BHARATHIAR UNIVERSITY : COIMBATORE - 641 046
M.Sc. Chemistry Degree Course(for affiliated Colleges) with compulsory Diploma 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 1\textsuperscript{st} or 2\textsuperscript{nd} 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

<table>
<thead>
<tr>
<th>Semester</th>
<th>Subjects</th>
<th>Hrs</th>
<th>Max. marks</th>
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</thead>
<tbody>
<tr>
<td><strong>I - SEMESTER</strong></td>
<td>Paper - I Organic Chemistry – I (Organic reaction mechanisms)</td>
<td>3</td>
<td>100</td>
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<td>Paper - II Inorganic Chemistry – I (Nuclear chemistry etc)</td>
<td>3</td>
<td>100</td>
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<td>Paper - III Spectroscopy, Group theory and computer in chemistry</td>
<td>3</td>
<td>100</td>
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<tr>
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<td>Diploma Paper I Dye Chemistry / Corrosion Chemistry</td>
<td>3</td>
<td>100</td>
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<tr>
<td><strong>II - SEMESTER</strong></td>
<td>Paper - IV Organic Chemistry – II (Organic reaction mechanisms)</td>
<td>3</td>
<td>100</td>
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<td>Paper - V Physical Chemistry-I (Quantum chemistry and spectroscopy)</td>
<td>3</td>
<td>100</td>
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<td>Paper - VI Physical methods in Chemistry</td>
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<td>Practical - I Organic Chemistry – I</td>
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<td>Practical - II Inorganic Chemistry – I</td>
<td>6</td>
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<td>Practical - III Physical Chemistry – I</td>
<td>6</td>
<td>100</td>
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<td>Diploma Paper II Industrial Chemistry</td>
<td>3</td>
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<tr>
<td><strong>III - SEMESTER</strong></td>
<td>Paper - VII Organic Chemistry – III (Chemistry of natural products)</td>
<td>3</td>
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<td>Paper - VIII Physical Chemistry – II (Thermodynamics)</td>
<td>3</td>
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<td>Paper - IX Elective – I Kinetics of polymerization</td>
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<td>100</td>
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<td>Diploma Paper III Water pollution and Industrial Effluent treatment</td>
<td>3</td>
<td>100</td>
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<tr>
<td><strong>IV - SEMESTER</strong></td>
<td>Paper - X Inorganic Chemistry – II (Coordination chemistry)</td>
<td>3</td>
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<td>Paper - XI Physical Chemistry – III (Reaction kinetics and electro chemistry)</td>
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<td>100</td>
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<td>Paper - XII Elective – II Polymer technology</td>
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<td>Practical - IV Organic Chemistry - II</td>
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<td>Practical - V Inorganic Chemistry - II</td>
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<td>Practical - VI Physical Chemistry - II</td>
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<tr>
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<td>Diploma Paper IV Project Work</td>
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<td>Total</td>
<td>1800 + 400</td>
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* Includes 25% continuous internal assessment marks.
Subject Title : PAPER I ORGANIC CHEMISTRY - I
(Oracle 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
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—II
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 nucleophilic substitution reactions and mechanisms:
SNI, SN2, SNi mechanisms. Factors affecting nucleophilic 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: E1, 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

REFERENCES
1. Jerry March — Advanced organic chemistry
3. R.T. Morrison and R.N. Boyd — Organic chemistry
4. E.S. Gould — Mechanism and structure in organic chemistry
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

UNIT – II

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 nucleues-subatomic particles and their properties – binding energy- N-P ratio in stable and metastable nuclei-eifferent types of nuclear forces-liquid drop model-shell model-mode of radioactive decay-α,β,γ decay-electron capture-nuclear isomerism-internal conversion.

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 poly atomic molecules-factors affecting the vibrational frequencies-application of IR spectroscopy for organic and inorganic compounds-problems.

UNIT - II


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.


UNIT - IV

Mossbauer Spectroscopy

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; software 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
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

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

UNIT-III
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(LiAlH₄ and NaBH₄). Reduction of nitro compounds, carbonyl compounds and aromatic compounds. Typical reactions such as Birch reduction, Clemmensen, Wolff – Kishner and MPV reduction.

UNIT-IV
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.
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
14. C.K. Ingold — 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.

UNIT-II

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.


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.


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-13 NMR spectroscopy-principle only

REFERENCES:
1. Ira.N.Levine, Allyn & Bacon IC : Quantum Chemistry, 1974
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.
Learned 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 – McLafferty 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
4. D. A. Skoog : Instrumental methods of analysis
5. B. K. Sharma : 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 elucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abietic acid and caryophyllene.

**UNIT-II**

**UNIT-III**

**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 :**
2. O.P.Aggarwal : Natural product chemistry
3. P.S.Kalsi : Chemistry of natural products
5. J.N.Guntu and R.Kapoor : Organic reactions and reagents
6. Acheson : Introduction to heterocyclic compounds
7. Katritsky : Principles of heterocyclic chemistry
8. S. W.PejJeLjez. : Alkaloids
PAPER — VIII PHYSICAL CHEMISTRY — II
(Thermodynamics)

No.of hours: 75 hrs

UNIT-I
Thermodynamics 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.

UNIT-II

UNIT-III

UNIT-IV

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

REFERENCES:
1. Klotz : Chemical thermodynamics
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-IX 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 and 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
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-IV
Chain copolymerization Types of copolymers, evaluation of monomer reactivity ratio
copolymer composition, the copolymer equation. Types — of copolymerization
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


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

UNIT – III

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
Cotton and Wilkinson : Advanced inorganic Chemistry, Wiley Eastern (P), Ltd., 1968
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 theories 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:

UNIT-I

UNIT-II

UNIT-III
UNIT – IV

UNIT – V

REFERENCES:
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 compatibility of polymers and additives added to them, learnt the techniques of converting basic polymers into finished products.
Contents

UNIT – I

UNIT – II

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 – V

REFERENCES
2. Dryden : Outlines of chemical technology, East West Press, 1965
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
11. R.M. Ogorikewiez : Thermoplastics – Properties and design, John Wiley
12. I.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).
Heterogeneous 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 – Freundlich isotherm – surface area determination.

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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, Bathochromatic shift, Hypsochromic 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 Anthraquinine disperse dyes.

Unit V
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
5. An introduction to industrial chemistry B.K. Sharma.
DIPLOMA PAPER I  Corrosion Chemistry and Nano Chemistry

Unit I
Introduction and principles


Unit II Monitoring of Corrosion


Unit III Corrosion Control

Cathodic and anodic protection-use of inhibitors-Classification of 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, sputtering and solvated metal dispersion) chemical methods (Thermolysis, sonochemical approach, reduction of metal ions by hydrogen and methanol)-Biosynthesis.

Unit V


DIPLOMA PAPER – II  Industrial Chemistry

No. of Hours: 45 hrs

Unit I


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

**Unit II**

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

**Unit III**

Cement: Manufacture and setting of cement.

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

**Unit IV**
Paints and pigments;


**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:

**Reference Books:**

1. Industrial Chemistry – B. K. Sharma
2. Engineering Chemistry – Sharma
4. Industrial Chemistry – B. N. Chakrabarty
5. Engineering Chemistry – Kuria Kose & Chemical technology - Shukla

**DIPLOMA PAPER III - Water Pollution and Industrial Effluents treatment**

No. of Hours: 45 hrs

**Unit I**


**Unit II**


**Unit III**


**Unit IV**

Unit V


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

Time 3 Hours Max. marks : 75

Answer ALL questions in Each Section

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:
   -NHCOCH₃; -OCH₃; -C₆H₅; -N(CH₃)₂.
4. What happens when phenol is treated with conc. HNO₃ and conc H₂SO₄ mixture?
5. What are bridge - headed compounds?
7. State Saytzeff rule.
8. What will be the product obtained in the following reaction?
   \[
   \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3 \quad \text{C}_2\text{H}_5\text{ONa} / \text{C}_2\text{H}_5\text{OH} \quad \text{Br} \quad \text{------------------------} > \quad ?
   \]
9. What are free radicals? Give example.
10. A diazonium salt and an aromatic liquid in presence of alkali is converted into bphenyl – 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 E₁cb 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 importance of Hunsdicker reaction.

SECTION – B

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 alkylation 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.

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2. Write the product obtained when ReO$_3$ is reduced with H$_3$PO$_2$
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 semiconductor?
7. Give an example for nuclear reaction involving $\beta$ – 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$_4$N$_4$
      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$_2$Cl$_8^{2-}$
      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 $^{18}_{40}\text{Ar}$. Mass of the isotope of argon is 39.962384 a.m.u.
OR
(b) (i). Show that 1 a.m.u. = 931.5 MeV.
(ii) Discuss the atomic power projects in India with their special features.

Semester -I

Paper III-SPECTROSCOPY, GROUP THEORY AND COMPUTER IN CHEMISTRY

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 and CH3OCH3
   Or
   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$^{-27}$Kg and 35Cl=58.06x10$^{-27}$Kg.
12. Define the following.
   a. i. Axis of proper rotation
      ii. Axis of improper rotation
   Or
   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 H2O 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 acid?
3. Name the class of dyes obtained by the coupling reaction.
4. What type of dye is Naphthol green 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?

Section B (5 X 5 = 25 Marks)

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 diazotisation of aniline explained? (Or)
    (b) Write an account of tautomerism in azo dyes.

13. (a) How is congo red 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)
    (b) How are the following dyes synthesized:
        (i). Picric acid
        (ii). Fast green O
        (iii). Methyl orange. (4+4)

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. (Or)
    (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.
4. Give the expression for $\Delta G_{ads}$ 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.
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 physisorption and chemisorption?
    OR
    (b) List down the various adsorption 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
2. Name the rearrangement involving the formation of cycloalkane giving an example.

3. Predict the product and its geometry in the following reaction.

\[ \text{H} \quad \text{KCH3} \]

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 furfural is treated with ethanolic KCN?

9. Assign E – Z nomenclature to the following:


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

SECTION B - (5 x 5 = 25)

11. (a) Discuss the mechanism of Neber rearrangement.

(b) Explain Stevens rearrangement.

12. (a) Explain (\[ \Delta \\alpha \\Delta \\beta \\alpha \\beta \] addition using Frontier – orbital theory.

(b) Write notes on Di- rearrangement.

13. (a) Discuss Paterno – Buchi reaction.

(b) Explain the mechanism of Sommelet reaction.

14. (a) What is Mannich reaction? Discuss its synthetic importance.

(b) Explain hydroboration reaction with suitable example.

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

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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 Schrödinger 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.

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**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 an example explain how x – ray diffraction useful for structural elucidation.
    OR
    (b) How the properties of diamond and graphite based on their structures.
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

(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

(Or)
19. (a) What are paints? How are they classified? What are the qualities of a good paint (2+3+3)

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

(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) \( \text{NH}_4 \text{NO}_3 \) (ii). CAN (iii). \( \text{NH}_4)_2 \text{SO}_4 \) (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 Oppanaier oxidation?
10. Give the chemical name of DBU.

SECTION B - (5 x 5 = 25)

11. (a) Establish 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.

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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.  
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 coefficient?  

Or  

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

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

Or  

b. Discuss the need for the third law.  


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^-5 g.cm.  

Or  

b. What is electronic partition function? What is its influence on thermodynamic 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 \( N_i e^{-\frac{\Delta E}{kT}} \) where \( N_i \) is the number of particles in a level of energy \( E_i \). 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. entropy.

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.
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.

(b) Derive an expression for weight distribution function for a linear stepwise Polymerization.

12. (a) Explain thermal decomposition of initiators with an example.

(b) Derive the rate expression for free radical chain polymerization.

13. (a) Distinguish between radical and ionic polymerizations.

(b) Derive an expression for degree of polymerization for an anionic polymerization system involving termination.

14. (a) What is ring opening polymerization? Explain with an example.

(b) What are block and graft polymers?

15. (a) Discuss the variation in the properties of stereoregular polymers.

(b) Write a note on the synthesis of polyisoprene.

16. (a) Distinguish between step and chain polymerization and derive an expression

(b) Discuss the thermodynamic and kinetic factors of cyclization

17. (a) Write the mechanism and kinetic equation for initiated radical chain Polymerization reaction.

(b) Discuss the following:

(i) Various types of initiators used in cationic polymerization.
(ii) Different reactions lead to termination of chain growth in cationic Polymerization.

(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 filtration?

SECTION B-(5x5=25 marks)

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

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

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$_2$O)$_6$]$^{3+}$
\[ \Delta_o = 13,900 \text{ cm}^{-1} \]. 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 ML$n$ and ML$n$-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 $T$ ?
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 $v$ ?
4. What is meant by relaxation time? Δ
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(NO₃)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 27⁰C to 37⁰C. 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 $a_{2}^\pm$ in 0.1 molal solution of CUSO$_4$ if the mean molal activity Coefficient $\gamma^\pm$ is 0.74.

(or)

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

15. (a). Define the following

(i). Half wave potential

(ii). Diffusion Current.

(or)

(b). Explain constant current coulometer

Section – C (5 x 8 = 40 marks)

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.

(or)

(b). For the dissociation of water $H_2O \rightleftharpoons H^+ + OH^-$, the relaxation time obtained from the temperature jump method is 40 $\mu s$, at 25°C. If $K_w$ at this temperature is $1.0 \times 10^{-14}$ (mol dm$^{-3}$)$^2$. Calculate the rate constants for the forward and the reverse reactions.

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

(Or)

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


(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.
(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.
15. (a) Give the preparation of butyl rubber.

(b) Describe the chemistry involved in the process of vulcanization.

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.

(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) Fluidity.

(b) Discuss the various theories of plasticization.

18. (a) Describe any four methods adopted in the fabrication of polymers.

(b) Discuss the various techniques involved in the application of coatings and Adhesives.

19. (a) Describe the production of one natural fiber, cellulose fiber, polyester fiber and polyacrylic fiber.

(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.

(b) What is meant by reinforcement? Discuss the types and theories of Reinforcement.