M.Sc. CHEMISTRY - SYLLABUS

Effective from July 2022 onwards

PT. RAVISHANKAR SHUKLA UNIVERSITY
RAIPUR
CHHATTISGARH

SYLLABUS

CODE 321 & 322

M.Sc. CHEMISTRY

SEMESTER EXAMINATION

Effective from July 2022 onwards

PT. RAVISHANKAR SHUKLA UNIVERSITY

RAIPUR-492010, CHHATTISGARH

VISION

The vision of the School of Studies in Chemistry is to develop an environment of enthusiasm and passionate involvement with continuous advancement in chemical sciences for producing human resource with world-class competence and skills in pure & applications of chemical sciences by; 1) providing world-class and user-friendly teaching methodologies for students of advanced studies, 2) Inculcating the research temperament of user-folks under the inter-disciplinary platform of industry-academia-research institutes with promotion of research consultancies and collaborations with institutes of national and international importance

MISSION

1. To develop the school, a centre of excellence for higher education and knowledge resources
2. To promote understanding the value of self-learning, creating and competence building:
   a) By providing world-class education through university teaching departments and schools.
   b) By promoting inter-disciplinary research and professional consultancy services and student exchange program with institute of national and international repute
   c) By creating environment conducive to nurture creativity and scientific temper

M. Sc. Chemistry (Programme Outcome)

Students of M. Sc. in chemistry will:

- Learn the latest advancement in different branches of chemical sciences, under the designed syllabus for theory and laboratory courses and their learning performance will be examined through performance on assignments, semester examinations and laboratory experiments/project performances.
- Develop a thorough knowledge of experimental approaches to solving problems of a chemical sciences and will develop an ability to extend that knowledge to the solution of new problems.
- Have writing and oral communication skills in a scientific manner, with especial emphasis on chemical sciences.
- Have knowledge to design a research project in chemical sciences.
- Integrate and apply relevant knowledge to problems that emerge from the broader interdisciplinary subfields (life, environmental and material sciences).

Students majoring in chemistry will:

- Demonstrate his/her mastery in: advanced analytical tools, environmental chemistry, organic and biochemistry, inorganic, and physical chemistry.
- Demonstrate critical thinking and analytical problem-solving abilities. She/he will be able to integrate chemical concepts and ideas learned in lecture courses with skills learned in laboratories to formulate hypotheses, propose and perform experiments,

- Demonstrate fundamental laboratory skills, essential knowledge of sophisticated instruments, knowledge of different software for models and simulation, laboratory safety protocols, and demonstrate proficiency in using computers to solve chemical problems.
- Demonstrate effective scientific communication skills – both written and oral. Students will be able to write review article, reports and present the results of scientific work
- Obtain information from library, online and literature resources that will support the solving of chemical and research problems.

Programme Specific Outcome

- Programme will be able to get global level research opportunities to students to pursue Ph.D programme, targeted approach of competitive Exams such as CSIR – NET/GATE/SET, discipline specific competitive exams conducted by service commission, etc.
- The students will be able to get employment opportunities in various chemical and pharmaceutical industries
- Understands the background of Physical chemistry, Inorganic reaction and organic reaction mechanisms, Environmental analytical chemistry and instrumental methods of chemical analysis, separation techniques and analytical methods.
- To gains complete knowledge about all fundamental aspects Physical, Inorganic, Organic, and Analytical Chemistry.

Course Outcome from Syllabus

Paper	Name of Paper	Learning Outcome
CH-101	Group Theory and chemistry of metal complex	After studying this paper (Course), students will be able to • Understand the principle of group theory and molecular symmetry. • Classify the molecules into point groups. • Critically understand the symmetry based spectroscopic properties of the molecules. • Understand principles of structure and bonding of metal complexes. • Understand about structural bonding, chemical reactivity and structural aspect of various complexes, metal-ligand equilibria in solution, isopoly and heteropoly acids, metal clusters, chains, rings.
CH-102	Concepts in Organic chemistry	• Understand about nature and bonding of organic molecules, conformational analysis and stereochemical aspect of organic molecules, reaction intermediate such as carbocation, carbanion as well as free radical, and their stability reactivity and types of reaction • Understand about pericyclic reaction, types in presence of heat and light.

CH-103	Quantum Chemistry, Thermodynamic and Chemical Dynamic-I	• Learners will be expected to learn the basic concepts of postulates of quantum mechanics, Schrodinger wave equation, particle in a box and fundamental mathematics required to study physical chemistry. The first part of course develops the relevant mathematical methods for chemistry and quantum mechanics. • The second part of the course develops some important concepts of thermodynamics like chemical potential, partial molar properties, Vant Hoff equation, fugacity and Gibbs Duhem equation. Students will also gain knowledge about electrochemistry of solution, ion solvent interactions, Debye-Huckel Onsager, activity and activity coefficients and electrified interfaces etc. • The last part of this course will provide an advanced level in-depth understanding about chemical kinetics, rate and rate laws, various theories of reaction rates, salt effect, chain and oscillatory reactions
CH-104	Theory and Applications of spectroscopy-I	• Understand about the electromagnetic radiation, principle and theory of microwave, Infrared and Raman spectroscopy as well as their real applications in food, water, air, clinical samples analysis.
CH-105	Lab Course - I	• Development of deeper understanding of concepts. • Experiencing experimental procedure directly. • Development of skill for qualitative and quantitative analysis of ores and minerals. • Development thinking skills (critical, quantitative, qualitative). • Development data analysis skills. • Development experimental skills (e.g., design, observation, and use of equipment). • Development communication skills, including those involved in working in groups.
CH-106	Lab Course - II	• Development of deeper understanding of basic concepts of Adsorption/surface chemistry, CMC, Phase equilibria, Chemical kinetics, Conductometry, pH metry, Potentiometry, Solution/molecular weight. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-201	Transition Metal complexes	After studying this paper (Course), students will be able to • Understand about the reaction mechanism of transition metal complexes. • Interpretation of electronic spectra, and magnetic properties of transition metal complexes.

		• Experience the building bridges between inorganic and organic chemistry. • Learn the relationship between structure& bonding and the reactions of organometallic compounds. • Understand the Aryl, allyl of transition metal complex, carbon multiple bond and fluxional behaviour of organometallic compounds
CH-202	Reaction Mechanism	• Recognize the basic practical skills for the synthesis and analysis of organic compounds. • Recall the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism. • Name the functional groups and different class of organic compounds. • Predict the reactivity of an organic compound from its structure. • Develop basic skills for the multi-step synthesis of organic compounds. • Understanding the nucleophile and electrophile group and their properties. • Understanding the Various reaction mechanisms such as SN_1, SN_2, for both aromatic and aliphatic system. • Understanding the reaction mechanism and reactivity with different electron withdrawing and electron donating group. • Understanding the chemical reaction of carbon- carbon multiple bonds with different reagent and their stereochemistry, chemoselectivity, regioselectivity. • Understanding the chemical reaction of carbon- Oxygen and heteroatom multiple bonds with different reagent and their stereochemistry, chemoselectivity, regioselectivity. • Understand the reactivity toward the conjugated aldehydes, ketones, acid and acid derivative to synthesize the new organic molecules. • Able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. • Able to explore new areas of research in both chemistry and allied fields of science and technology. • Able to recognize many functional groups and their reactivity • Understand the influence of bond polarization on a molecule’s structure and reactivity • Understand the basic Chemistry of heterocyclic compounds and some common name reactions.
CH-203	Quantum Chemistry, Thermodynamic and Chemical Dynamic-II	• Understands about application of matrices in quantum chemistry, Angular momentum in quantum chemistry, approximate methods, statistical thermodynamics, electrochemistry, chemical dynamic-II.
CH-204	Theory and	• Understand about the principle and theory of Ultraviolet and visible

	Applications of Spectroscpoy-II	spectroscopy, Scattering spectroscopy, Mass spectrometry, Nuclear magnetic resonance spectrophotometryas well as their real applications in food, water, air, clinical samples analysis.
CH-205	Lab Course - III	• Development of deeper understanding of basic concepts of organic chemistry, synthesis and design of organic molecules, separation purifications. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-206	Lab Course - IV	• Development of deeper understanding of basic concepts of Statistical and error data analysis, Use of computer program, Flame photometric, Nephelometric, determinations, electrophoresis, spectroscopy. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development communication skills, including those involved in working in groups.
CH-301	Resonance Spectroscopy, Photochemistry and Organocatalysis	• Understand about the principle and application of ESR, NQR, PAS, PES. • Understand about the photochemical reaction, determination of chemical reaction miscellaneous photochemical reaction, Organometallic chemistry
CH-302	Chemistry of Biomolecules	• Understand about Bioenergetics, electron transfer in biological system, transport and storage of dioxygen by biomolecules, reactivity and characteristics of metalloenzymes, the enzyme model, host guest chemistry, chirality biomimetic chemistry, types of enzymes coenzyme and their applications • Understand about Biopolymer interaction, thermodynamic of biopolymer solution, cell membrane and transport of ions.
CH-303	Catalysis, Solid state, and surface Chemistry	• Students should base basic knowledge about the Acid –Base concepts, Acid-Base Catalysis, Enzyme catalysis. They will be expected to know the acidity function and their application in reaction mechanism, Nucleophiles, Alpha Nucleophiles and different scales. Students will be able to formulate the concept of surface chemistry, micellization and adsorption. • Students are expected to learn determination of CMC and derivation of different models of thermodynamics of micellization, and Gibbs Adsorption isotherm and surface tension and capillary action.

		• Students will gain an advanced level understanding of the solid-state chemistry, crystal defects and non-stoichiometry, electronic properties and Band theory of semiconductor. • The last part of the course will help in developing knowledge about polymers and macromolecules, and their applications. It will provide an advanced level in-depth understanding about kinetics of polymerization, determination of molecular mass of polymers and chain configuration of macromolecules.
CH-304	Analytical Techniques and data analysis	• Understand about sample preparation, digestion and statistical analysis, separation technique, Thermal and X-ray diffraction methods (TGA, DTA, DSC), Electrochemical concept and their applications.
CH-305	Lab Course - V	• Development of deeper understanding of basic concepts of physical chemistry experiments. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-306	Lab Course - VI	• Development of deeper understanding of basic concepts of Spectrophotometry, pH-metry, Polarography, Flame photometric determination, separation and quantitative estimation. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-401	Instrumental Methods of Analysis	• Understand about the Instrumentation, principle and application of advanced Chromatography, X-ray and proton induced spectroscopy, atomic emission spectroscopy, Atomic absorption spectroscopy and hyphenated techniques.
CH-402	Natural Product and Medicinal Chemistry	• **Understanding about the Terpenoids and Carotenoids**: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α-Terpineol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β – Carotene. • **Understanding about the Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids

		in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)- Coline, Nicotine, Atropine, Quinine and Morphine. • **Understanding about the Steroids:** Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Esterone, Progesterone, Aldostrone and Biosythesis of cholesterol. • **Understanding about the Plant Pigments**: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzine, Butein, Aureusin, Cyanidin-7-arebinoside, Cyanidin, Hirsutidin. • **Understanding about the Drug design:** Development of new drugs procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, Structure-Activity Relationship (SAR), Factors affecting bioactivity, resonance, inductive effect. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative Structure Activity Relationship (QSAR). Concepts of drug receptors, lipophilicity, phamacophore, pharmacological activity and typical range of parameters related to drug likeness. General introduction of pharmacokinetics and pharmacodynamics. • **Understanding about the Anteoplastic Agents**: Introduction, Alkylating agents, antimetabolites, carcinolytic antibiotics, mitoticinhibitors. • **Understanding about the Antibiotics**: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin. • **Understanding about the Antimalarials**: Synthesis and properties of the following Antimalarial: 8-amino quinolone derivatives-Pamaquine, Primapune, Pentaquinr, Isopentaquine, 4-amino quinolone derivatives- Santoquine, Camaquine, Acridine derivatives-Mepracrine, Azacrin, Pyrimidine and Biguanid derivatives- Paludrine, Pyremethamine.
CH-403	Material and Nuclear Chemistry	• Understand about the non-equilibrium thermodynamic • Material chemistry; design, synthesis characterization and applications • Understand about the supramolecular chemistry: design, synthesis and application • Nuclear and radiochemistry
CH-404	Environmental and Applied Chemical Analysis	• Understand about the Air pollution monitoring and analysis, soil, water, chemical analysis involved with local industrial processes (steel, cement and thermal power generation) Food, cosmetics, clinical and drug analysis,
CH-405	Lab Course - VII	• Development of deeper understanding of basic concepts of organic

		chemistry, synthesis and design of organic molecules, isolation, separation and purifications. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH406	Lab Course - VIII	• Development of deeper understanding of basic concepts of Spectrophotometry, pH metry. Flame photometric determination, separation and quantitative estimation. Soil, water sample analysis. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.

EXAMINATION SCHEME

M.Sc. examination will be conducted in four SEMESTERS. Each semester exam shall consist of FOUR THEORY PAPERS AND TWO LAB COURSES.

SEMESTER –I (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and Paper Code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–101)	GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES	4	4 Hrs	20	80	100
2 (CH–102)	CONCEPTS IN ORGANIC CHEMISTRY	4	4 Hrs	20	80	100
3 (CH–103)	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - I	4	4 Hrs	20	80	100
4 (CH–104)	THEORY AND APPLICATIONS OF SPECTROSCOPY-I	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–105)	Lab Course - I	2	8 Hrs	100
6 (CH–106)	Lab Course - II	2	8 Hrs	100

SEMESTER –II (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–201)	TRANSITION METAL COMPLEXES	4	4 Hrs	20	80	100
2 (CH–202)	REACTION MECHANISMS	4	4 Hrs	20	80	100
3 (CH–203)	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - II	4	4 Hrs	20	80	100
4 (CH–204)	THEORY AND APPLICATIONS OF SPECTROSCOPY-II	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–205)	Lab Course - III	2	8 Hrs.	100
6 (CH–206)	Lab Course - IV	2	8 Hrs.	100

SEMESTER –III (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–301)	RESONANCE SPECTROSCOPY, PHOTOCHEMISTRY AND ORGANOCATALYSIS	4	4 Hrs	20	80	100
2 (CH–302)	CHEMISTRY OF BIOMOLECULES	4	4 Hrs	20	80	100
3 (CH–303)	CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY	4	4 Hrs	20	80	100
4 (CH–304)	ANALYTICAL TECHNIQUES AND DATA ANALYSIS	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–305)	Lab Course - V	2	8 Hrs.	100
6 (CH–306)	Lab Course - VI	2	8 Hrs.	100

SEMESTER –IV (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL	THEORY	TOTAL MARKS
1 (CH–401)	INSTRUMENTAL METHOSS OF ANALYSIS	4	4 Hrs	20	80	100
2 (CH–402)	NATURAL PRODUCS AND MEDICINAL CHEMISTRY	4	4 Hrs	20	80	100
3 (CH–403)	MATERIAL AND NUCLEAR CHEMISTRY	4	4 Hrs	20	80	100
4 (CH–404)	ENVIRONMENTAL AND APPLIED CHEMICAL ANALYSIS	4	4 Hrs	20	80	100

OR

OPTIONAL PAPER

CH-404a	MEDICINAL CHEMISTRY
CH-404b	CHEMISTRY OF SURFACTANTS
CH-404c	CHEMISTRY AND APPLICATION OF PESTICIDES
CH-404d	MOLECULAR SYMMETRY, COORDINATION AND ORGANOMETALLIC 404 d CHEMISTRY
CH-404e	NANOCHEMISTRY
CH-404f	CHEMISTRY OF NATURAL PRODUCTS
CH-404g	POLYMERS
CH-404h	FORENSIC CHEMISTRY

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH-405)	Lab course VII or seminar	2	8 Hrs	100
6 (CH-406)	Lab course VIII	2	8 Hrs	100
Or				
7 (CH-407)	**Project Work**	2	---------	100
8 (CH-408)	**Seminar**	2	-----------	100

SCHEME FOR LABORATORY EXPERIMENT EXAMINATION

EXPERIMENT	**MARKS**
Object-1	30
Object -2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	**100**

FIRST SEMESTER

PAPER NO 1. CH –101

GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES

Max. Marks 80

UNIT - I

SYMMETRY AND GROUP THEORY IN CHEMISTRY: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schoenflies

symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh},

D_{nh}, etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.

UNIT – II Transition Elements and Coordination Compounds:

A. **METAL-LIGAND BONDING:** Nomenclature, Structure and Isomerism, theories & limitations of Bonding (Valence bond theory (VBT), Crystal Field Theory (CFT) and Molecular Orbital Theory (MOT)), Energy level diagram in various crystal field (octahedral, tetrahedral and square planar complexes, Application of CFT. Jahn Teller Distortion.
B. **METAL-COMPLEXES:** Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

UNIT –III

A. **METAL–LIGAND EQUILIBRA IN SOLUTION:** Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

B. **Chemistry of Main Group elements:** Classification, Preparation, properties and structures of borides, Carbon allotropes, carbides, nitrides and silicides. Silicates- classification and Structure, Silicones- preparation, properties and application.

UNIT – IV

A. **METAL CLUSTERS:** Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbnonyl and halide cluster, compounds with metal-metal multiple bonds.
B. **CHAINS:** catenation, heterocatenation, intercatenation.
C. **RINGS:** Borazines, phosphazines.

BOOK SUGGESTED:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes and Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Comprehensive Coordination Chemistry Eds. G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
5. Inorganc Chemistr, E. Catherine. Houshecroft, Alan G. Sharpe
6. Principles of Inorganic Chemistry, Brian W. Pfenning
7. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr
8. Concise Inorgnic Chemistry, J. D. Lee

PAPER NO 2. CH –102

CONCEPTS IN ORGANIC CHEMISTRY

Max. Marks 80

UNIT - I

- **A. NATURE OF BONDING IN ORGANIC MOLECULES:** Localized and Delocalized chemical bond, conjugation and cross-conjugation, Bonding in Fullerenes, Bonds weaker than covalent, addition compounds,

  Crown ether complexes and cryptands. Inclusion compounds, Cyclodextrins, Catenanes and Rotaxanes.
- **B. AROMATICITY:** Aromaticity in benzonoid and non-benzenoid compounds, Huckel anti-aromaticity, homo-aromaticity. PMO approach for Aromaticity, Annulenes.

UNIT - II

- **A. CONFORMATIONAL ANALYSIS**: Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.
- **B. STEREOCHEMISTRY:** Elements of symmetry, chirality, molecules with more than one chiral center, methods of resolution, optical purity, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon - Biphenyls, allenes and spiranes, chirality due to helical shape**.**

UNIT - III

- **A. REACTION INTERMEDIATES:** Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Sandmeyer reaction, Free radical rearrangement and Hunsdiecker reaction.
- **B. ELIMINATION REACTIONS:** The E_2, E_1 and E_1cB mechanisms. Orientation of the double bond. Reactivity, effects of substrate structures, attacking base, the leaving group and the medium.

UNIT - IV

PERICYCLIC REACTIONS: Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions - conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions - antrafacial and suprafacial additions, 4n and 4n+2 system, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatrophic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Ene reaction.

BOOKS SUGGESTED:

1. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
2. Organic Chemistry, J. Clayden, N. Greeves, S. Warren
3. Modern Methods of Organic Synthesis, William Carruthers, Iain Coldham
4. Fundamental of Organic Chemistry, Jahn E. Mc Murry
5. Organic Chemistry, P. Y. Bruice, Eighth Edition
6. Organic Chemistry Principal and Mechanism, Joel Karty
7. Organic Chemistry, F. A. Carey, R. M. Giuliano
8. Reaction, rearrangements and reagents, S. N. Sanyal
9. Stereochemistry, P. S. Kalsi
10. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
11. Structures and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
12. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
13. Modern Organic Reactions, H. O. House, Benjamin.

14. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackle Academic and Professional.
15. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
16. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillian.
17. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
18. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
19. Rodd's Chemistry of Carbon Compounds, Ed. S. Coff
20. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
21. Stereo selective Synthesis: A Practical Approach, M. Nogradi, and VCH.
22. Organic Chemistry, Paula Yurkanis Bruice, Pearson Education.

PAPER NO 3. CH –103

QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - I

Max. Marks 80

UNIT - I

A. MATHEMATICAL CONCEPTS IN QUANTUM CHEMISTRY:

Vector quantities and their properties. Complex numbers and Coordinate transformation. Differential and Integral Calculus, Basic rules of differentiation and Integration applications.

B. The Schrodinger equation and postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz Particle in a box, the harmonic oscillator, the rigid rotator, the hydrogen atom.

UNIT –II

BASICS OF THERMODYNAMICS: Maxwell's thermodynamic relations, Vant's Hoff hypothesis. Partial molar volume and partial molar heat content. Chemical potential, Gibbs-Duhem equation, variation of chemical potential with temperature and pressure. Chemical potential of ideal gases, pure solids, liquids and mixture of ideal gases. Activity and Fugacity, Determination of Fugacity, Variation of Fugacity with Temperature and Pressure.

UNIT –III

ELECTROCHEMISTRY–I:

Electrochemical Cell, Redox system, Nernst equation, Electrolytic Conductance-Kohlrausch Law and its application, Electrochemistry of solution. Debye-Huckel Onsager treatment and its extension, ion solvent interactions. Debye-Huckel Limiting Law. Debye-Huckel theory for activity coefficient of electrolytic solutions. Determination of activity and activity coefficient, ionic strength, Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equation (surface excess), methods of determination.

UNIT –IV

CHEMICAL DYNAMICS –I: Methods of determining rate laws, consecutive reactions, collision theory of reaction rates, steric factor, Activated complex theory, kinetic salt effects, steady state kinetics, and thermodynamic and kinetic control of reactions. Dynamic chain (Hydrogen-bromine and Hydrogen-chlorine reactions) and Oscillatory reactions (Belousov-Zhabotinsky reaction etc.)

BOOKS SUGGESTED :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Coulson's Valence, R. McWeeny, ELBS.
3. Chemical Kinetics, K. J. Laidler, Pearson.
4. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
6. Thermodynamics for Chemists, S. Glasstone EWP.
7. An Introduction to Electrochemistry S. Glasstone EWP.
8. Organic Chemist's Book of Orbitals. L. Salem and W.L. Jorgensen, Academic Press
9. The Physical Basis of Organic Chemistry, H. Maskill, Oxford University Press

PAPER NO 4. CH - 104

THEORY AND APPLICATIONS OF SPECTROSCOPY- I

Max. Marks 80

UNIT - I

UNIFYING PRINCIPLES:

Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission transmission, reflection, dispersion, polarization and scattering, Uncertainty relation and natural line width and natural line broadening, transition probability, selection rules, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. Region of spectrum, representation of spectra, F.T. spectroscopy, computer averaging, lasers.

UNIT- II

MICROWAVE SPECTROSCOPY:

Classification of molecules in term of their internal rotation mechanism, determination of rotation energy of diatomic and polyatomic molecules, intensities of rotational spectral lines, effect of isotopic substitution on diatomic and polyatomic molecules, intensities of rotational spectral lines and parameters of rotational energy of linear and the transition frequencies, non-rigid rotators, spectral lines and parameters of rotational energy of linear and symmetric top polyatomic molecules. Application in determination of bond length.

UNIT- III

INFRA RED SPECTROSCOPY:

Introduction, simple and anharmonic oscillators in vibrational spectroscopy, diatomic-vibrating rotator, Modes of vibration in polyatomic molecules, vibration-coupling, Fourier Transform IR spectroscopy: instrumentation, interferometric spectrophotometer, sample handling, Factors influencing vibrational frequencies, Application of IR spectroscopy: Interpretation of IR spectra of normal alkanes, aromatic hydrocarbons, alcohols, phenols, aldehydes, ketones, ethers, esters, carboxylic acids, amines and amides.

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UNIT- IV

RAMAN SPECTROSCOPY:

Classical and quantum theories of Raman effect, pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, Surface-Enhanced Raman Spectroscopy (SERS), Coherent anti Stokes Raman spectroscopy (CARS), Instrumentation, Application of Raman effect in molecular structures, Raman activity of molecular vibration, structure of CO_2, H_2O, N_2O, SO_2, NO_3^-, ClF_3.

BOOKS SUGGESTED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell.
3. Spectroscopy, B.K. Sharma, Goel Publication.
4. Organic Spectroscopy: Principles and Applications, Jag Mohan, Narosa Publication.
5. Spectroscopy Methods in Organic Chemistry, D.H. Williams & I. Fleming, Tata Mcgraw-Hill Publication.
6. Spectrophometric Identification of Organic Compounds, R.M. Silversteion & F. X. Webster, John Wiley Publication.

PAPER NO 5. CH - 105

LABORATORY COURSE–I

Max. Marks 100

1. **QUALITATIVE ANALYSIS OF MIXTURE CONTAINING EIGHT RADICALS INCLUDING TWO LESS COMMON METAL FROM AMONG THE FOLLOWING BY SEMI MICRO METHOD.**
   1) *Basic Radicals :*

      Ag, Pb, Hg, Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt.
   2) *Acid Radicals :*

      Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Flouride. Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferrocyanide, Ferricyanide, Sulphocyanide, Chromate, Arsenate and Permanganate.

2. **QUANTITATIVE ANALYSIS:**

   Involving separation of two of the following in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.

3. **ESTIMATION OF:**
   1) Phosphoric acid in commercial orthophosphoric acid.
   2) Boric acid in borax.
   3) Ammonia in ammonium salts.
   4) Manganese dioxide in pyrolusite.
   5) Available chlorine in bleaching powder.
   6) Hydrogen peroxide in commercial samples.

4. PREPARATIONS:-

Preparation of selected inorganic compound and their studies by I.R. electronic spectra, Mössbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds

(1) VO (acac)$_2$
(2) $TiO(C_9H_8NO)_2 . 2H_2O$
(3) cis-K $[Cr(C_2O_4)_2 (H_2O)_2]$
(4) Na $[Cr (NH_3)_2 (SCN)_4]$
(5) Mn (acac)$_3$
(6) $K_2[Fe(C_2O_4)_3]$
(7) Prussian Blue, Turnbull’s Blue.
(8) $[Co (NH_3)_6] [Co (NO_2)_6]$
(9) cis-[Co(trien) $(NO_2)_2$] $Cl.H_2O$
(10) Hg [Co (SCN)$_4$]
(11) [Co (Py)$_2$Cl$_2$]
(12) $[Ni (NH_3)_6] Cl_2$
(13) Ni (dmg)$_2$
(14) $[Cu (NH_3)_4] SO_4 . H_2O$

BOOKS SUGGESTED

1. Vogel’s Textbook of Quantitative Analysis, revi Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.

PAPER NO 6. CH –106

LABORATORY COURSE –II

Max. Marks 100

ADSORPTION/SURFACE CHEMISTRY

1. Surface Tension - Concentration relationship for solutions (Gibbs equation).
2. To verify the Freundlich and Langmuir Adsorption isotherms using acetic acid/Oxalic acid and activated charcoal.
3. Determination of CMC of surfactants.

PHASE EQUILIBRIA

1. To Construct the Phase diagram for three component system (e.g., chloroform-acetic acid-water).

CHEMICAL KINETICS

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
3. Determination of the rate constant for the decomposition of hydrogen peroxide by Fe^{3+} and Cu^{2+} ions.
4. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).

SOLUTIONS/MOLECULAR WEIGHTS

1. Determination of molecular weight of non-volatile substances by Landsberger method.
2. Determination of Molar masses of Naphthelene/acetanilide.
3. Molecular weight of polymers by viscosity measurements.

CONDUCTOMETRY

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.
3. Determination of pK_a of Acetic acid and verification of Ostwald dilution law.

POTENTIOMETRY/pH METRY

1. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
2. Determination of the dissociation constatnt of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.
4. Determination of Redox potential of Fe^{++}/Fe^{+++} system.
5. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
6. Enzyme kinetics –inversion of sucrose.
7. Determine the specific and molecular rotation of optically active substances.

BOOKS SUGGESTED

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
   Handbook of Organic Analysis –Qualitative and Quantitative, H. Clark, Adward Arnold.
4. Vogel's Textbook of Practical Organic Chemistry,
5. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
6. Findley's Practical Physical Chemistry, B.P. Levi
   Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill

Chairman
Prof. Shamsh Pervez

Dr.Shaik Basha
External Member (Research Institute)

Prof. Goutam Kumar Patra
External member (Academics)

Dr. Suman Chakravarty
Member (Industry Side)

Dr. Deepa Pandey Chaturvedi
Member

Prof. K. K. Ghosh

Prof. Manas Kanti Deb

Prof. Manish K. Rai

Dr. Indrapal Karbhal

SECOND SEMESTER

PAPER NO 1 . CH - 201

TRANSITION METAL COMPLEXES

Max. Marks 80

UNIT - I

REACTION MECHANISM OF TRANSITION METAL COMPLEXES: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT - II

ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES:

Spectroscopic ground states, Correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rules, mechanism for break down of the selection rules, intensity of absorption, band width, spectra of d-d metal complexes of the type $[M\ (H_2O)]^{n+}$, spin free and spin paired ML_6 complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelauxetic series. Magnetic properties of complexes of various geometries based on crystal field model, spin free-spin paired equillibria in octahedral stereochemistry.

UNIT - III

A. **TRANSITION METAL COMPLEXES:** Transition metal complexes with unsaturated organic molecules, alkanes, allyl, diene dienyl, arene and trienyl complex, preparations, properties, nature of bonding and structure features. Imporant reaction relating to nucleophilic and electrophilic attack on ligands and organic synthesis.

B. **TRANSITION METALS COMPOUND WITH BOND TO HYDROGEN:** Transition Metals Compounds with Bond to Hydrogen.

UNIT-IV

A. **ALKYLS AND ARYLS OF TRANSITION METALS:** Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.

B. **COMPOUNDS OF TRANSITION METAL - CARBON MULTIPLE BONDS :** Alkylidenes, low valent carbenes, nature of bond and Structural characteristics.

C. **FLUXIONAL ORGANOMETALLIC COMPOUNDS:** Fluxionality and dynamic equilibria in compounds such as olefin, -allyl and dienyl complexes.

BOOKS SUGGESTED :

1. Principles and applications of organotransition metal chemistry, J.P.Collman, L.S.Hegsdus, J. R. Norton and R.G. Finke, University Science Books.
2. The Organometallic chemistry of the Transition metals, R. H. Crabtree, John Wiley.
3. Metallo - organic chemistry, A.J. Pearson, Wiley.
4. Organometallic chemistry, R.C. Mehrotra and A. Singh, New age International.
5. Inorganc Chemistr, E. Catherine. Houshecroft, Alan G. Sharpe
6. Principles of Inorganic Chemistry, Brian W. Pfenning
7. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr
8. Concise Inorgnic Chemistry, J. D. Lee
9. Basic Organometallic Chemistr, Concept Synthesis and Appliction, B. D. Gupta, A J Elias

PAPER NO 2. CH - 202

REACTION MECHANISMS

Max. Marks 80

UNIT - I

A. **ALIPHATIC/AROMATIC NUCLEOPHILIC SUBSTITUTION:** The S_N^2, S_N^1, mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile and regioselectivity.The von Richter, Sommelet-Hauser, and Smiles rearrangements.

B. **ALIPHATIC/ AROMATIC ELECTROPHILIC SUBSTITUTION:** Mechanisms of- S_E^2 S_E^1, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack, orienation in other ring systems. Vilsmeir reaction and Gattermann-Koch reaction.

UNIT -II

ADDITION TO CARBON-CARBON MULTIPLE BONDS: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings Hydroboration, Micheal reaction. Shrapless asymetric epoxdation.

UNIT - III

ADDITION TO CARBON-HETERO MULTIPLE BONDS: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids esters and nitriles. Addition of Grignard Reagents, Organo-Zinc and Organo-lithium to carbonyls and unsaturated carbonyl compounds, Wittig reaction.

Mechanism of condensation reactions involving enolates - Aldol, Knoevenagel and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

UNIT – IV

A. **Heterocyclic Chemistry:** Introduction to heterocyclics and their importance. Nomenclature of ring systems, structure, reactivity and synthesis of reduced three, four, five and six membered oxygen, nitrogen and sulphur heterocyclics; aromatic heterocyclics, 5-membered, 6- membered and polyhetero ring systems - indole, azoles and diazines.

B. **Name Reactions:** Favorskii reaction, Shapiro reaction, Baeyer-Villiger oxidation, Chichibabin reaction, Stork Enamine reaction, Mannich Reaction, Hoffmann-Loffler-Freytag Reaction, Wurtz reaction, Riemen tiemen reaction , Reimer-Tiemann reaction, Heck reaction Suzuki coupling, Sonogashira reaction, Birch reduction, Wolff-Kishner reduction, Meerwein-Ponndorf-Verley reduction, Paterno-Buchi reaction.

BOOKS SUGGESTED :

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March,Johan Wiley.
2. Organic Chemistry, J. Clayden, N. Greeves, S. Warren
3. Modern Methods of Organic Synthesis, William Carruthers, Iain Coldham
4. Fundamental of Organic Chemistry, Jahn E. Mc Murry
5. Organic Chemistry, P. Y. Bruice, Eighth Edition
6. Organic Chemistry Principal and Mechanism, Joel Karty
7. Organic Chemistry, F. A. Carey, R. M. Giuliano
8. Modern Organic Synthesis: An Introduction, G S. Zweifel, M. H. Nantz
9. Reaction, rearrangements and reagents, S. N. Sanyal
10. Modern Organic Reactions, H. O. House, Benjamin.
11. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackle Academic & Professional.
12. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
13. Structures and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
14. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillian

Chairman
Prof. Shamsh Pervez

Dr.Shaik Basha
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Patra
Prof. Goutam Kumar Patra
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Dr. Sumon Chakravarty
Member (Industry Side)

Dr. Deepa Pandey Chaturvedi
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Prof. Manas Kanti Deb

Prof. Manish K. Rai

Dr. Indrapal Karbhal

PAPER NO 3. CH –203

QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - II

Max. Marks 80

UNIT –I

A. **APPLICATION OF MATRICES IN QUANTUM CHEMISTRY:** Addition and multiplication, inverse and transpose of matrices. Determinants, in quantum Chemistry**.**

B. **ANGULAR MOMENTUM IN QUANTUM CHEMISTRY:** Angular momentum, angular momentum Operators. Eigen functions and Eigen values Angular momentum, ladder operators.

C. **APPROXIMATE METHODS:** The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.

UNIT –II

STATISTICAL THERMODYNAMICS: Probability, permutations and combinations concepts of probability, Maxwell Boltzmann distribution. Different ensembles and Partition functions translational, rotational, vibrational and Electronic. Thermodynamic function using appropriate Partition function. Fermi-Dirac and Bose-Einstein Statistics and statistical basis of entropy. Heat capacity of solids, Debye and Einstein Models.

UNIT –III

ELECTROCHEMISTRY –II: Structure of electrified interfaces. Gouy-Chapman, Stern, Over potentials and exchange current density, Derivation of Butler –Volmer equation, Tafel plot. Semiconductor interfaces, Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interfaces. Electro catalysis influence of various parameters. Hydrogen electrode.

UNIT –IV

CHEMICAL DYNAMICS –II: General features of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Transition state spectroscopy Femto chemistry and ultrafast dynamics, Molecular reaction dynamics, Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solutions, dynamics of unimolecular reaction. [Lindemann –Hinshelwood, RRK and Rice-Ramsperger-Kassel-Marcus {RRKM}] theories of unimolecular reactions.

BOOKS SUGGESTED :

1. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
2. Mathematics for Chemistry, Doggett and Sutclilffe, Longman.
3. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
4. Chemical Mathematics, D.M, Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.
7. Physical Chemistry, P.W. Atkins, ELBS.
8. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
9. Quantum Chemistry, Ira N. Levine, Prentice Hall.
10. Coulson’s Valence, R. McWeeny, ELBS.
11. Chemical Kinetics, K. J. Laidler, Pearson.
12. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
13. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
14. Thermodynamics for Chemists, S. Glasstone EWP.
15. An Introduction to Electrochemistry S. Glasstone EWP.
16. Physical Chemistry, Ira N. Levine McGraw Hill.
17. Physical Chemistry, Silbey, Alberty, Bawendi, John-Wiley.
18. Molecular Reaction Dynamics and Chemical Reactivity, R. D. Levine and R. B.Bernstein, Oxford University Press, Oxford 1987.
19. Molecular Reaction Dynamics, R. D. Levine, Cambridge University Press, Cambridge, 2005.
20. Femtochemistry-Ultrafast Dynamics of the Chemical Bond, A. H. Zewail, World Scientific, New Jersy, Singapore, 1994.

PAPER NO 4 . CH - 204

THEORY AND APPLICATIONS OF SPECTROSCOPY –II

Max. Marks 80

UNIT - I

ULTRAVIOLET AND VISIBLE SPECTROSCOPY:

Introduction, intensity of vibrational-electronic spectra and Frank-Condon principle for dissociation energy, rotational fine structure of electronic-vibrational spectra, Shape of some molecular orbitals viz., H_2, He_2, N_2, O_2. Electronic spectra of organic molecules, chromophores, application of electronic spectroscopy: spectrophotometric studies of complex ions, determination of ligand/metal ratio in a complex, identification of compounds, determination of stability constants.

UNIT -II

SCATTERING SPECTROSCOPY:

Principle, instrumentations and application of Auger spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM)

Theory, instrumentation and application of turbidimetry, nephelometry, fluorometry.
Fluoroscence and phosphorescence and factors affecting them.

UNIT - III

MASS SPECTROMETRY:

Introduction, basic principles, separation of the ions in the analyzer, resolution, molecular ion peak, mass spectral fragmentation of organic compounds, factors affecting fragmentation, McLafferty rearrangement. Instrumentation, Characteristics of mass spectra of Alkanes, Alkenes, Aromatic hydrocarbons, Alcohols, Amines. Nitrogen rule, ring rule, Molecular weight and formula determination, Use of Mass spectrometry for gas chromatography, Induced Couple Plasma Mass Spectrometry (ICPMS), for high-performance liquid chromatography (HPLC-MS) and for ion chromatography.

UNIT - IV

NUCLEAR RESONANCE SPECTROPHOTOMETRY:

Theory of NMR spectroscopy, interaction of nuclear spin and magnetic moment, chemical shift, processional motion of nuclear particles in magnetic field, spin-spin splitting, coupling constants, factor affecting the chemical shift, shielding effect, effect of chemical exchange, hydrogen bonding, instrumentation of Fourier transform NMR spectrophotometer, structure determination of organic compounds, Carbon-13 NMR spectroscopy, Multiplicity-proton (^1H) decoupling-noise decoupling, off resonance decoupling, selective proton decoupling, chemical shift.

BOOKS SUGGESTED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell.
3. Spectroscopy, B.K. Sharma, Goel Publication.
4. Organic Spectroscopy : Principles and Application, Jag Mohan, Narosa Publication.
5. Spectroscopic Methods in Organic Chemistry, D.H. Williams & I. Fleming, Tata Mc Graw-Hill Publication.
6. Spectrophometric Identification of Organic Compounds, R.M. Silverstein & F.X. Webster, John Wiley Publications.

PAPER NO 5. CH - 205

LABORATORY COURSE –III

Max. Marks 100

1. **GENERAL METHODS OF SEPARATION AND PURIFICATION OF ORGANIC COMPOUNDS WITH SPECIAL REFERENCE TO:**
   1) Solvent Extraction
   2) Fractional Crystallization

2. **DISTILLATION TECHNIQUIES:**
   Simple distillation, steam distillation, Fractional distillation and distillation under reduced pressure.

3. **ANALYSIS OF ORGANIC BINARY MIXTURE:**
   Separation and Identification of organic binary mixtures containing at least one component with two substituents.
   (A student is expected to analyse at least 10 different binary mixtures.)

4. **PREPARATION OF ORGANIC COMPOUNDS: SINGLE STAGE PREPARATIONS.**
   1) **Acetylation:** Synthesis of β-Naphthyl acetate from β-Naphthol / Hydroquinone diacetate from Hydroquinone.
   2) **Aldol condensation:** Dibenzal acetone from benzaldehyde.
   3) **Bromination:** p-Bromoacetanilide from acetanilide.
   4) **Cannizzaro Reaction:** Benzoic acid and Benzyl alcohol from benzaldehyde.
   5) **Friedel Crafts Reaction:** o-Benzoyl Benzoic acid from phthalic anhydride.
   6) **Grignard Reaction:** Synthesis of triphenylmethanol from benzoic acid,
   7) **Oxidation:** Adipic acid by chromic acid oxidation of cyclohexanol.
   8) **Perkin's Reaction:** Cinnamic acid from benzaldehyde.
   9) **Sandmeyer Reaction:** p-Chlorotoluene from p-toluidine/o-Chlorobenzoic acid from anthranilic acid.
   10) **Schotten Baumann Reaction:** β-Naphthyl benzoate from:β-Naphthol / Phenyl benzoate from phenol.
   11) **Sulphonation Reaction:** Sulphanilic acid from aniline.

BOOK SUGGESTED :

1. Practical Organic chemistry by A. I. Vogel.
2. Practical Organic chemistry by Mann and Saunders.
3. Practical Organic chemistry by Garg and Salija.
4. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
6. Practical Physical chemistry by Alexander Findlay.
7. Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, Mc Graw Hill Interscience.
8. Findlay's Practical Physical chemistry, revised B

PAPER NO 6. CH –206

LABORATORY COURSE –IV

Max. Marks 100

I. ERROR ANALYSIS AND STATISTICAL DATA ANALYSIS

1. Linear Regression Analysis
2. Curve Fitting
3. Student “t” Test
4. Data Analysis Using Basic Statistical Parameters
5. Calibration of volumetric Apparatus, Burette, Pipette Weight Box etc.

II. USE OF COMPUTER PROGRAMMES

The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes. Monte Carlo and Molecular dynamics. Programmes with data preferably from physical chemistry laboratory. Further, the student will operate one or two or the packages such as MICROSOFT ECXEL, WORLD, POWERPOINT, SPSS, ORIGIN, MATLAB, EASYPLOT.

III. A. FLAME PHOTOMETRIC DETERMINATIONS

1. Sodium and potassium when present together.
2. Sodium/potassium in solid samples.
3. Solid Sodium and Potassium in Liquid Samples.
4. Lithium/calcium/barium/strontium.
5. Cadmium and magnesium in tap water.

B. NEPHELOMETRIC DETERMINATIONS

1. Sulphate
2. Phosphate
3. Silver

IV. ELECTROPHORESIS

1. To separate cations of inorganic salts by paper electrophoresis.
2. Capillary Electrophoresis of water –soluble Vitamines

V. SPECTROSCOPY

1. Verification of Beer’s Lambert Law.
2. Determination of stoichiometry and stability constant of inorganic (e.g. ferric –salicylic acid) and organic (e.g. amine-iodine) complexes, thiocyanate.
3. Characterization of the complexes by electronic and IR, UV spectral data.
4. Determination of Indicator constant (pK_a) of methyl red.

BOOK SUGGESTED :

1. Computer and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
2. Computational Chemistry, A.C. Norris.
3. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.
4. Computer Programming in FORTRAN IV, V. Rajaraman, Prentice Hall.
5. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.
6. Experiments in Chemistry, D.V. Jahagirgar.

THIRD SEMESTER

PAPER NO 1. CH - 301

RESONANCE SPECTROSCOPY, PHOTOCHEMISTRY AND ORGANOCATALYSIS

Max. Marks 80

UNIT –I

A. **ELECTRON SPIN RESONANCE SPECTROSCOPY**: Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron).

B. **NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY:** Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting, applications.

UNIT –II

A. **PHOTOELECTRON SPECTROSCOPY:** Basic principle both for atoms and molecules; Photo-electric effect, ionization process, Koopman's theorem, Spectra of simple molecules Determination of Dipole moment, X-ray photo electron spectroscopy (XPS)

B. **PHOTOACOUSTIC SPECTROSCOPY:** Basic principle of Photo acoustic Spectroscopy (PAS), PAS – gases and condensed system Chemical and Surface application.

UNIT –III

A. **PHOTOCHEMICAL REACTIONS :** Interaction of electromagnetic radiation with matter, Photophysical processes , Stern Volmer equation, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, Actinometry.

B. **DETERMINATION OF REACTION MECHANISM**: Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.

C. **MISCELLANEOUS PHOTOCHEMICAL REACTIONS**: Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers, Photochemistry of vision.

UNIT –IV

A. **ORGANOCATALYSIS**

General Principles: Energetic, Catalytic cycles, catalytic efficiency and life time, selectivity. Type of organometallic reaction: Ligand substitution, Oxidative addition, reductive elimination and insertion and deinsertion. Homogeneous catalysis: Hydrogenetion of alkenes, Hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, Alkenes metathesis, Palladium-Catalysed C-C bond forming reactions, asymmetric oxidation. Heterogenous catalysis: The nature of heterogenous catalysts, Fischer- Tropsch synthesis, alkene polymerization.

BOOK SUGGESTED:

1. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
2. Fundamentals of Photochemsitry, K.K. Rohtagi-Mukherji, Wiley-Eastern.
3. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publications.
4. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
5. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
6. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
7. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
8. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
9. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
10. Shriver & Atkins Inorganic Chemistry: P.Atkins, T.Overtone, J. Rourke, M. Weller, F. Armstrong, Oxford University Press
11. Inorganic Chemistry: C.E. Housecraft, A.G. Sharpe, Pearson Education Limited.
12. Inorganic Chemistry: Principles of Structure and Reactivity: J.E. Huheey, E.A. Keiter, R.L.Keiter, O.K. Medhi, Pearson Education
13. Organometallic Chemistry: A Unified Approach: R.C. Mehrotra, A.Singh, New Age International Publishers.

PAPER NO 2. CH - 302

CHEMISTRY OF BIOMOLECULES

Max. Marks 80

UNIT –I

A. **BIOENERGETICS:** Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

B. **ELECTRON TRANSFER IN BIOLOGY**: Structure and function of metalloproteins in electron transport processes –cytochromes and ion-sulphur proteins, synthetic models.

C. **TRANSPORT AND STORAGE OF DIOXYGEN:** Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and haemerythrin, model synthetic complexes of iron, cobalt and copper.

UNIT –II

A. **METALLOENZYMES**: Zinc enzymes –carboxypeptibase and carbonic anhydrase. Iron enzymes – catalase, peroxidase and cytochrome P-450. copper enzymes- superoxide dismutase. Molybdenum oxatransferase enzymes –xanthine oxidase.

B. **ENZYME MODELS**: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, Cyclodextrin-based enzyme models, calixarenes, ionophores, synthetic enzymes or synzymes.

UNIT –III

A. **ENZYMES :** Nomenclature and classification of Enzyme. Induced fit hypothesis, concept and identification of active site by the use of inhibitors.

B. **CO-ENZYME CHEMISTRY:** Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B_{12}.

C. **BIOTECHNOLOGICAL APPLICATIONS OF ENZYMES:** Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilization enzymes in medicine and industry. Enzymes and Recombinant DNA Technology.

UNIT –IV

A. **BIOPOLYMER INTERACTIONS:** forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

B. **THERMODYNAMICS OF BIOPOLYMER SOLUTIONS:** Thermodynamics of biopolymer solution, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechnochemical system.

C. **CELL MEMBRANE AND TRANSPORT OF IONS**: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport and Nerve conduction.

BOOK SUGGESTED:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.L. Lippard and J.S. Valentine, University Science Books.
3. Inorganic Biochemistry vols II and I.Ed G.L. Eichhorn, Elservier.
4. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
5. Bioinorganic Chemistry, I. Bertinin, H.B. Gary, S.J. Lippard and J.S. Valentine, University Science.
6. Inorganic Biochemistry vols I and II ed. G.L. Eichhorn, Elsevier.
7. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-verlag.
8. Understanding Enzymes, Trevor palmer, Prentice Hall.
9. Enzyme Chemistry : Impact and Applications, Ed. Collin J Suckling, Chapman and Hall.
10. Enzyme Mechanisms Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
11. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
12. Immobilizaed Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, and John Wiley.

13. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
14. Enzyme Structure and Mechanisms, A Fersht, W.H. Freeman.
15. Biochemistry: The Chemical Reacitons of liging cells, D.E. Metzler, Academic Press.
16. Principles of Biochemistry, A.L. Lehninger, Wroth Publishers.
17. Biochemistry, L. Stryer, W.H. Freeman.
18. Biochemistry, J. David Rawn, Neil Patterson.
19. Biochemistry, Voet and Voet, John Wiley.
20. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
21. Bioorganic Chemistry : A Chemistry Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
22. Biochemistry and Molecular Biology of Plants, Buchanan, Gruissem and Jones, I.K. International Pvt. Ltd.

PAPER NO 3. CH –303

CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY

Max. Marks 80

UNIT –I

ACIDS, BASES, ELECTROPHILES, NUCLEOPHILES AND CATALYSIS:

Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity function and their applications. Effect of structure on reactivity: Resonance and field effects, Steric effect, Quantitative treatment, The Hammett equation and linear free energy relationship, Substituent and reaction constants, Taft equation. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The alpha effect. Ambivalent Nucleophilies. Acid base catalysis-specific and general catalysis. Bronsted catalysis, Enzyme Catalysis.

UNIT –II

MICELLES AND ADSORPTION :

Micelles : Classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of Surfactants. Thermodynamics of micellization - phase separation and mass action models. Reverse micelles, micro-emulsion. Micellar Catalysis, Surface tension capillary action, pressure difference across curved surface (Laplace equation), vapor pressure of droplets (Kelvin equation), Gibbs adsorption isotherm.

UNIT –III

SOLID STATE CHEMISTRY

Crystal System and Lattice, Miller Plane, Crystal Packing, Braggs Law, ionic crystal structure of AX, AX_2, ABX_3 type compounds, Crystal defects and Non-stoichiometry - Perfect and imperfect crystals, intrinsic and extrinsic defects - point defect, line and plane defects, vacancies - Schottky defects and Frankel defects. Thermodynamics of Schottky and Frenkel defect, formation of color centers, non-stoichiometry and defects. Spinels, Electronic properties, Band theory, Metal and Semiconductors (P and N-type semiconductor synthesis and structure properties).

UNIT –IV

MACROMOLECULES :

Polymer - Definition types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Synthesis and Application of Conducting Polymers: Polyaniline, polypyrrole, Polythiophene etc.

Molecular mass and average molecular mass. Molecular mass determination (Osmometry, Viscometry, diffusion and light scattering methods), Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

BOOK SUGGESTED :

1. G.W. Castellan, "Physical Chemistry", Addison- Lesley Publishing Co.
2. E.A. Moelwyn Hughes, "Physical Chemistry", Pergamon Press.
3. Denbigh, "Chemical Equilibria", D. Van Nostrand.
4. J. Rose, "Dynamic Physical Chemistry" Sir Issac Pitman and Sons.
5. Solid state "Chemistry and its Applications, A.R. West, Plenum.
6. Principle of Solid State H.V. Kar, Wiley Eastern.
7. Solid State Chemists, D.K. Chakrabarty, New Age International (P) Ltd.
8. Micelles, Theoretical and Applied Aspects, V. Moral Plenum.
9. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
10. Mathematics for Chemistry, Doggett and Sutcliffe, Longman.
11. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
12. Chemical Mathematics, D.M. Hirst, Longman.
13. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
14. Basic Mathematics for Chemists, Tebbutt, Wiley.
15. Quantum Chemistry, Ira N. Levine, Prentice Hall.
16. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

Chairman
Prof. Shamsh Pervez

Dr.Shaik Basha
External Member (Research Institute)

Prof. Goutam Kumar Patra
External member (Academics)

Dr. Suman Chakravarty
Member (Industry Side)

Dr. Deepa Pandey Chaturvedi
Member

Prof. K. K. Ghosh

Prof. Manas Kanti Deb

Prof. Manish K. Rai

Dr. Indrapal Karbhal

PAPER NO 4. CH –304

ANALYTICAL TECHNIQUES AND DATA ANALYSIS

Max. Marks 80

UNIT –I

SAMPLE PREPARATION, DEGESTION AND STATISTICAL ANALYSIS

A. Sampling - Collection, Preservation and preparation of sample, Techniques of sampling of solid, liquid and gaseous samples, Operation of drying and preparing a solution of the analyte.

Principle, methodology and application of different types of digestions such as acid digestion, base digestion, enzymatic and microwave digestion for liquid and solid materials.

B. Evolution and procession of Analytical Data, Precision and Accuracy, Types of Errors, Propagation of errors, Normal Distribution Curve, Standard deviation, Confidence limit, Graphical presentation of result-method of average, Method of Linear least square, Significant figures, Statistical aid to hypothesis of testing- t-test, F-test, Correlation coefficient, Rejection of data.

UNIT –II

SEPARATION TECHNIQUES

A. Principle of Solvent Extraction, Methods of Extraction, Efficiency of extraction, Selectivity of extraction, applications.

B. Principle, classification of chromatographic techniques, Technique and applications of paper chromatography, Thin-layer chromatography, HPTLC, Column chromatography. Liquid and Gas chromatography.

UNIT –III

THERMAL AND X-RAY DIFFRACTION METHODS

A. Principle, Instrumentation, Applications of TGA, DTA and DSC methods, C/H/S/N/O Analyzer.

B. Principle, instrumentation and application of x-ray diffraction.

UNIT –IV

ELECTROCHEMICAL METHODS

A. Principles and instrumentation of pH potentiometry, coulometry and counductometry.

B. Basic principles, Diffusion current, polarized electrode, Micro electrode, Dropping Mercury Electrode llkovic equation, Polarographic wave, Amperometric titration, Linear sweep voltammetry, anodic and cathodic stripping voltammetry, normal pulse voltammetry, differential pulse voltammetry, cyclic voltammetry

BOOK SUGGESTED :

1. Fundamental of Analytical Chemistry- Skoog D.A. and West D.M.
2. Saunders, College Publication.
3. Textbook of Quantitative Inorganic Analysis-Vogel A.I.
4. Principles and Practice of Analytical Chemistry-Fifield F.W and Kealey
5. D. Black well Science
6. Instrumental Analysis R. Braun, McGraw Hill, International Edition.
7. Analytical Chemistry, Christian, G.D., WSE/Wiley.
8. Instrumental Analysis, Willard Meritt Dean, CBS.
9. Chemical Analysis, Brawn, McGraw Hill.
10. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M.
11. Principles of instrumental analysis, Skoog Holler - Niemann.
12. Instrumental analysis, Wizard Dean and Merit.
13. Principle and PRACTICAL analytical chemistry, Fifield and Kealey.

PAPER NO 5. CH - 305

LABORATORY COURSE –V

Max. Marks 100

1. To calculate the activity with given radioactive source.
2. Determination of the half-life of Radionuclide.
3. Determination of absorption coefficient & half
4. Determination of absorption coefficient & half thickness of lead for gamma radiation.
5. Determination of range and energy of β particle
6. Prove the inverse square law for gamma rays.
7. Measurement of gamma ray energy by gamma ray spectrometry.
8. Determination of the partition coefficient for iodine between carbon tetrachloride & (a) Water, (b) aqueous potassium iodide.
9. Study of kinetics of exchange between ethyl iodide & the iodide ion.
10. Determination of the solubility product of lead iodide.
11. Determination of the dissociation constant of Barium Nitrate.
12. Determination of the concentration of iodine in a given sample (KI), by isotope dilution technique.
13. To study the effect of temperature, concentration of the reactant and catalyst on the rate of a chemical reaction (Hydrolysis/Nucleophilic Substituttion).
14. Reaction between Sodium Formate and Iodine by
    (i) Volumetric Method.
    (ii) Conductometric Method.
16. Saponification of ethyl acetate
    (i) Volumetric Method.
    (ii) Conductometric Method.

17. Reaction between Acetone and Iodine.
18. To study the autocatalylic reaction between $KMnO_4$ and Oxalic acid.
19. Reaction between $K_2S_2O_8$ and Iodine.
20. Determination of pKa by Kinetic Measurement.
21. Evaluation of Equilibrium constants from kinetic data.
22. Determination of rate constant of the decomposition of benzene diazonium chloride at different temperature.
23. To study the photolysis of uranyl oxalate.
24. To study the effect of substate catalyst etc (i) HCl, $K_2S_2O_8$ (ii) KOH, NaOH.
25. To study the Activation parameters.
26. To study the solvent effect using some Aprotic & Protic Solvents.
27. To examine the substituent effect (Hammett equation).
28. To study the effect of Electrolyte on the rate hydrolysis (KCl, NaCl,)
29. To study some simple enzyme catalyzed reaction.
30. To study the Micellar Catalyzed Reaction.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students.

BOOK SUGGESTED:

1. Basic Experiment with radioisotopes by John, N. Andrews & David J. Hornsey, Pitam Publishing New York.
2. Practical radiochemistry by M.F.C. Ladd & W.H. Lee, Cleaver Hune press Ltd.
3. Practical Physical Chemistry by Alexander Findlay.
4. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, Mc Graw Hill Interscience.
5. Findlay's Physical Practical Chemistry, revised B.Phys.Levitt,Longman.

PAPER NO 6. CH –306

LABORATORY COURSE –VI

Max. Marks 100

A. SPECTROPHOTOMETRIC DETERMINATIONS

- I. Manganese / Chromium, Vanadium in steel sample.
- II. Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric method.
- III. Fluoride / Nitrate / Phosphate.

- V. Zirconium –Alizarin Red –S complex: Mole-ratio method.
- VI. Copper –Ethylene diamine complex: Slope-ratio method.

B. pH METRY

Stepwise proton-ligand and metal-ligand stability constant of complexes by Leving –Rossoti methods.

C. POLAROGRAPHY

Composition and stability constant of complexes.

D. FLAME PHOTOMETRIC DETERMINATIONS.

- (i) Sodium and potassium when present together
- (ii) Lithium / calcium / barium / strontium.
- (iii) Cadium and magnesium in tap water.

E. REFRACTOMETRY

1. Determination the specific and molar refraction of a given liquid by abbe Refractometer.
2. Determine the variation of refractive index.
3. To verify law of refraction of mixture (glycerol + water).

F. SEPARATION AND QUANTITATIVE ESTIMATION OF BINARY AND TERNARY MIXTURES BY THE USE OF FOLLOWING SEPARATION TECHNIQUES:

1. Paper chromatography –Cadmium and Zinc, Zinc and Magnesium.
2. Thin –layer chromatography –separation of nickel, manganese, cobalt and zinc.
3. Ion-exchange.
4. Solvent extraction.
5. Electrophoretic separation.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students

BOOK SUGGESTED :

1. Quantitative Inorganic Analysis, A.I. Vogel.
2. Test book of quantitative chemical analysis, A.I. Vogel.
3. Practical Physical chemistry, A.M. James and F.E. Prichard, Longman.
4. Findley's Practical Physical Chemistry, B.P. Levi
5. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

FOURTH SEMESTER

PAPER NO 1. CH - 401

INSTRUMENTAL METHODS OF ANALYSIS

Max. Marks 80

UNIT –I

ADVANCED CHROMATOGRAPHY:

A. Ion chromatography: Ion exchange equilibrium, Ion-exchange packing and Inorganic Applications.

B. Size exclusion chromatography: Column packing, Theory of size of exclusion chromatography and applications.

C. Supercritical fluid chromatography: Properties of supercritical fluid SFC-Instrumentation and operating variables, comparison with other types of chromatography, applications.

D. Capillary Electrophoresis and capillary electro chromatography : overviews and applications

UNIT –II

X-RAY AND PROTON INDUCED SPECTROSCOPY:

A. X-Ray fluorescent method: Principles-Characteristics x-ray emission. Instrumentation x-ray tube, Radioactive sources. Wavelength dispersive instruments. Energy dispersive instruments. Analytical Applications-Qualitative Analysis.

B. Proton Induced X-Ray Spectroscopy : Theory, instrumentation and application.

UNIT –III

ATOMIC EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY

A. Selectivity, sensitivity and interferences of atomic spectroscopy.

B. Theory, instrumentation and application of flame photometer, AES, ICP-AES and AFS.

C. Theory instrumentation and application of flame and graphite furnace AAS, cold-vapor and hydride generation AAS.

UNIT –IV

PESTICIDE ANALYSIS AND ANALYSIS METHODS INVOLVED, PESTICIDE: Organophosphorus, Organochlorin, Carbamates, detection and interaction with nanoparticles, GC, HPLC, IC-MS and ICP-MS methods.

BOOK SUGGESTED:

1. Instrumental methods of analysis, Willard, Meritt and Dean.
2. Basic concepts of analytical chemistry, S.M. Khopkar, John Wiley & Sons.
3. Metallurgical analysis, S.C. Jain.
4. Material Science and Engineering. An Introduction, W.D. Callister, Wiley.
5. Material Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
6. Fundamentals of Analytical Chemistry, Skoog, Welt, Holler and Crouch Thomson Learning Inc.

PAPER NO 2. CH - 402
NATURAL PRODUCT AND MEDICINAL CHEMISTRY

Max. Marks 80

UNIT-I

A. **Terpenoids and Carotenoids**: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β – Carotene.

B. **Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)- Coline, Nicotine, Atropine, Quinine and Morphine.

UNIT-II

A. **Steroids:** Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterome, Testosterone, Esterone, Progestrone, Aldostrone and Biosythesis of cholesterol.

B. **Plant Pigments**: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzine, Butein, Aureusin, Cyanidin-7-arebinoside, Cyanidin, Hirsutidin.

UNIT- III

(A) **DRUG DESIGN**: Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure – activity relationship (SAR). Theories of drug activity: Occupancy theory, rate theory, induced fit theory. Concepts of drug receptors. Lipophilicity and Lipinski Rule of 5.

(B) **Modern methods in Medicinal Chemistry:** Combinatorial Chemistry: Principle, methods and application, High throughput Screening (HTS), QSAR and docking studies.

(C) **Pharmacokinetics and pharmacodynamics: Drug** metabolism: absorption, disposition, elimination. Elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, biotransformation, significance of drug metabolism in medicinal chemistry.

UNIT – IV

A. **Anteoplastic Agents**: Introduction, Alkylating agents, antimetabolites, carcinolytic antibiotics, mitotic inhibitors.

B. **Antibiotics**: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin.

C. **Antimalarials**: Synthesis and properties of the following Antimalarial: 8-amino quinolone derivatives-Pamaquine, Primapune, Pentaquinr, Isopentaquine, 4- amino quinolone derivatives- Santoquine, Camaquine, Acridine derivatives-Mepracrine, Azacrin, Pyrimidine and Biguanid derivatives- Paludrine Pyremethamine.

D. Antivirals, Antibacterial and Antioxidants: Introduction and Properties

Book Suggested:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs.
2. D. V. Banthrope and J. B. Harbrone, Longman, Essex., Organic Chemistry, Vol. 2, I. L. Finar, ELBS.

3. Chemistry, Biologcal and Pharmacological properties of Medicinal Plants from the Americans, Ed. Kurt Hostettmann, M. P. Gupta and A. Marston, Harwood Academic Publishers.
4. Introduction to Flavonoids, B. A. Bhom, Harwood Academic Publishers.
5. New Trends in Natural Product Chemistry, Att-ur-Rahman and M. I. Choudhary, Harwood, Academic Publishers.
6. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
7. Introduction to medicinal Chemistry, A Gringuage, Wiley-VCH.
8. Burger's Medicinal Chemistry-1 (Chapter-9 and Ch- 14), Drug Ed. M. E. Discovery, Wolff, John Wiley.

PAPER NO 3. CH - 403

MATERIAL AND NUCLEAR CHEMISTRY

Max. Marks 80

UNIT- I

NON EQUILIBRIUM THERMODYNAMICS:
Entropy of irreversible processes, Clausius inequality; entropy production (heat flow, chemical reactions, electrochemical reactions) and entropy flow, Entropy production in open systems; rate of entropy production, generalized forces and fluxes; Phenomenological equations, Onsager reciprocity relation; electro-kinetic phenomena; Thermomolecular pressure difference (TPD) and thermo-mechanical effects; stationary non-equilibrium states, states of minimum entropy production; non-linear thermodynamics of irreversible processes, applications.

UNIT- II

MATERIAL CHEMISTRY:

Preparation and Properties of Nanoparticles, Metal Oxides, Semiconductor Quantum Dots, Carbon Quantum Dots, Carbon Based materials (Graphene, Carbon Nanotube, Fullerene, porous Carbon and doped material, Conducting Polymers, polyaniline, Polypyrrole, polythiophene, Metal supphides) and composites, Ceramics (Oxide, carbides, sulphides, nitrides). Physical and chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Hydrothermal method, Chemical Vapor Deposition, Optical Properties, Electrical and Magnetic Properties, Application of Nanomaterials: Sensor, Battery, supercapacitor, fuel cell, Adsorbents, Catalyst, Characterization of Nanoparticles/Nanomaterials (SEM, TEM, PL, XRD, Raman, BET, XPS, AFM, STM etc.)

UNIT-III

SUPRAMOLECULAR CHEMISTRY:

Properties of covalent bonds, bond length, inter bond angles, Force constant, bond and molecular dipole moment, molecular and bond polarizability.

Intermolecular Forces, hydrophobic effects, Electro static, induction, dispersion and resonance energy, Hydrogen bond, Magnetic interactions. Host-Guest and Molecular Recognition, Principles of molecular association ad organization Biological marcomolecules, Molecular receptors and design principal, cryptands, Cyclophanes, calixeranes and cyclodextrins. Supramoleular reactivity and catalysis.

UNIT-IV

NUCLEAR AND RADIOCHEMISTRY
NUCLEAR THEORY :

Nuclear cross section and nuclear radii, nuclear shells and magic numbers, theory of nuclear shell model, nuclear potentials, square well and simple harmonic oscillator potentials, application, liquid drop model, semi-empirical mass equation, application and limitations.

NUCLEAR FISSION :

Mass, energy and charge distribution of fission products, decay chains, prompt and neutrons, liquid drop model of nuclear fission.

NUCLEAR ENERGY :
Nuclear fission, chain reaction, multiplication factor, nuclear reactors

APPLIED RADIOCHEMISTRY :

Radioactive isotopes, purity and strength of radioisotopes. Radiochemical principle in the use of tracers, Application of Tracers in Chemical investigations, Physico-chemical methods, Analytical applications, Age determinations, Medical applications, Agricultural application.

BOOKS SUGGESTED:

1. Nuclear and Radiochemistry by G. Friedlander, J.W. Kennedy & J.M. Miller, John Willey and Sons, New York.
2. Source Book an Atomic Energy – S. Glasstone, Affiliated East –West Press Pvt. Ltd. New Delhi.
3. Nuclear Physics by I. Kaplan, Addision –Willey Publishing company, London.

S

4. Nuclear Chemistry and its applications, M. Haissinsky, Addision –Welsley, Publishing Company, London.
5. Essentials of Nuclear chemistry, H.J. Arnikar, Wiley Eatern Ltd, New Delhi.
6. Molecular Mechanics, U. Burkert and N.L. Allinger, ACS Monograph 177, 1982.
7. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.

Chairman
Prof. Shamsh Pervez

Dr.Shaik Basha
External Member (Research Institute)

Prof. Gautam Kumar Patra
External member (Academics)

Dr. Suman Chakravarty
Member (Industry Side)

Dr. Alpa Pandey Chaturvedi
Member

Prof. K. K. Ghosh

Prof. Manas Kanti Deb

Prof. Manish K. Rai

Dr. Indrapal Karbhal

8. Introduction to Theoretical Organic Chemistry and Molecular Modelling, W.B. Smith, VCH, Weinheim.
9. Physical Organic Chemistry, N.S. Isaacs, ELBS./ Longman.
10. Supramolecular Chemistry: concept and Perspectives, J.M. Lehn, VCH.
11. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
12. Chemical Mathematics, D.M, Hirst, Longman.
13. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
14. Quantum Chemistry, Ira N. Levine, Prentice Hall.
15. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
16. Non-Equilibrium Thermodynamics – Principles and Applications, C. Kalidas and M. V. Sanganarayana, Macmillan, India (2002)
17. Introduction to Thermodynamics of Irreversible Process, I. Prigogine, 3rd Ed, Interscience, New York (1968)
18. Fundamental of Chemical Thermodynamics by E. N. Yeremin.
19. Transmission Electron Microscopy, A text book For Material Science, D. B. William, C. B. Carter
20. Core/Shell quantum Dots: Synthesis properties and Devices, X. Tong, Z. M. Wang
21. Semiconductor Nanocrystal quantum Dots; Synthesis Assembly Spectroscopy and Applications
22. Electrochemical Supercapacitor, B. E. Conway
23. Hand Book of Battery D. Linden, T. B. Reddy

PAPER NO 4. CH - 404

ENVIRONMENTAL & APPLIED CHEMICAL ANALYSIS

Max. Marks 80

UNIT –I

A. AIR POLLUTION MONITORING AND ANALYSIS

Classification of air pollution monitoring levels, air quality, standards and index, monitoring and analysis of selected air borne pollutants: SO_2, NO_x, SPM, VOC's, Pb, CO_2, POP's, Hg, carbon and ozone. Air pollution control devices Viz ESP, scrubber technique, baghouse filters etc. Atmospheric chemistry of acid rains, photochemical smog, green house effect, global warming, ozone hole.

B. SOIL AND WATER POLLUTION

Soil and water quality standards, monitoring and analysis of selected soil water contaminants: COD, pesticides, heavy metals, POPs, fluoride, cyanide, nitrate, phosphate, oil & grease, Geobiochemical impact of municipal solid waste, steel plant~~s~~ effluent, domestic sewage. Control devices of water pollutants.

UNIT –II

CHEMICAL ANALYSIS INVOLVED IN CEMENT, IRON PROCESSING, COAL AND THERMAL POWER PLANT

- **A. INTEGRATED STEEL PLANT:** analysis of iron ore, ore fines sinter limestone dolomite and iron bearing raw material and alloy by XRF X-Ray fluorescence spectrometer, Analysis of sulphur phosphorus and other impurities in hot metal by OES, Analysis of steel industries slag and other raw material used in steel manufacturing
- **B. CEMENT INDUSTRY:** Cement analysis for Loss of Ignition (LOI), CaO_2, SiO_2, Al_2O_3, MgO, Fe_2O_3, P_2O5, TiO_2, K_2O, Mn_2O_3, ZnO by chemical testing IS Code 4032 and physical properties (fitness of cement, soundness, consistency, strength, setting time, heat of hydration, bulk density, specific gravity (relative density) by Physical Testing by IS Code 4031
- **C. COAL BASED POWER PLANT:** coal and coal ash analysis, boiler waste water analysis (feed water hardness, sludge, conductance oxygen level, foaming) total alkalinity, phosphates, total dissolved chlorides, total solids, sulfides

UNIT –III

FOOD ANALYSIS

- **A.** Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives-Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants.
- **B.** Introduction standards composition and analysis of following foods : Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.

UNIT –IV

COSMETICS, CLINICAL AND DRUG ANALYSIS

- **A.** Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, face powders, Make-up, Shaving preparations, Bath preparations.
- **B.** Concepts and principles of analytic methods commonly used in the clinical species: i.e. ammonia, blood urea Nitrogen, Ca, Cl, CO_2, Fe, K, Li, Mg, Na, P, urea, glucose.

  Method for analysis of proteins (i.e. albumin, bilirubin, creatinine, cholesterol, HDL-cholesterol, triglycerides, creatinine) and Enzymes (i.e. Aanine Aminotransferase, acid phosphatase, alkaline phosphatase, amylase, aspartate, aminotransferase, cholinesterase, lactate, and lipase).

BOOK SUGGESTED :

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental chemistry, Sharma and Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Chemistry, Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.

6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Environmental Chemistry, C. Baird, W.H. Freeman.
8. Analytical chemistry, G.D. Christian, J. Wiley.
9. Fundamentals of Analytical Chemistry, D.A. Skoog, D.m. West and F.J. Holler, W.B. Saunders.
10. Analytical Chemistry - Principles, J.H. Kennedy, W. Saunders.
11. Analytical Chemistry-Principles, and Techniques, L.G. hargis, Prentice Hall.
12. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
13. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
14. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
16. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern.Basic Concepts of Analytical Chemistry, S.M. Khopkar, Wiley Eastern.
17. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.
18. Environmental Biotechnology, Indushekhar Thakur, I.K. International Pvt. Ltd.
19. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Thompson Learning Inc.
20. APHA, 1977, “Methods of Analysis of air, water and soil” Washington US.
21. Textbook of Clinical Chemistry and Molecular Diagnostics, Carl A. Burtis, David E Bruns, MD, and Edward R Ashwood, MD
22. Techniques in Clinical Chemistry, A hand Book for Medical Laboratory Technicians, Frederick N. Bullock
23. A textbook of Cosmetic Formulations, Gaurav Kumar Sharma, Jayesh Gadiya, Meenakshi Dhanawat

OPTIONAL PAPERS
CH-404 a
MEDICINAL CHEMISTRY

UNIT I

(a) DRUG DESIGN: Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure – activity relationship (SAR). Theories of drug activity: Occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Lipophilicity and Lipinski Rule of 5.

(b) PHARMACOKINETICS: Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetics parameters in defining drug disposition and in therapeutics.

(c) PHARMACODYNAMICS: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, biotransformation significance of drug metabolism in medicinal chemistry.

UNIT II

(a) ANTINEOPLASTIC AGENTS: Introduction, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and Mitotic inhibitors. Mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine.

(b) CARDIOVASCULAR DRUGS: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolo, oxyprenolo.

UNIT III

(a) LOCAL ANTIINFECTIVE DRUGS: Introduction and general mode of action. Synthesis of sulphonamides, furazolidine, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, econozole, griseofulvin, chloroquin and primaquin.

(b) ANTIBIOTICS: Cell wall biosynthesis, inhibitors, β-lactam rings, antibiotic inhibiting protein synthesis.

Synthesis of penicillin G, penicillin V, ampicillin, amoxicillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

UNIT IV

PSYCHOACTIVE DRUGS- THE CHEMOTHERAPY OF MIND : Introduction, neurotransmitters, CNS depressants, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, busipirone.Antipsychotic drugs – the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximode, trimethadione, barbiturates, thiopental sodium, glutethimide.

Books Suggested

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge
3. An Introduction to Drug Design, S. S. Pandeya and J.R.Dimmock, New Age International.
4. Burgers's Medicinal Chemistry and Drug Discovery, Vol-1(Chapter-9 and Chapter-14), Ed. M.E. Wolff, John Wiley.
5. Goodmann and Gilman's Pharmacological Basis of Therapeutics, Mc-Graw Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
7. Strategies for Organic Drug Synthesis and Design, D.Lednicer, John Willey

CHEMISTRY OF SURFACTANTS
CH-404 b

UNIT- I

OVERVIEW OF SURFACTANTS: Classification of Surfactants, Physicochemical Properties of Surfactants, Critical Micelle Concentration , Determination, Effect of Additives,Aggregate Shapes , Structure and Morphology, Novel and New Generation Surfactants, Aggregation Behavior.

UNIT-II

PRINCIPLES OF SELF-ASSEMBLY: Closed and Continuous Association , Surfactant MicellizationPseudo-Phase Model , Mass Action Model, Estimation of Micelle Size ,Size Dispersion of Micelles, Concentration Dependence of Micelle Size , Phase Behavior, Aggregation Behavior.

UNIT-III

SURFACTANT MIXTURES: Ideal and Non-Ideal Mixed Micelles ,Regular Solution Model Size and Composition Distribution of Aggregates ,Nonionic –ionic Surfactant Mixtures ,Ionic -Ionic Surfactant Mixtures,Origin of Ideal and Non-Ideal Mixing Behavior, Polymer SurfactantInteraction.

UNIT-IV

APPLICATIONS OF SURFACTANTS: Micellar Catalysis, Quantitative Models ,Micellar Enzymology, Phenomenon of Solubilization , Solubilization in Mixed Micelles, Drug Surfactant Interaction, Protein Surfactant Interactions, Microemulsions and its applications, Industrial Application of Surfactants.

Books:

1. Surfactants Edited by Th. F. Tadros, Academic Press
2. Micelles : Theoretical and Applied Aspects by Y. Moroi
3. Chemistry and Technology of Surfactants by R. J. Farn Wiley

CHEMISTRY AND APPLICATION OF PESTICIDES

CH-404c

UNIT-1

INTRODUCTION: What is pesticides, classification of pesticides, utility of pesticides, categories of toxicity, Threshold limit value, LD 50 value, Effect of pesticides in food, House hold and Human health.

UNIT-2

CHEMICAL TOXICOLOGY: Biochemical effects of pesticides, pesticides persistence, bioaccumulation and biomagnifications of pesticides, Toxicology of pesticides, Toxicology of organophosphates, carbamates, organochlorine and Dermal Toxicology of pesticides.

UNIT-3

INSTUMENTAL TECHNIQUES IN PESTICIDES DETECTION: Spectrophotometry, paper chromatography,

Thin layer chromatography (TLC), GC-MS, indicator tube, High performance (pressure) Liquid chromatography (HPLC).

UNIT-4

PESTICIDES AND ITS RESIDUE ANALYSIS: Steps in pesticides residue analysis, clean-up, concentration (evaporation), Analysis, Extent of residue of pesticides in different commodities.

References

- Environmental chemistry. A.K De. New Age International Pvt. Ltd. 6th edition.
- Soil Testing and Analysis,plant, water and pesticide residues- Patiram,Bajendra N.S. Azad, Thakur and T.Ramesh.Agricultural,Horticultural,Food and Veterinary Science Book.2nd edition.
- Toxicology of pesticides: Experimental,clinical and regulatory perspectives. Edited by: Lucio G. Costa,Corrado L. GalliSheldon D. Murphy.Springer,1st edition.
- Persistent Pesticide in the Environment- C.A Edward, CRC Press Inc.,Florida 2nd edition.
- Agricultural chemicals and chemical mutagens- C.L.Canoria.
- Progress in pesticide Biochemistry and Toxicology- D.H Hutson and T.R Roberts. Willey,7th edition.
- Air pollution from Pesticides and Agricultural process. Lee,R.F., Jr.CRC Press Inc., Florida, 1976,174.

MOLECULAR SYMMETRY, COORDINATION AND ORGANOMETALLIC CHEMISTRY CH-404 d

UNIT – I

SYMMETRY AND GROUP THEORY IN CHEMISTRY: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup.Conjugacy relation and classes.Point symmetry group.Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation.The great orthogonality theorem (without proof) and its importance.Character tables and their use; spectroscopy.

UNIT – II

A. METAL-LIGAND BONDING: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory.

B. ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES: Spectroscopic ground states, Correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rules, mechanism for break down of the selection rules, intensity of absorption, band width, spectra of d-d metal complexes of the type $[M (H_2O)]^{n+}$, spin free and spin paired ML6 complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelouxetic series.

UNIT – III

A. REACTION MECHANISM OF TRANSITION METAL COMPLEXES: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

B. METAL–LIGAND EQUILIBRA IN SOLUTION: Stepwise and overall formation onstants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexs with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

UNIT – IV

METAL π-COMPLEXES: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand. B. Tranisition metal complexes with unsaturated organic molecules,alkanes ,allyl ,dienedienyl,arene and trienyl complex,preparations,properties,nature of bonding and structure features.Important reaction relating to nucleophilic, electrophilic attack on ligands and organic synthesis.Alkylidenes, low valentcarbenes nature of bond and Structural characteristics.

NANOCHEMISTRY

CH-404 e

UNIT I

GENERIC METHODOLOGIES FOR NANOCHEMISTRY AND NANOTECHNOLOGY

Introduction and classification, What is nanotechnology?, Classification of nanostructures, Nanoscale architecture, Summary of the electronic properties of atoms and solids, The isolated atom, Bonding between atoms, Giant molecular solids, The free electron model and energy bands, Crystalline solids, Periodicity of crystal lattices, Electronic conduction, Effects of the nanometre length scale, Changes to the system total energy, Changes to the system structure, How nanoscale dimensions affect properties

UNIT -II

MATERIAL CHEMISTRY

Preparation and Properties of Nanoparticles, Materials-Metals, Ceramics (Oxide, carbides, sulphides, nitrides).physical and chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Optical Properteis, Electrical and Magnetic Properties, Application of Nanoparticles.

UNIT-III

CHARACTERIZATION METHODS

X-ray diffraction, Debye-Scherer formula, dislocation density, micro strain, Synchrotron Radiation, Principle and Applications, Raman Spectroscopy and its Applications, Dynamic Light Scattering (DLS). Electron microscopes: scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS, Working Principle, Instrumentation and Applications. Differential scanning calorimeter (DSC), Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA), UV – Visible Spectrophotometer, FTIR, Principle and Applications, Photoluminescence (PL) Spectroscopy.

UNIT-IV

APPLICATIONS ON NANOCHEMISTRY

Nanobiology, Introduction, Bio-inspired nanomaterials, Interaction Between Biomolecules and Nanoparticle Surfaces, Different Types of Inorganic Materials Used for the Synthesis of Hybrid Nano-bio Assemblies, Applications of Nano in Biology, Nanoprobes for Analytical Applications, Current Status of Nanobiotechnology, Future Perspectives of Nanobiology; Nanosensors, Electrochemical, Nanobiosensors, Smart Dust; Nanomedicines, Nanodrug Administration Diagnostic and Therapeutic Applications.

References:

1. Nanoparticles: From Theory to Application Edited by Gu¨nter Schmid, @ 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
2. Nanoparticles and Catalysis Edited by Didier Astruc @ 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Mike HagermanShriver and Atkin's Inorganic Chemistry, Fifth Edition, Oxford, 2010.
4. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
5. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
6. Nano:The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

CHEMISTRY OF NATURAL PRODUCTS

CH-404 f

UNIT-I Terpenoids and Carotenoids

Classification; nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules; Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.

UNIT-II Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, biosynthesis and synthesis of the following: Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

UNIT-III Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone.

UNIT -IV Plant Pigments

Occurrence, nomenclature, general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

UNIT -V Porphyrins

Structure and synthesis of Haemoglobin and Chlorophyll.

UNIT -VI Prostaglandins

Occurrence, nomenclature, classification, biogenesis and physiological effects.
Synthesis of PGE$_2$ and PGF$_{2\alpha}$.

UNIT-VII Pyrethroids and Rotenones

Synthesis and Reaction of Pyrethroids and Rotenones

Books Suggested :

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson,
2. J B Hobbs, D.V. Banthrope and J B Harborne, Longman Organic Chemistry, Vol 2 , IL Finar ELBS
3. New Trends in Natural Products Chemistry , A R Rahman and M I Choudhury, Harwood Academic Publishers
4. Roods Chemistry of Carbon Compounds, Ed S. Coffey, Elsevier

POLYMERS

CH-404 g

UNIT- I Basics

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers.Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous system.

UNIT- II Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscocity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

UNIT-III Structure and Properties

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm- melting point of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT-IV Polymer Processing

Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT-V Properties of Commercial Polyme

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resions and silicone polymers. Functional polymers- Fire retarding polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested :

1. Textbook of Polymer Science, F W . Billmeyer Jr. Wiley
2. Polymer Science, V R Gowarikar, N V Viswanathan and J Sreedhar, Wiley Eastern
3. Contemporary Polymer Chemistry, H R Alcock and F W Lambe, Prentice Hall
4. Physics and Chemistry of Polymers, J M G Cowie, Blackie Academic and Professional

FORENSIC CHEMISTRY

Course -404h

UNIT-I

Introduction to Forensic Science

Forensic science : methodologies and applications used in the forensic context. Organic and inorganic chemical analyses of physical evidence, principles of serology and DNA analysis, ballistics, arson, fingerprint analysis, drug analysis,

UNIT-II

Forensic Chemistry

Chemical aspects of forensic science as it applies to criminal investigation and laboratory preparation. Instrumentation and chemistry associated with crimes. properties of the chemical evidence.. Details of the methods employed for analysis, such as color test, Chromatography (GC, GLC, HPLC), mass spectrometry (MS), GC-MS. Laboratory course. Instrumental Aspects of Liquid Chromatography Solvent delivery systems, sample inlets, temperature control, coupled column systems, detectors, and indirect detection other Separation Techniques

UNIT-III

Toxicology

General principles and fundamentals of forensic toxicology, poisons, action, toxicity, postmortem characteristics, samples required for toxicological analysis and methods of collection, methods of preservation and analysis. Chemical, toxicological and pathological characteristics of commonly abused drugs, including the following: ethanol, barbiturates, narcotics, stimulants, and hallucinogens

UNIT-IV

Applications of Forensic Chemistry

Investigation of crime against society, food adulteration, environmental pollution, use and distribution of unsafe chemicals, career in criminal investigation, in the laboratory analysis of forensic evidence,. Drug Enforcement Administration, Food and Drug Administration, Environmental Protection Agency, and Occupational Safety and Health Administration. environmental sciences, industrial hygiene,.

PAPER NO 5.CH-405 and 407

(Combination should be- Lab course VII + Lab course VIII OR Seminar + Project work)

LABORATORY COURSE-VII

Max. Marks 100

A. MULTI-STEP SYNTHESIS OF ORGANIC COMPOUNDS

(i) Beckmann Rearrangement: Benzanilide from benzene (Benzene Benzophenone Benzophenone oxime Benzanilide).

(ii) Benzilic Acid Rearrangement: Benzilic acid from Benzoin (Benzoin Benzil Benzilic acid)

(iii) Skraup's synthesis (Synthesis of heterocyclic Quinoline from o - Amino phenol

(iv) p-Bromoaniline from Aniline (Aniline Acetanilide p - Bromoacetanilide p -Bromoaniline)

(v) p-Nitroacetanilide from Acetanilide (Aniline Acetanilide p - Nitroactanilide p - Nitroaniline)

(vi) m Nitroaniline from Benzene (Benzene Nitrobenzene m - dinitrobenzene m- nitroaniline)

(vii) Acridone from Anthranilic acid (Anthranilic acid o - Chlorobenzoic acid N –Phenylanthranilic acid Acridone)

(viii) Enzymatic Synthesis Enzymatic reduction : Reduction of ethylace enantiomeric excess of S(+) ethyl - 3 - hydroxybutanone and determine its optical purity.

B. QUANTITATIVE ORGANIC ANALYSIS

(i) Estimation of Sulphur by Messenger's Method.

(ii) Estimation of Nitrogen by Kjeldahl Method.

C. ESTIMATION OF FUNCTIONAL GROUP

(i) Extimation of Aniline.

(ii) Estimation of Amino Group By Acetylation Method.

(iii) Estimation of Hydroxyl Group By Acetylation Method.

(iv) Estimation of Carbonyl Group By Hydrazone Formation Method.

(v) Estimation of Carboxyl Group By Titration Method.

(vi) Determination of Equivalent Weight of Carboxylic Acid By Silver Salt Method.

(vii) Estimation of Glucose By Fehling Solution Method.

(viii) Estimation of Glycine By Titration Method.

D. EXTRACTION OF ORGANIC COMPOUNDS FROM NATURAL SOURCES

(i) Isolation of caffeine from leaves.

(ii) Isolation of Casein from milk.

(iii) Isolation of lactose from milk.

(iv) Isolation of nicotine dipicrate from tabacco.

(v) Isolation of Cinchonine from cinchona bark.

(vi) Isolation of Piperine from black pepper.

(vii) Isolation Lycopene from tomatoes.

(viii) Isolation of β–Carotene from carrots.

(ix) Isolation of Limonene from citrus rinds.

(x) Isolation of protein and carbohydrates from seeds –colour test

(xi) Extraction of Fatty oil from seeds and determination of refractive index of the oil.

(xii) Isolation of protein and carbohydrate (as reducing sugars) from seed-colour test.

E. Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students. SUGGESTED BOOKS:

1. Practical Organic chemistry by A. I. Vogel.
2. Practical Organic chemistry by Mann and Saunders.
3. Practical Organic chemistry by Garg and Saluja.
4. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
6. Experimental Organic chemistry, M. P. Doyle and W. S. Mungall.
7. Small Scale Organic preparation, P. J. Hill.
8. Experimental Biochemistry, by B.S.Roa and V.Deshpande. I.K. International Pvt.Ltd.
9. Comprehensive Practical Organic Chemistry, Preparation and Qualitative Analysis, V.K.Ahluwalia and Renu Aggarwal, University Press.

OR

Seminars

Seminar topics should be related to M. Sc. Syllabus or research oriented topics on recent trends in chemical sciences

PAPER NO6. CH –406 and 408

(Combination should be- Lab course VII + Lab course VIII OR Seminar + Project work)

LABORATORY COURSE –VIII

Max. Marks 100

A.TITRIMETIC/GRAVIMETRIC DETERMINATIONS

(i) Manganese in iron / Steel by Bismuthate / Linganane –Karplus/Periodate methods.

(ii) Maganese in pyrolusite ores.

(iii) Nickel in steel by dimethylglyoxine method.

(iv) Lead by dithizone precipitation.

B. SPECTROPHOTOMETRIC DETERMINATIONS

(i) Maganese/Chromium / Vanadium / Copper / Lead in Steel and Environmental / Industrial effluent samples.

(ii) Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric methd.

(iii) Fluoride / Nitrite / Phosphate in tap / pond / river industrial waste water.

(iv) Iron in water samples by thiocyanate and phenanthroline methods.

C. CHROMATOGRAPHIC SEPARATION

(i) Sepraration and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

(ii) Thin layer chromatography – separation of nickel, manganese, cobalt and zinc, Determination of Rf values.

D. FLOW INJECTION ANALYSIS.

Determination of the following anions/cations in synthetic/real/ environmental samples.

(i) Ca^{2+}, Mg^{2+}, Al^{3+}, Mn^{2+}, Cr^{6+}, Fe^{3+}

(j) (ii) F^- , Cl^- , $PO_{4\ 3-}$, NO_{2-} , $NO_{3\ -}$, $SO_4{}^{2-}$, $BO_3{}^{3-}$.

E. ATOMIC ABSORPTION SPECTROPHOTOMETER

Determination of metal contents (Fe/Pb/As/Zn/Co/Ni etc.) in real and environmental samples.

F.MISCELLANEOUS

(i) Nutrient and micronutrient analysis in plant/soil/sediment.

(ii) Speciation of toxic metals i.e. As, Hg, Se, etc.

(iii) Analysis of clinical samples i.e. blood, urine, hair, etc.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS,ϖ FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students.

SUGGESTED BOOK:

1. Quantitative Inorganic Analysis, A.I. Vogel.
2. Standard Methods of Water Analysis.
3. Colorimetric Determination of Traces of Metals, E.B. Sandell.
4. GBC, Manuals on AAS analysis, Austria.

OR

Projects

- Recent trends in chemical sciences
- Based on synthesis of organic compounds, characterization
- Kinetic, thermodynamic studies
- Analysis of chemical substances from environmental, biological, food and pharmaceutical samples with analytical techniques
- Ore, rocks, coal, cement analysis

Note: The Project work will be based on research facilities available in colleges, institutions or university

PREVIOUS YEAR QUESTION PAPERS SEMESTER-WISE

Roll No. .... Total Printed Pages - 8

F - 305

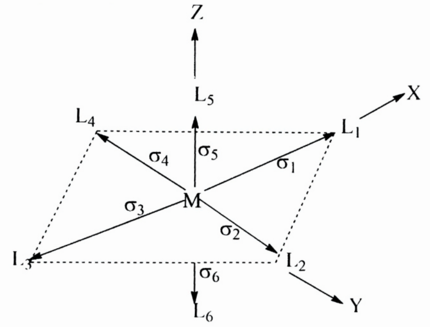
M. Sc. (First Semester)
Examination, Dec.-Jan., 2021-22
CHEMISTRY
Paper First
(Group Theory and Chemistry of Metal Complex)

Time : Three Hours] ***[Maximum Marks : 80***

Section-A **1 each**
(Objective/Multiple Choice Questions)

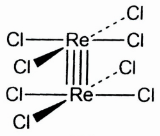
1. For a molecules with symmetry elements: E, $2C_3$, $3C_2$, σ_h, $2S_3$, $3\sigma_v$, the point group, number of classes and order of group are, respectively:
(A) D_{3h}, 12, 6
(B) C_{3h}, 6, 12
(C) C_{3v}, 6, 12
(D) D_{3h}, 6, 12

2. The coordinate system for octahedral complex ML_6 showing the M$-$L sigma (σ) bonding is presented below. The characters of the vectors under C_4 and S_4 classes will respectively be

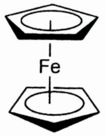


(A) 0, 0
(B) 0, 4
(C) 2, 0
(D) 4, 0

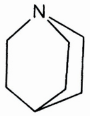
3. Following molecule will belongs to the point group



(A)



(B)



(C)

(A) A-D_{4h}, B-D_{5h}, C-D_{3d}
(B) A-D_{4h}, B-D_{5d}, C-D_{3h}
(C) A-C_{4h}, B-D_{5d}, C-C_{3v}
(D) A-D_{4h}, B-D_{5d}, C-C_{3v}

4. The character table of C_{3v} point group is given below, along with an additional reducible representation, Γ.

	E	$2C_3$	$3\sigma_v$
A_1	1	1	1
A_2	1	1	-1
E	2	-1	0
Γ	6	0	2

This reducible representation Γ will be reduced as:

(A) $A_1 + A_2 + 2E$
(B) $2A_1 + 2E$
(C) $2A_2 + 2E$
(D) $2A_1 + 2A_2 + 2E$

5. The partial character table of D_3 point group is given below with a missing row of irreducible representation.

D_3	E	$2C_3$	$3C_2$
A_1	1	1	1
??			
E	2	-1	0

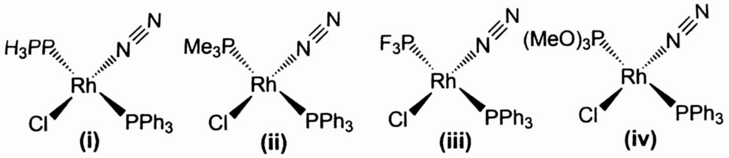
(A) A_2 1 1 -1
(B) A_2 1 -1 1
(C) B_1 1 -1 1
(D) B_2 1 -1 -1

6. The mission row will be:
The HOMO of CO is
(A) π-bonding
(B) σ-bonding
(C) π-antibonding
(D) σ-antibonding

7. Incorrect isolobal pair is
(A) CH_4 and $[Mn(CO)_6]^+$
(B) CH_3 and $[Mn(CO)_5]$
(C) CH_2 and $[Fe(CO)_5]^+$
(D) CH and $[Ni(CO)_3]^+$

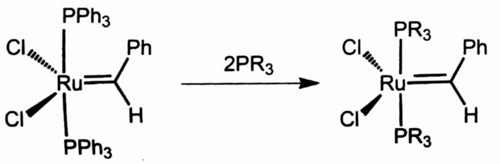
8. The arrangement of ligands on the basis of capability of delocalization of metal electrons in the ligand is known as:
(A) Spectrochemical series
(B) Trans effect series

9. The correct order of increasing N—N bond length in the following dinitrogen complex will be:



(A) (i) < (ii) < (iii) < (iv)
(B) (iii) < (iv) < (i) < (ii)
(C) (ii) < (i) < (iii) < (iv)
(D) (iii) < (iv) < (ii) < (i)

10. Which among the given phosphine will not be likely to give a positive reaction in the given scheme?



(A) When R = 4-FC_6H_4
(B) When R = Bu^t
(C) When R = Et
(D) When R = 4-$MeOC_6H_4$

11. The equilibrium for the reaction of Cd^{2+} with CH_3NH_2 and ethyelene diamine (en) are given below with the values of respective formation constants

(i) $[Cd(H_2O)_4]^{2+} + 4CH_3NH_2 \rightleftharpoons [Cd(CH_3NH_2)_4]^{2+} + 4H_2O$; $K = 3.10 \times 10^6$
1 + 4 = 5 particles   1 + 4 = 5 particles

(ii) $[Cd(H_2O)_4]^{2+} + 2\,(en) \rightleftharpoons [Cd(en)_2]^{2+} + 4H_2O$; $K = 3.20 \times 10^{10}$
1 + 2 = 3 particles   1 + 4 = 5 particles

The incorrect statement for these equilibrium are:

(A) ΔG^o, ΔH^o and ΔS^o values for equilibrium (i) will be negative
(B) ΔG^o value for equilibrium (ii) will be more negative
(C) ΔS^o value for equilibrium (ii) will be more positive
(D) ΔH^o value for both equilibrium (i) and (ii) are comparable

12. In styx code, '*t*' stand for
(A) Number of B—H—B bond
(B) Number of B—B—B bonds
(C) Number of B—B bonds
(D) Number of BH_2 units

13. According to Wades rule, the number of framework electron equals 2n+2 will have structure:
(A) *Closo*
(B) Nido
(C) Arachno
(D) Hypo

14. The order of increasing Bronsted acidity for boron hydride is:

(A) $B_5H_9 < B_6H_{10} < B_{10}H_{14}$
(B) $B_{10}H_{14} < B_5H_9 < B_6H_{10}$
(C) $B_6H_{10} < B_{10}H_{14} < B_5H_9$
(D) $B_{10}H_{14} < B_6H_{10} < B_5H_9$

15. The bond order of the $[Mo_2Cl_8]^{4-}$ and $[Os_2Cl_8]^{2-}$ are respectively:
(A) Both 4
(B) Both 3
(C) 3 and 4 respectively
(D) 4 and 3 respectively

16 The reaction of BCl_3 with NH_4Cl gives product **A** which upon reduction by $NaBH_4$ gives product **B**. Product **B** upon reacting with HCl affords compound **C**, which is
(A) $B_3N_3H_6$
(B) $[ClBNH]_3$
(C) $Cl_3B_3N_3H_9$
(D) $(ClH)_3B_3N_3(ClH)_3$

17. The correct arrangement of $[Ni(en)_3]^{2+}$, $[Ni(EDTA)]^{2-}$, and $[Ni(NH_3)_6]^{2+}$ in the order of increasing overall formation constant is:

(A) $[Ni(NH_3)_6]^{2+} < [Ni(en)_3]^{2+} < [Ni(EDTA)]^{2-}$
(B) $[Ni(en)_3]^{2+} < [Ni(EDTA)]^{2-} < [Ni(NH_3)_6]^{2+}$
(C) $[Ni(EDTA)]^{2-} < [Ni(NH_3)_6]^{2+} < [Ni(en)_3]^{2+}$
(D) $[Ni(NH_3)_6]^{2+} < [Ni(EDTA)]^{2-} < [Ni(en)_3]^{2+}$

18. Which Among the following polyanion, the face sharing of octahedral unit of oxyanion is occur?
(A) $[H_2W_{12}O_{40}]^{6-}$
(B) $[H_2W_{12}O_{42}]^{10-}$
(C) $[Mo_7O_{24}]^{6-}$
(D) $(NH_4)_2H_6CeMo_{12}O_{42}$

19. Correct match of different class of carbide is

	Class		Carbide
(i)	Methanides:	(a)	Na_2C_2, CaC_2
(ii)	Acetylides	(b)	B_4C, $B_{25}C$
(iii)	Allylides	(c)	Al_4C_3, Mg_2C
(iv)	Covalent carbides	(d)	Li_4C_3, Mg_2C_3

(A) (i)-(a), (ii)-(b), (iii)-(c), (iv)-(d)
(B) (i)-(c), (ii)-(a), (iii)-(d), (iv)-(b)
(C) (i)-(a), (ii)-(c), (iii)-(b), (iv)-(d)
(D) (i)-(c), (ii)-(d), (iii)-(a), (iv)-(b)

20. Using the crystal field stabilization energy (CFSE) to account the thermodynamic properties, correct match of the following is:

	Oxide		Lattice enthalpy (kJ mol^{-1})
(a)	CaO	(i)	3460
(b)	TiO	(ii)	3875
(c)	VO	(iii)	3913
(d)	MnO	(iv)	3810

(A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(C) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)
(D) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Section-B **2 each**
(Very short Answer Type Questions)

1. What are the symmetry criteria for a molecule to be chiral?
2. What will be the symmetry of p_x orbital of oxygen in water molecule?
3. Predict which of the complexes $[V(CO)_6]^-$, $Cr(CO)_6$, or $[Mn(CO)_6]^+$ has the shortest C—O bond, and why?
4. The $[RuCl(NO_2)(PPh_3)_2]^+$ complex exhibits two ν(NO) stretchs in its vibrational spectrum: one at 1845 cm^{-1} and the other at 1687 cm^{-1}. Sketch a reasonable geometry for the compound.
5. What are isopoly and heteropoly acids?
6. Given that $K_1 = 2.1 \times 10^3$ and $K_2 = 8.2 \times 10^3$, calculate the over-all stability constant β_2 for the formation of $[Ag(NH_3)_2]^+$. Why $K_2 > K_1$?
7. What are catenation and heterocatenation?
8. What are the carboranes?

Section-C **3 each**
(Short Answer Type Question)

1. Discuss the self-conjugation, mutual conjugation and associative conjugation of elements of C_{3v} point group.

2. Character table of C_{4v} point group is given below with additional reducible representation. Reduce this reducible representation using standard reduction formula and find out the number of representations of each type.

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_v'$		x^2+y^2, z^2
A_1	1	1	1	1	1	z	
A_2	1	1	1	-1	-1	R_z	
B_1	1	-1	1	1	-1		
B_2	1	-1	1	-1	1		
E	2	0	-2	0	0	(x, y) (R_x, Ry)	(x^2-y^2, xy) (xz, yz)
Γ_{cart}	18	2	-2	4	2		

3. For series of ligand substitution reactions given by the chemical reaction below, value for the the rate constant are given in the table. Does this reaction occur by an associative or dissociative pathways? Explain your answer.

cis-$[Mo(CO)_4(PR_3)_2]$ + CO → *cis*-$[Mo(CO)_5(PR_3)]$ + PR_3

Table showing the rates of ligand substitution at 70° C in the reaction above as a function of PR_3.

PR_3	Cone Angle	k, s^{-1}
PMe_2Ph	122°	$< 1.0 \times 10^{-6}$
$PMePh_2$	136°	1.33×10^{-5}
PPh_3	145°	3.16×10^{-3}
$PPh(cyclohexyl)_2$	162°	6.40×10^{-2}

4. Sketch the molecular orbital diagrams for CO and CN^- to show why the cyanide ligand will often form M—C≡N—M' bridge, and why the carbonyl ligand bridging in this manner is rare.
5. What do you understand by chelate effect? How metal chelation may affect the stability of the complex?
6. What are the silicones? Write their applications.
7. What is Borazene. Is it shows similarities in structure and reactivity with benzene?
8. Discuss the structure and bonding in phosphazines.

Section-D

(Short Answer Type Question)

1. Character table for D_{3h} point group is given below with additional reducible representation ($\Gamma_{cart.}$):

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		x^2+y^2, z^2
A_2'	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x,y)	(x^2-y^2, xy)
A_1''	1	1	1	-1	-1	-1		
A_2''	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)
$\Gamma_{cart.}$	12	0	-2	4	-2	3		

Using character table, answer the following question:
(i) What is order of group?
(ii) What is number of classes in this group.
(iii) How many sub-groups you may find out in this group?
(iv) Which irreducible representation is totally symmetrical?
(v) Which irreducible representation(s) will be Infra-red (IR) active?
(vi) Find out the irreducible representations for translational and rotational motions.
(vii) Prove that

$$\sum_k g\,(R)\chi_i\,(A_1)\,\chi_j(A_2) = 0$$

(viii) Find out the symmetry of the orbitals which participates in hybridization in trigonal bipyramidal (TBP) compound.
(ix) What will be the order of rotational sub-group?
(x) Which irreducible representations will be Raman active?

OR

For a C_{2v} point group:
(i) Construct character table, and assigned Mulliken's symbols to the irreducible representations.
(ii) Obtain reducible and irreducible presentations for different motions in H_2O molecules.
(iii) Find out irreducible representation for fundamental modes of vibrations.
(iv) Show, which irreducible representations will be infra-red and Raman active?

2. What do you understand by π-acidity? What the different kinds of π-bonding may occur between metal and ligands? What is the consequence of π-bonding on the Δo values in octahedral complexes?

OR

For an octahedral complex, obtain metal orbital and ligand group orbitals (LGO) of suitable symmetry to participate in molecular orbital (MO) formation. Draw molecular orbital diagram showing MOs of metal and ligand character. Distribute the electrons in MOs for $[Co(NH_3)_6]^{3+}$ complex.

3. What are the stability constants? What are different methods for determination of stability constants? Discuss spectrophotometric method for determination of formation constant.

OR

What are the silicates? How silicates can be classified in different classes? Write some of the applications of the silicates.

4. What are the different kinds of binding occurs in higher boranes? Considering these bonding, discuss the structure of B_4H_9, B_5H_9 and B_5H_{11} boranes.

OR

Considering metal-metal bonding:
(i) Discuss the metal-metal bonding in $[Re_2Cl_8]^{2-}$.
(ii) Explain the variation in bond orders in the following compound/ions:

$[Mo(HPO_4)_4]^{2-}$	$[Mo_2(SO_4)_4]^{3-}$	$[Mo_2(SO_4)_4]^{4-}$
Mo—Mo = 223 pm	Mo—Mo = 217 pm	Mo—Mo = 211 pm
(Bond order = 3)	(Bond order = 3.5)	(Bond order = 4)

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M. Sc. (First Semester)
EXAMINATION, Dec. - Jan., 2021-22
CHEMISTRY
Paper Second
(Concepts in Organic Chemistry)

Time : Three Hours

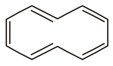
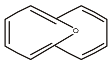
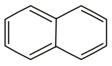
[Maximum Marks : 80]

[Minimum Pass Marks : 16]

Section - A
(Objective / Multiple Choice Questions)

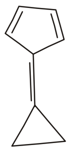
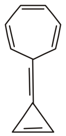
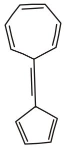
(1 Mark each)

1. Among P-R, the aromatic compounds are ?

(P)  (Q)  (R) 

(A) P, Q and R
(B) P and Q only
(C) Q and R only
(D) P and R only

2. The order of bond length in common C-C bond in the following compound is -

(1)  (2)  (3) 

(A) 2 > 3 > 1
(B) 1 > 3 > 2
(C) 3 > 1 > 2
(D) 1 > 2 > 3

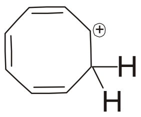
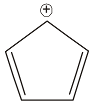
3. Zero dimensional nonomaterial is?

(A) CNT
(B) Graphene
(C) Fullerene
(D) None of these

4. Which side of crown ether is hydrophilic ?

(A) Inner side
(B) Outer side
(C) At the peripheri
(D) None of the above

5. Among the carbocation given below ?

(I)  (II)  (III) 

(A) I is aromatic, II antiaromatic and III is aromatic

(B) I is homoaromatic, II is antiaromatic and III is aromatic

(C) I is antiaromatic, II is aromatic and III is homoaromatic

(D) I is homoaromatic, II is aromatic and III is anti aromatic

6. In the boat confirmation of cyclohexane, the most destabilizing interaction is :

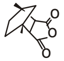
(A) Eclipsing

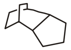
(B) 1,3 diaxial

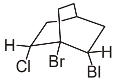
(C) 1,3 diequitorial

(D) Flagpole-Flagpole

7. Achiral compound is / are ?

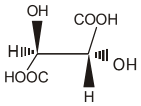
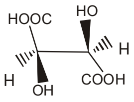
(A) 

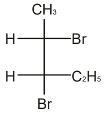
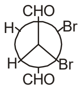
(B) 

(C) 

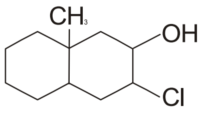
(D) All of these

8. Which one of the following compounds is meso ?

(A)  (B) 

(C)  (D) 

9. Number of stereocenter and stereoisomer of the following compound is ?



(A) 2 and 4 (B) 3 and 8

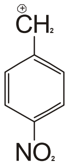
(C) 4 and 16 (D) None of these

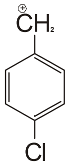
10. Match the following -

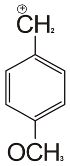
List -I	List - II
(a) α and β glucose	(a) Mutarotation
(b) (+) and (-) glucose	(b) Enantiomers
(c) D and L notation	(c) Anomers
(d) α - form-open chain - β form relationship	(d) Configurational

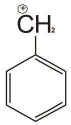
	a	b	c	d
(A)	2	3	4	1
(B)	2	3	1	4
(C)	3	2	4	1
(D)	3	2	1	4

11. What is the stability order of the following cabocations?

(II) 

(II) 

(III) 

(IV) 

(A) I V > III > II > I

(B) III > IV > II > I

(C) III > II > IV > I

(D) I > II > III > IV

12. Reaction intermediate of E_{1cb} reaction is ?

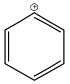
(A) Carbocation

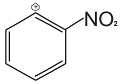
(B) Carbanion

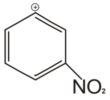
(C) Carbene

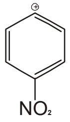
(D) Cyclic transition State

13. What is the stability order of following carbanion?

(I) 

(II) 

(III) 

(III) 

(A) III > II > I > IV

(B) II > IV > III > I

(C) I > III> IV > II

(D) I > II > IV > III

14. Alkyl azide in photolytic reaction to form N_2 gas and product, the reaction intermediate is :

(A) Carbene

(B) Nitrene

(C) Carbocation

(D) Carbanion

15. In E_2 reaction the dihedral angle to anti-periplanar conformation is

(A) 0^0 (B) 90^0

(C) 120^0 (D) 180^0

16. Cope reaction is a type of ?

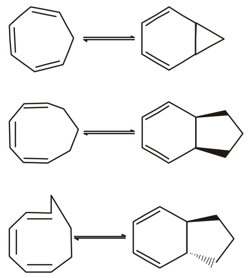
(A) Electrocyclic reaction

(B) Cycloaddition reaction

(C) Cheleotropic reaction

(D) Sigmatropic reaction

17. The direction of rotation of the following thermal electrocyclic ring closures respectively are -



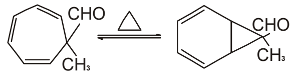
(A) Disrotatory, Disrotatory, Disrotatory,

(B) Conrotatory, Conrotatory, Conrotatory,

(C) Disrotatory. Disrotatory, Conrotatory,

(D) Disrotatory, Conrotatory, Disrotatory,

18. Select the correct classification in the following reaction from options I to IV given



(I) Conrotatory electrocyclic reaction

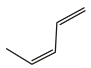
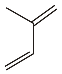
(II) Disrotatory electrocyclic reaction

(III) Valence isomerization

(IV) 4 π s + 2 π s cycloaddition reaction

(A) I and II (B) II and IV (C) II and III (D) I and IV

19. The order of reactivity of the following dienes X, Y and Z in the Diels Alder reaction -

X  Y  Z 

(A) X > Y > Z

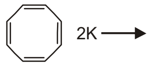
(B) X > Z > Y

(C) Y > Z > X

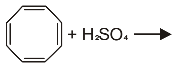
(D) Z > Y > X

20. The correct match for the product of the reactions in column A with the properties in column B in

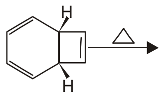
Column A Column B

I. 

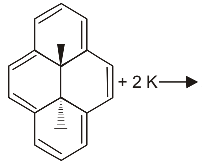
P. Aromatic

II. 

Q. Antiaromatic

III. 

R. Non-aromatic

IV. 

S. Homoaromatic

(A) I - P, II - S, III - R, IV - Q

(B) I - P, II - R, III - Q, IV - S

(C) I - Q, II - R, III - S, IV - P

(D) I - S, II - Q, III - R, IV - P

Section - B

(Very Short Answer Type Question)

(2 marks each)

1. How many pentagons and hexagons are present in C_{60}?
2. What are the difference between conjugation and cross conjugation? Give suitable examples.
3. What are meso compound? Give suitable examples.
4. Explain the optical activity in biphenyl.
5. Define singlet and triplet carbene.
6. What is E_{1CB} reaction?
7. What is Aza cope reaction?
8. What is Cheleotropic reaction? Explain with suitable examples.

Section - C

(Short Answer Type Question)

(3 marks each)

1. What do you mean by homoaromaticity?
2. What are cyclodextrins? Draw examples of beta-cyclodetrin.
3. What do you mean by stereoselective reaction? Explain with suitable examples.
4. Draw the structure of trans decalin and explain the stereochemistry.
5. What is hunsdieker reaction? Explain with example.
6. What is E_2 elemination reaction? Write a reaction and energy profile diagram.
7. Draw the molecular orbital diagram of 1, 3, 5 hexatriene.
8. What is Diels Alder reaction? Explain with suitable examples.

Section - D

(Long Answer Type Questions)

(5 marks each)

1. What are crown ethers? Explain synthesis and application.

   Or

   What are Rotanane? Explain synthesis and application.
2. Explain the Asymmetric Synthesis with suitable example.

   Or

   Explain the stability of different from of cyclohexane with energy profile.
3. What are elimination reaction? Explain the E_1 reaction with suitable example and energy profile diagram.

   Or

   What is Sandmeyer reaction? Write a reaction and mechanism
4. Discuss the FMO and PMO approcah.

   Or

   Draw and discuss the woodward correlation diagram of 1,3,5 hexa triene in disrotatory and conrotatory motion.

Roll No. .... Total Printed Pages - 8

F - 307

M.Sc. (First Semester)
EXAMINATION, Dec. - Jan., 2021-22
CHEMISTRY
Paper Third
(Quantum Chemistry, Thermodynamics and Chemical Dynamics-I)

Time : Three Hours] *[Maximum Marks:80*

[Minimum Pass marks :16

Note : Attempt all sections as directed

Section - A
(Objective/Multiple Choice Questions)

(1 mark each)

Note: Attempt all questions as directed.

Choose the correct answer.

1. Consider the vectors $u = i - 7j + 3k \text{ and } v = -3i + 4j + 2k$, sum of these two vectors is:

   (A) $-4i - 11j + 5k$

   (B) $2i + 3j + k$

   (C) $-2i - 3j + 5k$

   (D) $4i - 3j + 5k$

2. $\int\left(x^2 + \frac{2}{x^3} - 7\right)dx = ?$

   (A) $\frac{x^3}{3} + \frac{2}{x^2} - 7$

   (B) $\frac{x^3}{3} - \frac{2}{x^2} - 7$

   (C) $\frac{x^3}{3} - \frac{1}{x^2} - 7x$

   (D) $\frac{x^3}{3} - \frac{1}{x^2} - 7x + c$

3. Which of the following is not a vector quantity?

   (A) Potential energy

   (B) Weight

   (C) Nuclear spin

   (D) Momentum

4. If there exist more than one eigen function corresponding to a given eigen value, then the eigen value is called.

   (A) Nondegenerate

   (B) Degenerate

   (C) Discrete

   (D) Continuum

5. The zero - point energy for simple harmonic oscillator is E = ... (where h- Plank's constant and ω - oscillation frequency)

   (A) $\hbar\omega$

   (B) $1/2\hbar\omega$

   (C) $3/2\hbar\omega$

   (D) $5/2\hbar\omega$

6. Gibbs - Duhem equation relates composition with_____at constant temperature & pressure in liquid phase -

   (A) Fugacity

   (B) Partial pressure

   (C) Activity coefficient

   (D) (A), (B) and (C)

7. The ratio of chemical potential to free energy of a pure substance at constant temperature and pressure is:

   (A) Zero

   (B) 1

   (C) ∞

   (D) None of these

8. Which of the following Maxwell relation is not correct:

   (A) dU = TdS-PdV

   (B) dH = TdS+VdP

   (C) dF = SdT+PdV

   (D) dG = VdP-SdT

9. Partial molar free energy of an element A in solution is same as its:

   (A) Fugacity

   (B) Activity

   (C) Activity coefficient

   (D) Chemical potential

10. Partial molar quantities are important in the study of:

    (A) Ideal gases

    (B) Non - ideal mixtures

    (C) Ideal Solutions

    (D) A pure component

11. The ionic strength of K_2SO_4 is:

    (A) 1

    (B) 2

    (C) 3

    (D) 4

12. Which one of the following is a second - order reaction?

    (A) $CH_3COOCH_3 + N_aOH \rightarrow CH_3COON_a + H_2O$

    (B) $H_2 + C1_2 + \rightarrow 2HCI$

    (C) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

    (D) $H_2 + Br_2 \rightarrow 2HBr$

13. For an ideal gas, the activity coefficient is:

    (A) Directly proportional to pressure

    (B) Inversely proportional to pressure

    (C) Unity at all pressures

    (D) None of these

14. According to Debye - Huckel theory of strong electrolytes, and ion moving in an atmosphere of oppositely charged ions experiences a drag, this effect is known as:
    (A) Asymmetric effect
    (B) Electrophoresis effect
    (C) Inter - Ionic effect
    (D) Concentration effect
15. How many times will the rate of the elementary reaction $3X+Y \longrightarrow X_2Y$ Change if the concentration of the substance X is doubled and that of Y is half:
    (A) $r_2 = 4.5r_1$
    (B) $r_2 = 5r_1$
    (C) $r_2 = 2r_1$
    (D) $r_2 = 4r_1$
16. The rate constant of the reaction is $k = 3.28\times10^{-4}\,s^{-1}$, Find the order or the reaction is:
    (A) Zero order
    (B) First order
    (C) Second order
    (D) Third order
17. In chemical reaction, the rate of reaction increases with temperature, becuase:
    (A) The kinetic energy of reactants increases
    (B) The number of collisions between molecules increases
    (C) Of increases in the number of molecules with the activation energy
    (D) Of decreases with the activation energy

18. In Arrhenius plot, intercept is equal to:
    (A) In A
    (B) $\log_{10}a$
    (C) In K
    (D) None of these
19. The unit of rate constant for the reaction $2H_2 + 2NO \rightarrow 2H_2O + N_2$ Which has rate = K $[H_2][NO]^2$, is:
    (A) s^{-1}
    (B) $mol^{-2}L^2s^{-1}$
    (C) $mol\,L^{-1}$
    (D) $mol\,L^{-1}\,s^{-1}$
20. In terms of the collision theory of chemical kinetics the rate of a chemical reaction is proportional to:
    (A) The number of collisions per second
    (B) The number of product molecules
    (C) The change in temperature per second
    (D) The change in energy per second

Section - B

(Very Short Answer Type Question)

(2 marks each)

Note: Attempt all questions

1. If $e^{x-y} = xy$, then $\frac{dy}{dx}$ is.
2. Describe two postulates of quantum mechanics.
3. Explain the term of fugacity. How it is related to pressure and temperature.?

4. Describe Vant's Hoff reaction isotherm?
5. Calculate the ionic strength of a solution that is 0.10 M in $FeCl_2$ and 0.20 M in $FeCl_2$.
6. Give one method of determination of activity coefficient.
7. Explain activated complex theory of reaction rate.
8. What is steric factor?

Section - C

(Short Answer Type Questions)

(3 marks each)

Note: Attempt all questions.

1. Solve the following by differentiation:

$$y = \frac{1}{\sqrt{1-x^2}}, then\, dy/dx = ?$$

2. Evaluate $\int 2 \times \left(1-x^2\right)^5 dx$
3. An electron is bound in one dimensional box of size 4 $\times 10^{-10}$ m.What will be its minimum energy? (Given: m = 9.1 x 10^{-31}kg).
4. Derive the Maxwell relation for the following fundamental equation $(\partial T/\partial V)s = -(\partial P/\partial S)v$
5. Derive the value of chemical potential of a mixture of ideal gases.
6. Find the sum of the three vectors A (1,1,2), B (-1,2,-3), and C (2,-1, 0) with the magnitude and angles of resultant vector of summation.
7. Explain Debye - Huckel limiting law.
8. What is steady state kinetics? Explain

Section - D

(Long Answer Type Questions)

(5 marks each)

1. Derive, the equation of time independent Schrodinger equation for particle in one dimensional box.

   OR

   Explain the application of Schrodinger equation for simple harmonic oscillator.
2. Define the term of activity. Describe any method for the determination of activity? How Chemical potential vary with pressure.

   OR

   Explain partial molar properties and partial molar heat content of system. Derive Gibbs- Duhem equation.
3. What do you understand by thermodynamics of electrified interfaces? Explain Lippmann equation for surface excess.

   OR

   Derive the Debye-Huckel- Onsager equation and validity of Onsager's equation for aqueous solution.
4. Discuss the kinetics of chain reaction between H_2 and Br_2 and derive the rate law.

   OR

   What are the kinetic and thermodynamic requirements for Chemical oscillation? Explain briefly Belousov - Zhabotinsky (B-Z) Reaction.

Roll No. .... Total Printed Pages - 11

F-308

M.Sc. (First Semester)
EXAMINATION, Dec. - Jan., 2021-22

Paper Fourth

(Theory and Applications of spectroscopy - I)

Time : Three Hours ***[Maximum Marks : 80***

Section - A

(Objective/Multiple Choice Questions)

(1 mark each)

Note : Attempt all questions.

1. Select the correct statement from the following option.

   (A) Spectroscopic methods require less time and more amount of sample than classical methods.

   (B) Spectroscopic methods require more time and more amount of sample than classical methods.

   (C) Spectroscopic methods require less time and less amount of sample than classical methods.

   (D) Spectroscopic methods require more time and less amount of sample than classical methods.

2. How many degrees of freedom does a chemical compound of N atoms have?

   (A) 2N (B) 2N + 1

   (C) 3N (D) 3N + 1

3. For a particular vibrational mode to appear in the Raman spectrum, what must change?

   (A) Frequency of radiation

   (B) Intensity of radiation

   (C) Molecule's shape

   (D) Molecule's polarizability

4. What is the order of decreasing vibrational frequency for C - Cl, C - Br, C - C, C - O and C - H?

   (A) C - H, C - C, C - O, C - Cl, C - Br

   (B) C - Cl, C - Br, C - C, C - H, C - O

   (C) C - O, C - H, C - Br, C - Cl, C - C

   (D) C - Br, C - Cl, C - C, C - O, C - H

5. Which of the following lines are most intense?

   (A) Stokes lines

   (B) Rayleigh-scattered lines

   (C) Anti-strokes lines

   (D) All have same intensity

6. For a particular vibrational mode to appear in the Raman specturm, What must change?
   - (A) Frequency of radiation
   - (B) Intensity of radiation
   - (C) Molecule's shape
   - (D) Molecule's polarizability

7. The elastic scattering of photons is called as______
   - (A) Atmospheric scattering
   - (B) Rayleigh Scattering
   - (C) Conserved Scattering
   - (D) Raman Scattering

8. The number of vibrational modes for the acetaldehyde is:
   - (A) 23
   - (B) 24
   - (C) 15
   - (D) 9

9. The vibrational frequency of stretching vibration of the diatomic molecule in the above question will be:
   - (A) $v/2\pi = \sqrt{(\mu/k)}$
   - (B) $v/2\pi = \sqrt{(k/\mu)}$
   - (C) $v = 1/2\pi\sqrt{(\mu/k)}$
   - (D) $v = 1/2\pi\sqrt{(k/\mu)}$

10. The solid samples are analysed in IR spectroscopic analysis by -
    - (A) Preparing a solution of analyte
    - (B) Using a mulling agent
    - (C) Pyrrolysis
    - (D) All of the above

11. Which of the following bending vibration takes place in different planes?
    - (A) Asymmetric stretching
    - (B) Rocking
    - (C) Scissoring
    - (D) Twisting

12. How many vibrational modes are possible for HCl?
    - (A) 0
    - (B) 1
    - (C) 2
    - (D) 3

13. Which of the following vibrational mode of CO_2 is IR active?
    - (A) Symmetric stretching
    - (B) Asymmetric stretching
    - (C) Both A and B
    - (D) None

14. Which of the following comparison is correct for solvent shift on the n $->\pi*$ transition of acetone?

    (A) $H_20=CH_30H=C_2H_50H=CHCl_3=C_6H_{14}$

    (B) $H_20>CH_30H>C_2H_50H>CHCl_3>C_6H_{14}$

    (C) $H_20<CH_30H<C_2H_50H<CHCl_3<C_6H_{14}$

    (D) $H_20>CH_30H<C_2H_50H<CHCl_3<C_6H_{14}$

15. What is the correct order of $\lambda_{\max}$ for $n->\pi*$ transition for the following three compounds?

    (A) RCOOH > RCOOR’ > $RCONH_2$

    (B) RCOOH = RCOOR’ = $RCONH_2$

    (C) RCOOH = RCOOR’ < $RCONH_2$

    (D) RCOOH = RCOOR’ > $RCONH_2$

16. The ultraviolet spectrum of benzonitrile shows a secondary absorption band at 271 nm. If a solution of benzonitrile in water, with a concentration of 1 x 10^{-4} molar solution is examined at 271 nm, what will be the absorbance reading $(\varepsilon = 1000)$ and what will be the intensity ratio, Io/I, respectively?

    (A) 0.1, 1.26

    (B) 0.2, 2.26

    (C) 0.3, 3.26

    (D) 0.4, 4.26

17. Why ketenes absorb in IR at a very high frequency (2150 cm^{-1})?

    (A) The inner C is sp hybridized

    (B) The more s character in a bond, the stronger it is

    (C) Inner C is sp^2 hybridized

    (D) Inner C is sp^3 hybridized

18. What is the number of vibrational degrees of freedom in $C_6H_5CH_3$?

    (A) 39

    (B) 15

    (C) 18

    (D) 40

19. Why Monomeric saturated aliphatic carboxylic acids show carbonyl stretching frequency near 1760 cm^{-1}, while saturated aliphatic ketones near 1720 cm^{-1}?

    (A) Mesomeric (M) effect is dominant in acids over the inductive (1) effect

    (B) 1 effect is dominant in carboxylic acids over the mesomeric effect

    (C) 1 effect on ketones is dominant over the M effect

    (D) M effect in ketones is dominant

20. The third and fourth line in the rotational Raman spectrum of CO are separate by 8cm^{-1}, The CO bond length is given by:

(A) $\sqrt{\frac{h}{16\pi^2 \mu c}}$

(B) $\sqrt{\frac{3h}{16\pi^2 \mu c}}$

(C) $\sqrt{\frac{5h}{32\pi^2 \mu c}}$

(D) $\sqrt{\frac{h}{32\pi^2 \mu c}}$

Section - B

(Very Short Answer Type Questions)

(2 marks each)

Note: Attempt any eight questions.

1. Write about the source of Raman spectroscopy.
2. Write about filters in Raman spectroscopy.
3. Write two applications of IR spectroscopy.
4. Define selection rules.
5. What is dispersion?
6. Write a note on Born - Oppenheimer approximation.

7. What is electromagnetic radiation?
8. Write a note on the thermistors used in IR spectroscopy.
9. Why is CH4 Raman active?
10. Write a note on Vibrational coarse structure.

Section - C

(Short Answer Type Questions)

(3 marks each)

Note: Attempt any eight questions:

1. Explain the different sampling techniques in IR spectroscopy
2. Explain factors determining the intensity of spectral lines.
3. Describe the brief rotational fine structure of electronic-vibration transitions.
4. Write a short note on P,Q and R branches observed in IR spectrum of a diatomic molecule.
5. Discuss the principle of IR spectroscopy in molecular structure elucidation.
6. What are symmetric and asymmertric vibrations? Explain with the example of H_2O molecule.
7. Explain the activity of the following molecules with respect to IR and microwave specturm. H_2,HCl,CO_2, H_4&CH_3Cl
8. The first line in the rotational spectrum of $^{12}C^{16}O$ molecule is 3.84235cm^{-1}. Find out the bond length of the molecule.

Section - D

(Long Answer Type Questions)

(5 marks each)

Note : Attempt following questions.

1. (i) How does IR spectroscopy differ from Raman spectroscopy?

   (ii) Write about the sample in microwave spectroscopy.

OR

   (i) Write about detectors in microwave spectroscopy.

   (ii) What is the condition for a molecule to be microwave active? Why?

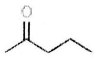
2. (i) Why isoxygenmolecule does not microwave active?

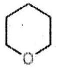
   (ii) Explain various advantages of Fourier transform spectroscopy.

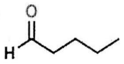
OR

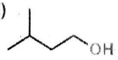
   (i) Unkonwn molecule with molecular formula $C_5H_{10}O$. Which of these five molecules is it most likely to be?

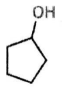
   Which of these molecules best corresponds to the IR spectrum below?

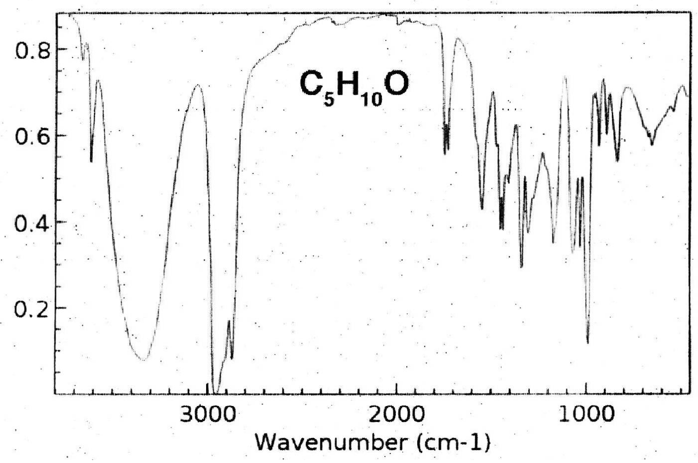
a)


b)


c)


d)


e)




   (ii) Discuss the IR bands can be classified as strong (s), medium (m), or weak (w)

3. (i) Calculate the wavenumber shift for the vibrational mode of Cl_2, given that the force constant k for the bond is 3.23 N cm^{-1}.

   (ii) What advantages does Raman spectroscopy have for process monitoring?

OR

   (i) The equilibrium vibration frequency of the iodine molecule is 215 cm^{-1} and the anharmonicity constant $xe\, is\, 0.003$. What is the intensity of the hot band for V = 1 to V = 2, realative to the fundamental V = 0 to V = 1, if the temperature is 300K?

   (ii) What is electromagnetic radiation?

4. (i) Why are Raman signals weak?

(ii) Why do the anti - Stokes lines of carbon tetrachloride have the following order of intensity: 219 > 314 > 459 cm^{-1}?

OR

(i) Which source is used in microwave spectrometer?

(ii) The average spacing between successive rotating lines of CO_2 is 3.826 cm^{-1}. Determine the transition which gives most intense spectral line at 3.

(iii) Explain various advantages of Fourier transform spectroscopy.

Roll No. ....

E–515

M. Sc. (Second Semester) (ATKT)

EXAMINATION, May-June, 2021

CHEMISTRY

Paper No. CH–7

(Transition Metal Complexes)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. A reaction undergoes with formation of seven coordination transition state. The mechanism of reaction is :
   - (a) S_N^1
   - (b) S_N^2
   - (c) Both (a) and (b)
   - (d) None of the above

2. The correct order of hydrolysis of cobalt amine complex is :
   - (a) $[Co(NH_3)_5Cl] > [Co(en)_2Cl_2]^+ > [Co(en)(NH_3)_2Cl]^{2+} > [Co(trien)Cl_2]^+$
   - (b) $[Co(NH_3)_5Cl] < [Co(en)_2Cl_2]^+ < [Co(en)(NH_3)_2Cl]^{2+} < [Co(trien)Cl_2]^+$
   - (c) $[Co(NH_3)_5Cl] > [Co(en)_2Cl_2]^+ > [Co(en)(NH_3)_2Cl]^{2+} = [Co(trien)Cl_2]^+$
   - (d) $[Co(NH_3)_5Cl] > [Co(en)_2Cl_2]^+ > [Co(en)(NH_3)_2Cl]^{2+} < [Co(trien)Cl_2]^+$

3. Following reaction undergoes with :

   $[Co(NH_3)_5Cl]^{2+} + [Cr(H_2O)_6]^{2+} \rightarrow [Co(NH_3)_5H_2O]^{2+} + [Cr(H_2O)_5Cl]^{2+}$
   - (a) Outer sphere mechanism
   - (b) S_N^2 Mechanism
   - (c) Inner-sphere mechanism
   - (d) All of the above

4. Following reaction undergoes with

   $[(NH_3)_5Co(CO_3)]^+ + H_2O \rightarrow [(NH_3)_5Co(H_2O)]^{3+}$
   - (a) Dissociation mechanism
   - (b) Association mechanism
   - (c) Electron transfer mechanism
   - (d) Without bond breaking

5. The rate-law for square planar complex given below condition :
   - (a) Two-path mechanism
   - (b) Only S_N^1
   - (c) Only S_N^2
   - (d) None of the above

6. For chromium ion (Cr^{3+}), the transition ${}^4A_{2g} \rightarrow {}^4T_{2g}$ is :
   - (a) Spin forbidden
   - (b) Laporte allowed
   - (c) Equivalent to 10 Dq
   - (d) All of the above

7. The molar extinction coefficient (intensity) of transition is $(CoCl_4)^{2-}$ is higher than transition in $[Co(H_2O)_6]^{2+}$, become :
   - (a) Transition is laporte allowed
   - (b) Transition is spin allowed
   - (c) Both (a) and (b)
   - (d) None of the above

8. The Cr^{3+} ion, the following transition may be assigned :

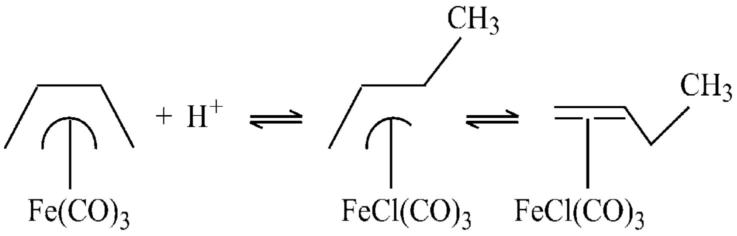
   ${}^4A_{2g} \rightarrow {}^4T_{1g}$ (P) v_3 34,400
   ${}^4A_{2g} \rightarrow {}^4T_{1g}$ (F) v_2 22,700
   ${}^4A_{2g} \rightarrow {}^4T_{2g}$ v_1 14,900

   Which transition will be responsible for the color in the visible region ?
   - (a) ${}^4A_{2g} \rightarrow {}^4T_{2g}$
   - (b) ${}^4A_{2g} \rightarrow {}^4T_{1g}$ (F)
   - (c) ${}^4A_{2g} \rightarrow {}^4T_{1g}$ (P)
   - (d) Both (a) and (b)

9. Number of microstates for the P^3 configuration will be :
   - (a) 15
   - (b) 20
   - (c) 45
   - (d) 10

10. Ground state term for d^4 and d^6 will be :
    - (a) ${}^5D$ for both
    - (b) ${}^5D$ for d^4 and ${}^6S$ for d^6
    - (c) ${}^6S$ for d^6 and ${}^5D$ for d^4
    - (d) ${}^3F$ for d^4 and ${}^4F$ for d^6

11. In the following hypothetical reaction, hapticity of the π -bonding ligands is/are :



   - (a) $a-\eta^4, b-\eta^2, c-\eta^3$
   - (b) $a-\eta^4, b-\eta^3, c-\eta^2$
   - (c) $a-\eta^3, b-\eta^4, c-\eta^2$
   - (d) $a-\eta^2, b-\eta^3, c-\eta^2$

12. Which statement is correct for metal alkene complexes ?

(a) The C-C bond length of alkene increases on complexation.

(b) The planar alkene molecule becomes non-planar on complexation.

(c) Pt-Cl bond length is trans to alkene is longer than other cis Pt-Cl bonds.

(d) None of the above

13. The correct order of M-C_p (M-C) distance in metallocene is :

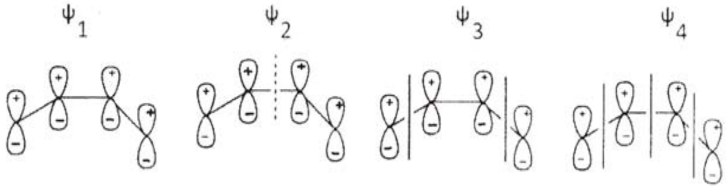
(a) $Fe(C_p)_2 > Co(C_p)_2 > Ni(C_p)_2$

(b) $Fe(C_p)_2 > Co(C_p)_2 > < Ni(C_p)_2$

(c) $Fe(C_p)_2 < Co(C_p)_2 > Ni(C_p)_2$

(d) $Ni(C_p)_2 > Co(C_p)_2 < Fe(C_p)_2$

14. The π-molecular orbitals of butadiene is given below :



The larger contribution of each molecular orbital will give rise to the different hapticity in M-L bonding the correct match is :

(a) $\psi_1 - \eta^4, \psi_2 - \eta^2, \psi_3 - \eta^1$ and η^2

(b) $\psi_1 - \eta^2, \psi_2 - \eta^1, \psi_3 - \eta^1$

(c) $\psi_1 - \eta^3, \psi_2 - \eta^2, \psi_3 - \eta^2$

(d) $\psi_1 - \eta^4, \psi_2 - \eta^3, \psi_3 - \eta^1$ and η^2

15. Which carbonyl do not obey the 18^{e-} rule ?

(a) $Mn_2(CO)_{10}$

(b) $V(CO)_6$

(c) $Fe(CO)_5$

(d) $Cr(CO)_6$

16. Grubb’s catalyst is used for :

(a) Hydroformylation

(b) Alkene polymerization

(c) Hydrogenation

(d) Alkene metathesis

17. The observation that, $Fe(\eta^1 - C_5H_5)(CO)_2(\eta^5 - C_5H_5)$ gives two singlets at room temperature for the two cyclopentadienyl ligands. This behavior is because of :

(a) Tautomerism

(b) Ligand substitution

(c) Fluxionality

(d) Electron transfer reaction

18. The complex $(OC)_5Cr\{(OEt)Me\}$ is :
    - (a) Schrock carbene
    - (b) Grubb's catalyst
    - (c) Fischer carbene
    - (d) All of the above

19. The major decomposition pathways for alkyl is β-elimination, which converts a metal alkyl into a hydridometal alkene complex. These decomposition may occur when :
    - (a) β-carbon of alkyl bears a hydrogen substituents.
    - (b) The M-C-C-M unit is in coplanar conformation which brings the β-hydrogen close to the metal.
    - (c) There is vacant site in the metal, cis to the alkyl.
    - (d) All of the above

20. The nature of carbine carbon in Schrock carbene is :
    - (a) Electrophilic
    - (b) Nucleophilic
    - (c) Both (a) and (b)
    - (d) None of the above

Section—B

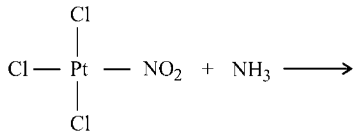
2 each

(Very Short Answer Type Questions)

Note : Attempt all questions. Write answer in **2-3** lines.

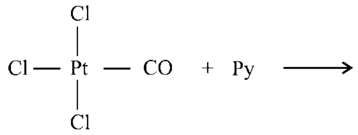
1. Complete the following reactions :

(i)



$Cl-\overset{\displaystyle Cl}{\underset{\displaystyle Cl}{Pt}}-NO_2 + NH_3 \longrightarrow$

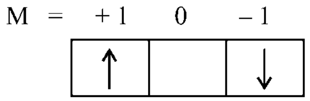
(ii)



$Cl-\overset{\displaystyle Cl}{\underset{\displaystyle Cl}{Pt}}-CO + Py \longrightarrow$

2. State the Marcus-Hush's equation/principle.

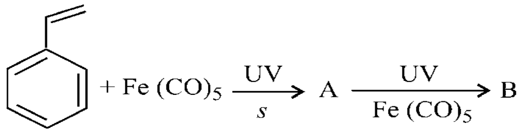
3. For the p^2 configuration given below, what will be the allowed value of term symbols ?



4. State the Curie's law of magnetic susceptibility.

5. Complete the following reactions :

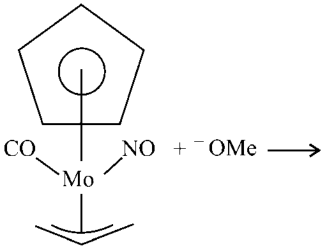
(i)

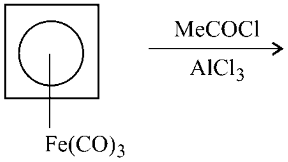


(ii) $Na[Mn(CO)_5] + CH_2-CH-CH_2-Br \rightarrow A$

$\xrightarrow{h\nu \text{ or } 80° C} B$

6. Complete the following reactions :

(i) 

(ii) 

7. Why is Fischer carbene carbon electrophilic in nature ?
8. Complete the following reactions :

   (i) $Fe(\eta^5 - C_5H_5)_2 + Li + C_2H_5NH_2 \rightarrow$

   (ii) $(OC)_5Cr{=}C(OMe)R + HNR'R'' \rightarrow$

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions. Write answers in > **75** words.

1. How does S_N1 reaction undergo in octahedral complexes ?
2. Why bridging ligand is required for the inner-sphere electron transfer reactions ?
3. What is nephelauxetic effect ?
4. Draw Orgel diagram and assigned all the allowed transitions.

5. Why does ferrocene undergo electrophilic substitution reaction ?
6. Free cyclobutadiene is anti-aromatic. Complexed cyclobutadiene gives electrophilic substitution reaction. Why ?
7. Using MO approach explain the η^1, η^2 and η^4 mode of bonding in butadiene complexes.
8. Cyclopentadienyl complexes undergo electrophilic reaction. Explain.

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions. Write answers in **150** words.

1. Discuss the mechanism of outer-sphere electron transfer reaction.

   Or

   What do you mean by *trans*-effect ? Discuss the π-bonding theory of *trans*-effect. How substitution reaction undergoes with two-path mechanism ?

2. What do you mean by charge transfer transition ? Discuss the metal-to-ligand and ligand-to-metal and charge transfer transition.

   Or

   What are the selection rules for electronic transition ? How can they be breakdown ?

3. Discuss the structure and bonding of ferrocene.

Or

Discuss structure and bonding of dibenzene chromium.

4. What do you mean by molecular fluxionality ? How NMR spectroscopy can help to explain fluxional behavior ? Discuss the fluxional behavior of organometallic compounds.

Or

What are carbene complexes ? Discuss the differences between Fischer and Schrock carbene on the ground of structure, bonding and chemical reactivity.

Roll No. ....

E–516

M. Sc. (Second Semester) (Main/ATKT)

EXAMINATION, May-June, 2021

CHEMISTRY

Paper No. CH–8

(Reaction Mechanism)

Time : Three Hours] [*Maximum Marks : 80*

[*Minimum Pass Marks : 16*

Note : Attempt all Sections as directed.

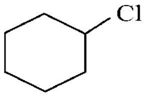
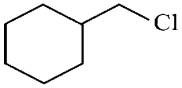
Section—A 1 each

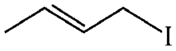
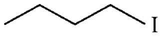
(Objective/Multiple Choice Questions)

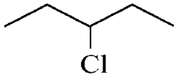
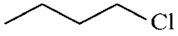
Note : Attempt all questions.

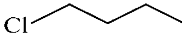
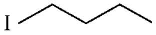
Choose the correct answer :

1. Which of the following statements is correct for reactivity in S_{N^2} reaction ?

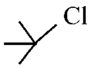
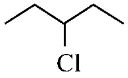
(a)  is more reactive than 

(b)  is more reactive than 

(c)  is more reactive than 

(d)  is more reactive than 

2. Using the given codes, arrange the following compounds in decreasing order of the rate of solvolysis by S_{N^1} mechanism :

(I)  (II)  (III) 

(a) I > III > II

(b) III > II > I

(c) I > II > III

(d) II > I > III

3. Which of the following is not ortho and para directing group in aromatic electrophilic substitution reaction ?

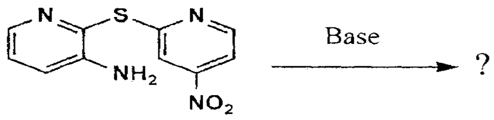
(a) NH_2

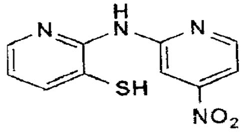
(b) NO_2

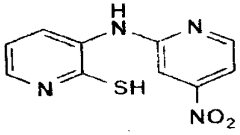
(c) OH

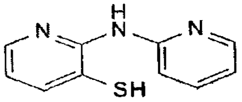
(d) NR_2

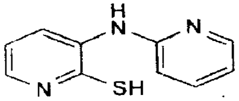
4. What is the product of the given reaction ?



(a) 

(b) 

(c) 

(d) 

5. The rate of which of the following S_{N^2} reactions will increase in solvent polarity ?

(a) $CH_3CH_2CH_2Br \xrightarrow{\overset{\ominus}{OH}} CH_3CH_2CH_2OH$

(b) $EtI + Me_3N \rightarrow Me_3\overset{\oplus}{N}Et$

(c) $Me - \overset{\oplus}{O}H_2 + \overset{\ominus}{Br} \rightarrow MeBr + H_2O$

(d) $Me_4\overset{\ominus}{N} + H_2S \rightarrow Me\text{-}\overset{\oplus}{S}H_2 + Me_3N$

P. T. O.

6. Which among the following will be most reactive in S_{E^1} reaction (L = leaving group) ?

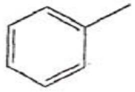
(a) CH_3L

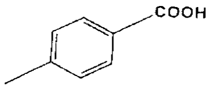
(b) $ClCH_2L$

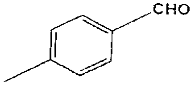
(c) Cl_2CHL

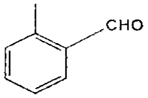
(d) CCl_3L

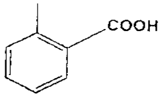
7. What is the product of the given reaction ?

 $+ CO + HCl \xrightarrow{AlCl_3} ?$

(a) 

(b) 

(c) 

(d) 

8. Which one of the following reactions will take place most readily at bridgehead carbon in a [2, 2, 1] bycyclic system ?

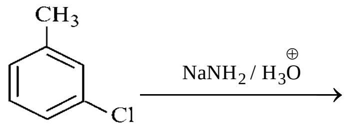
(a) S_{N^1}

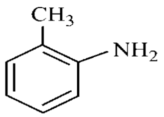
(b) S_{E^1}

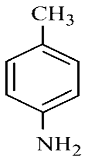
(c) S_{E^2} (back)

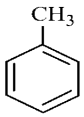
(d) S_{N^2}

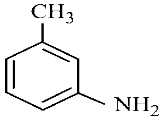
9. Which is the product of the given reaction ?



(a) 

(b) 

(c) 

(d) 

10. The base can be used in Vilsmeir reaction is :

(a) $SOCl_2$

(b) $POCl_3$

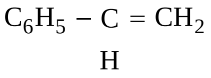
(c) $COCl_2$

(d) Both (b) and (c)

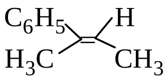
(e) All (a), (b) and (c)

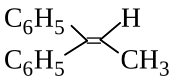
P. T. O.

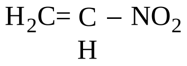
11. Arrange the following compounds in decreasing order for electrophilic addition reaction with HX :

(I) 

$C_6H_5-\underset{H}{C}=CH_2$

(II) 

(III) 

(IV) 

$H_2C=\underset{H}{C}-NO_2$

(a) IV > I > II > III

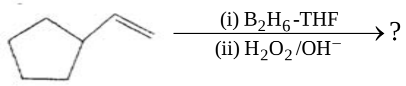
(b) III > II > I > IV

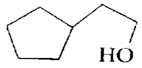
(c) II > III > I > IV

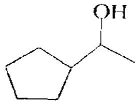
(d) I > III > IV > I

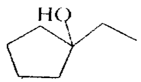
(e) None of the above

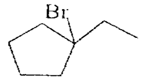
12. What is the product of the given reaction ?



(a) 

(b) 

(c) 

(d) 

13. Consider the following statements :

(I) Alkene is more reactive than alkyne for electrophilic addition.

(II) Alkyne is more reactive than alkene for nucleophilic addition.

(III) Alkyne is more reactive than alkene for electrophilic addition reaction.

(IV) Alkene having CF_3 at vinylic carbon is more reactive than alkene having CH_3 group.

The correct statements are :

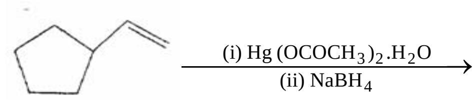
(a) III and IV

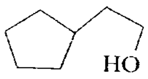
(b) I, II and III

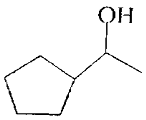
(c) I, II and IV

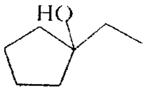
(d) I and II

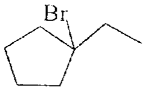
14. What is the product of the following reaction ?



(a) 

(b) 

(c) 

(d) 

15. Which of the following will give anti addition reaction ?

(a) Br_2

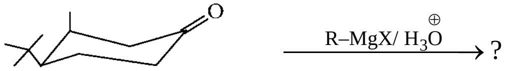
(b) $Hg(OCOCH_3)_2.H_2O$

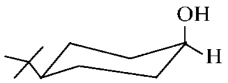
(c) $[RhCl(PPh)_3]$

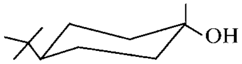
(d) Ni/Pd/Pt- H_2

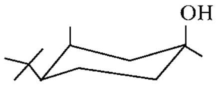
(e) None of the abve

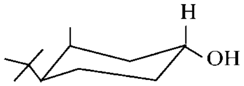
16. What is the product of the given reaction ?



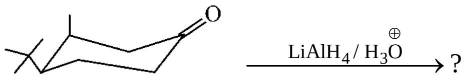
(a) 

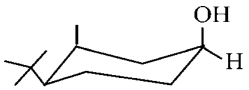
(b) 

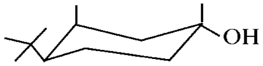
(c) 

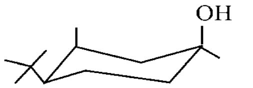
(d) 

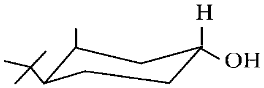
17. What is the product of the given reaction ?



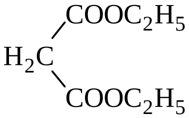
(a) 

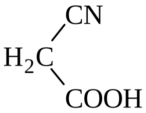
(b) 

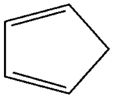
(c) 

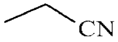
(d) 

18. Anion of which compounds can give Knoevenagel reaction with aromatic aldehydes ?

(1) 
$H_2C(COOC_2H_5)_2$

(2) 
$H_2C(CN)(COOH)$

(3) 

(4) 

Select the correct answer from the codes given below :

Codes :

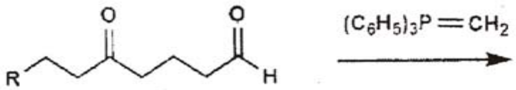
(a) Only (1) and (2)

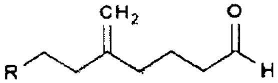
(b) (1), (2) and (4)

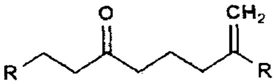
(c) (1), (2) and (3)

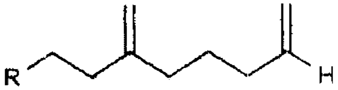
(d) (1), (2), (3) and (4)

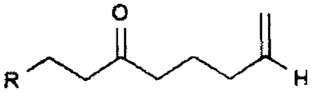
19. What is the product of the given reaction ?



(a) 

(b) 

(c) 

(d) 

20. Which of the following reactions can be used for the preparation of C – C bond in organic synthesis ?

(I) Reformatsky reaction

(II) Claisen ester condensation

(III) Wittig reaction

(IV) Knoevenagel reaction

(a) Only IV

(b) II, III and IV

(c) I, II and III

(d) I, II, III and IV

(e) None of the above

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. Write any *one* reaction of ArS_{N^2} reaction.
2. What do you mean by achimeric assistance ?
3. Write the reaction of SE^1 reaction.
4. Write reaction on aliphatic diazonium coupling.
5. Write the reaction of Michael reaction.
6. What do you mean by Stereoselective reaction ?
7. Write any *two* reactions of metal hydride with carbon-hetero multiple bond.
8. Write the reaction of hydrolysis of amides.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. What do you mean by Smile Rearrangement ? Explain with suitable example.
2. Explain the benzyne mechanism with suitable example.
3. Explain the SE^2 reaction with mechanism.
4. What is Gottermann Koch reaction ?
5. Explain the hydrogenation of double and triple bond.
6. Discuss the addition reaction of cyclopropane ring.
7. What is Aldol condensation reaction give the mechanism and application ?
8. What is Knoevenagel reaction ? Write the mechanism and examples.

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. Explain the following :
   - (a) Ambident nucleophilicity
   - (b) Neighbouring group mechanism

   Or

   What is Von-Richter reaction ? Give the mechanism and application.
2. Explain the following :
   - (a) ipso attack
   - (b) Arenium ion mechanism

   Or

   What is Vilsmeir reaction ? Give the mechanism and application.
3. Explain the following :
   - (a) Hydroboration reaction
   - (b) Regioselective reaction

   Or

   What is sharpless asymmetric epoxidation ? Explain with suitable examples.
4. Explain the following :
   - (a) Wittig reaction
   - (b) Ammonolysis of ester

   Or

   What is Stobbe reaction ? Give the mechanism and application.

Roll No. ....

E–517

M. Sc. (Second Semester)
EXAMINATION, May-June, 2021

CHEMISTRY

Paper No. CH-9

(Quantum Chemistry, Thermodynamics and Chemical Dynamics—II)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A

1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. If $A = \begin{pmatrix} 0 & 1 \\ 2 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & -1 \\ 5 & 2 \end{pmatrix}$, which of the following is false ?

   (a) $3A - 4B = \begin{pmatrix} -4 & 7 \\ -14 & 1 \end{pmatrix}$

   (b) $A^2 = \begin{pmatrix} 0 & 1 \\ 4 & 9 \end{pmatrix}$

   (c) $A + B = \begin{pmatrix} 1 & 0 \\ 7 & 5 \end{pmatrix}$

   (d) $AB = \begin{pmatrix} 5 & 2 \\ 17 & 4 \end{pmatrix}$

2. If $\psi_n^{(0)}$ is the wave function of unperturbed non-degenerate level with energy $E_n^{(0)}$ and perturbed wave function is ψ_n; the Schrödinger equation will be :

   (a) $\hat{H} = \hat{H}_0 + \lambda \hat{H}_1$

   (b) $\hat{H} = \psi_n^{(0)} = E_n^0 \psi_n^0 + \lambda$

   (c) $\hat{H} \psi_n = E_n \psi_n + \lambda$

   (d) $\hat{H}\psi_n = \left(\hat{H}^0 + \lambda\hat{H}'\right)\psi_n = E_n \psi_n$

3. For the inverse of a matrix A, it is necessary that A must be :

   (a) Non-singular

   (b) Singular

   (c) Diagonal

   (d) None of the above

4. Which of the following statements is correct ?

(a) Angular momentum is extremely important in the quantum mechanics of atomic structure.

(b) In classical mechanics, the angular momentum L of a particle is defined as the vector product of its position vector and the linear momentum.

(c) Many properties of angular momentum operators can be derived from their commutation relations.

(d) All of the above statements are correct.

5. The determinant of the following is ....

$$\begin{bmatrix} -1 & 2 \\ 3 & -4 \end{bmatrix}$$

(a) 10

(b) 2

(c) – 2

(d) 4

6. Five distinguishable particles are distributed in three non-degenerate levels with energies 0, E and 2E. The most probable distributions for total energy 3E corresponds to what combination of options given below ?

(a) $N_3 = 1, N_2 = 1, N_1 = 3$

(b) $N_3 = 2, N_2 = 2, N_1 = 1$

(c) $N_3 = 3, N_2 = 2, N_1 = 1$

(d) $N_3 = 2, N_2 = 3, N_1 = 1$

7. In a grand canonical ensemble, a system A fixed volume is contact with a large resorvoir B. Then :

(a) A cannot exchange energy with B

(b) A can exchange energy with B

(c) A cannot exchange anything with B

(d) None of the above

8. The translational partition function for A_r confined to a volume of 1 L at 300 K, having thermal wavelength of 1.60×10^{11} m, is closet to ....

(a) 0.244×10^{29}

(b) 2.4×10^{29}

(c) 244×10^{29}

(d) 24.4×10^{29}

9. Statistical thermodynamic relation between the partition function Q and internal energy, E is :

(a) $kT \ln Q$

(b) $-RT \ln \left(\frac{Q}{N}\right)$

(c) $RT^2 \ln Q$

(d) $RT^2 \left(\frac{\partial \ln Q}{\partial T}\right)_v$

10. The specific heats of non-metallic solids at very low temperatures obey :

    (a) $C^\circ_{p,m} = aT^3 - bT$

    (b) $C^\circ_{p,m} = aT^3 + bT$

    (c) $C^\circ_{p,m} = aT^3$

    (d) $C^\circ_{p,m} = \frac{aT^3}{3}$

11. For studying fast chemical reactions using relaxation spectrometry .... awarded Nobel Prize in 1967.

    (a) Prof. Manfred Eigen

    (b) Prof. George Porter

    (c) Prof. R. G. W. Norrish

    (d) Prof. R. Marcus

12. For the studying molecular reaction dynamics of the reactions, HI + Cl $\rightarrow$ HCl + I, which method is suitable ?

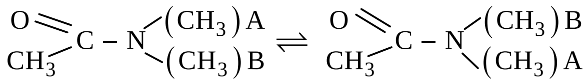
    (a) Flash phtolysis

    (b) NMR method

    (c) Infrared chemiluminescence method

    (d) Crossed molecular beam method

13. One sharp NMR peak is observed for the following exchange reaction :



    It indicates :

    (a) No change

    (b) Fast exchange

    (c) Coalescence

    (d) Slow exchange

14. One unimolecular reaction is considered best in terms of the following scheme :

$$A + M \rightleftharpoons A^* + M$$

$$A^* \rightarrow A^{\neq} \rightarrow \text{Products}$$

    The name of this unimolecular theory is :

    (a) Hinshelwood's theory

    (b) Lindemann-Christiansen theory

    (c) Slater's theory

    (d) Rice-Ramsperger-Kassel theory

15. k^1 is the first order rate constant for the following unimolecular reactions :

$$A + M \underset{k-1}{\overset{k_1}{\rightleftharpoons}} A^* + M$$

$$A^* \xrightarrow{k_2} P$$

The slope and intercept of the plot of $1/k^1$ *vs*. 1/[M] are 4×10^6 and 8×10^{11} respectively. The value of k_{-1} / k_2 will be :

(a) 2×10^5

(b) 0.5×10^5

(c) 32×10^{17}

(d) 2×10^{-5}

16. Standard Tafel extrapolation assumes that the contribution of the following to the measured current is negligible :

(a) Cathodic reaction

(b) Anodic reaction

(c) Double layer capacitance and solution resistance

(d) None of the above

17. Correct statement about Helmholtz electrical double layer is :

(I) It is a combination of two layers of opposite charges around the colloidal sol.

(II) It is a combination of two layers of similar charges around the colloidal sol.

(III) In it 1st layer of ions is diffused while 2nd layer of ions is fixed.

(IV) The potential difference between the fixed layer and the diffuse layer is called Zeta potential.

(a) II and III

(b) I and IV

(c) III and IV

(d) II and IV

18. Fermi Energy level for intrinsic semiconductors lies :

(a) Close to conduction band

(b) Close to valence band

(c) Outside the conduction band

(d) In the middle of the forbidden gap

19. For a semiconductor-based light sources, it should be a/an :

(a) Direct band gap semiconductor

(b) Indirect band gap semiconductor

(c) Either direct band gap or indirect band gap

(d) The semiconductor cannot be used a light source

20. Why is standard hydrogen electrode called as the primary reference electrode ?
    (a) It has a constant output potential.
    (b) It has a known output potential.
    (c) Its output potential is zero volts.
    (d) Its output potential is independent of the composition of the solution.

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. Find the inverse of the matrix :

$$A = \begin{bmatrix} 5 & 2 \\ 7 & 3 \end{bmatrix}$$

2. Define angular momentum operator.
3. What is micro canonical ensemble ?
4. Write three applications of Fermi-Dirac statistics.
5. Write one limitation of Gouy-Chapmon theory of electrical double layer.
6. What is the effect of light at semiconductor solution interfaces ?
7. Write the principle of pressure jump technique of fast reaction.
8. Write *five* examples of unimolecular reactions.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Determine the value of x for which the matrix :

$$A = \begin{bmatrix} 2 & -1 & 1 \\ 1 & 3 & x \\ x & 2 & 4 \end{bmatrix}$$

is singular.

2. Discuss the advantage of variation method over perturbation method.
3. In CO, the first excited vibrational level is 25 kJ mol^{-1} above the ground level. Calculate the proportion of the population in 1st excited and ground vibrational level at 25°C. (R = 8.314 J).
4. How is entropy determined using partition function ?
5. Write one theory of electrocatalysis. What factors influencing electrocatalysis ?
6. What do you understand by structure of electrified interface ?
7. For the fast reaction $\mathrm{H + O\bar{H}} \underset{k-1}{\overset{k_1}{\rightleftharpoons}} \mathrm{H_2O}$ the relaxation time has been measured is 36 μs at 25° C. Calculate k_1 and k_{-1} ($k_w = 1 \times 10^{-14}$).

8. Using Lindemann's unimolecular theory prove that as the pressure is lowered the first order kinetics changes to second order.

Section—D

5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. What are the various methods for obtaining approximate solutions to wave equation ? Discuss the perturbation methods and application of first-order perturbation theory to Helium atom.

Or

What is the importance of angular momentum in quantum mechanics ? Devise ladder operators for angular momentum.

2. Derive Bose-Einstein statistics. How Planck's equation for the distribution of energy is black body radiation is deduced from Bose-Einstein statistics ?

Or

Define specific heat of solid. Describe Debye's theory of specific heat of solid state and explain Debye's T^3 law.

3. Define overpotential and exchange current density. How variation of current density with over potential is studied ?

Or

Explain electrical double layer. Discuss Stern model of electrical double layer.

4. What are the limitations of Hinshelwood theory ? Discuss Rice-Ramsperger-Kassel (RRK) theory of unimolecular reaction.

Or

How are fast reactions determined ? Describe NMR and flow method for the determination of fast reactions.

Roll No. ....

E–518

M. Sc. (Second Semester) (Main/ATKT)
EXAMINATION, May-June, 2021

CHEMISTRY

Paper Fourth (CH–10)

(Theory and Application of Spectroscopy–II)

Time : Three Hours] [*Maximum Marks : 80*

[*Minimum Pass Marks : 16*

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. The Beer-Lambert's law gives a linear correlation with positive gradient between :
   (a) Molar extinction coefficient and concentration
   (b) Molar extinction coefficient and absorbance
   (c) Wavelength and absorbance
   (d) Absorbance and concentration

2. What is a red shift ?
   (a) The shifting of an absorption band to shorter wavelength of the spectrum
   (b) The shifting of absorption band towards the longer wavelength of the spectrum
   (c) The shifting of absorption band to higher energy
   (d) The shifting of absorption peak to higher energy

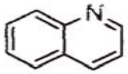
3. Which of the following electronic transitions is not possible in the UV-Vis region ?
   (a) $n \rightarrow \sigma^*$
   (b) $n \rightarrow \pi^*$
   (c) $\pi \rightarrow \pi^*$
   (d) $\sigma \rightarrow \sigma^*$

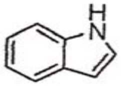
4. Which of the methods is used to determine the stoichioinetry of the complexes where the total concentration of metal and ligand are kept constant but their ratio vary for measurement of absorption of solution in UV-Vis ?
   (a) Slope Ratio method
   (b) Mole-Ratio method
   (c) Job's method
   (d) Stability constant method

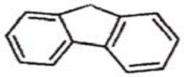
5. Phenol shows the primary absorption band at 230 nm. If the concentration of phenol in water is 1×10^{-4} M showing the absorbance value of 1.30 at 230 nm in UV-Vis spectrophotometry, calculate the molar absorptivity of this absorption band :
   (a) 2.3×10^4
   (b) 3.3×10^4
   (c) 1.3×10^4
   (d) 4.3×10^4

6. Which of the following molecule shows the highest fluorescence intensity ?

(a) 

(b) 

(c) 

(d) 

7. The presence of oxygen in the sample solution could cause one of the following processes :
   (a) External conversion
   (b) Intersystem crossing
   (c) Internal conversion
   (d) Vibrational relaxation

8. The morphology of sample surface can be determined by measurement of the following in SEM technique is :
   (a) Secondary electron
   (b) Secondary ions
   (c) Emitted X-ray
   (d) Back scattered electron

9. Electron diffraction technique is good for analysis of :
   (a) Oxidation state
   (b) Morphology
   (c) Crystalline structure
   (d) Topography

10. Turbidimtery is preferred for the measurement for :
   (a) high concentrated sample
   (b) low concentrated sample
   (c) medium concentrated sample
   (d) Both (a) and (b)

11. Which of the following ions first reaches the detector in TOF ?
   (a) $CH_3CH_2CH_2CH_2^+$
   (b) $CH_3CH_2CH_2^+$
   (c) $CH_3CH_2^+$
   (d) CH_3^+

12. In which technique the methane gas is used for ionization of molecules in MS ?
    - (a) EI
    - (b) CI
    - (c) FAB
    - (d) MALDI-MS

13. Which of the following is not a use for mass spectrometry ?
    - (a) Calculating the isotopic abundance in elements
    - (b) Investigating the elemental composition of plants
    - (c) Confirming the presence of O–H and C = O in organic compounds
    - (d) Calculating the molecular mass of organic compounds

14. GC-MS has been developed for which of the following systems ?
    - (a) Packed column
    - (b) Closed tubular column
    - (c) Open tubular column
    - (d) Porous layer

15. Which of the following is most hard ionization technique in MS ?
    - (a) ESI
    - (b) EI
    - (c) MALDI
    - (d) FAB

16. The molecule $HOCH_2CH_2OH$ will have an NMR spectrum consisting of :
    - (a) two singlets
    - (b) a triplet and a doublet
    - (c) two doublets
    - (d) a singlet and a doublet

17. Using a 60 MHz instrument, the difference in frequency between TMS absorption and a certain proton in a compound was found to be 120 MHz. What is the chemical shift value for this absorption in parts per million ?
    - (a) 3
    - (b) 2
    - (c) 1
    - (d) 0.5

18. When an external magnetic field is applied, what happens to the protons in a sample ?
    - (a) All protons align with the field
    - (b) All protons align opposite to the field
    - (c) Some protons align with the field and some align opposite to the field
    - (d) All protons assume a random orientation

19. The fine structure of the CH_2 group in diethyl ether consist of lines with an intensity distribution (given by Pascal's triangle) :
    (a) 1 : 3 : 3 : 1
    (b) 1 : 2 : 1
    (c) 1 : 1
    (d) 1 : 4 : 6 : 4 : 1

20. Which of the following molecules will show highest chemical shift (δ) ?
    (a) $CH_3–CH_2–CH_3$
    (b) $CH_2 = CH–CH_3$
    (c) $CH \equiv CH–CH_3$
    (d) CH_3CH_3

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions in 2-3 sentences.

1. Define Franck-Condon's principle.
2. What is mole-ratio method for determination of ligand/metal ratio ?
3. Write the principle of electron diffraction technique.
4. What is the reason for obtaining the relaxation vibration phenomenon in fluorescence process ?
5. State the nitrogen rule and write its significance.

6. Sketch the fragmentation pattern of $CH_3CH_2CH_2CH_3$ in EI.
7. Why TMS is used as a standard in nuclear magnatic resonance spectoscopy ?
8. Write the application of NMR for estimation of hydrogen bonding.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions. Write answer in < 75 words.

1. Give the name of chromophoric reagent and chemical reaction for determination of Fe(III) from drinking water using UV-Vis spectrophotornetry.
2. What is rotational fine structure of electronic-vibrational spectra ?
3. Write the difference between Nephelometry and Turbidimetry.
4. How does the temperature and pH of sample solution affect the fluorescence phenomenon ?
5. How many fragmentation of molecule ($CH_3 (CH_2)_3CH_2OH$) mass spectrometer ?
6. What is the working principle of Quadrupole analyzer ?
7. Show how you would distinguish between propanol and acetone using NMR spectroscopy. Label the axes and schematically shows all the important features in the spectrum.

8. What do you mean by spin-spin splitting and spin coupling in NMR ?

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions. Write answer in < 150 words.

1. Describe the vibrational-electronic spectra of diatomic molecules.

Or

Discuss any *one* of the method with example to determine the stoichiometric ratio of ligand to metal ratio in any metal complexes.

2. Shortly explain the principle and instrumentation of Nephelometry for analysis chemical of substances.

Or

Write the principle of Scanning Electron Microscope (SEM). What are the different applications of SEM ?

3. Explain the guidelines to determine the molecular formula in mass spectrum.

Or

Shortly explain the different types of mass analyzer for separation of compound mixture in MS.

4. How does the inductive, anisotropic and hybridization of molecule affect the chemical shift in NMR ?

Or

Write short notes on the following :

(a) Carbon-13 NMR spectroscopy

(b) Theory and application of NMR

Roll No. .... Total Printed Pages - 9

F - 758

M.Sc. (Third Semester)
EXAMINATION, Dec. - Jan., 2021-22
CHEMISTRY
Paper First
(Resonance Spectroscopy, Photochemistry and Organocatalysis)

Time : Three Hours] *[Maximum Marks:80*
[Minimum Pass Marks:16

Note : Attempt all sections as directed.

Section - A

(1 Mark each)

(Objective/Multiple Choice Questions)

1. Electron spin resonance is also known as which of following?
   - (A) Electron paramagnetic resonance
   - (B) Electron diamagnetic resonance
   - (C) Electron paramagnetic resonance
   - (D) Electron diamagnetic resonance

2. Which is reference standard in ESR?
   - (A) KBr
   - (B) Nacl
   - (C) Cu
   - (D) DPPH

3. Which of the following nuclei has $I = \frac{3}{2}$?
   - (A) ${}^{36}_{17}\mathrm{Cl}$
   - (B) ${}^{14}_{7}\mathrm{N}$
   - (C) ${}^{11}_{5}\mathrm{B}$
   - (D) ${}^{27}_{13}\mathrm{Al}$

4. Which of the following nuclei is expected to exhibits the NQR spectra?
   - (A) ${}^{27}_{13}\mathrm{Al}$
   - (B) ${}^{35}_{17}\mathrm{Cl}$
   - (C) ${}^{133}_{55}\mathrm{Cs}$
   - (D) All

5. Klyston is produce frequency of?
   - (A) 95000 MHz
   - (B) 9500 MHz
   - (C) 900 MHz
   - (D) 500 MHz

6. ESR sensitivity increases with _____ temperatures and with _____ magnetic field strength.
   - (A) Increasing, increasing
   - (B) Increasing, decreasing
   - (C) Decreasing, increasing
   - (D) Decreasing, decreasing

7. Which of the following element is analyzed by Auger electron spectroscopy?
   - (A) C and N
   - (B) H and He
   - (C) Li and B
   - (D) All of the above

8. What are possibe X-axis co-ordinates in graphs made from photoelectron spectroscopy data?
   - (A) Electron volt (ev)
   - (B) Mega joules per mole (mj/mol)
   - (C) Energy
   - (D) All of the above

9. Fourier Transform-Photoacoustic spectroscopy has application for analysis of-
   - (A) High molecular weight polymer
   - (B) Coals
   - (C) Air Pollutants
   - (D) All of the above

10. The most important chemical Actionometry is:
    - (A) Thermopile
    - (B) Barrier layer
    - (C) Ferioxalate Actionometer
    - (D) Photomultiplier tube

11. Which of the following electronic excitations requires highest energy?
    - (A) $n \rightarrow \sigma *$
    - (B) $\sigma \rightarrow \sigma *$
    - (C) $n \rightarrow \pi *$
    - (D) $\pi \rightarrow \pi *$

12. Which of the following is an example of photochemical reaction?
    - (A) Photsynthesis
    - (B) Decomposition of ammonia
    - (C) Formation of NaOH
    - (D) Decomposition of HCl

13. Which of the following is an incorrect statement?
    - (A) First step in photochemistry is excited state (photoexcitation)
    - (B) Photochemical reactions are caused by absorption of ultraviolet only
    - (C) When a molecule or atom in the ground state (S_0) absorbs light, one electron is excited to a higher orbital level
    - (D) It is possible for the excited state S_1 to undergo spin inversion.

14. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon?

(A) low extinction coefficients (Lambert-Beer law)

(B) Vertical transitions (Kasha's rule)

(C) High ISC rates (El Sayed rule)

(D) The Franck-condon principle

15. Photochemical smog does not possess?

(A) Ozone

(B) CO_2

(C) Nitrogen dioxide

(D) PAN

16. Hetergeneous catalyst involves in:

(A) Wilkinson catalysis

(B) Ziegler-Nata catalysis

(C) Oxo-process

(D) Wacker oxidation

17. A key feature of the Fischer-Tropsch process?

(A) Hydrocarbon formation

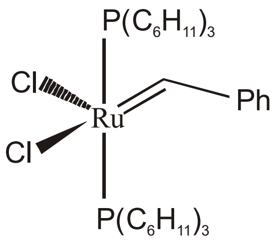
(B) Alkene hydrogenation

(C) Alkene polymerization

(D) Hydroformylation

18. Grubbs catalyst is:

(A)



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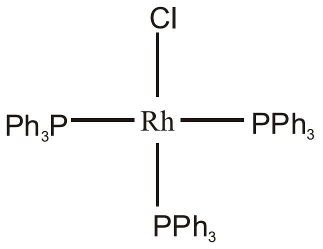

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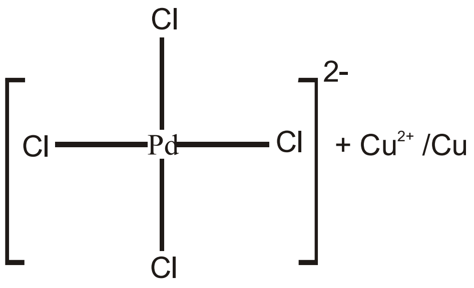

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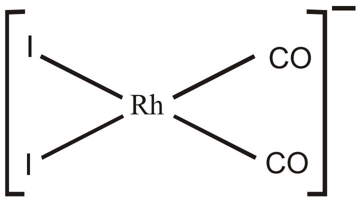

19. Which catalyst is used in the synthesis of acetic acid by Moosanto process?

    (A) $\mathrm{RhCl(PPh_3)}$

    (B) $\mathrm{Al(C_2H_5) + TiCl_4}$

    (C) $\mathrm{[RhI_2(CO_2]^-}$

    (D) All of the above

20. Which reaction does not involve in organometallic catalysis?

    (A) Reductive elimination

    (B) Decomposition

    (C) Insertion

    (D) Oxidative addition

Section - B

(2 Marks each)

(Very Short Answer Type Questions)

1. Write two limitation of NQR technique?
2. What is coupling constant?
3. Write the principle of photoacoustic spectroscopy.
4. What do you understand by photoelectric effect?
5. How quantum yield can be determined?
6. Write the photo-Fries chemical reaction of anilides.
7. Explain the term "regioselectivity" and "chemoselectivity" of catalysts.
8. What do you mean by alkenes metathesis?

Section - C

(3 Marks each)

(Short Answer Type Questions)

Note: Attempt all questions. Write answer in <75 words.

1. What is the significance of g-tensors?
2. What are different application of NQR spectroscopy?
3. What are Koopman's theorem and it's use?
4. Define photoelectric affect and it's significance.
5. Derive the Stern-Volmer equation and it's use.
6. Discuss the photochemical formation of smog.
7. Write the difference between homogenous and heterogeneous catalysts.
8. What are oxidative, insertion andreductive elemination reactions?

Section - D

(5 Marks each)

(Long Answer Type Questions)

Note- Attempt all questions. Write answer in <150 words.

1. Explain the principle and instrumentation of NQR spectroscopy.

   OR

   Explain the hyperfine structure of hydrogen and methyl radical using ESR spectroscopy.

2. What is Auger electron spectroscopy (AES) and write the application of AES for chemical characterization of samples.

OR

Write notes on the following-

(A) Surface application of PAS

(B) Instrumentation of PAS.

3. Discuss the interaction of matter with electromagnetic radiation and derive Einstein treatment of absorption and emission phenonmenon.

OR

What are adiabatic and diabatic photochemical reactions? Discuss the arte constant and life time of reactive energy states in unimolecular photochemical reaction.

4. Why hydrogenation reaction of alkene does not occurs under uncatalyzed conditions? Discuss the machanism of Wilkinson catalysis for hydrogenation reaction.

OR

Why organometallic compounds are used as a catalyst? Discuss the principles for designing organometallic catalysts.

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M.Sc. (Third Semester)
EXAMINATION, Dec. - Jan., 2021-22
CHEMISTRY
Paper Second
(Chemistry of Biomolecules)

[Time : Three Hours] ***[Maximum Marks : 80]***
[Minimum Pass marks : 16]

Note : Attempt all questions as directed.

Section - A
(Objective/Multiple Choice Questions)

(1 mark each)

Note : Attempt all questions.

1. Select the correct statement of the following :

   (a) Fe (III) will not reduce easily in presence of CN^-.

   (b) ΔG will negative in exergonic reaction.

   (c) ΔG will positive in endergonic reaction.

   (d) Oxy-haemocyanin is paramagnetic and colourless.

   (A) a, b and c

   (B) b and c

   (C) b, c and d

   (D) All a, b, c and d

2. Select the correct statement of the following:

   (a) The biological function of cytochrome P - 450 is epoxidation of olifins.

   (b) In the catalytic cycle the oxidation of Fe are II, III, IV and V.

   (c) The colour of haemoglobin is due to π to $\pi *$.

   (d) Raman frequency of O_2 in oxy-heamoglobin is 1100 cm^{-1}.

   (A) a and d

   (B) a, b and d

   (C) a, c and d

   (D) All a, b, c and d

3. Select the correct statement of the following:

   (a) Hemoglobin Contain four-six member ring and four- five memberring.

   (b) If CN- bind with cobalt the Co (II) has magnetic moment of 4 and paramagnetic.

   (c) If CN-bind with cobalt the Co(II) has magnetic moment of 2 and paramagnetic.

(d) The active site of oxy-heamocyanin will show john teller distortion.

(A) a, c and d

(B) a, b and d

(C) a and b

(D) a and c

4. Select the correct statement of the following:

(a) Production of ATP during aerobic respiration is an example of endergonic reaction.

(b) In the cytochrome P- 450 catalytic cycle, at the first step Fe has microstate of 252.

(c) Fe^{2+} has term symbol of $^5D_4$.

(d) Myoglobin can transport 4 O_2 molecule.

(A) a, and c

(B) a, b and c

(C) a, c and d

(D) All a, b, c and d

5. Select the correct statement of superoxide dismutage :

(a) Serve as antioxidant defensive enzyme against oxidative stress.

(b) The active site of isoform of SOD-2 is Mn.

(c) The Cu^{2+} has microstate of 10 and ^2D term

symbol.

(d) Reaction of superoxide and superoxide dismutase is first order kinetic.

(A) a and d

(B) a, c and d

(C) a and b

(D) All a, b, c and d

6. Choose the correct statement of the following:

(a) Cytochrome c is a redox protein and electron carrier.

(b) Graphene oxide can behave as exo-receptor.

(c) Crown ether can behave as endo-receptor.

(d) Diastereomers will obtain if already a chiral centre exist in prochiral molecule.

(A) a, c and d

(B) a, b and c

(C) a and c

(D) All a, b, c and d

7. Choose the correct statement of the following:

(a) CN^- bind more stronger than CO with Fe.

(b) CO bind more stronger than CN^- with Fe.

(c) Calixarine is made by phenol monomer unit.

(d) Beta cyclodextrin is made by beta 1- 4 linkase.

(e) In enzyme the zinc activates H_2O and provide zinc bound hydroxide.

(A) a, b and c

(B) a, c and e

(C) b, c and e

(D) a, c, d and e

8. Choose the correct statement -

(a) Cytochrome P-450 act as monooxygenases and catalase the insertion of O into a C-H bond.

(b) The magnetic moment is 6 before losing of H_2O molecule in Cytochrome P-450.

(c) The term symbol of active site in Cytochrome P- 450 before losing of H_2O molecule is ^2G.

(d) The term symbol of active site in Cytochrome P-450 before losing of H_2O molecule is ^6S.

(A) a, b and d

(B) a, b and c

(C) a and c

(D) a and d

9. Choose the correct statement of the following :

(a) Carbonic anhydrase is an example of hydrolysis enzyme.

(b) The reaction of carbonic anhydrase and CO_2 is

example of electrophilic addition reaction.

(c) Fe-O binding is shorter than Co-O in FeMb or CoMb.

(d) CO has bond order of 3.

(A) a and b

(B) a, b and d

(C) a, b and c

(D) All a, b, c and d

10. Choose the correct statement :

(a) The oxidation of Mo is +VI and diamagnetic in xanthine oxidase enzyme.

(b) P-450 is named in cytochrome due to LMCT.

(c) Cyclodextrin behave as inclusion complex.

(d) C_{20} is known as smallest fullerene.

(A) a, b and d

(B) b, c and d

(C) a, c and d

(D) All a, b, c and d

11. Choose the correct statement -

(a) The activation energy of reaction is lowered so that a fewer substrate molecule can overcome it.

(b) A competitive inhibitor of enzyme of an enzyme is usually a metal ion usually Hg^{2+} or Pb^{2+}.

(c) An enzyme lowers the free energy difference between substrate (s) and product (s) but it cannot change the equilibrium position of the reaction it catalyses.

(d) An enzyme cannot change the equilibrium position of the reaction it catalyses but it lowers the energy of activation of that reaction.

(A) a, b and c

(B) b and c

(C) b and d

(D) b, c and d

12. Choose the incorrect statement :

(a) NAD+ is the initial electron acceptor in many metabolic oxidation reactions.

(b) The separation of proteins by isoelectric focusing is only based on charge.

(c) Mass spectrometry involves the separation of ionic fragments on a gel.

(d) Cathepsin D is not cysteine active site of protease

(A) a, and b

(B) b and c

(C) b, c and d

(D) All a, b, c and d

13. Choose the correct option :

(a) A proton moves from the serine to the histidine side chain in the catalytic triad of chymotrypsin.

(b) Gel-filtration chromatography separates proteins on their ability to bind to specific groups on the column matrix.

(c) Modern hypothesis about enzyme action is called induced-fit hypothesis.

(d) Proteins separated by isoelectric focusing can be tested for biological activity.

(A) a, and c

(B) a, b and d

(C) a, c and d

(D) All a, b, c and d

14. Restriction enzyme are also called-

(a) K_m, the Michaelis constant, is expressed in terms of the reaction velocity.

(b) K_m, the Michaelis constant, is a measure of the affinity the enzyme has for its substrate Molecular scissors.

(c) The V_{max} for a reaction remains unchanged in the presence of a competitive inhibitor.

(d) The V_{max} and K_m (Michaelis constant) for a reaction are unchanged in the presence of a competitive inhibitor.

(A) a and b

(B) b and c

(C) b, c and d

(D) All a, b, c and d

15. Choose the correct option -

(a) Enzyme do not alter the over all change in free energy for a reaction.

(b) Enzyme enhance the rate of reaction by lowering the activation energy.

(c) The nucleophile is in serine proteases is serine and water.

(d) Holoenzyme produced with the combination of epoenzyme and coenzyme.

(A) a and b

(B) a, b and d

(C) b and d

(D) All a, b, c and d

16. Choose the correct statement :

(a) In vitamin $B_{12,}$ one-five membered ring and three six membered.

(b) Ca^{2+} released into a myofibril by the action of a nerve

impulse binds to a site on troponin to initiate con traction.

(c) Na and K pump are example of active transport.

(d) Digestion of starch by α - amylase is an ender gonic process.

(A) a, b and c

(B) b, c and d

(C) b and c

(D) All a, b, c and d

17. Which of the following statements about the mechanism of the Na^+/K^+ pump are not correct?

(a) The Na^+/K^+ATPase uses energy to pump Na^+ out side the cell and K^+ inside.

(b) The Na^+/K^+ ATPase use energy to pump Na^+ inside the cell and K^+ outside.

(c) The Na^+/K^+ ATPase use energy to bind both Na^+ and K^+ in turn.

(d) The phosphorylation of the Na^+/K^+ ATPase does not change its conformation.

(A) Only a

(B) a and b

(C) b, c and d

(D) a,c and d

18. Which of the following statements are not correct?
    - (a) Cell theory is not applicable to virus.
    - (b) Cell membranes retain the contents of cells.
    - (c) Symport movement is bidirectional.
    - (d) Cell membranes are permeable to most inorganic ions.
    - (A) a and d
    - (B) b and c
    - (C) b, c and d
    - (D) c and d
19. Choose the incorrect statement :
    - (a) 3 Na^+ and $2K^+$ are involved in sodium potassium pump.
    - (b) 2 Na+ and 3K+ are involved in sodium potassium pump.
    - (c) K^+ can be trap by [18] crown-6.
    - (d) Na^+ cannot be trap by [15] crown -5.
    - (A) a and c
    - (B) a and d
    - (C) b and d
    - (D) a, c and d
20. Choose the correct statement :
    - (a) Calcium can make complex with EDTA due to hard-hard interaction.
    - (b) Thin filaments of skeletal muscle have plus and minus ends.
    - (c) Fatty acid activation requires energy in the from of ATP.
    - (d) Calcium can make complex with EDTA due to hardsoft interaction.
    - (A) b and c
    - (B) a, b and c
    - (C) b, c and d
    - (D) a, b and d

Section - B

(Very Short Answer Type Questions)

(2 marks each)

Note : Attempt all questions.

1. How will you define any reaction is exergonic?
2. Explain how cytochrome act as redox protein?
3. What do you mean by exoreceptor? Explain with suitable example.
4. How will you prepare calixarene? Write a reaction.
5. Define competitive inhibition with suitable example.
6. How many stereoisomers is possible in riboflavin?
7. Define the hydrophobic force in biopolymers.
8. What do you mean by reverse osmosis? Explain with suitable example.

Section - C

(Short Answer Type Questions)

(3 marks each)

Note : Attempt all questions.

1. If both heamoglobin and myoglobin bind oxygen reversibly why are their binding curves qualitatively different?
2. How do you explain the magnetic behaviour in iron-sulphur protein [Fe_4S_4].
3. Why Zinc is so valuable in biology relative to other metals?
4. What do you mean by partial asymmetric synthesis? Explain with suitable reactions.
5. What kind of reaction take place during induced-fit mechanism? Explain with suitable example.
6. Discuss the importance of Michaelis-Menten equation in enzyme chemistry.
7. Explain the ion binding mechanism in valinomycin.
8. What will happen when concentration of Na ion disbalance in body?

Section - D

(Long Answer Type Questions)

(5 marks each)

Note : Attempt all questions.

1. Explain the following:
   (a) The electron transfer reaction in Co substituted cytochrome-c in place of Fe. Explain the rate different.
   (b) Discuss the chemistry of O_2 binding in copper-enzyme.

OR

Discuss the following:

(a) Why IR/Raman spectroscopy is best suited method for the verification of oxidation state of O_2 ligand?

(b) Explain the binding mechanism of CO in biological system.

2. Which metalloenzymes are responsible for the removal of hydrogen peroxides? Discuss their active site structure and function.

OR

Discuss the following:

(a) How do you classify superoxide dismutase?

(b) How could you decide any molecule as endo-receptor? Give suitable example.

3. Discuss the four principal components of vitamin B12 complex.

OR

Discuss the following:

(a) How do you prepare aldehyde from alcohol using enzyme?

(b) Explain the biological function of non-aromatic co-enzyme A.

4. Explain molecular mechanism of ion transport across membrane.

OR

Discuss the following:

(a) Gibbs Donnan effect

(b) Explain the irreversible thermodynamic treatment of membrane transport.

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F - 760

M.Sc. (Third Semester)
EXAMINATION, Dec. - Jan., 2021-22

(Paper Third)

CHEMISTRY

(Catalysis, Solid State and Surface Chemistry)

[Time : Three Hours] ***[Maximum Marks : 80]***

[Minimum Pass marks : 16]

Note : Attempt all sections as directed.

Section - A
(Objective/ Multiple Choice Questions)

(1 mark each)

Note : Attempt all questions.

Choose the correct answers:

P.T.O.

1. The pK_a of H_2O at 25^0 C is-

   (A) 14.0

   (B) 15.74

   (C) -1.74

   (D) 7.0

2. For an enzyme catalysed reaction a plot of $\frac{1}{V}$ vs. $\frac{1}{[S]}$ for Lineweaver and Burk equation gives slope and intercept values 0.156 and 2.12 respectively. The Km (Michaclis constant) will be-

   (A) 0.330

   (B) 13.58

   (C) 0.73

   (D) 0.073

3. Which of the following is a soft Lewis acid?

   (A) BH_3

   (B) BF_3

   (C) CO_2

   (D) $B(OR)_3$

4. Which of the following nucleophiles show the $\propto$ - effect

(A) SCN^- (B) N_3^-

(C) N_2H_4 (D) $P-NO_2C_6H_4O^-$

5. The Nucleophilicity scale can be measured by the following equation :

(A) Swain and Scott

(B) Edward

(C) W.P. Jencks

(D) All of the above

6. Aerosol - OT is ____________surfactant.

(A) Cationic

(B) Anionic

(C) Non - ionic

(D) Gemini

7. What is the main result of adding surfactants into a liquid composed of two immisible phases such as oil and water?-

(A) Reduction in the interfacial tension between the phases

(B) Increase in interfacial tension between the phases

(C) Catalyzation of chemical reaction between the phases

(D) Nothing happens

8. A surfactant with a HLB (Hydrophile Lipophile Balance) range 13 - 15, is expected to function as a:

(A) Solubilizer

(B) Wetting agent

(C) Detergent

(D) Water - in - oil emulsifier

9. Which of the following statements is incorrect ?

(A) The CMC decreases strongly with increasing alkyl chain length of the surfactant

(B) The CMC of the non - ionics are much higher than for ionics.

(C) The negative free energy of micellization is the result of large positive entropy

(D) The CMC can be ditermined by light scattering method also.

10. The correct form of Laplace equation is:

(A) $P = P^* e^{2\gamma v m}$

(B) $d\gamma = -\Sigma \gamma \, d\mu_n$

(C) $h = \frac{2\gamma}{Pg\pi}$

(D) $\text{Pin} = \text{Pout} + \frac{2\gamma}{r}$

11. Extrinsic point defects are...............

(A) Defects introduced into a solid as a result of doping

(B) Defects that occur in the pure substance

(C) Shear planes that collect defects along certain crystallographic directions -

(D) None of the above

12. Frenkel defect is not found in the halides of alkali metals because alkali metal have:

(A) High Electropositivity

(B) High Reactivity

(C) High Ionic Radii

(D) Ability to occupy interstitial sites

13. With which one of the following elements silicon should be doped so as to give p-type semiconductor?

(A) Germanium

(B) Arsenic

(C) Boron

(D) Selenium

14. In a semiconductor, the energy gap between the valence band and conduction band is about............

(A) 10 e v (B) 1 e v

(C) 15 e v (D) 5 e v

15. In an intrinsic semiconductor, the number of free electrons-

(A) Is greater than the number of holes

(B) Is less then the number of holes

(C) Is double then number of holes

(D) Equals the number of holes

16. Which of the following is not an addition polymer?

(A) Nylon 66

(B) PVC

(C) Polypropylene

(D) All of the above

17. The unique properties of liquid crystal polymer............

(A) Thermal Actuation

(B) Arisotropic Swelling

(C) Soft Elasticity

(D) All of the above

18. Polydispersity index is difined as..........,where M_w and M_n are the weight average and number average molecular masses respectivity.

    (A) $M_w \times M_n$

    (B) M_n / M_w

    (C) M_w / M_n

    (D) $M_w - M_n$

19. The catalyst used for the synthesis of polymers of 1 - alkenes (alpha olefins)

    (A) Wilkinsons catalyst

    (B) Ziegler - Natta catalyst

    (C) Pd - Catalyst

    (D) Zeise salt complex

20. The number average molecular weight of polymer can be determined by _______method

    (A) Osmometry

    (B) Light Scattering

    (C) Sedimentation

    (D) All of the above

Section - B

(Very short answer type question)

(2 marks each)

Note : Attempt all questions. Write answer in 2-3 sentences.

1. What is alpha effect?
2. Define Bronsted catalysis law.
3. What is the difference between reverse micelles and microemulsions?
4. How surfactant classified?
5. Define perfect and imperfect crystals.
6. What is conduction phenomenon in a semiconductor?
7. How is average dimensions of various chain structure calculated? (No derivation)
8. Define crossed linked polymers.

Section - C

(Short Answer Type Questions)

(3 marks each)

Note : Attempt all questions.

1. Calculate the pK_a of H_3O^+ at 25^0 C (Given that $K_w = 1 \times 10^{-14}$)

2. For acid - base catalysis explain the signficance of the following equation.

$$[H^+]_{\min} = \left(\frac{k_{0\overline{H}} K_w}{k_{H+}} \right)^{\frac{1}{2}}$$

3. Define CMC and counter ion binding. How CMC and counterion binding of a surfactent is determined?
4. Explain the pressure across curved surface and write Laplace equation.
5. Explain why crystalline solids are generally more defective as a result of increasing temperature?
6. What is n - p junction? Explain.
7. A polymer sample consists of 9 molecules of MW 30 000 and 5 molecules of MW 50 000. Calculate number average molecular weight.
8. Discuss the importance of electrically conducting polymer with example.

Section - D

(Long Answer Type Questions)

(5 Marks each)

Note : Attempt all questions.

1. Define Hammett acidity function. Derive kinetic equation for the following reaction.

$$S + H^+ \rightleftharpoons SH^+$$

$$SH^+ \rightarrow \text{Product}$$

OR

What are the Characteristics of enzyme catalysed reaction? Discuss the mechanism of competitive inhibition enzyme catalysed reaction.

2. Define surface excess concentration and minimim surface area. Derive the following equation.

$$\Gamma = -\frac{1}{RT}\left(\frac{\partial \gamma}{\partial \ln c}\right)_T$$

γ = Surface Tension

c = Concentration

OR

Define micellization. Discuss Mass action model and phase separation model for the thermodynamics of micellization.

3. Discuss the thermodynamics of Schottky and Frenkel defects.

OR

Explain electronic properties and Band theory of semiconductors.

4. Define relative viscosity, reduced viscosity and intrinsic viscocity as applied to solutions of high polymers. Explain how molecular weight of polymers is determined by viscosity measurements.

OR

Discuss the mechanism of the Kinetics of addition and condensation polymerization.

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M.Sc. (Third Semester)
Examination, Dec, - Jan., 2021 - 22
CHEMISTRY
Paper Fourth (CH-16)
(Analytical Techniques and Data Analysis)

Time : Three Hours]   [Maximum Marks : 80
[Minimum pass Mark : 16

Note: Attempt all sections as directed.

Section – A   1 each

(Objective/Multiple Choice Questions)

Note: Attempt all questions.

Choose the correct answer:

1. Add 2.8×10^{-7} and 3.3×10^{-6} with due regards to significant figures
   (a) 3.7×10^{-6}
   (b) 3.7×10^{-7}
   (c) 5.1×10^{-6}
   (d) 2.3×10^{-7}
2. Which statistical test is used to compare group means in a sample?
   (a) Correlation
   (b) Regression
   (c) Covariance
   (d) Analysis of variance
3. The test performed to learn whether the result obtained from the new method and the standard method have significant difference is:
   (a) Q-test
   (b) F-test
   (c) t-test
   (d) χ^2-test
4. If the standard deviation of a data is 0.017. Then find its variance
   (a) 0.0289
   (b) 0.00289
   (c) 0.000289
   (d) 0.0000289

5. Cluster sampling, stratified sampling and systematic sampling are types of
   (a) Random sampling
   (b) Direct sampling
   (c) Indirect sampling
   (d) Non random sampling
6. Which of the following is used as spraying reagent for paper chromatography?
   (a) Ninhydrin solution
   (b) Conc. HCl
   (c) NaCl solution
   (d) $CuSO_4$ solution
7. Craig apparatus is used in
   (a) Batch extraction
   (b) Continuous extraction
   (c) Countercurrent extraction
   (d) None of the above
8. In which type of chromatography, the stationary phase is held in a narrow tube and the mobile phase is forced through it under pressure?
   (a) Column chromatography
   (b) Planar chromatography
   (c) Liquid chromatography
   (d) Gas chromatography
9. Thin layer chromatography is based on
   (a) Partition chromatography
   (b) Adsorption chromatography
   (c) Electrical ability of ionic species
   (d) None of the above
10. The simplicity of extraction is decided by
   (a) The dielectric constant
   (b) Electrostatic capacity
   (c) Partition coefficient
   (d) Solvent polarity Sere
11. Which of the following is true?
   (a) The area under a DTA peak represents the enthalpy of the change
   (b) In DTA both the reference and the sample undergo change with temperature
   (c) DTA stands for Direct Thermal Analysis
   (d) None of the above
12. Which of the following option is appropriate for the TGA and DTA?
   (a) TGA and DTA measures only weight
   (b) TGA measures only weight while DTA measures other effects
   (c) TGA and DTA measures only temperature
   (d) TGA measures only temperature while DTA measures other effects
13. DTA can be used for which of the following process.
   (a) Line positions of the crystals
   (b) Mechanical properties of the crystals
   (c) Phase diagrams
   (d) Catalytic properties of enzymes

14. What is used to monitor the temperature in DTA?
    (a) thermobalance
    (b) electrode
    (c) active electrolyte
    (d) thermocouple
15. Which of the following are miniaturization advantage for flow injection analysis?
    (a) Increase the diffusion of the sample into the stream of reagent
    (b) Reduce the volume of reagent and sample
    (c) Reduce volume of waste that could be polluting
    (d) All of the above
16. In polarography, DME is used as............... electrode
    (a) Working electrode
    (b) reference electrode
    (c) non- polarizable electrode
    (d) gas electrode
17. In a cyclic voltametric process, the current is measured between
    (a) The working electrode and the reference electrode.
    (b) The working electrode and the counter electrode.
    (c) The counter electrode and the reference electrode.
    (d) None of the above
18. Polarography is a branch of ....
    (a) Potentiometry
    (b) Amperometry
    (c) Coulometry
    (d) Voltammetry
19. Coulometric techniques result in a plot of:
    (a) Electrochemical potential versus time
    (b) Current versus time
    (c) Current versus electrochemical potential
    (d) Current only
20. The limiting current in a linear sweep voltammogram is related to:
    (a) The reduction potential of the reference electrode
    (b) The point at which concentration polarization begins
    (c) The standard reduction potential for the redox couple under investigation
    (d) The concentration of the analyte of interest

Section – B

2 each

(Very Short Answer Type Questions)

Note: Attempt all questions.

1. Define precision and accuracy.
2. How many significant figures does each of the following numbers have?

(a) 0.02680 (b) 500.0 (c) 0.0020 (d) 2.38

3. What is distribution coefficient?
4. Which law governs the solvent extraction?
5. What kind of reference material is used in DTA?
6. What is the difference between DTA and DSC?
7. What do understand by the term Half wave potential?
8. Give the equation for diffusion current in polarography and explain the terms involved in it.

Section – C

3 each

(Short Answer Type Questions)

Note: Attempt all questions.

1. Discuss F-Test?
2. Discuss the sample collection procedure for liquid samples. What is the nature of containers for sample collection?
3. Discuss thetheory and applications of HPTLC.
4. Briefly explain counter current extraction.
5. Draw the TG curve of calcium oxalate monohydrate.
6. Explain instrumentation of DSC technique.
7. Write a short note on cyclic voltammetry.
8. Explain the terms migration, residual and diffusion currents in polarography.

Section – D

5 each

(Long Answer Type Questions)

Note: Attempt all questions.

1. Replicate water samples are analyzed for water hardness with the following results: 102.2, 102.8, 103.1 and 102.3 ppm $CaCO_3$. Calculate (a) the standard deviation, (b) the relative standard deviation, (c) the standard deviation of the mean, and (d) the relative standard deviation of the mean.

   Or

   What is digestion? Briefly explain acid, base and microwave digestion.

2. Explain the principle, technique and application of TLC. How it is different from paper and column chromatography?

   Or

   Briefly explain solvent extraction and types of solvent extractions.

3. What do you understand by TGA? Explain its basic principle, types, TG curve and factors affecting the TG curve.

   Or

Discuss the advantages of automated method over classical method. Explain the principle and instrumentation of Flow injection analysis.

4. Explain the principle of potentiometry. Discuss the instrumentation of potentiometer.

Or

Write short note on Differential pulse polarography and square wave polarography.

Roll No. ....

E–988

M. Sc. (Fourth Semester) (Main/ATKT) EXAMINATION, May-June, 2021

CHEMISTRY

Paper CH-19

(Instrumental Methods of Analysis)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A

1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. The strongly acidic group (SO_3^-) present on the surface of styrene/divinylbenzene copolymer, which is used for the separation of the following substances from sample solution :
   (a) Anions
   (b) Cations
   (c) Anions or Cations
   (d) Neutral substances

2. The separation of compounds based on molecular mass is done in which of the chromatographies ?
   (a) Ion-exchange chromatography
   (b) High performance liquid chromatography
   (c) Gas chromatography
   (d) Size exclusion chromatography

3. In electrophoresis, the volume of the sample used for injection is :
   (a) 5 to 50 nL
   (b) 5 to 50 μL
   (c) 5 to 50 mL
   (d) 0.5 to 5 mL

4. Which of the following techniques having a higher number of theoretical plate height for separation of compound mixture ?
   (a) HPLC
   (b) TLC
   (c) Capillary electrophoresis
   (d) Paper chromatography

5. The softening of hard water can be done in which of the following chromatographic techniques ?
   (a) Size exclusion chromatography
   (b) Thin layer chromatography
   (c) High performance liquid chromatography
   (d) Ion-exchange chromatography

6. K_β X-ray line is produced from a transition of electron from :
   (a) L to K shell
   (b) M to K shell
   (c) N to K shell
   (d) K to M shell

7. XRF is used to study :
   (a) Crystal structure
   (b) Elemental composition
   (c) Morphology
   (d) Inside structure

8. Which of the following techniques is good for analysis of elemental composition of archaeological materials without destroying the sample ?
   (a) Proton induced X-ray spectroscopy
   (b) Mass spectrometry
   (c) ICP-AES
   (d) AAS

9. The extent of the method that can detect the interest of analyte in the presence of sample matrix is called as a/an :
   (a) Accuracy
   (b) Sensitivity
   (c) Selectivity
   (d) Ruggedness

10. Which of the following is a non-destructive technique for determining the purity of gold in ornaments ?
    (a) AAS
    (b) ICP-MS
    (c) GF-AAS
    (d) XRF

11. Acetylene-nitrous oxide flame is used for analysis of following elements in AAS :
    (a) Al, Mo, Zr
    (b) As, Se, Bi
    (c) Cu, Ni, Zn
    (d) Fe, Co, Hg

12. The deuterium lamp is employed in AAS for removal of :
    (a) Chemical interference
    (b) Spectral interference
    (c) Physical interference
    (d) Optical interference

13. In flame photometry, flame is used as :
    (a) Atomization source only
    (b) Excitation source only
    (c) Atomization and excitation source
    (d) Detecting source

14. In which of the following instruments, the scattered radiation is measured ?
    (a) AFS
    (b) AAS
    (c) ICP-AES
    (d) Flame photometry

15. The presence of BHC in food material can be analyzed in HPCL by which of the detectors showing better sensitivity ?
    - (a) FID
    - (b) ECD
    - (c) TCD
    - (d) UV

16. The fuel gas used in FID is :
    - (a) Helium
    - (b) Neon
    - (c) Argon
    - (d) Hydrogen

17. What is the effect of temperature programming on retention and resolution of chromatographic peaks in GC, respectively ?
    - (a) Decrease and decrease
    - (b) Increase and decrease
    - (c) Increase and increase
    - (d) Decrease and increase

18. The solvent composition of binary solvent (Methanol : Water) system changes to 100 : 0, 80 : 20, 60 : 40, 40 : 60, 20 : 80, 0 : 100 during the separation of compound mixture in HPLC. The elution is called as :
    - (a) Iso-gradient
    - (b) Quaternary
    - (c) Gradient
    - (d) Isocratic

19. The compound mixture of phenol, benzene, toluene and hexane are analyzed in normal phase chromatography, what will be the order of elution of compound from this column will be ?
    - (a) Hexane, toluene, benzene and phenol
    - (b) Toluene, benzene, hexane and phenol
    - (c) Phenol, benzene, toluene and hexane
    - (d) Phenol, hexane, benzene and toluene

20. Which of the following ionization techniques can be used in GC-MS ?
    - (a) Cl
    - (b) ESI
    - (c) MALDI
    - (d) APCI

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions in **2-3** sentences.

1. Write the name of sample injection systems which is used in capillary electrophoresis.
2. What do you mean be ‘exclusion limit’ in exclusion chromatography ?
3. Draw schematic diagram to explain the process of XRF in calcium element (Atom).
4. Give the principle of PIXE.
5. Why the elements like carbon, nitrogen, fluorine, chlorine, argon cannot be analyzed in AAS ?
6. In flame-AAS and GF-AAS, which instrument is sensitive and why ?

7. Why the formation of metal hydrides (MH_3) is required in analysis of metals like As, Se, Bi and Sb in AAS ?
8. Write the difference between normal and reverse phase chromatography.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions. Write answer in < **75** words.

1. Shortly explain the mechanism for separation of compound mixtures in capillary electrophoresis.
2. What are disadvantages of GC and HPLC, which are excluded using supercritical fluid chromatography ?
3. Shortly explain the linear relationship between the square root of the frequency for K and L lines and the atomic number of elements given by Moseley.
4. Draw the different components of proton induced X-Ray Spectroscopy.
5. What are different applications of atomic fluorescence spectrometry ?
6. What is method selectivity and how it is useful in analytical chemistry ?
7. Write the principle for analyzing different chemical substances in HPLC-MS.
8. Shortly describe the formation of 'plasma' in ICP-AES which is used for atomization and emission.

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions. Write answer in < **150** words.

1. Explain the mechanism for separation of compound mixture in Size Exclusion Chromatography (SEC). Write the column packing materials in SEC.

Or

What is ion-exchange chromatography ? Explain the separation of metal ions and proteins in ion-exchange chromatography.

2. Describe the principle behind the working of XRF and shortly write its different applications.

Or

Write short notes on the following :

(a) Radiation source of PIXE

(b) Application of PIXE

3. Explain the chemical and spectral interferences of atomic spectroscopy and how it can be overcome.

Or

Shortly describe the atomization and excitation process in flame photometry and ICP-AES along with some applications using both the instruments.

4. What is the principle of hydride generation AAS ? Shortly describe the instrumentation.

Or

Write short notes on the following :

(a) CV-AAS

(b) GC-MS

Roll No. ....

E–989

M. Sc. (Fourth Semester) (Main/ATKT)

EXAMINATION, May-June, 2021

CHEMISTRY

Paper No. CH–20

(Natural Product and Medicinal Chemistry)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

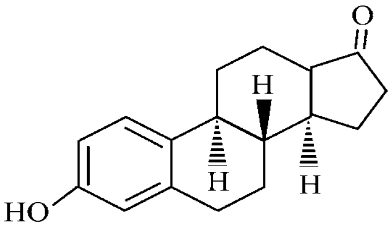
Choose the correct answer :

1. Which one of the following is not a terpenoid ?
   - (a) Menthol
   - (b) Farnesol
   - (c) Phytol
   - (d) Morphene

2. The molecular formula of ephedrin is :
   - (a) $C_{10}H_{15}NO$
   - (b) $C_{10}H_{10}O$
   - (c) $C_{10}H_{15}O$
   - (d) $C_{10}H_{15}N$
3. Morphene is used for :
   - (a) Treatment of shortness of breath
   - (b) Reducing the acute pain
   - (c) Reducing the chronic pain
   - (d) All of the above
4. Monoterpenoids consist of :
   - (a) 1 carbon
   - (b) 5 carbon
   - (c) 10 carbon
   - (d) 20 carbon
5. What is the isoprene rule ?
   - (a) Terpenes contain tail-to-tail connected isoprenes
   - (b) Terpenes contain head-to-tail connected isoprenes
   - (c) Terpenes contain head-to-head connected isoprenes
   - (d) Terpenes contain 5*n* atoms
6. Example of flavonones is :
   - (a) Hesperetin
   - (b) Taxifolin
   - (c) Luteolin
   - (d) Quercetin

7. Which of the following is right about flavonoids ?
   - (a) Daily use of flavoids reduce the risk of cancer.
   - (b) They are good antioxidant.
   - (c) They have anti-inflammatory activity.
   - (d) All of the above

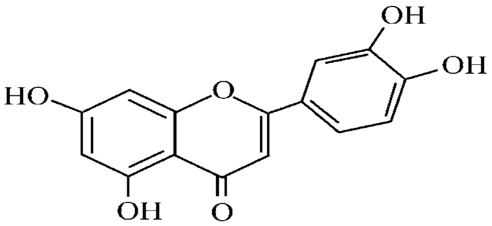
8. The given structure is :



   - (a) Androsterone
   - (b) Testosterone
   - (c) Esterone
   - (d) Aldosterone

9. The molecular formula of progesterone is :
   - (a) $C_{21}H_{30}O_3$
   - (b) $C_{21}H_{30}N_2$
   - (c) $C_{21}H_{30}O$
   - (d) $C_{21}H_{30}O_2$

10. The given structure is :



   - (a) Apigenin
   - (b) Luteolin
   - (c) Vitexin
   - (d) Butein

11. What is meant by a drugs specification ?
   - (a) The molecular dimentions of a molecules.
   - (b) The physical properties of a drug.
   - (c) The purity tests and purity standards required of a drug.
   - (d) The functional groups on a drug that are important to its activity.

12. Aspirin is converted into salicylic acid in your body by which of the following reactions ?
   - (a) Hydrolysis
   - (b) Oxidation
   - (c) Reduction
   - (d) Substitution

13. You can usually tell if a drug is a natural product because :
    - (a) Its structure is very simple.
    - (b) Its structure contains lots of chiral centres and is very complex.
    - (c) You can't tell just by looking at its structure.
    - (d) None of the above

14. What is a semi-synthetic drug ?
    - (a) A drug isolated from nature and used without any further modification
    - (b) A drug made entirely in a lab from scratch
    - (c) The structure of a drug half-way through its preparation
    - (d) A drug which has been part-made by nature and part-made in a lab

15. Which of the following drugs was inspired by nature ?
    - (a) Morphine
    - (b) Salbutamol
    - (c) Citalopram
    - (d) Erythromycin

16. Which of the following species is used for producing Streptomycin ?
    - (a) *S. ramosus*
    - (b) *S. griseus*
    - (c) *S. aureofaciens*
    - (d) *S. griseoflavus*

17. Which statement about penicillins is true ?
    - (a) Penicillins on high dose cause convulsions.
    - (b) Benzyl penicillin is not effective for infections due to normal strains of Neisseria meningitidis.
    - (c) Phenoxymethyl penicillin is not resistant to gastric acid.
    - (d) Penicillins are not effective against normal strains of Gram positive bacteria.

18. The penicillins act by :
    - (a) Inhibition of protein synthesis
    - (b) Interfering with bacterial cell wall synthesis
    - (c) Inhibition of nucleic acid synthesis
    - (d) Phagocytic action

19. All of the following antimalarial drugs influence blood schizonts, except :
    - (a) Mefloquine
    - (b) Chloroquine
    - (c) Primaquine
    - (d) Quinidine

20. The group of antibiotics having an antimalarial effect :
    - (a) Aminoglycosides
    - (b) Tetracyclines
    - (c) Carbapenems
    - (d) Penicillins

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. What is Zingiberene ?
2. Write the role of quinine.
3. Draw the structure of Aldosterone.
4. What is butein ?
5. Write any *two* characteristics about soft drug.
6. What do you mean by drug receptor ?
7. What do you mean by alkylating agent ?
8. Draw the structure of Streptomycin.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Write the synthesis of beta carotene.
2. Write the synthesis of atropine.
3. Discuss the structural feature of cholesterol.
4. What do you mean by plant pigments ? Discuss the synthesis of Vitexin.
5. What do you mean by structure-activity relationship ?
6. Discuss about pharmacophore.
7. What do you mean by mitotic inhibitor ?
8. Discuss the synthesis process of pamaquine.

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. What are terpenoids ? Discuss the synthesis and application of abietic acid.

   Or

   What are alkaloids ? Discuss the nomenclature, physiological action and synthesis of ephedrine.

2. What are steroids ? Discuss the biosynthesis of testosterone.

   Or

   Discuss the synthesis steps of Myrcetin and Cyanidin.

3. Discuss the theories of drug activity.

   Or

   Write a short note on Pharmacodynamic and QSAR.

4. What are antibiotics ? Discuss the synthesis of chloramphenicol.

   Or

   What are the antimalarial agents ? Discuss the synthesis and applications of santoquine and pentaquine.

Roll No. ....

E–990

M. Sc. (Fourth Semester) (Main/ATKT)
EXAMINATION, May-June, 2021

CHEMISTRY

Paper Third (CH-21)

(Material and Nuclear Chemistry)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. The rate equations can be expressed in the form of linear phenomenological equation (J = Flux and X = Force) :

   (a) $X_i = \sum_{j=1}^{n} L_{ij} J_j$

   (b) $J_i = \sum_{j=1}^{n} L_{ij} X_j$

   (c) $J_i = \sum_{n=1}^{i} R_{ij} J_i$

   (d) $J_i = \sum_{j=1}^{n} L_{ij}$

P. T. O.

2. If the system is subjected to irreversible process, the $d_i\text{S}$ will be :

   (a) $d_i\text{S} = 0$

   (b) $d_i\text{S} < 0$

   (c) $d_i\text{S} = d\text{S}$

   (d) $d_i\text{S} > 0$

3. Which one of the following is biological application of irreversible thermodynamics ?

   (a) Transport across biological membrane

   (b) The synthesis of RNA

   (c) Muscle contraction to perform mechanical work

   (d) All of the above

4. Which of the following statements is correct ?

   (a) The matrix of the phenomenological coefficients is symmetric provided a proper choice of fluxes and forces is made.

   (b) In an irreversible process the entropy production is always negative.

   (c) Entropy of the system is an intensive property.

   (d) Fick's law is used for the heat transfer.

5. The rate of entropy production ($d\sigma$) for the irreversible process can be written as :

   (a) $d\sigma = -\dfrac{dq}{\text{T}}$

(b) $d\sigma = \frac{dq}{T}$

(c) $d\sigma = dS + dS_{rev}$

(d) $d\sigma = dS - dS_{rev}$

6. The lowering of the melting points of nanoparticles of metals and semiconductors as compared to with bulk forms is due to ....

(a) Reduced imperfection

(b) Surface energy increases with a decreasing size

(c) Spatial confinement

(d) None of the above

7. Degree of scattering in Transmission Electron Microscope (TEM) is a function of :

(a) Wavelength of electron beam used

(b) Number of atoms that lie in the reaction path

(c) Mass of atoms that lie in the electron path

(d) Number of mass of atoms that lie in the electron path

8. The following ceramic product is mostly used as pigment in paints :

(a) TiO_2

(b) SiO_2

(c) UO_2

(d) ZnO_2

9. Which ratio decides the efficiency of naomaterials ?
   (a) Weight/Volume
   (b) Volume/Weight
   (c) Surface area/Volume
   (d) Surface volume/Surface area

10. The semiconductor nanoparticle GaN (Gallium Nitride) can be used as :
    (a) Light-emitting diodes
    (b) Aerospace industry
    (c) Amplifiers
    (d) All of the above

11. What type of guest would a cyclic polyether be able to bind ?
    (a) Anions
    (b) Zwitterions
    (c) Cations
    (d) Neutral species

12. Choose the incorrect statement :
    (a) Supramolecular chemistry may be defined as chemistry beyond the molecule.
    (b) The ability of acyclic ligands to form more stable and selective complexes than macrocyclic ligands.
    (c) Supramolecular reactivity and catalysis involve binding and transformation of the bound species into products.
    (d) Selective binding of a specific substrate to its receptors involves a molecular recognition process.

13. Which of the following cyclodextrins is called cycloheptamylose ?
    - (a) β-cyclodextrin
    - (b) γ-cyclodextrin
    - (c) α-cyclodextrin
    - (d) None of the above

14. Which one of the following elements is likely to participate in a hydrogen bond ?
    - (a) F
    - (b) N
    - (c) O
    - (d) S

15. Which one of the following represents weakest interaction between two species ?
    - (a) Hydrogen bond
    - (b) Dispersion force
    - (c) Dipole-dipole force
    - (d) Disulfide bond

16. For a given nuclear fission reaction of ^{235}U :

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^{1}_{0}n$$

The amount of energy (in kJ/mol) released during this process is (Given ^{235}U = 235.0439 a.m.u., ^{142}Ba = 141.9164 amu, ^{91}Kr = 90.9234 amu, neutron = 1.00866 a.m.u.) :

- (a) 1.68×10^{10}
- (b) 1.0×10^{9}
- (c) 2.8×10^{11}
- (d) 3.12×10^{12}

17. The particles postulated to always accompany the positron emission among :

(A) Neutrino

(B) Anti-neutrino

(C) Electron

Codes :

(a) A, B and C
(b) A and B
(c) A and C
(d) B and C

18. Which one of the following pairs has two magic numbers for closed nuclear shells ?

(a) 8, 10

(b) 50, 82

(c) 10, 20

(d) 82, 130

19. In the nuclear reactor, the material used to control the chain reaction is :

(a) Bismuth

(b) Zinc

(c) Iron

(d) Cadmium

20. Which nuclei has the highest nuclear binding energy per nucleon ?

(a) ^{238}U

(b) ^{4}He

(c) ^{62}Ni

(d) ^{52}Cr

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions. Write answer in 2-3 sentences.

1. Define forces and fluxes.
2. What is the difference between equilibrium state steady state ?
3. Define size and shape controlled synthesis of nanoparticles.
4. What are ceramics ? Give their examples.
5. What do you mean by 'Host and Guest Chemistry' in the case of supramolecules ?
6. Write the names of *two* cryptands with structure.
7. Explain briefly the strength of radioisotopes.
8. Write *two* applications of tracers in chemical investigation.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Explain Prigogini's principle of minimum entropy production in non-equilibrium thermodynamics.
2. What is the relationship between coupled reactions and non-equilibrium thermodynamics ?
3. What are the advantages of sol-gel method for synthesis of nanoparticles ?
4. Discuss briefly the different properties of nanoparticles which make them different from bulk material.
5. Discuss the principle of molecular receptor and design in supramolecular chemistry.
6. What are cyclophanes ? Write some important applications.
7. Write the analytical application of radiochemistry.
8. What is the significance of nuclear shells and magic numbers ?

Section—D

5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. What are the fundamental concepts of non-equilibrium thermodynamics ? Explain phenomenological laws and Onsager's reciprocity relations.

Or

Discuss the application of non-equilibrium thermodynamics for biological system.

2. Describe different methods for the preparation of nanoparticles. Discuss synthesis of metallic and semiconductor nanoparticles.

Or

How is nanoparticles characterized ? Discuss SEM and TEM methods for the morphological study of nanoparticles.

3. How reactivity and catalysis represent major features of the functional properties of supramolecular systems ?

Or

State and explain shapes and dimensions of the α, β and γ cyclodextrin molecules. Discuss and chemical features and their molecular complexations.

4. Derive semi-empirical mass equation. Give its application and limitation.

Or

Write short notes on any *two* of the following :

(i) Nuclear fission and chain reaction

(ii) Radioactive isotopes

(iii) Nuclear potentials

(iv) Liquid drop model

Roll No. ....

E–991

M. Sc. (Fourth Semester) (Main/ATKT)
EXAMINATION, May-June, 2021

CHEMISTRY

Paper Fourth (CH–22)

(Environmental and Applied Chemical Analysis)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A

1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. Which vitamin deficiency disease may be found in severe alcoholism ?
   - (a) Beri-Beri
   - (b) Rickets
   - (c) Pellagra
   - (d) Xerophthalmia

2. Which of the following statements is true about the air quality index ?
   - (a) It indicates the colour of the air.
   - (b) It predicts ozone levels in your area.
   - (c) It determines intensity of sound and sound pollution.
   - (d) It estimates air pollution mainly sulphur content in the air.
3. What is the main ingredient in face powder ?
   - (a) Calcium carbonate
   - (b) Talc
   - (c) Magnesium carbonate
   - (d) China clay
4. What is the total percentage of nitrogen gas in the air ?
   - (a) 12 percent
   - (b) 21 percent
   - (c) 78 percent
   - (d) None of the above
5. The amount of protein per 100 g of red meat is between :
   - (a) 5-10 g
   - (b) 15-25 g
   - (c) 30-40 g
   - (d) 45-60 g
6. A candlelight test is used to measure .... of an egg by incubator maintainers.
   - (a) External shell quality
   - (b) Internal egg quality
   - (c) Colour of egg
   - (d) None of the above

7. Which of the following is not a solid form of aerosol ?
    - (a) Fume
    - (b) Dust
    - (c) Mist
    - (d) Smoke

8. The maximum size of fly ash is ....
    - (a) 1 μm
    - (b) 100 μm
    - (c) 1000 μm
    - (d) 10 μm

9. Lithium concentrations in body fluids is determined by :
    - (a) gravimetrically
    - (b) photometrically
    - (c) volumetrically
    - (d) complexometrically

10. Which of the following salts is the main cause of permanent hardness of water ?
    - (a) Magnesium sulphate
    - (b) Magnesium bicarbonate
    - (c) Magnesium carbonate
    - (d) None of the above

11. Chlorofluorocarbon is non-flammable chemicals mainly used in ....
    - (a) Perfumes
    - (b) Refrigerators
    - (c) Air conditioners
    - (d) All of the above

12. What is the health effect of excess fluoride in drinking water ?
    - (a) Fluorosis
    - (b) Toothaches
    - (c) Lung disease
    - (d) Intestinal infection

13. The main sources of Arsenic in water are ....
    - (a) Floods
    - (b) Fertilizers
    - (c) Industrial waste
    - (d) Both (b) and (c)

14. Coffee is prepared from coffee beans by leaching with :
    - (a) Cold water
    - (b) Hot water
    - (c) Dilute hot cuastic solution
    - (d) Naphtha

15. Which of the following units is used for measuring the turbidity of water ?
    - (a) FAU–Formazin Attenuation Units
    - (b) FNU–Formazin Nephelometric Unit
    - (c) NUT–Nephelometric Turbidity Units
    - (d) All of the above

16. The chemicals released due to unsustainable agricultural practises and cause soil pollution are :
    (a) Pathogens
    (b) Chemical fertilizers
    (c) Strontium-90
    (d) Weedicides

17. Which of the following statements is true about proteins ?
    (a) Proteins are polymers of glucose.
    (b) Proteins are polymers of amino acids.
    (c) Proteins are polymers of peptide bonds.
    (d) Proteins are polymers of disulfide bridges.

18. Benzene and methylbenzene the major soil pollutants mostly from the petroleum industries are :
    (a) Heavy organic pollutants
    (b) Inorganic pollutants
    (c) Carcinogenic pollutants
    (d) None of the above

19. Antioxidant BHA stands for :
    (a) Butyl Hydroxyl Amine
    (b) Boron Hydroxyl Amine
    (c) Butylated Hydroxy Anisole
    (d) None of the above

20. Sodium benzoate is used in food as :
    (a) Preservative
    (b) Colouring agents
    (c) Fragrance
    (d) Nutrient

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions in 2-3 sentences.

1. Differentiate pollutant and pollution.
2. Why the white marbles of Taj Mahal becoming yellowish day by day ?
3. What are the sources of soil pollution ?
4. What is the role of bath salt in bath preparation ?
5. Define antioxidant.
6. Write the function of lipase.
7. How are butter and cheese prepared ?
8. Write the names of analytical techniques used for determination of trace elements from biological samples.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions. Write answer in < 75 words.

1. What are the do’s and don’t to save the environment ? Write at least 3-3 points for each.
2. What are the effects of photochemical smog ? How can photochemical smog be controlled ?
3. List the green house gases. How is it causing global warming ?

4. Discuss the self-purification of river water.
5. What is the purpose of introduction of food additives in food and why do we need to analyze the constituents of food materials ?
6. Comparatively explain the beauty of bathing with respect to applying cosmetics.
7. Write the composition of cold creams. Also provide the function of each component.
8. Describe the method for analysis of protein albumin.

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. (a) Define BOD. What does it signifies ?

   (b) How is it determined ?

Or

Shortly describe :

(a) The major water pollutants with their sources.

(b) Preventive measure to control water pollution.

2. (a) In which part of the atmosphere ozone layer is found ?

   (b) How is ozone layer formed in nature ? Provide suitable reaction.

   (c) Discuss the ozone depletion with reactions of ozone with different depleting agents.

Or

Write short notes on the following :

(a) Scrubber technique

(b) Baghouse filters

3. (a) Explain the importance of additives and preservatives in food samples.

   (b) Describe any *one* technique to check purity of honey.

Or

Briefly describe the standard composition and analysis of :

(a) Milk powder

(b) Jam

4. What do you mean by cosmetics ? What does it signifies in the society ? Write the composition of saving cream with the function of each component.

Or

Write the principle and procedure for determination of :

(a) Glucose in urine sample

(b) Enzyme amylase