GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
M.Sc. ORGANIC OF CHEMISTRY SYLLABUS

II- SEMESTER

PAPER I: GENERAL CHEMISTRY – II

(Effective from 2020-21 admitted batch)

MOLECULAR SPECTROSCOPY - SYMMETRY & GROUP THEORY AND ELEMENTS OF COMPUTER PROGRAMMING

Credits : 4		**Theory : 4 Hours**
Max Marks : 100	**External : 80**	**Internal : 20**

Course objectives:

1. Understanding of Vibrational, Rotational, Raman and Electronic spectroscopies through physical approach
2. Concepts of symmetry, group elements and character tables of various molecules
3. Using Microsoft Fortran language for chemical applications.

MOLECULAR SPECTROSCOPY

UNIT I:

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

UNIT II:

Raman Effect – classical and quantum mechanical explanations – rotational Raman and vibrational Raman spectra - electronic spectra of diatomic molecules – vibrational coarse structure – intensity of spectral lines – Franck Condon principle – applications - rotational fine structure – band head and band shading - charge transfer spectra.

MOLECULAR SYMMETRY AND GROUP THEORY

UNIT III:

Basic concepts of symmetry and group theory – symmetry elements- symmetry operations and point groups. Schoenflies symbols – classification of molecules into point groups – axioms of group theory. Group multiplication tables for C_{2V} and C_{3V} point groups –similarity transformation and classes. Representations – reducible and irreducible representations, Mullikan symbols, orthogonality theorem and its implications, Character table and its anatomy – symmetry selection rules for IR and Raman activity – IR and Raman activity of stretching and bending vibrations of SO_2 molecule.

ELEMENTS OF COMPUTER PROGRAMMING

UNIT IV:

Microsoft Fortran – constants - variables and operators - arithmetic expressions and statements - input and output statements -. format free and format directed I/O statements – Iw, Fw.d, Ew.d and Gw.d format specifications, conditional and unconditional statements - logical IF, Block IF and Go To statements - Do statements –syntax and rules.

Application to chemical problems:

Flowcharts and programs for

1. Statistical analysis – calculation of arithmetic mean, mean deviation, variance and standard deviation of replicate measurements.
2. Calculation of the pH and hydrogen ion concentration of an aqueous solution of a strong acid taking into account the auto ionization of water.
3. Calculation of the rate constant of a first order reaction by linear least squares method.

4. Calculation of molar extinction coefficient using Beer–Lambert's Law by linear least squares method.

Course Outcomes:

1. Students gain understanding of
2. The basic principle of different spectroscopic techniques (Microwave, IR) employed in molecular spectroscopy
3. Applications of Raman and Electronic Spectroscopy for chemical analysis.
4. Prediction the point group of important molecules and know how they are classified
5. Basic ideas of computational chemical calculations.

Text books:

1. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, McGraw Hill, 5th Edition, New Delhi, 2013.
2. Chemical Applications of Group Theory, F.A. Cotton, 3rd Edition, Wiley-Interscience, New Delhi, 1990.
3. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, New Age International Publishers, New Delhi, 2007.
4. A Text Book of Physical Chemistry - Vol. 6, K.L. Kapoor, 3rd Edition, Mc Graw Hill India, New Delhi, 2014.

GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
M.Sc. ORGANIC OF CHEMISTRY SYLLABUS
II- SEMESTER
PAPER – II: INORGANIC CHEMISTRY – II
(Effective from 2020-21 admitted batch)

Credits : 4		**Theory : 4 Hours**
Max Marks : 100	**External : 80**	**Internal : 20**

Course objectives:

1. Understanding of metal-metal bonds in metal clusters
2. To know the isolobal relationships, electron rules and isoelectronic relationships in organometallic compounds.
3. To explain metal ligand equilibrium, spectrophotometric and pH metric methods in order to understand the stability of metal complexes.
4. Understanding of various reaction mechanisms in coordination chemistry.

UNIT – I

Metal cluster compounds – definition – evidences for existence of M- M bonds - conditions favorable for formation of M- M bonds –structure and bonding of the following metal cluster compounds - $Re_2Cl_8^{2-}$, $Mo_2Cl_8^{4-}$, Re_2 $(RCOO)_4X_2$, $Mo_2(RCOO)_4(H_2O)_2$, $Cr_2(RCOO)_4(H_2O)_2$, $Cu_2(RCOO)_4(H_2O)_2$, $Cr_2Cl_9^{3-}$, $Mo_2Cl_9^{3-}$, $W_2Cl_9^{3-}$, Re_3Cl_9, $Re_3Cl_{12}^{3-}$, $Mo_6Cl_8^{4+}$, $Nb_6X_{12}^{2+}$ and $Ta_6X_{12}^{2+}$

UNIT – II

Organometallic compounds – electron rule - isoelectronic relationship – synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen and nitric oxide complexes - Isolobal relationship – H, Cl, $Mn(CO)_5$; S, CH_2, $Fe(CO)_4$; P, CH, $Co(CO)_3$ - Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene.

UNIT – III

Metal Ligand Equilibrium in solution - Stepwise and overall formation constants and their interaction - trends in stepwise constants - factors affecting the stability of metal complexes – chelate effect and its thermodynamic origin, determination of stability constants of complexes – spectrophotometric method and pH-metric method - reactivity of metal complexes – inert and labile complexes. Explanation of lability on the basis of valence bond and crystal field theories.

UNIT – IV

Inorganic Reaction Mechanisms - Substitution reactions of metal complexes –D, I_d, I_a and A mechanisms – ligand replacement reactions of metal complexes – acid hydrolysis – factors affecting acid hydrolysis - anation and base hydrolysis of cobalt(III) complexes - ligand displacement reactions of square planar complexes of platinum(II) - factors affecting square planar substitution - trans effect (theories) – electron-transfer reactions of complexes – concept of complementary and non – complementary reactions with examples - inner and outer sphere mechanisms.

Course outcome:

Students will gain understanding of

1. The basic concepts of structure and bonding of metal clusters.
2. Acquire knowledge on ligands and fluxional molecules, different organic ligands and metal complexes
3. Methods to determine stability of metal complexes
4. Different types of reaction mechanisms of metal complexes.

Text books:

1. Advanced Inorganic Chemistry, F.A. Cotton and R. G. Wilkinson, 4th Edition, John Wiley & Sons, New York, 1980.

2. Inorganic Chemistry, J.E. Huheey. 3rd Edition, Harper International Edition, London, 1983.
3. Theoretical Inorganic Chemistry, M.C. Day and J. Selbin, 2nd Edition, Affiliated East-West Press Pvt. Ltd., New Delhi.
4. Inorganic Chemistry, D.F. Shriver and P.W. Atkins, Oxford University Press, Oxford , 1999.
5. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, 3rd Edition, Pearson, New Delhi, 2008.
6. Organometallic Chemistry – A Unified Approach, R.C. Mehrotra and A. Singh, New Age International Publishers, New Delhi, 1995.
7. Mechanisms of Inorganic Reactions in Solution, D.Benson, McGraw Hill, London, 1968.
8. Inorganic Chemistry, K.F. Purcell and J.C.Kotz, W.B. Saunders Company, New York, 1977.

GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
M.Sc. ORGANIC OF CHEMISTRY SYLLABUS
(Effective from 2019-20 admitted batch)
II- SEMESTER
PAPER – III: ORGANIC CHEMISTRY – II
(Effective from 2020-21 admitted batch)

Credits : 4		**Theory : 4 Hours**
Max Marks : 100	**External : 80**	**Internal : 20**

Course Objectives:

1. Understands various substitution reactions, addition reactions and elimination reactions
2. To have a good knowledge on named reactions
3. To have a fundamental concept of UV and IR spectroscopic techniques.
4. To have a fundamental concept of NMR and mass spectroscopic techniques.

UNIT – I

Aromatic substitution reactions: Electrophilic, nucleophilic and through benzynes - radical substitution of arenes - orientation of nucleophilic substitution at a saturated carbon, S_N1, S_N2, S_N1 reactions - effect of structure, nucleophile, leaving group, solvent - additions involving electrophiles - nucleophiles - free radicals - elimination reactions – E_1, E1CB, E_2 reactions – elimination versus substitution reactions.

UNIT – II

Mechanism of some named reactions: Reactions: Aldol – Perkin – Benzoin – Cannizaro – Wittig -, Grignard – Reformatsky, Clemmensen, Meerwein–Pondrof-Verley and Birch reductions - Stark enamine reactions - Michael addition - Mannich reaction - Diels–Alder reaction, Ene–reaction, Openauer oxidation Rearrangement: Wagner-Meerwein – Hofmann – Claisen,- Favorsky, – and Baeyer–Villeger reaction.

UNIT – III

Ultraviolet spectroscopy – basic principle – types of electronic transitions – concept of chromophore and auxochrome – absorption laws – basic instrumentation – effect of conjugation – effect of solvent – bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

Infrared spectroscopy – molecular vibrations – Hooke's law – modes of vibrations – factors influencing vibrational frequencies – basic instrumentation – sampling techniques – selection rules – characteristic absorption of various functional groups

UNIT-IV

Proton NMR spectroscopy – basic principles – spin-spin and spin-lattice relaxations – basic instrumentation – number of signals – equivalent and non-equivalent protons – chemical shift and factors influencing chemical shift – electronegativity – shielding and deshielding – Vander Walls deshielding and anisotropic effects – alkenes, carbonyl compounds, alkynes, aromatic compounds and alkanes.

Mass spectroscopy – basic principles – instrumentation – mass spectrometer – isotope abundances – molecular ion – metastable ions - simple cleavage – retro Diels Alder reaction – hydrogen transfer rearrangement and Mclafferty rearrangement - Application of spectroscopic techniques (^{1}H, IR and UV) to simple organic compounds such as phenol, o-nitro phenol, aniline, o-nitro aniline, diethyl ether, methyl ethyl ketone, 1-butanol and 2-butanol.

Course outcome:

Students gain understanding of

1. Basic aspects of mechanism in organic chemistry
2. Different types named reactions which are having industrial importance.

3. Determination of structures of organic molecules using spectroscopic techniques like UV, IR, NMR, Mass Spectrometry.
4. Certain natural products having biological activity and their synthesis.

Text books:

1. Organic Chemistry, I.L. Finar, Vol. I, 6th Edition and Vol. II 5th Edition, ELBS, New Delhi, 2002.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, 6th Edition, PHI India, New Delhi, 2011
3. Organic Chemistry, F.A. Carey, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007
4. Pericyclic Reactions: A Mechanistic Study, S.M. Mukherji and S.P. Singh, Macmillan India Pres Delhi, 2012
5. A guide book to mechanism in organic chemistry, Peter Sykes, Pearson, New Delhi, 2003.
6. Organic Spectroscopy – Principles and Applications, Jag Mohan. 2nd Edition, Narosa Book Distribu New Delhi,
   2009.
7. Organic Spectroscopy , William Kemp. 3rd Edition, Palgrave Macmillan, New York, 2008.
8. Spectroscopic Methods in Organic Chemistry, D.H. Williams and I. Fleming, McGraw-Hill Edu Noida, 2007.
9. Organic chemistry, L.C. Wade and M.S. Singh, 6th Edition, Pearson India, New Delhi, 2008
10 A Logical Approach to Modern Organic Chemistry, Jagadamba Singh, Pragati Prakasan, Meerut, 2(

Reference Books:

1. Advanced Organic Chemistry: Reactions Mechanisms and Structure, Jerry March, McGraw H Kogakush., 2006
2. Stereochemistry of Carbon Compounds, E. Eliel, McGraw Hill Education, Noida, 2008
3. Chemistry of Natural products by P.S. Kalsi, Kalyani Publishers, New Delhi, 2001
4. Stereochemistry of Organic Compounds: Principles and Applications, D. Nasipuri, New Age Interna Publishers,
   New Delhi, 2018

GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
M.Sc. ORGANIC OF CHEMISTRY SYLLABUS
II- SEMESTER
PAPER - IV: PHYSICAL CHEMISTRY – II
(Effective from 2020-21 admitted batch)

Credits : 4		**Theory : 4 Hours**
Max Marks : 100	**External : 80**	**Internal : 20**

Course Objectives:

1. Understanding of magnetic resonance spectroscopies and its applications in free radials, metal complexes and biological systems
2. To know various polymerizations and its determination through various methods
3. To know the importance of photochemistry and its applications in organic and inorganic chemistry
4. Understanding of various electrochemical cells and concentration cells with and without transference.

UNIT-I: Magnetic Resonance Spectroscopy
Principle and theory of NMR spectroscopy - nature of spinning particle and its interaction with magnetic field - chemical shift and its origin - spin-spin interactions - experimental methods - applications of NMR studies in structural elucidation - NMR spectra of ethanol, dimethyl formamide, styrene and acetophenone - ESR studies - principle and experimental technique – g factor-line shapes and line widths – hyperfine interactions – applications ESR studies to the structure of free radicals, metals complexes and biological systems.

UNIT-II: Polymers
Shapes of macro molecules - bulk solution and emulsion polymerization – co-polymerization - block and graft polymers - Ziegler-Natta catalysis - molecular mass number and mass average molecular mass - molecular mass determination – osmometry – viscometry - diffusion and light scattering methods - sedimentation - chain configuration of macromolecules - calculation of average dimensions of various structures.

UNIT-III: Photochemistry
Photochemical kinetics - experimental study – determination of quantum yields using chemical actinometry quenching effect – Stern Volmer equation – delayed fluorescence - concept of excimer and exciplex - photolysis of aldehydes and ketones, ammonia – photosensitization – chemiluminescence - photochemical reactions – photo dissociation, addition and isomerization reactions with examples.

UNIT-IV: Electrochemistry
Derivation of Nernst equation – electrochemical cell - Galvanic and electrolytic cells – concentration cell with and without transference - effect of complexation on redox potential – ferricyanide / ferrocyanide couple, iron(III)-1,10-phenthroline / iron(II)-1,10-phenthroline couple – determination of standard potential and activity coefficients from cell EMF - theories of overvoltage - decomposition potential and concentration polarization**.**

Course outcome:
Students will gain an understanding of

1. Determination of structures of molecules using NMR and ESR
2. Different types of polymerization reactions useful in polymer industry.
3. Basic concepts of photochemistry and how reactions will be affected in presence of light.

4. Calculations of solubility product and EMF of a cell.

Text books

1. Text Book of Physical Chemistry, S. Glasstone, D. Van Nostrand Company Incorporated, 1943.
2. Physical Chemistry, P. Atkins and J.D. Paula, 10th Edition, Oxford University Press, Oxford, 2014
3. Physical Chemistry, G.W. Castellan, 3rd Edition, Addison-Wesley, London, 1983
4. Chemical Kinetics, K.J. Laidler, 3rd Edition, Pearson, New Delhi, 2003.
5. An Introduction to Electrochemistry, S. Glasstone, 2nd Edition, East-West Press (Pvt.) Ltd., New Delhi, 2006.
6. Principles of Physical Chemistry, B.R. Puri, L.R. Sarma and M.S. Pathania, 47th Edition, Vishal Publishing Co., Jallandhar, 2016.
7. Fundamentals Of Photochemistry, K.K. Rohtagi-Mukherjee, 3rd Edition, New Age International Publishers, New Delhi, 1978.
8. Polymer Science, V. R. Gowarikar, N.V. Vishwanathan and J. Sreedhar, 3rd Edition, New Age International Publishers, New Delhi, 2006.

LIST OF EXPERIMENTS
SEMESTER – II
(Effective from 2020-21 admitted batch)

Credits : 3		**Lab : 15 Hours**
Max Marks : 75	**External : 60**	**Internal : 15**

INORGANIC CHEMISTRY

I. Quantitative analysis:

a) Volumetric: i) Determination of Ferric ion by photochemical reduction.
ii) Determination of Nickel using EDTA.
iii) Determination of Calcium and Magnesium in a mixture using EDTA.
iv) Determination of copper (II) in presence of iron (III) using EDTA.
v) Determination of Ferrocyanide using Ceric sulphate.

b) Gravimetric: i) Determination of Zinc as Zinc Pyrophosphate
ii) Determination of Nickel as Dimethylglyoximate

Text books:

3. Vogel's Text book of Quantitative Inorganic Analysis,
J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th Edition, Pearson Education, New Delhi, 2008.

Credits : 3		**Lab : 15 Hours**
Max Marks : 75	**External : 60**	**Internal : 15**

ORGANIC CHEMISTRY

Organic qualitative analysis: Systematic identification of about six compounds containing one or two functional groups by chemical reactions

Text books:

1. Vogel's Text Book of Practical Organic Chemistry,
B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatehal, Pearson Education, New Delhi, 2008.
2. A Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International Publishers, New Delhi, 2008.

Credits : 3		**Lab : 15 Hours**
Max Marks : 75	**External : 60**	**Internal : 15**

PHYSICAL CHEMISTRY

1. Determination of composition of cuprammonium cation
2. Determination of equilibrium constant of the reaction: $KI + I_2 = KI_3$
3. Determination of iron(II) using $K_2Cr_2O_7$ by potentiometric titration method
4. Determination of relative strength of acids (HCl) by ester hydrolysis
5. Estimation of HCl using standard NaOH by pH metric method
6. Estimation of iron(II) using 1,10-pheanthroline by spectrophotometric method

Text books:

1. Experiments in Chemistry, D.V.Jahagirdan, 2nd Revised Edition, Himalaya Publishing House, New Delhi, 2011.
2. Physical Chemistry Practical, S.K. Maity and N.K. Ghosh, New Central Book Agency, Kolkata, 2012.
3. Practical Physical Chemistry, B. Viswanathan and P.S. Raghavan, Viva Books, New Delhi, 2012.