GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF CHEMISTRY

(Effective for those admitted from 2020-2021 onwards)

SYLLABI

M.Sc., CHEMISTRY

Government Arts College (Autonomous), Kumbakonam-2

Department of Chemistry

M.Sc., Chemistry

Programme Outcomes

After successful completion of two year degree program in chemistry a student should be able to:

1. Having a clear understanding of the subject related concepts and of contemporary issues.
2. Determine molecular structure by using UV, IR and NMR.
3. Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems.
4. Having a clear understanding of professional and ethical responsibility
5. Create awareness and sense of responsibilities towards environment and apply knowledge to solve the issues related to Environmental pollution.
6. Apply knowledge to build up small scale industry for developing endogenous product.
7. Apply various aspects of chemistry in natural products isolations, pharmaceuticals, dyes, textiles, polymers, petroleum products, forensic etc. and also to develop interdisciplinary approach of the subject.

ProgrammeSpecific Outcomes

1. Apply advanced concepts of organic, analytical, physical and inorganic chemistry to solve complex problems to improve human life.
2. Design experiments, analyze, synthesize and interpret data to provide solutions to different industrial problems by working in the pure, inter and multi-disciplinary areas of chemical sciences.

3. Able to independently carry out research / investigation to solve practical problems and write / present a substantial technical report/document
4. Collaborate effectively on team-oriented projects in the field of Chemistry or other related fields
5. Inculcate logical thinking to address a problem and become result oriented with a positive attitude.
6. Apply the knowledge to develop the sustainable and eco-friendly technology in Industrial Chemistry.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS) KUMBAKONAM – 612 002
M.Sc., CHEMISTRY PROGRAMME (CHOICE BASED CREDIT SYSTEM) (2020-2021 onwards)

Semester	Course	Course Title	Hours/ Week	Credit	Exam Hours	Marks		Total
						Internal	External	
I.	Core Course-I	Organic Chemistry I (CC)	6	4	3	25	75	100
	Core Course-II	Inorganic Chemistry I(CC)	6	4	3	25	75	100
	Core Practical-I	Inorganic Chemistry Practical I (CP)	6	4	6	40	60	100
	Core Practical-II	Physical Chemistry Practical I (CP)	6	4	6	40	60	100
	Elective Course-I	Industrial & Agriculture Chemistry (EC)	6	5	3	25	75	100
		TOTAL	**30**	**21**	**-**	**-**	**-**	**500**
II.	Core Course –III	Organic Chemistry II(CC)	6	5	3	25	75	100
	Core Course –IV	Physical Chemistry I (CC)	6	5	3	25	75	100
	Core Practical-III	Inorganic Chemistry Practical II(CP)	6	4	6	40	60	100
	Core Practical-IV	Physical Chemistry Practical II(CP)	6	4	6	40	60	100
	Elective Course II	Nano Materials & Green Chemistry (EC)	6	5	3	25	75	100
		TOTAL	**30**	**23**	**-**	**-**	**-**	**500**
III.	Core Course –V	Organic Chemistry III (CC)	6	5	3	25	75	100
	Core Course –VI	Inorganic chemistry II(CC)	6	5	3	25	75	100
	Core Course –VII	Physical Chemistry II (CC)	6	5	3	25	75	100
	Core Practical-V	Organic Chemistry Practical (CP)- I	6	4	6	40	60	100
	Elective Course-III	Scientific Research & Analytical Techniques(EC)	6	5	3	25	75	100
		TOTAL	**30**	**24**	**-**	**-**	**-**	**500**
IV.	Core Course - VIII	Physical Chemistry III(CC)	6	5	3	25	75	100
	Core Practical-VI	Organic Chemistry Practical II(CP)	6	4	6	40	60	100
	Elective Course IV	Food & Medicinal Chemistry(EC)	6	4	3	25	75	100
	Elective Course V	Applications of Spectroscopy and Chemistry of Secondary Metabolites(EC)	6	5	3	25	75	100
	Project		6	4	-	25	75	100
		TOTAL	**30**	**22**	**-**	**-**	**-**	**500**
		GRAND TOTAL	**120**	**90**	**-**	**-**	**-**	**2000**

Core Course (Theory) - 08 Core Course (Practical) - 06 Elective Course (EC) - 05 Project - 01 **Total - 20**

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM

DEPARTMENT OF CHEMISTRY

SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)

M.Sc., CHEMISTRY PROGRAM

Title of the Subject: ORGANIC CHEMISTRY – I **Credits: 4**

Subject Code: **Contact Hours: 90**

Semester: I (Core Course I) **Marks: 100**

Program Purpose: The purpose of this syllabus on first semester is to provide the key knowledge of organic chemistry.

Learning Outcomes:

From **Unit I** Students will have a firm foundation in the nomenclature of organic compounds with the complex structures.

From **Unit II** Students will be able to understand the aromaticity.

From **Unit III- V** Students will be able to gain the knowledge on reaction mechanism such as addition-elimination and electrophilic substitution reactions at aromatic and aliphatic molecules.

UNIT I: Nomenclature: IUPAC nomenclature of complex organic molecules – acyclic compounds – mono, bi and tricyclic compounds – polynuclear hydrocarbons – heterocycles- five membered, six membered, five and six membered fused heterocycles – rare alkaloids such as indoloquinolines, naphthyridines and fused carbazoles. Reaction intermediate: formation, stability, detection and reactions of carbonium ions – carbanions-carbon radical – carbenes – nitrenes.

UNIT II: Aromaticity: Six membered ring - five, seven and eight membered rings - other system containing aromatic sextet - alternate and non-alternate hydrocarbons - aromatic system with electron numbers other than six - systems of two electrons. Systems of four electrons - anti aromaticity - systems of eight electrons, ten electrons and more than ten electrons: 4n+2 electrons - other aromatic compounds - meso ionic compounds, the dianion of squaric acid and homo aromatic compounds.

UNIT III: Addition and Elimination: Addition to double and triple bonds – Mechanism Hydration – Hydroboration – Hydroxylation – epoxidation. Elimination reactions E1, E2, E_1cB Mechanism – Orientation effects in elimination reactions – stereo chemistry of elimination reactions - dehydration of alcohols – dehydro halogenation – cope elimination.

UNIT IV: Aliphatic Electrophilic Substitution Reactions: Mechanisms- Bimolecular mechanisms- SE2 and SEi - SE1 mechanism-electrophilic substitution accompanied by double bond shifts-other mechanisms. Reactivity - Effect of substrate - effect of leaving group and effect of solvents.Reactions - hydrogen as a leaving group-migration of double bonds - ketoenoltautomerism. Halogen electrophiles - halogenation of aldehydes and ketones, halogenation of carboxylic acids and acyl halides- halogenation of sulfoxides and sulfones- nitrogen electrophiles-sulfur electrophiles- carbon electrophiles- Stork enamine reaction.

UNIT V: Aromatic electrophilic substitution Reactions: Mechanisms- arenium ion mechanism-effects on arenium ion mechanism including isotope effect – isolation of arenium ion intermediate - SE1 mechanism. Orientation and reactivity - orientation and reactivity in mono substituted benzene rings – ortho para ratio - ipso attack – orientation in benzene ring with more than one substituent – orientation in other ring systems-quantitative treatments of reactivity in the substrate – the effect leaving group -mechanism of following reactions - nitration – sulphonation – halogenation - Friedel Crafts reaction – Scholl reaction – Blanc reaction-Gattermann Koch reaction - HoubenHoesch synthesis – Vilsmeier Haack reaction- Gattermann reaction-Reimer-Tiemann reaction- Kolbe Schmitt reaction.

References:

1. Advanced Organic Chemistry; Reactions, Mechanisms and Structure -Jerry March.
2. Reaction Mechanism in Organic Chemistry - S. M. Mukherji and S. P. Singh.
3. Advanced Organic Chemistry; Part A – Structure and Mechanisms, -Carey and Sundberg.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: INORGANIC CHEMISTRY – I **Credits: 4**
Subject Code: **Contact Hours: 90**
Semester: I (Core Course II) **Marks: 100**

Course outcome:

- To understand the properties of solids and its applications
- To study the various concept of acid and bases and to know the chemistry of non-aqueous solvents
- To learn the several inorganic polymer and their applications
- To understand the radioactivity of elements and their chemical reactions
- To get the knowledge about bio-inorganic materials and their applications to human system

UNIT I: Crystal defects and Properties of Solids

Defects-Stoichiometric – point, line, layer and vacancies- Non stoichiometric-metal excess and metal deficiencies. Electrical properties- band theory, VB and MO theory, conductor, insulator, semiconductor-compound semiconductor and its type II-VI, III-V & IV-VI group elements, superconductor-types, BCS theory, High Tc, Magnetic properties- para, dia, ferro, antiferro and ferri magnetism, hysteresis-soft and hard magnetic materials and its applications. Pyro, ferro, piezo and thermoelectric properties.

UNIT II: Acid-Base and Non-aqueous Solvents

Usanovich concept of acid and base – steric and salvation effects – measure of acid – base strength –Limiting acid and base. Hard and Soft Acids and Bases (HSAB concept) – theoretical basis for hardness and softness-Super acids.. Non-aqueous solvents: Leveling effect and differentiating solvents-Protic solvent-H_2SO_4, HF, aprotic solvent- N_2O_4 and BrF_3 – acid-base oxidation – reduction – hydrolysis.

UNIT III: Inorganic Polymers

Inorganic polymers – classification-general properties-polymers containing boron- boroxine-Boron nitride, boroncarbide. Preparations-properties-uses of polysilanes, polysilazane and polycarbosilane. Polymers containing phosphorus-Types-poly phosphonitrilic chloride-poly orthophosphoric acids-polymeric compounds of sulphur - Trithiazyltrichloride, Silicon carbide, silicon nitride preparation, properties an application.

UNIT IV: Nuclear Chemistry

Radioactivity-type- detection and measurement by GM counter. Isotopes-Identification by Aston and Dempster's mass spectroscopy-separation of isotopes-thermal diffusion methods-fraction evaporation method. Nuclear reactions-Transmutation reaction, capture reaction, fission reaction, spallation reaction. Fast breeder reactor-Nuclear structure-liquid drop model and shell model. Detection and determination of activity by cloud chamber, bubble chamber and scintillation counter. Particle accelerators- linear accelerator, cyclotron and betatron. Uses of radioisotopes in analytical chemistry and medicinal chemistry.

UNIT V: Bioinorganic Chemistry

Metal ions in biology- Mechanism of ion transport across membranes-Sodium and potassium pump, Photosynthesis -PSI, PSII, Porphyrins, Metalloenzymes-Carbonic anhydrase and Carboxypeptidase, Oxygen transport, Iron-sulphur proteins-rubredoxin, ferriedoxin, nitrogen fixation, metal complexes in medicine- anti cancer activity of Pt, Au and Ru.

References:

1. Advanced Inorganic Chemistry: A Comprehensive Text, F.A. Cotton & G. Wilkinson.
2. New concise Inorganic chemistry, J. D. Lee, Van Nostrand – Reinhold, New York, 1964
3. Inorganic chemistry, K. F. Purcell & J. C. Kotz, Saunders, Philadelphia, 1977
4. Inorganic chemistry: Principles of structure and reactivity, J. E. Huheey.
5. Source Book on Atomic Energy, Samuel Glasstone, D. Van Nostrand – Reinhold
6. Essentials of nuclear chemistry, H.J.Arnikar, Wiley Eastern Ltd., 1987
7. Nuclear and radiochemistry, G.Friedlander, J.W.Kennedy, E.S.Macias and J.M.Miller, Wiley – Interscience.
8. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life W. Kaim and B. Schewederski, , John Wiley & Sons, New York, USA.
9. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, , Panima Publishing Company, New Delhi, 1997.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: INORGANIC CHEMISTRY PRACTICAL – I **Credits: 4**
Subject Code: **Contact Hours:**
Semester: I (CORE PRACTICAL-I)

Marks: 60+40=100

Course Outcome:

To understand the identification of common and less common cations in inorganic mixture
To know about the concentration of the coloured solutions.

Semi-micro qualitative analysis

Analysis of a mixture contains four basic radicals of which two common and two rare earths.

Common Basic radicals

Lead, Copper, Cadmium, Bismuth, Aluminium, Iron, Zinc, Nickel, Calcium, Magnesium and Barium

Rare-earths

Tellurium, Cerium, Selenium, Tungsten, Molybdenum, Thorium, Zirconium, Vanadium and Lithium

Calorimetric Estimations

1. Estimation of Nickel

2. Estimation of Copper

3. Estimation of Iron

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: PHYSICAL CHEMISTRY PRACTICAL – I Credits: 4
Subject Code: **Contact Hours:**
Semester: I (Core Practical-II) **Marks: 60 + 40 = 100**

Course Outcomes: Students learn various experiments in couductometry and potentiometry. The list of experiments are provided from which suitable experiments can be selected as convenient.

Electrical Experiments

Conductometric Titrations

1. Determination of strength of strong acid (Strong acid Vs Strong base)
2. Determination of strength of weak acid (Weak acid Vs Strong base)
3. Determination of strength of weak acid (Weak acid Vs Weak base)
4. Determination of strength of Mixture of acids (Strong acid + Weak acid Vs Strong base)
5. Verification of Ostwald's dilution law
6. Verification of Onsager's equation

Potentiometric Titrations

7. Determination of strength of strong acid (Strong acid Vs Strong base)
8. Determination of strength of weak acid (Weak acid Vs Strong base)
9. Determination of strength of Mixture of acids (Strong acid + Weak acid Vs Strong base)
10. Determination of single electrode potential
11. Determination of pH of the buffer using Quinhydrone electrode
12. Determination of pKa of weak acid using Std.NaOH solution
13. Determination of strength of FAS using Redox titration (FAS Vs $KMnO_4$)

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: INDUSTRIAL & AGRICULTURE CHEMISTRY Credits: 5
Subject Code: …… Contact Hours: 90
Semester: I (Elective Course I) Marks: 100

Course outcome

1. To impart the students about the basics of industrial and agricultural chemistry
2. To describe the students about various methods of preparation of paints, polymers and fertilizers

Unit I: Fuels: Introduction – classification of fuels – calorific value – characteristics of an ideal fuel.Solid fuel: classification of coal –proximate and ultimate analysis– carbonization of coal.Liquid fuel: crude petroleum – cracking – types –properties – knocking – octane and cetane numbers – anti-knocking – flash point – smoke point – production of synthetic petrol – Fischer-Tropsch method, Bergius method. Fuel gases:Manufacture and industrial applications of coal gas, producer gas, water gas, semi-water gas and LPG.

UnitII: Paints– constituents – manufacture – requirements – emulsion paint – varnishes. Pigments-classification –Examples.Dyes –classification based on structure and application – azo dyes – xanthene dyes.Paper and pulp – manufacture of pulp – mechanical, chemical and semi chemical methods –Production and types of paper.Soaps – classification, manufacture – cleaning action of soap – detergents – principal groups of synthetic detergents –comparison of soaps and detergents.

UnitIII:Basic Concepts of polymer science: Classification of polymers – Types of polymerization techniques. Polymer degradation -Types of degradation –Polymer reactions- Hydrolysis, hydrogenation, addition and substitution reactions –cross-linking reactions.Experimental methods: Polymer synthesis, isolation and purification of polymers – fractionation Fiber science:Natural fibers – cotton, wool, silk – general characteristics – synthetic fibers – poly amide fiber – Nylon 66– preparation, properties.

Unit IV: Soil chemistry: Chemical composition of soil – mineral and organic constituents –properties – adsorption and desorption – soil reactions.Soil Physics: Physical composition of soil – Soil air, Soil temperature, Soil water, Soil moisture contents.Soil fertility: Concept of nutrient availability – soil fertility evaluation – principles and methods of soil test crop response studies.Fertilizer recommendations.Nutrition requirements: Characteristics of essential element – role of essential elements in plant nutrition – nutrient deficiency symptoms– secondary nutrients and micro nutrients-their function in plants.

UnitV: Chemistry of Fertilizers: Requirements of good fertilizer – classification.Fertilizers: Effect of nitrogen, potassium and phosphorous on plant growth - manufacture and composition of urea, triple super phosphate, complex fertilizers, mixed fertilizers and biofertilizers.Pesticides: classification – general methods of preparation and applications – toxicity – safety measures.Insecticides: Insecticides: Nicotine, pyrithrin, borates, DDT and BHC.Fungicides: Bordeaux mixture – MCO.Herbicides:MCPA, MCPB and MCPP.

References:

1. Industrial Chemistry, B. K. Sharma.
2. B.N.Chakrabarthy, Industrial Chemistry, Oxford and IBH, New Delhi, 1981
3. Polymer Science, V.R. Gowariker et al., Wiley Eastern, 1986.
4. Fundamentals of Polymer Science and Engineering, Kumar Gupta, Tata McGraw Hill, 1981.
5. Textbook of Soil Science T.D. Biswas, S.K. Mukherjee, Tata McGraw Hill (1994).
6. Agricultural Chemistry, Vols. 1 and 2, Edited by Yagodin, Mir Publishers, Mascow.
7. Fundamentals of Soil Science C.E.Millar, L.M.Turk, H.D.Foth, John Wiley and Sons, (1965).
8. Soil Fertility in India, R.R.Ararwal, Asia Publishing Hosue. (1967)
9. Soil Physics L.D.Baver, Asia Publishing Hosue. (1960).

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: ORGANIC CHEMISTRY – II **Credits: 5**
Subject Code: **Contact Hours: 90**
Semester: II (Core Course III) **Marks: 100**

Program Purpose: The purpose of this syllabus on second semester is to extend the knowledge on reaction mechanism.

Learning Outcomes:

From **Unit I-III** Students will be able to gain the knowledge on reaction mechanism such as nucleophilic substitution reactions at aromatic and aliphatic molecules and oxidation and reduction.

From **Unit IV** Students will be able to understand the structural phenomenas like conformational and configurational analysis.

From **Unit V** Students will able to apply the reaction mechanism studied earlier to construct the heteroannular molecules which are backbone of drug discovery.

UNIT I: Aliphatic nucleophilic substitution reactions:

Mechanisms - the SN2 mechanism - the SN1 mechanism – ion pairs in the SN1 mechanism – mixed SN1 and SN2 mechanisms – SET mechanisms – the neighboring- group mechanism – neighboring –group participation by σ and π bonds – the SNi mechanism – nucleophilic substitution at an allylic carbon – nucleophilic substitution at an aliphatic trigonal carbon – nucleophilic substitution at a vinylic carbon. Reactivity- the effect of substrate structure – the effect of the attacking nucleophile – the effect of the leaving group – the effect of the reacting medium – ambident nucleophiles – ambident substrates.

UNIT II: Aromatic nucleophilic substitution Reactions:

SNAr mechanisms SN^1 mechanism-benzyne mechanism, - SRN1 mechanism- other mechanism. Reactivity – the effect of substrate structure, the effect of the leaving group and the effect of attacking nucleophile. Nitrogen nucleophiles – amino dehalogenation - Goldberg reaction.Halogen nucleophiles- halo-de-halogenation. Amino de hydroxylation - Bucherer reaction- -Von Braun reaction—the Hurtley reaction - Hydrogen as leaving group – Zeigler alkylation – Chichibabin reaction - Schiemann reaction – the Von-Richter rearrangement.

UNIT III: Oxidation and reduction:

Direct electron transfer, hydride transfer, hydrogen atom transfer, formation of ester intermediates, displacement mechanisms and addition-elimination mechanisms. Oppenauer oxidation, with *N*-Bromosuccinamide or related compounds- - ozonolysis – oxidative cleavage of double bonds and aromatic rings – Lemieux-von Rudloff reagent- oxidation of aromatic side chains – oxidative cleavage of alkyl groups from rings – Dakin reaction- Baeyer-Villiger reaction – oxidative decarboxylation – bisdecarboxylation – oxidation of methylene to carbonyl – oxidation of arylmethanes. Catalytic reduction – electrochemical reduction at low overvoltage at high overvoltage electrode – photochemical reduction – reduction by hydrazines – homogeneous hydrogenation – reduction by metal hydrides and alkoxides – disproportionation – reduction by dissolving metals

UNIT IV: Stereo chemistry:

Stereoisomerism.- Conformational analysis in acyclic and simple cyclic systems - substituted ethanes, cyclohexane, cyclooctane and decalins, optical isomerism - optical activity - molecular dissymmetry Chirality of organic molecules with or without chiral centres. Specification of configuration in compounds having one or more stereogenetic centres. Enatiotopic and diastereotopic atoms, and faces. Stereoselective and stereospecific synthesis. Fischer's projection, D, L and R, S configurations - relative and absolute configurations optical isomerism due to asymmetric carbon atoms - optical isomerism in biphenyls, allenes and spirans, cycloalkenes - optical isomerism of nitrogenous compounds racemisation and resolution - geometrical isomerism and E, Z configurations, properties of geometrical isomers- stereochemistry of nitrogen compounds – syn and anti isomers.

UNIT V: Synthesis of heteroannular heterocyclic rings

Synthesis of Indole: Fischer indole synthesis – Bischler indole synthesis – Hemetsberger indole synthesis – Nenitzescu indole synthesis – Bartoli indole synthesis. Synthesis of Quinoline: Skraup synthesis, Knorr synthesis, Friedlender synthesis, Combes synthesis, Conrad-Limpach synthesis, Doebner reaction.

References:

1. Advanced Organic Chemistry; Reactions, Mechanisms and Structure -Jerry March.
2. Reaction Mechanism in Organic Chemistry - S. M. Mukherji and S. P. Singh.
3. Advanced Organic Chemistry; Part A – Structure and Mechanisms - Carey and Sundberg.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: PHYSICAL CHEMISTRY I **Credits: 5**
Subject Code: **Contact Hours: 90**
Semester: II (Core Course IV) **Marks: 100**

Course Outcomes:

- **To study the basic concepts of quantum chemistry**
- **To know and to study the basic concepts of group theory**
- **To give the concepts and ideas of electrochemistry**
- **To understand the fundamental of Kinetics**
- **To study the surface reactions solids**

Unit I: Introduction to Quantum Chemistry

Classical Quantum Theory - Quantum Theory of radiation- photoelectric effect- Bohr's quantum Theory - Heisenberg Uncertainty principle- Compton Effect-Quantum mechanics-Postulates of quantum mechanics - functions -operators - Linear and Hermitian operators- eigen value- eigen function- solving eigen values by secular equations and similarity transformation methods – The Schrodinger wave equation- application of Schrodinger wave equation - Particle in a box (one and three dimensional systems).

Unit II: Group theory

Group Theory: Principles of group theory – properties of a group, sub-group and classes – Abelian, cyclic and non-abelian groups – Multiplication tables – Symmetry elements – Point groups – Matrix representations of operations – Reducible and irreducible representations – Orthogonality theorem – construction of character table for C_2V and C_3V point groups.

Unit III: Electrochemistry I

Arrhenius theory of electrolytic dissociation, revision of basic electrochemistry (Types of electrodes and cells). Electrochemical cells with and without transference, determination of activity coefficients of an electrolyte, degree of dissociation, instability constant of silver ammonia complex. Mean ionic activity - ideal and non-ideal solutions; excess functions; Hydration number; Debye - Huckel theory of inter-ionic attraction , Debye-Huckel treatment of dilute electrolyte solutions; Debye-Huckel limiting law- Debye-Huckel-Onsager equation and its validity for dilute and concentrated solutions.

Unit IV: Chemical Kinetics

Theories of reaction rates: Simple Collision Theory, Absolute Reaction Rate Theory – applications to bimolecular and termolecular reactions. Theory of unimolecular reactions – Lindeman's theory, Hinshelwood theory. Primary and secondary kinetic isotope effects – steady state approximation – chain reactions – thermal and photochemical reactions between hydrogen and halogens – H_2-O_2 reaction – Rice-Herzfeld mechanisms. Fast reactions- study of kinetics by stopped flow technique, relaxation method, flash photolysis and magnetic resonance method. Solution kinetics –Hammett and Taft equations.

UNIT V: Surface Chemistry

Surface Chemistry: Introduction – Adsorption of gases on solids – Derivation of BET adsorption isotherm – Study of surfaces – surface area determination (calculation needed) – surface films – Heats of adsorption – free energy relationship at interfaces – Adsorption from solution – Derivation of Gibb's Adsorption Isotherm – study of kinetics of surface reactions – Langmuir-Hinshelwood mechanism, Langmuir Rideal mechanism; derivation of Unimolecular and Bimolecular surface reactions – Heterogenous catalysis – The role of surface in catalysis.

References

1. Introductory quantum chemistry, A.K.Chandra, Tata-McGraw Hill.
2. Quantum chemistry, R.K.Prasad, Wiley Eastern Ltd.
3. Molecular quantum mechanics, P.W.Atkins, Clarenden.
4. Chemical applications of group theory, F.A.Cotton, Wiley eastern.
5. Group theory and its applications in chemistry, K.V.Raman, Tata-McGraw Hill.
6. An Introduction to Electrochemistry by S. Glasstone.
7. Physical chemistry, P.W.Atkins, ELBS.
8. Thermodynamics for students of chemistry, J.Rajaram & J.C.Kuriacose, Shobhen Lal NaginChand.
9. Thermodynamics for chemists, S.Glasstone, Affiliated East-West Press.
10. Chemical Kinetics, K.J.Laidler, Tata-McGraw Hill.

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: INORGANIC CHEMISTRY PRACTICAL – II **Credits: 4**
Subject Code: **Contact Hours:**
Semester: II (CORE PRACTICAL-III) **Marks: 60+40=100**
Course Outcome:

To estimate the amount of inorganic ions present in the whole of the given solution.
To enrich to the knowledge in inorganic preparation

Gravimetric & Volumetric analysis

1. Estimation of Copper Volumetrically & Barium Gravimetrically

2. Estimation of Copper Volumetrically & Nickel Gravimetrically

3. Estimation of Calcium Volumetrically & Magnesium Gravimetrically

4. Estimation of Copper Volumetrically & Zinc Gravimetrically

Preparations

Preparation of simple complexes

1. Hexathiourea plumbus nitrate

2. Potassium tri oxalate chromate [III]

3. Thiourea copper(I) sulphate

4. Tetrammine copper(II) sulphate

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: PHYSICAL CHEMISTRY PRACTICAL - II **Credits: 4**
Subject Code: **Contact Hours: 06**
Semester: II (Core Practical-IV) **Marks: 60 + 40 = 100**

Course Outcomes: Students learn the experiments in thermodynamics, colligative properties, phase rule, surface phenomenon, chemical equilibrium and chemical kinetics. List of experiments is provided from which suitable experiments can be selected as convenient.

Non-Electrical Experiments

1. Comparison of relative strength of two acids from hydrolysis of an ester
2. Determination of energy of activation for first order kinetics
3. Determine rate of the reaction between potassium per sulphate Vs potassium iodide (2^{nd} order kinetics)
4. Primary salt effect on 2^{nd} order kinetics
5. Determination of molecular weight by transition temperature method
6. Determine the CST of phenol – water system and study the effect of impurity
7. Verification of Freundlich adsorption isotherm
8. Study the effect of ionic strength on the rate of saponification of an ester
9. Determine the molecular weight of benzoic acid in benzene and find the degree of association
10. Construct the phase diagram – simple eutectic system
11. Determination of partition coefficient of iodine
12. The study of equilibrium reaction between potassium iodide and iodine

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: NANO MATERIALS & GREEN CHEMISTRY Credits: 5
Subject Code: …… **Contact Hours: 90**
Semester: II (Elective Course II) **Marks: 100**

Course outcome
To introduce the students about Nanochemistry and nanomaterials synthesis
To teach the importance of characterization & applications of nanomaterials
To teach the importance of Green Chemistry

UNIT-I: Chemistry of Materials
Synthesis of solid state materials using different techniques - ceramic techniques, co-precipitation techniques, sol gel techniques, precursor techniques, high temperature & high pressure synthesis.Purification and crystal growth: zone refining, growth from solution - preparation of semiconductors and applications. Oxide Films - Growth of oxide films, structure and physical properties; thin films-various stages of film growth, defects during growth, surface area and roughness; techniques of film growth.

UNIT-II: Introduction to Nanotechnology
Basic nanotechnology science and chemistry concepts, nanoparticles- Size effects on Structure and Morphology;Synthesis of Nanomaterials and Nanoparticles - Top–down approach (physical vapor deposition, chemical vapor deposition) – bottom–up approach (sol–gel, co–precipitation,and hydrothermal methods) – growthmechanism (vapor– liquid–solid, solid–liquid–solid).Nanoporous Materials,nanocrystals, quantum dot,catalysts - Metal nanoparticles- Synthesis of Metal oxide nanoparticle;Study of nucleation.

UNIT-III: Properties & Applications of Nanotechnology
Physical and Chemical and Propertieson the Nanoscale, some properties of nanomaterials like Magnetism, Electronic Structure in Clusters, Optical Properties, Mechanical, Super plasticity Chemistry; Techniques for Nanoparticle Characterization (TEM, SEM, and AFM). Application as sensors, biomedical applications, application in optics and electronicsand electromagnetism - nanoparticles in polymers - Nanocatalysis (transition metal nanoparticles in catalysis, aerogel supported nanoparticle incatalysis, multi metallic nanoparticles in catalysis).

UNIT-IV: Basic Principles of Green Chemistry
The need for green chemistry -Twelve principles of green chemistry, environmental protection laws, pollution control and pollution prevention – Prevention of waste by products, maximum incorporation of the reactants into the final product, prevention or minimization of hazardous products, recycling of waste. Solvent Free Organic Synthesis:Reactions on solid supports, phase transfer catalysis, reactions without support or catalyst.Green Catalyst: -Acid catalyst, oxidation catalyst and basic catalyst.

UNIT-V: Green Synthesis & Applications
Designing Green Synthesis – choice of starting materials, choice of reagents, choice of catalysts – bio catalysts, polymer supported catalysts, choice of solvents. Synthesis involving basicprinciples of green chemistry – Examples – synthesis of adipic acid, synthesis of catechol, synthesis of methyl methacrylate, paracetamol.Microwave assisted reactions in water – oxidation of toluene to benzoic acid. Ultrasound assisted reactions – esterification, alkylation, oxidation, reductionreactions. Green chemistry in day to day life.

RECOMMENDED BOOKS

1. Solid State Chemistry by D. K. Chakrabarty.
2. Material Science and Engineering, V. Raghavan.
3. J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
4. A.R. West, Plenum, Solid State Chemistry and its applications
5. R. Raghwan, First Course in Material Science
6. Kenneth. Klabunde, Nanoscale Materials in Chemistry, John Wiley & Sons, Inc. 2002
7. RashmiSanghi, M. M. Srivastava, Green Chemistry, Environment Friendly Alternatives, Narosa Publishing House, 2007
8. V. Kumar, An Introduction to Green Chemistry, Vishal Publishing CO. Jalandhar, 2007

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: ORGANIC CHEMISTRY – III **Credits: 5**

Subject Code: **Contact Hours: 90**

Semester: III (Core Course V) **Marks: 100**

Program Purpose: The purpose of this syllabus on third semester is to enrich the knowledge on secondary metabolites and the importance of unconventional energy source on organic synthesis.

Learning Outcomes:

From **Unit I-III** Students will be able to understand the different orientation on organic mechanism such as molecular rearrangement and pericyclic reaction.

From **Unit IV-V** Students will be able to understand the importance and total synthesis of secondary metabolites like alkaloids, terpenoids, coumarins, flavones and flavanoids and in addition with biopolymers.

UNIT I: Molecular Rearrangements: Wagner Meerwin Rearrangement- Demyanovrearrangment - Hoffmann rearrangement - Curtius rearrangement - Losson- Schmidt reaction- Willgerodt Kindler rearrangement - Stevens – quinone-quinol rearrangement- Favorski rearrangement- Wallasch synthesis- Calisen rearrangement- Beckmaan rearrangement – Wolff rearrangement. Fries rearrangement - Baeyer Villiger rearrangement – Von-Richter rearrangement - Sommelet Hauser - Arndt-Eistert synthesis - Neber rearrangement Wittig reaction- Orton rearrangement - Sommelet - Hauser rearrangement– Bamberger rearrangement - the smiles rearrangement.

UNIT II: Organic photochemistry: Photochemistry of carbonyl compounds – Norrish type – I and II reactions (application oriented)- photo chemical reactions of cyclic ketones – Barton reaction,Paterno – Buchi reaction - photo chemistry of nsaturated ketones- photo chemistry of olefins- cis – trans isomerisation – dimerization reaction – photo chemistry of butadiene- Zimmermann reaction- photo chemistry of santonin

UNIT III: Pericyclic reactions : Conservation of molecular orbital theory – symmetry properties of molecular orbital's – electrocyclic reactions – correlation diagram and FMO method – cyclo addition reactions – correlation diagram and FMO method- sigmatropic rearrangements- FMO method – applications of PMO methods to pericyclic reactions.

UNIT IV: Organic synthesis: Synthesis, reactions, mechanisms and selectivity involving the following – alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines- use of compounds of Mg, Li, Cu B and Si in organic synthesis- concepts in multistep synthesis – retro synthetic analysis - disconnections ethyl-indole-3-butyrate, ethylcinnamate – furo-maleate adduct. Synthetic equivalent, synthons - unpoloung – selectivity – protection and deprotection of functional groups

UNIT V: Chemistry of Natural Products and Biopolymers

Steroids - structural elucidation and bio-synthesis of oesterone and progesterone. Vitamins -structural elucidation and bio synthesis of vitamin A and C.

Structure and functions of biopolymer such as proteins - primary, secondary and tertiary structures of proteins – enzymes classification - mechanism of enzyme action – structure of DNA and RNA.

References:

1. Advanced Organic Chemistry; Reactions, Mechanisms and Structure -Jerry March.
2. Reaction Mechanism in Organic Chemistry - S. M. Mukherji and S. P. Singh.
3. Advanced Organic Chemistry; Part A – Structure and Mechanisms, -Carey and Sundberg.
4. Organic Reactions and their mechanisms – P. S. Kalsi.
5. A guide book to mechanism in organic chemistry – Peter Sykes.
6. Organic Chemistry, Volume I- I. L. Finar
7. Organic Chemistry, Volume II- I. L. Finar

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: INORGANIC CHEMISTRY – II **Credits: 5**
Subject Code: **Contact Hours: 90**
Semester: III (Core Course VI) **Marks: 100**

Course outcome:

- To acquire knowledge about theories of coordination compounds
- To understand the spectroscopic evidence for inorganic complexes
- To study the reactions in inorganic complexes and their synthesis
- To develop knowledge about crystal structure and their determination by various methods

UNIT I: Theories of Coordination Compounds

Crystal Field Theory (CFT) – splitting of d- orbitals under various geometries (octahedral, tetrahedral, tetragonal and square-planar) – factors affecting the splitting – crystal field stabilization energy calculation – Consequences of CFS – ionic radii of transition elements, heats of hydration, lattice energy- limitation – ACFT or LFT – Molecular Orbital Theory (MOT) - π bonding. John-Teller distortion

UNIT II: Stability and Electronic Spectra of Complexes

Stability of complexes: Stepwise stability constant and overall stability constant – factors affecting the stability of complexes –determination of stability constant by Job's variation method and polarographic method. Electronic spectra: Term symbols for d^1 to d^9 ions – characteristics of d-d transition – energy level diagram – Orgal and Tanabe-Sugano diagrams – charge transfer spectra ORD – Cotton effect – Circular Dichroism – nephlauxetic effect – ESR and Maussbauer spectra.

UNIT III: Reactions of Complexes

Substitution reactions: Labile and inert complexes – ligand displacement reactions. S_N1, S_N2 & S_N1CB mechanisms – substitution in square-planar complexes – Marcus Hush principle-trans effect – theories of trans effect - Electron transfer reactions: Inner sphere and outer sphere mechanisms-two electron transfer reactions & non complementary electron transfer reaction – isomerization and isomerization reactions. Photochemical reactions of complexes – photosubstitution, photoreduction and photosensitization.

UNIT IV: Complexes of Acceptor Ligand

Carbonyls (mono and polynuclear): EAN rule- Preparation and uses of metal carbonyl- nature of bonding in metal carbonyls. Nitrosyls – linear, bent and bridging – carbonyl nitrosyls – metal carbonyl halides (reparation and structure of Fe compounds). Organometallics and complexes of biological importance: 18 electron rule and Organometallic complexes- Olefinic and acetylinic complexes – arene complexes – catalysis by organometallics –Wilkinson's catalyst, Wacker process, oxo process, Ziegler-Natta catalyst, Fischer Tropsch's synthesis and Reppe's catalysis.

UNIT V: Crystal geometry and structure determination

Crystal geometry – packing factor, coordination number, Miller indices- Reciprocal lattice and its applications: Radius ratio -structures of ZnS, Fluorite, Wurtzite, NiAs, CdI_2, rutile, perovskite and spinel and inverse spinel. Determination of crystal structure by powder X-ray diffraction and Rotating crystal method – interpretation and results. Neutron diffraction: An elementary treatment – application and comparison with X-ray diffraction. Electron diffraction: Basic principles and applications.

References:

1. Concept and models of Inorganic chemistry, B. E. Douglas, D.H. Mc Dani Waltham, Mass, 1965.
2. Introduction to Advanced Inorganic Chemistry, P.J. Durrant & B Durrant, Wiley.
3. Modern aspects of Inorganic Chemistry, 3/e, H.J. Emeleus, J.S.Anderson, Van Nostrand-Reinhold, New York, 1962.
4. Inorganic reactions and structure, E.S.Gould, Holt, Rinehart & Winston, New York, 1962.
5. Advanced Inorganic Chemistry: A comprehensive Text, 3/e, F.A. Cotton & G Wilkinson.
6. New concise Inorganic Chemistry, 2/e, J. D. Lee, Van Nostrand-Reinhold.
7. Inorganic Chemistry, K. F. Purcell & J. C. Kotz, Saunders, Philandelphia, 1977.
8. The Principles of inorganic Chemistry, W. L. Jolly, McGraw-Hill, New York, 1976.
9. Inorganic Chemistry: Principles of structure and reactivity, J.E. Huheey.
10. Basic Solid State Chemistry, A. R. West, John Wiley and Sons Ltd, 1999.

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: PHYSICAL CHEMISTRY II **Credits: 5**
Subject Code: **Contact Hours: 90**
Semester: III (Core Course VII) **Marks: 100**
Course Outcomes:

- **To study the applications of quantum chemistry**
- **To know and to study the applications of group theory in spectroscopic aspects**
- **To give the concepts and ideas of electrochemistry**
- **To understand the fundamental of catalysis**
- **To study the significance of various spectroscopic techniques**

Unit I: Applications of Quantum Chemistry

Concept of Orthogonalization and normalization- Concept of angular momentum operators- Ladder operators, the orbital and spin angular operators. Applications of Schrodinger wave equation for multi-electron atom - Variation and Perturbation methods– application of variation method to hydrogen molecule and application of perturbation method to helium atom. Molecular Quantum mechanics - Valence bond theory for hydrogen molecule – Molecular Orbital theory for di- and polyatomic molecules.Born - Oppenheimer approximation

Unit II: Applications of group theory

Direct product representation – Application of group theory in forming the selection rules for IR and Raman spectra. Determinations of representations of vibrational modes in non-linear molecules (NH_3, H_2O, trans N_2F_2) – electronic spectra of ethylene and formaldehyde. Applications to bonding theory – Application of group theory in σ and π bond. Group theory orientations of ligand field theory – construction of energy level diagrams – hybrid orbitals in non-linear molecules (CH_4, BCl_3).

Unit III: Electrochemistry II

Zeta potential - Polarization- types - over voltage - hydrogen and oxygen over voltage - Butler-Volmer equation - Tafel equation. Electrolysis - Decomposition potentials - calculations and determinations. Fuel cells – Batteries - primary and secondary fuel cells - significance of fuel cells- hydrogen - oxygen, hydrocarbon - air, natural gas and carbon monoxide, air fuel cells. Corrosion: concept and importance, mechanism of corrosion and Pourbaix diagrams - Evan's diagram – electrodeposition.

Unit IV: Fundamentals of Catalysis

Concepts – classifications, mechanism and applications. Super acid catalysis –sulphates, metal oxides. Enzyme catalysis - kinetics of enzyme catalysis, Neutral salt catalysis-primary salt effect – Bronsted-Bjerrum equation-secondary salt effect - Acid-base catalysis – catalysis by transition metal ions and their complexes – supported transition metal complexes as catalysts – catalysis by enzymes – phase transfer catalysis - photocatalysis – adsorption – chemisorption on metals, metal oxides and semiconductors. Catalyst deactivation and regeneration

Unit V: Spectroscopy

Microwave spectroscopy: Microwave spectroscopy: Introduction – The rotation of molecules – Rotational spectra – The rigid diatomic molecule(derivation), Selection rule – The effect of isotopic substitution – The stark effects – Applications.
IR Spectroscopy: Introduction – The simple harmonic oscillator, The an harmonic oscillator – The diatomic vibrating rotator.
Raman spectroscopy: Raman effect – theory – pure rotational Raman spectra – vibrational Raman spectra – comparison of IR and Raman spectra – laser Raman spectroscopy – techniques and instrumentations (Principles only). Structural determinations of simple molecules.
Electronic spectroscopy: Vibrational Coarse structure – Frank-Condon principle – dissociation energy and dissociation products rotational fine structure of electronic vibrational transitions – The Fortrat diagram – pre-dissociation.

References

1. 1.Chemical applications of group theory, F.A.Cotton, Wiley eastern.
2. Group theory and its applications in chemistry, K.V.Raman, Tata-McGraw Hill.
3. An Introduction to Electrochemistry by S. Glasstone.
4. Electrolytic Solutions by R. A. Robinson and R. H. Strokes.
5. Physical chemistry, P.W.Atkins, ELBS.
6. Chemical thermodynamics, T.M.Koltz, Benjamin.
7. Chemical Kinetics, K.J.Laidler, Tata-McGraw Hill.
8. Introduction to molecular spectroscopy, G.M.Barrow, McGraw Hill.
9. Molecular spectroscopy, C.N.Banwell, McGraw Hill.
10. Basic principles of spectroscopy, R.Chang, McGraw Hill.

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: ORGANIC CHEMISTRY PRACTICAL – I **Credits: 4**
Subject Code: **Contact Hours: 90**
Semester: III (**Core Practical-V**) **Marks: 60+40=100**

Organic Chemistry Practical-I

Course outcome:

- To prepare organic compounds with green chemistry approach
- To check the purity of organic compound experimentally
- To understand the mechanism and procedure to prepare simple organic compound
- To get knowledge about the characteristic of organic compound

I. Separation and Analysis of organic mixture of two substances.

1. Glucose + Phenol
2. Urea + Tertiary amine
3. Benzoic acid + Nitrobenzene
4. Phenol + Ethyl salicylate
5. Aniline +Acetophenonel
6. Resorcinol + Benzaldehyde
7. Cinnamic acid + Nitrobenzene
8. Tertiary amine + Acetophenone
9. Phthalic acid + Benzaldehyde
10. Aniline + Methyl salicylate

II. Single stage preparation of organic compounds with green chemistry approach – purification and recrystallization.

1. Preparation of Dibenzalacetone from Benzaldehyde.
2. Preparation of 5-nitro salicyclic acid.
3. Preparation of S-Benzyl isothio uranium chloride.
4. Preparation of Glucosazone from Glucose.
5. Preparation of Salicylic acid from Methyl salicylate.

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: SCIENTIFIC RESEARCH & ANALYTICAL TECHNIQUES
Credits: 5
Subject Code: ….. **Contact Hours: 90**
Semester: III (Elective Course III) **Marks: 100**

Course outcome
To train the basics of scientific research: literature survey, data collection and evaluation.
To explain the students about chromatographic methods nephelometry and turbidimetry

UNIT-I: INTRODUCTION OF RESEARCH
Nature and importance of research - aims, objective, motivations in research, significance of research, research methods v/s methodology, criteria of good research, selection of research problem, Sources - primary and secondary sources -Survey of scientific literature – primary and secondary sources – current literature methods – identification and selection of research problems – experimental design – writing scientific papers -citation index for scientific papers and journals – writing of thesis-preparation of tables and figures – referencing.

UNIT-II: RESEARCH SPECIALIZATION
Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure. Separation of non-metals and metals -Ion Exchange separation: Theories of ion exchange, separation of halides and Rare earths.

UNIT-III: EVALUATION OF ANALYTICAL DATA
Definition of Terms – Mean Median, Precision, accuracy - Reliability - Errors in chemical analysis, determinate and random errors - distribution of random errors - Average deviation and standard deviation, variance and confidence limit- Least square method. Methods of sampling: samples size - Techniques of sampling of gases, fluid,solids, and particulates.
Statistical treatment of finite samples - the students test and F test - Criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

UNIT-IV:CHROMATOGRAPHIC & THERMAL METHOD OF ANALYSIS
General principle, classification of chromatographic methods - Thin layer chromatography: coating of materials, preparative TLC. Solvents used and methods of detection Column chromatography: Nature of column materials - Preparation of the column. Column efficiency and resolution - Solvent systems and detection methods
Thermogravimetry [TG], differential thermal analysis [DTA], differential Scanning calorimetric [DCS] - applications of thermometric titrations.

UNIT-V: Nephelometry & Turbidimetry: Theory, Instrumentation – determination of sulphate and phosphate - Application in organic, inorganic, biological fluids and pollution analysis - Turbidimetric titrations – determination of molecular mass of high polymers.
Flurometry: Theory, Instrumentation – relation between intensity and concentration. Measurement of fluorescence – filter fluorometer – spectrofluorometer – advantages, limitations – reporting fluorescence spectra – application of fluorometric analysis – organic, inorganic and biological

RECOMMENDED BOOKS

1. Research Methodology. Methods and Techniques: C. R. Kothari.
2. Tests, Measurements and Research Methods in Behavioral Sciences: A. K.Singh.
3. Thesis and Assignment writing by Anderson.
4. K.Eckschlager, "Errors measurement and results in chemical Analysis"Reinhold Company.
5. A.I Vogel, Text Book of Quantitative Inorganic Analysis,Pearson V Edn., 2001.
6. Instrumental methods of chemical analysis by Chatwal. K, Anand, 5th edition.
7. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: PHYSICAL CHEMISTRY III **Credits: 5**
Subject Code: **Contact Hours: 90**
Semester: IV (Core Course VIII) **Marks: 100**

Course Outcomes:

- **To study the Statistical thermodynamic concepts and its significance**
- **To know the significancant applications of statistical themodynamics**
- **To identify the behavior of crystalline and amorphous polymers**
- **To understand the basics of macromolecules**
- **To study the photochemical reactions and its types**

Unit I: Statistical Thermodynamics – I

Introduction – combinatory rules, permutations and combinations, concepts of system, assembly, ensembles, energy levels, energy states, macrostates and microstates – thermodynamic probability – stirling's approximation – Lagrange's indetermined multipliers. Derivation, comparision and applications of M-B, B-E and F-D statistics.

Unit II: Statistical Thermodynamics - II

Molar partition functions for an ideal gas – Derivation of translational, rotational, vibrational and electronic partition functions. Thermodynamic functions in terms of partition functions – Internal energy, molar heat capacity, entropy, Helmholtz function, pressure, Gibbs function, enthalpy – Het capacities of monoatomic crystals – Einstein theory and Debye T^3 law.

Unit III Crystalline and Amorphous Polymers

Crystalline and amorphous polymers-factors affecting crystallinity - effect on polymer properties. Glass transition temperature- thermal transitions -Determination of Tg and Tm – factors affecting Tg Polymer characterization by IR, NMR, TGA, DTA and DSC – Molecular weight of polymers and its distribution – molecular weight determination by GPC and Viscosity measurement- Mark – Houwink equation.

Unit IV: Macromolecules

Molar masses of polymers – Number-average molar mass, Weight- average molecular mass. Determination of molar masses of macromolecules – viscometry, Osmometry, Ultracentrifugation. The sedimentation velocity method- Diffusion – Stokes-Einstein equation, Einstein – smoluchowski equation. Kinetics of polymerization – kinetics of addition and condensation polymerisation.

UNIT V: Photochemistry

Photophysical process in electronically excited molecules – Jablonski diagram – Experimental techniques – Chemical actinometers – Laser and its applications. Fluorescence mechanism – resonance fluorescence – sensitized fluorescence – Quenching of fluorescence (Stern – Volmer equation) – applications. Phosphorescence – mechanism. Photosensitization- Photosynthesis.

References

1. 1.Thermodynamics for chemists, S.Glasstone, Affiliated East-West Press.
2. Statistical Thermodynamics, Lee Sears & Turcotte, Addison Wesley.
3. Physical chemistry, P.W.Atkins, ELBS.
4. Chemical thermodynamics, T.M.Koltz, Benjamin.
5. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, "Polymer Science" New Age
6. International (p) Ltd., New Delhi (2010).
7. F.W.Bill Mayer, "Text Book of polymer science" 3rd Edition – John Wiley & sons, Inc.,
8. New York (2011).
9. Rohatgi Mukherjee, Fundamentals of Photochemistry, 2nd edition, New Age International (2004).

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: ORGANIC CHEMISTRY PRACTICAL – II **Credits: 4**
Subject Code: **Contact Hours: 90**
Semester: IV (**Core Practical-VI**) **Marks: 60+40=100**

Organic Chemistry Practical-II

Course outcome:

- To know the accuracy of estimation of compounds
- To check the purity of organic compound experimentally
- To prepare organic compounds with green chemistry approach
- To understand the mechanism and procedure to prepare organic compound

I. Organic Estimations

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Ethyl methyl ketone
4. Estimation of Glucose
5. Estimation of Saponification value of an Oil

II. Double stage preparation of organic compounds

1. Hoffmann rearrangement of aromatic amides with household bleach and acetylation of the resultant amines with acetic anhydride.
2. Hoffmann rearrangement of aromatic amides with household bleach and bromination of the resultant amines.
3. N-Bromination of acetanilide with Br_2/NaOH mixture; and the Orton rearrangement of respective N-bromoacetanilide.
4. N-Acetylation of aromatic amines and bromination of the resultant product.

Comparative thin layer chromatographic slides must be shown for the products of 3^{rd} and 4^{th} experiment. (**Only for Class Observation**)

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M. Sc., CHEMISTRY PROGRAM

Title of the Subject: FOOD & MEDICINAL CHEMISTRY **Credits: 4**
Subject Code: …… **Contact Hours: 90**
Semester: IV (Elective Course IV) **Marks: 100**

Course outcome

To teach the basics and applications of food chemistry and medicinal chemistry
To impart knowledge on drug designing and QSAR
To explain the students about chromatographic methods,nephelometry and turbidimetry

Unit I: Food and Nutrients

Foods – classification – proximate principles – invalid foods –nutritive properties of vegetables –nutrition properties of meat, fish and oil of sea foods.Carbohydrates: Classification –carbohydrates in diets – digestion and absorption – regulation of blood glucose – insulin – adrenaline.Protein: Sources and chemical nature – amino acids – nitrogen balance – factors affecting nitrogen balance – physiological needs – dietary sources – biological tests – requirements – protein deficiency.Fats: Visible & Invisible fats – phospholipids – digestion and absorption – essential fatty acids (EFA) deficiency – dietary needs for fat.

Unit – II: Electrolytes, Minerals and Vitamins

Salt: Na and K in the body. Water balance – Na excess –Na deficiency – K deficiency – K excess. Minerals – intake – absorption – substances – recommended intake – trace elements – iodine – physiology – sources – therapeutic uses – fluorine – prevention of dental caries, fluorosis in man – fluoride and osteoporosis – Pb – Hg – Hazards.Vitamins: Vitamins – classification – source, physiological functions of vitamin A, D, E, K, B-complexes (B_1, B_2, $B_6$and B_{12}), folic acid and vitamin-C.

Unit III: Drug design

History of organic medicinal compounds, various routes of administration – definition of allergy, side effects. Factors influencing drug metabolism and metabolic changes in drugs. Drug interactions – non specific and specific interactions. Relationship of chemistry and biological activity.Development of new drugs, procedures followed in drug design, concepts of prodrugs and soft drugs. Theories of drug activity, Quantitative structure activity relationship. Concepts of drug receptors.

Unit IV: Analgesics

Classification –narcotic analgesics – Opium derivatives –Uses and toxic effects of morphine and codeine - antipyretic analgesics – paracetamol, phenacetin – uses. Salicylic acid derivatives – aspirin – uses and toxic effects. Anti inflammatory– ibuprofen and indo methacin –uses and toxic effects. Synthetic drugs – pethidine and methadones – uses and side effects.Antibiotics: Introduction – classification – Penicillin, streptomycin and chloramphenicol – structure and uses.
Anti malarial: Quinine,– structure, uses and toxic effects.

Unit V: A general study of the following classes of compounds

Histamines and anti histamines, Sedatives, hypnotics and tranquilizers, Antiseptics and disinfectants, Anti radiation and anti cancer drugs- Recent developmentin cancer chemotherapy.Antitubercular&antileprotic– Isoniazide. Cardiovascular -Synthesis of quinidine, methyldopa, atenolol, oxyprenol.AIDS: General study – symptoms –prevention & treatment.

References

1. Fundamentals of Nutrition, Corinne H. Robinson, Macmillan Publishing Co., Inc.
2. Food Science and Experimental Foods, M.Swaminathan, Ganesh & Co.
3. Food and Nutrition Vols 1&2, M.Swaminathan, BAPCO.
4. Goodman and Gillman, Pharmacology and Pharmacothearputics.
5. AshutoshKar, Medicinal Chemistry, Wiley Eastern, Madras.
6. Harkishan Singh and V.K.Kapoor, Organic Pharmaceutical Chemistry, VallabhPrakashan, Delhi.
7. I.L.Finar, Organic Chemistry Vol. II, ELBS.
8. Bentley and Driver, Text book of pharmaceutical chemistry, 3rd edn,
9. JayashreeGhosh, A Textbook of Pharmaceutical Chemistry, 1st edn.

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SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021) (CBCS)
M. Sc., CHEMISTRY PROGRAM

Title of the Subject: APPLICATIONS OF SPECTROSCOPY AND CHEMISTRY OF SECONDARY METABOLITES **Credits: 5**

Subject Code: …… **Contact Hours: 90**

Semester: IV (ELECTIVE COURSE V)
Marks: 100Course outcome
To elaborate the basic principles and applications of UV, IR, Mass and NMR spectra
To guide the students on solving spectral problems
To teach the chemistry of secondary metabolites

UNIT I:Applications of UV-Visible and IR Spectroscopy in Organic Chemistry: UV-Visible spectroscopy: Various electronic transitions (185-800nm) – Ultraviolet bands for carbonyls compound – unsaturated carbonyl compounds, dienes, conjugated polyenes. Fischer-Woodward rules for conjugated dienes and carbonyls compounds – ultraviolet spectra of aromatic and heterocyclic compounds.IR Spectroscopy: Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, esters, phenol and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds).Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

UNIT II:Applications of NMR Spectroscopy in Organic Chemistry: PMR spectroscopy: General introduction and definition – chemical shift – spin-spin interaction – shielding mechanism – chemical shift values and correlation of protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto) – Simplification of complex spectra – nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier Transform technique, Nuclear Overhauser Effect (NOE), C13 NMR chemical shift (aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbon)Coupling constant- application to structural elucidation of simple organic compounds.

UNIT III:Applications of Mass Spectroscopy in Organic Chemistry: Application ofMass Spectroscopy: FD and FAB factors affecting fragmentation – ion analysis – ion abundance. Mass spectral fragmentation of organic compounds – common functional groups – molecular ion peak – metastable peak–isotopic peak – McLafferty rearrangement. Nitrogen Rule – high resolution mass spectroscopy.Examples of mass spectral fragmentation of organic compounds with respect to their structural determination.

UNIT IV:Synthesis and structural elucidation of natural phenolic and additive aromas: Secondary metabolites -Isolation, synthesis and reactivity of flavones, iso-flavones, chromones, coumarins, Algar-Flynn-Oyamada reaction and anthocyanins – basic fraction. Terpenoids - structural elucidation, disconnection approach and synthesis of Zingiberene, squaleneand limonene.

UNIT V:Synthesis and structural elucidation of some common alkaloids: Tests for alkaloids –Isolation of alkaloids- Acid fraction- qualitative analysis of alkaloids with respect to functional groups - stereochemistry of nitrogen compounds - Zeisel method – Herzig-meyer method- Hoffmann's exhaustive methylation - Emde degradation- Von Braun's method- structural elucidation, disconnection approach and synthesis of nicotine, perlolidine and mytomycine – Synthesis of cryptosanguinolentine through Fischer-indole method.

References:

1. Introduction to Spectroscopy – D. L. Pavia, G. M. Lampman, G. S. Kriz and J. A. Vyvyan.
2. Organic Chemistry Vol I & II, I.L.Finar. (3). Organic Spectroscopy – R. M. Silverstein.
4. Chemistry of Natural Products Vol I & II, O.P.Agarwal.
5. Organic Chemistry of Natural Products Vol I & II, G. R. Chatwal.
6. Ph.D. Thesis - Dr. P. Pitchai – Submitted to Bharathiar University, Coimbatore (April-2009).
7. Ph.D. Thesis –Mr. A. Nepolraj – Submitted to Bharathidasan UniversityTrichy (Dec-2016).
8. Ph.D. Thesis – Mr. M. Sathiyaseelan – Submitted to Bharathidasan University Trichy (Dec-2016).
9. Ph.D. Thesis – Mr. M. Sathiyamoorthy – Submitted to Bharathidasan University Trichy (Aug-2019).