Annexure No.	23 A
SCAA Dated	29.02.2008

BHARATHIAR UNIVERSITY : COIMBATORE - 641 046
M.Sc. Chemistry Degree Course(for affiliated Colleges)
with compulsory Dipolma in Industrial Chemistry

(for the students admitted from the academic year 2007-2008 and onwards)

1. Eligibility for Admission to the Course
A candidate who has passed the Degree Examination **in B.Sc. Chemistry with Physics & Mathematics as allied subjects** of this University or an examination of some other University accepted by the syndicate as equivalent thereto shall be eligible for admission to the Master Degree of this University.

2. Duration of the Course
This Course of Study shall be based on Semester System. This Course shall consist of four Semesters covering a total of two Academic Years. For this purpose, each Academic Year shall be divided into two Semesters; the first and third Semesters; July to November and the second and the fourth Semesters; December to April. The Practical Examinations shall be conducted at the end of even Semester.

3. Course of Study

The Course of the Degree of Master of Science/Arts/Commerce shall be under the Semester System according to the Syllabus to be prescribed from time to time. This Course consists of Core Subjects and Elective Subjects. There shall be one Paper on applied Skill Oriented, subject preferably in each semester as part of the adjunct Diploma Programme.

4. Requirement to appear for the Examinations
a) A candidate will be permitted to take the University Examination for any Semester, if

   i)   he/she secures not less than 75% of attendance out of the 90 instructional days during the Semester.

b) A candidate who has secured attendance less than 75% but 65% and above shall be permitted to take the Examination on the recommendation of the Head of the Institution to condone the lack of attendance as well as on the payment of the prescribed fees to the University.

c) A candidate who has secured attendance less than 65% but 55% and above in any Semester, has to compensate the shortage of attendance in the subsequent Semester besides, earning the required percentage of attendance in that Semester and take the Examination of both the Semester papers together at the end of the latter Semester.

d) A candidate who has secured less than 55% of attendance in any Semester will not be permitted to take the regular Examinations and to continue the study in the subsequent Semester. He/she has to re-do the Course by rejoining the Semester in which the attendance is less than 55%.

e) A candidate who has secured less than 65% of attendance in the final Semester has to compensate his / her attendance shortage in a manner to be decided by the Head of the Department concerned after rejoining the Course.

5.   Restriction to take the Examinations
a) Any candidate having arrear paper(s) shall have the option to take the Examinations in any arrear paper(s) along with the subsequent regular Semester papers.
b) Candidates who fail in any of the papers shall pass the paper(s) concerned within 5 years from the date of admission to the said Course. If they fail to do so, they shall take the Examination in the revised Text / Syllabus, if any, prescribed for the immediate next batch of candidates. If there is no change in the Text / Syllabus they shall take the Examination in that paper with the Syllabus in vogue, until there is a change in the Text or Syllabus.

In the event of removal of that paper consequent to the change of Regulations and / or Curriculum after a 5 year period, the candidates shall have to take up on equivalent paper in the revised syllabus as suggested by the chairman and fulfill the requirements as per Regulations/Curriculum for the award of the Degree.

6. The Medium of Instruction and Examinations
The medium of instruction and Examinations shall be in English.

7. Submission of Record Notebooks for Practical Examinations
Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations. Otherwise the candidates will not be permitted to take the Practical Examinations.

8. The Minimum (Pass) Marks
A candidate shall be declared to have passed in a paper if a student obtains not less than 50% of marks in that paper. A candidate shall be declared to have passed the whole Examination if the student passes in all the papers.

9. Improvement of Marks in the subjects already passed
Candidates desirous of improving the marks secured in their first attempt shall reappear once within the subsequent Semester. The improved marks shall be considered for classification but not for ranking. If there is no improvement there shall not be any change in the original marks already awarded.

10. Classification of successful candidates

A candidate who passes all the Examinations in the first attempt within a period of two years securing 75% and above marks in the aggregated shall be declared to have passed with First Class with Distinction.

Successful candidates passing the P.G. Degree Examinations, securing 60% marks and above shall be declared to have passed the examination in First Class. All other successful candidates shall be declared to have passed the Examination in Second Class.

12. Ranking

A candidate who qualifies for the PG Degree Course passing all the Examinations in the first attempt, within the minimum period prescribed for the Course of Study from the date of admission to the Course and secures 1st or 2nd Class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks.

The improved marks will not be taken into consideration for ranking.

13. Conferment of the Degree

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed Course of Study for a period of not less than four Semesters in an Institution approved of by and affiliated to the University or has been exempted there from in the manner prescribed and has passed the Examinations as have been prescribed.

14. Evening College

The above Regulations shall be applicable for candidates undergoing the respective Courses in the Evening Colleges also.

16. Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

17.Transitory Provision

Candidates who have undergone the Course of Study prior to the Academic Year 2007-2008 will be permitted to take the Examinations under those Regulations for a period of four years i.e. up to and inclusive of the Examination of April 2012 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.

Scheme of Examination

	Subjects	Hrs	Max. marks *
I - SEMESTER			
Paper - I	Organic Chemistry – I (Organic reaction mechanisms)	3	100
Paper - II	Inorganic Chemistry – I (Nuclear chemistry etc)	3	100
Paper - III	Spectroscopy, Group theory and computer in chemistry	3	100
Diploma	Paper I Dye Chemistry / Corrosion Chemistry	3	100
II - SEMESTER			
Paper - IV	Organic Chemistry – II (Organic reaction mechanisms)	3	100
Paper - V	Physical Chemistry-I (Quantum chemistry and spectroscopy)	3	100
Paper - VI	Physical methods in Chemistry	3	100
Practical - I	Organic Chemistry – I	6	100
Practical - II	Inorganic Chemistry – I	6	100
Practical - III	Physical Chemistry – I	6	100
Diploma	Paper II Industrial Chemistry	3	100
III - SEMESTER			
Paper - VII	Organic Chemistry – III (Chemistry of natural products)	3	100
Paper - VIII	Physical Chemistry – II (Thermodynamics)	3	100
Paper - IX	Elective – I Kinetics of polymerization	3	100
Diploma	Paper III Water pollution and Industrial Effluent treatment	3	100
IV - SEMESTER			
Paper - X	Inorganic Chemistry – II (Coordination chemistry)	3	100
Paper - XI	Physical Chemistry – III (Reaction kinetics and electro chemistry)	3	100
Paper - XII	Elective – II Polymer technology	3	100
Practical - IV	Organic Chemistry - II	6	100
Practical - V	Inorganic Chemistry - II	6	100
Practical - VI	Physical Chemistry - II	6	100
Diploma	Paper IV Project Work	3	100
		Total	1800 + 400

∗　Includes 25% continuous internal assessment marks.

Subject Title   :   PAPER I   ORGANIC CHEMISTRY - I
(Organic Reaction Mechanisms)

No.of hours: 75 hrs

Subject Description   :
This contents of this paper present the basic principles of understanding mechanism of organic reactions. In addition to the general physical methods of approaching the course of reactions, specific examples like aromatic electrophilic substitution, aliphatic nucleophilic substitution, elimination and free radical reactions have been dealt with in detail.

Goals :
To motivate and enable the students to comprehend the possible chemical route by which a reaction may proceed.

Objectives :
On successful completion of the course the students should have:
Understood aromaticity, antiaromaticity and nonaromaticity in organic compounds,
Learnt possible reaction pathways in aromatic electrophilic, aliphatic nucleophilic, elimination and free radical reactions.

Contents

UNIT-I
1. Aromaticity : Introduction - Aromaticity of benzenoids and heterocyclic compounds. Non-benzenoid aromatics - annulenes. Azulenes and ferrocenes(synthesis not necessary). Antiaromatic and non aromatic compounds.
2. Kinetic and nonkinetic methods of study of reaction mechanisms - Kinetic methods primary and secondary kinetic isotopic effects, non-kinetic methods - study of reaction mechanism — study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control.
3. Linear free energy relationship — Hammett equation (Taft equation not necessary).

UNIT—Il
Aromatic electrophilic substitution. reactions – Introduction - Mechanism of electrophilic substitution. reactions such as halogenation, nitration, sulphonation and Friedel – Crafts alkylation and acylation reactions. Orientation and reactivity. Electrophilic substitution on monosubstituted and disubstituted benzenes. Typical reactions such as Gattermann reaction Gattermann Koch reaction. Rimer -Tiemann reaction. Kolbe reaction. Hofmann-Martius and Jacobson's reactions.

UNIT-III
Aliphatic nucleephilic substitution reactions and mechanisms:
SNI, SN2, SNi mechanisms. Factors affecting nucleephilic substitution reaction – nature of the substrate, solvent, nucleophile and leaving group.   Neighbouring group

participation. Ambident nucleophiles and ambident substrates. Stereochemistry of nucleophilic substitution reactions. Substitution at vinyl carbon allylic carbon and bridge head carbon. Typical substitution reactions such as Von Braun reaction, Claisen condensation and hydrolysis of esters.

UNIT- IV

1. Elimination reactions: El, E2, Ei, E1CB mechanisms, Stereochemistry of elimination reactions. Elimination Vs substitution. Typical elimination reactions such as Chugaev reaction. Hofmann degradation. Cope elimination.
2. Carbenes and nitrenes — structure, generation and reactions.

UNIT-V

Free radical reactions: Introduction -structure, stability and geometry of free radicals. Generations of long lived and short lived free radicals. Characteristics of free radical reactions - substitutions - additions and eliminations, rearrangements. of free radicals. Typical reactions such as Sandmeyar, Gamberg, Pechmann,　Ullman, Pschorr and Hunsdiecker reactions.

REFERENCES

I. Jerry March — Advanced organic chemistry
2. I.1. Finar — Organic chemistry. Vol. 1 & II
3. R.T. Morrison and R.N. Boyd — Organic chemistry
4. E.S. Gould — Mechanism and structure in organic chemistry
5. E. R. Alexander — Principles of ionic organic reactions
6. Fieser and Fieser — Advanced organic chemistry
7. J.B. Hendrickson, D.J.Gram and G.S.Hammond — Organic chemistry
8. P.J. Garrat — Aromaticity
9. Badger — Aromaticity and aromatic character
10. D.V. Banthorpe — Eliminations

Subject title　　　　　　　: **Paper –II -INORGANIC CHEMISTRY - I**

No.of hours: 75 hrs

Subject Description　:
　　　　This paper presents an idea about inorganic ring systems and clusters. Some basic concepts of solid state chemistry, nano materials and crystallographic techniques are included in this paper.

Goals　:
　　　　To enable the students to learn some principles and theories in inorganic and solid state chemistry.

Objectives   :
        On successful completion of the course the students should have an exposure to the nano technology and chemical crystallography.
        Basic idea about the properties of solids

Contents
UNIT – I
                Inorganic rings – chains – cages and clusters – metal clusters – dinuclear, trinuclear, tetra nuclear and hexa - nuclear clusters – organometallic clusters.

UNIT – II
                Borazines – phosphonitrilic compounds – sulpher - nitrogen ring compounds.Metallic state – free electron and band theories – non stochiometry – point defects in solids – Schotty - Frenkel defects – linear and dislocation effects.

UNIT – III
        Electrical properties of solids – superconducting elements – critical temperature – persistent currents – thermoelectric properties – magnetic properties (perfect diamagnetism) – Meissner effect

UNIT – IV
        Nuclear chemistry-the nuclues-subatomic particles and their properties –binding energy- N-P ratio in stable and metastable nucluei-different types of nuclear forces-liquid drop model-shell model-mode of radioactive decay-α,β,γ decay-electron capture-nuclear isomerism-internal converstion.

UNIT – V
        Nuclear reactions Q-value, coulombic barrier, cross section, different types of nuclear reactions-projectiles capture – particle emission, spallation, fission fusion-theories of fission, use of fission products, fissile and fertile isotopes – U^{233}, U^{235}, Pu^{239}, Th^{232}, - atomic power projects in India, stellar energy, synthetic elements – application of radio isotopes-hot atom chemistry.

References   :
Cotton and Wilkinson : Advanced inorganic Chemistry, Wiley
                        Eastern (P), Ltd., 1968
Gurdeep and Harish   : Advanced inorganic Chemistry, Geol
                            Publishing House
G.M.Arora   : Solid State Chemistry
R.A.Alberty and Silbey   : Solid State Chemistry
J.P.Srivastava   : Elements of Solid State Physics
Glasstone   : Source book of nuclear of chemistry

PAPER III- SPECTROSCOPY, GROUP THEORY AND COMPUTER IN CHEMISTRY

No.of hours: 75 hrs

UNIT - I

Infrared Spectroscopy
Principle of infrared spectroscopy-description of double beam IR spectrophotometer-IR spectra of poty atomic molecules-factors affecting the vibrational frequencies-application of IR spectroscopy for organic and inorganic compounds-problems.

UNIT - II

Symmetry elements and symmetry operations: definition of identical and equivalent elements- configurations-symmetry operations and symmetry elements-rotation-axis of symmetry- reflections-symmetry planes-inversion center-improper rotations-rotation-reflection axis-effect of performing successive operations (commutative and non - commutative) - inverse operations.

Groups and their basic Properties: Definition of a group-basic properties of a group-definition of Abelian group-isomorphic group-similarity transformation and classes-group multiplication tables-symmetry classification of molecules into point groups (Schoenflies symbol only) difference between point group and space group.

UNIT-III

Definition of reducible and irreducible representations-irreducible representations as orthogonal vectors-direct product rule-the great orthogonality theorem and its consequences (statement only proof not needed)-determinations of the characters for irreducible representation of C2v and C3v point groups using the orthogonality theorem-calculation of binary co-ordinates in the character tables for C2v and C3v point groups—calculation of character values of reducible representations per unshifted atom for each type of symmetry operation-determination of total Cartesian representation—determination of direct sum from total Cartesian representation.

Group theory and vibrational spectroscopy-vibrational modes as basis for goup representation- symmetry selection rules for IR and Raman spectra (mutual exclusion principle)-classification of vibrational modes.

UN IT - IV

Mossbauer Spectroscopy
Principle-Mossbauer spectrometer-isomer shift-quadrupole interaction-nuclear Zeeman splitting-application.

ESR Spectroscopy - principle – kramers degeneracy – zero field splitting – applications .

UNIT-V

Introduction to computers and computation in chemistry

Basic structure and functioning of computers with a PC as an illustrative example-memory. I/O devices-secondary storage-computer languages-operating systems with DOS as an example-introduction to UNIX and WINDOWS-data processing, principle of programming- algorithms and flow charts.

Data entry devices for sequential processing-data entry devices for direct access processing-data communication concepts: LAN, WAN, e-mail internet concept; computer virus; soft ware packages; lotus 1 2 3 (elementary treatment).

REFERENCES:

1. W.Kemp   : Organic spectroscopy
2. R.S.Drago   : Physical methods in Inorganic Chemistry
3. Suilverstein Baslei- & Morril   : Spectrometiic identification of organic
                                       compounds
4. F.Sheirmann   : An introciLiction to Spectroscopic methods for
                                       identification of organic compounds. Vol. I & II
5. C.N.Flanwell   : Fundamentals of Molecular Spectroscopy
6. F.A.Cotton   : Chemical applications of Group theory
7. M. Orchin and H.H. Jaffe   : Symmetry, Orbital and spectra
8. G. Davidson   : Introductory Group theory for Chemists
9. K.V. Raman   : Computers in Chemistry
10. E. Balagurusamy and Deenadialu   : Introduction to Computer Science
11. E. Balagurusamy   : Programming in C

Subject Title   :   PAPER IV   ORGANIC CHEMISTRY - II

No.of hours: 75 hrs

Subject Description   :

This paper gives a concise idea of organic reaction mechanisms in molecular rearrangement and concerted reactions. In addition, mechanism in organic photochemical, oxidation- reduction reactions, addition reactions and stereoisomerism have been presented.

Goals :

To enable the students to learn different rearrangement reactions, pericyclic and name reactions in organic chemistry. A comprehensive knowledge on conformational analysis is also aimed.

Objectives :

On successful completion of the course the students should have:

Mastered rearrangement reactions, Woodward-Hofmann rules, organic photochemistry, synthetically important name reactions in organic chemistry and stereoisomerism in organic compounds.

Contents

PAPER -IV   ORGANIC CHEMISTRY - II
(Organic reaction mechanisms)

UNIT-I

Molecular rearrangements: Introduction - Wagner - Meerwein rearrangements, Neber rearrangement, Baeyer —Villiger rearrangement. Rearrangements to electron deficient nitrogen and oxygen — Dienone phenol, Favorski, Fries, Wolt Benzidine and Stevens rearrangements.

UNIT—Il

Concerted reactions: Pericyclic reactions — the perturbation theory of pericyclic reactions, the electrocyclic reactions & sigmatrophic reactions. Woodward — Hofmann rules, orbital correlation diagrams, the frontier orbital theory. Cycloadditions - Diel's Alder reaction. Cope, Claisen and Di-pi - methane rearrangements.

UNIT-Ill

1. Organic photochemistry: Introductory theory of light absorption, photophysical processes –Jablonski diagram , energy transfer photochemical reaction of ketones - Norrish type I and type II reactions. Paterno – Buchi reaction and cis and trans isomerisation.

2. Oxidation and reductions: Mechanisms — oxidation of olefins, alcohols, glycols, ozonolysis and aromatization reaction and Sommelet reaction. Reduction reactions and selectivity in reduction. Reduction reactions involving metal hydrides(LiAlH$_4$ and NaBH$_4$). Reduction of nitro compounds, carbonyl compounds and aromatic compounds. Typical reactions such as Birch reduction, Clemmensen, Wolff – Kishner and MPV reduction.

UNIT-IV

1. Additon reactions : Eelectrophilic and nucleophilic. Addition to double and triple bonds — Hydration. hydroxylation. Michael addition. hydroboration and epoxidation.

2. Addition to carbonyl compounds : Mannich reaction, Dieckmann, Stobbe, Knovenagel, Darzen, Wittig, Thorpe and Benzoin reactions.

UNIT - V

  Stereoisomerism – Configurational & conformational isomerism**:**

 1. Introduction, definition & classification. Molecular representation (Fischer projection, Newmann projection formula). Basic requirements of optical isomerism. Optical isomerism exhibited by a few nitrogen and sulphur compounds – the role of nitrogen inversion.

2. Configurational nomenclature: D & L, R & S and E & Z(olefins) nomenclatures.

3. Conformations of acyclic and cyclic molecules:

Conformations of ethane and 1, 2 disubstituted ethanes. Configurations and conformations of cyclohexane, mono and disubstituted cyclohexanes(conformational equilibrium – delta G). Configurations and conformations of fused polycyclic systems – decalin, perhydrophenanthrene, perhydroanthracene.

REFERENCES

1. Jerry March :   Advanced organic chemistry
2. Jaffee and Drchin :   Orbital symmetry
3. Entwistle :   Orbital symmetry correlations in organic chemistry
4. Lehr and Marchand :   Orbital symmetry
5. Pant Dc Mayo :   Molecular rearrangements vol. 1 & II
6. N.J. Turro :   Molecular photochemistry
7. C.H. Depuy and O.S. Chapman :   Molecular reactions and photochemistry
8. J.M. Coxon and B.Halton :   Organic chemistry
9. W.A. Pnyer :   Introduction to free radical chemistry
10. S.M.Munergee and S.P.Singh :   Reaction mechanisms in organic chemistry
11. L.N.Ferguson — The modern structural theory of organic chemistry
12. C.A.Buntcn -- Nucleophilic substitution at the saturated carbon atom
13. J .Miller -—- Atomic nucleophiclic substitution
14. C.K. lngold — Structure and mechanism in organic chemistry
15. K.Milson — Introduction to stereochemistry
16. LL.Lliel — Stereochemistry of carbon compounds
17. Whitaker David — Stereochemistry
18. Eliel and Ailsinger — Stereochemistry

PAPER - V PHYSICAL CHEMISTRY -1
(Quantum Chemistry and Spectroscopy)

No.of hours: 75 hrs

UNIT-I

1. The time-dependent and time-independent schrodinger equations — Born's interpretation of the wave function. Requirements of the acceptable wave function.

2. Algebra of operators. Sums and products of operators. Commutator. Linear operators. Eligen functions and eigen values. Correspondence between physical quantities in classical mechanics and operators in quantum mechanics. Hamiltonian operator. Angular momentum operator. Quantization of angular momentum and its spatial orientation. Average (expecation) values. Postulates of quantum mechanics.

UNIT-II

1. Particle in a one—dimensional box. Quantization of energy. Normalization of wave function. Orthogonality of the particle in a one—dimensional box wave functions. Illustration of the uncertainty principle and correspondence principle with reference to the particle in a one dimensional box. Particle in a three-dimensional box. Separation of variables.

2. Solving of Schrodinger equation for the one—dimensional harmonic oscillator. Harmonic oscillator model of a diatomic molecule. Illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator.

3. Solving of Schrodingcr equation for a rigid rotor. Rigid rotor model of a diatomic molecule.

UNIT-III

1. Schrodinger equation for the H-atom (or H-like species) separation of variables (solving of radial equation is not needed but nature of solution is given), energy levels. Radial factors of the H-atom wave functions. Orbitals and orbital shapes. Probability density and radial distribution functions. The most probable distance of the H-atom (or H-like species) 1S electron.

2. Need for approximation methods. The perturbation theory (first order only). Application of the perturbation method to He-atom.

3. The variation method. Application of variation method to He-atom.

UNIT-IV
Proton NM R spectroscopy:
Principle of NMR spectroscopy - description of the PMR instrument-- factors affecting chemical shifts - chemical shift equivalence and magnetic equivalence - dynamic 1-HNMR (basic idea) - Spin-Spin coupling - first order and non-first order spectra - Heteronuclear coupling in 1HNMR - deuterium exchange.

UNIT-V
High - field spectra - double resonance - shift reagents - applications to organic and inorganic compounds - problems. Fourier transform NMR spectroscopy - carbon-l3 NMR spectroscopy-principle only

REFERENCES:
1. Ira.N.Levine, Allyn & Bacon IC   : Quantum Chemistry, 1974
2. Mc. Quarie   : Quantum Chemistry
3. Ira.N.Levine, McGrav   : Physical Chemistry, Hill Book Company, 1971
4. Ira.N.Levine, Wiley   : Interscience, N.Y. 1975
5. W.Kemp   : Organic spectroscopy
6. D.L.Pavia & G.M Lampman   : Introduction to spectroscopy
7. Abraham and Lofters   : 13C NMR spectroscopy

**Subject Title   :   PAPER VI   PHYSICAL METHODS IN
                                                                      CHEMISTRY**

No.of hours: 75 hrs

Subject Description   :
This paper presents the principles and applications of mass spectroscopy, optical rotatory dispersion, circular dichroism, turbidimetry, nephelometry, thermal analysis and principles of ESCA, AES and GLC and HPLC.

Goals :
To enable the students the use of physical tools to understand structure of compounds.

Objectives :
On successful completion of the course the students should have:
Understand the basis of mass spectroscopy, mode of recording mass spectrum and its applications.
Learnt physical techniques like ORD, CD, DTA, DSC, TGA, ESCA, GLC, HPLC, neutron and X – ray diffraction

Contents
UNIT – I
Mass spectroscopy
Principles of mass spectrometry-resolution-description of single focusing and double focusing electron impact mass spectrometers, ion-cyclotron resonance analyzer and fourier transform mass spectrometers-presentation and analysis of spectra-determination of molecular formulae-nitrogen rule-isotope abundance analysis-meta stable ions and peaks-the molecular ion peak-fragmentation processes-symbolism (scission only)-even and odd electron ions- double bond and or ring equivalents implied from a formula.

UNIT – II
Applications of mass spectroscopy
 Scission with rearrangement – retro Diels-Alder rearrangement – McLaffertty rearrangement –-fragmentation associated with functional groups-aliphatic compounds-aldehydes and ketones-carboxylic acids, esters, amides, alcohols, thiols and amine ethers, sulphides and halides aromatic compounds (elimination due to ortho groups) - solving problems.

UNIT – III
        Circular dichroism and optical rotatory dispersion-basic principles-basic principles of O.R.D. and C.D.-cotton effects-Octants rule-axial halo ketone rule-application of O.R.D. and C.D.
        Turbidimetry and Nephelometry-applications.
        Thermal analysis: Differential thermal analysis (DTA) and differential scanning calorimetry (DSC)-basic principles-thermo gravimetric analysis.

UNIT – IV
Electron spectroscopy:
      ESCA (XPS): principle, chemical shifts-description of SCA spectrometer, X-ray sources, samples analysis, detectors and recording devices-applications.
      Auger electron spectroscopy (AES) and ultra-violet photo electron spectroscopy (UPS/PES)-principles and applications.
Chromatography:
      Theory, instrumentation and applications in the chemical analysis of the following: GLC and HPLC

UNIT – V
Chemical crystallography:
Neutron diffraction and Electron diffraction.
X-ray diffraction-an elementary discussion of structural factors-Fourier synthesis and analysis.
Structures of rutile, fluorite and antifluorite, zinc blend, wurtzite, diamond and graphite.

REFERENCES:
1. A. I. Vogel   : A text book of quantitative inorganic analysis
2. G. D. Christian   : Analytical chemistry
3. D. A. Skoog and D. M. West   : Fundamentals of Analytical Chemistry
4. D. A. Skoog   : Instrumental methods of analysis
5. B. K. Sharma   : Instrumental methods of analysis
6. H. H. Willard, L.L.Merrit, J.A. Dean: Instrumental methods of analysis
7. S.N.Khopkar   : Fundamental concepts of Analytical Chemistry
8. Das and James   : Mass spectrometry
9. Mc Lafferty   : Mass spectrometry

Subject Title   :   **PAPER VII   ORGANIC CHEMISTRY - III**
                                   (Natural Products Chemistry)

No.of hours: 75 hrs

Subject Description   :
This paper deals with chemistry of natural products – terpenoids, steroids, alkaloids, proteins and heterocyclic compounds.

Goals :
To enable the students to know the chemical compositions of natural substances around them and to motivate them device synthetic routes to prepare natural products in the laboratory.

Objectives :
On successful completion of the course the students should have:

Understood the composition of the important natural materials around them.
Learnt scientific methods to synthesise organic natural products.

Contents :

UNIT-I
Terpenoids: Isolation and classification of terpenoids — structural eIucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abeitic acid and caryophyllene.

UNIT-Il
Steroids: Introduction — structural elucidation and synthesis of cholesterol, ergosterol, equilenin, estrone, testosterone and progesterone.

UNIT-Ill
Alkaloids: Introduction – isolation of alkaloids, structural elucidation and synthesis of morphine, reserpine. Quinine, atropine and glaucine.

UNIT-IV
1. Proteins and nucleic acids: Classification and characteristics(structure) of proteins — synthesis of polypeptides and oxytocin, enzymes and coenzymes. Structure of RNA and DNA and their biological importance.
2. Heterocyclic compounds: Structure, synthesis and reactions of flavones, isoflavones, purines (adenine and guanine) and anthocyanins (cyanin and pelargonin).

UNIT – V
Reactions and reagents: Reactions in organic synthesis: Oppanauer oxidation, Barbier – Wieland degradation, Barton reaction, Jones oxidation and Vilsmeier reaction.
Reagents in organic synthesis : Preparations and synthetic applications of DDQ(2,3-dichloro-5,6-dicyano-1,4-benzoquinone), DBU(1,5-diazabicyclo[5.4.0]undecene-5), DCC(dicyclohexylcarbodiimide) and crown ethers.

REFERENCES :
I. J.L. Finar : Organic chemistry Vol. I & II
2. O.P.Agarwal : Natural product chemistry
P.S.Kalsi : Chemistry of natural products
R.K.Mackie and D.M.Sjnjti1 : Guide book to organic synthesis
J.N.Guntu and R.Kapoor : Organic reactions and reagents
Acheson : Introduction to heterocyclic compounds
Katritsky : Principles of heterocyclic chemistry
S. W.PejJeLjez. : Alkaloids

PAPER — VIII PHYSICAL CHEMISTRY — II
(Thermodynamics)

No.of hours: 75 hrs

UNIT-I
Themodynamics and Non-ideal systems: Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. fugacity and the standard state for non—ideal gases.
Definition of activity. Activity coefficient. Temperature coefficient of activity. Standard states. Applications of activity concept to solutions. The rational and practical approaches. Measurement of activity of solvent from colligative properties. Determination of activity of solute.

UNIT-II
Third Law of Thermodynamics: Probability and third law. Need for third law. Nernst heat theorem and other forms stating third law. Thermodynamic quantities at absolute zero. Statistical meaning of third law and apparent exception.
Mathematical Introduction: Theories of permutation & combination, Laws of probability. Distribution laws. Gaussian distribution.

UNIT-III
Quantum statistics: Maxwell - Boltzmann statistics. Thermodynamic probability. Thermodynamic probabilities of systems in equilibrium. Boltzrnann expression for entropy. Stirling's approximation. States of maximum thermodynamics probability. Legrangian multipliers, thermodynamic probabilities of systems involving energy levels. Maxwell - Boltzmann distribution law. Evaluation of alpha and beta in M.B. distribution law.

UNIT-IV
Partition function: Partition function - definition, justification of nomenclature, microcanonical and canonical ensembles. Molecular partition function and canonical function. The relation between the total partition function of a molecule and the separate partition functions. 'Translational partition function, rotational partition function. Effect of molecular symmetry on rotational partition function. Ortho and para hydrogen. Vibrational partition function. Electronic partition function. Evaluation of thermodynamic properties E, H, S, A, G, Cv and Cp from monoatomic and diatomic ideal gas molecule partition functions.

UNIT-V
Heat capacities of solids: Einstein's and Debye's theories of heat capacities of solids.

Bose-Einstein and Fermi-Dirac Statistics: Bose-Einstein distribution law. Entropy of Bose- Einstein gas. Plank distribution law for black-body radiation. Fermi - Dirac distribution law. Entropy of a Fermi-Dirac gas.

REFERENCES:

1. Klotz	:	Chemical thermodynanics
2. P.W.Aikins	:	Physical chemistry
3. S. G lassione	:	Thermodynamics
4. M . C. Gupta	:	Statistical thermodynamics
5. Lee. Sears and Salinger	:	Statistical thermodynamics

PAPER-1X ELECTIVE-I
Kinetics of Polymerization

No.of hours: 75 hrs

UNIT-I
Step polymerization: Theory of reactivity of large molecules, reactivity of functional groups and molecular size. kinetics of step polymerization, self catalysed polymerization,external catalysis of polymerizations. Cycization Vs linear polymerization, thermodynamic ançl kinetic consideration. Molecular weight control and distribution in Linear polymerization.

UNIT- II
Kinetics of' radical chain polymerization: Kinetic scheme for polymerization in the presence of an initiator. Thermal decomposition of initiators. redox initiation. Photochemical initiation, propagation and terminations — rate expression. Initiator efficiency, auto acceleration mechanism. Kinetics of chain transfer, chain transfer to monomer, initiation and solvents.

UNIT-III
Ionic chain polymerization: Comparision of radical and ionic polymerizations. Cationic polymerization - initiation, propagation and termination - chain transfer to monomer spontaneous and backbiting. Kinetics expression and validity of steady state assumption. The nature and mechanism of anionic polymerization, effect of monomers, initiators and solvents. Initiation, termination - polymerization without termination, termination by impurities and added transfer agents. Kinetics of polymerization with terminations.

UNIT-1V
Chain copolymerization Types of copolymers, evaluation of monomer reactivity ratio copolymer composition, the copolymer equation. Types — of copolyrnerization behaviour — ideal co-polymerization, alternating copolymerization and block — copolymerizations. The Q-e scheme and rate of copolymerization — chemical controlled termination, diffusion controlled termination.

UNIT-V
Ziegler — Natta catalysis and polymerization: Definition Ziegler-Natta catalysts, chemical description of Ziegler-Nattn catalysts for olefins, co-factors determining behaviour of catalysts. modification of Ziegler—Natta catalysts by third components,

mechanisms for initiation and propagation mechanisms for stereochemical control of alpha—olefins. isotactic and syndiotactic propagation. Basic kinetics schemes and rate of polymerization.

REFERENCES

1. P.J. Flory : Principles of' Polymer Chemistry, Cornell Unit, Press. New York, 1953

2. HR. Allcock and F.W. Lampc : Contemporary Polymer Chemistry, Prentice Hall, Englewood, NJ, 1981

3. N.G. Gaylord and H.F.Mark : Linear and Stereographer Addition Polymers, Wiley (lnterscience), New York, 1959

4. F.W.Billmeyer : Jr. Textbook of Polymer Science, Wiley, New York, 1984

5. R.B. Seymour and CE. Carraher : Polymer Chemistry, An Introduction Dekker, New York, 1981

6. T Keii : Kinetics of Ziegler — Natta Polymerization; Chapman and Hall, 1972

Subject title   : **INORGANIC CHEMISTRY – II**
                                    (Coordination Chemistry)
No.of hours: 75 hrs

Subject Description :

      This paper presents basic principles of coordination chemistry. Some basic concepts of solid state chemistry, nano materials and crystallographic techniques are included in this paper.

Goals :
      To enable the students to learn some principles and theories in coordination and organometallic chemistry.

Objectives :
      On successful completion of the course the students should learn basic principles, important theories and applications of coordination chemistry.

Contents
UNIT – I

Methods of preparation of coordination compounds – crystal field theory – spectrochemical series – molecular orbital theory – pi- bonding – magnetic behavior of the transition metal ions.

UNIT – II

Term symbols for the 3d-block elements and their ions – Orgel diagram – Tanabe-Sugano diagram for Co^{3+} system – John-Tellar distortions – spin-orbit coupling – Nephelauxetic effect – charge transfer spectra.

UNIT – III

Metal carbonyls – methods of preparation – properties and structure of Iron carbonyls – carbonyl halides – Vasca's compound – Zeise salt – Structure – hemoglobin – myoglobin - cyanocobalamine – chlorophyll (structure and functions).

UNIT – IV

Substitution reactions in square planar and octahedral complexes – trans effect – redox reactions.

Homogeneous catalysis by coordination compounds – hydroformylation – carboxylation of methanol – hydrogenation of unsaturated organic compounds.

UNIT – V

Building bridges between inorganic and organic chemistry – fragments – the isolobal analogy – structural implications of the isolobal analogy – the relationship between ML_n and ML_{n-2} fragments - from inorganic to organic chemistry – from organic to inorganic reaction mechanisms – beyond the octahedron.

References
James E. Huheey, Ellen A. Keiter
and Richerd L.Keiter   : Inorganic Chemistry, IV Edn.,
                                                        1993
Cotton and Wilkinson   : Advanced inorganic Chemistry, Wiley
                                                       Eastern (P), Ltd., 1968
H.J.Emeleus and A.G.Sharp   : Modern aspects of Inorganic
                                                      Chemistry, IV Edn., 1989
R.S.Drago   : Physical methods in Inorganic
                                                      Chemistry, 1978
R.C.Mehrotra and A.Singh   : Organometallic Chemistry

Subject Title   :   PAPER XI   PHYSICAL CHEMISTRY – III

No.of hours: 75 hrs

Subject Description   :
This course presents theories of reaction rates, comparison between reactions in different phases, catalysis, and theories of double layer and polarography.

Goals :
To enable the students to understand the kinetic aspects of chemical reactions and the role of catalysts on some specific reactions and the thories of double layers.

Objectives :
On successful completion of the course the students should have:
understood the relation between different theories of reaction rate, study of reaction rate in solution, fast reaction and concept of homogeneous and heterogeneous catalysis
learnt polarography, coulometric and amperometric methods of estimations.

Contents :
PAPER — XI   PHYSICAL CHEMISTRY
(Reaction kinetics and electrochemistry)
No.of hours: 75 hrs

UNIT-I
Theories of reaction rates: Arrhenius theory. Hard - sphere collision theory of gas - phase reactions. Activated complex theory or absolute reaction rate theory(ARRT) for ideal gas reactions (in terms of partition functions). Relation between activated - complex theory and hard - sphere collision theory. Thermodynamic formulations of activated complex theory & kinetic isotopic effect.

UNIT-II
1. Reactions in solution: Comparison between gas-phase and solution reactions. The influence of the solvent on the reactions between ions. Influence of ionic strength on rates of reactions in solution - Primary salt effect. Influence of pressure on rates of reactions in solution. Significance of volume and entropy of activations.
2. Study of Fast reactions: Flow methods, pulse methods, relaxation methods, Shock-tube method & nuclear magnetic resonance method.

UNIT-III
1. Homogeneous catalysis: Specific and general acid - base catalysis. Bronsted catalysis law. Hammett acidity function. Enzyme catalysis (single substrate reaction only). Michaelis-Menton law. Influence of pH and temperature on enzyme catalysis.
2. Surface phenomenon and heterogeneous catalysis: Adsorption and free energy relation at interfaces. Gibb's adsorption isotherm. Physisorption and chemisorption. Adsorption isotherms (Freundlich & Langmuir). Kinetics of heterogeneous catalysis. Langmuir - Hinshelwood and Langmuir - Rideal - Eley mechanisms.

UNIT – IV

1. Interionic attraction theory: Debye – Huckel – Onsager equation. Falkenhagen effect. Wien effect. Activity and activity coefficient. Ionic strength. Debye – Hukel limiting law and its applications.

2. Theories of double layer. Helmholtz – Perrin - Gouy chapmann – Stern theories.

UNIT – V

1. Polarography: Current – voltage relationships. The dropping mercury electrode. Diffusion current. Half – wave potentials. Applications of polarography. Amperometric titrations.

2. Fundamental principles of coulometric methods. Constant current and controlled potential methods. Simple applications.

REFERENCES:

1. K.J. Laidler   : Chemical kinetics. Tata McGraw Hill
2. Gurdeep Raj   : Chemical kinetics. Goel Publishing House
3. Puri, Sharma & Pathania   : Principles of Physical Chemistry
4. A. A. Frost & R. G. Pearson   : Kinetics and Mechanism. Wiley Eastern, Pvt
5. S. Glasstone   : Introduction to electrochemistry.

**Subject Title   :   PAPER XII   ELECTIVE – II   POLYMER
                                                                        TECHNOLOGY**

No.of hours: 75 hrs

Subject Description   :

This course presents additives used in plastics, fabrication process, fibre technology and elastomer technology.

Goals :

To enable the students to understand the fillers and their specific use in the end products of polymers, fabrication process and methods of making plastics, fibres and elastomers.

Objectives :

On successful completion of the course the students should have:

understood plastic materials commonly used, their manufacture and compatiability of polymers and additives added to them,

learnt the techniques of converting basic polymers into finished products.

Contents
UNIT – I
　　　Plastic Technology: Production of ethenic polymers (polythene, PVC polyvinyl acetate, polyvinyl alcohol, polymethyl methacrylate. Polyacrylonitrile etc). Production of polycondensation polymers (phenol – formaldehyde, urea formaldehyde and epoxy resins).

UNIT – II
　　　Polymer additives – use of fillers in plastics – degrading agencies and mechanism of degradation – antioxidants and other stabilizers – plasticizers – effect of plasticizers on polymer properties (Tg. Fluidity, mechanical properties and dielectric properties) – compatibility of plasticizers and polymers – theory of plasticization – use of flame retardants and colourants.

UNIT – III
　　　Fabrication process – one-dimensional processes (application of coatings and adhesives) – two-dimensional processes (extrusion in general flat film, sheet and tubing) – three dimensional processes (injection moulding, foaming).

UNIT-IV　　　Fibre technology: Production of natural and synthetic fibre, cellulosis fibres, polyamide fibres, polyester and acrylic fibres.Properties of textile fibres – criteria for fibre formation orientation of molecules on drawing.
Spinning processes – melt spinning- dry spinning and wet spinning.

UNIT – V
　　　Elastomer technology: Synthetic rubbers, natural rubbers, butyl rubber, nitrile rubber and silicone rubber Vulcanization – chemistry of vulcanization (sulphur and nonsulphur vulcanization) – physical aspects of vulcanization accelerators – activators.
　　　Reinforcement –Theories of reinforcement. Types of fillers – carbon black and non – black fillers.

REFERENCES
1. F. Rodriguez　　　:　　　Principles of polymer science, TMH Edition, 1970
2. Dryden　　　:　　　Outlines of chemical technology, East West Press, 1965
3. L.K. Arnold　　　:　　　Introduction to plastics, George Allen Ltd. 1968
4. E.W. Duck　　　:　　　Plastics and rubbers, Butterworths, London, 1971
5. F.W. Billmeyer　　　:　　　Text books of polymer science, Wiely, Interscience 1971
6. K.K. Walczak　　　:　　　Formation of synthetic fibres
7. M. Morton　　　:　　　Introduction to rubber technology
8. W.C. Wake　　　:　　　The analysis of rubber and rubber-like polymers
9. C.V. Cagle　　　:　　　Hand-book of adhesive bonding, McGraw Hill
10. D.H. Kecalble　　　:　　　Physical chemistry of adhesion, Wiley-Interscience, 1971
11. R.M. Ogorikewiez:　　　Thermoplastics – Properties and design, John Wiley
12. 1.1. Rublin　　　:　　　Injection moulding theory and practice, Wiley Inter science

PRACTICAL SYLLABUS

Practical – I   Organic Chemistry – I

Analysis of two component – component mixtures. Separation and characterization of compounds.

About ten preparations involving one or two or three stages comprising of the following processes: Nitration, acylation, halogenation, diazotisation, rearrangement, hydrolysis, reduction, alkylation and oxidation and preparations illustrating the following: Benzoin condensation, Cannizzaro reaction, Perkin reaction, Reimer-Tiemann reaction, Sandmeyer reaction, Fries rearrangement, Skraup synthesis.

Note: A minimum of six organic mixtures should be analysed by each student. A minimum of ten preparations involving one or two stages should be done by each student.

Practical – II Inorganic Chemistry – I

Qualitative analysis, employing semimicro methods and spot tests of mixtures of common cations and ions of the following less familiar elements.

Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, Titanium, Zirconium, Vanadium, Beryllium, Uranium and Lithium.

About ten preparations involving different techniques selected from the following:

Lead tetra acetate, dipyridinium hexachloroplumbate, hydroxylamine hydrochloride, ortho-and para-hydroxy phenyl mercuric chloride, potassium cupric chloride, chrome alum, copper(I) chloride, trithio urea copper(I), potassium trioxalato-aluminato(III), potassium trioxalato chromate(III), potassium trioxalato ferrate(III), hexamine cobalt(III) chloride, chloro pentammine chromium(III), chloro aquo pentammine chromium(III) nitrate, tetrammine copper(II) sulphate, ammonium hexachloro stanate(IV).

Note: A minimum of six inorganic mixtures, each of two common and two rare elements should analysed by a student. A minimum of six preparations should be done by a student.

Colorimetric estimations (using Nessler technique and colorimeters) of copper, iron, nickel, manganese, chromium and zirconium.

Practical – III Physical Chemistry – I
Thermodynamics:
a. Heat of solution from solubility
b. Heat of solution by calorimetry
Molecular weight determination by
i. Freezing point depression of solvents (benzene and water) by Beckmann method.
ii. By Rast micro methods
Distribution of activity and activity co-efficients by freezing point method.
Distribution co-efficient and determination of equilibrium constant.

Properties of matter
Variation of viscosity of liquids with temperature.
Determination of refractive index (Unknown composition of a mixture of liquids).
Heterogenecus equilibria
Thermal analysis of binary systems forming compounds with congruent melting points.
Three component systems (chloroform-acetic acid-water).

Electromotive force
Determination of standard potentials (Cu, Zn, Ag)
Evaluation of thermodynamic quantities from e. m. f. data (Daniel cell).
Determination of PH and Pka values using hydrogen and quinhydrone electrodes and glass electrode (PH meter), potentiometric acid-base titrations.
Determination of formal redox potential of a redox system, redox titrations.
Determination of instability constant (of silver ammonia complex) and its dependence on temperature.
Determination of solubility product of a sparingly soluble salt (concentration cell and chemical cell).
Determination of activity co-efficients from e. m. f. data.
Precipitation titration of a mixture of halides.

Practical – IV Organic Chemistry – II

Estimation of phenol, methyl ketone, glucose, nitro, amino and methoxy groups, unsaturation.
Analysis of oils (Reichart – Meisel value, Iodine value, Saponification value and acetyl value).
Extraction and estimation of active constituents:
a. Lactose from milk   b. Caffeine from tea   c. Nicotine from tobacco extract   d. Citric acid or ascorbic acid from a tablet or from a natural source.
About five preparations from literature.

Practical – V Inorganic Chemistry – II

Industrial analysis: a. Analysis of two of the following alloys – brass, bronze, stainless steel, solder type metal. B. Analysis of any one of the following – cement, dolomite, glass.

Titrimetry: Oxidation using ceric and vanadium salts: Complexometric titrations involving estimation of calcium, magnesium, nickel, zinc and hardness of water.

Chromatography: Column, paper, thin layer and ion exchange.
Titrations in non-aqueous solvents.
Preparation, analysis and study of the properties of co-ordination complexes.

Note: Quantitative analysis (involving volumetric and gravimetric estimations) of at least five mixtures of cations should be done by a student. The volumetric procedure may also include EDTA titration for estimation of mixtures of cations.

Practical –VI Physical Chemistry – II

Conductivity experiments:
　　　　Determination of i) Equivalent conductance of a strong electrolyte and the verification of Debye-Huckel Onsagar law. ii) Verification of Ostwald dilution law and kohlrausch law for weak electrolytes.
Conductometric determination of Pka of a weak acid.
Hydrolysis constant of aniline hydrochloride.
Determination of the solubility of a sparingly soluble salt.
Conductometric titrations: Acid-base and precipitation titrations (including mixture of halides).
Colorimetric estimation using Beer-Lambert law (copper, nickel).
Dropping mercury cathodes – half-wave potentials and estimations by differential method of cadmium, copper, zinc and lead.
Chemical kinetics:
i. Evaluation of Arrhenious parameters using acid hydrolysis of an ester.
ii. Base catalysed hydrolysis of an ester conductometrically.
Rate of reaction between persulphate and iodide ions study of salt effects over the persulphate – iodide reaction.
Study of rate of polymerization of monomer solutions by viscosity.
Evaluation of i) Catalytic constant of a strong acid for the iodination of acetone or hydrolysis of an ester.
ii) Catalytic constants for weak acids and verification of Bronsted catalysis law.

Adsorption experiments: Adsorption of oxalic, acetic, formic acids on activated charcoal – Freundlish isotherm – surface are determination.

＊ ＊ ＊ ＊ ＊ ＊ ＊

DIPLOMA PAPER I-DYE CHEMISTRY OR CORROSION CHEMISTRY

Dye Chemistry
No. of Hours: 45 hrs

Unit I

Colour and Constitution:

Relationship of colour observed to wavelength of light absorbed – Terms used in colour chemistry – chromophores, Auxochromes, Bathochromic shift, Hypsochrmic shift. Quinonoid theory and modern theories: Valence bond theory, molecular orbital theory.

Unit II

Chemistry of organic intermediates used in dye manufacture. Benzene, Naphathalene and Anthroqucnone intermediates.

Nitro dyes, Nitrosodyes, Azo dyes – principles governing azo coupling – mechanism of diazotization coupling with amines, coupling with phenols. Classification according to the number of azo groups and application – Tautomerism in azo dyes.

Unit III

Synthesis of specifics dyes and uses

Orange IV, Diamond Block F, Metanil yellow, Tartrazines Direct Deep Black, Eriochrome Black T, Eriochrome Red B, Cellition Scarlet B, Congo Red, Malachite green, methylene blue, Safranine – T, Acid Magenta, Cyanin Green G, Alizarine, Benzanthrone, Indigo, Copper phthalo cyanine, Sulphur black – T .

Unit IV

Synthesis, reactions and applications of xanthene dyes, 'Cyanine dyes, acridine dyes, Sulphur dyes, Anthranquinone dyes: Anthraquinone mordant dyes, Anthroquinone acid dyes and Anthraqyinone disperse dyes.

Unit V

Pigments – Introduction - Requirements of organic pigments Types of Pigments – Applications. Fluorsecent. Brightening agents – application of dyes in other areas – Leather, paper, medicine, chemical analysis, cosmetics, colouring agents Food and Beverages

Reference books:
1.   Organic chemistry volume – I I.L. Finar
2.   The chemistry of synthetic dyes volume I, III, III+IV K.
        Venkataraman.
3.   Synthetic Dyes – Gurdeep R. Chatwal
4.   An Introduction to synthetic drugs and dyes Ra. Chawathe. Shah.
5.   An introduction to industrial chemistry B.K. Sharma.

DIPLOMA PAPER I Corrosion Chemistry and Nano Chemistry

Unit I
Introduction and principles

Definition-Cost of corrosion-importance of corrosion,studies-Electrochemical principles of corrosion-forms of corrosion-(Defintion,cause and effects)-Galvanic-crevice-pitting-intergranular-erosion and stress-expression of corrosion rate.

Unit II Monitoring of Corrosion

Determination of corrosion parameters-non-electrochemical methods: weight loss and gasometric methods-Elecrochemical methods:Polarization methods-Galvanostatic-pentiodynamic and AC impedance methods.

Unit III Corrosion Control

Cathodic and anodic protection-use of inhibitors-Classificationof inhibitors-Mechanism of inhibition adsorption isotherms(basic ideas only)

Nano Chemistry

Unit IV

Introduction-importance and characterisation of nanomaterials-stability of nanoparticles in solutuions-synthesis of metal nanomaterials:Physical methods(Laser Ablation,Evaporation,sputerring and solvated metal dispersion) chemical methods (Thermolysis,sonochemical approach,reduction of metal ions by hydrogen and methanol)-Biosynthesis.

Unit V

Synthesis of semiconductor nanomaterials-precipitation-methods-thermal decomposition of complex precursors-synthesis of ceramic nanomaterials-Physical methods(gas condensation and laser methods) Chemical method(Sol-gel synthesis)-properties Nanomaterials-size effects-optical,electrical and magnetic properties.

DIPLOMA PAPER – II Industrial Chemistry
No. of Hours: 45 hrs

Unit I

Fuels: Introduction – what is a fuel? – calorific value – classification of fuels-properties of fuels – petroleum: classification of petroleum – Origin of petroleum – petroleum resources in India – Cracking of petroleum: Thermal cracking – catalytic

cracking – knocking – chemical structure and knocking – octane rating. Improvement of anit- knocking characteristics of fuel. Non petroleum fuels. Benzol and power alcohol.

Nuclear fuels: Nuclear reactor, Breeder reactor Disposal of radio active wastes.

Unit II

Rubber: Importance of rubber – Coagulation of rubber – Draw backs of raw rubber – Rubber fabrication Vulcanisation – Properties of vulcanized rubber.

Synthetic rubber – Buna – s, Neoprene rubber, Buna – N, Thiokol, silicone rubber, Spong rubber, Foam rubber

Unit III

Glass: Introduction – physical and chemical properties of glass –Raw materials – methods of manufacture: Formation of the Batch material, melting, shaping, Annealing and finishing.

Cement: Manufacture and setting of cement.

Ceramics: Manufacturing   process – Application of clolurs to the pottery – Earthenware's and stonewares.

Unit IV

Paints and pigments;

Pigments: Introduction – Requirements of a pigment Typical inorganic pigments – Application. Paints: Classification of paints – Distempers- constituents of paints – setting of the paint – Requirements of a good paint – Emulsion paints – Latex paints – paint removers – Varnishes – Solvents and thinners.

Unit V

Fertilizers: Plant nutrients – Fertilizers type – Essential requirements – Fertility of the soil – PH. value of the soil, classification of fertilizers, straight and mixed fertilizers.

Nitrogenous fertilizers: Manufacture of Ammonium nitrate, Ammonium sulphate, Urea, nitrolim, CAN.

Phosphatic fertilizers: Normal superphosphate   and triple superphosphate Potassium fertilizers.

Explosives:

Introduction - Classification – Characteristics, Nitro Cellulose – TNB - TNT – Dynamite – Cordite,   Gun Powder – RDX – HMX - Tetryl – Pentryl – Hexyl.

Reference Books:

1.   Industrial Chemistry – B. K. Sharma

2.   Engineering Chemistry – Sharma

3.   Engineering Chemistry - P.C. Jain & Monika Jain
4.   Industrial Chemistry – B. N. Chakarbarty
5.   Engineering Chemistry – Kuria Kose **&** Chemical technology - Shukla

DIPLOMA PAPER   III -   Water Pollution and Industrial Effluents treatment
No. of Hours: 45 hrs

Unit I

Characteristics of water – Introduction – sources of water – Hardness of water - Units of hardness – problems on calculation of hardness – Disadvantages of hard water – Scale and sludge formation in boiler – Boiler Corrosion - Softening methods – problems on softening – desalination of Brackish water: Distillation, Electro dialysis and reverse osmosis.

Unit II

Water Pollution: Introduction – Definition of water pollution – water Pollutants – physical and chemical pollution of water – ground water pollution – harmful effects of ground water pollution – surface water. River water and sea water pollution, Oil pollution of water. Effects oil pollution in marine water – Radioactive materials in water.

Unit III

Complete physico chemical Examination of water: collection of samples – colour – odour Turbidity P^H – temperature – Soilds: Total Solids, Dissolved solids, suspended solids, settable solids – Acidity – Free carbon dioxide – Alkalinity – Hardness – calcium, Magnesium, Sodium - Potassium - Iron – Aluminum – Sulphate – Silica – Heavy metal such as Arsenic, Calcium, chromium – copper – lead - Manganese – Mercury - Nickle – Selenium – Tin and Zinc – Dissolved Oxygen, BOD, COD, Permanganate value – Ammonia Nitrogen – Albuminoidal nitrogen – Total Kjeldhal Nitrogen etc.

Unit IV

Industrial Effluents: Pulp and paper industries Cotton Processing – Cane sugar industry - Distillery –Dairy– Iron production. Electroplating   industry – oil field and oil refinery – Fertilizer industry - Pesticide manufacture - Rubber   wastes   –Slaughter House and Meat   packing – Soaps and Detergents manufacture -   Soft Drinks Manufactures. Viscose rayon Manufacture – Radio active Pollution.

Unit V

Treatment of Industrial Effluents :   Primary Treatment: Screening   – Sedimentation – Equalization – Neutralization – Coagulation. Secondary Treatment: Aerated Lagoons – Trickling Filtration – Activated sludge process – Oxidation Ditch – Oxidation Ponds - Anaerobic digestion.Tertiary Treatment :   Evaporation – Reverse osmosis – Dialysis – Ion Exchange – chemical precipitation Activated Carbon Treatment. Tolerance limits for Industrial Effluents.

Reference Books
1.   Industrial Effluents – N. Manivasakam
2.   Physico chemical Examination of Water, sewage and Industrial Effluents – N. Manivasakam
3.   Water Pollution P.K .Goel
4.   Engineering chemistry P.C. Jain & Monika Jain
5.   Environmental Chemistry B. K. Sharma
6.   Insecticides, Pesticides and Agro based Industries R.C. Falful, K. Goel , R.K. Gupta

M.Sc., Degree Course
CHEMISTRY
(Model Question Papers)
Semester -I
PAPER - I : **ORGANIC CHEMISTRY – I**

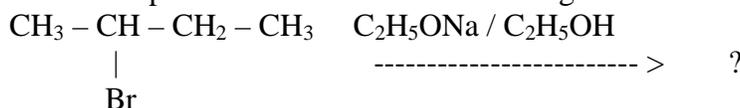**Time 3 Hours**   **Max. marks : 75**
Answer <u>ALL</u> questions in <u>Each Section</u>

SECTION A -   (10 x 1 = 10)

1. Give Hammett equation and define the terms involved in the equation.
2. What do you understand by the term aromaticity?
3. Classify the following into ortho, para and meta directing groups:
    $-NHCOCH_3$; $- OCH_3$; $-C_6H_5$; $- N(CH_3)_2$.
4. What happens when phenol is treated with conc.HNO_3 and con H_2SO_4 mixture?
5. What are bridge - headed compounds?
6. Vinyl compounds resist nucleophilic substitution. Give reason.
7. State Saytzeff rule.
8. What will be the product obtained in the following reaction?
    $CH_3 – CH – CH_2 – CH_3$ C_2H_5ONa / C_2H_5OH
             | ------------------------ >   ?
            Br
9. What are free radicals? Give example.
10. A diazonium salt and an aromatic liquid in presence of alkali is converted into
     biphenyl – name the reaction

SECTION – B   (5 x 5 = 25)
11. (a) Discuss about the aromaticity of annulens and azulenes.
                        OR
    (b) Explain the importance of stereochemical studies and crossover experiments
         in the study of reaction mechanism.

12. (a) Explain the mechanism of nitration of monosubstituted benzene.
                        OR
    (b) Discuss the mechanism of (i) Gattermann – Koch reaction and
         (ii) Hoffmann – Martius reaction.

13. (a) Explain neighbouring group participation.
                        OR
    (b) Discuss the stereochemistry of nucleophilic substitution reactions.

14. (a) What is E_1cb mechanism? Explain.
                        OR
    (b) Explain the mechanism of cope elimination.

15. (a) Write notes on the generation of short and long lived free radicals.

OR
(b) Discuss the mechanism and imporatance of Hunsdicker reaction.

SECTION – B   (5 x 8 = 40)

16. (a) Write note on kinetic isotope effect.
                                OR
    (b) Discuss the following (i) Hammond's postulate (ii) thermodynamic versus kinetic control.

17. (a) Explain Friedel – Crafts alkylation using different alkylating agents and also discuss the merits and demerits of alkylation reaction.
                                OR
    (b) Discuss the mechanism of the following (i) Reimer – Tiemen reaction (ii) Jacobson's reaction.

18. (a) Explain the effect of solvent and nucleophile on the mechanism of nucleophilic Substitution.
                                OR
    (b) (i) What are ambident nucleophiles? Explain.
       (ii) Discuss the mechanism of claisen condensation reaction.

19. (a) What are carbenes? Discuss the generation, reactions and structure of carbenes.
                                OR
    (b) Give the mechanism of the following:
       (i) Chugaev reaction (ii) Hoffmann elimination.

20. (a) Discuss the synthetic importance of (i) Sandmeyer's reaction and (ii) Pschorr Reaction.
                                OR
    (b) Write notes on the following:
        (i) Rearrangement reactions involving free radicals and (ii) Ullman reaction.

----------   --------------

Semester -I

PAPER – II INORGANIC CHEMISTRY – I

Time : 3 hours   **Maximum marks : 75**
Answer ALL questions in Each Section

Section – A (10 x 1 = 10)
   1. What are metal clusters?

2. Write the product obtained when ReO_3^- is reduced with H_3PO_2
3. What are isoelectronic compounds? Give examples
4. What are phosphams?
5. Give two examples each for paramagnetic and diamagnetic transition metal ions
6. What is a semi conductor?
7. Give an example for nuclear reaction involving β – decay
8. What are isobars?
9. Define nuclear spallation
10. Define binding energy

Section – B (5 x 5 = 25)

11.(a) Discuss catenation and heterocatenation

OR

(b) Write a note on hexa nuclear clusters

12.(a) Discuss the structure of S_4N_4

OR

(b) What are Schotty and Frenkal defects

13.(a) Explain Meissner effect

OR

(b) With examples explain para, dia and ferromagnetic substances

14.(a) Explain nuclear isomerism

OR

(b) Discuss orbital electro capture

15.(a) Give any four applications of radio isotopes

OR

(b) What is hot atom chemistry? Explain with example

Section – C (5 x 8 = 40)

16.(a) Explain the structure of $(ReCl_3)_3$ and $Re_2Cl_8^{2-}$

OR

(b) Discuss the structure of one dimensional conductors

17.(a) Describe the structure of borazene

OR

(b) Explain free electron and band theories

18.(a) Explain the determination of magnetic moment by Gouy's method

OR

(b) Write notes on (i) critical temperature
(ii) superconducting elements
(iii) persistent current

19.(a) Explain liquid model with semi empirical formula

OR

(b) Explain the stability of nuclei on the basis of N/P ratio and Magic numbers

20.(a) Calculate the packing fraction, mass defect and energy released in the formation of $_{18}Ar^{40}$. Mass of the isotope of argon is 39.962384 a.m.u.

<div align="center">OR</div>

   (b) (i). Show that 1 a.m.u. = 931.5 MeV.

   (ii)Discuss the atomic power projects in India with their special features.

<div align="center">

Semester -I
Paper III-SPECTROSCOPY, GROUP THEORY AND COMPUTER IN CHEMISTRY

</div>

Time: Three hours   **Maximum:75 Marks**

Answer all questions in each section

SECTION A-(10X1=10 Marks)

1. Write the zero point energy of a harmonic oscillator.
2. How many normal modes of vibrations are possible in CH3Cl?
3. Mention the number of classes in C3V point group.
4. Write the symmetry elements of a C2 point group.
5. Write the point group to which trans-dichloro ethylene belong.
6. What is the principal axis present in methane?
7. How many signals are observed in the Mossbauer spectrum of sodium nitro prusside?
8. What is the standard used in ESR spectroscopy?
9. Which part of the computer causes the error 'Bug'?
10. What does HTML stand for?

SECTION B-(5X5=25 Marks)

11.a.How will you distinguish the following by IR spectra?

   i.CH3COCH2CH3 and CH3COC6H5

   ii.CH3CH2OH andCH3OCH3

<div align="center">Or</div>

   b.The fundamental vibrational frequency of HCl is 2890 cm-1.Calculate the force constant of   this molecule.The atomic masses are 1H=1.673x10-27Kg and 35Cl=58.06x10-27Kg.

12.Define the following.

   a   i.Axis of proper rotation

      ii.Axis of improper rotation

<div align="center">Or</div>

 b.Differentiate space group from point group.

13. a.State Great orthogonality theorem.What are its consequences?

Or

   b.Explain similarity transformation.

14. a.Define isomer shift.Mention the factors which affect it.
Or
   b.Discuss about 'g' in ESR spectroscopy.

15. a.Define and distinguish between LAN and WAN.
Or
   b.Explain the input and output devices in computer.

SECTION C-(5x8=40 Marks)

16.a.Discuss the factors which affect vibrational frequencies.
Or
   b.Write a note on the following
     i.Fermi resonance
     ii.Finger print region

17.a.. Discuss the procedure to classify the molecules into various point groups.
Or
   b.Discuss the basic properties of a group.

18.a.Obtain the group theoretical selection rules for IR and Raman spectroscopy.
                           Or

   b.Determine the symmetries of vibrational modes in H_2O molecule and explain which are Raman active and IR active.

19. a.Discuss the applications of Mossbauer spectroscopy.
                           Or
   b.Explain Zero field splitting and Kramers degeneracy with a suitable example.

20.a.Write algorithm and flow chart for the program to reverse the number 1234 to 4321.
                           Or
  b. (.i).Sketch the basic structure of a PC and explain its functioning.
    (ii).Write notes on computer virus.

Diploma in Industrial Chemistry
(Model Question Paper)
Semester –I

Paper I – Dye Chemistry
Time : Three hours   **Maximum : 75 marks**

Answer All the questions
              Section A   **(10 X 1 = 10 Marks)**
   1. What is the colour of the substance which absorb in the red region of the visible light?

2. What is the chromophore present in picric accd?
3. Name the class of dyes obtained by the coupling reaction.
4. What type of dye is Naphtholgreen B?
5. Which dye is used as an indicator for complexometric titrations using EDTA?
6. What is the catalyst used in the synthesis of copper phthalocyanine.
7. What is uranine?
8. Which mordant gives red colour with alizarin?
9. What is the general name of the chelate compound formed between the metal and dye?
10. In which region fluorescent brightening agent absorbs light?

<div align="center">Section B   (5 X 5 = 25 Marks)</div>

11. (a) Explain chromophores and auxochromes by suggesting two examples for each (Or)

   (b) Explain bathochromic and Hypsochromic shifts with suitable examples.

12. (a) How is diazoti'sation of anline explained ? (Or)

   (b) Write an account of tautomerism in azo dyes.

13. (a) How is congored synthesized? (Or)

   (b) How is Indigo prepared from aniline ?

14. (a) write a brief note on cyanine dyes. (Or)

   (b) Write an account of acridine dyes.

15. (a) What are organic pigments? What are the essential requirements of the pigments? (2+3)

(Or)

   (b) Give an account of the application of dyes in Paper and Leather.

16. (a) How is the colour of a dye explained on the basics of quinonoid theory (Or)

   (b) Discuss the molecular orbital concept to account for the colour of substances.

17. (i) Give an account of dye intermediates from benzene.

   (ii). Describe the coupling reactions of diazotized amines with amines (Or) (4+4)

   (b) How are the following dyes synthesized '
      (i). Picric acid
      (ii). Fast green O
      (iii). Methyl orange.   (2+3+3)

18. (a) How are the following triphenyl methane dyes prepared?
      (i). Malachite green   ii). Acid magenta

(Or)

18. (b) Write the synthesis of the following dyes
      (i). Orange IV
      (ii). Methylene blue
      (iii). Safranine – T   (2+3+3)

19. (a). Write a brief note on sulphur dyes.

<div align="center">(Or)</div>

   (b). Write a brief note on anthraquinone mordant dye.

20. (a). Give an account of the application of dyes in medicine chemical analysis, cosmetics and colouring agents   (2 X 4)

(Or)

(b). Write notes on
   (i). Phthalocyanines
   (ii). Fluorescent brightening agents.

Diploma in Industrial Chemistry
(Model Question Paper)
Semester –I

PAPER - I : CORROSION AND NANOTECHNOLOGY

Time 3 Hours   **Max. marks : 75**

Answer ALL questions in Each Section

SECTION A -   (10 x 1 = 10)

1. Define corrosion.
2. Give the expression for corrosion rate in mmpy.
3. Mention any two electrochemical methods for monitoring corrosion.
4. Give the expression for ΔG_{ads} and E_a.
5. What is an anodic inhibitor?
6. What is an adsorption isotherm.
7. Define nanotechnology.
8. Name any two physical methods used in the preparation of metal nanomaterials.
9. Define semiconductor.
10. Name any two precursors which on heating give nanomaterials.

SECTION B -   (5 x 5 = 25)

11. (a) Give briefly the various forms of corrosion.
                         OR
    (b) Explain the mixed potential concept of corrosion.

12. (a) Give briefly the weight loss method for determining corrosion rate.
                         OR
    (b) What is the basic principle of polarization studies.

13. (a) What do you mean by physisorbtion and chemisorbtion?
                         OR
    (b) List down the various adsorbtion isotherms with their expressions.

14. (a) Write a note on the importance of nanotechnology.
                              OR
    (b) Describe the synthesis of metal nanomaterials by evaporation technique.

15. (a) Describe the precipitation method of preparation of semiconductor
        nanomaterials.
                              OR
    (b) Write a note on the sol-gel synthesis of ceramic nanomaterials.

SECTION C – (5 x 8 = 40)

16. (a) Discuss the electrochemical principles of corrosion.
                              OR
    (b) Derive the Tafel equation for corrosion kinetics.

17. (a) Discuss the gasometric method of monitoring corrosion.
                              OR
    (b) Describe the electrochemical impedance spectroscopic method of determining
        Corrosion kinetic parameters.

18, (a) Give in detail the various kinds of inhibitors.
                              OR
    (b) Discuss the mechanism of corrosion inhibition.

19. (a) (i) Write a note on the characterization of nanomaterials.
        (ii) Describe the Laser ablation method of synthesis of metal nanoparticles.
                              OR
    (b) Discuss the thermolysis and reduction methods of preparation of
        Nanomaterials.

20. (a) (i) Describe the method of thermal decomposition of complex precursors.
        (ii) Write a note on the synthesis of ceramic nanomaterials.
                              OR
    (b) Discuss optical, electrical and magnetic properties of nanomaterials.

Semester –II

PAPER - IV : **ORGANIC CHEMISTRY – II**

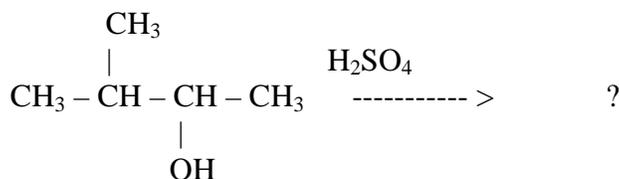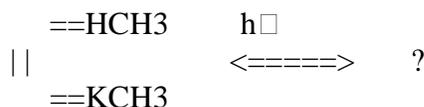**Time 3 Hours**   **Max. marks : 75**
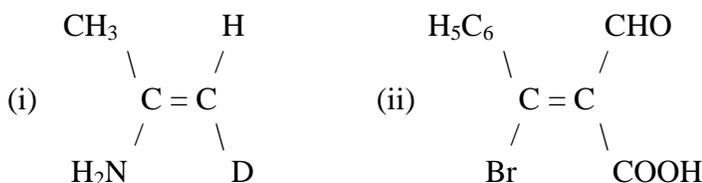
Answer ALL questions in Each Section

SECTION A -   (10 x 1 = 10)

1. Identify the product and name the rearrangement

```
            CH₃
             |                    H₂SO₄
   CH₃ – CH – CH – CH₃    ----------- >        ?
                 |
                OH
```

2. Name the rearrangement involving the formation of cycloalkane giving an example.
3. Predict the product and its geometry in the following reaction.

```
              ==HCH3        h□
        ||                 <=====>     ?
              ==KCH3
```

4. What is cope rearrangement?
5. List out the radiative and nonradiative processes.
6. What is Clemmensen reduction?
7. What is Prevost reaction?
8. What happens when furfral is treated with ethanolic KCN?
9. Assign E – Z nomenclature to the following:

```
        CH₃        H              H₅C₆        CHO
          \      /                  \       /
  (i)       C = C          (ii)       C = C
          /      \                  /       \
        H₂N        D              Br        COOH
```

10. Identify the most stable conformation of 1, 3 – dimethylcyclohexane.

SECTION B -   (5 x 5 = 25)

11. (a) Discuss the mechanism of Neber rearrangement.
                          OR
    (b) Explain Stevens rearrangement.

12. (a) Explain (□□s□□,addition using Frontier – orbital theory.
                          OR
    (b) Write notes on Di - □methane rearrangement.

13. (a) Discuss Paterno – Buchi reaction.
                          OR
    (b) Explain the mechanism of Sommelet reaction.

14. (a) What is Mannich reaction? Discuss its synthetic importance.
                          OR
    (b) Explain hydroboration reaction with suitable example.

15. (a) Discuss the stereochemistry of nitrogen compounds.
                          OR

(b) Write briefly on the conformation of perhydrophenanthrene.

SECTION B -   (5 x 8 = 40)

16. (a) Explain the mechanism of the following: (i) Bayer – Villiger
        Rearrangement (ii) Favorski rearrangement.

OR

    (b) Discuss in detail the salient aspects of wolf rearrangement.

17. (a) Draw the correlation diagram for the electrocyclic reaction involving
        correlating ring closure of 1,3,5 – hexatriene and predict whether the
        process is thermal or photochemical.

OR

    (b) Write notes on the following:
        (i) sigmatropic reactions (ii) Woodward – Hofmann rules.

18. (a) Explain the following: (i) Jablonski diagram (ii) Norrish type II reaction.

OR

    (b) Discuss the mechanism of (i) Birch reduction and (ii) ozonolysis reaction.

19. (a) Explain the mechanism of the following reactions: (i) Michael addition
        (ii) Stobbe reaction.

OR

    (b) Explain the importance of the following reagents in organic reactions:
        (i) OsO_4 (ii) Phosphorane.

20. (a) Explain the conformation of 1, 2 and 1, 3 – disubstituted cyclohexanes.

OR

    (b) Write notes on the stereochemistry of decalin and perhydrophenanthrene.

------------------   -------------------------------

Semester -II

Paper V-PHYSICAL CHEMISTRY-I
QUANTUM CHEMISTRY AND SPECTROSCOPY
Time:Three hours   Maximum:75 Marks
Answer all questions in each Section

SECTION A-(10x1=10 marks)
1.Write the commutator of Px X.
2.What is the value of [L2,Lz]?
3.Write the value of first degree Hermite polynomial.
4.What is the energy of an electron present in the third level of a one-dimensional box of length a?

5.Are the orientations of the three 2p orbitals similar?

6.Mention the component of the rectangular volume element.

7.Give an example for a nucleus whose I value is zero.

8.Name the internal used in proton NMR.

9.What is the relative intensities of the peaks in a quartet?

10.How many number of NMR signals are expected for Diethyl ether?

SECTION B-(5x5=25 marks)

11.a.Explain Hermitian operator.

Or

   b.Discuss about eigen functions and eigen values.

12.a.Illustrate Bohr's correspondence principle with reference to particle in one dimensional box

Or

   b.Explain the degeneracy in particle in three dimensional box.

13.a.Explain radial probability distribution curves.

Or

   b.State and prove variation theorem.

14.a.Discuss the principle of NMR spectroscopy.

Or

   b.Write a brief note on chemical shift equivalent.

15.a.What is double resonance?Explain.

Or

   b.Write a note on spin-spin coupling.

SECTION C-(5x8=40 marks)

16.a.Derive time independent schrodinger wave equation.

Or

   b.Illustrate the postulates of quantum mechanics.

17.a.Solve the SWE for rigid rotar.

Or

   b.Solve the SWE for a simple harmonic oscillator.

18.a.Explain the application of perturbation method for He-atom.

Or
  b.Discuss the shapes of various orbitals.

19.a.Give a detailed account on the factors affecting chemical shift.
Or
  b.Discuss first order and non first order NMR spectra.

20.a.Briefly discuss about 13C NMR spectroscopy.
Or
  b.Discuss the salient features of FT NMR technique.

Second Semester
(Model question paper)
PAPER VI – PHYSICAL METHODS IN CHEMISTRY
Time: THREE HOURS   **Maximum: 75 Marks**

Answer ALL questions in each section

SECTION – A   (10 x 1 = 10)
  1. In mass spectrometer which is used as a bombarding agent?
  2. State nitrogen rule.
  3. Give the names of two rearrangements found in the analysis of mass spectra
     of organic compounds.
  4. Which molecule is predominantly lost in the mass spectral analysis of alcohol.
  5. What is meant by nephelometry?
  6. What is the difference between DTA and DSC?
  7. Give the relationship between the wavelength of X-ray beam and the angle of
     diffraction.
  8. Which detector is used in GLC?
  9. What are thermal neutrons?
  10. What is the coordination number of Zn^{2+} in wurtzite structure?

SECTION – B   (5 x 5 = 25)

  11. (a) Differentiate single focusing and double focusing electron impact mass
         Spectrometer.
                          OR
      (b) Explain: (i) molecular ion peak (ii) metastable peak and (iii) Double bond or
         Ring equivalent.

12. (a) Discuss the general fragmentation of aliphatic alcohols.

OR

(b) Mass spectrum of phenol gives peaks at m/z = 66, m/z = 65 and m/z = 94. Explain the fragmentation pattern of phenol.

13. (a) State and explain ostant rule.

OR

(b) What is the main difference between TGA, DTA and DSC?

14. (a) Name the recording devices used in ESCA. Explain the function of any one of them.

OR

(b) What is HPLC? In what way this is superior to column chromatography?

15. (a) Write a note on electron diffraction.

OR

(b) Discuss the crystal structure of rutile.

SECTION C   (5 x 8 = 40)

16. (a) Discuss the principle and instrumentation of mass spectrometry.

OR

(b) Write a note on ion cyclotron resonance analyzer and fourier transform mass spectrometer.

17. (a) Discuss the rearrangements observed in the mass spectral analysis of organic compounds.

OR

(b) Explain the fragmentation pattern of the following:
(i) aldehydes (ii) ketones (iii) esters and (iv) amides.

18. (a) Discuss the applications of ORD and CD.

OR

(b) Explain the principle and applications of turbidimetry and nephelometry.

19. (a) Distinguish photoelectron spectroscopy from Auger electron spectroscopy.

OR

(b) Discuss the theory and instrumentation of GLC.

20. (a) Choosing sodium chloride as on example explain how x – ray diffraction useful for structural elucidation.

OR

(b) How the properties of diamond and graphite based on their structures.

Diploma in Industrial Chemistry
(Model Question Paper)
Semester –II

Paper II– Industrial Chemistry
Time : Three hours   Maximum : 75 marks

Answer All the questions in Each Section
                              Section A   (10 X 1 = 10 Marks)

1. What is ignition temperature?
2. Give the use of Tetra ethyl lead?
3. What is vulcanization?
4. What is the name of the polymer obtained by the co- polymerization of butadiene with styrene.
5. What is annealing?
6. Which is the principal constituent of cement?
7. What is the colour of the pigment lithopone.
8. What is Distemper?
9. Which acid is used in the manufacture of triple super phosphate?
10. What is chemical name of RDX.

Section B   (5 X 5 = 25 Marks)

11.   (a). What are fuels? How are they classified? Define calorific value

(2+1+2)

(Or)

(b) Give an account of Non-petroleum fuels

12.   (a). Give two uses of Neoprene rubber, Thiokol rubber, silicone rubber, spong rubber and foam rubber

(Or)   (1 X 5)

(b). What are the drawbacks of raw rubber.

13. (a). What are the reactions taking place during the setting of cement.

(Or)

(b). Give an account of Earthenwares and stonewares.

14. (a). Give the requirements of a pigment?

(Or)

(b). What are the constituents of paints?

15. (a). What are the characteristics of good fertilizers?

(Or)

(b). Give the preparation of TNB, DNB and HMX.

Section C   (5 X 8 = 40 Marks)

16. (a) Explain the following   (4 X 2)

(i). Thermal cracking
(ii). Catalytic cracking
(iii). Knocking
(iv). Octane rating.

(Or)

(b). Give a brief account on Breeder reactor and   disposal   of radioactive wastes.   (4+4)

17. (a) (i) Explain rubber fabrication

(ii). Give the properties of vulcanized rubber

(Or)

(b). Give a brief account on synthetic rubber.

18. (a). (i). What are the characteristics of Glass.

(ii). Give an account of raw materials used in the manufacture of glass   (3+5)

(Or)

(b). Give a brief account on the application of colours   to pottery.

19. (a) What are paints? How are they classified? What are the
       qualities of a good paint   (2+3+3)
                              (Or)
    (b). Give a brief account on varnishes paint removers,   solvents   and
thinners.   (2+2+2+2)
    20. (a) How are the following manufactured
        (i) $NH_4 NO_3$ (ii). CAN   (iii). $NH_4)_2$ SO_4 (iv). Nitrolim
                          (Or)
        (b). Give a brief account on classification of fertilizers,   straight   and
    mixed fertilizers.

Semester -III

PAPER VII: ORGANIC CHEMISTRY – III
(Natural Products Chemistry)

Answer ALL questions in each Section
Time: 3 Hours   Max. marks: 75
                    SECTION A -   (10 x 1 = 10)

1. Mention the source of zingiberene.
2. Give the structure of eudesmol.
3. Define steroids.
4. Which is the precursor of vitamin D?
5. How is nicotine isolated from tobacco leaves?
6. Give the structural formula of quinine.
7. Define enzyme.
8. Which is used as the source of isoflavones?
9. What are the reagents used in Oppanauer oxidation?
10. Give the chemical name of DBU.

                    SECTION B -   (5 x 5 = 25)

11. (a) Estabilish the structure of zingiberene.
                        OR
    (b) Give a brief account of Juvenile hormones.

12. (a) Establish the structure of side chain of ergosterol.
                        OR
    (b) Give the synthesis of equilenin.

13. (a) Establish the constitution of tropic acid.

OR

   (b) How would you show that nicotine contains a pyrrolidine nucleus?

14. (a) Give any three methods of synthesis of polypeptides.

OR

   (b) How will you convert 2,6,8 – trichloropurine to adenine and guanine?

15. (a) Discuss Barbier – Wieland degradation.

OR

   (b) Write a short note on crown ethers.

SECTION C -   (5 x 8 = 40)

16. (a) Elucidate the structure of eudesmol.

OR

   (b) Give the total synthesis of caryophyllene.

17. (a) (i) Discuss the position of the two angular methyl groups in cholesterol.
       (ii) Establish the nature and position of side chain in cholesterol.   (4+4)

OR

    (b) Elucidate the structure of testosterone and adduce it by giving its synthesis.

18. (a) Give the synthesis of morphine.

OR

   (b) (i) Show that quinine contains quinoline nucleus.
       (ii) Establish the structure of quininic acid. Give its synthesis.   (4+4)

19. (a) Discuss the primary and secondary structures of DNA.

OR

   (b) Discuss the structure of cyanin and give its synthesis.

20. (a) Give the mechanism and uses of the following reactions:
       (i) Barton reaction &
       (ii) Vilsmeier reaction.   (4+4)

OR

   (b) Give the preparation and synthetic applications of DDQ and DCC.

--------------   ---------------

Semester -III
Paper VIII-PHYSICAL CHEMISTRY-II
(Thermodynamics)

Time:Three hours   **Maximum:75 Marks**
Answer all the questions in Each Section

SECTION A-(10x1=10 marks)

1.Explain the term fugacity.
2.Mention the standard states for real gases.
3.State the third law of thermodynamics.
4.Write the statistical interpretation of third law of thermodynamics.
5.Give the Boltzmann equation relating entropy and probability.
6.Relate beta and temperature.
7.Among the four partition functions which one will have highest value?
8.Give the symmetry number of benzene in rotational partition function.
9.Regading vibration write Debye's assumption in calculating heat capacity of a solid.
10.Why is it that electrons can never follow Maxwell Boltzmann statistics?

SECTION B-(5x5=25 marks)

11.a.How is rational activity coefficient different from practical activity co efficient?

Or

b.Define standard states for gases,liquids and solids.

12.a.What are the features of guassian distribution?Represent a guassian distribution graphically.

Or

b.Discuss the need for the third law.

13.a.Evaluate 15! Using Stirling's approximation.

Or

b.Based on Boltzmann distribution calculate the ratio of the number of molecules in the higher level to those in the lower at TK if the energy difference is kT.Assume the degeneracy factor in these levels is unity.

14.a.Calculate the rotational entropy of CO at 0 degree C.The moment of inertia is 14.5x10   g.cm.

Or

b.What is electronic partition function? What is its influence on thermodyanamic properties?

15.a. Calculate the heat capacity at 5 K for a solid. The characteristic

temperature is 500K.

Or

　b.Explain the term Fermi level.What is its physical significance ?

SECTION C –(5x8=40 marks)

16.a.How will you determine activity of solvent from freezing point
　　measurements.

Or

　b.Define activity and activity coefficient .Explain the need for the concept of
　　activity.

17.a.Account for the apparent exceptions to third law of thermodynamics from
　　statistical point of view.

Or

　b.Explain how the entropy of a substance at a given temperature may be
　　calculated,using an example.

18.a.The Boltzmann exponential law is given by Ni $e^{-\square E}$ where Ni is the number
　　of particles in a level of energy Ei.Evaluate beta.

Or

　b.Derive the expression for the distribution function for a particle obeying
　　Maxwell-Boltzmann statistics.

19.a.Derive an equation to show the relationship between partition function and
　　i.internal energy ii.entopy.

Or

　b.Derive the expression for the rotational partition function of a diatomic
　　molecule.

20.a.Derive an equation for the distribution of particles according to Fermi Dirac
　　statistics.

Or

　b.Discuss Debye 's theory of heat capacity of solids.

Semester -III
PAPER - IX　　　ELECTIVE - I
(Kinetics of polymerization)

Time 3 Hours　　　　　　　　　　　　　　　　　　　**Max. marks : 75**
Answer ALL questions in Each Section

SECTION A – (10 x 1 = 10)
1. Define step polymerization.
2. Which is thermodynamically favoured, cyclisation or linear polymerization?
　　Why?

3. Suggest any two initiators that are widely used in radical polymerization reaction.
4. Explain the term autoacceleration with an example.
5. How do you differentiate radical polymerization from ionic polymerization?
6. What is meant by backbiting?
7. Define copolymers.
8. Give the copolymer equation.
9. Define coordination polymerization
10. How polymers are classified on the basis of stereoregularity?

SECTION B – (5 x 5 = 25)

11. (a) Explain the kinetics of acid catalysed stepwise polymerization with an
       Example.
                              OR
    (b) Derive an expression for weight distribution function for a linear stepwise
        Polymerization.

12. (a) Explain thermal decomposition of initiators with an example.
                              OR
    (b) Derive the rate expression for free radical chain polymerization.

13. (a) Distinguish between radical and ionic polymerizations.
                              OR
     (b) Derive an expression for degree of polymerization for anionic polymerization
         system involving termination.

14. (a) What is ring opening polymerization? Explain with an example.
                              OR
    (b) What are block and graft polymers?
15. (a) Discuss the variation in the properties of stereoregular polymers.
                              OR
    (b) Write a note on the synthesis of polyisoprene.

16. (a) Distinguish between step and chain polymerization and derive an expression
                              OR
     (b) Discuss the thermodynamic and kinetic factors of cyclization

17. (a) Write the mechanism and kinetic equation for initiated radical chain
        Polymerization reaction.
                              OR
18. (a) Discuss the following:
        (i)   Various types of initiators used in cationic polymerization.
        (ii)   Different reactions lead to termination of chain growth in cationic
                Polymerization.
                              OR
     (b) Give an account on:

(i) Effect of monomers, initiators and solvents in anionic polymerization
(ii) Presence of cocatalyst in cationic polymerization.

19. (a) What is ring opening polymerization. Explain anionic mechanism of ring
    Opening polymerization with an example.

                              OR

    (b) Discuss the Q-e scheme and rate of copolymerization.

20. (a) Explain the monometallic and bimetallic mechanism of coordination
    Polymerization.

                              OR

    (b) Discuss the stereochemistry of polymers formed in coordination
    Polymerization.

DIPLOMA IN INDUSTRIAL CHEMISTRY
(Model Question Paper)
Semester -III

PAPER III-WATER POLLUTION AND EFFLUENT TREATMENT
Time:Three hours   **Maximum:75 Marks**
Answer all the questions

SECTION A-(10x1=10 marks)

1.By which unit hardness of water is expressed?
2.What are the main constituents of scale?
3.Define water pollution.
4.Give an example for water pollutant.
5.Mention the source for the acidity in water.
6.What is the PH of water?
7.To what pollutant detergents are known for?
8.What is DDT?
9.Name the adsorbant used in the tertiary treatment of effluents.
10.At what temperature better results are observed for trickling filteration?

SECTION B-(5x5=25 marks)

11.a.Discuss the sources of water.
Or
   b.Write a note on salinity of water.

12.a.Give a short note on sea water pollution.
Or
   b.Briefly discuss radio active wastes in water.

13.a.Explain BOD and COD.

Or

   b.Give a short note on the physical properties of water.

14.a.Discuss the hazardous components present in Fertiliser industry effluent.

Or

   b.What are the harmful materials present in the rubber industry?

15.a.Explain screening.

Or

   b.Explain aerated Lagoon treatment.

SECTION C-(5x8=40 marks)

16.a.Discuss in detail about the desalination processes.

Or

   b.Write an essay on hardness of water.

17.a.Illustrate how ground water get polluted and discuss its consequences.

Or

   b.Along with the adverse effects discuss oil pollution.

18.a.Give a detailed account on the heavy metals present in water.

Or

   b.Explain the experimental determination of BOD and COD.

19.a.Point out the health hazards caused by pulp and paper industry effluents.

Or

   b.Elaborately discuss the harmful effects of pesticide industry effluents.

20.a.Discuss briefly the tertiary treatment.

Or

   b.Discuss the activated sludge and sedimentation process.

Semester -IV

PAPER - X   INORGANIC CHEMISTRY – II

Time : 3 hours   **Maximum marks : 75**

Section – A (10 x 1 = 10)

Answer all the questions

   1. Calculate the magnetic moment of Cu(II) ion

   2. Define charge transfer transition

3. What kind of transition is responsible for the colour of CrO_4^{2-} ion?
4. What is a term symbol?
5. Give the structure of $Ni(CO)_4$?
6. What are the metal ions present in Hemoglobin and chlorophyll?
7. Give the catalyst involved in the hydrogenation of alkenes
8. What are the theories proposed to explain trans effect?
9. What are fragments?
10. Define organometallic compounds

Section – B (5 x 5 = 25)
11.(a) The heat of hydration of chromium(II) ion is 460 Kcal/mole. For $[Cr(H_2O)_6]^{3+}$
$\Delta_o = 13,900$ cm^{-1}. Calculate what heat of hydration would be if there is no crystal field stabilization energy
OR
(b) What are the factors that influence the 10Dq
12.(a) Explain the effect of spin–orbit coupling on the electronic spectra of metal complexes
OR
(b) Find the term symbol for the ground and excited state of Ni^{2+}
13.(a) Give the preparative methods for $Fe(CO)_5$ and $Cr(CO)_6$
OR
(b) Discuss the structure of chlorophyll
14.(a) Explain hydroformylation
OR
(b) Write a note on substitution reaction in square planar complexes
15.(a) Write a brief account on isolobal analogy
OR
(b) Discuss the relationship between MLn and MLn-2

Section – C (5 x 8 = 40)
16.(a) Explain pi-bonding in metal carbonyls and the effect of pi-bonding on the C-O stretching frequency
OR
(b) How the d- orbital energy levels change in d^9 ion when the octahedron distorts

17.(a) Describe the Tanabe – Sugano diagram for Co^{3+} system
OR
(b) Explain the principle and types of charge transfer spectra with examples

18.(a) Explain the structure and function of cyanocobalamine
OR
(b) Explain the functions of hemoglobin and myoglobin

19.(a) With example discuss inner and outer sphere mechanism
OR
(b) Discuss the mechanism of hydrogenation of unsaturated compounds

20.(a) Discuss the structural implications of the isolobal analogy

OR

  (b) "Unity is diversity" Justify the statement based on organometallics

Semester -IV

Paper XI – Physical Chemistry -III
Time : Three hours   **Maximum : 75 marks**
Answer all Questions in each Section

Section – A   (10 x 1 = 10 marks)

1. What is the value of E_a if $T \to \alpha$?
2. Who developed the transition state theory?
3. What happens to the rate when the hydrostatic pressure is increased on the reaction having large negative $v^{\neq}$?
4. What is meant by relaxation time?
5. Give the name of the plot of 1/rate Vs 1/[s] in an enzyme catalyzed reaction.
6. The absorption of a gas on a surface is described by Langmuir isotherm, if the fractional coverage of the surface area at 1 atm. Pressure is ½. Calculate the pressure at which the surface area covered is ¾.
7. Calculate the ionic strength of a 0.01m La (NO_3) $_3$.
8. Explain the term ionic atmosphere.
9. What is polarogram?
10. Give the basic equation in coulometry?

Section – B   (5 x 5 = 25 marks)

11. (a) The rate of a reaction is doubled when the temperature of   the   reaction   is increased from 27^0C to 37^0C. Calculate the   activation energy of the reaction.

(Or)

  b) Explain kinetic isotope effect.

12. a) Explain cage effect and electrostriction.

(Or)

  b) How is NMR used to follow fast reactions?

13. (a) Explain specific and general acid catalysis.

(Or)

  (b) Distinguish between Physisorption and chemisorption.

14. (a) Calculate the mean ionic activity $a_{\pm}$ and the activity a_2 in 0.1   molal solution of $CUSO_4$ if the mean molal activity Coefficient $\gamma_{\pm}$ is 0.74.

<div align="center">(or)</div>

(b). Explain Debye Falkenhagon effect and wien effect.

15. (a). Define the following

(i). Half wave potential

(ii). Diffusion Current.

<div align="center">(or)</div>

(b). Explain constant current coulometer

<div align="center">Section – C   (5 x 8 = 40 marks)</div>

16. (a). Compare collision theory with activated complex theory (or)

(b). Explain the thermodynamic formulation of activated complex theory.

17. (a). Derive the rate equation in solution for reaction between   ions and explain how the rate of the ionic reactions are   influenced by dielectric constant of the solvent.

<div align="center">(or)</div>

(b). For the dissociation of water $H_2O \underset{k_{-2}}{\overset{k_1}{\rightleftharpoons}} H^+ + OH^-$, the

relaxation time obtained from the temperature jump method is 40 μ S , at 25°C. If K_w at this temperature is 1.0×10^{-14} $(mol\ dm^{-3})^2$. Calculate the rate constants for the forward and the reverse reactions.

18. (a). Derive the Michaelis – Menton equation

<div align="center">(Or)</div>

(b). Derve the Gibb's adsorption isotherm.

19. (a). Derive the Debye – Huckel limiting law. Mention its importance.

(b). Give an account of any two theories of electrical double   layer.

20. (a). (i) Expalin briefly the current – voltage relationships.

(ii). What are the applications of coulometry.

(Or)

(b). What is the principle of amperometric titration? Discuss   the different types of amperometric titrations.

Semester -IV

PAPER - XII: ELECTIVE – II
(Polymer Technology)

Time 3 Hours   **Max. marks : 75**

Answer ALL questions in Each Section

SECTION A – (10 x 1 = 10)

1.   Give the name of a water soluble polymer.
2.   Give two different physical properties of phenol – formaldehyde and urea – formaldehyde resins.
3.   Mention the purposes of adding fillers to plastics.
4.   Define T_g.
5.   What is meant by calendaring?
6.   Give the names of any two foaming agents.
7.   Define fiber.
8.   How will you identify a natural silk from an artificial silk?
9.   Which material is having high elasticity? Why it is so?
10. Give the names of any two nonsulphur vulcanizing agents

SECTION B – (5x5 = 25)

11. (a) Compare the properties of polyethene and PVC.
                          OR
     (b) Give the preparation and properties of polyacrylonitrile.

12. (a) Discuss the mechanisms of degradation and the factors which affect the degradation.
                          OR
     (b) Mention any two antioxidants and the mechanisms of their actions as Antioxidants.

13. (a) What are the essential requirements of an adhesive? Suggest suitable adhesives for wood, metal and plastics.
                          OR
     (b) Describe the calendaring process.

14. (a) Give the production of a natural fiber.

OR
(b) Mention the properties of textile fibers.

15. (a) Give the preparation of butyl rubber.
OR
(b) Describe the chemistry involved in the process of vulcanization.

SECTIUN C - (5 x 8 = 40)

16. (a) Discuss the methods of production of addition polymers using any two
    Examples. Explain the steps involved in the reactions in the production
    of these polymers.
OR
(b) Describe the production of phenol – formaldehyde, urea – formaldehyde
    and epoxy resins

17. (a) Explain the effect of plasticizers on the following properties of the polymers:
    (i)   Glass transition temperature
    (ii)   Dielectric properties
    (iii) Fludity.
OR
(b) Discuss the various theories of plasticization.

18. (a) Describe any four methods adopted in the fabrication of polymers.
OR
(b) Discuss the various techniques involved in the application of coatings and
    Adhesives.

19. (a) Describe the production of one natural fiber, cellulosis fiber, polyester fiber
    and polyacrylic fiber.
OR
(b) Discuss melt spinning and wet spinning in fiber technology.

20. (a) Discuss the method of preparation of the following synthetic rubbers:
    (i)   Silicone rubber
    (ii)   Buna – s
    (iii) Nitrile rubber.
OR
(b) What is meant by reinforcement? Discuss the types and theories of
    Reinforcement.