -caking agents, coloring and flavoring substance.

Unit-V Food Adulteration

Types of adulterants- intentional and incidental adulterants, methods of detection. Detection of common food adulterants in Spices , Grains, Coffee , Tea, Oil fats , Food colours and Milk. Health hazards and risks.

References:

1. The Food Safety and Standard ACT, 2006 – Seth & Capoor
2. Hand book of Food Adulteration and Safety Laws – Sumeet Malik
3. Food Science – B.Srilakshmi

Course Code	Course Title	L	T	P	C
20117OEC	Open Elective-Mushroom Technology	4	0	0	2

Aim:

- Mushrooms represent microbial technology that recycles agricultural residues into food and manure
- Mushroom technological interventions aims to increase productivity, quality, and income of farmers through cultivation of mushrooms.

Objectives:

- To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and offices
- To provide the Unit with appropriately trained personnel for the promotion of mushroom production in the country
- To increase the production and consumption of mushrooms.

Outcomes:

- Light. Mushrooms cannot extract nutrients from the sun as green plants do, so they do not need light.
- Cultivating specialty mushrooms is the most accessible way to growing edible mushrooms for profit. The two most popular specialty mushrooms grown in the United States are shiitake and oyster.

Unit – I

Introduction – history – scope of edible mushroom cultivation – Types of edible mushroom available in India – *Calacybeindica, VolvariellaVolvacea, Pleurotus*sp.*,Agaricusbisporus*

Unit – II

Pure culture – preparation of media (PDA and Oatmeal agar media) sterilization –Preparation of test tube slants to store mother culture – culturing of Pleurotus mycelium on petriplates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

Unit – III

Cultivation Technology : Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood – inoculation loop – low cost stove – sieves – Culturel rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves.

Unit – IV

Storage and nutrition : Short term storage – Long term storage (scanning, Pickles, papads, drying, storage in salt solutions) – Nutrition : Proteins, amino acids, mineral elements.Nutrition : Carbohydrates – Crude fiber content, vitamins.

Unit – V

Food preparation, Types of foods prepared from mushroom - soup, cutlet, omelette, samosa, pickles, curry. Research Centres – National level and Regional Level Cost benefit ratio – Marketing in India and abroad – Export value

Reference:

1. Marimuthu et al., (1991) Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore.
2. Nita Bahl (1988) Hand book of Mushrooms, II edition, Vol.I& II.
3. Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press.
4. Shu-Ting Chang, Philip G. Miles, Chang, S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2nd ed, CRC press.
5. Swaminathan M. (1990) Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore.

Course Code	**Course Title**	L	T	P	C
20120OEC	Open Elective -Web Technology	4	0	0	2

Aim:

- To equip the students with basic programming skill in Web Designing

Objective:

- To understand and practice mark up languages
- To learn Style Sheet and Frames

Outcomes:

- Explore markup languages features and create interactive web pages using them
- Learn and design Client side validation using scripting languages

UNIT I

Introduction to the Internet – Internet Technologies – Internet browsers.

UNIT II

Introduction to HTML – Head and body sections – Designing the body section.

UNIT III

Ordered and unordered lists – Table handling.

UNIT IV

DHTML and Style Sheet – Frames.

UNIT V

A web page design project – Forms.

Text Book

World Wide Web design with HTML – C. Xavier – Tata McGraw – Hill – 2000.

Reference Book

Principles of web design – Joel Sklar – Vikas publishing house 2001.

Course Code	Course Title	L	T	P	C
20122OEC	Open Elective- E-Commerce and its Application	4	0	0	2

Aim:

- To organize and promote the exchange of information on communication protocols and information exchange mechanisms for Electronic Commerce.

Objectives:

- To be aware of all aspects of communication and information exchange in Electronic Commerce, including:
- Navigation, brokerage, advertising and catalogue exchange in pre-sales activities.
- Negotiation and contract making protocols in interactions between consumers, businesses, and public administration.
- Secure exchange of documents, content and value in open trading protocols.
- Communication platforms for the e-Economy, including e-commerce, e-business and e-government.

Outcomes:

- Secure exchange of documents, content and value in open trading protocols.
- Communication platforms for the e-Economy, including e-commerce, e-business and e-government

UNIT-I:

History of E-commerce and Indian Business Context: Early Business Information Interchange Effort - Emergence of the Internet-Emergence of the world wide web – The milestones – Advantages of E-Commerce-Disadvantages of E-commerce-Online Extension of a BAM model-Transition to E-commerce in India- The internet and India TELCO-Managing Supply chain on the Internet- Hindustan Lever – Getting the E-advantage – Asian paints – E-transforming the organization - CRISIL – Cost – Effective distribution channels – ICICI Bank – Comprehensive Transactions – E-transition challenges for Indian Corporate – The Information Technology Act,2000 – ITC'S echoupal Business Models for E-Commerce: E-business models based on the Relationship of Transaction parties- E-business model base on the relationship of transaction types.

UNIT-II:

Enabling Technologies of the World Wide Web: Internet client – Server Application – Networks and Internets –Software agents – Internet Service Provider – Broadband Technologies – Hypertext –Java Script – XML.

UNIT- III:

E-Marketing: Traditional Marketing – Identifying web presence Goals –The Browsing Behaviour model – online marketing – E-advertising – Internet Marketing Trends – Target Markets – E-branding – Marketing strategies – The Times of India.

UNIT-IV:

E-Security: Information system security-security on the Internet-E-Business risk Management issues-Information security environment in India.

UNIT-V

E-payment Systems: E-Banking at ICICI bank-Main concerns in internet baking-History's lesson about payments: People drive change-digital payment requirements-digital token-based E-payment systems-classification of new payment system-properties of electronic cash(E-cash)-check payment system on the Internet-risk and E-payment system-Designing E-payment system-digital signature-online financial service in India-online stack trading: The high speed alternative.

Reference Book:

"E-Commerce: An Indian Perspective" P.T.Joseph, S.J. Third Edition.

Course Code	Course Title	L	T	P	C
20161OEC	Open Elective – Indirect Taxes	4	0	0	2

Aim:

- To acquaint with the knowledge of indirect taxes

Objectives:

- To make the students to gain expert knowledge in indirect taxes.
- To have practical knowledge on excise duties and customs duties.
- To learn the fundamentals of service tax, sales tax and VATS.

Outcome

- Students gained knowledge of various provisions of central excise customs law, service tax, VAT and sales tax and their applications in different circumstance**.**

UNIT – I

Objectives of Taxation - contribution to Government revenue- cannons of Taxation – Tax system in India – Direct and Indirect taxes Advantages and Disadvantages of Indirect taxes.

UNIT – II

Central Excise Duty – Meaning - Levy and collection - Distinction between Excise duty and Customs Duty and Sales Tax. Types of excise duties Methods of Levying Excise Duty – Excise and small scale Industries – Excise and Exports.

UNIT – III

Customs Duty – Levy and collection of customs duty Different types of customs Duties – Prohibition on importation and exportation of goods. Exemptions from customs duty.

UNIT – IV

Service Tax – Growth of Service sector – Meaning of Service Tax – Elements of Service Tax- exempted services from tax - Value of taxable services-Different services on which tax is payable.

UNIT – V

Value Added Tax (VAT)

Meaning of VAT, Justification of VAT – VAT and Sales Tax Advantages and Disadvantages of VAT. Methods of Calculating VAT Levy of VAT and Types of VAT.

Reference Books:

Income Tax Law and Practice - N.Hariharan.
Business Taxation – T.S.Reddy/Hari Prasad Reddy.

SEMESTER - IV

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC41	Physical Chemistry - III	6	1	0	6

Aim:

- The aim of this course is to provide a core for future studies in chemistry and aspects of Physical Chemistry.

Objective:

- To learn the importance of Physical Chemistry.

Outcomes:

- Having successfully completed this module you will be able to:

- Learning various concepts of Electro Chemistry.
- Learning various concepts of QuantumChemistry.
- Learning various concepts of Thermodynamics

UNIT –I

Electrochemistry:

Electrochemical cell reactions, Nernst equation, electrode kinetics, electrical double layer, electrode /electrolyte interface, batteries-primary & secondary fuel cells, corrosion and corrosion prevention.

UNIT –II

Non-Equilibrium Thermodynamics:

Postulates and methodologies, linear laws, Gibbs equation, Onsagar reciprocal theory. **Ideal and Non-Ideal Solutions:**

Excess functions, activities, concept of hydration number, activities in electrolytic solutions, mean ionic activity coefficient, Debye-Huckel treatment of dilute electrolyte solutions.

UNIT –III

Quantum Chemistry:

Planck's quantum theory, wave-particle duality, uncertainity principle, operators and commutation relations, postulates of quantum mechanics, free particle, particle in a box, degeneracy harmonic oscillator, rigid rotator and the hydrogen atom. Angular momentum, including spin coupling of angular momenta including spin-orbit coupling.

UNIT –IV

Born-Oppenheimer Approximation:

Hydrogen molecule ion, LCAO-MO and VB treatments of the hydrogen molecule, electron density, forces, and their role in chemical binding.

Hybridization and valence MOs of H_2O, NH_3 and CH_4. Huckel pi-electron theory and its applications to ethylene, butadiene and benzene, idea of self-consistent fields.

UNIT –V

Statistical Thermodynamics:

Thermodynamic probability, and entropy , Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, partition function, rotational, translational, vibrational and electronic partition functions for diatomic molecules, calculations of thermodynamic functions and equilibrium constants. Theories of specific heat for solids.

REFERENCES:

1. K.Veera Reddy, Symmentry and Spectroscopy of Molecules, New Age International(P) Ltd., Publishers, New Delhi.
2. A.K.Chandra, Introductory Quantum Chemistry, 4th Edn., Tata Mc-Graw Hill(1994)
3. R.K.Prasad, Quantum Chemistry, 2nd Edn., New Age International Publishers(2000)
4. I.N.Levine , Quantum Chemistry, 4th Edn., Prentice Hall of India(1994)
5. D.A.McQuarrie, Quantum Chemistry, University Science Books (1998).
6. P.W.Atkins, Molecular Quantum Mechanics, Clarendon(1973)
7. S.Glasstone, Introduction to Theoretical Chemistry, Affiliated East-West press
8. C.N.Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill(1993)
9. G.M.Barrow , Introduction to Molecular Spectroscopy, International Mc-Graw Hill student edition(1984)
10. B.P Straughan and S.Walker, Spectroscopy, Champon Hall, London
11. F.W.Sears, Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics, 2nd Edn., Addision Wesley(1972)

12. S.Glasstone, Thoeritical Chemistry, Affiliated East-West press
13. Lee,Sears and Turcotte, Statistical Thermodynamics Addition Wesley(1974)
14. S.Glasstone, Text Book Of Physical chemistry ,Macmillan(1969)
15. G.C.Bond, Hetrogeneous Catalysis-Principles and applications Clarendon(1974)
16. J.C.Kuriacose and Rajaram, Kinetics and Mechamism of Chemical Transformation, Mac-Millan & Co.,(1993)

COURSE CODE	COURSE TITLE	L	T	P	C
20214SEC42	Industrial Chemistry	6	1	0	5

UNIT - I Industrial Corrosion

Introduction - Economic aspects of corrosion - Dry or Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical Corrosion.

Galvanic Corrosion - Concentration Cell Corrosion - Differential aeration corrosion - Pitting Corrosion - Underground or soil corrosion.- Passivity.

UNIT - II Glass and Matches

Glass- Composition, Types, Formation operations – Melting, Blowing, Pressing, Annealing and finishing; Matches – Composition ,Types, Manufacture – safety matches.

Unit - III Pigments, Dyes and Paints

Pigments – Classification, Manufacture and uses; Dyes –Classification, preparation, Dyeing processes; Paints – Composition,Types, Manufacture and testing of Paints.

Unit - IV Plastics and Fibres

Fibres – Natural and synthetic fibres, Artificial silk, rayon, nylon and trylene; Plastics – composition, Classification, manufacture, properties and uses.

Unit -V Fertilizers and Fuels

Fertilizers – Organic and Inorganic fertilizers, Preparation and uses. Fuels – Energy resources - Industrial gases, Water gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.

TEXTBOOKS:

Author name	Title of the Book	Edition/year	Publication
Sharma B.K Units – 1,2,3,4,5	Industrial Chemistry	16th/2011	Goel Publishing House

REFERENCES:

1.Kirk Othmer, Encyclopedia of Chemical Technology. ALL THEFIVE UNITS
2.Charkarabarthy B.N, Industrial Chemistry, Oxford and IBHPrb.Co. IV AND V

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC43A	Nano Chemistry	5	0	0	4

UNIT 1

Introduction, nanostructures: tubes, fibers, wires, bricks and building blocks, nanostructure formation: lithography, self-assembly, molecular synthesis, crystal growth and polymerization, measurement of nanostructure: spectroscopy, microscopy and electrochemistry, nanoCAD, Material study: nanocomposites, consumer goods, 'smart materials,' Applications to various fields: optics, telecommunication, electronics, digital technology and

environment, Biomedical applications: diagnosation, mapping of genes, drug delivery and biomimetics

UNIT II

Novel physical chemistry related to nanoparticles such as colloids and clusters: different equilibrium structures, quantum effects, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state. Exploitation of self-assembly and self-organization to design functional structures in 1D, 2D or 3D structures. Examples to emphasize on self-assembled monolayers. Role of polymers in lithography resists, as well as self-organization of more complicated polymer architectures such as block copolymers and polymer brushes.

UNIT III

Nanomaterials (Nanoparticles, nanoclusters, quantum dots synthesis): Preparation and Characterization: "Top-Down" and "Bottom-Up" approaches of nanomaterial (nanoparticles, nanoclusters and quantum dots)

UNIT IV

Synthesis: Top-down techniques: photolithography, other optical lithography (EUV, X-Ray, LIL), particle-beam lithographies (e-beam, FIB, shadow mask evaporation), probe lithographies, Bottom-up techniques: self-assembly, self-assembled monolayers, directed assembly, layer-by-layer assembly. Pattern replication techniques: soft lithography, nanoimprint lithography.

UNIT V

Pattern transfer and enhancement techniques: dry etching, wet etching, pattern growth techniques (polymerization, directed assembly). Combination of Top-Down and Bottom-up techniques: current state-of-the-art. Synthesis and purification of carbon nanotubes, Single-walled carbon nanotubes and multiwalled carbon nanotubes, Structure-property relationships, Physical properties and Applications

REFERENCES

1. G.A.Ozin, A.C. Arsenault Nano chemistry, RSC
2. Diwan, Bharadwaj, Nanocomposites, Pentagon
3. Scanning Probe Microscopy: Analytical Methods (NanoScience andTechnology)- Roland Wiesendanger

COURSE CODE	COURSE TITLE	L	T	P	C
20214DSC43B	Material chemistry	5	0	0	4

Unit-1:
Introduction and structure of materials, why study properties of materials? Structure of atoms - Quantum states-Atomic bonding in solids-binding energy-inter atomic spacing - variation in bonding characteristics - Single crystals– polycrystalline - Non crystalline solids - Imperfection in solids – Vacancies –Interstitials - Geometry of dislocation - Schmid´s law - Surface imperfection -Importance of defects - Microscopic techniques - grain size distribution.

Unit-2: Solid solutions and alloys - Phase diagrams - Gibbs phase rule – Single component systems – Eutectic phase diagram – lever rule - Study of properties of phase diagrams - Phase transformation - Nucleation kinetics and growth.

Unit-3:
Batteries and Super capacitors for electrochemical energy storage: Batteries – primary and secondary batteries, Lithium, Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries, Super capacitors for energy storage. Role of carbon nanomaterials as electrodes in batteries and super capacitors.

Unit-4:
Materials for energy storage: Synthesis of nanomaterials, top-down and bottom-up approaches, mechanical milling, solgel method, chemical vapour deposition (CVD), Carbon Nano-Tubes (CNT), Carbon Nano-Fibres (CNF),graphene, preparation of graphene. Fabrication of CNTs and CNFs, CNTs and CNFs for hydrogen stora

Unit-5:
Fuel Cells and its applications: Fuel Cells, components of fuel cells, Types of fuel cells, Acid/alkaline fuel cells, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell.

Text Book:
1. . W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley & Sons, 2007
REFERENCES

2. K. Vijayamohanan Pillai and Meera Parthasarathi Functional Materials: A Chemist's
Perspective by, Orient Blackswan (21 November 2013)
3. C. Kittel, "Introduction to Solid State Physics" Wiley Eastern Ltd, 2005.
4. V. Raghavan, "Materials Science and Engineering: A First Course", Prentice Hall, 2006
5. Dieter, G. E., "Mechanical Metallurgy", 3rd Ed., 1988,McGraw Hill,.
6. Reed-Hill, R.E. and Abbaschian, R., "Physical Metallurgy Principles",1992, The PWS-KENTSeries in Engg.
7. Hutchings, I.M. "Tribology - Friction and Wear of Engineering Materials", 1992, Edward Arnold Publications Ltd.
8. Linden D. and Reddy Thomas B., "Handbook of Batteries", 2001, McGraw Hill Publications
9. Larminie and A. Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley (2003)
10.Xianguo Li, Principles of Fuel Cells, Taylor and Francis (2005)

Research Integrated Curriculum

The relationship between teacher and learner is completely different in higher education from what it is in school. At the higher level, the teacher is not there for the sake of the student, both have their justification in the service of scholarship. For the students who are the professionals of the future, developing the ability to investigate problems, make judgments on the basis of sound evidences, take decisions on a rational basis and understand what they are doing and why is vital. Research and inquiry is not just for those who choose to pursue an academic career. It is central to professional life in the twenty-first century.

It is observed that the modern world is characterized by heightened levels of complexity and uncertainty. Fluidity, fuzziness, instability, fragility, unpredictability, indeterminacy, turbulence, changeability, contestability: these are some of the terms that mark out the world of the twenty-first century. Teaching and research is correlated when they are co-related. Growing out of the research on teaching- research relations, the following framework has been developed and widely adopted to help

individual staff, course teams and whole institutions analyse their curricula and consider ways of strengthening students understanding of and through research. Curricula can be:

Research – Led: Learning about current research in the discipline

Here the curriculum focus is to ensure that what students learn clearly reflects current and ongoing research in their discipline. This may include research done by staff teaching them.

Research – Oriented: Developing research skills and techniques

Here the focus is on developing student's knowledge of and ability to carry out the research methodologies and methods appropriate to their discipline(s)

Research – Based: Undertaking research and inquiry

Here the curriculum focus is on ensuring that as much as possible the student learns in research and or inquiry mode (i.e. the students become producers of knowledge not just consumers). The strongest curricula form of this is in those special undergraduate programmes for selected students, but such research and inquiry may also be mainstreamed for all or many students.

Research- Tutored: engaging in research discussions

Here the focus is on students and staff critically discussing ongoing research in the discipline.

All four ways of engaging students with research and inquiry are valid and valuable and curricula can and should contain elements of them.

Moreover, the student participation in research may be classified as,

Level 1: Prescribed Research

Level 2: Bounded Research

Level 3: Scaffolded Research

Level 4: Self actuated Research

Level 5: Open Research

Taking into consideration the above mentioned facts in respect of integrating research into the MSc-Chemistry curriculum, the following Research Skill Based Courses are introduced in the curriculum.

Semester	RSB Courses	Credits
I	Research Led Seminar	1
II	Research Methodology	3
II	Participation in Bounded Research	2
III	Design Project/ Socio Technical Project (Scaffolded Research)	4
IV	Project Work	12

Blueprint for assessment of student's performance in Research Led Seminar Course

- **Internal Assessment:**

  40 Marks

- Seminar Report (UG)/Concept Note(PG) : 5 X 4= 20 Marks
- Seminar Review Presentation : 10 Marks
- Literature Survey : 10 Marks

- **Semester Examination :**

  60 Marks

(Essay type Questions set by the concerned resource persons)

Blueprint for assessment of student's performance in Socio Technical Project

- **Continuous Internal Assessment through Reviews:**

  40 Marks

  - Review I : 10 Marks
  - Review II : 10 Marks
  - Review III : 20 Marks

- **Evaluation of Socio Technical Practice Final Report:**

  40 Marks

- **Viva- Voce Examination:**

  20 Marks

- **Total:**

  100 Marks

Blueprint for assessment of student's performance in Research Methodology Courses

Continuous Internal Assessment:

20 Marks

- Research Tools(Lab) :
  10 Marks
- Tutorial: 10 Marks

Model Paper Writing: 40 Marks

- Abstract: 5 Marks
- Introduction:
  10 Marks
- Discussion: 10 Marks
- Review of Literature:
  5 Marks
- Presentation:
  10 Marks

Semester Examination: 40 Marks

Total:

100 Marks

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