# ANDHRA UNIVERSITY

# DEPARTMENT OF CHEMISTRY

**PROGRAM : M.SC CHEMISTRY, ANALYSIS OF FOOD, DRUGS & WATER**

**REGULATION AND SYLLABUS**

**EFFECTIVE FROM 2021-2022 BATCH**

**ANDHRA UNIVERSITY**
**SCHOOL OF CHEMISTRY**
**DEPARTMENT OF ORGANIC CHEMISTRY & FDW**
**Revised Syllabus for Chemistry, Analysis of Foods, Drugs & Water Specialization**
**(With effect from the Admitted batch of 2021-2022 Academic Year)**

## PROGRAM OBJECTIVES:

1. To provide students in the scientific skills and chemical knowledge essential to develop and apply the knowledge in chemical sciences related to analysis of food and drug chemistry.
2. To provide knowledge, application, skills in water analysis
3. To equip students with effective scientific communication skills
4. To encourage the pursuit of lifelong education
5. To develop each student into a committed individual with ethical and social responsibility

## PROGRAMME OUTCOMES:

The Students Who Completes M.Sc Organic Chemistry Programms

PO1: Have strong foundations in the basic concepts of Organic Chemistry
PO2: Have good employment opportunities in pharmaceutical labs
PO3: Will get Jobs in various Chemical industries related to Pharma companies , polymer companies, pollution control boards etc.
PO4: Have excellent opportunities to pursue research
PO5:Can build their careers as Entrepreneurs by establishing "Start ups".
PO6: Have an opportunity to pursue career teaching in chemistry at various levels.

## PROGRAMME SPECIFIC OUTCOMES:

The students who complete the M.Sc. Chemistry (**Chemistry of Foods, Drugs and Water Analysis Specialization**) course shall:

PSO1: Have strong foundation in the fundamentals and applications of chemical knowledge and understanding

PSO2: Have the abilities to think critically, logically and analytically and solve problem in the area of chemical sciences, drug chemistry, medicinal chemistry and water pollution

PSO3: Have the abilities to carry out chemical experiments, record and analyze the results and design advanced models

PSO4: Have the abilities to use modern library and information retrieving tools to obtain information and assimilate to generate concepts and apply them in challenging situations

PSO5: Have the abilities to effectively communicate their knowledge and skills to other chemists and non-chemists in oral or written formats.

PSO6: Secure suitable employment in the areas of chemical industries like pharmaceutical (R&D, QA & QC), polymers, , environmental and pollution control, nanotechnology and composite materials, teaching and research, etc.

PSO7: Have the personal attributes and ethical sensibilities to enable them to function as effective scientists and citizens

## REGULATIONS

1. The duration of the course is for two academic years with total four semesters. The nature of the course is full-time.
2. Candidates for the degree of Master of Science in Chemistry shall be required to have passed the B.Sc with Chemistry / Applied Chemistry / Industrial Chemistry as one the subject of this university or any other university recognized by the academic council as equivalent thereto.
3. The course and scope of instruction shall be as defined in the syllabus prescribed. (Annexure-III )
4. Candidate who takes instruction shall be required to take examinations at the end of each semester as specified in Annexure-I.
5. Each candidate has to undergo an internship for a duration of four weeks during the fourth semester in any chemical industry/ R&D / organization/ or at the department at their own expense and have to submit project report.
6. A candidate shall be declared to have passed in any course if he /she secures not less than "E" grade in theory and not less than "D" grade in the practical /Project, provided the result otherwise is withheld. There is no minimum pass marks for internal assessment marks both theory as well as practical.

A candidate shall be deemed to have satisfied the minimum requirement for the award of the degree of M.Sc. Chemistry.

i. If he / she is declared to have passed all the subjects included in the scheme of instruction and examination and
ii. if he /she secures 5.0 CGPA in each of the semesters by the end of the fourth semester.

Further, a candidate shall be permitted to choose any course(s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examinations. There shall not be any provision for the improvement of internal assessment marks in any theory or practical subjects in any year /semester of study. Grades and calculation of SGPA and CGPA are given in Annexure-II

7. The successful candidates in the M.Sc Chemistry degree examination shall be arranged in the order in which they are registered for the examination in the following classes on the basis of the CGPA. However, students who pass in any supplementary examination shall not be awarded Distinction even if they obtain a CGPA of 8.0 or above, they shall be considered as First Class only.

| | |
|---|---|
| First Class with Distinction | – CGPA 8.0 or more |
| First Class | – CGPA 7.0 or more but less than 8.0 |

Second Class/Pass – CGPA 5.0 or more but less than 7.0

8. The Question course setting and valuation shall be as per the University regulations at the end of each semester.
9. The practical examinations shall be conducted and valued by both internal and external examiners at the end of each semester.
10. The viva- voce examination for Project Work shall be conducted both internal and external examiners at the end of the completion of project and after submission of the Project Report by each of the candidates.

11. The Minimum attendance required by a candidate will be 75% of the total number for the working days in that semester. Provided that in special cases and for sufficient cause shown, the Vice-chancellor may, on the recommendation of the Principal and the Head of the department concerned, condone the deficiency in the average attendance to an extent of 9% for reasons such as ill health, if the application for condonation is submitted at the time of actual illness and is supported a certificate of an authorized medical officer approved by the Principal. However, 100% attendance should be maintained for all practicals/ labs/ Internship>
12. Each of the student has to study two MOOC courses from NPTEL/SWAYAM etc. one in the third semester and the other in the fourth semester of the programme and the grade obtained should be submitted to the Department/ College/ University for incorporation in the marks list along with the Grade/ Course Completion Certificate. The Departmental Committee shall decide whether to accept or not the grade/score obtained by the student. The student has to complete each of these courses during the concerned semester period only.
13. Keeping in view of the objectives of NPE 2020 and the directives of the University, two value added courses have been included each in 3rd and 4th semesters of the course. Intellectual Property rights in 3rd semester and Research Methodology in the 4th semester under non-credit scheme. However, the students have to attend the examination and pass the examination similar to that of other subjects of the course.
14. The University may, from time to time, revise, amend or change the regulations, scheme of examination and syllabus. In the case of students already undergoing the course, the changes will take effect from the beginning of the following academic year after the change are introduced and shall cover the part of the course that remains to be completed.

**M.SC. CHEMISTRY WITH SPECIALIZATION CHEMISTRY Analysis of Foods, Drugs and Water**
**SCHEME OF INSTRUCTION AND EXAMINATION FOR I-SEMESTER**

| Course code | Course Title | Course type (Theory/ Practical) | Instruction periods per week | Internal Marks | External Marks | Total Marks | Duration of Examination | Credits |
|---|---|---|---|---|---|---|---|---|
| SCS -117 | General Chemistry-I | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -118 | Inorganic Chemistry-I | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -119 | Organic Chemistry-I | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -120 | Physical Chemistry-I | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| (PR-347) | Inorganic Chemistry Laboratory-1 | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| (PR-348) | Physical Chemistry Laboratory-1 | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| (PR-349) | Organic Chemistry Laboratory-1 | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| | | Total | 34 | | | 625 | | 25 |

**M.SC. CHEMISTRY WITH SPECIALIZATION CHEMISTRY Analysis of Foods, Drugs and Water**
**SCHEME OF INSTRUCTION AND EXAMINATION FOR II-SEMESTER**

| Course code | Course Title | Course type (Theory/ Practical) | Instruction periods per week | Internal Marks | External Marks | Total Marks | Duration of Examination | Credits |
|---|---|---|---|---|---|---|---|---|
| SCS -215 | General Chemistry-II | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -216 | Inorganic Chemistry-II | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -217 | Organic Chemistry-II | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| SCS -218 | Physical Chemistry-II | Theory | 04 | 20 | 80 | 100 | 3 hrs | 04 |
| (PR-350) | Inorganic Chemistry Laboratory-1I | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| (PR-351) | Physical Chemistry Laboratory-I1 | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| (PR-352) | Organic Chemistry Laboratory-1I | Practical | 06 | 15 | 60 | 75 | 3 hrs | 03 |
| | | Total | 34 | | | 625 | | |
| | | Total Number of credits | | | | | | 25 |

**M.SC. CHEMISTRY WITH SPECIALIZATION CHEMISTRY Analysis of Foods, Drugs and Water**
**Scheme of Instruction and Examination for III semester**

| Course Code | Course Title | Course Type | Instruction Periods per week | External Marks | Internal Marks | Total Marks | Duration of External Examination | Credits |
|---|---|---|---|---|---|---|---|---|
| SCWS- 305 | Paper-I: CHEMISTRY OF DRUGS-I | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 306 | Paper-II: CHEMISTRY OF DRUGS-II | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 307 | Paper-III: DRUG ANALYSIS-I | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 308 | Paper-IV: DRUG ANALYSIS-II | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| (PR-733) | Practical - I: DRUG ANALYSIS | Lab | 3 | 80 | 20 | 100 | 6 hours | 4 |
| (PR-A 1062) | Practical - II: DRUG ANALYSIS-II | Lab | 3 | 80 | 20 | 100 | 6 hours | 4 |
| | MOOCs Course | - | | | | - | - | 2 |
| | | Total: | | | | 600 | | 26 |

**M.SC. CHEMISTRY WITH SPECIALIZATION CHEMISTRY Analysis of Foods, Drugs and Water**
**Scheme of Instruction and Examination for IV semester**

| Course Code | Course Title | Course Type | Instruction Periods per week | External Marks | Internal Marks | Total Marks | Duration of External Examination | Credits |
|---|---|---|---|---|---|---|---|---|
| SCWS- 406 | PAPER-I: CHEMISTRY OF FOODS-I | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 407 | Paper-II: CHEMISTRY OF FOODS-II | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 408 | Paper-III: FOOD ANALYSIS-I | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| SCWS- 409 | Paper-IV: FOOD ANALYSIS-II | Theory | 4 | 80 | 20 | 100 | 3 hours | 4 |
| | Project Work | Lab | - | 100 | - | 100 | - | 4 |
| (PR-734) | Practical - I: FOOD ANALYSIS | Lab | 3 | 80 | 20 | 100 | 6 hours | 4 |
| (PR-A 1061) | Practical - II: WATER ANALYSIS | Lab | 3 | 80 | 20 | 100 | 6 hours | 4 |
| (VV-647) | Viva-Voce | - | - | - | | 50 | - | 2 |
| | MOOCs Course | - | | | | - | - | 2 |
| | | Total: | | | | 750 | | 32 |

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**SEMESTER-I**
**PAPER-I: GENERAL CHEMISTRY-I**

**Course Outcomes (COs)/Course Specific Outcomes (CSOs):**

Upon completion of the course the students will be able to,

**CO1:** Learn and understand the selection rules and criteria for molecules to exhibit rotational and IRspectroscopy.

**CO2:** Understand the Classical and quantum mechanical theories of Raman spectroscopy and basic concepts of electronic spectroscopy.

**CO3:** Learn spectroscopic methods based on magnetic resonance principles.

**CO4:** Learn basics of group theory and its application in chemistry.

**CO5:** Understand the basic concepts of FORTRAN programming and its applications.

**Learning Outcomes (LOs):**

Upon completion of the course the student will be able

- To apply the spectroscopic methods for structure elucidation of molecules.
- To acquire knowledge of molecular symmetry and group theory and to solve chemical problems.
- To write FORTRAN programs for simple chemical problems.

**COURSE CONTENT**

**UNIT – I**

Rotational spectra of diatomic molecules-rigid rotor-selection rules-calculation of bond length-isotopic effect, second order stark effect and its applications, Infrared spectra of diatomic molecules-harmonic and anharmonic oscillators. Selection rules-overtones-combination bands calculation of force constant, anharmonicity constant and zero point energy. Fermi resonance, simultaneous vibration rotation spectra of diatomic molecules.

**UNIT-II**

Raman effect-classical and quantum mechanical explanations-Rotational Raman and vibrational Raman spectra, Electronic spectra of diatomic molecules-Vibrational coarse structure-intensity of spectral lines-Franck Condon principle-applications, Rotational fine structure-band head and band shading, Charge transfer spectra.

**UNIT-III**

Spin Resonance Spectroscopy: Principle and theory of NMR spectroscopy-Nature of spinning particle and its interaction with magnetic field. Chemical shift and its origin. Spin-Spin interaction-experimental methods. Application of NMR to structural elucidation-Structure of ethanol, dimethylformamide, styrene and acetophenone. Principle and theory of ESR-g-factor, hyperfine interactions-applications of ESR studies to the structure of free radicals, metal complexes.

**UNIT-IV**

Basic concepts of Symmetry and Group theory – Symmetry elements, symmetry operations and point groups – Schoenflies symbols – Classification of molecules into point groups – Axioms of Group theory – Group multiplication tables for $C_{2V}$ and $C_{3V}$ point groups – Similarity Transformation and classes – Representations – reducible and irreducible representations, Mulliken symbols, Orthogonality theorem and its implications, character table and its anatomy.

**UNIT-V**

Basic components of Computers, higher and lower level languages, Microsoft Fortran: constants, variables and operators, arithmetic expressions, assignment and replacement statements, Input and Output statements – Format free and Format directed I/O statements – Iw, Fw.d, Ew.d and Gw.d format specifications, conditional and unconditional statements – Logical IF, Block IF and Go To statements, Do statement – syntax and rules.

Application of Chemical Problems:

Flowcharts and Programs for

1. Statistical Analysis calculation of arithmetic mean, mean deviation, variance and standard deviation of replicate measurements.
2. Solution of Quadratic equation – calculation of the roots of a quadratic equation.
3. Calculation of the pH and hydrogen ion concentration of an aqueous solution of a strong acid taking into account the auto ionization of water.
4. Calculation of the root of a polynomial using Gauss-Newton method – Application to Vander-Waal's equation.
5. Calculation of the rate constant of a first order reaction or calculation of molar extinction coefficient using Beer-Lambert's Law by Linear least-squares method.

**Text Books:**


1. Symmetry and Spectroscopy of Molecules, K Veera Reddy, New Age International Publishers.
2. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
3. Chemical Applications of Group Theory, F. A. Cotton Wiley Eastern Limited New Delhi.
4. Group Theory and its Applications to Chemistry, K. V. Raman, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
5. Computer programming in Fortran-IV by V .Rajaraman, Prentice-Hall of India Pvt. Ltd., New Delhi.
6. Molecular Spectroscopy, - Gordon M. barrow
7. Fundamentals of Molecular Spectroscopy – Banwell.

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**SEMESTER-I**
**PAPER-II: INORGANIC CHEMISTRY-I**

**Course Objectives: To make the students**

**CO1:** Acquiretheknowledgeon applications of VSEPR, Valence Bond and Molecular orbital theories in explaining thestructures of simple molecules **and** role of p and d orbitals in pi bonding.

**CO2:** Understandthe concept of MO theory to square planar ($PtCl_4^{2-}$) and Octahedral complexes ($CoF_6^{3-}$, $Co(NH_3)_6^{3+}$).And Walsh diagram for $H_2O$ molecule

**CO3:** Apply theknowledgeandunderstandingofUnderstand the Orgel and Tanabe-Sugano diagrams for $d^1$ –$d^9$ octahedral and tetrahedral transition metal complexes of 3d series tonewly prepared metal complexes

**CO4:** Develop interest in the areas of magnetic properties of transition and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes.

**CO5:** To understand the concept of Term symbols and Electronic spectra and Magnetic properties of complexes

**LearningOutcomes:**Attheendofthecourse,thelearnersshouldbeableto:

**LO1:** Explainidea of structure and bonding theories of inorganic compounds
**LO2:** InterpretWalsh diagram for other liner and bent molecules
**LO3:** Introduce electron counting rules for higher boranes
**LO4:** Analyse the preparation and structures of heteropoly acids
**LO5:** Understanding structure and bonding in coordination compounds
**LO6:** Explain selections rules, Tanabe-Sugano diagrams. Orgel diagrams
**LO7:** Experimentally Identify the covalency in metal complexes.
**LO8:** To calculate the magnetic susceptibility of metal complexes
**LO9:** Understand and analyse structure-property correlation of coordination compounds
**LO10:** Design new coordination compounds based on a fundamental understanding of their electronic properties

## COURSE CONTENT

**UNIT-1**

Structure & Bonding: Applications of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules- role of p and d orbitals in pπ-dπ bonding, Bent's rule, Non-valence cohesive forces

Application of MO theory to square planar ($PtCl_4^{2-}$) and Octahedral complexes ($CoF_6^{3-}$, $Co(NH_3)_6^{3+}$). Walsh diagrams for linear ($BeH_2$) and bent ($H_2O$) molecules

**UNIT-II**

Inorganic cage and ring compounds – preparation, structure and reactions of boranes, carboranes, metallocarboranes, boron–nitrogen ($H_3B_3N_3H_3$), phosphorus–nitrogen ($N_3P_3Cl_6$) and sulphur-nitrogen ($S_4N_4$, $(SN)_x$) cyclic compounds. Structure and bonding in higher boranes with (special reference to B12 icosahedra). Electron counting rules in boranes – Wades rules (Polyhedral skeletal electron pair theory).

Polyacids: Introduction to polyacids- Types of polyacids- Isopolyacdis, Isopoly molybdates, Isopolytungstates, Isopolyvanadates, Structures of Polyacids $]Mo_7O_{24}]$,$^{6-}$$(V_{10}O_{28})^{6-}$ and $W4O_{16}]^{8-}$, Heteropolyacids- properties of heteropolyacids and salts, structures of heteropolyacids and theories , Mialalicopause and Roscnneium theories , Pauling's theory and keggin's theory, applications of polyacids.

**UNIT-III**

Coordination compounds: Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies – Spectrochemical series, Jahn – Teller theorem (static and dynamic Jahn-Teller theorem) and its consequences, nephelauxetic effect, applications and limitations of CFT; ligand field theory

Experimental evidences for covalence in complexes. Molecular Orbital Theory of bonding for Octahedral, tetrahedral and square planar complexes. π-bonding and MOT - Effect of π - donor and π -acceptor ligands on Δo. Experimental evidence for π - bonding in complexes

**UNIT- IV**

Electronic spectra of transition metal complexes:

Term symbol-Free Ion terms and Energy Levels: Configurations, Terms, States and Microstates, calculation of Microstates for $P^2$ and $d^2$ Configuration, Russell- Saunders Coupling Schemes, J-J Coupling scheme, derivation of terms for various configurations $P^2$ and $d^2$ configuration, spectroscopic Ground state , Hole Formalism, Energy ordering of terms (Hund's Rules), Selection rules: Laporte orbital selection rule, spin selection rules. Splitting of energy levels and spectroscopic states Orgel diagrams of $d^1$ to $d^9$ metal complexes. Interpretation of electronic spectra of aquo Complexes of Ti(III), V(III), Cr(III), Mn(II), Fe(II), Fe(III), Co(II), Ni(II) and Cu(II). Calculation of interelectronic and spectral parameters for $d^8$ metal complexes.

**UNIT- V**

Tanabe- Sugano diagrams for $d^1$ –$d^9$ octahedral and tetrahedral transition metal complexes of 3d series. Calculation of Dq, Racah Parameter (B) and nephelauxetic parameter (β), Charge transfer (L→M and M→L) spectra of metal complexes.

Magnetic properties of metal Complexes: Types of magnetic behavior, Temperature independent paramagnetism. Magnetic properties of transition and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes. Magnetic susceptibility and its determination by Gouy's method, and Faraday's method. orbital contribution to magnetic moment ( $O_h$and $T_d$ Complexes)

**Text books**:


1. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson, IV Edition, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III Edition, Harper International Edition, 1983.
3. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999)

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**SEMESTER-I**
**PAPER-III: ORGANICCHEMISTRY-I**

**Course Objectives:**

**CO1:** Acquiretheknowledgeofaliphaticnucleophilic,aliphaticelectrophilic,stereochemistryand conformational analysis, chemistry of heterocyclic compoundsandchemistryofnaturalproducts

**CO2:** Understandaliphaticnucleophilic, aliphaticelectrophilic, stereochemistry andconformational analysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**CO3:** Apply theknowledgeandunderstandingofaliphaticnucleophilic,aliphaticelectrophilic, stereochemistry and conformational analysis, chemistry of heterocyclic compounds and chemistry of natural products to new situations

**CO4:** Develop interest in the areas of aliphatic nucleophilic, aliphatic electrophilic,stereochemistry and conformational analysis, chemistry of heterocyclic compoundsandchemistryofnaturalproducts

**Learning Outcomes:** Attheend of the course, the learners should be able to:

**LO1:** Explainaliphaticnucleophilic,aliphatic electrophilic,stereochemistryandconformational analysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**LO2:** Interpretaliphaticnucleophilic,aliphatic electrophilic,stereochemistryandconformational analysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**LO3:** Comparealiphaticnucleophilic, aliphaticelectrophilic,stereochemistryandconformational analysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**LO4:** Analysealiphaticnucleophilic,aliphaticelectrophilic,stereochemistryandconformationalanalysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**LO5:** Solvealiphaticnucleophillic,aliphaticelectrophilic,stereochemistryandconformational analysis, chemistry of heterocycliccompounds and chemistry ofnaturalproducts

**LO6:** Identify aliphatic nucleophilic,aliphaticelectrophilic, stereochemistry andconformationalanalysis,chemistryofheterocycliccompoundsand chemistryofnaturalproducts

**LO7:** Apply aliphaticnucleophilic,aliphaticelectrophilic, stereochemistry andconformationalanalysis,chemistryofheterocycliccompoundsand chemistryofnaturalproducts

**COURSE CONTENT**

**UNIT–I**

**Aliphatic Nucleophilic Substitutions:** The SN2, SN1, SNi and SET mechanisms.Substitutionreactionsofambidentnucleophiles,anchimericassistance,theneighbouring group mechanism: neighbouring group participation by 0,N, S,halogens, aryl groups, alkyl and cycloalkyl groups in nucleophilic substitutionreactions. Sigma, Pi bond participation in acylic and bicyclic systems (Non-classiccarbocations).NucleophilicSubstitutionalallylic,ŁrigonalandVinyliccarbons.Effectofsubstrate,attackingnucleophile,leavinggroupandreactionmedium

**UNIT-II**

**Aliphatic Electrophilic Substitutions:** SEI SE2 and SEi mechanisms. Reactivity-effects of substrate, leaving group and solvent. Reactions- hydrogen exchange,migration of doublebonds, halogenation of aldehydes, ketones, carboxylic acids, acylhalides,sulphoxidesandsulphones.

**UNIT-III**

**Stereochemistry and Conformational Analysis:** Optical Isomerism:FiCal activity,moleculardissymmetryand chirality- elements of symmetry.Fisher'sprojectionD,L. and R,S. configurations - relative and absolute configurations optical isomerismdue to asymmetric carbon atoms - optical isomerism in biphenyls, allenes andspirans-opticalisomerismofnitrogenouscompounds,racemisationandresolution.

**Geometricalisomerism:**E,Z-configurations,propertiesofgeometricalisomers.Conformationalanalysis:Conformationsofacyclicmolecules-alkanesandsubstitutedalkanes-compoundshavingintramolecularhydrogenbonding.Conformations of cyclohexane, mono and disubstituted cyclohexanes and decalins,effectofconformationsonreactivity.

**UNIT—IV**

Chemistry of Heterocyclic Compounds :Structure, reactivity and synthesis of threemembered Heterocycles: (a) Oxirane: Sharpless method, Shi epoxidation, Jacobsenepoxidation, etc, (b) Aziridine; four membered Heterocycles: (a) Oxetane (b) Azetine;five memberedHeterocycles:(a) Pyrrole: Paa1 Knorr, Hantzsch Methods,etc, (b)Thiophene: Paa1 Knorr, Hinsberg method, etc. (c) Furan: Paa1 Knorr, Fiest-Benary,IndustrialMethod, etc.; (d) Pyrazole,(e) Imidazole,(f) Oxazole, (g) Thiazole; Sixmembered Heterocycles: (a) Pyridine, (b)Pyridazine,(c) pyrimidine and (d) Pyrazine;Aromatic heterocyclics: a) Indole: Fischer indole synthesis, Bischler synthesis, andMadelungsynthesis(b)QuinolineandIsoquinoline,(c)CoumarinsandChromones.

**UNIT—V**

**Chemistry of Natural Products:**

Terpenoids:-Occurrence,Isolation,isoprenerule,structureelucidationandsynthesisofn-Terpineolandn-pinene

Steroids:-Nomenclatureofsteroids,structureelucidation,synthesisandstereochemistryofcholesterolandprogesterone

Lipids:-Classification,propertiesandfunction-freefattyacids,triglycerides,phospholipids,glycolipids&waxesconjugatedlipids-lipoproteins

.**ReferenceBooks**


1. AdvancedOrganicChemistry:ReactionsMechanismsandStructurebyJerryMarch, Mc.GrawHillandKogakush.
2. OrganicChemistryVol.I(Sixth Ed.)andVol.II(FifthEd.)byILFinarELBS.
3. OrganicChemistry(fifthEd.,)byMorrison andBoyd,PHI,India.
4. OrganicChemistry(fifthedition)byFrancisA.CareyTataMcGrawHillpublishing

CompanyLimited,NewDelhi.

5. StereochemistryofOrganiccompoundsbyErnestL.E1ie1,SamuelH.Wilen

6. Chemistry of natural products by S. V. Bhat, B. A. Nagasampangi and M.Sivakumar NarosaPublishingHouse,6threprint2010

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**SEMESTER-I**
**PAPER-IV: PHYSICALCHEMISTRY-I**

**Course Outcomes (COs)/Course Specific Outcomes (CSOs)**
Upon completion of the course the students will be able to,

**CO1:** Explain the basic concepts of Thermodynamics and its applications

**CO2:** Understand the concepts of thermodynamics of solutions.

**CO3:** To understand the principle of micellisation.

**CO4:** Understand the various kinetic theories, measurements of reaction rates.

**CO5:** Learn experimental techniques for measuring the kinetics of fast reactions and homogenous catalyzed reactions.

**Learning Outcomes (LOs):**
Upon completion of the course the student will be able to understand

**LO1:** To apply the concepts of thermodynamics to various problems in chemistry.

**LO2:** To predict various reaction mechanisms.

**LO3:** To apply the concept of micellization to various chemical reactions.

## COURSE CONTENT

**UNIT-I**

Basic concepts of second law of Thermodynamics-Entropy- Entropy changes accompanying different processes-Entropy changes in an ideal gas, entropy changes in the mixing of ideal gases, entropy as a function of V and T and entropy as a function of P and T- Entropy change in isolated systems- Clausius inequality-Helmholtz and Gibbs energy -Maxwell relations - Criteria for spontaneity-variation of Gibbs energy with temperature and pressure for solids, liquids and gases-Concept of fugacity-determination of fugacity coefficient of gases-Thermodynamics of phase transitions- Concept of chemical potential-Location of phase boundaries- (Clausius-Clapeyron equation for Liquid- Vapour, Solid -Liquid and Solid-Vapour boundaries)- Ehrenfest classification of phases.

**UNIT-II**

Thermodynamics of mixtures -partial molar quantities - experimental methods of determination of partial molar quantities -Gibbs-Duhem equation and Duhem-Margules equation-Thermodynamics of mixing of liquids ($\Delta H_{mix}$, $\Delta G_{mix}$ and $\Delta S_{mix}$) - Thermodynamics of ideal solutions - Raoult's law -Thermodynamics of colligative properties of dilute solutions - concept of activity and activity coefficient- Experimentaldetermination of activity coefficient - Thermodynamic concept of equilibrium, variation of equilibrium with temperature (Van't Hoff equation) and pressure - Nernst heat theorem, Third law of thermodynamics- exceptions to third law of thermodynamics.

**UNIT-III**

Surface tension- Capillary action- Adsorption-Adsorption isotherms- Freundlich adsorption isotherm, Langmuir adsorption isotherm-limitations - BET adsorption isotherm-estimation of Surface area.Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization- phase separation and mass action models.

**UNIT-IV**

Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory.Lindeman's theory of unimolecular reactions -Limitations. Diffusion controlled reactions. Effect of ionic strength on rates of reactions- Primary and secondary salt effects. Effect of dielectric constant onreactions - kinetic isotope effect -Primary and secondary isotopic effects -Effect of substituent -Linear free energy relationships - Hamett equation - limitations- Taft equation. Kinetics of consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation).

**UNIT-V**

Specific and general acid-base catalysis. Skrabal diagrams. Steady state approximation- Enzyme catalysis- Michaelis -Menten mechanism. Derivation of Kinetic equation and Kinetic parameters. Lock and Key hypothesis-pH dependence of enzyme catalyzed reactions.Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods.

**Text Books:**


1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
2. Chemical Kinetics by K. J. Laidler, McGraw Hill Pub.
3. Physical chemistry by K.L. Kapoor


**Reference Books:**


1. Thermodynamics for Chemists, Samuel Glasstone
2. Physical chemistry by Puri, Sharma and Pathania
3. Micelles, Theoretical and applied aspects, V. Moroi, Plenum publisher

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**SEMESTER-I**

## PRACTICAL I: INORGANICCHEMISTRY

**Course Objectives:**

**CO1:** To develop an insight into the preparation of inorganic complexes
**CO2:** To understand the process of preparation of inorganic complexes
**CO3:** To acquire skills in the preparation of inorganic complexes

**Learning Outcomes:**

At the end of the course, the learners should be able to:

**LO1:** Prepare various inorganic complexes
**LO2:** Develop skill in handling apparatus, measure the quantities and carryout the reaction and analyse the inorganic mixtures
**LO3:** Applies the skill in preparing new metal complexes and analysis of inorganic mixtures
**LO4:** Understand the regulations in handling and disposal of chemicals.

## COURSE CONTENT

1. **Synthesis of Inorganic Metal Complexes:**Synthesis of 3d transition metal complexes of tetrahedral, square planar and octahedral geometries.
   (i) Preparation of TetraammineCopper(II) sulphate monohydrate
   (ii) Potassium tris-oxalatoferrate (III) trihydrate
   (iii) Tris-thiourea copper(I) sulphate

2. **Systematic SemimicroQualitative Analysisof Inorganicsix radical mixtures**
   In systematic Semi micro qualitative inorganic analysis, inorganic mixture containsthree cations and three anions. The analysis involves identification and conformation of cations and anions containing one less familiar cation(Tungsten, Molybdenum, Zirconium, Thorium, Titanium, Uranium, Cerium, Vanadium, Lithium, Berkelium Etc... and one interfering anion

**Anions:** $CO_3^{2-}$ , $S^{2-}$ , $SO_3^{2-}$ , $Cl^-$ , $Br^-$ , $I^-$ , $NO_3^-$ , $SO_4^{2-}$, $CH_3COO^-$, $C_2O_4^{2-}$ , $C_4H_4O_6^{2-}$ , $PO_4^{3-}$ , $CrO_4^{2-}$, $AsO_4^{3-}$, $F^-$, $BO_3^{3-}$

**Cations** : Ammonium ($NH_4^+$),1st group: Hg, Ag, Pb, Tl, W ; 2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo; 3rd group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be
4th group: Zn, Mn, Co, Ni5th group: Ca, Ba, Sr6th group: Mg,K, Li

**Note: A minimum of 4 inorganic mixtures must be analysed in this Semester**

**REFERENCE BOOKS:**

**1**. Practical Inorganic Chemistry, G. Marr and B. W. Rockett.

2. Practical Inorganic Chemistry by G.Pass H.Sutchiffe,2nd edn John Wiley & Sons.

3. Experimental Inorganic/Physical Chemistry, M. A. Malati, Horwood Publishing, Chichester, UK (1999)

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**SEMESTER-I**

# PRACTICAL II: PHYSICALCHEMISTRY

**Course Objectives:**

**CO1:** To maintain laboratory ethics, safety and cleanliness
**CO2:** To Preparation and standardization of solutions
**CO3:** To have hands-on experience/practical knowledge in performing Physical chemistry experiments
**CO4:** To develop skills on handling instruments like conductometry and perform different types of acid-base titrations
**CO5:** To plot accurate graphs of the desired scale for the calculations of Langmuir and Freundlich isotherms
**CO6:** To Prepare the solution of the desired concentration and the desired volume in Cuprammonium cation.

**LearningOutcomes:**

At the end of the course, the learners should be able to:

**LO1:** To be able to develop/practical skills to solve problems in chemistry.
**LO2:** To extend the principle of Conductometric titration to other kind of reactions.
**LO3:** To learn to use the concept of phase diagram for different systems
**LO4:** To apply adsorption isotherms for other reactions.

## COURSE CONTENT:

1. Conductometry
   a) Conductometric titration of strong acid (HCl) vs strong base (NaOH)
   b) Conductometric titration of weak acid ($CH_3COOH$) vs strong base (NaOH)
   c) Conductometric titration of mixture of acids (HCl + $CH_3COOH$) vs strong base (NaOH)
2. Determination of Cell constant of conductivity cell
3. Determination of Dissociation constant of weak acid by conductometric Method
4. Determination of Critical solution temperature of phenol-Water system
5. Determination of effect of electrolyte (NaCl) on the miscibility temperature of Phenol-Water system
6. Determination of composition of Cuprammonium cation using partition coefficient method
7. To verify Langmuir and Freundlich isotherm for absorption of acetic acid onto activated Charcoal

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**SEMESTER-I**

# PRACTICAL III: ORGANICCHEMISTRY

**Course Objectives:**

**CO1:** To develop an insight into the preparation of organic compounds in various reactions

**CO2:** To understand the process of preparation of organic through various reactions

**CO3:** To acquire skills in the preparation of organic compounds, their separation, purification and identification

**Learning Outcomes:**

At the end of the course, the learners should be able to:

**LO1:** Prepare various organic compounds using various reactions

**LO2:** Develop skill in handling apparatus, measure the quantities and carryout the reaction, separate the products, purify them and analyse the products formed

**LO3:** Applies the skill in preparing novel organic moieties

## COUSE CONTENT:

**Synthesis of Organic compounds**

Synthesis, purification and characterization of about ten organic compounds involving one or two stages.

List of some suggested compounds

1. β-Napthyl methyl ether from β-Naphthol
2. m-dinitrobenzene from Nitrobenzene
3. Azo dye from primary amine
4. Aromatic acid from ester
5. Benzanilide from aniline
6. p-nitroaniline from Acetanilide
7. p-Bromo acetanilide from aniline
8. Phthalimide from phthalic acid
9. 1,2,3-Tribromo benzene from aniline
10. Benzanilide from Benzophenone

**Text Books:**


1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.

MODEL QUESTION PAPER

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**SEMESTER-I**

## Paper- I: GENERAL CHEMISTRY-I

**Time**: 3 hours **Max. Marks**: 80 **(5x16=80 Marks)**

***Answer ALL questions***

1. (a) (i) What kind of molecules exhibit microwave spectra.
   (ii) Discuss isotope effect in microwave spectra.

   (or)

   (b) (i) Derive an expression for energy or harmonic oscillator and discuss the selection rules.
   (ii) Describe the origin of PQR structure of Vibrational-Rotational spectra.

2. (a) (i) Discuss the classical and quantum mechanical theories of Raman spectra
   (ii) Explain rotational fine structure in electronic spectroscopy?

   (or)

   (b) (i) State and explain Franck Condon principle.
   (ii) Write a short note on charge transfer spectra.

3. (a) (i) Explain the terms spin active nuclei, resonance, Larmor precession and chemical shifts in NMR.
   (ii) Explain hyperfine interactions in ESR spectroscopy taking examples.

   (or)

   (b) (i) What are the factors affecting ‘g’ value in ESR spectroscopy.
   (ii) Explain spin-spin interactions in NMR spectroscopy?

4. (a) (i) State and explain the axioms of group theory.
   (ii) State the great Orthogonality theorem and discuss its implications

   (or)

   (b) (i) Give the points groups for $NH_3$, $XeF_4$, eclipsed $C_2H_6$, Cis $C_2H_4$, $B_3$,$N_3H_6$ and allene
   (ii) Describe the anatomy of character table.

5. (a) (i) Write a flowchart and FORTRAN program for calculation of rate constant of a first order reaction.
   (ii) Give the syntax and rules of DO statement

   (or)

   (b) (i) Write a flowchart and FORTRAN program for calculation of pH and hydrogen ion concentration of an aqueous solution of a strong acid taking into account the auto ionization of water
   (ii) Write a brief note on format direction Input/output statements.

MODEL QUESTION PAPER

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**SEMESTER-I**

## Paper- II: INORGANIC CHEMISTRY-I

**Time**: 3 hours **Max. Marks**: 80 **(5x16=80 Marks)**

***Answer ALL questions***

1. (a) (i) Predict the geometries of $ClF_3$, $XeF_4$ and $SF_4$ molecules using VSEPR theory
   (ii) What is LCAO method? Predict bond order and bond lengths in $O_2^+$ and $O_2^-$ ions based on MO energy level diagram

   (or)

   (b) (i) Draw the MO energy level diagram for $[Co(NH_3)_6]^{3+}$ and discuss its magnetic properties
   (ii) Draw the Walsh diagram for $H_2O$ molecule and predict its structure.
2. (a) (i) Discuss the preparation of, structure of, and bonding in $N_3P_3Cl_6$.
   (ii) Discuss the structure and properties of borazole

   (or)

   (b) (i) Explain Mialalicopause and Rosenneium theories Pauling's theory and Keggin's theory of polyacids.
   (ii) Explain the method of counting skeletal electrons in cluster compounds

   (or)
3. (a) (i) Draw and explain the crystal field splitting of 'd' orbitals in square planar and trigonal bipyramidal geometries.
   (ii) Discuss the factors affecting crystal field splitting energies.

   (or)

   (b) (i) What are static and dynamic Jahn-Teller theorem and discuss its consequences
   (ii) Write a note on nephelauxetic effect
4. (a) (i) How do Tanable-Sugano diagrams differ from Orgel diagram? Draw Tanabe-Sugano diagram for $[V(H_2O)_6]^{3+}$
   (ii) Draw the Orgel diagram for $[TiCl_4]^-$ ion and explain the electronic transition

   (or)

   (b) (i) Write an account on Russell – Saunders coupling.
   (ii) Derive the terms symbols for $Ni^{2+}$ and identify the ground state term symbol
5. (a) (i) Discuss different types of paramagnetic behaviour of transition metal complexes
   (ii) Calculate the spin only magnetic moments of the $[MnCl_6]^{3-}$ and $[Fe(CN)_6]^3$

   (or)

   (b) (i) Describe the Magnetic properties of inner transition metal complexes
   (ii) Determination of magnetic susceptibility a determination by Gouy's and Faraday's methods

MODEL QUESTION PAPER

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**SEMESTER-I**

## Paper- III: ORGANIC CHEMISTRY-I

**Time**: 3 hours **Max. Marks**: 80 **(5x16=80 Marks)**

***Answer ALL questions***

1. (a) (i) Explain $SN_2$ reaction with stereo chemical evidence
   (ii) What are non-classical carbocations? Explain them.

   (or)

   (b) (i) Describe neighbouring group participation reactions of Oxygen and Halogens with an examples.
   (ii) Write a note on nucleophilic substitution reaction at allylic and trigonal carbons

2. (a) (i) Explain SE1 and SE2 reactions with examples.
   (ii) Write a note on halogenations of ketones and carboxylic acids with examples

   (or)

   (b) (i) Write a note on $SE^i$ reaction and migration of double bonds
   (ii) Describe halogenations of sulphoxide and sulphones

3. (a) (i) Explain optical isomerism of biphenyls and spirans
   (ii) Write about racemization and resolution with examples

   (or)

   (b) (i) Describe the properties of geometrical isomers.
   (ii) Write the conformational analysis of cyclohexane with an example

4. (a) (i) Write any two synthesis and reactivity of Oxirane
   (ii) Explain any two synthesis and reactivity of Indole

   (or)

   (b) (i) Describe the synthesis and properties of Pyridine
   (ii) Write a note on coumarins and chromones with examples

5. (a) (i) Explain the synthesis of *a*-pinene
   (ii) Write any synthesis of progesterone

   (or)

   (b) (i) Explain triglycerides with examples
   (ii) Write the structure elucidation of cholesterol

MODEL QUESTION PAPER

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**SEMESTER-I**

## Paper- IV: PHYSICAL CHEMISTRY-I

**Time**: 3 hours **Max. Marks**: 80 **(5x16=80 Marks)**

***Answer ALL questions***

1. (a) (i) Derive Maxwell's relations
   (ii) Define fugacity. How do you determine the fugacity of real gases?

   (or)

   (b) (i) Derive Clausius-Clapeyron equation
   (ii) Explain the entropy changes accompanying in different processes

2. (a) (i) Define partial molar quantity? Explain the experimental methods for determining partial molar quantities.
   (ii) Explain briefly about thermodynamics of mixing of liquids

   (or)

   (b) (i) State and explain third law of thermodynamics and write its limitations
   (ii) What is effect of temperature on equilibrium constant?

3. (a) (i) Discuss the features and limitations of Langmuir adsorption isotherm
   (ii) Give a classification of surface-active agents along with examples

   (or)

   (b) (i) What are important features of BET isotherm
   (ii) What is CMC? What are the factors affecting CMC

4. (a) (i) Discuss the Lindeman theory of unimolecular reaction and its limitations
   (ii) Write a note on diffusion-controlled reactions

   (or)

   (b) (i) Derive an expression for effect of ionic strength on rate of reaction
   (ii) Discuss the kinetics of consecutive reactions

5. (a) (i) Explain the Michaelis-Menten mechanism for enzyme catalysis
   (ii) Explain the mechanism of specific acid-base catalysis

   (or)

   (b) (i) Explain steady-state approximation with examples
   (ii) Explain temperature jump method for fast reactions and derive an expression for relaxation time

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**SEMESTER-II**
### PAPER-I: GENERAL CHEMISTRY-II

**Course Objectives:**

**CO1** Students will have the idea of wave function and understand the uncertainty relations

**CO2** Students will learn how to solve the Schrodinger Eq. rigorously for model systems

**CO3** Students will be able to understand and be able to explain the origin of quantized energy levels

**CO4** Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules

**CO5** They will be able to understand and explain the differences between classical and quantum mechanics

**Learning Outcomes:**

**LO1** Gain knowledge about wave equation-interpretation of wave function-properties of wave function-normalization and orthogonalization.

**LO2** Understand about symmetry arguments in deriving the selection rules, the concepts of tunneling-particle in three-dimensional box. Calculations using wave functions of the particle in a box.

**LO3** Gain knowledge about Perturbation theory-time independent perturbation (only first order perturbation is to be dealt with) – application to ground state energy of helium atom

**LO4** Study about variation principle-applications-calculation of zero-point energy of harmonic oscillator-many electron atom

**LO5** Gain knowledge about Valence bond approach-directed valence-hybridization-covalent bond-calculation of ionic and covalent bond contributions in hydrogen molecule

**LO6** Gain knowledge about hydrogen molecule ion-hydrogen molecule (fundamental concepts only

## COURSE CONTENT

**Unit I**

Wave equation – interpretation of wave function – properties of wave function – normalization and orthogonalisation, operators – linear and non-linear commutators of operators, Postulates of quantum mechanics, setting up of operators observables – Hermitian operator – Eigen values of Hermitian operator.

**Unit-II**

Wave mechanics of simple systems with constant potential energy, particle in one dimensional box – factors influencing colour – transition – dipole integral, symmetry

arguments in deriving the selection rules-the concept of tunneling – particle in a three dimensional box, Rigid rotor, wave mechanics of systems with variable potential energy-simple harmonic oscillator-solution of wave equation-selection rules.

**UNIT-III**

Hydrogen atom-solution of R(r), $\theta(\theta)$ and $\Phi(\phi)$ equations-probability density in orbitals-shapes of orbitals. Perturbation theory-time independent perturbation (only first order perturbation is to be dealt with) – application to ground state energy of hydrogen and helium atom

**UNIT –IV**

Variation principle-applications to hydrogen and helium atoms-calculation of zeropoint energy of harmonic oscillator-many electron atom- Comparison between Perturbation and variation theorems. Hartee-Fock self-consistent field method and introductory concepts of Density functional theory(DFT).

**UNIT-V**

Valence bond approach-directed valence-hybridization-covalent bond-calculation of ionic and covalent bond contributions in hydrogen molecule. Molecular orbital theory – LCAO approximation – hydrogen molecule ion – hydrogen molecule (fundamental concepts only) – The electronic transitions in the hydrogen molecule.

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**SEMESTER-II**

## PAPER-II: INORGANIC CHEMISTRY-II

**Course Objectives:**

**CO1** To give a basic and updated knowledge for the students on metal clusters, Organometallic chemistry of transition metals

**CO2** To discuss the preparation and structures of and functional aspects of metal clusters

**CO3** Design new coordination compounds based on a fundamental understanding of their electronic properties

**CO4** To discuss basics principles of reaction mechanism in metal complexes

**CO5** To understand the concept of Term symbols and Electronic spectra and Magnetic properties of complexes

**LearningOutcomes:** Attheendofthecourse,thelearnersshouldbeable to:

**LO1** Explain the idea of metal clusters

**LO2** Interpret the bonding nature in metal clusters

**LO3** Understand the basics of inorganic and coordination chemistry

**LO4** Verity the 18 electron rules in various metal clusters

**LO5** Determine the stability constants of metal complexes

**LO6** Explain the kinetics of substitution reaction, conjugate bas mechanism and trans effect

**LO7** Design new coordination compounds based on a fundamental understanding of their Reaction mechanism

## COURSE CONTENT

### UNIT-I

**Metal cluster compounds -** definition – evidences for existence of M-M bonds - conditions favorable for formation of M-M bonds – preparation, structure and bonding of the following metal cluster compounds.

$Re_2Cl_8^{2-}$, $Mo_2Cl_8^{4-}$, $Re_2(RCOO)_4X_2$, $Mo_2(RCOO)_4(H_2O)_2$, $Cr_2(RCOO)_4(H_2O)_2$, $Cu_2(RCOO)_4$ $(H_2O)_2$, $Cr_2Cl_9^{3-}$, $Mo_2Cl_9^{3-}$, $W_2Cl_9^{3-}$, $Re_3Cl_9$, $Re_3Cl_{12}^{3-}$, $Mo_6Cl_8^{4+}$, $Nb_6X_{12}^{2+}$ and $Ta_6X_{12}^{2+}$.Polyatomic clusters – Zintle ions, Chevrel phases.

### UNIT-II

**Organometallic compounds -** 16 and 18 electron rules.

Isoelectronicrelationship - Synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen and nitric oxide complexes.

Isolobal relationship – H, Cl, $CH_3$, $Mn(CO)_5$; S, $CH_2$, $Fe(CO)_4$; P, CH, $Co(CO)_3$

Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene

**UNIT-III**

**Metal Ligand equilibria in solution:**
Step wise and overall formation constants and their interaction. Trends in stepwise constants ((statistical effect and statistical ratio), factors affecting the stability of metal complexes; Stability correlations - Irwing -William's series, Pearson's theory of hard and soft acids and bases (HSAB), Application of HSAB: Biological functions and toxicology of metals, and medicinal applications; chelate effect and its thermodynamic origin

**UNIT-IV**

Determination of stability constants of complexes by spectrophotometric method ((Job's method) and pH –metric method(Bjerrum's).
Reactivity of metal complexes – inert and labile complexes. Explanation of lability on the basis of valence bond and crystal field theories.

**UNIT- V**

**Reaction Mechanisms of Metal Complexes:**
Reactivity of metal complexes, inert and labile complexes, Kinetics and mechanisms of substitution reactions, kinetics of substitutions reactions in octahedral complexes, acid hydrolysis, Factors affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism, Anation reactions, substitution reactions in square planar complexes, Trans effect, Mechanism of trans effect, Electron transfer reactions-– concept of complementary and non-complementary reactions with examples, inner sphere and outer sphere mechanisms, Marcus theory.

**Text books**:


1. Advanced Inorganic Chemistry by F.A. Cotton and R.G. Wilkinson, IV Edition, John, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III edition, Harper International Edition, 1983.
3. Organometallic Chemistry-A unified approach by A. Singh and R.C. Mehrotra, Wiley Eastern Ltd.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999)
5. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
6. Mechanisims of Inorganic reactions in solution by D.Benson, MCgraw Hill, London, 1968.
7. Inorganic chemistry by K.F. Purcell and J.C.Kotz, W.B. Saunders company, New York, 1977.

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**SEMESTER-II**

## PAPER-III: ORGANICCHEMISTRY-II

**Course Objectives:**

**CO1** Acquire the knowledge of aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**CO2** Understand aromaticity, aromatic nucleophilic substitution, reactive intermediate and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**CO3** Apply the knowledge and understanding of aromaticity, aromatic nucleophilic substitution, reactive intermediate and name reactions, molecular rearrangements, spectroscopy, alkaloids peptides, proteins and nucleic acids to new situations

**CO4** Develop interest in the areas of aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**Learning Outcomes:** At the end of the course, the learners should be able to:

**LO1** Explain aromaticity, aromatic nucleophilic substitution, reactivity intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**LO2** Interpret aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**LO3** Compare aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**LO4** Analyse aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**LO5** Solve aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

**LO6** Identify aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids peptides, proteins and nucleic acids

**LO7** Apply aromaticity, aromatic nucleophilic substitution, reactive intermediates and name reactions, molecular rearrangements, spectroscopy, alkaloids, peptides, proteins and nucleic acids

## COURSE CONTENT

**UNIT-I: Aromaticity**

A) **Aromaticity:** Concept of Aromaticity, Aromaticity of five membered, six membered and fused systems-non-benzenoidaromatic compounds:-cyclopropenylcation, cyclo butadienyldication, cyclopentadienyl anion — tropyliumcation and cyclo octatetraenyl dianion—matallocenes, ferrocenes, azulenes, fulvenes, annulenes, fullerenes. Homoaromaticity, Antiaromaticity and Pseudoaromaticity.

B) **Aromatic Nucleophilic Substitutions:** The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity: Effect of substrate, leaving group and attacking nucleophile. The Von-Richter, Somm1et-HauserandSmilesrearrangements.

**UNIT-II: Reactive Intermediates and Name Reactions**

A) **Reactive Intermediates:** Generation, structure, stability and reactivity of reactive intermediates: carbanion, carbocation, freeradicals, carbenes and nitrenes.

B) **NameReactions:**Wittigreaction,Grignardreaction,Storkenaminereaction,Michaeladdition, MannichReaction,Diel's-AlderreactionandEne-reaction

**UNIT-III: Molecular Rearrangements**

**Molecular Rearrangements:** Types of molecular rearrangements, migratory aptitude;

**Rearrangements to electron deficient carbon:** Pinacol-pinacolone, Wagner-Meerwein and Benzil-Benzilicacid,

**Rearrangements toelectron deficientnitrogen:** Beckmann, Hofmann, Curtius, Schmidt and Lossen rearrangements;

**Rearrangements to electron deficient oxygen:** Baeyer-villiger,Dakin rearrangements;

**Other rearrangements:** Neber rearrangement and Favorskii rearrangements

**UNIT-IV: Spectroscopy**

A) **UV Spectroscopy:** Various electronic transitions, selection rules, effect of solvent on electronic transitions, the absorption laws, chromophores, auxochromes, bathochromic and hypso chromic shifts, hyperchromic and hypochromic effects, Woodward-Fieser rules for conjugated dienes and carbonyl compounds.

B) **Infrared Spectroscopy:** Basic principles: types of molecular vibrations, fingerprint region and identification of functional groups.

C) **Nuclear Magnetic Resonance Spectroscopy ($^{1}$H-NMR):** nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shifts, factors affecting the chemical shift, and assignment of chemical shifts.

D) **Mass Spectroscopy:** Basic principles, nitrogen rule and fragmentation pattern of carbonyl compounds and alcohols

**UNIT—V: Alkaloids, Peptides, Proteins and Nucleic acids**

A) **ALKALOIDS:** Occurrence, Isolation, classification based on nitrogen heterocyclic ring and synthesis of quinine and nicotine

B) **Peptides and Proteins:** O-Amino acids, their general properties and synthesis, Synthesis of peptides by Merrifield solid phase synthesis. Primary, secondary and tertiary structures of proteins

C) **Nucleic acids**: Heterocyclic bases; Purines: Adenine and Guanine; Pyramidines: Cytosine, Uracil and Thymine; nucleosides, nucleotides Basic concepts of the structures of RNA and DNA

**Textbooks:**


1. Organic Chemistry Vol.I (SixthEdn.) and Vol.II (FifthEd.,) by ILfinarELBS.
2. Organic Chemistry (fifthEdn.,) by Morrison and Boyd, PHI, India.
3. Organic Chemistry (fifthedition) by FrancisA.Carey TataMcGraw Hillpublishing Company Limited, New Delhi.
4. ReactionMechanisminOrganicChemistrybyMukherjeeSirigh,NTerniit arr,Indiar
5. A guide book to mechanism in Organic Chemistry by Peter Sykes, ELBS.
6. Advanced organic chemistry by Jerry March (4thEdition)WileyEastern..
7. Stereochemistry of carbon compounds by E.Eliel, John Wiley &Sons, Inc.
8. Stereochemistry of Organic compounds by D.Nasipuri., Chemistry of Natural products by R.S. Kalsi Kalyani Publ

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**SEMESTER-II**

## PAPER-IV: PHYSICAL CHEMISTRY -II

**Course Outcomes (COs)/Course Specific Outcomes (CSOs)**

Upon completion of the course the students will be able to,

**CO1** Explain the basic concepts of Crystallography

**CO2** Understand the types of polymers and analyze various physical properties of polymers

**CO3** Understand the concepts of electrochemistry and theories like Debye Huckel theory

**CO4** Understand the basic concept and theories of electrode-electrolyte interface

**CO5** Learn principles of photochemistry and various photochemical reactions

**Learning Outcomes (LOs):**

Upon completion of the course the student will be able

- To determine electrical magnetic properties of solids.
- To apply the basic concept of electrochemistry to different electrochemical cells
- To predict the mechanisms of photochemical reactions

## COURSE CONTENT

**UNIT-I:**

Crystal structure of solids: Fundamental of lattices, unit cell, Bravais lattices, symmetry elements in crystals, packing efficiency, radius ratios; Miller indices. structures and types of solids. Structure determination by X-ray diffraction (Bragg's equation). Magnetic properties of solids- classification of magnetic materials, Magnetic susceptibility, Measurement of magnetic susceptibility. Electric properties-Band theory, the band structure of metals, insulators, and semiconductors. The temperature dependence of the conductivity of extrinsic semiconductors. Superconductivity and occurrence. Meisner effect. Types of superconductors. Theories of superconductivity - BCS theory.

**UNIT-II**

Classification of polymers - Free radical, ionic and Zeigler - Natta Polymerization - kinetics of free radical polymerization - Techniques of polymerization - Glass transition temperature - Factors influencing the glass transition temperature - Number average and Weight average, Molecular weights - molecular weights determination - End group analysis - Osmometry - Light scattering and ultra-centrifugation methods.

**UNIT-III:**

Electrochemistry I: Ionic mobilities and conductivities - Debye-Huckel theory of strong electrolytes, Debye-Huckelonsagar equation-limitations- mean activity coefficient - Verification of Debye-Huckel limiting law. Electrochemical cell- Galvanic and electrolytic cell. Nernst equation-Concentration cell with and without transference- effect of complexation on redox potential- ferricyanide/ ferrocyanide couple, Iron(III) phenonthroline/ Iron(II) phenonthroline couple. Fuel Cells- construction-Various types-Examples.

**UNIT-IV:**

Electrochemistry II: The electrode-electrolyte interface. The electrical double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model. Electrodics: Charge transfer reactions at the electrode-electrolyte interface.Derivation of Butler-Volmer equation. High field approximation, Tafel equation, Low field equilibrium, over voltage. Theories of over voltage- Corrosion - Concentration polarization - Polarography -Half wave potential and Ilkovic equation.

**UNIT-V:**

Photochemistry: Electronic transitions in molecules, Franck-Condon principle. Electronically excited molecules- singlet and triplet states, spin-orbit interaction. Quantum yield and its determination. Actinometry. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence- E-type and P-type. Photochemical primary processes, types of photochemical reactions-photodissociation, addition and isomerization reactions with examples.

**Text Books:**

1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.

2. Physical Chemistry by G.W. Castellon, Narosha Publishing House

3. Physical chemistry by K.L. Kapoor.

4. Principles of photochemistry, RohitgeeMukhargee.

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**SEMESTER-II**

## PRACTICAL -I: INORGANIC CHEMISTRY

**Course Objectives:**

**CO1** To have hands-on experience/practical knowledge in Inorganic chemistry experiments
**CO2** To develop skills on estimations of analyte by volumetrically
**CO3** To determine analyte by Gravimetrically
**CO4** To study the photochemical reactions

**Learning Outcomes:**

At the end of the course, the learners should be able to:

**LO1** To be able to solve problems in analytical chemistry
**LO2** To extend the idea of determination of analyte by volumetric titration to advanced analytical determinations of various organic and inorganic analytes
**LO3** Able to design gravimetric experiments for quantitative estimation of organic and inorganic analytes

COURSE CONTENT

Quantitative analysis:

1.Volumetric methods of Analysis:

i) Determination of Ferric iron by photochemical reduction

ii). Determination of Nickel by EDTA

iii) Determination of Calcium and Magnesium in a mixture by EDTA

iv) Determination of Ferrocyanide by Ceric sulphate

v) Determination of Copper(II) in presence of iron(III)

2.Gravimetric methods of Analysis:

i) Determination of Zinc as Zinc pyrophosphate

ii). Determination of Nickel from a mixture of Copper and Nickel.

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**SEMESTER-II**

## PRACTICAL-II: PHYSICAL CHEMISTRY

**Course Objectives:**

**CO1** To have hands-on experience/practical knowledge in performing Physical chemistry experiments

**CO2** To develop skills on handling instruments like Potentiometry and perform different types of acid-base and redox titrations

**CO3** To determine specific rotations and percentage of to optically active substances by polarimetrically

**CO4** To study the stability of complex ion and stranded free energy change and equilibrium constant by potentiometry

**Learning Outcomes:**

At the end of the course, the learners should be able to:

**LO1** To be able to develop/practical skills to solve problems in chemistry

**LO2** To extend the principle of Potentiometric titration to other kind of reactions.

**LO3** To study the kinetics of reactions and determine the order of reaction

## COURSE CONTENT

1. Potentiometric titration of Iron (II) using potassium dichromate
2. Potentiometric titration of strong acid with a strong base using quinhydrone electrode
3. Determination of kinetics of Ester hydrolysis
4. Determination of Equilibrium constant of Potassium Iodide-Iodine system
5. Determination of kinetics of inversion of cane sugar by polarimetry method.
6. Determination of partial molar volume of solute $-H_2O$ system by apparent molar volume method.

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**SEMESTER-II**

## PRACTICAL III: ORGANIC CHEMISTRY

**Course Objectives:**

**CO1** To develop an insight into the identification of organic compounds by systematic analysis
**CO2** To understand the process of identification of organic compounds by systematic analysis
**CO3** To acquire skills in the identification of organic compounds by systematic analysis

**Learning Outcomes:**

At the end of the course, the learners should be able to:

**LO1** Identify an organic compound by systematic analysis
**LO2** Develop skill in identification of organic compounds by systematic analysis
**LO3** Apply the skill in the identification of new organic compounds by systematic analysis

## COURSE CONTENT:

**Identification of the unknown organic compounds**

Systematic identification of organic compounds – preliminary tests, detection of extra elements, solubility, common functional group tests (determination of functional group/s in a single compound, if present), preparation of two rational derivatives

The given organic compound must be identified by comparing the melting point /Boiling point of the compound and melting points of its derivatives with the literature

**List of suggested compounds**

Glucose, fructose, benzaldehyde, p-anisaldehyde, p-chloro benzaldehyde, acetophenone, phenol, cresols, naphthols, esters, p-chloro benzoic acid, aniline, p-tolune, p-anisidine, p-chloroaniline, diphenyl amine, N,N-dimethylaniline, benzamide, naphthalene and anthracene.

TEXT BOOKS

1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.

MODEL QUESTION PAPER

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**SEMESTER-II**

**Time: 3 Hours** **Maximum marks: 80 (5X16 =80 marks)**

**Answer ALL questions**

(1) (a) i) Derive Schrodinger wave equation?
ii) Explain the postulates of Quantum mechanics

(or)

(b) i) Write notes on Hermitian operator and its properties
ii) Explain normalization and orthogonalization

(2) (a) i) Solve the Schrodinger wave equation for a particle in a one-dimensional box
ii) Write the factors influencing color

(or)

(b) i) Derive the Schrodinger wave equation for a simple harmonic oscillator
ii) Describe the concept of tunnelling

(3) (a) i) Explain the solution of R(r), $\theta(\theta)$ and $\Phi(\phi)$ equations of hydrogen atom
ii) Explain probability density in orbitals

(or)

(b) i) Explain the time independent perturbation theory to evaluate the ground state energy of helium atom
ii) Application of above to ground state energy of hydrogen and helium atom

(4) (a) i) What is variation principle. Write its application to calculation of ground state energy of harmonic oscillator
ii) Compare Perturbation and variation theorems

(or)

(b) i) Explain Hartee-Fock self-consistent field method for multi electron atoms
ii) Write a note on Density functional theory (DFT)

(5) (a) i) Explain quantum mechanical approach of molecular orbital theory
ii) Calculate the ionic and covalent bond contributions in hydrogen molecule

(or)

(b) i) Discuss the valence bond approach of $H_2$ molecule.
ii) Write the electronic transitions in the hydrogen molecule.

MODEL QUESTION PAPER

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**SEMESTER-II**

**Paper- II: Inorganic Chemistry-II**

**Time: 3 Hours** **Max marks: 80 (5X16 =80M)**

**Answer ALL questions**

(1) a) (i) Discuss the structure and magnetic property of $Cu_2(RCOO)_4(H_2O)_2$

(ii) Write a note on Chevrel phases

(or)

b) (i) Discuss the preparation of, structures of and bonding in $Re_2Cl_8^{2-}$.

(ii) Describe the structures of hexanuclear metal clusters

(2) a) (i) Explain the synthesis, structure and reactions of metal carbonyls.

(ii) Explain Isolobal relationship with suitable examples.

(or)

b) (i) Describe the preparation of, structure of and bonding in ferrocene.

(ii) What is 18 electron rules? Illustrate with suitable examples

(3) a) (i) Explain the factors affecting the stability of coordination compounds

(ii) Distinguish between stepwise and overall stability constants

(or)

b) (i) Describe the Irwing-William's series, Pearson's theory of hard and soft acids and bases (HSAB)

(ii) What is chelate effect and discuss its thermodynamic origin

(4) a) (i) Discuss a spectrophotometric method for the determination of binary formation constant of a metal complex

(ii) What are inert and labile complexes?

(or)

b) (i) Describe the pH – metric method for the determination of stability constants

(ii) Explain inert and labile complexes by using crystal field stabilization energies?

(5) a) (i) What is acid hydrolysis reactions? Discuss factors affecting acid hydrolysis reactions

(ii) What is trans effect? Distinguish between the trans effect and trans influence

(or)

b) (i) Give an account of base hydrolysis of Cobalt (III) complexes

(ii) Discuss the various factors affecting the rates of substitution reaction of octahedral complexes

MODEL QUESTION PAPER

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**SEMESTER-II**

**Paper- III: Organic Chemistry-II**

**Time: 3 Hours** **Maximum marks: 80 (5X16 =80 marks)**

**Answer ALL questions**

(1) a) (i) Explain Aromaticity and Anti aromaticity give examples.
(ii) Write a note on Von- Ritcher rearrangement
(or)
b) (i) Describe Aromatic Nucleophilic Substitution reactions give examples.
(ii) Write a note on Non-benzenoid aromatic compounds and Annulenes.

(2) a) (i) Write any two preparations and reactivity of carbocation.
(ii) Write a note on Stork enamine reaction.
(or)
b) (i) Explain carbanion and nitrene
(ii) Briefly explain Mannich Reaction with applications.

(3) a) (i) Explain Pinacol-pinacolone rearrangement give examples.
(ii) Describe mechanism and applications of Beckmann rearrangement.
(or)
b) (i) Discuss about Baeyer-villager rearrangement.
(ii) Write a note on Favorskii rearrangement.

(4) a) (i) Write the Woodward-Fieser rules for conjugated dienes.
(ii) Explain types of molecular vibrations in Infrared Spectroscopy.
(or)
b) (i) Describe factors affecting the chemical shift.
(ii) Give the fragmentation pattern of alcohols.

(5) a) (i) Write the synthesis of nicotine
(ii) Explain Merrifield solid phase synthesis.
(or)
b) (i) Write about Primary, secondary and tertiary structures of proteins.
(ii) How do you differentiate RNA and DNA

MODEL QUESTION PAPER

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**SEMESTER-II**

**M.Sc. Chemistry (Previous)Paper- IV: Physical Chemistry-II Semester-II**

**Time: 3 Hours** **Max. Marks: 80 (5X16 =80M)**

**Answer ALL questions**

(1) a) (i) Derive Bragg's equation
(ii) Explain the theories of superconductivity

(or)

b) (i) Describe the different methods of measurement of magnetic susceptibility
(ii) Write a brief note on semiconductors

(2) a) (i) Give the classification of polymers with examples
(ii) What are the factors influencing glass transition temperature

(or)

b) (i) How is molecular weight of polymers determined by osmometry and light scattering methods
(ii) Write a brief note on kinetics of free radical polymerization

(3) a) (i) Explain Debye-Huckel theory of strong electrolytes
(ii) Discuss the effect of complexation on redox potential with examples?

(or)

b) (i) Derive an expression for EMF of concentration cell without transference
(ii) Discuss the important features of Debye-Huckel limiting law

(4) a) (i) Derive Bulter-Volmer equation
(ii) Explain the Stern model for double layer

(or)

b) (i) Explain in detail about polarography
(ii) Discuss important features of Gouy-Chapman diffuse charge model and Helmholtz parallel plate model

(or)

(5) a) (i) Derive Stern-Volmer equation
(ii) State and explain Franck-Condon principle

b) (i) Define quantum yield and explain its experimental method determination
(ii) Discuss the mechanism of photo addition and photo isomerization with examples

**ANDHRA UNIVERSITY**

**SCHOOL OF CHEMSITRY**

**DEPARTMENT OF ORGANIC CHEMISTRY & FDW**

**Revised Syllabus for Chemistry of foods, drugs and water analysis specialization**

**(With effect from the Admitted batch of 2021-2022 Academic Year)**

**Programme objectives:**

6. To provide students in the scientific skills and chemical knowledge essential to develop and apply the knowledge in chemical sciences related to analysis of food and drug chemistry.
7. To provide knowledge, application, skills in water analysis
8. To equip students with effective scientific communication skills
9. To encourage the pursuit of lifelong education
10. To develop each student into a committed individual with ethical and social responsibility

**Programme Specific objectives:**

The students who complete the M.Sc. Chemistry (**Chemistry of foods, drugs and water analysis specialization**) course shall:

1. Have strong foundation in the fundamentals and applications of chemical knowledge and understanding
2. Have the abilities to think critically, logically and analytically and solve problem in the area of chemical sciences, drug chemistry, medicinal chemistry and water pollution
3. Have the abilities to carry out chemical experiments, record and analyze the results and design advanced models
4. Have the abilities to use modern library and information retrieving tools to obtain information and assimilate to generate concepts and apply them in challenging situations
5. Have the abilities to effectively communicate their knowledge and skills to other chemists and non-chemists in oral or written formats
6. Secure suitable employment in the areas of chemical industries like pharmaceutical (R&D, QA & QC), polymers, , environmental and pollution control, nanotechnology and composite materials, teaching and research, etc.
7. Have the personal attributes and ethical sensibilities to enable them to function as effective scientists and citizens

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### SEMESTER-III

### Paper -I: Chemistry of Drugs -I

**Course Objectives: To make the students**

CO 1: Acquire the knowledge of introduction to drugs, CNS drugs, analgesics, drugs forallergic and urinary infections

CO 2: Understand introduction to drugs, CNS drugs, analgesics, drugs for allergic andurinary infections

CO 3: Apply the knowledge and understanding of in new situations introduction todrugs, CNS drugs, analgesics, drugs for allergic and urinary infections

CO 4: Develop interest in the areas introduction to drugs, CNS drugs, analgesics, drugsfor allergic and urinary infections

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain introduction to drugs, CNS drugs, analgesics, drugs for allergic and urinaryinfections
LO 2: Interpret introduction to drugs, CNS drugs, analgesics, drugs for allergic andurinary infections
LO 3: Compare introduction to drugs, CNS drugs, analgesics, drugs for allergic andurinary infections
LO 4: Analyse introduction to drugs, CNS drugs, analgesics, drugs for allergic andurinary infections
LO 5: Solve introduction to drugs, CNS drugs, analgesics, drugs for allergic and urinaryinfections
LO 6: Identify introduction to drugs, CNS drugs, analgesics, drugs for allergic and urinaryinfections
LO 7: Apply introduction to drugs, CNS drugs, analgesics, drugs for allergic and urinaryinfections

COURSE CONTENT

**Unit-I: Introduction to Drugs**

Basic consideration of drugs: Classification, nomenclature, metabolism. Development ofdrugs: Sources, Genesis of drugs – molecular modification general and special processes:prodrugs (prolongation of action, shortening of action, drug localisation, transport regulation, adjunct to pharmaceutical formulation).Rational drug design. Theoretical aspects of drugaction: Structure–activity relationship(SAR), physicochemical parameters andpharmacological activity; drug receptors; mechanism of drug action.

**Unit-II: CNS Drugs**

Drugs affecting the central nervous system: Sedatives and hypnotics -Barbiturates (structure- activity relationship, metabolism); benzodiazepines (structure-activity relationship, metabolism); Synthesis of phenobarbital, hexobarbital, nitrazepam and oxazepam. Anaesthetics: General anaesthetics; local anaesthetics- Mode of action, structure-activity relationships. Synthesis of methohexital and chloro-procaine.

**Unit-III: Analgesics:**

Analgesics: Synthetic analgesics, structure - activity relationships, antipyretic analgesics, ant-inflammatory analgesics, metabolism and mode of action. Opioid analgesics and antagonists. Synthesis of meperidine , methadone and 6,7 -benzomorphans. Tranquilizers: phenothiazine derivatives - structure activity relationship, metabolism and mode of action; Synthesis of chlopromazine.

**Unit-IV: ANS Drugs**

Drugs acting on autonomous nervous system (ANS). Adrenergic agents: Chemical classification, structure activity relationship, mode of action; Adrenergic blocking agents: Synthesis Ephedrine, propranolol, methyl dopa; cholinergic agents: Classification, structure - activity relationships, therapeutic actions. Cholinergic blocking agents: chemical classification, Synthesis: Cyclopentolate. ganglionic blocking agents.

**Unit-V Drugs curing allergic and urinary infection:** Drugs curing allergic and urinary infection: Antihistamines: chemical classification; metabolism, structure activity relationship, mode of action. Synthesis: Diphenhydramine, tripelånnamine, chlorcyclizine, promethazine. Diuretics (Drugs acting on renal system): Classification, structure activity relationships and mode of action of organomercurials, phenoxy acetic acids, purines carbonic anhydrase inhibitors, benzothiadiazines, sulphamoyl benzoic acid derivatives, endocrine antagonists. Synthesis: Meralluride, acetazolamide, furosemide.

**Text Books**:


1. Essentials of medicinal chemistry , eds., Korolkovas and Burkhaltar, J.H., John wiley& sons.
2. Text book of Organic medicinal and pharmaceutical chemistry by Wilson and Gisvold.
3. Synthetic drugs by O. D. Tyagi.
4. Swinyard, E.A., " Remington's phramaceutical sciences ", Ed., Artor Osal, Mackpublishing company co., 1980, p.873.
5. Medicinal Chemistry, Volume ed. Burger.
6. The Organic Chemistry of Drug synthesis by Daniel Lednicer and Lester A.Mitscher

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### SEMESTER-III

### PAPER -II: CHEMISTRY OF DRUGS –II

**Course Objectives:**

CO 1: Acquire the knowledge of drugs related to infectious diseases, anti-neoplastic,antibiotics, steroidal and non-steroidal hormones

CO 2: Understand drugs related to infectious diseases, anti-neoplastic, antibiotics,steroidal and non-steroidal hormones

CO 3: Apply the knowledge and understanding of drugs related to infectious diseases,anti-neoplastic, antibiotics, steroidal and non-steroidal hormones in new situations

CO 4: Develop interest in the areas drugs related to infectious diseases, anti-neoplastic,antibiotics, steroidal and non-steroidal hormones

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidaland non-steroidal hormones and their synthesis

LO 2: Interpret drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidaland non-steroidal hormones and their synthesis

LO 3: Compare drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidaland non-steroidal hormones and their synthesis

LO 4: Analyse drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidaland non-steroidal hormones and their synthesis

LO 5: Solve drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidal andnon-steroidal hormones and their synthesis

LO 6: Identify drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidaland non-steroidal hormones and their synthesis

LO 7: Apply drugs related to infectious diseases, anti-neoplastic, antibiotics, steroidal andnon-steroidal hormones and their synthesis

### COURSE CONTENT

**UNIT-I: Drugs Acting on Infectious Diseases:** Anthelmintic agents - Synthesis of diethyl carbamazine, niclosamide. Anti-tubercular drugs - synthesis of isoniazide, p-amino salicylic acid and thiacetazone. Antilepral drugs - Synthesis of dapsone, clofazimine Sulpha Drugs: Classification, structure - activity relationship, mode of action. Synthesis: Sulphadiazine, sulphaisoxazole, sulphadimethoxine.

**UNIT-II: Antineoplastic Drugs:**

Classification; Synthesis: Chlorambucil, mercaptapurine Anti-AIDS and Anti-viral agents (A brief study and medicinal importance) Antimalarial Drugs - Classification Synthesis of Chloroquine

**UNIT-III: Plant drugs and Antibiotics Plant drugs:** Chemical composition, characteristics and therapeutic applications of the following plant drugs - Digitalis, strophanthus, ergot, opium, strychnosnux vomica, ipecacuanha, rauwolfia. Antibiotics: Brief account on the chemistry and mode of action of penicillins, cephalosporins, chloramphenicol, streptomycine and tetracyclines; Synthesis: chloramphenicol, Penicillin G.

**UNIT-IV: Steroidal Drugs**

Brief account on the chemistry, structure - activity relationship and mode of action of estrogens, progestogens, androgens and anabolic agents and adrenal cortex hormones. Synthesis: Estrone, estradiol, progesterone, testosterone, cortisone.

**UNIT-V: Non-steroidal hormones:** Brief account on the non-steroidal hormones and their functions - thyroid, para thyroid, pituitary and pancreas hormones. Synthesis: Thyroxine, adrenaline.

**Text Books:**


1. Essentials of medicinal chemistry , eds., Korolkovas and Burkhaltar, J.H., John wiley& sons .
2. Text book of Organic medicinal and pharmaceutical chemistry by Wilson and Gisvold.
3. Synthetic drugs by O. D. Tyagi.
4. Swinyard, E.A., " Remington's phramaceutical sciences ", Ed., Artor Osal, Mackpublishing company co., 1980, p.873.
5. Medicinal Chemistry Volumes, ed. Burger.
6. The Organic Chemistry of Drug synthesis by Daniel Lednicer and Lester A. Mitscher

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### SEMESTER-III

### Paper -III: Drug Analysis –I

**Course Objectives: To make the students**

CO 1: Acquire the knowledge of characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

CO 2: Understand characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

CO 3: Apply the knowledge and understanding of characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy in new situations

CO 4: Develop interest in the areas characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 2: Interpret characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 3: Compare characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 4: Analyse characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 5: Solve characterization and quantification of drugs, separation techniques, quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 6: Identify characterization and quantification of drugs, separation techniques,quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

LO 7: Apply characterization and quantification of drugs, separation techniques,quantitative methods of analysis, hyphenated analytical techniques and spectroscopy

## COURSE CONTENT

**UNIT-I: Properties of Drugs**

General discussion Elementary explanation of IP, BP and USP. General Idea of the propertiesof drugs (due to presence of analytically useful groups) for their Characterisation and quantification. The typical drugs included barbiturates, carbamic acid derivatives, anti-pyretic analgesics, local anaesthetics, organometallic compounds, Sampling, identification tests, and limiting tests.

**UNIT-II: Separation Techniques**

Separation techniques - Principles of quantitative separations, solvent extraction. General idea on chromatographic separations of drugs - adsorption, ion exchange, paper, thin layer, molecular sieving, electrophoresis.

**Unit-III: Quantitative Methods of Analysis** Quantitative methods of analysis Gravimetric analysis, volumetric estimations (acid-base, aqueous and non aqueous media; redox; precipitation and complex formation). Traditional and electrical properties: potentiometric, coulometric, amperometric and biamperometric titrations.

**Unit-IV: Hyphenated Analytical Techniques** Gas liquid chromatography and high performance liquid chromatography, polarography, polarimetry the techniques employed in the determination of drugs - Sulpha drugs, antibiotics (Penicillins, cephalosporins, tetracyclines, chlorampenicol, streptomycin, cárdiac glycosides. General idea of the techniques employed in the determination of drugs.

**Unit-V: Spectroscopy:** Colorimetry & UV-Visible Spectrophotometry, IR Spectrophotometry, fluorimetry, NMR and Mass spectrophotometry.

**Text Books:**


1. Analytical chemistry by Gary D. Christian, John Wiley & sons
2. Pharmaceutical analysis by T. Higuchi and Brochmann Haussen.
3. Pharmaceutical chemistry ( Volumes I&II) by L.G. Chattan (for analytical techniques)
4. Practical Pharmaceutical chemistry by AÉ. Beckett and J.B.Stanlake (for limiting)tests only.
5. Pharmacognacy by C.S. Shaw and J.S. Qudry.
6. Microbiology by M.J. Pelezar and R.D. Reld ( for Microbiological assays only)
7. Instrumental Methods of Chemicial Analysis by Chatwal and Anand
8. Instrumental Methods of Chemicial Analysis by B. K. Sharma
9. Drugs and Cosmetics act.

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**SEMESTER-III**

### Paper -IV: Drug analysis –II

**Course Objectives: To make the students**

CO 1: Acquire the knowledge of good laboratory practices, microscopic techniques, physic-chemical assay of drugs and their application and drug act

CO 2: Understand good laboratory practices, microscopic techniques, physic-chemical assay of drugs and their application and drug act

CO 3: Apply the knowledge and understanding of good laboratory practices, microscopic techniques, physic-chemical assay of drugs and their application and drug act in new situations

CO 4: Develop interest in the areas good laboratory practices, microscopic techniques, physic-chemical assay of drugs and their application and drug act

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain good laboratory practices, microscopic techniques, physic-chemical assayof drugs and their application and drug act

LO 2: Interpret good laboratory practices, microscopic techniques, physic-chemical assayof drugs and their application and drug act

LO 3: Compare good laboratory practices, microscopic techniques, physic-chemical assayof drugs and their application and drug act

LO 4: Analyse good laboratory practices, microscopic techniques, physic-chemical assayof drugs and their application and drug act

LO 5: Solve good laboratory practices, microscopic techniques, physic-chemical assay ofdrugs and their application and drug act

LO 6: Identify good laboratory practices, microscopic techniques, physic-chemical assayof drugs and their application and drug act

LO 7: apply good laboratory practices, microscopic techniques, physic-chemical assay ofdrugs and their application and drug act

## COURSE CONTENT

**UNIT-I: Good Laboratory Practices** Method validation and quality assurance for testing laboratories; Hierarchy of analytical methodology (technique, method, procedure, protocol) validation process: selectivity, linearity, accuracy, precision, sensitivity, range, limit of detection, limit of quantification, ruggedness or robustness. Quality assurance: control charts, documenting and archiving, proficiency testing, and laboratory accreditation. Reliability of analytical data: Errors in chemical analysis, classification of errors, determining the accuracy of methods, improving accuracy of analysis, statistical analysis, rejection of results, presentation of data.

**UNIT-II: Microscopic Techniques** Microbiology and microscopic examination of plant drugs General procedure for microbiological assays of antibiotics and disinfectants. Elementary treatment of methods (morphological, chemical and pharmacological) suitable for characterization of plant drugs, Evaluation of plant drugs through microscopical examination. The plant drugs include Digitalis, strophanthus, ergot, opium, strychnos nux vomica , ipeca caunha , rauwolfia.

**UNIT-III: Physicochemical Assay of Drugs** Applicability of physicochemical methods for the assay of drugs (any four different methods) based on the presence of analytical useful groups barbiturates, carbamic acid derivatives, anti- pyretic analgesics, local anesthetics, organometallic compounds

**UNIT-IV: Application of Physicochemical Assay of Drugs** Applicability of physicochemical methods for the assay of drugs (any four different methods) Sulpha drugs, antibiotics (penicillin, cephalosporin, tetracycline, chloramphenicol, streptomycin) and cardiac glycosides. Use of the reagents for the determination of drugs - metol oxidant, fast green FCF, Gibbs reagent, cobalt thiocyanate, MBTH.

**UNIT-V: Drug Act**

Brief account of drugs and cosmetics act: Definitions of terms – drug quality , adulterated drug, misbranded drugs, imported drugs functions of the drugs, technical advisory board and central drug laboratories; Duties of government analyst and drug inspectors; packing and labelling of drugs; conditions for sale and license conditions for manufacture and license.

**Text Books:**


1. Analytical chemistry by Gary D. christian, John wiley & sons
2. Pharmaceutical analysis by T. Higuchi and Brochmann Haussen.
3. Pharmaceutical chemistry (Volumes I&II) by L.G. Chattan (for analytical techniques)
4. Practical Pharmaceutical chemistry by AÉ. Beckett and J.B.Stanlake (for limiting)tests only.
5. Pharmacognacy by C.S. Shaw and J.S. Qudry.
6. Microbiology by M.J. Pelezar and R.D. Reld ( for Microbiological assays only)
7. Instrumental Methods of Chemical Analysis by Chatwal and Anand
8. Instrumental Methods of Chemical Analysis by B.K. Sharma
9. Drugs and Cosmetics act.

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**SEMESTER-III**

**III SEMESTER PRACTICALS - SYLLABUS** (w.e.f. 2015-16 admitted batch)

**Practical-I: Drug analysis-I**

1. Assay of typical drugs in dosage forms following procedures incorporated in I.P.B.P. or U.S.P:

(a) Acid-base titrations: Ephedrine hydrochloride, Adrenaline hydrochloride, barbitone sodium;
(b) Redox titrations: Aminacrine hydrochloride, benzocaine, ascorbic acid, crystal violet, isoniazid
(c) Complexometric titrations: Calcium gluconate, aluminium hydroxide gel;
(d) Precipitation titrations: Gammaxene; chlorambutol;
(e) Amodiaquine hydrochloride, Vitamin $B_1$ (Gravimetric);

2. Limiting tests for:
(a) Tracer elements ( lead, arsenic, iron)
(b) Organic toxicants;
(c) Determinations of moisture and volatile oil in drugs

3. Microscopical characterstics of plant drugs: Belladona, cinchona, ipecac, Nuxvomica digitalis, ergot, Rauwolfia Datura, clove, corriandor

**Practical-II: Drug analysis-II**

1. (a) Conductometric titrations: Phenol
(b) Potentiometric titrations: Phenobarbitone, Ferrous gluconate
(c) Biamperometric titrations: Sulphadrugs;
(d) Fluorimetric analysis, Quinine, Thiamine;
(e) Colorimetric analysis: sulphadrugs, folic acid, Acetyl salicyclic acid, chlororamphenicol , tetracycline;
(f) I.R. Spectrophotometry: Phenacetin
(g) UV spectrometry: Cortisone acetate , Ethisterone, Reserpine.

2. Separation and estimation of drugs
(a) Nuxvomica seeds - Belladona tincture ( Solvent extraction)
(b) Ephedrine hydrochloride ( ion-exchange chromatrography)
(c) Babiturates, Carbohydrates ( Paper and thin layer chromatography)
(d) Proteins and amino acids ( electrophoresis and molecular sieving)
(e) HPLC ( one or two experiments in detail)
(f) GC ( one or two experiments in detail)

MODEL QUESTION PAPER

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**SEMESTER-III**

Paper - I : CHEMISTRY OF DRUGS -I

Time : Three hours Maximum : 80 (16x5=80)Marks

Answer ALL questions

All questions carries equal marks

Unit-I

1.(a) Write notes on classification of drugs and Nomenclature

(b) What is a " prodrug " ? Explain with examples

Or

(a ) Explain " Drug Metabolism " in detail with examples

(b) Explain the following :

(i) Structure -activity of drug action

(ii) Drug Receptors

Unit-II

2. (a) Give a brief account on structure -activity relationship and mode of action of
(i) Barbiturates

(b) Give the SAR activity and metabolism of Benzodiazepines

Or

(a) Write a brief notes on Sedatives and Hypnotics with examples.

(b) Give the synthesis of Nitrazepam and Oxazepam.

Unit-III

3. (a) What are Analgesics? Write notes on antipyretic analgesics with examples

(b) Give the synthesis of Meperidine and Methadone

Or

(a) What are Tranquilizers? Write the synthesis of Chlopromazine.

(b) Write notes on SAR activity of phenothiazine derivatives.

Unit-IV

4. (a) Describe briefly the drugs acting on " Autonomous nervous system" with examples
   (b) Give the mechanism and synthesis of methyl dopa

Or

(a) Write the mechanism and synthesis of Propranolol

(b) Discuss briefly about the Cholenergic and Ganglionic blocking agents

Unit-V

5. (a) What are Antihistamines? Explain their chemical classification and metabolism

(b) Give the synthesis of Diphenhydramine and Prometathazine.

Or

(a) What are Diuretics? Explain with reference to Organomercurals.

(b) Give the synthesis of Meralluride and Furosemide.

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**SEMESTER-III**

**PAPER-II-Chemistry of Drugs -II**

**Answer one question from each Unit**
**All questions carry equal marks**

**Time: 3 Hours**

**Max.Marks.80 (16x5=80)**

## Unit -1

1) ( a) What are Anthelmintic agents? write the synthesis of diethyl carbamazine & niclosamide

(b) Write structure activity relationship & mode of action of sulphadrugs.

**or**

(a) Write about lepral drugs & their synthesis of dapsone & Clofazimine

(b) What are Antitubercular drugs & write synthesis of

1) Isoniazide

2) p-amino salicylic acid

3) Thiacetazone

## Unit -2

2. (a) Write about classification of Antineoplastics & synthens of chlorambucil & mercaptapurine.

(b) Write about brief study &medical importance of Anti rival agents

**or**

(a) Give explanatory note on AIDS & HIV transmission takes place & what are drugs for treatment of AIDS.

(b) What are antivalarial drugs & discribe about classification & synthesis of chloroquine?

## Unit- 3

3. (a) Discuss briefly about chemical composition, characteristics & therapeutic applications of Opium, Rasswolfia.

   (b) Give brief account on synthesis and mode of action of

   1) chloromphenicol
   2) streptomycine

   or

   (a) Discuss briefly about chemical composition, characteristics & therapeutic applications of nux vomica, Strophanthus

   (b) Give brief account on synthesis and mode of action of

   i) pencillin-G

   ii) cephalosporin

## Unit- 4

4. (a) Discuss briefly chemistry and structure activity relationship of Estrogen.

   (b) Discuss briefly about chemistry and structure activity relation of Adrenal cortex hormones

   or

   (a) Write Synthesis of Estrone, Estradiol

   (b) Write Synthesis of progesterone, testosterone

## Unit- 5

5. (a) What are non steroidal hormones? write Brief note on thyroid hormones?

   (b) Write brief account on para-thyroid and pituitary hormones ?

   **or**

   (a) write Synthesis of Thyloxine, adraniline,

   (b) write brief account of Pancreatic hormones?

MODEL QUESTION PAPER

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**SEMESTER-III**

# Paper -III – DRUG ANALYSIS – I

Answer one question from each unit
All questions carry equal marks

Time: Three hours Maximum marks: 80 (16x5=80)

## Unit – I

1. a) How do you differ between IP, BP and USP? Give simple explanation for them
   b) Explain briefly the structural features of the following category of drugs necessary for the characterization and quantification.
   I. Barbiturates II.Antipyretic analgesics

(OR)

a) Explain briefly about the methods involved in characterization and quantification of drugs:-
I. Organometallic compounds
b) Describe briefly about the limit tests for As, Pb in drug.

Unit –II

2. a) Explain the principle involved in electrophoresis and its suitability for drugs.
   b) Thin layer chromatography plays an important role for the determination of certain drugs. Explain briefly.

(OR)

a) Give the general principle involved in the quantitative separation and explain about column chromatography.

b) Paper chromatography plays a vital role for the determination of certain drugs. Explain briefly.

Unit –III

3. a) Write about gravimetric analysis ?
   b) Give detailed explanation about volumetric analysis

(OR)

a) Discuss briefly about potentiometric and coulometric titrations and give one example.
b) Discuss briefly about amperometric and biamperometric titrations?

Unit –IV

4. a) Write briefly about Gas liquid chromatography.
   b) Write briefly about techniques employed in determination of penicillin and tetracyclin ?

(OR)

a) Write briefly about principle and instrumentation involved in HPLC technique and its suitability for drugs.
b) Write any four methods of characterization of Chloramphenicol.

Unit –V

5. Discuss the principle and instrumentation employed in the following technique and its suitability for the assay of certain drugs.
   a) UV Spectrophotometry
   b) Visible Spectrophotometry

(OR)

a) Give a detailed discussion about Chromophores, auxophores and Wade's rule.
b) What is Nitrogen rule? And write about fragmentation pattern of carbonyl compounds?

MODEL QUESTION PAPER

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**SEMESTER-III**

# Paper -IV – DRUG ANALYSIS – II

Answer one question from each unit
All questions carry equal marks

Time: Three hours Maximum marks: 80 (16x5=80)

## Unit – I

1. a) Write the hierarchy of analytical methodology and explain about the validation process
   b) Linearity 2. Sensitivity 3. Accuracy

(OR)

a) Write a short notes about:
   1) Documenting and archiving 2) Proficiency testing
   3) Laboratory Accreditation
b) Explain the classification of errors and their chemical analysis and determine the accuracy of methods.

## Unit – II

2. a) Explain about the morphological, chemical and pharmacological characteristics of the plant drugs.

b) write the characterization and quantification of the plant drugs Digitalis & opium.

(OR)

a) write the microscopical examination of any two plant drugs.
b) Explain the microbiological assays of antibiotics and disinfectants.

## Unit – III

3. a) Explain any four different analytically useful group on :
   1) Barbiturates 2. Carbamic acid derivatives
   b) Write the physiochemical methods of any two drugs.

(OR)

a) Explain the four different physiochemical methods of different organometallic compounds.
b) Write a short note on:
   1. Antipyretic analgesics
   2. Local Anesthetics

**Unit – IV**

4. a) Write any four methods for the identification and detection of:
   1. Sulpha drugs
   2. Penicillin
   b) Explain the four different Physiochemical methods for the assay of drugs:
   1) cardiac glycosides
   2) Chloramphenicol

(OR)

a) Give a detailed note on
   1. Gibbs reagent
   2. Metol
b) Give a detailed note on
   1. Fast green FCF
   2. Cobalt thiocyanate

5. a) What are the duties of Government Analyst and Drug inspector?
   b) Brief account on:
   1. Drug quality
   2. Adulterated drug

(OR)

a) Explain briefly about branded and misbranded drugs.
b) What are the duties of central drug laboratories?

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### SEMESTER-IV

### PAPER-I: CHEMISTRY OF FOODS –I

**Course Objectives:**

CO 1: Acquire the knowledge of foods, food quality, food additives, pigments and coloursand vitamins

CO 2: Understand foods, food quality, food additives, pigments and colours and vitamins CO 3: Apply the knowledge and understanding of foods, food quality, food additives, pigments and colours and vitamins in new situations

CO 4: Develop interest in the areas foods, food quality, food additives, pigments andcolours and vitamins

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain foods, food quality, food additives, pigments and colours and vitamins

LO 2: Interpret foods, food quality, food additives, pigments and colours and vitamins

LO 3: Compare foods, food quality, food additives, pigments and colours and vitamins

LO 4: Analyse foods, food quality, food additives, pigments and colours and vitamins

LO 5: Solve issues related to foods, food quality, food additives, pigments and coloursand vitamins

LO 6: Identify foods, food quality, food additives, pigments and colours and vitaminsLO 7: apply foods, food quality, food additives, pigments and colours and vitamins

COURSE CONTENT

**UNIT-I: Introduction to Foods**

Classification, Chemical Composition and Nutritional value of common food stuffs, properties of foods. Food preservation and processing: Food deterioration, methods of preservation and processing by heat, cold, chill storage, deep freezing, drying, concentration, fermentation and radiation.

**UNIT-II: Food Quality**

Sensory evaluation, objective methods, non-nutritional constituents and food safety.

**UNIT-III: Food Additives**

Permitted food additives and their role: Antioxidants, coloring agents, flavors, emulsifiers, curating agents, non-nutritive sweeteners, flour improvers, leavening agents, stabilizers, thickeners and preservatives.

**Unit-IV: Pigments and Colours**

Chlorophylls, myoglobin and hemoglobin, anthocyanins, flavonoids, tannins, belalains, quinones, xanthones, carotenoids.

**Unit-V: Vitamins**

Classification, functions requirements, distribution in foods, loss during processing, effects of deficiency and characteristic properties of vitamins – B1 (Thiamine), B2(Riboflavin), B3(Pantothenic acid), B6(pyridoxine), B12( Cyanocobalamine), H(Biotin), P(Rutin) C(ascorbic acid) A(Retinol),D (Calciferol), E(Tocopherol) K(naphthoquinone), Folic acid(PGA) and Niacin.

**Text Books:**


1. Food Chemistry by L.W. Aurand and A.E. woods the AVI Publising Inc.
2. Food Chemistry by L.H. Meyer, Affliated East- West press Ltd, New Delhi.
3. Foods- Facts and principles by N. Shakuntala Manay, M. Shdakshara Swamy.
4. Principles of Food Chemistry by John M. deMan.
5. Principles of Food Science, Part I,Food Chemistry edited by Owen R. Fennama ,Mareal Dekker, Inc., New York.
6. Hand book of Food and Nutrition by M. Swaminathan.

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### SEMESTER-IV

### Paper - II: Chemistry of Foods – II

**Course Objectives: To make the students**

CO 1: Acquire the knowledge of enzymes, carbohydrates and their metabolism, proteins,amino acids and lipids
CO 2: Understand enzymes, carbohydrates and their metabolism, proteins, amino acidsand lipids
CO 3: Apply the knowledge and understanding of enzymes, carbohydrates and theirmetabolism, proteins, amino acids and lipids in new situations
CO 4: Develop interest in the areas enzymes, carbohydrates and their metabolism,proteins, amino acids and lipids

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids
LO 2: Interpret enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids
LO 3: Compare enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids
LO 4: Analyse enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids
LO 5: Solve issues related to enzymes, carbohydrates and their metabolism, proteins,amino acids and lipids
LO 6: Identify enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids
LO 7: apply enzymes, carbohydrates and their metabolism, proteins, amino acids andlipids

**COURSE CONTENT**

**UNIT-I: Enzymes**

Enzymes: Classification, specificity, factors effecting the rate of enzyme catalyzed reactions, enzyme inhibitors, enzymic browning, enzymes in food processing - carbohydrates, proteases, lipases, oxidoreductases. Water: Physical properties, structure of water molecule, bound water.

**UNIT-II: Carbohydrates**

Carbohydrates: Classification, reactions of simple sugars; Oxidation, reduction, condensation with phenyl hydrazine, action of alkalis, action of acids, formation of esters, formation of coloured products. Function of sugars in foods - Browning reaction(non-enzymic). Polysaccharides: Brief study of the chemistry - starch dextrin, glycogen, cellulose, hemicellulose, pectic substances, gums. Sweetness of sugars, relation of structure tosweetness.

**UNIT-III: Carbohydrate Metabolism**

Carbohydrate metabolism: Inter-conversion of hexoses in liver, anaerobic metabolism of glucose, krebs citric acid cycle, glyoxalate cycle, pentose phosphate path way.

**UNIT-IV: Amino acids and Proteins** Amino acids - classification, properties; food proteins -

classification, protein structure, properties of proteins, denaturation, and protein gels, protolithic enzymes, chemistry of nucleic acids and their role in protein synthesis.

**UNIT-V: Lipids**

Classification, role of lipids, fatty acids and glycerol derived from oils and fats; Physical properties - polymorphism, reactions of fats, rancidity, reversion, polymerisation, saponification, addition, hydrogenation, phospholipids, lipid metabolism; intermediary metabolism of fatty acids, synthesis of fatty acids.

**Text Books:**


1. Food Chemistry by L.W. Aurand and A.E. woods the AVI Publising Inc.
2. Food Chemistry by L.H. Meyer, Affliated East- West press Ltd, New Delhi.
3. Foods- Facts and principles by N. Shakuntala Manay, M. Shdakshara Swamy.
4. Principles of Food Chemistry by John M. deMan.
5. Principles of Food Science, Part I,Food Chemistry edited by Owen R. Fennama,Mareal Dekker, Inc., New York.
6. Hand book of Food and Nutrition by M. Swaminathan .

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### SEMESTER-IV

### Paper-III: Food Analysis – I

**Course Objectives:**

CO 1: Acquire the knowledge of food standards, assessment of vitamins, minerals and pesticides, preservatives, anti-oxidants and food adulteration

CO 2: Understand food standards, assessment of vitamins, minerals and pesticides, preservatives, anti-oxidants and food adulteration

CO 3: Apply the knowledge and understanding of food standards, assessment of vitamins, minerals and pesticides, preservatives, anti-oxidants and food adulteration in new situations

CO 4: Develop interest in the areas foods, food quality, food additives, pigments and colours and vitamins

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

LO 2: Interpret food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

LO 3: Compare food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

LO 4: Analyse food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

LO 5: Solve issues related to food standards, assessment of vitamins, minerals andpesticides, preservatives, anti-oxidants and food adulteration

LO 6: Identify food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

LO 7: apply food standards, assessment of vitamins, minerals and pesticides,preservatives, anti-oxidants and food adulteration

COURSE CONTENT

**UNIT-I: Food Standards**

Definitions of standards of quality Assessment of quality using routine and official methods of analysis and interpretation of analytical results: General methods for the determination of components: carbohydrates, proteins, amino acids, fats, mineral matter, moisture, crude fibre, synthetic dyes.

**UNIT-II: Assessment of Vitamins** Methods for the determination of Water soluble vitamins :(B1, B2, B3, B5, B12, C and Folic acid) and fat soluble vitamins: (A, D, E and K) by visible spectrophotmetric technique only.

**UNIT-III: Minerals and Pesticides** Inorganic components (minerals): arsenic, cadmium, copper, lead, mercury, zinc, fluorine, sodium, potassium, calcium, phosphorous. Pesticides: thin layer chromatography and gas liquid chromatography as tools for organophosphorous and organo chlorine pesticides .

**UNIT-IV: Preservatives and Antioxidants** Preservatives: (sulphur dioxide, benzoic acid, 4 hydroxy benzoic acid, nitrite, sorbic acid). antioxidants: (Gallates, butylated hydroxy anisole,butylated hydroxyl toluene). Fungal toxins (afflatoxins). Restriction on the use of colouring matter, preservatives, antioxidants, non- nutritive sweeteners and insecticides; contaminants in foods.

**UNIT-V: Food Adulteration**

Prevention of food adulteration act: definition of the terms- Food, nutritional food, adulterant, adulteration, misbranded common instances of adulteration in foods, central committee for food standards and central food laboratories and their functions; public analyst and Food inspectors and their duties. Packing and labelling of foods, conditions for sale and licence, conditions for manufacture and licence;

**Text Books:**


1. The Chemical analysis of foods by D. Pearson.
2. Food adulteration by Thankamma Jacob
3. Prevention of food adulteration act, Government of India and Ministry of health.
4. Food analysis by Wood man.
5. Instrumental methods of food analysis by A.J. Macleod.
6. Fruit and vegetable analysis by Ranganna.
7. Analysis of Water by J. Rodier.
8. The examination of water and water supplies by Edwin windle Taylor.
9. Instrumental analysis for water pollution control by Mancy.
10. Method of sampling and test for $H_2O$ used in industry – ISI.

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**SEMESTER-IV**

**Paper - IV: Food Analysis –II**

**Course Objectives:**

CO 1: Acquire the knowledge of sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oils and fats and water and its analysis

CO 2: Understand sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oils and fats and water and its analysis

CO 3: Apply the knowledge and understanding of sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oils and fats and water and its analysis in new situations

CO 4: Develop interest in the areas sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oils and fats and water and its analysis

**Learning Outcomes:** At the end of the course, the learners should be able to:

LO 1: Explain sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oilsand fats and water and its analysis

LO 2: Interpret sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oilsand fats and water and its analysis

LO 3: Compare sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oilsand fats and water and its analysis

LO 4: Analyse sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oilsand fats and water and its analysis

LO 5: Solve issues related to sugars, non-alcoholic and alcoholic beverages, meat andfish, edible oils and fats and water and its analysis

LO 6: Identify sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oilsand fats and water and its analysis

LO 7: apply sugars, non-alcoholic and alcoholic beverages, meat and fish, edible oils andfats and water and its analysis

COURSE CONTENT

**UNIT-I: Sugars**

Honey sugar, cane sugar, jams and jellies. Fruits and Vegetables: Fruits, canned fruits, pickles, fruit juices, soft drinks, cereals and flours; Wheat flour, Maida, bread, rice.

**UNIT-II: Non-alcoholic and Alcoholic beverages** Non-alcoholic beverages: Analysis of tea, coffee and cocoa; soft drinks. Alcoholic beverages (Fermentation products); Wine, brandy, whisky, beer chider, vinegar.

**UNIT-III: Meat and Fish**

Meat: composition, nutritional value, assessment of spoilage of raw meat and cured meat, Sausage meat, meat extract. Fish: Raw fish, canned fish, fish caves - nutritional value and spoilage assessment.

**UNIT-IV: Edible Oils and Fats**

Edible oils and fats: General study of the quality assessment. Herbs and Spices. Dairy products: Quality assessment of milk, butter, ghee, milk powder and ice-cream. Toxic elements (chromium, fluorine, arsenic and lead), undesirable elements (aluminium, copper, iron, manganese and zine), bacteriological analysis (detection and count of bacteria indicating faecal pollution).

**UNIT-V: Water Analysis**

Water sampling, determination of the origin of infiltration's, organoleptic characterization, preliminary examination, physicochemical determination. Chemical and microbiological constituents of water; acidity and alkalinity, anions (phosphate, chloride, nitrite, nitrate, sulphate, silica), Cations (calcium, magnesium), chemical pollution indicators (free and saline

ammonia albuminoidal ammonia, Organic nitrogen, oxygen consumed by permanganate,chemical and biological oxygen demand),

**Text Books:**


1. The Chemical analysis of foods by D. Pearson.
2. Food adulteration by Thankamma Jacob.
3. Prevention of food adulteration act, Government of India and Ministry of health.
4. Food analysis by Wood man.
5. Instrumental methods of food analysis by A.J. Macleod.
6. Fruit and vegetable analysis by Ranganna.
7. Analysis of Water by J. Rodier.
8. The examination of water and water suppliés by Edwin windle Taylor.
9. Instrumental analysis for water pollution contrle by Mancy.

Method of sampling and test for H20 used in industry – IS

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**SEMESTER-IV**

**IV SEMESTER PRACTICALS - SYLLABUS** (w.e.f.2015-16 admitted batch)

## Practical-I: FOOD ANALYSIS

I. General methods for the determination of :

(a) Common constituents in foods - moisture, crude protein, fat, crude fibre, glucose, sucrose, ash ( complete investigations)
(b) Additives in foods: colours ( coal tar dyes ) , preservatives ( sulphite, nitrite ) , antioxidants ( BHA, BHT )
(c) Contaminants in foods: Aflatoxins , Pesticides , metals
(d) Starches ( rice, wheat, barley, arrow root); Chemical and microscopical procedures.

II. Assessment of quality to judge suitability for human consumption using official methods of analysis and interpretation of analytical results:

(a) Dairy products - milk, ghee, milk powder;
(b) Oils and fats - vegetable oils;
(c) Flesh foods - Meat and fish;
(d) Poultry products - Eggs;
(e) Fermentation products - alcoholic beverages;
(f) Spices ;
(g) Non-alcoholic beverages - Coffee & Tea;
(h) Wheat products - Maida, Bread;
(i) Fruits & Vegetables - Fruit juice, jams;
(j) Sugars - Honey ;

## Practical-II: WATER ANALYSIS

Chemical and microbiological constituents of water.

Hardness
Acidity
Alkalnity

Anions ( Phosphate, Chloride, Nitrite, Sulphate, Silicate)
Cations ( Calcium & Magnesium )
Chemical pollution indicators ( free) saline ammonia and albunoid ammonia
Oxygen consumed by permanganate, COD , BOD
Toxic and undesirable elements : Chromium, Fluorine, arsenic, lead, iron, Mn, Zn
General procedure and quality assessment study of water

MODEL QUESTION PAPER

**ANDHRA UNIVERSITY**

**SCHOOL OF CHEMISTRY**

**Department of Organic Chemistry &FDW**

**Revised Syllabus for Chemistry Analysis of Foods, Drugs & Water Specialization**

**(With effect from the Admitted batch of 2021-2022 Academic Year)**

**SEMESTER-IV**

## Paper-I Chemistry of Foods - I

Time: Three hours Maximum marks: 80

Answer ALL questions

Each question carries equal marks 5x16 = 80 M

1. (a) Give the classification and 'Nutritional Value' of common food stuffs.

   (b) Write notes on Fermentation and Radiation used in food processing.

   Or

   (a) Explain Food deterioration with examples

   (b) Describe Chill storage and deep freezing with examples.

2. (a) Write notes on Food quality with examples .

   (b) Describe Objective methods in estimating food quality.

   Or

   (a) Explain 'Food safety' with examples.

   (b) Whar are "Non-nutritional constituents? Explain with examples

3. (a) Write notes on permitted food additives and their role in food chemistry

   (b) Give the applications of Thickeners and Preservatives in food industry

   Or

   (a) What are Non-nutritive sweeteners? Describe with examples

   (b) Explain the role of Emulsifiers and Curating agents in food applications.

4. (a) What are Pigments? Explain the colour chemistry relating to them

   (b) Write notes on Xanthones and Carotenoids

   Or

   (a) Give the similarities and differences between Myoglobin and Haemoglobin

   (b) Explain the source and structural aspects of Tannins and Betalins .

5. (a) Give the classification and distribution if Vitamins in foods.

   (b) Write the structure and importance of Vitamin B6 and B12

   Or

   (a) Explain the loss of vitamins during various food processing and their consequences

   (b) Write the sturucture, sources and importance of 'Calciferol and Tocopherol'

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**SEMESTER-IV**

## PAPER II-CHEMISTRY OF FOODS –II

**Answer one question from each Unit**
**All questions carry equal marks**

**Time: 3 Hours** **Max.Marks.80 (16x5=80)**

UNIT-I

1. (a) Write about enzymes used in food processing

   (b) Discuss briefly about enzyme inhibitors.

   (Or)

   (a)Write about physical properties and structure of water molecule.

   (b)Write briefly about bound Water.

UNIT-II

2. (a) Discuss briefly carbohydrates classification and write any two reactions of simple sugars.

   (b) Write about sweetness of sugars and how it is related to Structure

   (Or)

   (a) Write brief study of chemistry of Hemicellulose and pectin substances

   (b) write about non enzymatic browning reactions.

UNIT-III

3. (a) Explain briefly about HMP pathway of carbohydrate metabolism.

   (b)Explain briefly about glyoxolate cycle of carbohydrate metabolim

   (Or)

   (a) Explain briefly about Interconversion of Hexoses in liver .

   (b) Describe briefly about krebs citric acid cycle.

UNIT-IV

4. (a) Discuss briefly about amino acids classification and properties.

   (b) Write brief about Proteolytic enzymes

   (Or)

   (a) What are food proteins &write classification of proteins.

   (b) Write about protein structure and properties of protein.

UNIT-V

5. (a) Write about lipids classification and role of lipids.

   (b) Write about lipid metabolism and give synthesis of fattyacid.

   (Or)

   (a) Write about fatty acids and glycerides derived from oils and fats.

   (b) Write about polymerisation ,saponification and hydrogenation.

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**SEMESTER-IV**

## Paper -III – FOOD ANALYSIS – I

Answer one question from each unit
All questions carry equal marks

Time: Three hours Maximum marks: 80 (16x5=80)

### Unit – I

1. a) Write the methods for the estimation of coloring matter
   b) Write the methods for the estimation of Preservatives

(OR)

Describe the methods for determination of
a) (i) Carbohydrates (ii) Proteins

b) (i) Moisture (ii) ash

### Unit –II

2. Visible spectroscopic methods are useful in estimation of vitamin. Describe how the following are estimated

a) $B_1$ (b) E

(OR)

Visible spectroscopic methods are useful in estimation of vitamin. Describe how the following are estimated

a) A (b) D

### Unit –III

3. Describe the principle and method of estimation of the following

a) (i) Arsenic (ii) calcium

b) (i) potassium (ii) copper

(OR)

Write brief account about extraction, purification and identification (chromatographic separation ) of samples of
(a) Organo phosparous pesticides (b) Organo chlorine pesticides

### Unit –IV

4. Give a brief description on preservatives

a) (i) Sulphur dioxide (ii) 4-hydroxy benzoic acid

b) (i) Benzoic acid (ii) Sorbic acid

(OR)

Give a brief description of Antioxidants

a) (i) Gallates (ii) butylated hydroxyl toluene

b) (i) Fungal Toxins ( afflatoxins)

Unit –V

5. (a) (i) What is food adulteration?
(b) (ii) Mention briefly about misbranded common instances of adulteration in foods

(OR)

Write briefly about the qualifications, powers and duties of
(a) Food inspector.

(b) Central food laboratories

MODEL QUESTION PAPER

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**SEMESTER-IV**

## Paper -IV – FOOD ANALYSIS – II

Answer one question from each unit
All questions carry equal marks

Time: Three hours Maximum marks: 80 (16x5=80)

Unit – I

1. a) Describe the methods of analysis similar to specification in FSSAI act for quality assessment of sugars

   (i) Honey (ii) cane sugar

   b) Describe relevant analysis for the assessment of

   (i) Fruits (ii) Vegetables

   (OR)

   Describe relevant analysis for the assessment of
   (i) Cerals and flours

   (ii) Pickles

   (iii) soft drinks

Unit –II

2. What is meant by fermentation ? Describe how the following alcoholic beverages are manufactured by fermentation process.

   i) Brandy ii) whisky iii) Beer chider

   (OR)

   Describe the methods of analysis similar to specification in FSSAI act for quality assessment of non-alcoholic beverages.

   (a) (i) Tea (ii) Coffee

   (b) (i) Cocoa (ii) Soft drinks

Unit –III

3. Write brief account on composition, nutritional value, assessment of spoilage of

   (a) Raw meat (b) Sausage meat

   (OR)

   Write brief account on composition, nutritional value, spoilage assessment of

   (a) canned fish (b) Fish caves

Unit –IV

4. Describe the methods for the assessment of cleanliness & efficiency of heat treatment of milk and dairy products.

(OR)

(a) Describe the relevant test for assessment of edible oils and fats
(b) Describe the quality assessment methods for analysis of herbs & spices.

Unit –V

5. Write briefly sampling, determination of
(a) Cations (b) Anions

(OR)

Write brief note on chemical pollution indicators
(a) (i) Organic nitrogen (b) (ii) Chemical and biological oxygen demand.