

**KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY,
JALGAON**



**DRAFT SYLLABUS
(For Affiliated Colleges of KBC NMU, Jalgaon)
For
M.Sc. Part-II
Inorganic Chemistry
(Semester III and IV)**

**Choice Based Credit System (60:40 Pattern)
(Outcome Based Curriculum)
As Per U.G.C. Guidelines
To Be Implemented From
Academic Year: 2022-23**

2022

SYLLABUS

M. Sc. Inorganic Chemistry (Semester I, II, III and IV)

Summary of Distribution of Credits under CBCS Scheme

[at affiliated colleges w.e.f. Academic Year: 2022-23]

Sr. No.	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	12	12	12	08
02	Core Skill Based	02	20	-	12
03	Elective	-	-	04	04
04	Project	-	-	-	06
05	Audit	02	02	02	02
06	Total Credits	16	34	18	32

Subject Type	Core	Core Skill Based	Elective	Project	Audit	Total
Credits	44	34	08	06	08	100

Total Credit = 100

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
M.Sc. Part-II Inorganic Chemistry (Sem-III and IV)
[At affiliated colleges w.e.f. Academic Year: 2022-23]
Choice Based Credit System (Outcome Based Curriculum)

Course credit scheme

Semester	(A) Core Courses			(B) Core Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
III	3	12	12	1	4+0	4	1	2	2	18
IV	2	08	08	4	4+18	22	1	2	2	32
Total Credits	20			26			4			50

(T: Theory; P: Practical)

Structure of Curriculum

		Second Year				Total Credit Value
		Semester III		Semester IV		
		Credit	Course	Credit	Course	
(A)	Prerequisite and Core Courses					
1	Theory	12	03	08	02	20
2	Practical	-	-	18	03	18
(B)	Core Skill Based / Subject Elective Courses					
1	Theory /Practical	4	1	4	1	08
(C)	Audit Course (No weightage in CGPA calculations)					
1	Technology Related + Value Added Course	2	1	--	--	2
2	Professional and Social + Value Added Course	--	--	2	1	2
	Total Credit Value	18	05	32	07	50

List of Audit Courses (Select any ONE course of Choice from Semester III and Semester IV)

Semester III (Choose One)		Semester IV (Choose One)	
Technology + Value Added Course		Professional and Social + Value Added Course	
Course Code	Course Title	Course Code	Course Title
AC-301 A	Computer Skills	AC-401 A	Human Rights
AC-301 B	Cyber Security	AC-401 B	Current Affairs
AC-301 C	Molecular Docking	AC-401 C	Technical Report Writing
AC-301 D	Seminar on Review of Research Paper	AC-401 D	Intellectual Property Rights (IPR)

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Syllabus under CBCS for M. Sc. Part-II Inorganic Chemistry
Syllabus Structure (w.e.f. 2022-23)
Semester-III

Course Type	Course Code	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
Core I	CH-330	Co-ordination and Bioinorganic Chemistry	04	--	04	40	--	60	--	100	--	04
Core II	CH-331	Inorganic Polymers Chemistry and Molecular Clusters	04	--	04	40	--	60	--	100	--	04
Core III	CH-332	Selected Topics in Inorganic Chemistry	04	--	04	40	--	60	--	100	--	04
Core Skill Based/ Elective (Any one)	CH-333 (A)	Instrumentation Technique in Inorganic Chemistry - I	04	--	04	40	--	60	--	100	--	04
	CH-333 (B)	Research Methodology	04	--	04	40	--	60	--	100	--	04
hAudit Course (Any one)	AC-301 (A)/(B)/(C)/(D)	Choose one out of four (AC-301 A/B/C/D) (Technology + Value Added Course)	--	02	02	--	100	--	--	--	100	02

List of Audit courses to be offered in Semester-III:

AC-301 (A): Computer Skills	AC-301 (C): Molecular Docking
AC-301 (B): Cyber Security	AC-301 (D): Seminar on Review of Research Paper

Semester-IV

Course Type	Course Code	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
Core I	CH-430	Organo-metallic Chemistry and catalysis	04	--	04	40	--	60	--	100	--	04
Core II	CH-431	Solid State Chemistry	04	--	04	40	--	60	--	100	--	04
Core Skill Based/ Elective (Any one)	CH-432 (A)	Instrumentation Technique in Inorganic Chemistry - II	04	--	04	40	--	60	--	100	--	04
	CH-432 (B)	Analysis of Environmental Pollutants	04	--	04	40	--	60	--	100	--	04
Core Skill Based	*CH-I-2	Inorganic Chemistry Practical-II (Annual)	--	06	06	--	40	--	60	--	100	06
Core Skill Based	*CH-I-3	Inorganic Chemistry Practical-III (Annual)	--	06	06	--	40	--	60	--	100	06
Core Skill Based	*CH-I-4	A Short Research Project (Annual)	--	06	06	--	40	--	60	--	100	06
Audit Course	AC-401 (A)/(B)/(C)/(D)	Choose one out of four (AC-401 A/B/C/D) (Professional and Social + Value Added Course)	--	02	02	--	100	--	--	--	100	02

* To be started from Semester-III and evaluated at the end of Semester-IV

List of Audit courses to be offered in Semester-IV:

AC-401 (A): Human Rights	AC-401 (C): Technical Report Writing
AC-401 (B): Current Affairs	AC-401 (D): Intellectual Property Rights (IPR)

Syllabus for M.Sc. Part-II Inorganic Chemistry
(Semester - III and IV)
Course Structure for Second Year

Course Type	Course Code	Title of the Course
Semester - III		
Core	CH-330	Co-ordination and Bioinorganic Chemistry
Core	CH-331	Inorganic Polymers Chemistry and Molecular Clusters
Core	CH-332	Selected Topics in Inorganic Chemistry
Core Skill Based/ Elective (Any one)	CH-333(A)	Instrumentation Technique in Inorganic Chemistry - I
	CH-333(B)	Research Methodology
Audit Course (Any one)	AC-301 (A)/(B)/(C)/(D)	Choose one out of four (AC-301 A/B/C/D) (Technology + Value Added Course) AC-301 (A): Computer Skills AC-301 (B): Cyber Security AC-301 (C): Molecular Docking AC-301 (D): Seminar on Review of Research Paper
Semester - IV		
Core	CH-430	Organo-metallic Chemistry and catalysis
Core	CH-431	Solid State Chemistry
Core Skill Based/ Elective (Any one)	CH-432(A)	Instrumentation Technique in Inorganic Chemistry - II
	CH-432(B)	Analysis of Environmental Pollutants
Core Skill Based	CH-I-2	Inorganic Chemistry Practical-II (Annual)
Core Skill Based	CH-I-3	Inorganic Chemistry Practical-III (Annual)
Core Skill Based	CH-I-4	A Short Research Project (Annual)
Audit Course (Any one)	AC-401 (A)/(B)/(C)/(D)	Choose one out of four (AC-401 A/B/C/D) (Professional and Social + Value Added Course) AC-401 (A): Human Rights AC-401 (B): Current Affairs AC-401 (C): Technical Report Writing AC-401 (D): Intellectual Property Rights (IPR)

-: Important Notes: -

- 1. There are four theory courses for third semester and three theory courses for fourth semester and three annual practical courses.**
- 2. Each theory course prescribed for M. Sc. should be covered in 4 lectures, each of 60 minutes duration per week per course including lectures, tutorials, seminars, classroom discussions etc. (Total 60 hrs. / theory course).**
- 3. Each practical course will require 06 hours of laboratory work per week and will be extended over two semesters. All three practical courses will be examined at the end of the academic year. (Total 180 hrs. / Practical course).**
- 4. There should not be more than 10 students in a batch for M. Sc. Practical course.**
- 5. In the 60 lectures theory course about 10 lectures will include tutorials, student seminars, classroom discussions and tests.**
- 6. The marks for each paper are distributed as external examination 60 marks and internal examination 40 marks. For internal assessment of each theory and practical course, 2 written tests will be taken.**
- 7. The 80 % attendance of students is compulsory.**
- 8. Students should visit at least one chemical industry and submit the observations/report to the department.**
- 9. The duration of practical examination will be of six hours.**
- 10. At the time of examination of the CH-I-4 (A Short Research Project) Viva-voce, the internal and external examiner should be a research guide recognized by the university.**

CH-330: Co-ordination and Bioinorganic Chemistry

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To understand the basic concepts of Inorganic Reaction Mechanism.
2. To know electronic structural concepts through Ligand field theory of coordination compounds.
3. To aware the students about the iron transport systems, storage proteins, biological role of elements and metalloenzymes.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand the path or the way by which reaction carried out.
2. Gain the knowledge of inertness and lability of the complexes and many more about coordination chemistry.
3. Differentiate between CFT and LFT of metal complexes.
4. Understand the biological functioning of inorganic molecules in plants and animals as well as importance of the metals in drugs, medicine etc.
5. Aware the active sites of enzymes and their functions in body.

Unit No.	Name of the unit	Lectures
1	Inorganic Reaction Mechanism Substitution reactions in octahedral complexes, unimolecular nucleophilic substitution (SN1) mechanism, bimolecular nucleophilic substitution (SN2) mechanism, types of intermediate formed during SN1 and SN2 reactions, lability and inertness of octahedral complexes, valence bond theory, crystal field theory, lability of non-transition metal complexes, mechanism of acid hydrolysis of octahedral complexes when no inert ligand in the complex is a π donor or π acceptor, mechanism of acid hydrolysis of octahedral complexes when inert ligand in the complex is a π donor or π acceptor, intermediates formed during aquation of complexes containing inert π acceptor ligands, mechanism of electron transfer reactions in solution phase (i) Inner sphere mechanism (ii) Outer sphere mechanism, two electron transfer reactions.	12
2	Ligand field theory of coordination compounds Crystal field theory, Octahedral complexes, tetrahedral complexes, tetragonal distortion, distorted octahedral complexes, square planar complexes, The method of descending symmetry, square pyramidal complexes, trigonal bipyramidal complexes, the effect of weak crystal fields on S, P, D, F terms, Ligand field term diagrams: Orgal diagram for d^1 , d^2 , d^3 , d^4 , d^6 , d^7 , d^8 configurations, excited electronic transitions, Tanabe Sugano (T.S.) diagrams for d^2 and d^8 configurations.	12
3	Oxygen, electron, iron transport systems and storage proteins <ul style="list-style-type: none">• Essential and trace metal ions in biology and their distribution; special ligands - porphyrins, chlorin and corrin. O₂ binding properties of heme (hemoglobin and myoglobin) and non-heme proteins (hemocyanin and hemerythrin), their coordination geometry and electronic structure, co-operativity effect, Hill coefficient and Bohr Effect; characterization of O₂ bound species by Raman and Infrared spectroscopic methods; representative synthetic models of heme and non-heme systems.• Active site structure and functions of ferredoxin, rubredoxin and	12

	cytochromes, and their comparisons. Vitamin B-12 and cytochrome P-450 and their mechanisms of action. Iron transport and storage proteins in bacterial and mammalian systems – siderophores, transferrin, and ferritin.	
4	<p>Biological role of some elements</p> <ul style="list-style-type: none"> • Role of 'S' block elements (Na, K, Mg and Ca) in biological system, sodium pump, calcium pump. • Biological functions and toxicity of Cr, Mn, Co, Ni, Cu, As, Se, Mo, I, Hg, Pb, Fe, Zn elements. • Application of metal in medicine, Deficiency and over dose of metal disease, metal in drug (anticancer drugs e.g., Pt complexes) • Mn in photosynthesis: Chlorophyll and photosynthetic reaction center, photo system I and II. 	12
5	<p>Metalloenzymes</p> <p>Structural and functional relationships and mechanisms of enzymatic reaction in the following metalloenzymes.</p> <ul style="list-style-type: none"> • Urease, peptidases and phosphatases and their structure and function. • Carbonic anhydrase and carboxypeptidases, • Super oxide dismutases, • Catalase and peroxidases, • Nitrogenase and xanthineoxidase, P- and M- clusters in nitrogenase, transition-metal dinitrogen complexes and insights into N₂ binding, reduction to ammonia. • B-12 Actions of Cobalamines 	12

References:

1. Principles of Inorganic Chemistry by B. R. Puri, L. R. Sharma and K. C. Kalia, Milestone publishers.
2. Symmetry and Spectroscopy of molecules K. Veera Reddy, second edition, New age international P Limited publishers (2009).
3. Mechanism of Inorganic Reactions, by Basalo and Pearson (1977), Wiley Eastern Ltd.
4. Inorganic Reaction Mechanism by M. L. Tobe (1972), Thomas Nelson and Sons.
5. Inorganic Chemistry by Shriver and Atkins, Oxford University Press.
6. Biological Chemistry of Elements. J. J. R. Frausto da Silva, R. J. P. Williams
7. Principles of Bioinorganic chemistry by S. J. Lippard and J. M. Berg, (1994) University Science Books (USA)
8. Bioinorganic chemistry: inorganic elements in the chemistry of life, An Introduction and Guide by Wolfgang Kaim, Brigille Schwederski (1994) John Wiley and Sons.
9. Bioinorganic chemistry, Bestini, Gray, Lippard, Vlentine, 1st South asian Edn. (1980) Viva books pvt.ltd.
10. Bio-organic chemistry: A Chemical approach to enzyme action 3rd edition by Hermann Dugas, 1999; CBS Publishers and Distributors Pvt. Ltd., New Delhi.
11. *Advanced Inorganic Chemistry*, 5th Edn. By F. A. Cotton and G. Wilkinson, (1999), John-Wiley and Sons, New York.
12. Inorganic Chemistry by Catherine E. Housecroft and Alan Sharpe Pearson Education Limited
13. Inorganic Chemistry: Principles of Structure and Reactivity, by J. H. Huheey, E.A. Keiter and R.L.Keiter Pearson Education India.
14. Inorganic Chemistry, by Shriver and Atkins, Oxford University Press
15. Inorganic Chemistry, by Gary L. Miessler and Donald A. Tarr Pearson Education.
16. Concise Coordination Chemistry, by R Gopalan and V Ramalingam Vikas Publishing House Pvt Ltd.

CH-331: Inorganic Polymers Chemistry and Molecular Clusters

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To familiar the students about Synthesis, Characterization and its various application of Zeolites.
2. To understand about the interaction of molecules, ions and hydrogen bonding and assemblies through the Macrocyclic complexes and Supramolecular chemistry.
3. The course implements the knowledge of Non-Transition and transition metal clusters.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Explore the knowledge of zeolites and get fundamentals about the synthesis, structure and bonding in zeolites.
2. Know the applications of zeolites in softening of water, agriculture etc.
3. Differentiate the types of boranes by STYX notation.
4. Understand about the synthesis, structure pattern of high nuclearity and low nuclearity carbonyl clusters.

Unit No.	Name of the unit	Lectures
1	Basic Concept and Synthesis of Zeolites <ul style="list-style-type: none">• Basic concept of Zeolites: Introduction, definition, natural and synthetic Zeolites or aluminosilicates, the primary and secondary building blocks, final framework structures.• Synthesis of Zeolites: Hydrothermal synthesis of zeolites Hydrothermal synthetic techniques, Examples of zeolite synthesis, Important factors affecting the synthesis batch composition, Si and Al sources, Si/Al ratio, alkalinity, H₂O content, Inorganic cations, Organic templates, solvents, Crystallization temperature and time, aging, stirring, seeding. Solvothermal synthetic route, Ionothermal synthetic route, Microwave-assisted hydrothermal synthetic route, F-synthetic route, Dry-gel conversion synthetic route.	12
2	Characterization and Applications of Zeolites <ul style="list-style-type: none">• Characterization of Zeolites using : XRD, FTIR, Solid state NMR techniques• Applications of Zeolites: Softening of water, agriculture applications in organic synthesis with at least five reactions.• Metal organic framework: Introduction, methods of synthesis, Structure and properties.	12
3	Macrocyclic Complexes and Supramolecular Chemistry <ul style="list-style-type: none">• Types of macrocyclic ligands, design and synthesis by co-ordination template effect, di- and polynuclear macrocyclic complexes, applications of macrocyclic complexes.• Concept of supramolecular chemistry, molecular recognition, nomenclature, design of supramolecule through non covalent interactions and their applications in transport processes.	12
4	Non-Transition Metal Chemistry and Clusters <ul style="list-style-type: none">• Synthesis, Properties, Structure and reactions of Borazines, Silicates and silicones polysilicates and aluminosilicates, Phosphazenes, P-N compounds, cyclophosphazenes and phosphazene polymers. Structural features and reactivity Sulfur-Nitrogen compounds, S-N heterocycles, S₄N₄, (SN)_x. Iso- and Hetero-poly anions.• Synthesis, Properties, Structure and Bonding of: Boranes, Carboranes, Metallocarboranes, Main group clusters: Geometric and electronic	12

	structure, <i>styx</i> notation; three-, four- and higher connect clusters, the <i>closo-</i> , <i>nido-</i> , <i>arachno-</i> borane structural paradigm, Wade-Mingos and Cluster Valence Electron Theory. Clusters with nuclearity 4-12 and beyond 12. Structure, synthesis and reactivity. Naked or Zintl clusters.	
5	<p>Transition Metal Clusters</p> <ul style="list-style-type: none"> • Metal carbonyl and halide clusters, low nuclearity clusters and High nuclearity carbonyl clusters synthesis and structural pattern. $14n+2$ rule, high nuclearity metal-carbonyl clusters with internal atoms. Structure synthesis and reactivity. Capping rules, isoelectronic and isolobal relationships between main-group and transition metal fragments, metal-ligand complexes vs heteronuclear cluster. Metal-metal bonding in carbonyl and halide clusters. • Heteroatoms in clusters carbides, nitrides. Electron counting in high nuclear carbonyl clusters. High nuclear carbonyl clusters of Ge, Ru, Os, Co, Rh, Ir, Ni, Pd and Pt. Halide and chalcogenide clusters. Chevrel phases, triangular clusters. Solid state extended arrays. 	12
<p>References:</p> <ol style="list-style-type: none"> 1. Introduction to Zeolite Science and Practice, H. Van Bekkum, E. M. Flanigen, P. A. Jacobs and J. C. Jansen (Elsevier pub. Amsterdam, 2001) 2. Verified Synthesis of Zeolite material, (Elsevier science pub, 2001) 3. Atlas of Zeolite framework types 5th edn., Ch. Bbaerlocher, W. M. Meier and D. H. Olson Published on behalf of the Structure Commission of the International Zeolite Association by Elsevier. 4. Introduction to Zeolite Science and Practice, Jiri Cejka , Herman Van Bekkum, Avelino, Ferdi Schuth 5. <i>Advanced Inorganic Chemistry</i>, 5th Edn. By F. A. Cotton and G. Wilkinson, (1999), John-Wiley and Sons, New York. 6. <i>Inorganic Chemistry</i> by Catherine E. Housecroft and Alan Sharpe Pearson Education Limited 7. <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, by J. H. Huheey, E. A. Keiter and R. L. Keiter Pearson Education India. 8. <i>Inorganic Chemistry</i>, by Shriver and Atkins, Oxford University Press 9. <i>Inorganic Chemistry</i>, by Gary L. Miessler and Donald A. Tarr Pearson Education. 10. <i>Principles of Inorganic Chemistry</i> By B. R. Puri, L. R. Sharma, K. C. Kalia, Milestone Publishers, 11. <i>Supramolecular Chemistry</i>, 2nd ed. J. W. Steed and J. L. Atwood 2009 John Wiley and Sons, Ltd 12. <i>Supramolecular Chemistry (Concepts and Perspectives)</i> - Jean Marie Lehn (VCH-1995). 		

CH-332: Selected Topics in Inorganic Chemistry

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. The course introduce the Basic concepts, structural arrangements its principles by Group Theory.
2. To aware the students about the Metal – ligand equilibrium and its properties in solution.
3. To know the characteristic properties and reactivity of Noble gas compounds.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand the basic definitions and Theorems of Group Theory.
2. Use definitions and theorems to solve problems in group theory to analyze the structure of finite groups.
3. Know the stability of metal complexes by knowing the nature of ligand and metal ion, chelate effect etc.
4. Acquire the knowledge about the importance and uses of noble gases with understanding the properties and reactivity of noble gases, its clathrate and the other compounds.

Unit No.	Name of the unit	Lectures
1	Group Theory-I Products of symmetry operations, Group multiplication table: C_{2V} , C_{2h} , C_{3V} , C_{4V} , D_{2h} , D_{3h} , D_{2d} , Classes for C_{2V} , C_{2h} , C_{3V} , C_{4V} and D_{2h} , D_{3h} , D_{2d} , point groups	12
2	Group Theory-II Matrix methods in Symmetry: Matrix, Type of Matrix (Rectangular, Column, Row, Zero, Square, Diagonal, Scalar, Unit Matrix), Matrix Mathematics (Addition, Subtraction and Multiplication), Matrix representation of symmetry elements	12
3	Group Theory-III Reducible and irreducible representations, The Great orthogonality theorem, rules derived from Great Orthogonality Theorem, rotational vectors, construction of character table; Mullikan's symbolism for irreducible representations, character tables for C_2 , C_3 , C_4 , D_2 , D_3 , D_4 , C_{2V} , C_{3V} , C_{4V} , C_{6V} , C_{2h} , C_{4h} , D_{2h} , D_{3h} , D_{2d} . Reducible representations and their reduction: C_{2V} , C_{3V} , C_{4V} .	12
4	Metal – Ligand Equilibria in Solution Stepwise and overall formation constants and their interaction, trends in Stepwise constants, Factors affecting the stability of metal complexes with Reference to nature of metal ion and ligand, chelate effect and its thermodynamic Origin	12
5	Compounds of Noble Gases Introduction, compounds of noble gases: Hydrates of noble gases, clathrate of noble gases, Fluorides, oxy fluorides and oxides of xenon (XeF_2 , XeF_4 , $XeOF_2$, XeF_6 , $XeOF_4$, XeO_2F_2 , XeO_3), Fluorides of Krypton.	12

References:

1. Chemical applications of Group theory by F-Albert cotton second edition, willey Eastern limited New Delhi.
2. Group theory and its chemical applications by P. K. Bhattacharya Himalaya Publishing House.
3. Concept and application of Group theory by Kishor Arrora Anmol publications Pvt. Ltd., New

Delhi

4. Concise Inorganic Chemistry fifth edition, J. D. Lee
5. Principles of Inorganic Chemistry By B. R. Puri, L. R. Sharma, K. C. Kalia, Milestone Publishers,
6. Inorganic Chemistry by A. G. Sharpe third edition.
7. Advanced Inorganic Chemistry Fifth edition by F. A. Cotton and G. Wilkinson.
8. Inorganic Chemistry by J. E. Huhey
9. Electrons and Chemicals bonding by H. B. Gray.

CH-333 (A): Instrumentation Technique in Inorganic Chemistry - I

(60 L, 100 Marks and 4 Credits)

Course Objectives:

The students will gain the knowledge of analytical technics of inorganic materials by the instruments like,

1. Electron Spin Resonance spectroscopy
2. Nuclear magnetic resonance spectroscopy
3. Mossbauer spectroscopy
4. Nuclear Quadrupole Resonance
5. Thermal methods TGA, DTG, DTA, DSC

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand ESR and its active applications in pharmaceuticals and agricultural basic research as well as the advanced and useful applications in clinical and medical fields for the cancer diagnosis etc.
2. Familiar with the knowledge of complexes containing paired or unpaired electrons by ESR spectroscopy.
3. Understand the physical, chemical, and biological properties of matter by NMR.
4. Understand the instrumentation and working about ESR, NMR, NQR, Mossbauer spectroscopy.
5. Apply the knowledge about thermal methods for the characterization of the inorganic compounds.

Unit No.	Name of the unit	Lectures
1	Electron Spin Resonance Spectroscopy Introduction, principle of ESR spectroscopy, presentation of spectrum, hyperfine splitting in various structures, hyperfine splitting diagram of representative examples, factors affecting the magnitude of 'g' values, Zero field splitting, Kramer's degeneracy, Anisotropy in the hyperfine coupling constant, electron delocalization, instrumentation and applications.	12
2	Nuclear Magnetic Resonance Spectroscopy (NMR) Principal of NMR spectroscopy, Chemical shift, mechanism of electron shielding and factors affecting the magnitude of chemical shift. Volume diamagnetic susceptibility, Chemical shifts for which the local diamagnetic term does not predominate, spin-spin splitting, spin-spin coupling mechanism for transmitting nuclear spins, applications of spin-spin coupling to structure determination, applications involving magnitude of coupling constants, complex spectra, chemical exchange and the factors affecting line width, effect of chemical exchange on spectra and the evaluation of reaction rates for fast reactions, study of exchange reactions between ligands and metal ions. The double resonance technique, NMR of paramagnetic complexes –contact shift. Applications of NMR to Inorganic problems.	12
3	Mossbauer Spectroscopy and Nuclear Quadrupole Resonance (NQR) • Mossbauer Spectroscopy: Principle, Instrumentation and Mossbauer spectra, Mossbauer nuclides and characteristics, Applications: Nature of chemical bond, chemical shift, quadrupole effects, effect of magnetic field and structure determination, Isomer shift or chemical shift, isomer shift and Curie point.	12

	<ul style="list-style-type: none"> • Nuclear Quadrupole Resonance: Introduction, Theory of NQR, Instrumentation for NQR spectroscopy, sample requirement, Applications of NQR: Structural information from NQR, limitation of NQR. 	
4	<p>Thermal Gravimetric Analysis Introduction to thermal methods of analysis</p> <ul style="list-style-type: none"> • Thermogravimetry (TGA): Definition, Types of TGA, Instrumentation, Information from TGA Curve; Factors affecting TGA curves (instrumental as well as characteristics of sample factors); Application of thermogravimetry; Calculation of percent decomposition and composition of compounds; Limitation and Advantages of TGA. • Derivative thermogravimetry (DTG) and its advantages 	12
5	<p>Differential Thermal Analysis</p> <ul style="list-style-type: none"> • Differential Thermal Analysis (DTA): Definition; Theoretical Basis of DTA; Instrumentation for DTA apparatus; Factors affecting the DTA curve; Application of DTA; Advantages and disadvantages of DTA. • Differential Scanning Calorimetry (DSC): Definition; Comparison of DTA and DSC techniques; Instrumentation of DSC, Factors affecting DSC curves, applications. 	12
<p>References:</p> <ol style="list-style-type: none"> 1. Physical methods in Inorganic Chemistry, R. S. Drago, Renhold Publishing Corporation 2. Instrumental Methods of Analysis, 6th edition, Willard, Merit, Dean. 3. Instrumental Methods of Chemical Analysis, 5th edition, Golden W. Ewing 4. Principals of Instrumental Analysis, 3rd edition, Douglas A. Skoog 5. Instrumental Methods of Chemical Analysis, Anand, hatwal 6. Quantitative Inorganic Analysis, A. I. Vogel 7. Spectroscopy of Compounds: V. M. Parikh 8. Coordination Chemistry by Experimental Methods: K. Barger 9. Coordination Chemistry vol. I: E. Martell 10. Structural Methods in Inorganic Chemistry: E. A. V. Ebsworth and D. W. H. Rankin 11. Instrumental Methods of Chemical Analysis by Gurdeep R. Chatwal, Anand K. Sharma, Himalaya Publishing House. 		

CH-333 (B):- Research Methodology

(60 L, 100 Marks and 4 Credits)

Course Objectives:

To make the students familiar with the,

1. To learn the important chemical safety handling tools while working in a laboratory.
2. To understand the detailed referencing and literature review procedure before beginning on Research topic.
3. To learn the Ethics and plagiarism precautions to be taken while doing research.
4. To understand the process of writing research project report and research proposal.
5. To learn various opportunities after completing a research degree in chemistry.

Learning Outcomes:

On completion of this course, the students will be able to:

1. Acquire the knowledge about various hazardous chemical handling procedures and implement it while working.
2. To be able to write comprehensive literature review on a given research topic.
3. To follow the ethical guidelines while doing research avoid plagiarism in research publications.
4. To be able to write a crisp research proposal or research project independently.
5. To identify and utilize the opportunities and build his/her career in chemistry research field.

Unit No.	Name of the unit	Lectures
1	Chemical Safety and Ethical Handling of Chemicals Safe working procedure and protective environment, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, disposal of waste chemicals, recovery, recycling, and reuse of laboratory chemicals. Ref 1: 1-71; Ref 7 and 8: Relevant Pages	12
2	Perspective of Scientific Research Scope of Research: Introduction, Objective, Importance and need of research. Scientific methodology: Rules and principles of scientific methods, Hypothesis, and testing of hypothesis. Selection and formulation of research problem. Research ethics: Principles and values. Plagiarism and its types. Ref 2: 1-24; Ref 3: Relevant Pages	12
3	Literature Review and its significance <ul style="list-style-type: none">• Literature Survey: Sources of information, Primary, Secondary, Tertiary sources, Journals, Journal abbreviations, Abstracts, Current titles, Reviews, Monographs, Textbooks, Current contents, Cross referencing, Introduction to Chemical Abstracts.• Digital resources: Search engines, INFLIBNET, Shodsindhu, Shodhganga, Google Scholar, ResearchGate, PubMed, EndNote, Ref Works, Mendeley, Publons, Highwire, Google patents, Indian patent database, Online searching, Database: Scifinder, Beilstein, Scopus, Citation Index, Impact Factor etc. spreadsheets, word processors, databases and other packages, finding and citing Information. Ref. 3: 147-179; Ref. 4: 299-317; Ref. 5: 1569-1603.	15
4	Scientific Writing and Presentation <ul style="list-style-type: none">• Communicating Information:	15

	<p>General aspects of scientific writing, reporting practical and project work, writing literature reviews, Maintaining Laboratory Notebook, Paper writing for International Journals, submitting to editors, organizing a poster display, giving an oral presentation in seminars/conferences.</p> <ul style="list-style-type: none"> • Writing of Research Report: Format of the research report, style of writing the report, references, and bibliography. Research Proposal: Format of research proposal, individual research proposal. <p>Ref. 2: 344-360; Ref. 3: 180-229; Ref. 4: 325-348</p>	
5	<p>Opportunities in Chemical Research: Funding Agencies, Academic/Society Fellowships, Government Awards, Opportunities for Startup. Ref. 9 to 29.</p>	06

References:

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3. Research Methodology for Scientific Research, K. Prathapan, I.K. International Pvt. Ltd., New Delhi – 110002, (2019).
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9. <https://www.ugc.ac.in/romrp/>
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11. <https://dst.gov.in/scientific-programmes/scientific-engineering-research>
12. <https://www.aicte-india.org/opportunities/students/research-funds>
13. <https://csirhrdg.res.in/Home/Index/1/Default/2011/62>
14. <https://www.drdo.gov.in>
15. <https://dae.gov.in/node/1085>
16. https://brns.res.in/brns_rp.php
17. <http://dbtindia.gov.in/schemes-programmes/research-development/>
18. <https://www.dsir.in/rdfunding.php>
19. <https://main.icmr.nic.in/content/online-schemes>
20. <https://www.ias.ac.in/>
21. <http://www.iacs.res.in/>
22. <https://www.crsi-india.org/>
23. <http://www.sciencecongress.nic.in/awards.php>
24. <https://ssbprize.gov.in/>
25. https://en.wikipedia.org/wiki/Om_Prakash_Bhasin_Award
26. <https://www.infosys-science-foundation.com/prize/laureates/category.asp#Life-Sciences>
27. <http://www.vasvik.org/index.html>
28. <https://www.startupindia.gov.in/>
29. <https://www.entrepreneur.com/article/270330>

SEMESTER – IV

CH430: Organometallic Chemistry and catalysis

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To understand the Transition metals Carbon monoxide compounds.
2. Transition metal compounds with bonds to hydrogen
3. To understand the chemistry of transition metal compounds with single, double and triple bonds to carbon.
4. To learn the Catalysis and Heterogeneous catalysis.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand the nature of chemical bond between metal and carbon based ligand.
2. Know the compounds of transition metals with alkenes, alkynes and delocalize hydrogen system.
3. Acquire knowledge about the catalytic path and rate of reaction
4. Develop skill in modern synthetic chemistry by using homogenous, heterogeneous catalysts.

Unit No.	Name of the unit	Lectures
1	<p>Transition Metals Carbon Monoxide Compounds</p> <p>Stable electron configurations, 16- and 18-electron rule, and concept of hapticity and Recapitulation <i>d</i>-block metal carbonyls. Determining the structure of a carbonyl from IR data. Metal-Metal bonding in metal carbonyl. Synthesis, structure and bonding and reactions of homo and heteroleptic metal-carbonyls and Carbonylate anions.</p>	12
2	<p>Transition metal compounds with bonds to hydrogen</p> <p>Transition metal Compounds with M-H bonds: Metal hydrides (classical and non-classical). Agostic interaction, Application of NMR in studying hydrido complexes.</p>	12
3	<p>Compounds of Transition Metals with Single, Double and Triple Bonds to Carbon</p> <ul style="list-style-type: none"> • Reactions of organometallic complexes and factors affecting in: Substitution, oxidative addition, reductive elimination, insertion and deinsertion α-, γ- and δ-Hydride eliminations and cyclometallations. • Transition metal of nitrosyls, tertiary phosphines, alkenyls, alkynyls, carbenes, N-heterocyclic carbenes and carbines. • Synthesis, reactivity and reaction of Fischer and Schrock carbenes. • Synthesis, reactions and reactivity of cyclopentadienyl compounds. 	12
4	<p>Compounds of Transition Metals with Alkenes, Alkynes and Delocalize Hydrogen System.</p> <ul style="list-style-type: none"> • Preparation, bonding and structure of allyl, dienyl and trienyl complexes; reactions with special reference to organic synthesis. • Hydrides and dihydrogen complexes. • Carbocyclic polyenes: Synthesis, bonding, properties and applications: 	12

	Allyls, Pentadienyls, Cyclobutadienes, Cyclopentadienyls, Cycloheptatrienyls and Arenes.	
5	<p>Catalysis and Heterogeneous Catalysis</p> <ul style="list-style-type: none"> • Organometallic catalysts, theories of adsorption. Terminology in catalysis: Turnover, Turnover number (TON), Turnover frequency (TOF). Introduction, the water-gas-shift reaction, Concepts of heterogeneous catalysis, CO and CO₂ hydrogenation and Fischer-Tropsch process, Transformation of hydrocarbons, Metathesis of alkanes, alkenes and alkynes, Oxidation of hydrocarbons. • Catalytic Processes Combining CO₂ and Alkenes for the synthesis of Cyclic Carbonates, Lactones, Carboxylic Acids. 	12

References:

1. Advanced Inorganic Chemistry, 5th Ed. F. A. Cotton and G. Wilkinson, (1999), John-Wiley and Sons, New York.
2. Organometallic chemistry by R. C. Mehrotra and A. Singh, 1992, Wiley Eastern Ltd.
3. Inorganic chemistry by Butler, Harrod, 1989, Benjamin / Cummins Pub. Co.
4. Principles of organometallic chemistry 2nd Ed. P. Powell, 1988, Chapman and Hall.
5. The organometallic chemistry of the transition metals, fourth edition by Robert H. Crabtree Yale University, New Haven, Connecticut, A John Wiley and Sons, Inc., Publication
6. Organometallic Chemistry And Catalysis by Didier Astruc Member of The Institute Universities De France, Springer Berlin Heidelberg New York
7. Organometallics for Green Catalysis by Pierre H. Dixneuf, Jean-Francois Soule, Springer
8. Organometallic compounds –Morries sijlirn. IVY Publication house
9. Organometallics in Organic Synthesis – Swan and Black
10. Organometallic Chemistry - E. J. Elias and Gupta
11. Inorganic Chemistry by Catherine E. Housecroft and Alan Sharpe Pearson Education Limited
12. Inorganic Chemistry: Principles of Structure and Reactivity, by J. H. Huheey, E. A. Keiter and R. L. Keiter Pearson Education India.
13. Inorganic Chemistry, by Shriver and Atkins, Oxford University Press
14. Inorganic Chemistry, by Gary L. Miessler and Donald A. Tarr Pearson Education.

CH-431: Solid State Chemistry

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To understand the characteristics of crystals and its properties.
2. Student will be aware about the ceramic, ceramic composites and Composite materials as well as its uses as superconducting and magnetic properties.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand the defects, imperfections and vacancies in crystal structure.
2. Acquire knowledge about ceramic, composite materials, their synthesis, properties and uses.
3. Know the superconducting, magnetic materials their types and differentiation on the basis of their magnetic properties.

Unit No.	Name of the unit	Lectures
1	Imperfections and Related Phenomenon: Perfect and imperfect crystal, Intrinsic and Extrinsic defect, point defects, plane defects, Vacancies (Schottky and Frenkel) defects, line defects: Edge and Screw dislocations, dislocations and melting. Thermodynamics of Schottky and Frenkel, Colour centers.	12
2	Ceramic and Composite Materials Ceramic Materials <ul style="list-style-type: none">• Introduction, Types of ceramic, raw materials required• Whitewares: Manufacture of whitewares, glazing• Structural clay products• Refractories: Manufacture of refractories, properties of refractories, classification of refractories, various refractory materials• Specialized ceramic products Composite Materials <ul style="list-style-type: none">• Introduction, Classification of Composite materials• Particle-reinforced composites: Large Particle composites, Dispersion strengthened composites• Fiber reinforced composites: The fiber phase, the matrix phase• Fiber glass- reinforced composites: fiber glass wool• Structural Composites: A laminar composites, sandwich panels	12
3	Superconducting Materials Definition of superconductivity, Critical temperature (T_c), Critical field, Bardeen – Cooper –Schrieffer (BCS) theory, properties and classification of superconducting compounds, High T_c superconductivity, Examples of superconducting materials: Structure of $YBa_2Cu_3O_{7-x}$ -dioxide, Fullerenes, intermetallic superconductors, Synthesis of superconductors. Application of superconducting materials.	12
4	Magnetic Materials and Magnetic Properties-I Atomic magnetism and solids, type of magnetic materials (Diamagnetism, Para-magnetism, Antiferromagnetism, ferrimagnetism, Variation of magnetic	12

	<p>susceptibility with temperature, Curie temperature (TC), Neel temperature (TN). Measurement of magnetic susceptibility by Guoys, Faradays method, Quenching of magnetic moments, Magnetic moments based on crystal field ground term, spin orbit coupling operator for magnetic susceptibility and magnetic moments of T terms and A, E terms.</p>	
5	<p>Magnetic Materials and Magnetic Properties-II Magnetic moment and structure, exchange interactions, Lanthanides magnetic moment, Spin-cross over region and effect of temperature, hysteresis loop and their classification, calculation of magnetic moment from saturation magnetization, magnetic domains, examples of magnetic materials, soft and hard ferrites, structure and magnetic interactions in spinel, garnet hexagonal ferrites, application of magnetic materials</p>	12

References:

1. Structural Inorganic Chemistry by A. F. Wells, - 5th edition (1984)
2. Principles, structure and reactivity by J H Huheey, Inorganic Chemistry - Harper and Row Publisher, Inc. New York (1972)
3. Concise Inorganic Chemistry by J. D. Lee, Elbs with Chapman and Hall, London
4. Solid State Chemistry and its applications by A. R. West, Plenum,
5. Solid State Physics by N. B. Hanney,
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7. Solid State Physics by S. O. Pillai
8. Material Science and Engineering: An Introduction by W. D. Callister, Wiley
9. First Course in Material Science by R. Raghwan
10. The coming of Material Science by R. W. Cahan
11. Basic Solid State Chemistry by A. R. West, 2nd edition
12. Synthesis of Inorganic Materials by U. Schubert and N. Husing, Wiley VCH (2000)
13. Theoretical Inorganic Chemistry by M. C. Day and J. Selbin, Reinhold, EWAP
14. Solid State Chemistry by A. H. Hanney, A. H. Publications
15. Metals and Metabolism by O. A. Phiops
16. The structure and properties of materials by John Wulff,
17. Electronic processes in materials by L. V. Azoroff, J. J. Brophy, Mc Craw Hill
18. Advanced Inorganic chemistry by F. A. Cotton, R. G. Wilkinson.
19. Modern Inorganic Chemistry by Willam L. Jooly,
20. Atomic Structure and Chemical bonding by Manas Chanda
21. Magnetism and Transition Metal Complexes, F. E. Mabbs and D. J. Machin (Chapman and Hall), London (1973).
22. Introduction to Magnetochemistry, A. Earnshaw, Academic Press, (1968).
23. Elements of Magnetochemistry, R. L. Dutta and A. Syamal, Affiliated East/West Press Pvt. Ltd. 2007.
24. Electrochemistry for Chemists, D. T. Sawyer, A. Sobkowak, J. L. Roberts Jr. 2nd Edition, John Wiley, Inc. New York, 1995.

CH-432(A): Instrumentation Technique in Inorganic Chemistry - II

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. The students will gain the knowledge of analytical technics like SEM, TEM, Electron and Inductively Coupled Plasma-Atomic Emission Spectrometry.
2. To introduce the knowledge about the analytical separations techniques by Solvent Extraction as well as Ion Exchange Chromatography.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Know the working of instruments, its uses and importance of imaging technique.
2. Differentiate TEM and SEM analysis.
3. Know the different analytical techniques for the extraction of solvent.
4. Understand the separation techniques for compounds by ion exchange chromatography.

Unit No.	Name of the unit	Lectures
1	Imaging techniques Principle, instrumentation, working and applications of following spectroscopic techniques: <ul style="list-style-type: none">• Transmission Electron Microscopy• Scanning Electron Microscopy Ref.-2 Pages 79-144	12
2	Electron Spectroscopy for Surface Analysis Basic Principles, X-Ray Photoelectron Spectroscopy, Auger Electron Spectroscopy, Instrumentation, Ultrahigh Vacuum System, Source Guns, X-Ray Gun, Electron Gun, Ion Gun, Electron Energy Analyzers, Characteristics of Electron Spectra, Photoelectron Spectra, Auger Electron Spectra, Qualitative and Quantitative Analysis, Qualitative Analysis, Peak Identification, Chemical Shifts, Problems with Insulating Materials, Quantitative Analysis, Peaks and Sensitivity Factors, Composition Depth Profiling. Ref.-2 Pages 197-221	12
3	Inductively Coupled Plasma-Atomic Emission Spectrometry <ul style="list-style-type: none">• Inductively Coupled Plasma AES: Introduction to Atomic emission spectroscopy, inductively coupled plasma, Direct current plasma, microwave induced plasma, glow discharge, plasma spectroscopy, spectrometers, Detectors, interferences.• Inductively Coupled Plasma MS: Fundamental of MS, Inorganic mass spectroscopy, Interface, mass spectrometer, quadrupole mass analyser, detectors, interferences, isotope dilution analysis, mass spectral interpretation.• Applications: Forensic analysis of documents, Clinical analysis of blood and urine, Analysis of metals from waste water sample by ICP-MS method. Ref.-5 Pages 57-117 , Ref-6 Pages 3120-3125	12
4	Analytical Separations by Solvent Extraction <ul style="list-style-type: none">• Introduction, Nature of the separation process, separation by precipitation, separation based on control of acidity, sulfide separations, other inorganic	12

	<p>precipitant, organic precipitant, separation of constituents present in trace amounts, separation by electrolytic precipitation.</p> <ul style="list-style-type: none"> • Extraction methods: Introduction, theory • Sequence of the extraction process • Extraction technique: Batch extraction, Stripping or back extraction, continuous extraction, counter current extraction • Application of extraction procedures: Inorganic separations • Ion exchange separation • Application of ion exchanges to analytical separations <p>Ref.- 1 Pages 2.552 to 2.564</p>	
5	<p>Ion Exchange Chromatography Introduction, Definition, Principle, cation exchange, anion exchange, regeneration, ion exchange column used in chromatographic separations, selection of suitable systems, Ion exchange capacity, Ion exchange techniques, application of ion exchanges. Ref.- 1 Pages 2.662 to 2.672</p>	12

References :

1. Instrumental methods of chemical Analysis by Gurdeep R. Chatwal, Anand K. Sharma, Himalaya Publishing House
2. Materials Characterization Introduction to Microscopic and Spectroscopic Methods by Yang Leng, 2nd Ed., 2013, Wiley-VCH Verlag GmbH and Co. KGaA, Boschstr. Weinheim, Germany
3. Principles of Instrumental Analysis by Douglas A. Skoog, F James Holler, Stanley R. Crouch, Sixth edition, Thomson Brooks, USA
4. Analytical Spectroscopy Library- Vol.-3, Introduction to Inductively Coupled Plasma Atomic Emission Spectrometry by G. L. Moore, Council for Mineral Technology, Mintek, South Africa.
5. Practical Inductively Coupled Plasma spectroscopy Analytical Techniques in the Sciences, John R. Dean, Wiley India Pvt. Ltd. (AnTs Series book)
6. Standard methods for the examination of water and waste water, 23rd Ed. Jointly published by American Public Health Association, American Water Work Association, Water Environment Federation. 2017.
7. Practical Guide to ICP-MS, Edited by Robert Thomas, CRC press, Francis and Taylor.
8. Vogel's quantitative chemical analysis, 6th edition

CH-432(B): Analysis of Environmental Pollutants

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To introduce the knowledge of environment and its constituents as well as factors affecting it.
2. To gaining the theoretical concepts about the analysis of pollutants their limits in air, water and soil.

Learning Outcomes:

After successful completion of this course, students are able to:

1. Understand the about the pollutants, their limits in air, water and soil.
2. Monitor and analyze Air, Water, Soil Pollutants.

Unit No.	Name of the unit	Lectures
1	Environment Definition, characteristics and pollution, type of environmental pollution, Environmental pollutants: Metallic and nonmetallic, Toxic chemicals: heavy metals, pesticides and carcinogenic compounds.	12
2.	Analytical Methods for Monitoring Air Pollutants Introduction, sampling of gases and vapours, Sampling of particulate pollutants, Stack sampling, Monitoring of air pollutants, Instrumental techniques for monitoring air pollutants: monitoring of NO _x , Monitoring of Sulphur dioxide, Monitoring of Hydrogen sulphide (H ₂ S), Monitoring of Oxidants and ozone, Monitoring of Ammonia, Monitoring of hydrocarbons, Determination of lead in petrol by atomic absorption spectroscopy, Monitoring of CO, Monitoring of Particulate matter, Monitoring of trace gases. Ref-1 Pages-170-190	12
3	Analysis of Water Pollutants <ul style="list-style-type: none">• Sampling and sampling methods, Chemical substances affecting potability, Odour, Turbidity, conductivity, Hydrogen ion concentration, Acidity, Alkalinity, Chloride, Total solids, Hardness, Calcium, Magnesium, Iron, Manganese, Mercury, Silver, Zinc, Nitrate and nitrite, Sulphide, Phosphate, Fluoride.• Chemical substances Indicative of pollution, Analytical technique for dissolved oxygen, Chemical oxygen demand, Biochemical oxygen demand, Total organic Carbon, Bacteriological, Biological and radiological examination of water. Ref-1 Pages- 384-409, 423-433	12
4	Analysis of Toxic Chemical Substances in Polluted Water Inorganic Pollutants and toxic Metals, Detrimental effects of toxic metals, Organic pollutants, Effect of organic pollutants, Analysis of: Beryllium, Cadmium, Copper, Zinc, Arsenic, Chromium, Lead, Selenium, Silica, Determination of oil and gases, Analysis of: Phenols, cyanides, Surfactants, Pesticides. Ref-1 Page-253-257, 409-423	12
5	Analysis of Soil Pollutants Introduction, Control of soil pollution, Effective measures to prevent soil	12

	pollution, Soil fertility and productivity, Analysis of: Soil moisture, pH, Total nitrogen, Phosphorus, Sulphur, Total manganese, Iron, Silica, Lime, Salts, Sodium, Potassium, Calcium, Magnesium, Mechanical analysis of soil. Ref-1 Pages-502-524	
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References:

1. Environmental Chemistry by H. Kaur, Pragati prakashan
2. Environmental Chemistry by B. K. Sharma, Goel Publishing House, Meerut
3. Standard Methods of water and waste Water Analysis by A. K. De
4. Standard Methods of Chemical Analysis by F. J. Welcher
5. Environmental Chemistry by S. M. Khopkar
6. Environmental Chemical Analysis by M. S. Cress and Morr
7. Analytical Chemistry by G. D. Christion
8. New Trends in Green Chemistry by V. K. Ahluwalia

CH-I-2: Inorganic Chemistry Practical-II(Annual)

(180 Hrs., 100 Marks and 6 Credits)

Course Objective:

Students able to understand the analysis of ore and alloy and gain the skill of various process of the estimation of metals.

Learning Outcomes:

After successful completion of this course, students will be able to analyze ore and alloy sample and gain the skill for the separation, estimation process of metals.

1. Analysis of ore/alloy (**any two**)
 - i) Analysis of Cement (Si, Fe, Ca, Mg and Al).
 - ii) Analysis of Ilmenite (Fe and Ti).
 - iii) Analysis of Steel (Fe, Cr and Ni).
 - iv) Analysis of Bronze – alloy.
2. Estimation of Vitamin 'C' from Lemon juice.
3. Estimation of Calcium from calcium supplementary tablet.
4. Estimation of Zinc from iron zinc supplementary tablet/capsule.
5. Estimation of Fe from Soap Bar.
6. Estimation of Copper from fungicide.
7. Analysis of pigment (Zn and Cr).
8. Analysis of Plaster of Paris.
9. Complexometric determination of Bismuth by EDTA titration.
10. Soil analysis: pH, conductivity, organic carbon and calcium carbonate.
11. To study the kinetics of 1,10-Phenanthroline Fe(II) in acid solution by spectrophotometry.
12. Determination of N, P and K in a fertilizer sample.
13. To study the current –potential characteristics of Cd^{+2} ions using DC polarography, sampled DC, cyclic voltammetry and pulse polarographic techniques.
14. Cyclic Voltametric study of i) Potassium ferricyanide ii) Ferrocene.
15. Determine the redox potential of Fe(II)/Fe(III) system and hence determine the number of electron involved in the system using $\text{K}_2\text{Cr}_2\text{O}_7$ by potentiometric method.
16. Stability constant of metal complexes by Bjerrum/Potentiometry method/pH metry.
17. Flame Photometric Determination: Sodium and Potassium in fruit juice.

CH-I-3: Inorganic Chemistry Practical-III (Annual)

(180 Hrs., 100 Marks and 6 Credits)

Course Objective:

1. Synthesis, purification and analysis of coordination complexes of simple and chelating ligands.
2. Preparation, characterization and activity of Solid State Materials.
3. To familiar the students about the instruments TGA, Magnetic susceptibility measurements and Kinetic masking.
4. Interpretation of IR, ESR and electronic spectra of coordination compounds.

Learning Outcomes:

After successful completion of this course, students will be able to:

1. Synthesize, purification and analysis of coordination complexes.
2. Use the instruments TGA and find Magnetic susceptibility.
4. Interpret IR, ESR and electronic spectra of coordination compounds.

1. Synthesis, purification, analysis of co-ordination complexes of simple and chelating ligands and Structure determination (UV, IR, TGA, Magnetic, and Conductivity). **(Any-4)**

(Metals = Cr, Fe, Mn, Cu, Co)

- i) Bis (acetylacetonato complex of Cu (II), Co(II) and V(IV) **(any-1)**
- ii) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$
- iii) Thiourea
- iv) Salicyladoxime (Fe or Cu)
- v) 8-hydroxy quinoline

2. Solid State Materials: Preparation, characterization and activity: **(any- 3)**

Preparation of solid-state materials:

- i) NiO
- ii) ZnO
- iii) ZnFe_2O_4 or NiFe_2O_4
- iv) Fe_3O_4
- v) BaZrO_3 or SrZrO_3

3. Purity and Percentage of Metal in Coordination Complexes.

4. Preparation of manganese (III)acetylacetonate nanoparticles via an environmentally benign route.

5. Preparation of *trans*-dichloro-bis(ethylenediamine)cobalt (III)chloride.

6. Magneto Chemistry: Magnetic susceptibility measurements of the synthesized complexes.

7. TGA (Thermogravimetric analysis) of two samples.

8. Kinetic masking: Determination of Cr (III) and Fe (III) in a mixture.

9. Spectrophotometer: Estimate the amount of Copper and Bismuth ions using EDTA Photometric titration method.

10. Interpretation and spectral analysis.

a) To interpret IR spectra of acetylacetone and its complex. (1d)

i) To determine force constant of $-\text{C}=\text{O}$ bond.

ii) To determine bond lengths of $-\text{C}=\text{O}$ bond.

iii) To identify coordination site and type of coordination.

b) To interpret ESR spectrum of $\text{Mn}^{+2}(\text{Oh})$ / $\text{Co}^{+2}(\text{Oh})$ / $\text{Cu}^{+2}(\text{D}_4\text{h})$ etc.

To calculate magnetic parameters isotropic, anisotropic *viz.* g-factor, hyperfine coupling constant etc.

c) To interpret electronic spectra of coordination compounds.

- i) To determine interelectronic repulsion parameter ($B \text{ cm}^{-1}$) and crystal field parameter ($10 Dq$) using numerical fitting procedure.
- ii) To calculate bonding parameters.

References:

1. Systematic experimental physical chemistry – T. K. Chondhekar and S. W. Rajbhoj
2. Experiments in chemistry – D.V. Jahagirdar
3. Textbook of quantitative Inorganic Analysis – IV Edn. J. Bassett, R. C. Denny, G.H.Gefery and J. Mendham
4. Chemical Curiosities, H. Denny and W. Roesky, WILEY VCH, Ed. 1996.
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8. Vogel's Textbook of Quantitative Analysis, G. Svehla, Pearson, Ed. 2006.
9. A Collection of Interesting General Chemistry Experiments, Anil J. Elias, University Press, Ed. 2002.
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11. Catalysis: Principles and Applications B. Viswanathan, S. Savasankar and A. V. Ramaswamy Narosa Publication; 2004.
12. Solid State Chemistry: An Introduction Lesley Smart and Elaine Moore, 2nd Edition, Chapman and Hall, 1996.

CH-I-4: A short Research Project

(180 Hrs., 100 Marks and 6 Credits)

Course Objectives:

1. Working within a small team to achieve a common research goal.
2. Carry out project based on the use instrumental methods.
3. Search the Literature to carry out the research work.
4. To learn some advanced reaction techniques to successful achievement for the products.
5. Handle instruments neatly for analysis and discuss their experiment results.
6. Know specification of instrumental techniques and interpretation data.
7. Use ICT tools to write project reports and Power point presentation.

Learning Outcomes:

On completion of the course, student will able to,

1. Literature search and carry out the research work to submit their project report.
2. Understand the basic steps of research to carry out research in near future.
3. Handle advanced reaction techniques and instruments for the research work, analysis of the synthesized compounds.
4. Interpret analytical data of the compounds.
5. Use ICT tools to write project reports and power point presentation.

The course includes:

- **Project Report: Introduction, Literature survey, Objectives, Research methodology, Result and Discussion**
- **Industrial Visit Report/Internship**

Internal Examination Marking Scheme

1. Power Point Presentation	10
2. Viva -voce	10
3. Project Report	10
4. Industrial visit report/Internship	10
Total	40

A short Research Project External Examination Marking Scheme

1. Literature Search	10
2. Project Report	20
2. Power Point Presentation	20
3. Viva-voce	10
Total	60

Skeleton of Question Paper
CH-XXX : Subject Name

Time- Three Hours

Marks: 60

1. Answer **any three** of the following: (15)

- a)
- b)
- c)
- d)
- e)

2. Answer **any three** of the following: (15)

- a)
- b)
- c)
- d)
- e)

3. Answer **any three** of the following: (15)

- a)
- b)
- c)
- d)
- e)

4. Answer **any three** of the following: (15)

- a)
- b)
- c)
- d)
- e)

Audit Courses

Technology + Value Added Course/ Professional & Social + Value Added Course

**KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-III Audit Course (w.e.f. 2022-23)
AC-301(A): Computer Skills**

Credit: 02
Marks: 100

Hours of instruction/week: 02
Total hours of instruction: 60

	Course Objectives: CO-1. Student will be able to understand various types of literature resources, technical reports. CO-2. Student will be able to make a technically sound presentation. CO-3. To learn the Ethics and plagiarism precautions to be taken while doing research. CO-4. To understand the process of writing research project report and research proposal. CO-5. At the end of this course, Student will be able to write a technically effective report.	
	Course Contents (Topics and subtopics)	
1	Elements of Information Technology 1.1 Information Types: Text, Audio, Video, and Image, storage formats 1.2 Components: Operating System, Hardware and Software, firmware 1.3 Devices: Computer, Mobile Phones, Tablet, Touch Screen, Scanner, Printer, Projector, smart boards 1.4 Processor & Memory: Processor functions, speed, Memory types: RAM/ROM/HDD/DVD-ROM/Flash drives, memory measurement metrics	04 L
2	Office Automation Text Processing 2.1 Views: Normal View, Web Layout View, Print Layout View, Outline View, Reading Layout View 2.2 Working with Files: Create New Documents, Open Existing Documents, Save Documents to different formats, Rename Documents, Close Documents 2.3 Working with Text: Type and Insert Text, Highlight Text, Formatting Text, Delete Text, Spelling and Grammar, paragraphs, indentation, margins 2.4 Lists: Bulleted and Numbered Lists, 2.5 Tables: Insert Tables, Draw Tables, Nested Tables, Insert Rows and Columns, Move and Resize Tables, Moving the order of the column and/or rows inside a table, Table Properties	10 L

	<p>2.6 Page Margins, Gutter Margins, Indentations, Columns, Graphics, Print Documents,</p> <p>2.7 Paragraph Formatting, Paragraph Attributes, Non-printing characters</p> <p>2.8 Types of document files: RTF, PDF, DOCX etc</p>	
3	<p>Office Automation-Worksheet Data Processing</p> <p>3.1 Spreadsheet Basics: Adding and Renaming Worksheets, Modifying Worksheets,</p> <p>3.2 Moving Through Cells, Adding Rows, Columns, and Cells, Resizing Rows and Columns, Selecting Cells, Moving and Copying Cells</p> <p>3.3 Formulas and Functions: Formulas, Linking Worksheets, Basic Functions, Auto Sum, Sorting and Filtering: Basic Sorts, Complex Sorts, Auto-fill, Deleting Rows, Columns, and Cells</p> <p>3.4 Charting: Chart Types, drawing charts, Ranges, formatting charts</p>	10 L
4	<p>Office Automation :</p> <p>4.1 Create a new presentation, Auto Content Wizard, Design Template, Blank Presentation, Open an Existing Presentation, PowerPoint screen, Screen Layout</p> <p>4.2 Working with slides: Insert a new slide, Notes, Slide layout, Apply a design template, Reorder Slides, Hide Slides, Hide Slide text, Add content, resize a placeholder or text box, Move a placeholder or text box, Delete a placeholder or text box, Placeholder or Text box properties, Bulleted and numbered lists, Adding notes</p> <p>4.3 Work with text: Add text and edit options, Format text, Copy text formatting, Replace fonts, Line spacing, Change case, Spelling check, Spelling options</p> <p>4.4 Working with tables: Adding a table, Entering text, Deleting a table, Changing row width, Adding a row/column, Deleting a row/column, Combining cells, Splitting a cell, Adding color to cells, To align text vertically in cells, To change table borders, Graphics, Add clip art, Add an image from a file, Save & Print, slide shows, slide animation/transitions.</p>	12 L
5	<p>Internet & Applications:</p> <p>5.1 Computer Network Types: LAN, PAN, MAN, CAN, WAN, Defining and describing the Internet, Brief history, Browsing the Web, Hypertext and hyperlinks, browsers, Uniform resource locator</p> <p>5.2 Internet Resources: Email, Parts of email,</p> <p>5.3 Protecting the computer: Password protection, Viruses, Virus protection software, Updating the software, Scanning files, Net banking precautions.</p> <p>5.4 Social Networking: Features, Social impact, emerging trends, issues, Social Networking sites: Facebook, Twitter, LinkedIn, Orkut, online booking services</p> <p>5.5 Online Resources: Wikipedia, Blog, Job portals, C.V. writing</p> <p>5.6 e-learning: e-Books, e-Magazines, e-News papers, OCW(open course wares): Sakshat</p>	08 L

	(NPTEL) portal, MIT courseware	
6	Cloud Computing Basics 6.1 Introduction to cloud computing 6.2 Cloud computing models: SAS, AAS, PAS 6.3 Examples of SAS, AAS, PAS (Drop Box, Google Drive, Google Docs, Office 365 Prezi, etc.)	06 L
	References: 1. TCI, "Introduction to Computers and Application Software", Publisher: Jones & Bartlett Learning, 2010, ISBN: 1449609821, 9781449609825 2. Laura Story, Dawna Walls, "Microsoft Office 2010 Fundamentals", Publisher: Cengage Learning, 2010, ISBN: 0538472464, 9780538472463 3. June Jamrich Parsons, Dan Oja, "Computer Concepts Illustrated series", Edition 5, Publisher Course Technology, 2005, ISBN 0619273550, 9780619273552 4. Cloud computing online resources	

Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To create new document, work with existing documents.	2
2	To acquire skill to insert and resize tables.	3
3	To make power point presentation, auto content wizards.	4

**KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-III Audit Course (w.e.f. 2022-23)
AC-301(B): Cyber Security**

Credit: 02
Marks: 100

Hours of instruction/week: 02
Total hours of instruction: 60

. Course Objectives:

CO-1. Student will be able to understand different types of networks

CO-2. Student will be able to understand security concepts.

CO-3. Student will learn about cyber crimes

1	<p>Networking Concepts Overview Basics of Communication Systems, Transmission Media, ISO/OSI and TCP/IP models, Network types: Local Area Networks, Wide Area Networks, Internet working, Packet Formats, Wireless Networks: Wireless concepts, Advantages of Wireless, Wireless network architecture, Reasons to use wireless, Internet.</p>	06 L
2	<p>Security Concepts Information Security Overview, Information Security Services, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography. Importance of Physical Security, Biometric security & its types, Risk associated with improper physical access, Physical Security equipment. Passwords: Define passwords, Types of passwords, Passwords Storage – Windows & Linux.</p>	14 L
3	<p>Security Threats and vulnerabilities Overview of Security threats, Hacking Techniques, Password Cracking, Types of password attacks, Insecure Network connections, Wi-Fi attacks & countermeasures, Information Warfare and Surveillance. Cyber-crime: e-mail related cyber-crimes, Social network related cyber-crimes, Desktop related cyber-crimes, Social Engineering related cyber-crimes, Network related cyber-crimes, Cyber terrorism, Banking crimes,</p>	14 L
4	<p>Cryptography Understanding cryptography, Goals of cryptography, Types of cryptography, Applications of Cryptography, Use of Hash function in cryptography, Digital signature in cryptography, Public Key infrastructure,</p>	10 L
5	<p>System & Network Security System Security: Desktop Security, email security: PGP and SMIME, Web Security: web authentication, Security certificates, SSL and SET, Network Security: Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems, Overview of Firewalls, Types of Firewalls, VPN Security, Security in Multimedia Networks, Fax Security</p>	06 L
6	<p>OS Security OS Security Vulnerabilities updates and patches, OS integrity checks, Anti-virus software, Design of secure OS and OS hardening, configuring the OS for security, Trusted OS.</p>	04 L
7	<p>Security Laws and Standards Security laws genesis, International Scenario, Security Audit, IT Act 2000 and its amendments. References: 1. Principles of Computer Security, W.A.Cokline, G.White, 4th Edition, McGraw Hills. 2. Cryptography and Network Security Principles and Practices-William Stallings, 7th Edition, Pearson</p>	06 L

	<ol style="list-style-type: none"> 3. Cryptography and Network Security -William Stallings, 4th Edition, Pearson 4. Cryptography and Network Security- Forouzan Mukhopadhyay, McGraw Hills 2nd Edition. 5. Principles of Information Security- Michael E. Whiteman, Herbert J Mattoral, CENGAGE Learning 4th Edition. 6. Kimberly Graves: CEH-official Ethical Hacker Guide,Wiley Publishing Inc.2007, ISBN:978-0-7821-4437-6. 7. Shakeel Ali & TediHeriyanto” Backtrack-4Assuring Security by penetration testing PACKT Publishing,2011, ISBN: 978-1-849513-94-4. 8. Understanding Laws- Cyber laws and Cyber-crimes (Lexix Nexis) 9. Cyber Crime Mannual by Bibhas Catterjee, Lawman Publication. 	
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Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To understand different types of networks	2
2	To acquire skill to use Hash function, digital signature	3

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(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-III Audit Course (w.e.f. 2022-23)
AC-301 (C): Molecular Docking**

Credit: 02
Marks: 100

Hours of instruction/week: 02
Total hours of instruction: 60

Course Objectives:

- CO-1. Student will be able to know about natural products.
CO-2. Students will understand structure-based drug design.
CO-3. Student will learn about the docking method.

1	<p>Introduction drug design and discovery Introduction: - Natural product, Drugs; principles of drug Development. Bioinformatics in drug development, Chemoinformatics and Pharmacoinformatics. Applications of Drug Discovery and In-Silico Drug Designing, Area influencing drug discovery; Molecular Biology, pharmacogenomics and pharmacoproteomics</p>	20 L
2	<p>Structure-based drug designing Introduction, Structure-based drug designing approaches: - Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps.</p>	20 L
3	<p>Ligand-based drug designing and docking 4.1 Introduction, Ligand-based drug designing approaches: Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property. 4.2 Introduction to docking methods to generate new structure; Tools and Molecular docking programs: Auto Dock, Dock, HEX References: 1. The Pharmacological Basis of Therapeutics, Louis S. Goodman, Alfred Gilman Sr., Edited by Laurence L. Brunton, John S.L., K.L. Parkar, McGraw Hill Education, 11th Edition (2005). 2. Oxford Textbook of Clinical Pharmacology and Drug Therapy, D.G. Grahame-Smith and J.K. Aronson, Oxford University Press, 3rd Edition (2002). 3. Organic Chemistry of drug design and drug action, R.B. Silverman, Academic Press, 2nd Edition (2004). 4. Statistical Methods in Biology, Bailey M. A., Norman T. J., Cambridge University Press, 3rd Edition (1995). 5. A Text book of Drug design and development, Povl. Krogsgaard-Larsen Tommy L. and U Madsen, CRC Press, 2nd Edition (1996).</p>	20 L

Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To understand the principle of drug development.	2
2	To identify target and its validation, in case of structure based drug design	3

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON (For Affiliated Colleges of KBC NMU) Syllabus under CBCS M. Sc. Part-II Organic Chemistry Semester-III Audit Course (w.e.f. 2022-23) AC-301 (D): Seminar on Review of Research Paper		
Credit: 02 Marks: 100		Hours of instruction/week: 02 Total hours of instruction: 60
Course Objectives: CO-1. Students will learn how to do the referencing. CO-2. Students will understand how to write the review of literature.		
1	Select a topic for research duly in consultation with his/her guide.	10L
2	Identify the appropriate databases for literature survey and compile a working bibliography adopting standard referencing style.	20L
3	Prepare a comprehensive and critical review of the literature highlighting the growth, development, evolution and landmarks in the area of research. The review should result in identification of gaps in the existing literature and should form the basis to present the novelty, significance and need for the study. The objective, methodology and findings of the earlier studies shall be examined in the context of the research topic chosen by the researcher.	20L
4	Present the literature review report in the form of a seminar and submit the same to be evaluated by the Department Council.	10L
Suggested Studies: 1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press Model Curriculum of Engineering & Technology PG Courses [Volume -II] 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. 4. Adrian Wall work , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011		

Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To select the topic for research in consultation with guide.	2
2	To present the literature review in the form of seminar.	3

	KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON (For Affiliated Colleges of KBC NMU) Syllabus under CBCS M. Sc. Part-II Organic Chemistry Semester-IV Audit Course (w.e.f. 2022-23) AC-401 (A): Human Rights	
	Credit: 02 Marks: 100	Hours of instruction/week: 02 Total hours of instruction: 60
	Course Objective To impart the basic ideas about Human Rights at post graduations level. This paper provides different aspects of human rights which includes children and women. Students can learn not only their basic rights bus also can understand the duties to be carried out in the days to come.	
1	An Introduction to Human Rights 1.1: Values – Dignity, Liberty, Equality, Justice, Unity in Diversity 1.2: Human Rights – Meaning and features; Significance of the study 1.3: Classification of Human Rights 1.4: Rights and Duties – Correlation	10 L
2	Human Rights of Vulnerable Groups: 2.1: Women’s Rights 2.2: Rights of the Child 2.3: The Rights of Persons Belonging to Minorities 2.4: Rights of Refugees and Migrant Workers 2.5: Indigenous People and Human Rights 2.6: Human Rights of Prisoners 2.7: Rights of Physically Disabled	14 L
3	Human Rights in India 3.1: Human Rights and Fundamental Rights 3.2: Fundamental Rights and Fundamental Duties 3.3: Directive Principles 3.4: Role of Judiciary in the protection of Human Rights	12 L
4	Protection and promotion of Human Rights in India 4.1: National Human Rights Commission – Composition and functions 4.2: Human Rights and NGOs 4.3: Human Rights and Media	12 L
5	Issues and concerns in Human Rights 5.1: Changing dimensions of Human Rights 5.2: Challenges to Human Rights promotion in India-Poverty, Illiteracy, Communal and caste conflicts, patriarchal values, lack of inclusive development 5.3: Human Rights and Terrorism 5.4: Human Rights and problems of health and environment	12 L
	References : 1. “Protect Human Rights”, http://www.un.org/en/sections/what-we-do/protect-human-rights/index.html 2. Aftab Alam, ed., Human Rights in India: Issues and Challenges, Delhi; Raj Publications., 2012 3. D.D. Basu, Human Rights in Constitutional Law, Gurgaon; Lexis Nexis, 2008 4. Upendra Baxi, The Future of Human Rights, New Delhi; OUP India, 2012 5. Andrew Clapham, Human Rights A Very Short Introduction, Oxford; OUP, 2015	

<p>6. Human Rights by S. Subrahmanyam</p> <p>7. M.P.Dube and Neeta Bora, eds., Perspectives on Human Rights, Delhi; Anamika Pub., 2000</p> <p>8. Manisha Priyam, Krishna Menon and Madhulikea Banerjee, Human Rights, Gender and the Environment, Chennai; Pearson Education, 2009</p> <p>9. K.P. Saksena, ed., Human Rights and the Constitution: Vision and Reality,, New Delhi; Gyan Pub., 2003</p> <p>10. K.S. Pavithran, Human Rights in India: Discourses and Contestations, New Delhi; Gyan Pub., 2018</p> <p>11. H.O. Agarwal, Human Rights, Allahabad: Central Law Pub., 2016</p> <p>12. Baradat Sergio and Swaronjali Ghosh. Teaching of Human Rights : Dominant Publishers and distributors, New Delhi,2009.</p> <p>13. Asish Kumar Das and Prasant Kumar Mohanty, Human Rights in India, New Delhi; Sarup & Sons, 2007</p> <p>14. C.J. Nirmal, Human Rights in India, Historical, Social and Political Perspectives, New Delhi, OUP, 2002</p>	
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Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	Understand the importance and different approaches to Human rights.	2
2	Understand the different Constitutional provisions and legislation to protect Human rights in India.	3
3	Examine the challenges to Human Rights of different vulnerable sections.	2
4	Understand the issues concerning the rights of citizens in general.	2

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Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-IV Audit Course (w.e.f. 2022-23)
AC-401 (B): Technical Report Writing**

Credit: 02
Marks: 100

Hours of instruction/week: 02
Total hours of instruction: 60

	<p>Course Objectives: To make the students familiar with the,</p> <p>CO-1. Student will be able to understand various types of literature resources, technical reports.</p> <p>CO-2. Student will be able to make a technically sound presentation.</p> <p>CO-3. To learn the Ethics and plagiarism precautions to be taken while doing research.</p> <p>CO-4. To understand the process of writing research project report and research proposal.</p> <p>CO-5. At the end of this course, Student will be able to write a technically effective report.</p>	
	Course Contents (Topics and subtopics)	
	Literature Resources, Writing Scientific Reports, Scientific Paper and Writing a Scientific Paper	
1	<p>Literature Resources:</p> <p>Introduction of Print and Digital Literature Resources, Sources of Information, Types of Literature: Primary, Secondary, and tertiary sources of Information, Types of Journals, Literature Review, Need for Literature Review, Writing a Literature Review, Conference Proceedings, Journal Impact Factor, <i>h</i>-index, and Citation Index. Seminar Conference and Workshop. Shodhganga: a reservoir of Indian Theses.</p> <p>Ref.: Ref. - 1: Pages: 149-177; Ref. – 2.</p>	20 L
2	<p>Writing Scientific Reports:</p> <p>Introduction, Types of Scientific Reports, General Rules for Scientific Writing, Synopsis Writing, Progress Report, Formats for Report Writing, Reporting Practical and Project work, Research Proposal, Referencing. Introduction of Plagiarism, Reading Research Paper. Scientific work presentation, Organizing a Poster display, Oral Presentation, Resume, Curriculum Vitae, A Comparison between a Resume, Curriculum Vitae.</p> <p>Ref.: Ref. - 1: Relevant Pages; Ref. – 3: Pages: 85-107, 209-232, Ref. 5: 344-360.</p>	20 L
3	<p>Scientific Paper and Writing a Scientific Paper:</p> <p>Introduction of Scientific Paper, Title, Abstract, Keywords, Introduction, Materials and Methods, Result and Discussion, Conclusion, Acknowledge and References.</p> <p>Introduction to writing a scientific paper, Importance of Scientific Writing, Characteristics of Scientific Writing, Duties and Responsibilities of Authors, Communicating to a Journal,</p>	20 L

	Submission Methods, Peer Review: Single Blind Review, Double Blind Review and Open Review. Ref.: Ref. – 1: Pages: 180-208.; Ref. – 4: 325-354, Ref. 5: 344-360.	
	<p>References:</p> <p>30. Research Methodology for Scientific Research, K. Prathapan, I. K. International Pvt. Ltd., New Delhi (2019).</p> <p>31. https://shodhganga.inflibnet.ac.in/</p> <p>32. Advanced Manual for Communication Laboratories and Technical Report Writing, D. Sudha Rani, Dorling Kindersley (India) Pvt. Ltd, Pearson Education in South Asia, New Delhi 110 017, India (2012).</p> <p>33. Practical Skills in Chemistry, 2nd Ed, Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. Prentice-Hall, Harlow (2011).</p> <p>34. Research Methodology: Methods and Techniques, 3rd edition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004).</p> <p>35. APPENDIX A: The Literature of Organic Chemistry March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013).</p> <p>36. Research Methodology, G. H. Sonawane, H. A. Mahajan, H. R. Talele, S. S. Rajput, S. D. Yeole, S. L. Sonawane, Prashant Publications (2020).</p>	

Course Outcomes (COs):		
Upon the completion of course, the student should be able:		
CO No.	CO	Cognitive level
1	To be able to write comprehensive literature review, project or scientific reports on a given research topic.	2
2	To follow the ethical guidelines while doing research avoid plagiarism in thesis and research publications.	3
3	To be able to present and communicate their scientific work as well as ideas to scientific community.	2
4	To utilize the gained knowledge or skills in the scientific research and build his/her career in chemistry research field	2

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Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-IV Audit Course (w.e.f. 2022-23)
AC-401 (C): Current Affairs**

Credit: 02
Marks: 100

Hours of instruction/week: 02
Total hours of instruction: 60

Course Objective:

Students will be expected to display general knowledge of history, politics and International Affairs, as deemed necessary to interpret current affairs.

• **Current Affairs: Global Issues**

- International Security
- International Political Economy
- Human Rights
- Environment: Global Warming, Kyoto Protocol, Copenhagen Accord
- Population: world population trends, world population policies
- Terrorism and Counter Terrorism
- Global Energy Politics
- Nuclear Proliferation and Nuclear Security
- Nuclear Politics in South Asia
- Millennium Development Goals, Current Status,
- Globalization
- Middle East Crisis
- Kashmir Issue
- Palestine Issue

60 L

Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	Understand effect of green house gases.	2
2	To understand the reasons of Crisis and the solutions.	3

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Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-IV Audit Course (w.e.f. 2022-23)
AC-401 (D): Intellectual Property Rights**

**Credit: 02
Marks: 100**

**Hours of instruction/week: 02
Total hours of instruction: 60**

Course Objectives:

- ❖ To acquaint the learners with the basic concepts of Intellectual Property Rights.
- ❖ To develop expertise in the learners in IPR related issues and sensitize the learners with the emerging issues in IPR and the rationale for the protection of IP

1	<p>Introduction</p> <p>Introduction to IPRs, Basic concepts and need for Intellectual Property – Meaning and practical aspects of Patents, Copyrights, Geographical Indications, IPR in India and Abroad. Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.</p>	12 L
2	<p>Intellectual Property Rights</p> <p>The IPR tool kit, Patents, the patenting process, Patent cooperation treaties: International Treaties and conventions on IPRs: Trade Related Aspects of Intellectual Property Rights Agreement, Patent Cooperation Treaty, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act</p>	12 L
3	<p>Intellectual Property Protections</p> <p>IPR of Living Species, protecting inventions in biotechnology, protections of traditional knowledge, biopiracy and documenting traditional knowledge, Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection. Case studies: The basmati rice issue, revocations of turmeric patent, revocation of neem patent.</p>	12 L
4	<p>Exercising and Enforcing of Intellectual Property Rights</p> <p>Rights of an IPR owner, licensing agreements, criteria for patent infringement. Case studies of patent infringement, IPR – contract, unfair competitions and control, provisions in TRIPS,</p>	12 L
5	<p>Role of Patents in Product Development & Commercialization</p> <p>Recent changes in IPR laws impacting patents and copy rights, intellectual cooperation in the science and allied industry. Patentable and non-patentable research. Case studies</p>	12 L

References

- 1.P.B. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy. Tata Mc Graw Hill, 2001.
2. Steve Smith, The Quality Revolution.1st ed., Jaico Publishing House, 2002.
- 3.Kompal Bansal and Praishit Bansal. Fundamentals of IPR for Engineers, 1st Edition, BS Publications, 2012.
4. Prabhuddha Ganguli. Intellectual Property Rights. 1st Edition, TMH, 2012.
- 5.R Radha Krishnan & S Balasubramanian. Intellectual Property Rights. 1st Edition, Excel Books, 2012.
- 6.M Ashok Kumar & Mohd. Iqbal Ali. Intellectual Property Rights. 2nd Edition, Serial Publications, 2011.
7. VinodV. Scople, Managing Intellectual Property. Prentice Hall of India PvtLtd, 2012.
8. Deborah E. Bouchoux. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Cengage Learning, 3rd
9. Prabhuddha Ganguli. Intellectual Property Rights: Unleashing the Knowledge Economy. McGraw Hill Education, 2011.
10. Edited by Derek Bosworth and Elizabeth Webster. The Management of Intellectual Property. Edward Elgar Publishing Ltd., 2013.
11. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House

Course Outcomes (COs):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	to understand the concept of intellectual property Rights, its protection.	2
2	To know the latest changes made in Intellectual Property Rights.	2