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| M.sc.,  INORGANIC CHEMSITRY |
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| **SYLLABUS** |
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| **from the acadmic year**  **2023-2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** | |
| **Programme** | **M.Sc. INORGANIC CHEMISTRY** |
| **Programme Code** |  |
| **Duration** | **2 years for PG** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**  Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.  **PO2: Decision Making Skill**  Foster analytical and critical thinking abilities for data-based decision-making.  **PO3: Ethical Value**  Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.  **PO4: Communication Skill**  Ability to develop communication, managerial and interpersonal skills.  **PO5: Individual and Team Leadership Skill**  Capability to lead themselves and the team to achieve organizational goals.  **PO6: Employability Skill**  Inculcate contemporary business practices to enhance employability skills in the competitive environment.  **PO7: Entrepreneurial Skill**  Equip with skills and competencies to become an entrepreneur.  **PO8: Contribution to Society**  Succeed in career endeavors and contribute significantly to society.  **PO 9 Multicultural competence**  Possess knowledge of the values and beliefs of multiple cultures and  a global perspective.  **PO 10: Moral and ethical awareness/reasoning**  Ability to embrace moral/ethical values in conducting one’s life. |
| **Programme Specific Outcomes**  **(PSOs)** | **PSO1 – Placement**  To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.  **PSO 2 - Entrepreneur**  To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.  **PSO3 – Research and Development**  Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.  **PSO4 – Contribution to Business World**  To produce employable, ethical and innovative professionals to sustain in the dynamic business world.  **PSO 5 – Contribution to the Society**  To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I | 5 | 7 | 2.1. Core-IV | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI | 5 | 6 |
| 1.2 Core-II | 5 | 7 | 2.2 Core-V | 5 | 6 | 3.2 Core-VIII | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric  Elective -I | 3 | 5 | 2.4 Discipline Centric  Elective – III | 3 | 4 | 3.4 Core – X | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship)  20% Theory  80% Practical | 3 | 4 |
| 1.5 Generic Elective-II: | 3 | 5 | 2.5 Generic Elective -IV: | 3 | 4 | 3.5 Discipline Centric Elective - V | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** | | | | | | | | | | | |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity [Credits] | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship) | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

**M.Sc. INORGANIC CHEMISTRY**

**Curriculum**

**Semester I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Semester** | **Title of the Course** | **Core/ Elective** | **Credits** | **Hours** |
| *S*  **I** | Fundamentals of Analytical Chemistry | Core 1 | 5 | 7 |
| Coordination and Nuclear Chemistry | Core 2 | 5 | 7 |
| Stereochemistry and Organic Reaction Mechanism | Core 3 | 4 | 6 |
| Thermo dynamics and Chemical Kinetics | Elective 1 | 3 | 5 |
| Organic Chemistry Practical-I |  |  |  |
| Physical Chemistry Practical-I |  |  |  |
| Electronics and Computers for Chemists | Elective 2 | 3 | 5 |
|  |  | **Total** | **20** | **30** |

**Semester II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **II** | Analytical Instrumentation | Core 4 | 5 | 6 |
| Main Group Elements and Inorganic Polymers | Core 5 | 5 | 6 |
| Organic Reaction Mechanism | Core 6 | 4 | 6 |
| Quantum Chemistry and Group Theory | Elective 3 | 3 | 4 |
| Analytical Chemistry Practical-I |  |  |  |
| Inorganic Chemistry Practical-I |  |  |  |
| Macromolecular Chemistry | Elective 4 | 3 | 4 |
| NME |  | 2 | 4 |
|  | **Total** | **22** | **30** |

**Semester III**

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| **III** | Physical Methods in Chemistry | Core 7 | 5 | 6 |
| Inorganic Chemistry Practical–II | Core 8 | 5 | 6 |
| Inorganic Chemistry Practical–III | Core 9 | 5 | 6 |
| Biological Chemistry | Core 10 | 4 | 6 |
| Photochemistry and Nano materials | Elective 5 | 3 | 3 |
| Elective from Other School | NME | 2 | 3 |
|  | Internship / Industrial Activity |  | 2 | - |
|  |  | **Total** | **26** | **30** |

**Semester IV**

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| **IV** | Transition Metal Chemistry | Core 11 | 5 | 6 |
| Organometallic Chemistry | Core 12 | 5 | 6 |
| Project with Viva Voce |  | 7 | 10 |
| Novel Reagents in Organic Synthesis | Elective 6 | 3 | 4 |
| Skill Enhancement course / Professional Competency Skill |  | 2 | 4 |
|  | Extension Activity |  | 1 | - |
|  | Total |  | **23** | **30** |

**Total Credits: 91**

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| **SCHEMEOFVALUATION** | |
| **COREPAPERS** | **ELECTIVE PAPERS (No Practicals)** |
| CREDITS–3or4;MARKS–100 | CREDITS–3;MARKS-100 |
| **MarksDistribution:** | **MarksDistribution:** |
| Internal–40Marks | Internal–40Marks |
| External–60Marks | External–60Marks |
| **INTERNSHIP** | **PROJECTWORK&VivaVoce** |
| CREDITS–2;MARKS–50 | CREDITS–6;MARKS–100 |
| **MarksDistribution:** | **MarksDistribution:** |
| Internal–12Marks | ProjectWork&Vivavoce(75Marks) |
| External–38Marks | **Thesis(25Marks)** |

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| **Semester**  **-1** | | | **CHEC101** | | **COORDINATIONANDNUCLEAR**  **CHEMISTRY** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | | **Core** | | **4** | **0** | **0** | | **3** |
| **Pre-requisite** | | | | Students must know about thefundamentaltermsofcoordinationchemistry, Werner’s theory, Valence BondTheory,basicsofnucleus,nuclear  particlesandnuclearforces. | |  | | | |  |
| **CourseObjectives:** | | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Knowaboutthestructure,propertiesandbondingnatureofcoordinationcompounds * Illustratethebasicconceptoftheoriesofcoordinationcomplexes * ToimpartthebasicknowledgeonAtomicstates,microstatesandtermsymbol * UnderstandorgelandTanabeSuganodiagramsforpredictionofabsorptionband * Illustratedifferenttypesofnuclearmodelsandtheirfeatures * Describenuclearreactionsandtheirenergies * Studytheapplicationsofnuclearchemistryinvariousfields | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | |
| 1 | Understand and compare different theories involve in thecoordinationcomplexes | | | | | | | | | K1-K2 |
| 2 | InterprettheelectronicandmagneticpropertiesofcoordinationcompoundsbasedonCFT | | | | | | | | | K2-K4 |
| 3 | KnowledgeonthemodernM.Otheoryanditsapplicationinconsciousunderstandingofbondingofmetalcomplexes | | | | | | | | | K2-K5 |
| 4 | Calculatenuclearspin,Ivalueofelements | | | | | | | | | K3-K4 |
| 5 | Differentiatedifferentnuclearreactionsandtodetermineactivitybyvarioustechniques | | | | | | | | | K5-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | |
| **UNIT:1** | | **STRUCTURALASPECTSANDCRYSTALFIELDTHEORY** | | | | | | | **20hours** | |
| Crystalfieldtheory-crystalfieldsplittingpatternsinoctahedral,tetrahedral,tetragonal,squareplanar,geometries–CFSE,FactorsaffectingCFSE–Interpretationofelectronicspectraandmagneticproperties– Spectrochemicalseries–Jahn-Tellereffect;Effectofchelationandstabilityofcomplexes–Thermodynamicaspectsofcomplexformation–Determinationof stabilityconstantsbyspectrophotometric,polarographicandpotentiometricmethods–  Hardandsoftacidsandbases | | | | | | | | | | |
| **UNIT:2** | | **MOLECULARORBITALTHEORY** | | | | | | | **20hours** | |
| Theoretical failure of the Crystal Field Theory - Nephelauxetic effect - Evidencesfor the metal-ligand orbital overlap; the ligand field theory; Molecular Orbital -applicationofgroup theorytotetra coordinateandhexacoordinatesystems -  M.O.theoryasappliedtonon-bondingandanti-bondingcomplexes–Calculation  of Dq, B and β parameters. Colour of transition metal complexes, types of | | | | | | | | | | |

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| electronicspectra-d-dtransition,Chargetransferspectra,selectionruleandits  relaxation,Termstatesfordnions,energydiagram,-OrgelandTanabe-Suganodiagrams–Spin-Orbitcoupling | | | |
| **UNIT:3** | | **NUCLEARCHEMISTRY** | **20hours** |
| Models of nucleus – Modes of radioactive decay: orbital electron capture:nuclearisomerism, internal conversion, Nuclear reaction:Types, reactions, cross section,Q-value,thresholdenergy,compoundnucleustheory,Highnuclearreactions,nuclearfissionandfusionreactionsasenergysources;directionreactions,photonuclearandthermonuclearreactions, detection and determination ofactivitybycloudchamber,nuclearemulsion,bubblechamber,G.Mcounter–ScintillationandCherenkovcounters.Applicationofradioactivityinthechemistry  -Structuredeterminationandmechanismofelectrontransferreactions,Determinationofsolubilityofasparinglysolublesalt,medicalfield,agedetermination and in agriculture, Neutron activation analysis, isotopic dilution  analysis, radiometric titrations, Nuclear reactors, the breeder reactor, nuclearreactors inIndia | | | |
|  | | **TotalLecturehours** | **60hours** |
| **TextBook(s)** | | | |
| 1. | F.A.Cotton&G.Wilkinson-AdvancedInorganicChemistry,3rdand4thEd.,JohnWiley | | |
| 2. | Huheey,J.W.-InorganicChemistry,4thEdition-HarperandRow | | |
| 3. | J.D.Lee,ConciseInorganicChemistry,5thedition,JohnWiley | | |
| 4. | A.K.DasVol.1&2,FundamentalsofInorganicChemistry | | |
| 5. | GregoryRChoppin;Jan-OlovLiljenzin;JanRydberg,RadiochemistryandNuclearChemistry,3rdEdition,2002,Butterworth-Heinemann | | |
| **ReferenceBooks** | | | |
| 1. | K.F.Purcell& J.C.Kotz-Inorganic Chemistry,Saunder Company | | |
| 2. | S.F.A.Kettle-CoordinationCompounds | | |
| 3. | B.N.Figgis-IntroductiontoLigandFields | | |
| 4. | A.B.P.Lever-InorganicElectronicSpectroscopy,Elsevier | | |
| 5. | C.J.Balehausen- IntroductiontoLigandFieldTheory,McGrawHill,1962. | | |
| 6. | G.Friedlander, G. Herrmann (auth.), Attila Vértes, Sándor Nagy, Zoltán  Klencsár, Rezső G. Lovas, Frank Rösch (eds.), HandBook of NuclearChemistry,2011,springers | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | |
| 1. | Coordinationcomplexes:<http://www.infocobuild.com/education/audio->  video-courses/chemistry/CoordinationChemistry-IIT-Kharagpur/lecture-18.html | | |
| 2. | Nuclearshellmodel:YouTubeVideos:  https://nptel.ac.in/courses/115/104/115104043/ | | |
| 3. | GMcounterslectureNotes:  https://qa.ff.up.pt/rq2020/Bibliografia/etc/geiger1.pdf | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | S | M | S | M | S | L | M | L | L |
| **CO2** | S | S | S | S | S | M | L | M | L | L |
| **CO3** | M | M | S | S | M | M | L | S | M | L |
| **CO4** | S | S | S | S | S | S | M | S | L | L |
| **CO5** | S | S | L | M | M | L | S | L | M | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-I** | | **CHEE101** | | **INORGANICREACTION**  **MECHANISM** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | **Elective** | | **3** | **0** | **0** | | **3** |
| **Pre-requisite** | | | Studentsshouldawareabout basicknowledgeofformationofmetalligandcomplexes,bondingandgeometriesandstabilities.Studentshouldalsoknowthe  basicsofchemicalbondingincludingmetalcarbonbondformation. | |  | | | | **R-2021** |
| **CourseObjectives:** | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Describetheeffortsofinorganicandorganometallicchemiststoapplyoldprinciplesanddevelopnewonesinanincrediblesetofcontexts * Illustrateshowligandsinfluencethestability,structuralandreactivitypropertiesof central metal atoms * Describevariousreactionpathwaysformechanismofformationofvariousgeometricsofmetalligandcomplexes * Giveknowledgeonthetheoryofelectrontransferprocessfromsimplemoleculestocomplexmolecules * Understandvarioustheoryonthestability of organometallic compoundsandtheirreactivitywithnucleophileandelectrophiliccompounds | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | |
| 1 | Knowmostcommonandimportantfuturesofoxidationofmetalscomplexesanditslabilityandinertnessintheaspectofkinetics  andthermodynamicofthecoordinationcomplexes | | | | | | | K1-K2 | |
| 2 | Understandtheformationofmetalcomplexesbondingandtoable  tostudythevariousreactionmechanisminvolvedininorganiccomplexalongwithtransinfluenceofligands | | | | | | | K2-K5 | |
| 3 | Gain more knowledge on the electron transfer/redox reactions invariousmetalcomplexes and understand the Marcus-Hushtheory,tobecomefamiliarwithsomeapplicationsof  photochemicalreactionofcoordinationcompounds | | | | | | | K3-K5 | |
| 4 | Comprehendthepotentialnewligandsandpredictthebinding | | | | | | | K2-K4 | |

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|  | | affinitytoitstarget | | | | |  |
| 5 | | Abletoelucidatethedifferenttypesofapplicationinmetalcomplexes and its reaction mechanism of different metal complexconcernedreactionsinorganometallicchemistry | | | | | K3-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | |
| **UNIT:1** | | | **INERTANDLABILEMETALCHEMISTRY** | | **20hours** | | |
| Reactivityofmetalcomplexes–Inertandlabilecomplexes–Explanationoflabilityonthebasisofvalencebondandcrystalfieldtheories–Metalioncatalysedreactionsandreactionmechanism,inducedreactionsandtheircharacteristics,applications – kinetics and mechanism of induced reaction in metal complexes, –Stabilization of unusual oxidation states in solution – Survey of oxidation stateswithvariouselectronicconfigurationoftransitionmetalsandinner-transition  metals | | | | | | | |
| **UNIT:2** | | | **SUBSTITUTIONREACTIONSINCOORDINATION**  **COMPLEXES** | | | **20hours** | |
| Reactionpathways–mechanismsofsubstitutionsinoctahedralcomplexes–Dissociative(D),Associative(A),andInterchange(I)mechanisms–Aquation(acidhydrolysis)–Acidcatalyzedaquationreactions,Anationreactions. Basehydrolysis, CB mechanism in octahedral complexes– Substitution reactions insquareplanarcomplexes,transeffect,theoriesandapplications–Isomerisationandracemisationreactions of coordination complexes; Electron transferreactions or redox reactions – two electron transfer reactions, Inner sphere andoutersphereprocesses,electron exchange reactions, complementary reactionsandnoncomplementaryreactions,Marcus-Hushtheoryandphotochemical  reactions | | | | | | | |
| **UNIT:3** | | | | **BASICCONCEPTSOFORGANOMETALLICCOMPOUNDSANDREACTIONMECHANISM** | | **20hours** | |
| Definition of Electron counting–Types of ligands and their classifications inorganometalliccompounds,Hapto-nomenclature–16and18electronruleanditslimitations – Metal carbonyls – Metal π-cyclic compounds; Oxidative addition,reductive elimination, insertion migration and rearrangement –salient featuresandevidences,ligandprotonation,electrophilicandnucleophilicattackonligands–C-Hactivation-orthometalationandcyclometalation,Fluxional  behaviourofmetalcomplexes | | | | | | | |
| **TotalLecturehours** | | | | | | **60hours** | |
| **TextBook(s)** | | | | | | | |
| 1. | Huheey,J.E.-InorganicChemistry,4thEdition,HarperandRow | | | | | | |
| 2. | Basolo,F.andPearson,R.G.-Mechanismof InorganicReactions,Wiley  Eastern | | | | | | |
| 3. | Purcell,K.F.andKotz,J.C.-InorganicChemistry,Saunders | | | | | | |
| 4. | D.F.ShriverandP.W.Atkins,InorganicChemistry,OxfordUniversityPress,5thEdition,2010 | | | | | | |
| 5. | J.D.Lee,ConciseInorganicChemistry,OxfordUniversityPress,5thEdition,2014 | | | | | | |
| 6. | F.A.CottonandG.WilkinsonAdvancedinorganicChemistry,JohnWiley&Sons,6thEdition,1999 | | | | | | |

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| **ReferenceBooks** | |
| 1. | Nyholm, R.S. and Tobe M.L., - The stabilisation ofoxidation state of theTransition metals, Advances in Inorganic and Radiation Chemistry, Volume 5(1963) |
| 2. | (a)J.Hartwig,OrganotransitionMetalChemistry:FromBondingtoCatalysis,University:ScienceBooks,Sausalito,CA,2010 |
| 3. | G.L.Miessler,P.J.Fischer,D.A.Tarr,InorganicChemistry,5thedn,Pearson,UpperSaddleRiver,NJ,2014 |
| 4. | R. H.Crabtree,TheOrganometallicChemistryof theTransition Metals,Vol.4,JohnWiley&Sons,Inc.,Hoboken,NJ,2005 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | |
| 1. | [https://www.youtube.com/watch?v=ez40OI](http://www.youtube.com/watch?v=ez40OIQrP60)QrP60 |
| 2. | [https://www.dalalinstitute.com/wp](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-[content/uploads/Books/A](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-[Textbook](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-of-Inorganic-Chemistry-Volume-1/ATOICV1-3-1-Inert-and-Labile-Complexes.pdf |
| 3. | https://link.springer.com/chapter/10.1007%2F978-1-4419-9276-5\_6 |
| 4. | [https://www.schoollearningresources.com/PDF/\_Lectures%208](http://www.schoollearningresources.com/PDF/_Lectures%208-10(1).pdf)-[10(1).pdf](http://www.schoollearningresources.com/PDF/_Lectures%208-10(1).pdf) |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | S | M | S | M | S | L | M | L | M |
| **CO2** | S | S | L | S | S | M | L | M | L | L |
| **CO3** | S | M | S | M | L | M | L | S | M | L |
| **CO4** | S | S | L | S | S | S | M | S | L | S |
| **CO5** | S | S | S | M | M | L | S | L | L | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-II** | **CHEC102** | | **MAINGROUPELEMENTSANDINORGANICPOLYMERS** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | | **Core** | | **4** | **0** | **0** | **3** |
| **Pre-requisite** | | Students should have basic knowledgeaboutunitcell,latticepoints,radiusratio,  basicsolidstructuresandpolymers | |  | | |  |
| **CourseObjectives:** | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Provideintroductionandoverviewoffundamentalpropertiesofsolids * Illustratetheimportanceofhavingdefectsinsolids * Tointerpretelectrical,opticalandmagneticpropertiesofionicsolids * Describebandtheoryandfreeelectrontheories * Explainsemiconductors,superconductorandmagneticpropertiesofvariouscompounds * Explaindifferenttypes,synthesis,structuralfeaturesandapplicationsof | | | | | | | |

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| silicates,silicones,isopolyandheteropolyacidsoftransitionmetals   * Make students to acquire the methods of preparation, nature of bonding,properties,applicationsofsulphurnitrogenandphospohorusnitrogencompounds * Explain preparation, properties, reactivity and application of various boranecompounds | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | |
| 1 | Learn different equations related to lattice energy calculation andanalyze the structures adopted by different ionic crystals. Studentsareexpectedtoexplaintheuniquepropertiesofsolidsdueto  varioustypesofdefects | | | K1-K4 |
| 2 | Analyzephysicalpropertiessuchaselectrical,magneticandopticalaspects of solids and properties of superconductors and  semiconductors | | | K4-K6 |
| 3 | Comparethetrendsinthesynthesisandpropertiesofmaingroup  elementsanddiscussthechemistryofSi,S,NandPbasedinorganicpolymers | | | K2-K5 |
| 4 | Understandthechemistryandapplicationsofboranes,carboranesand metalloboranes | | | K2-K3 |
| 5 | Elucidatevariousmethods of synthesis, properties andapplicationsofpolymetallateanions,isopolyandheteropolyacidsoftransitionmetalions | | | K3-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-Create | | | | |
| **UNIT:1** | | **STRUCTUREOFSOLIDS** | **20hours** | |
| Basics of structure of ionic solids – Dissolution of Ionic Solids – Derivation ofBorn-Lande and Born-Mayer equations-Kapustinski’s modification - entropy ofsolutionanditssignificance,latticeenergy–Structureofrutile,fluoriteantifluorite,zincblende,wurttzite,cadmiumiodideandnickelarsenide,spinelsandinversespinels-defectsinsolids,non-stoichiometriccompounds.  Electrical,magneticandopticalpropertiesofsolids–freeelectronsandbandtheory – semiconductors – superconductors – Ionic conductivity in solids - Solidelectrolytes-typesofmagneticbehaviour,dia,para,ferro,antiferroandferrimagnetism;Hysterisis–solidstatelasers–inorganicphosphors–ferrites–  garnets | | | | |
| **UNIT:2** | | **Si,S,NANDPBASEDINORGANICPOLYMERS** | **20hours** | |
| Chemistryofsilicon–classificationandstructureofsilicatesandsilicones–Synthesis,structure,reactivityandapplicationofpolysilanes–Preparation,structure,properties,reactivityandapplicationsofsulphurnitrogencompounds-  Phosphorusnitrogencompounds | | | | |
| **UNIT:3** | | **HIGHERBORANESANDPOLYOXOMETALATES** | **20hours** | |
| Chemistry of boron and its isotopes, neutron Capture Therapy – Preparation andstructure of borane and higher boranes – STYX numbers – Wade's and Wade's -Mingo'srule–Preparation,structure,propertiesandreactivityofcarboranes,metalloboraneandmetallocarboranes–IsopolyacidsofVanadium,Chromium,  Molybdenumand Tungsten– Heteropolyacids | | | | |

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|  | | **TotalLecturehours** | **60hours** |
| **TextBook(s)** | | | |
| 1. | Cotton,F.A.andWilkinson,L-AdvancedInorganicChemistry3rdand4th  Edition,John Wiley | | |
| 2. | EarnshawandGreenwood-ChemistryofElements | | |
| 3. | Huheey,J.E.,-InorganicChemistry,2ndEdition,HarperandRow,1976 | | |
| 4. | Concise Inorganic Chemistry,J.D.Lee | | |
| 5. | SolidStateChemistry andapplications- A.R.West(John Wileyand Sons) | | |
| 6. | PrinciplesoftheSolidState-H.V.Keer(WileyEasternLimited) | | |
| **ReferenceBooks** | | | |
| 1. | Hanney,N.D.-SolidStateChemistry,PrenticeHall,1967 | | |
| 2. | Greenwood,N.N.-IonicCrystals,LatticeDefectsandNon-Stoichiometry,Butterworths,1968 | | |
| 3. | A.F.Wells-StructuralInorganicChemistry | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | |
| 1. | https://nptel.ac.in/courses/104/104/104104101/ | | |
| 2. | https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cy16/ | | |
| 3. | [https://www.britannica.com/science/fluorocarbon](http://www.britannica.com/science/fluorocarbon-polymer)-polymer | | |
| 4. | <http://homes.nano.aau.dk/fp/uke/pdf/chapter12.pdf> | | |
| 5. | [https://www.dalalinstitute.com/books/a](http://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-)-[textbook](http://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-)-of-[inorganic](http://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-)-[chemistry](http://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-)-  volume-1/isopoly-and-heteropoly-acids-and-salts-of-mo-and-w-structures-of-isopoly-and-heteropoly-anions/ | | |
| 6. | [https://www.britannica.com/science/coordination](http://www.britannica.com/science/coordination-compound/Isopoly-and-)-[compound/Isopoly](http://www.britannica.com/science/coordination-compound/Isopoly-and-)-and-heteropoly-anions | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | L | M | S | M | M | M | M |
| **CO2** | S | S | S | S | M | M | S | M | L | L |
| **CO3** | M | M | S | M | S | M | L | L | M | S |
| **CO4** | S | S | S | S | S | S | M | S | L | L |
| **CO5** | M | S | L | L | M | L | S | L | M | M |

\*S-Strong;M-Medium;L-Low

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| **Semester-II** | **CHEC103** | | **INORGANICCHEMISTRYPRACTICAL–I** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | | **Core** | | **0** | **0** | **6** | **3** |
| **Pre-requisite** | | Basic knowledge on inorganic salts and  metalchelatedcomplexes | | **Syllabus**  **Version** | | |  |
| **CourseObjectives:** | | | | | | | |

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| Themainobjectivesofthispracticalcourseisableto:   * Identifyindividualtwocommonandrarecations,respectively,presentinthe given mixture of inorganic salts and reactions behind it through semimicroqualitativeanalysis * Develop the skill for systematic qualitative analysis with strong theoreticalbackround * To develop the skill for the estimation of various metal cations from themixturesthroughcomplexometrictitrations | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | |
| 1 | | Thestudents will develop the key technical skill related to the  quantitative determination of various metal ions throughcomplexometrictitrations | | | K3-K4 |
| 2 | | Learn the lab discipline and maintain high standards ofprofessionalandscientificethicsinthelaboratory | | | K1-K3 |
| 3 | | Learnquickidentificationofnatureofanyunknownmetalions | | | K1-K4 |
| 4 | | Developtheskilltopreparevariousunknownsolutionsandreagentsfortheirrespectiveexperiments | | | K2-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | |
|  | | | **(A)QUANTITATIVE ANALYSIS** | **30hours** | |
| Complexometric titrations using EDTA - Estimation of zn, Ca, Ni, Mg andHardnessandsoftnessofwater | | | | | |
|  | | | **(B) QUALITATIVE ANALYSIS** | **30hours** | |
| Semimicroqualitativeanalysisofmixturescontainingtwocommonandrarecations.  Thefollowingaretherarecationsareincluded:  Tl,Mo,W,Se,Te,Ce,Th,Ti,Zr,V,Be,UandLi.  *Note:*ExaminationtobeconductedforsixhoursandtoconsistofPart-ISemi-microqualitativeanalysisofonemixturecontainingthreerarecationsalongwith  onecommoncations. | | | | | |
|  | | | **TotalLecturehours** | **60hours** | |
| **TextBook(s)** | | | | | |
| 1. | Vogel'sTextbook of Macro and Semimicro Qualitative Inorganic Analysis,  ArthurIsraelVogel,ArthurIsraelVogel,G.Svehla,1979. | | | | |
| 2. | V.V. Ramanugam, Inorganic semimicro qualitative analysis, 3rd edition,  NationalPublishingcompany,1974. | | | | |
| 3. | ATextBookofQuantitativeInorganicAnalysis-A.I.Vogel6theditionLongman | | | | |
| 4. | Concise Inorganic Chemistry, J.D.Lee | | | | |
| 5. | InorganicSynthesis-R.A.RoweandM.M.Jones(1957)5,113–116. | | | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | L | S | M | L | L | L | M | L | L |
| **CO2** | L | L | L | M | L | L | M | S | S | S |
| **CO3** | M | M | S | M | S | M | L | L | M | S |
| **CO4** | S | M | S | L | L | L | S | L | M | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-II** | | | | | **UOMS147** | | **SOFTWARE PACKAGEFORCHEMISTS–MATLAB,ORIGINandCHEMDRAW** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | | | | **SOFTSKILS** | | **2** | **0** | **0** | | **2** |
| **Pre-requisite** | | | | | | Basicknowledgeonspreadsheets,simplematrix formation, programming and  chemicalstructures | |  | | | |  |
| **CourseObjectives:** | | | | | | | | | | | | |
| Themainobjectivesofthispracticalcourseisableto:   * UnderstandthebasicprinciplesofMATLAB,programmingandplotting * Illustratesvariousplottingfunctionsandformulatethegraphswithvariousfitting analysis * Drawthesimplechemicalstructuretocomplexstructureandmechanismofvarious chemicalreactions | | | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | | | |
| 1 | | Equip the students with deep knowledge on the matrix  programmingforvariouschemicalprocessandconvertrespectivedatafunctionsintoplots | | | | | | | | | | K1-K3 |
| 2 | | Learn various mathematical functions for various plot functionsincluding3Dplotsandgainknowledgeonthepeakfitting,whichisapplicablefor data analysis | | | | | | | | | | K3-K6 |
| 3 | | Developtheskilltodrawvariouschemicalcompounds,whichisapplicablefortheirprojectsandresearchfields | | | | | | | | | | K3-K5 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-Create | | | | | | | | | | | | |
| **UNIT:1** | | | **MATLAB** | | | | | | | | **15hours** | |
| Basic concepts of MATLAB – Important functions – Addition, multiplication andsubtractionof2x2,3x3and5x5matrix– Programming in MATLAB – Plotfunctionsandprogramming–2-Dplots(twovectors)and3-Dplotswiththree  vectors–Additional2Dplots | | | | | | | | | | | | |
| **UNIT:2** | | | | **ORIGIN** | | | | | | | **15hours** | |
| Spreadsheets–Basicoforigin–variousmathematicalfunctionsforplotting,statisticalcalculations–Drawingofvariousplotsanditsfunctions–Background | | | | | | | | | | | | |
| correctionfor various plots – Plot fitting, linear, exponential, Gaussian and  LorenTzianwithmultiplepeakfitting– Barchats-3Dplotting–errorbarsinplotting | | | | | | | | | | | | | |
| **UNIT:3** | | | | **CHEDRAW** | | | | | | | **15hours** | | |
| Basicconceptsofchemdraw–Functions–variousarrowsusedinthechemicalequations–conceptofdrawingofchemicalequations– Concepts of valance ofatomsinamolecules–Drawingofsimplemolecules,macromolecules,inorganiccomplex,organometalliccomplex,peptidesanddendrimers–drawingofcatalytic  cyclesandorganicreactionmechanism | | | | | | | | | | | | | |
|  | | | | **TotalLecturehours** | | | | | | | **45hours** | | |
| **TextBook(s)** | | | | | | | | | | | | | |
| 1. | AmosGilat,MATLAB:AnIntroductionwithApplications,4ed,2012 | | | | | | | | | | | | |
| 2. | S.N.Alam,S.S.Alam,UnderstandingMatlab:ATextbookfor Beginners,2019,DreamtechPress | | | | | | | | | | | | |
| 3. | JakeWoods,ChemdrawProfessional(TutorialUserGuide)KindleEdition,2019. | | | | | | | | | | | | |
| 4. | [https://www.originlab.com/doc/Tutorials](http://www.originlab.com/doc/Tutorials) | | | | | | | | | | | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | L | S | M | L | L | L | M | L | L |
| **CO2** | L | L | L | M | L | L | M | S | S | L |
| **CO3** | L | M | L | L | M | M | L | L | S | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-II** | | **UOMI001** | | **INTERNSHIP** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | | | **INTERNSHIP** | | **2** | **0** | **0** | **2** |
| **Pre-requisite** | | | Basic practical skill gained from twosemesters | |  | | |  |
| **CourseObjectives:** | | | | | | | | |
| Themainobjectivesofthispracticalcourseisableto:   * Providetheindustrialvisitandlearnthepossibleinstrumentaltechniques,whichwillbeusefulfortheirprojectsandresearch * Learnthebasicanalysisofthesimplecompoundstodeveloptheiranalyticalskills | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | |
| 1 | Betrainedsimpleanalyticaltestingforcompoundofinterest | | | | | | | K4 |
| 2 | Developthebasicunderstandingofthevarious instrumentalmethods | | | | | | | K2 |

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| 3 | Gain the infrastructure of the industries and  institutes/Universitiesintheacrossthecountry,whichhelpthemtoprosper their life in future | | | | K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-  Create | | | | | |
|  | | **INTERNSHIP** | | **45hours** | |
| Studentscanoptfortrainingprograminanappropriateindustry/corporate/Governmentorpublicsector/reputeduniversities/researchinstitutesacrossthecountryforaminimumofthreemonths.Priorregistrationismandatoryforinternshipthroughstudentadviser/programmecoordinatorwiththepermissionfromtheconsentorganizationwherestudentswillundergotheinternshipis  requiredandthesameshallbeevaluatedforgrading | | | | | |
|  | | | **TotalLecturehours** | **45hours** | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | S | M | M | L | L | L | M | L | L |
| **CO2** | L | S | L | M | L | L | M | S | S | L |
| **CO3** | L | S | L | L | M | M | L | L | S | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-III** | **CHEC101** | **PHYSICALMETHODSINCHEMISTRY** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | **Core** | | **4** | **0** | **0** | **4** |
| **Pre-requisite** | Students should know about the fundamentalaspects on spectroscopy and their importanceinthecharacterizationof chemicalcompounds. Basic knowledge on UV-Vis, IR,NMRandMassspectroscopictechniqueswill  beadvantageous. | |  | | |  |
| **CourseObjectives:** | | | | | | |
| Themainobjectivesofthiscourseareto:   * To provide the deep understanding of electronic structural changes of metalcoordinationcomplexesuponinteractionwithvisiblelight * Tounderstandbasictheoryandinstrumentationinvolvedintheoriginofspectroscopy * Understand UV, IR, NMR and Mass spectra and their significance in thecharacterizationoforganiccompounds * Illustrate the basic principle of splitting of spectral line of inorganic complexesinthepresenceofmagneticfielduponinteractionwith electromagneticradiation * Tounderstandroleofspectroscopy(UV,IR,NMR&Massspectroscopy)todeterminethestructureoforganiccompounds | | | | | | |

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| * TolearnESRandtheirimportanceinthecharacterizationofradicals * To understand basic theory&instrumentationinvolvedwithanalyticaltechniquesforcharacterizationandimaging | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | |
| 1 | Interpretationofvariousabsorptionbandinthevisible,IRandmicrowaveregiontounderstandthestructuralbonding,geometry  andreactivityofinorganiccoordinationcomplexes | | | K1-K4 |
| 2 | To understand the basic concept, interpretation and application ofelectronic spectra of hydrogen and many electron atoms also toderiveangularmomentumofmanyelectronatomsandterm  symbolsofatoms | | | K2-K4 |
| 3 | Knowledgeofcrystal,vibrational,thermal,ATRandimagingmodestocharacterizechemicalcompounds | | | K3-K4 |
| 4 | UnderstandbasictheoryaswellasinstrumentationtechniquesforrecordingUV,IR,NMR,ESR,MS,XRD,Raman,Mossbauerand  Thermalspectraofchemicalcompounds | | | K2-K5 |
| 5 | Interpretation of UV, IR, NMR, TGA, DSC, XRD, Raman,Mossbauer,ESRandMSspectraofcompoundstounderstandtheir  structuralcharacteristics | | | K2-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-Create | | | | |
| **UNIT:1** | | **ELECTRONICSPECTROSCOPY(PHYSICAL&INORGANICCHEMISTRY)** | **18hours** | |
| Spectraofhydrogenandmanyelectronatoms,angularmomentumofmanyelectronatoms, term symbols, spectra of many electron atoms- Zeeman effect. Spectra ofdiatomic molecules, Representation of electronic states through potential energydiagrams-FrankCondon principle.  Intensities of electronic transitions- theoretical treatment of absorption intensities,transitiondipolemomentintegral,oscillatorstrength,selectionrulesparity,spinandsymmetry considerations, Factors inducing forbidden transitions vibronic and spinorbitcoupling, polarization bands.  Spectraofformaldehyde,butadieneandbenzene–grouptheoreticaldiscussion.Electronicspectraofinorganiccomplexes–Selectionrules(Laporte,orbitalandspinselectionrules),bandintensities,bandwidths,spectrainsolids,spectraofaqueous  solutionsofd1-d9ionsinOhandTdenvironments | | | | |
| **UNIT:2** | | **MOSSBAUER&RAMANSPECTROSCOPY,X-RAYANDTHERMALMETHODSOFANALYSES(ANALYTICAL**  **CHEMISTRY)** | **18hours** | |
| Mossbauerspectroscopy:Introduction,principle,instrumentation,recoilenergy,Doppler effect, number of MB signals, isomer shift, quadrupole splitting, magnetichyperfinesplittingapplicationsto57Fe,119Snand129Icompounds  Raman Spectroscopy: SERS, SERRS. ATR techniques – UV, IR, Raman. Principle &application of ORD and CD in the identification of complexes. 3D, 4D & 5D NMRimagingtechniques;X-raydiffraction– Bragg equation, space groups and pointgroups,diffractionmethods.Thermalmethodsofanalysis–TGA,DTAandDSC–  Principleandapplications | | | | |
| **UNIT:3** | | **NUCLEARMAGNETICRESONANCE(ORGANIC**  **CHEMISTRY)** | **18hours** | |

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| Origin of NMR spectrum-Nuclear spin states – NMR active nuclei – Nuclear magneticmoment–Larmorequation – Absorption of energy and Resonance – Populationdensity of nuclear spin states. Saturation phenomena – Relaxation mechanisms,Blochequation(onlysignificance and derivation not required). Comparison of CWandFTinstrument–Chemicalshift-StandardsinNMR–ShieldingandDe-shielding  –Factorsaffectingchemicalshift–electronegativity,hybridization,hydrogenbonding  -anisotropiceffect–double,triplebond,aromaticcompoundsandcarbonylcompounds.Spin-spincoupling–splittingoriginandrules– factors affectingcouplingconstant:cis,trans,gem,ortho,meta,paracoupling–exchangewithdeuterium. Vicinity of the proton, Long range coupling, Karplus equation and curve.1J, 2J, 3J, 4J and 5J coupling in NMR, order of NMR spectrum. Spin systems: Twointeracting nuclei: A2, AB, AX, AA’BB’, dd, pair of doublet, AB quartet. Threeinteractingnuclei:AMX,ABX,ABCsystems(onlypatternisrequired).SimplificationofcomplexNMRspectra-Lanthanideshiftreagents,CIDNPandNOE. Basicprinciples andapplicationsofVT NMR&MRI.  13C NMR – difficulties in recording 13C NMR: Homo nuclear and heteronuclearcoupling.Decouplingtechnique:SFORDandOffResonancedecoupledspectrumidentificationofvarioustypesofcarbonusing13CNMR.APT&DEPTspectra(DEPT-45, DEPT-90 and DEPT-135). 19F NMR Precessional frequency and heteronuclearcoupling. Identification of organofluoro compounds (CF3CO2Et and CF3CH2OH)using NMR. 31P NMR – Chemical shift and heteronuclear coupling. Identification oforganophosphoruscompoundssuchas(CH3)3P,(C2H5O)2P=OandPh3P.P-Pbond  inNMR.Basicprinciplesof2DNMR(COSY,NOSEY,HSQC&HMBC) | | |
| **Unit:4** | **UV,IR,MS(ORGANICCHEMSITRY)&ESR(INORGANIC**  **CHEMSITRY)** | **18hours** |
| Electronicabsorption-Beer-Lambertslaw,Typesofelectronicexcitation.ChromophoreandAuxochrome-BathochromicandHypsochromicshifts.UV-visspectra of simple organic compounds such as alkenes, phenols, anilines, carbonylcompounds and 1,3-diketones. Woodward and Fieser rule for calculation of λ-maxvaluesofdienesandunsaturatedketones.  InfraredSpectra:IdentificationoffunctionalgroupsinOrganicCompounds,Fingerprintregion.InterandIntramolecularhydrogenbonding  Origin,basicsandblocdiagramofMassspectrum-VarioustypesofIonizationtechniques-StabilityofMolecularions,Metastableions.BasepeaksandIsotopepeaks.Fragmentationpatternsoforganicmoleculessuch as benzenes, phenylhalides, phenols, benzyl alcohols, benzyl halides, aliphatic alcohols, aliphatic as wellas aromatic aldehydes, ketones, acids, esters and amides. Fragmentation patterns ofaliphatic/aromaticnitroandaminecompounds.Fragmentation patterns ofheterocycliccompounds(furan,pyrroleandpyridineonly). McLaffertyrearrangementsoforganicmolecules.  StructuraldeterminationofOrganicCompoundsusingUV,IR,NMRandMassSpectra.  ESRSpectraofd1-d9TransitionMetalComplexeswithexamples.Interpretationofgincubic,axialandrhombohedralgeometries.Calculationofgvalueswithsimpleexamples.Intensitiesof‘g║andg┴peaks.EvidenceforMetal-LigandBondCovalency-Cu(II)- Bis –Salicylaldimine, Bis-Salilcylaldoximatocopper(II)[(NH3)5CoO2CoNH3)5]5+,Cu(II)-diethyldithiophosphinate,Vanadyldithiophsphinate, Copper(II) tetraphenylporphyrin, Co(II)- phthalocyanine,  K2[IrCl6].Interpretationof‘g’and‘A’valuesfromesrspectraldatain-i)MnF6 4-,ii) | | |

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| CoF64-,andCrF63-. | | | |
|  | | **TotalLecturehours** | **72hours** |
| **TextBook(s)** | | | |
| 1. | Chang,R(1971);BasicPrinciplesofSpectroscopy,McGrawHill,ISBN-13:978-007010517 | | |
| 2. | Banwell, C. N.; McCash, E. M (1994); Fundamentals of MolecularSpectroscopy,IVthEd,McGrawHill,ISBN0-07-707976-0 | | |
| 3. | Kemp,W.(2016);OrganicSpectroscopy,3rdEd,Palgrave | | |
| 4. | Kalsi,P.S(2016);SpectroscopyofOrganicCompounds,7thEd,NewAge  International | | |
| 5. | Silverstein, R. M, Webster,F. X, Kiemble, D. J, Bryce, D. L (2015);  SpectrometricIdentificationofOrganicCompounds,8thEd,Wiley | | |
| 6. | JagMohan(2016);OrganicSpectroscopyPrinciples&Applications,3rdEd,  NarosaPublishingHouse | | |
| **ReferenceBooks** | | | |
| 1. | Pavia,L,Lapman,G.M,Kriz,S,Vyvyan,J.-R(2015);IntroductiontoSpectroscopy,CengageLearning,ISBN13:978-81-315-2916-4 | | |
| 2. | RussellS.Drago,R.S(2016),PhysicalMethodsforChemists,IIEd | | |
| 3. | Huheey,J.E.;Keiter,E.A.;Keiter,R.L.;Medhi,O.K(2006);InorganicChemistry:PrinciplesofStructureandReactivity,IVthEd,PearsonEducation | | |
| 4. | Skoog,D.A;Holler,F.;Crouch,S(2017);PrinciplesofInstrumentalAnalysis,7thEd,Brooks/Colepublisher | | |
| 5. | Ebsworth,E.A.V.;Rankin,D.W.H.;Craddock,S(1986);StructuralMethodsinInorganicChemistry,Wiley-Blackwell,ISBN-13:978-0632015924 | | |
| 6. | Willard,H.H.;Merritt,L.L.Jr.;Dean,J.A.;Settle,F.A.Jr.(2004);InstrumentalmethodsofanalysisCBSPublishers&Distributors;7thEd,  [ISBN13:9780534081423](https://www.abebooks.com/products/isbn/9780534081423/30739525494%26cm_sp%3Dsnippet-_-srp1-_-PLP1) | | |
| 7. | Macomber, R. S (1998); A complete introduction to Modern NMR  Spectroscopy,JohnWiley,ISBN:0-471-15736-8 | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | |
| 1. | <https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf> | | |
| 2. | <https://www2.chemistry.msu.edu/courses/cem351/FS16_HUANG/Lecture_Presentation/Ch_10_Lecture_Presentation.pdf> | | |
| 3. | <https://www.slideshare.net/siraj174/sir-aj-nmr-spectroscopy-lecture> | | |
| 4. | <http://web.iyte.edu.tr/~serifeyalcin/lectures/chem305/cn_1.pdf> | | |
| 5. | <https://www.youtube.com/watch?v=qtpVfccYEHE&t=98s> | | |
| 6. | <http://www.digimat.in/nptel/courses/video/104106122/L54.html> | | |
| 7. | <https://pubs.rsc.org/en/content/articlelanding/2018/cs/c6cs00565a> | | |
| 8. | https://chem.libretexts.org/Bookshelves/Physical\_and\_Theoretical\_Chemistry\_Textbook\_Maps/Supplemental\_Modules\_(Physical\_and\_Theoretical\_Chemistry)/Spectroscopy/Magnetic\_Resonance\_Spectroscopies/Electron\_Paramagneti  c\_Resonance/EPR%3A\_Application | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | L | S | S | M | M | L | L | L | L |
| **CO2** | S | M | S | M | L | S | L | M | M | L |
| **CO3** | S | M | L | M | S | M | L | L | M | L |
| **CO4** | L | S | M | S | M | L | M | M | S | L |
| **CO5** | L | M | S | M | L | M | S | L | M | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-III** | | | **CHEC104** | | **INORGANICCHEMISTRYPRACTICAL–II** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | | **Core** | | **0** | **0** | **6** | | **3** |
| **Pre-requisite** | | | | Basic knowledge on volumetric and  complexometrictitrationsandgravimetricanalysis. | |  | | | |  |
| **CourseObjectives:** | | | | | | | | | | |
| Themainobjectivesofthispracticalcourseisableto:   * Learntheorybehindthesolubilityandextractionofvariousoresandalloys * Designexperimentalprocedureonoresandalloys * Interprettheresultsanddemonstratestheskillofchemicalanalysisofdifferentoresandalloyscompounds | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | |
| 1 | Developtheskillsforgravimetricandvolumetricanalysisofores  andalloys | | | | | | | | | K3-K4 |
| 2 | Acquiretheskillstopresenttheexperimentaldatasanddetermine  thepercentagepurityofvariousmetalandcompoundsintheoresand alloys | | | | | | | | | K1-K3 |
| 3 | Learn various separation and analytical techniques for theseparationandestimationofmetalandcompounds | | | | | | | | | K2-K4 |
| 4 | Animpartingknowledgeonquantitativeinorganicanalysisofores,alloys helps to design the analysis of various compound mixturesinindustries | | | | | | | | | K5-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-Create | | | | | | | | | | |
|  | | **(A)ANALYSISOFORES** | | | | | | | **30hours** | |
| Compositionand analysis of Dolomite, Bauxite, Ilminite, galena, pyrites, and  pyrolusitefortheirmajorconstituentsusingoneofthestandardmethodsofanalysisanddeterminationofpurityofcorrespondingmetalormetaloxides | | | | | | | | | | |
|  | | **(B)ANALYSISOFALLOYS** | | | | | | | **30hours** | |
| Composition,Properties,usesandanalysisof:Brass,BronzeSolder,StainlessSteelandSilvercoinfortheirmajorconstituentsusingoneof the standardmethodsofanalysisdeterminationofpurityofcorrespondingmetals. | | | | | | | | | | |

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|  | | **TotalLecturehours** | **60hours** |
| **TextBook(s)** | | | |
| 1. | Vogel'sTextbookofMacroandSemimicroQualitativeInorganicAnalysis,G.  Svehla,Vogel’squalitativeInorganicanalysis,VIEdition,OrientLongman,1987. | | |
| 2. | V.V. Ramanugam, Inorganic semimicro qualitative analysis, 3rd edition,NationalPublishingcompany,1974. | | |
| 3. | J.Basset,R.C.Denney,G.H.JefferyandJ.MendhamVogel’sTextbookof  quantitativeinorganicanalysis,IVEdition,ELBS,1985. | | |
| 4. | D.N. Grindley, An advanced course in practical Inorganic Chemistry,  Butterworths,1964. | | |
| 5. | W.G.Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold  Co.,London, 1972. | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | L | L | M | L | M | L | L |
| **CO2** | S | M | L | M | L | S | M | S | S | M |
| **CO3** | M | M | S | M | S | M | L | L | M | S |
| **CO4** | S | S | S | L | M | L | S | L | M | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-III** | **CHEC105** | | **INORGANICCHEMISTRYPRACTICAL–III** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | | **Core** | | **0** | **0** | **6** | **3** |
| **Pre-requisite** | | Knowledge on bonding and theorycoordinationcomplexesandprinciplesof  variousinstrumentationtechniques | |  | | |  |
| **CourseObjectives:** | | | | | | | |
| Themainobjectivesofthispracticalcourseisableto:   * Motivatethestudentstounderstandthebasicprinciplesandsyntheticskillforthepreparationofvariousmetalligandcoordinationcomplexes * Gainfamiliaritywithavariety of instrumental techniques to understandthebondingandgeometryofmetalcomplexes * Providethebasicknowledgefortheinterpretationofrequiredinstrumentaldatastounderstandthestructureandbondingof metalcomplexes * Developtheabilityofscientificcommunicationsthroughoralquizzes,writtenreportsandpresentations. * Learnthetechnicalskillforthecrystallizationofmetalcoordinationcomplexes. | | | | | | | |

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| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | | |
| 1 | | Studentswillgainexperienceinsomescientificmethodsemployedinbasicandappliedinorganicchemistry | | | | | | | | | K1-K3 |
| 2 | | Theskillsinwriting neat experimental procedures andinstrumentalmethodsappliedinanalyticalandpracticaltaskofinorganicchemistrywillbedeveloped | | | | | | | | | K3-K6 |
| 3 | | Gainingexperienceinvarioussyntheticmethodsforthemetalcoordinationcomplexeswillenablethestudenttodesignthe  advancedmaterialsneedforthesociety | | | | | | | | | K2-K4 |
| 4 | | Studentswilllearnthekeyinstrumentaltechniqueswouldgreatly  assistthemtosolvethecomplexproblemintheirresearchfiled | | | | | | | | | K5-K6 |
| 5 | | Thelaboratoryskillsandinterdependentworkingcultureduring  thepracticalsessionwillenablethestudentstoworkindiverseteamtoachievedeliverableoutcomeinaassignedresearch/project | | | | | | | | | K3-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | | |
|  | | | **INORGANICCHEMISTRYPRACTICALIII** | | | | | | | **60hours** | |
| 1. Chromatographictechniques;paper,thinlayerandionexchangechromatographic methods for the separation and estimation of inorganiccompounds. 2. StudyofComplexcompounds:    1. Synthesisandanalysisofcomplexcompoundsanduseofspectroscopictechniques(IR,NMR,ESR,MS,UV)forcharacterizationofcomplex       1. Sodiumhexanitrocobalt(III)       2. Tris(ethylenediamine)cobalt(III)chloride       3. Chloropentamminecobalt(III)chloride       4. Bis(acetylacetanato)copper(II)       5. Hexamminecobalt(III)chloride       6. Hexamminenickel(II)chloride       7. Bisthiocyanato(S)pyridineMn(II)       8. Bisthiocyanato(S)pyridineCu(II)       9. Bis(ethylenediamine)Cu(II)chloride       10. Tris(ethylenediamine)Ni(II)chloride    2. Determinationofcompositionandformationconstantsbyabsorption.pH-metricandpolarographictechniques,magneticsusceptibilitymeasurement | | | | | | | | | | | |
|  | | | **TotalLecturehours** | | | | | | | **60hours** | |
| **TextBook(s)** | | | | | | | | | | | |
| 1. | Vogel'sTextbookofMacroandSemimicroQualitativeInorganicAnalysis,G.Svehla,Vogel’squalitativeInorganicanalysis,VIEdition,OrientLongman,1987. | | | | | | | | | | |
| 2. |  | Chemistry Experiments for InstrumentalHeinemanandJ.M.Beebe. | | | | | Methods:- | D.T. Sawyer, W.R. | | | |
| 3. | J.Basset,R.C.Denney,G.H.JefferyandJ.MendhamVogel’sTextbookof  quantitativeinorganicanalysis,IVEdition,ELBS,1985. | | | | | | | | | | |
| 4. |  | D.N. Grindley, AnButterworths,1964. | | advanced | course | in | practical | Inorganic | Chemistry, | | |
| 5. | W.G.Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold | | | | | | | | | | |

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|  | Co.,London,1972. |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | s | M | M | M | M | S | S |
| **CO2** | S | M | S | M | L | S | M | S | S | M |
| **CO3** | M | M | M | M | S | M | L | L | M | S |
| **CO4** | S | S | S | L | M | L | S | L | M | L |
| **CO5** | S | M | S | M | L | S | M | S | S | M |

\*S-Strong;M-Medium;L-Low

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| **Semester**  **-1** | | **CHEE601** | | **BIOLOGICALCHEMISTRY** | **L** | **T** | **P** | **C** |
| **Core/Elective**  **/Supportive** | | | **Elective** | | **4** | **0** | **0** | **3** |
| **Pre-requisite** | | | Student able to understand the role of bio-organic compounds. Students should knowaboutthefundamentalaspectsonbiologicalsystem,mechanism,kineticsand  analyticaltools. | |  | | |  |
| **CourseObjectives:** | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Tounderstandthefunctionofcarbohydrateinbiologicalchemistry,determinationofringsizeandstudyofstarchandcellulose * To understand the significances of amino acids, proteins nucleic acids inbiologicalsystem. * Illustratetheimportanceofthevariouselementsinthebiologicalsystemandtogainmoreinsightsintothebindingofmetalcomplexeswithbiomacromolecules and transport and storage mechanism involving in themetalloenzymes. * To understand the role of heavy metals in the human body- therapeutic andtoxicitylevels. | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | |
| 1 | Tolearnaboutstructuralandfunctionsofcarbohydrates,lipids,membranes,aminoacids,proteins,antibioticsandvitamins | | | | | | | K1-K5 |
| 2 | UnderstandstructureandbiologicalimportanceofRNAandDNA | | | | | | | K2-K4 |
| 3 | Understand the key function of metal ions such as Fe, Co, Ni, ZnandCuinlivingsystem,particularlyintransports(energyandO2),storage,electron-andprotontransfer,hydrolysis,etc.whichare  takingplaceattheactivesiteofmetalloproteinsandenzymes | | | | | | | K1-K4 |
| 4 | Toxicityofmetalsandtheireffectsinthebiologicalsystem | | | | | | | K1-K4 |
| 5 | Toevaluatetoxicityofdrugsusedincancerandradiodiagnosis | | | | | | | K5-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | |

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| **UNIT:1** | **BIO-ORGANICCHEMISTRY** | **15hours** |
| **Carbohydrates**: Pyranose and furanose forms of aldo-hexose and ketohexose-methodsusedforthedeterminationofringsize-conformationofaldo-hexopyranose-structureandsynthesisoflactoseandsucrose.Abrief study ofstarchandcellulose.  **Lipids and Membranes**: Molecular structure of lipids. Fatty Acids, Triglycerides.Typesofmembranelipids  **Amino acids and Proteins:** Amino acids and Protein structure, Analysis of N-terminalandC-terminalsinapolypeptide.Sangermethod,EdmandegradationandEnzymaticanalysis.Primary,secondaryandtertiarystructureofproteins.Structureofcollagen,myoglobinandhaemoglobin.  **Nucleic acids:** Chemistry of nucleic acids, nucleosides and nucleotides –  StructureRNAandDNAandtheirbiologicalimportance.  **Biomolecules:Antibioticsandvitamins:**Adetailedstudyofstructure,andstereochemistry of penicillin, cephalosporin. Chemistry and physiological action ofascorbicacid,thiamin,riboflavinandpyridoxine–Elementaryaspectofvitamin  A,E,KandB12 | | |
| **UNIT:2** | **BIO-INORGANICCHEMISTRY** | **15hours** |
| Essentialandtracemetalions:Enzymes-Nomenclatureandclassification–Coenzymes - Vitamin B12, Carboxypeptidase andSuperoxide dismutase – Heme-enzyme - Peroxidase and catalases. Oxygen carriers: Hemeproteins - Hemoglobin,myoglobin - Structure Oxygenation and stereochemistry - Bohr effect. Non-hemeoxygen carriers - Hemerythrin and hemocyanin. Nitrogen fixation: Introduction,types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters innitrogenase - redox property - Dinitrogen complexes - transition metal complexesofdinitrogen-nitrogenfixationvianitrideformationandreductionofdinitrogento ammonia. Biological redox systems: Cytochromes -Classification, cytochromea, b and c. Cytochrome P- 450. Transport of electrons:Iron-Sulphur Proteins:RubredoxinsandFerredoxins,StructuralandSpectralfeaturesofIron-Sulphur  Proteins.Photosynthesisandchlorophyll’s | | |
| **UNIT:3** | **BIO-PHYSICALCHEMISTRY** | **15hours** |
| Thermodynamicsandbiology-Basicconceptsofstructureandfunctionality-membranes-structure,functiontransportproperties,aspectsofelectrochemicalphenomena – active transport, ionophores, biological energy storage systems –stepwise mechanism of photosynthesis versus potential. Enzymes - Nomenclatureandclassification,chemicalkinetics,thefreeenergyofactivationandtheeffectsofcatalysts,kineticsofenzymecatalyzedreactions–Michaelis-Mentenequation  -EffectofpH,temperatureonenzymereactions,Factorscontributingtothecatalytic efficiency of enzymes. Membranes - Phase Equilibria, Donnan effect,DonnanPotential,PhasetransitioninLipidbilayers,Freeenergydeterminationfor ATP hydrolysis from sodium-potassium pump, Allosteric effects – Monod-Wyman-Changeux Theory, Assigning of Statistical weights for Helix-Coil  transitioninproteins,Studybyspectroscopicmethods | | |
| **UNIT:4** | **BIO-ANALYTICALCHEMISTRY** | **15hours** |
| Essentials of trace elements and chemical toxicology: Trace elements in biologicalsystem. Metal ion toxicity - classes of toxic metal compounds– detoxification.Metalsinmedicine:Anti-arthritisdrugs–AuandCuinrheumatoidarthritis–Liinpsychiatry–Pt,Auandmetallocenesinanti-cancerdrugs-metalsinradio  diagnosis,radiotherapyandmagneticresonanceimaging.Transportandstorage | | |

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| ofmetals:Mechanism–Fe,Cu,ZnandVstorageandtransport–metallothioeins.  Molecularmechanismofirontransportacrossthemembrane–sodiumandpotassiumionpumps.Pollutionstudies–Effluentandwatertreatment | | | |
|  | | **TotalLecturehours** | **60hours** |
| **TextBook(s)** | | | |
| 1. | Zubay,G,L.(1997);Biochemistry,4thedition,Brown(WilliamC.)Co | | |
| 2. | Nelson,D,LLehninger,A,LCoxM,M.(2008);PrinciplesofBiochemistry,5th  Edition,NewYork:W.H.Freeman | | |
| 3. | JohnMcMurray,(2008);OrganicChemistry,8thedition,Brooks/Cole | | |
| 4. | Finar,I.L.Vol2(2018);OrganicChemistry:StereochemistryandtheChemistryofNaturalproduct,IIIrdEd,Pearson | | |
| 5. | [Williams](https://www.amazon.com/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=David%2BR.%2BWilliams&text=David%2BR.%2BWilliams&sort=relevancerank&search-alias=books)D.R.(1976);IntroductiontoBioinorganicChemistry,Thomas,ISBN-13:978-0398034221 | | |
|  | | | |
| **ReferenceBooks** | | | |
| 1. | Kaim,W,Schwederski,B,Klein,A.(2013);Bioinorganicchemistry:InorganicElementsinthechemistryoflife,2ndedition,Wiley | | |
| 2. | DasAsimK.(2007);BioinorganicChemistry,1stedition,BooksandAllied(P)  Limited | | |
| 3. | MugherjeeG.N,ArabindaD,(1993);ElementsofBioinorganicChemistry,4th  Edition,U.N.Dhur&SonsPvt.Ltd | | |
| 4. | SatakeM. Mido Y. (1996); Bioinorganic Chemistry, ISBN 81-7141-301-1,  DiscoveryPublishingHouse,NewDelhi | | |
| 5. | Eichorn,G,(1973);InorganicBio-ChemistryVol.IandII,IVEd,Elsevier | | |
| 6. | Zhimin,T,(2008);AnalysisofCytotoxicityofAnticancerDrugs,VDMVerlagDr.MuellerE.K.ISBN:9783639063486,3639063481 | | |
|  | | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | |
| 1. | <https://www.youtube.com/watch?v=iuW3nk5EADg> | | |
| 2. | <https://www.youtube.com/watch?v=aeC7M9PDjQw> | | |
| 3. | <https://www.youtube.com/watch?v=DhwAp6yQHQI> | | |
| 4. | <https://www.youtube.com/watch?v=ZqoX2W1N6l0> | | |
| 5. | [https://www.youtube.com/watch?v=lsNalwRnaq0&list=PLbMVogVj5nJSHhL\_](http://www.youtube.com/watch?v=lsNalwRnaq0&list=PLbMVogVj5nJSHhL_)  cMKfzLv556ddrIT90 | | |
| 6. | [https://www.youtube.com/watch?v=pXztk04J7u0&list=PLFW6lRTa1g83](http://www.youtube.com/watch?v=pXztk04J7u0&list=PLFW6lRTa1g83-)-  gUOcT3ay875UG3a9Mu11 | | |
| CourseDesignedBy: | | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | M | L | M | M | M | M | M | L | M |
| **CO2** | L | M | L | S | L | M | L | M | M | M |
| **CO3** | L | L | M | S | L | L | M | L | L | M |
| **CO4** | L | L | L | M | L | M | L | M | L | L |
| **CO5** | M | L | M | M | L | L | M | L | L | S |

\*S-Strong;M-Medium;L-Low

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| **Semester**  **-III** | | | **CHEE602** | | | **PHOTOCHEMISTRYAND**  **NANOMATERIALS** | | | | | **L** | | **T** | **P** |  | **C** |
| **Core/Elective/Supportive** | | | | | **Elective** | | | | | | **4** | | **0** | **0** | | **3** |
| **Pre-requisite** | | | | | Students are expected to have basic idea aboutphotochemistry, various reactive intermediatesgeneratedduringchemicalreactionsandorganometallic complexes. They should knowaboutthebasicquantumchemistrytounderstandpreliminaryideaofNanomaterials  anditsproperty | | | | | |  | | | | | **R-2021** |
| **CourseObjectives:** | | | | | | | | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * To recall and understand the fundamental concepts of photochemistry andprinciplesoffluorescencespectroscopyforinvestigatingphotophysicalphenomena. * Illustratedifferentphotochemicalreactionsofcoordinationandorganometalliccomplexes * Knowledgeonthefasterreactionkineticsstudies. * To know various techniques employed for the capturing of reactive transientspeciesinareaction * Basicunderstandingofsizedependentpropertiesinnanoscalematerials * Describeaboutnanosystems,theirproperties,synthetic methods,structureandapplications * Tomakethemlearndifferentanalyticaltechniquesofmicroscopytocharacterize nanomaterials | | | | | | | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | | | | | | | |
| 1 | Distinguishdifferentphotochemicalprocessessuchasfluorescence,phosphorescence,non-radiativedecayetc. | | | | | | | | | | | | | | K2-K3 | |
| 2 | Understandtheeffectofenvironmentslikesolvents,neighbouringmoleculesonphotochemicaldecayprocessesofmolecules | | | | | | | | | | | | | | K1-K2 | |
| 3 | Quantifytheparameterofdecaykineticsafterphoto-excitation | | | | | | | | | | | | | | K3-K4 | |
| 4 | Compareradiation | | | photolytic | | techniques | induced | by | light | and | ionizing | | | | K3-K5 | |
| 5 | Elucidatevariousmethodsofsynthesis,propertiesandapplicationsof nanomaterials | | | | | | | | | | | | | | K5-K6 | |
| 6 | Toillustratesthebasiccomponentsofanartificialphotosyntheticsystemassembledindifferentways | | | | | | | | | | | | | | K3-K6 | |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | | | | | | | |
| **UNIT:1** | | **PHOTOPHYSICALPHENOMENA** | | | | | | | | | | **20hours** | | | | |
| Fundamentals of photochemistry – photochemical laws – emission of radiations –types of photophysical pathways – delayed fluorescence – basic instrumentation ofsteady-state and time-resolved fluorometer – fluorescence emission, solvent andenvironmentaleffects,red-edgeeffects,effectsofintermolecularphotophysicalprocessesonemission–staticanddynamicquenching,Stern-Volmerkinetics–  emission anisotropy – electron transfer probes – energy transfer in multiple | | | | | | | | | | | | | | | | |

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| acceptors | | | | |
| **UNIT:2** | | **PHOTOCHEMISTRYOFINORGANICCOMPLEXES** | | **20hours** |
| Inorganicphotochemistry–photoredoxandisomerizationprocess–Photosubstitutionreactions–photosensitizationreactions–photochemistryinenergyconversion,applicationofmetalcomplexesinsolarenergyconversion;organometallicphotochemistry–photochemicalreactionsinmetalcarbonyls;Photochemicaltechniques–flashphotolysis–lasersinphotochemistry;radiation  chemistry–primaryprocesses–trackeffects–dosimetry–pulseradiolysis | | | | |
| **UNIT:3** | | **NANOSCALEMATERIALS** | | **20hours** |
| Definition of a nano system - classification of nanoscale materials - dimensionalityandsizedependentphenomena–Quantumeffect–Nanoscaleeffectsinsizedependentvariationinmechanical,physicalandchemical,magnetic,electronictransport,reactivity–Methodsofpreparation.ToptodownandBottom upapproach–Mechanical,PhysicalandChemicalmethods;Structuralcharacterization;differenttypesofelectronicspectroscopy–Elementalcomposition;Electronspectroscopies–Morphologicalcharacterization–Electron  microscopy;SEM–TEM–Forcemicroscopies;Applicationofnanoscalematerials | | | | |
|  | | **TotalLecturehours** | **60hours** | |
| **TextBooks** | | | | |
| 1. | PhysicalChemistry:D.W.Ball | | | |
| 2. | Flashphotolysisandpulseradiolysis-R.V.Bensasson,E.J.LandandT.G.Truscott,PergamonPress | | | |
| 3. | Fundamentalsofphotochemistry-K.K.RohtagiandMukherjee,NewAgeInternational(P)Ltd.Publishers | | | |
| 4. | TheexplorationofSupramolecularsystemsandNanostructuresbyphotochemicaltechniques,Volume78,PaolaCeronieditor,Springer | | | |
| 5. | Nanomaterials:Anintroductiontosynthesis,propertiesandapplication,DieterVollath,WILE-VCH,2008 | | | |
| 6. | Adamson,A.W-,andFleischauer,P.D.,(Editors)“ConceptsofInorganic  Photochemistry,"Wiley-Interscience,NewYork,1975. | | | |
| **ReferenceBooks** | | | | |
| 1. | TheoreticalChemistrybyS.Glasston | | | |
| 2. | ModernAspectsofInorganicChemistry-H.J.EmeleusandA.G.Sharpe | | | |
| 3. | Fundamentals ofRadiation Chemistry-A. Mozumder,Academia Press | | | |
| 4. | Nanostructures&Nanomaterials: Synthesis, Properties &Applications” G.  Cao,ImperialCollegePress,2004 | | | |
| 5. | Balzani,V.,andCarassiti,V.“PhotochemistryofCoordinationCompounds,”  AcademicPress,NewYork,1970 | | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | | |
| 1. | [https://www.youtube.com/watch?v=hIHNUVBvVkU](http://www.youtube.com/watch?v=hIHNUVBvVkU) | | | |
| 2. | H. Hennig,D. Rehorek,R.D. Archer.Photocatalytic systems with light-sensitivecoordinationcompoundsandpossibilitiesoftheirspectroscopic  sensitization—anoverview.CoordinationChemistryReviews1985,61,1-53 | | | |
| 3. | https://nptel.ac.in/courses/104/103/104103069/ | | | |
| 4. | https://nptel.ac.in/courses/104/105/104105038/ | | | |
| 5. | https://onlinecourses.nptel.ac.in/noc21\_cy04/preview | | | |
| 6. | https://nptel.ac.in/courses/104/106/104106077/ | | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | M | S | S | M | M | S | L | L | L |
| **CO2** | S | L | M | S | S | M | S | L | L | L |
| **CO3** | S | S | M | S | S | S | M | L | L | L |
| **CO4** | S | S | S | S | S | S | S | L | M | L |
| **CO5** | S | S | L | M | M | L | S | L | S | L |

\*S-Strong;M-Medium;L-Low

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| **Semester-**  **IV** | | **CHE**  **C106** | | **TRANSITIONMETALCHEMISTRY** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | **Core** | | **4** | **0** | **0** | | **4** |
| **Pre-requisite** | | | Studentsshouldknowthevarioustypesofligands including chelating ligands andtheirapproachtometalionstoform  complexes. | |  | | |  | |
| **CourseObjectives:** | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Providemorebasicanduncomplicatedknowledgeaboutinorganicmetalcomplexandtheirreactivitytowardstheligandandmetalinteraction * Perceptiveofhowligandsplaythevitalroleinthemetalcomplexstability,structuralandreactionpathwayofmetalspecies * Motivatecriticalthinkingandanalyticalskillstosolveknowledgeintheaspectsofinorganicchemistryinmetalcomplexes. * Demonstratetheabilitytodesignandsynthesisofvariousligandandtheirinteractionwith metal core * Cram the magnetic property in metal complex in the part ofmagnetochemistryandderivetheVanvlek’sequations | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | |
| 1 | Demonstrates most common and important futures of oxidation ofmetalscomplexesandnatureofinertandlabilityinterms ofkineticsandthermodynamicaspectsofcomplexesformation  reactionsandtheirmechanisms | | | | | | K1-K2 | | |
| 2 | Understandingtheformationofmetalcomplexesandtheirmechanism involved with trans influence of ligand. In addition, todescribethestabilityofmetalcomplexesbytheuseofformation  constantsandtocalculatethermodynamicparameters | | | | | | K2-K5 | | |
| 3 | Demonstratebroadknowledgeofdescriptive electrontransfer/redoxreactionsinvariousmetalcomplexformationreactionandunderstandfundamentalaspect of Marcus-Hushtheoryitsapplicationsinphotochemicalreactionofcoordination  compounds | | | | | | K1-K4 | | |

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| 4 | | Designand tailor various types of chelating ligandsand its  bindingaffinitytothetargetmetalandprovidethebasicconceptsofligandsdesignandsynthesisitsapplicationinvariousfields | | | | K3-K6 |
| 5 | | Derivethespin,orbitandspin-orbitmagneticdipolemomentforvariousmetalionsandcomplexesandunderstandtheorbitalquenchinginA,TandEterms | | | | K3-K5 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | |
| **UNIT:1** | | | **INERTANDLABILEMETALCHEMISTRY** | | **18hours** | |
| Reactivityofmetalcomplexes–Inertandlabilecomplexes–Explanationoflabilityonthebasisofvalencebondandcrystalfieldtheories–Metalioncatalysedreactionsandreactionmechanism,inducedreactionsandtheircharacteristics,applications – kinetics and mechanism of induced reaction in metal complexes, –Stabilization of unusual oxidation states in solution – Survey of oxidation stateswithvariouselectronicconfigurationoftransitionmetalsandinner-transition  metals. | | | | | | |
| **UNIT:2** | | | **SUBSTITUTIONREACTIONSINCOORDINATION**  **COMPLEXES** | | **18hours** | |
| Reactionpathways–mechanismsofsubstitutionsinoctahedralcomplexes–Dissociative(D),Associative(A),andInterchange(I)mechanisms–Aquation(acidhydrolysis)–Acidcatalyzedaquationreactions,Anationreactions. Basehydrolysis, CB mechanism in octahedral complexes– Substitution reactions insquare planar complexes, Ttans effect, theories and applications – Isomerisationandracemisationreactions of coordination complexes; Electron transferreactionsorredoxreactions–twoelectrontransferreactions,Innersphereand  outer sphere processes, electron exchange reactions, complementary reactionsandnoncomplementaryreactions,Marcus-Hushtheory,photochemicalreactions | | | | | | |
| **UNIT:3** | | | **LIGANDDESIGN** | **18hours** | | |
| Geometrical consequences of the metal ion and the donor atoms – Reactive versusand ancillary ligands, cooperative ligands – extension of ligand coordination byreactionatdonorandnon-donoratoms-templatereactions,kineticsandthermodynamics–chelatingagentswhichbindtotwometalatoms.Macrocyclic  effect-Designandsynthesisofvariouschelatingandmacrocyclicligands.Principlesofsynthesisofliganddesign–dendrimers | | | | | | |
| **UNIT:4** | | | **MAGNETOCHEMISTRY** | **18hours** | | |
| VanVlek’sequation,Magnitudeofmagneticmoments-experimentaldetermination,quenchingoforbitalangularmomentum,magneticproperitesofA,EandTgroundterms,effectofspinorbitcouplingantiferromagneticinteractionsindi-andpolynucleartransitionmetalcomplexes,magneticbehaviouroflanthanidesandactinides-ferro,ferriandantiferromagneticinteractioninsolids  –anomalousmagneticmoments,magneticexchangecouplingandspincrossover | | | | | | |
|  | | | **TotalLecturehours** | **72hours** | | |
| **TextBook(s)** | | | | | | |
| 1. | Huheey,J.E.-InorganicChemistry,4thEdition,HarperandRow. | | | | | |
| 2. | Basolo,F.andPearson,R.G.-Mechanismof InorganicReactions,Wiley  Eastern | | | | | |
| 3. | Purcell,K.F.andKotz,J.C.-InorganicChemistry,Saunders | | | | | |
| 4. | D.F.ShriverandP.W.Atkins,InorganicChemistry,OxfordUniversityPress, | | | | | |

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|  | 5thEdition,2010 |
| 5. | J.D.Lee,ConciseInorganicChemistry,OxfordUniversityPress,5thEdition,2014 |
| 6. | B.N.Figgis-ModernCoordinationChemistryEd.byLewis&Wilkins(UnitIV) |
| 7. | Bourdeax, E.A. and Mulay, M.N., - Theory and application of Molecular  Paramagnetism,JohnWiley |
| 8. | F.A.CottonandG.WilkinsonAdvancedinorganicChemistry,JohnWiley&  Sons,6thEdition,1999 |
| **ReferenceBooks** | |
| 1. | Nyholm, R.S. and Tobe M.L., - The stabilisation ofoxidation state of theTransition metals, Advances in Inorganic and Radiation Chemistry, Volume 5(1963) |
| 2. | (a)J.Hartwig,OrganotransitionMetalChemistry:FromBondingtoCatalysis,University;ScienceBooks,Sausalito,CA,2010 |
| 3. | G.L.Miessler,P.J.Fischer,D.A.Tarr,InorganicChemistry,5thedn,Pearson,UpperSaddleRiver,NJ,2014 |
| 4. | D.S.C.BladeandHartshon,A.J.,-Ligand,DesignandSynthesisCoord.Chem.Rev.9(1972)219 |
| 5. | Nyholm.,R.S.andTobe.M.L.,-TheStabilizationof oxidationstatesofthetransitionmetals,AdvancedInorganicandRadiationChemistry,5(1963). |
| 6. | R. H.Crabtree,TheOrganometallicChemistryof theTransition Metals,Vol.4,JohnWiley&Sons,Inc.,Hoboken,NJ,2005 |
| 7. | Maabs,F.D.andMachin,D.T.,MagnetismandTransitionMetalComplexes |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | |
| 1. | https[://www.youtube.com/watch?v=ez40OIQrP60](http://www.youtube.com/watch?v=ez40OIQrP60) |
| 2. | [https://www.dalalinstitute.com/wp](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-[content/uploads/Books/A](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-[Textbook](http://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-)-of-  Inorganic-Chemistry-Volume-1/ATOICV1-3-1-Inert-and-Labile-Complexes.pdf |
| 3. | https://link.springer.com/chapter/10.1007%2F978-1-4419-9276-5\_6 |
| 4. | [https://www.youtube.com/watch?v=\_eak](http://www.youtube.com/watch?v=_eak-XY3Vx8)-XY3Vx8 |
| 5. | https://onlinecourses.nptel.ac.in/noc20\_cy19/preview |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | S | S | S | S | M | L | M | L | S |
| **CO2** | S | S | S | S | M | S | M | M | L | L |
| **CO3** | S | S | M | S | M | L | L | S | L | S |
| **CO4** | M | S | S | M | S | S | M | S | M | L |
| **CO5** | S | M | S | M | M | L | S | L | S | M |

\*S-Strong;M-Medium;L-Low

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| **Semester**  **-1V** | | | | **CHEC107** | | **ORGANOMETALLICCHEMISTRY** | **L** | **T** | **P** | | **C** |
| **Core/Elective**  **/Supportive** | | | | | **Core** | | **4** | **0** | **0** | | **4** |
| **Pre-requisite** | | | | | Students must aware of fundamentals of | | **Syllabus** | | | |  |
|  | | | | | organometalliccompoundssuchas16and  18electronrule,basictermssuchasσ-donor,π-donor,π-acceptorligands. | | **Version** | | | |  |
| **CourseObjectives:** | | | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Knowaboutthenomenclatureandbondingoforganometalliccompounds * Understandthesynthesisandstructureofcomplexeswithσ-donor,cyclic   π-donorsandπacceptorligands   * Study the vibrational spectra of metal carbonyl and metal nitrosylcomplexes * Studythefluxionalnatureoforganometalliccompounds * Describeapplicationsoforganometalliccompoundsascatalyst * KnowthemechanismofWilkinson’shydrogenation,oxoprocess,Fischer-Tropschprocessetc. | | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | | |
| 1 | | Recall nomenclature and classification of organometalliccompounds | | | | | | | | | K1-K2 |
| 2 | | Differentiateandcomparecomplexeswithσ-donor,cyclicπ-donorsandπacceptorligands | | | | | | | | | K2-K3 |
| 3 | | Differentiateandidentifylinearandbentmodesofmetalnitrosylcomplexes | | | | | | | | | K3-K4 |
| 4 | | Demonstrateindustriallyimportantcatalysisreactions | | | | | | | | | K4-K5 |
| 5 | | Applyconceptswhilehandlinghighlyreactivechemicals | | | | | | | | | K5-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | | |
| **UNIT:1** | | | **COMPLEXWITH σ-BOND** | | | | | | | **18hours** | |
| Nature of bonding in organometallic compounds and coordination complex– Typesofligandsandtheirclassificationsinorganometalliccompounds,Hapto-nomenclature –16 and 18 electron rule and its limitations– Carbon σ- donor:Synthesis,natureofbond,structure,reactivitiesandapplicationsofalkylLi,Mg,  AlandZn,Cd | | | | | | | | | | | |
| **UNIT:2** | | | **COMPLEXESWITHCYCLIC****DONORS** | | | | | | | **18hours** | |
| Synthesis,natureofbond,structure,reactivitiesandapplicationsofolefins,acetylenes,π-allylanddialkene,Cyclobutadiene,cyclopentadiene,benzene,cycloheptatrieneandcyclooctatetraene–Metallocenesandsandwichcomplexes–  Classification of fluxional organometallic Compound,mechanism and analysis offluxionalityincompounds | | | | | | | | | | | |
| **UNIT:3** | | | **COMPLEXESOF****-ACCEPTORLIGANDS** | | | | | | | **18hours** | |
| Mono-andpolynuclearmetalcarbonyls:preparation,structureandreactivity,carbonylate anions and carbonyl hydrides, carbonyl halides, vibrational spectra ofmetal carbonyls – Nitrosyls*:* Mono -polynuclear nitrosyl complexes; linear, bentandbridgingnitrosyl,cyanocomplexes–Phosphine,Arsineandcyanidecomplexes:ComplexesoftrivalentPandAsderivatives.Methodsofsynthesisand  structure | | | | | | | | | | | |
| **UNIT:4** | | | **CATALYSIS** | | | | | | | **18hours** | |
| Oxidative addition, reductive elimination, insertion-migration reactions – | | | | | | | | | | | |
| Hydrogenationofolefins-Hydroformylationofolefins-oxidationofolefinstoaldehydesandketones-polymerizationofalkenes- Cyclooligomerization ofacetyleneandFischer-Tropschprocess–isomerization–watergasshiftreaction  andsupportedorganometalliccatalysis | | | | | | | | | | | |
|  | | | **TotalLecturehours** | | | | | | | **72hours** | |
| **TextBook(s)** | | | | | | | | | | | |
| 1. | F.A.Cotton&G.Wilkinson-AdvancedInorganicChemistry,3rdand4thEd.,JohnWiley. | | | | | | | | | | |
| 2. | Huheey,J.W.-InorganicChemistry,4thEdition-HarperandRow. | | | | | | | | | | |
| 3. | K.F.Purcell& J.C.Kotz-Inorganic Chemistry,Saunder Company | | | | | | | | | | |
| 4. | Coatsetal.-Organometalliccompounds,Vol.IandII. | | | | | | | | | | |
| 5. | A.K.DasVol.5&6,FundamentalsofInorganicChemistry | | | | | | | | | | |
| **ReferenceBooks** | | | | | | | | | | | |
| 1. | [RobertH.Crabtree](https://bookauthority.org/author/Robert-H.-Crabtree),TheOrganometallicChemistryoftheTransitionMetals,7thedition,Wiley. | | | | | | | | | | |
| 2. | Shaw,B.L.andTucker,N.L.-Organotransitionmetalcompoundsandrelatedaspectsofhomogeneouscatalysisin comprehensiveInorganicChemistry,Vol.4.Bailer,J.C.et.al(Eds)Pergamon. | | | | | | | | | | |
| 3. | Zuckermann,H.,-BasicOrganometallicChemistry,WalterdeGruyterandCo. | | | | | | | | | | |
| 4. | Wade,K.,-StructureandbondingpatterninclusterChemistryinAdvancesinInorganicChemistryandRadiochemistry18(1976)1. | | | | | | | | | | |
| 5. | Wilkinson,StoneandAbel(eds)-ComprehensiveOrganometallicChemistry,Volume1 | | | | | | | | | | |
| 6. | [Edward Maslowsky Jr.](https://bookauthority.org/author/Edward-Maslowsky-Jr), Vibrational Spectra of Organometallics, TheoreticalandExperimentalData | | | | | | | | | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | | | | | | | | | |
| 1. | Organometallicchemistry:  https://nptel.ac.in/courses/104/101/104101079/ | | | | | | | | | | |
| 2. | Introduction to organometallic chemistry :https://nptel.ac.in/courses/104/108/104108062/ | | | | | | | | | | |
| 3. | Advanced transition metal chemistry:https://freevideolectures.com/course/4311/nptel-advanced-transition-metal-  organometallic-chemistry | | | | | | | | | | |
| CourseDesignedBy: | | | | | | | | | | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | M | S | M | M | S | L | M | M | L |
| **CO2** | S | M | S | M | S | M | L | L | M | L |
| **CO3** | S | M | S | S | S | S | M | L | L | L |
| **CO4** | S | S | S | S | S | S | S | M | L | M |
| **CO5** | S | S | S | S | M | M | S | L | L | M |

\*S-Strong;M-Medium;L-Low

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| **Semester**  **-IV** | | | **CHEE603** | | **NOVELREAGENTSINORGANIC**  **SYNTHESIS** | **L** | **T** | **P** | | **C** |
| **Core/Elective/Supportive** | | | | **ELECTIVE** | | **4** | **0** | **0** | | **3** |
| **Pre-requisite** | | | | Studentsshouldlearnaboutthebasicsofmetal-catalyzed organic synthesis, includingunderstandingmechanism,roleof catalystandotheradditives.In addition, studentsmustbeawareofthedifferencein thereactionmechanism involving typicalorganicreactionVscarbon-metalcatalyzed  reaction. | |  | | | |  |
| **CourseObjectives:** | | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Tounderstandvarioustypes of metal-catalyzed organic syntheses,includingRingClosingMetathesis,synthesisofcyclicand acyclicmolecules,newcarbon-carbon&C-NbondformationandC-Hactivation * To know utility of silicon compounds in the generation of reactive diene likeortho-quinodimethaneanditsapplication * TounderstandthemechanismandsyntheticapplicationoftrifluoromethylationusingRuppert-Prakashreagent * Tostudythecorrelationbetweenstructure,propertiesandreactivityofvarioustypesmetalcarbonbondcompounds * Understanding the homogeneous and heterogeneous metal-carbon bondcatalyzed reactions and their mechanism | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | |
| 1 | Metal-catalyzedorganicreactionsandtheirsyntheticutility | | | | | | | | | K1-K4 |
| 2 | Studythevarioustypesofcarbon-carbonformationreactionsand  synthesisof cyclic andacyclic frameworks | | | | | | | | | K2-K5 |
| 3 | To study specific reaction by comparing theoretical and/or  experimentaldata | | | | | | | | | K2-K4 |
| 4 | Togetnewideasorinnovationinthefieldoforganometallic  chemistryandtheirapplicationsinorganicsynthesis | | | | | | | | | K1-K6 |
| 5 | TodesignsuitableorganometalliccompoundsforactivationofhighlystableandsymmetricalmoleculessuchasCO2andmethane  for the synthesis of industrially importantintermediates/compounds | | | | | | | | | K3-K6 |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | |
| **UNIT:1** | |  | | | | | | | **15hours** | |
| Application of following d & p block elements in organic synthesis: Syntheticutility of Samarium iodide, Ruthenium (Ring Closing Metathesis-RCM) Zirconium(Schwartz's reagent) and Cobalt (Pauson-Khand reaction and Nicholas reaction) inorganicsynthesis.AsymmetricReformatskyreactionusingSamarium.Homogeneoushydrogenation.ApplicationofTitaniuminorganicsynthesis–Mc  Murry coupling. Tin in organic synthesis. Use of – Bu3SnH and Tin mediatedcarbon-carbonbondformationinthesynthesisofcyclicandacyclicmolecules | | | | | | | | | | |

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| **UNIT:2** | |  | **15hours** |
| Role of Palladium and Nickel catalyst in organic reactions. Both Pd(0), Ni(0) andPd(II), Ni(II) complexes are included. Typical reaction involving Heck, Negishi,Suzuki-Miyaura,Kumada,Sonogashira,StilleandHiyamacouplingforthecarbon-carbonbondformation.Buchwald-Hartwig couplingforthecarbon-heteroatombondformationreactions.Transition-metalcatalyzedC-Hbond  activationinorganicsynthesis | | | |
| **UNIT:3** | |  | **15hours** |
| Silicon compounds. Use of trimethylsilyl chloride and t-butyldimethylsilyl chlorideas a productive group. Use of trimethylsilyl iodide and trimethylsilyl cyanide.Vinylsilanes-Silyl Peterson olefination reaction. Trichloro silane and triethyl silaneasreducingagents.Roleoftrimethylsilylgroupinthegenerationofreactivedienelikeortho-quinodimethane.Generationandreactionsofαandβsilyl-carbanions.Conjugate addition using lithium organocuprates (Gilman’s reagent) 1,2 vs 1,4addition.Umpolung-aldehydeketoneandacidsynthesisfrom1,3dithiane.  TrifluoromethylationusingRuppert-Prakashreagent | | | |
| **UNIT:4** | | **BONDINGANDAPPLICATIONSOFMETALCARBONYLCOMPOUNDS** | **15hours** |
| Metal carbonyl reactions-substituted metal carbonyls, cis-labilising effect, metal-metal bonded carbonyl and cluster-insertion reaction-CO insertion, CO2insertion,SO2insertion,methylmigration,phenylmigration,carbonhydrogenbondactivation-Oxoreaction,WackerprocessandReppesynthesis-photochemical  reactionofmetalcarbonyls-Chromium,Manganese,Iron,Rhenium andRuthenium.Oxidativeaddition-Hydrogen,organichalides-FischerTropshprocess | | | |
|  | | **TotalLecturehours** | **60hours** |
| **TextBook(s)** | | | |
| 1. | Colvin,E.W.(1981);SiliconinOrganicSynthesis,1stEdition,[Elsevier](https://www.elsevier.com/about) | | |
| 2. | Carruthers,W.(2015);ModernMethodsofOrganicSynthesis,4thEdition,CambridgeUniversityPress | | |
| 3. | Smith,M,(2016); OrganicSynthesis,4thEdition, Academic Press | | |
| 4. | Huhee,J.E,(2014);InorganicChemistry,4thEdition,Pearson | | |
| 5. | PurcellK.F,Kotz,J.C. (1980);InorganicChemistry,1stEdition,ThomsonLearning | | |
| **ReferenceBooks** | | | |
| 1. | Weber,W.P.(1983);SiliconReagentsforOrganicSynthesis,Springer-Verlag,  ISBN978-3-642-68661-0 | | |
| 2. | Tsuji, J. (2004); PalladiumReagents and Catalysts, Wiley, ISBN: 978-0-470-  85032-9 | | |
| 3. | Hegedus,L.S.(2009);TransitionMetalsintheSynthesisofComplexOrganic  Molecules,3rdEdition,UniversityScienceBooks | | |
| 4. | Crabtree.R. H. (2019); The Organometallic Chemistry of the Transition  Metals,Wiley | | |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | | | |
| 1. | <https://www.youtube.com/watch?v=s8VqAqibrr8> | | |
| 2. | <https://www.youtube.com/watch?v=YAkAKsHsLyU> | | |
| 3. | [https://www.youtube.com/watch?v=8pqCeN7GoMc&list=PLbMVogVj5nJR65](http://www.youtube.com/watch?v=8pqCeN7GoMc&list=PLbMVogVj5nJR65)WP0IQaDCBtCRq\_HAuI\_ | | |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | M | L | S | M | M | M | M | L | L |
| **CO2** | M | M | M | S | S | M | M | L | M | M |
| **CO3** | M | M | M | M | S | M | S | L | M | L |
| **CO4** | L | M | L | S | M | L | M | M | L | L |
| **CO5** | M | M | M | S | M | L | M | L | M | M |

\*S-Strong;M-Medium;L-Low

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| **Semester-IV** | | **CHEE004** | | **ELECTROANALYTICALCHEMISTRY** | **L** | | **T** | **P** | | **C** |
| **Core/Elective/Supportive** | | | **ELECTIVE** | | **3** | | **0** | **0** | | **3** |
| **Pre-requisite** | | | Basicknowledgeofelectrochemistryisessential | |  | | | | **R-2021** | |
| **CourseObjectives:** | | | | | | | | | | |
| Themainobjectivesofthiscourseareto:   * Tolearnthetheoryandbasicsofelectrochemicaltechniquesandtheirapplications * Designandfunctioningofelectrochemicalsensors * IntroductiontoElectrochemicalImpedanceSpectroscopy * Describethetheoryandpracticalapplications of voltametric techniquesandpolarography * Understand the principles and applications of coulometry andelectrogravimetry | | | | | | | | | | |
| **ExpectedCourseOutcomes(CO):** | | | | | | | | | | |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: | | | | | | | | | | |
| 1 | Workingknowledge on sensors and electrochemical impedance  spectroscopy | | | | | | | K1-K4 | | |
| 2 | Typesofelectrodesandtheirfunctions | | | | | | | K3-K5 | | |
| 3 | Electricaldoublelayerandelectrokineticproperties | | | | | | | K2-K4 | | |
| 4 | Distinguishdifferenttypesofvoltametricandpolarographictechniques | | | | | | | K2-K5 | | |
| 5 | Interpretandapplyelectroanalyticaltechniquesinresearch | | | | | | | K3-K4 | | |
| 6 | Fundalmentalsofcorrosionanditsprevention | | | | | | | K5-K6 | | |
| K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–  Create | | | | | | | | | | |
| **UNIT:1** | | **ELECTRICALDOUBLELAYER,CORROSIONANDELECTROKINETICAPPLICATIONS** | | | | **15hours** | | | | |
| Electricaldoublelayer–Electrode-electrolyteinterface,Typesofinterfaces,thermodynamicsofelectrifiedinterfaces,derivation of electrocapillaryphenomena,PointofZeroCharge(PZC),Lippmannequation, estimation ofsurfacechargeandsurfaceexcessandGibbsadsorption.Structureofelectrified  interfaces, Helmholtz-Perrin, Gouy – Chapman and Stern models, specific | | | | | | | | | | |

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| adsorption. Corrosion - Thermodynamic criteria of corrosion of metals – Dry andwetcorrosion,homogenous(WagnerandTraud’s)andheterogenoustheories,classification of corrosion –Uniform, Galvanic, Crevice, Pitting and Intergranularcorrosion- Povrbaix diagram. Corrosion prevention - passivation and inhibitors.Electrokineticphenomena-overviewofZetaPotential–Principles,Mechanism  andapplications.Conversionandstorageofelectrochemicalenergy.FuelcellsandLithium-ionbattery | | | | |
| **UNIT:2** | | **POTENTIOMETRICANDSENSINGTECHNIQUES** | | **15hours** |
| Potentiometry-standardandformalpotentials-Nernstequation.Typesofelectrodes -indicator and reference electrodes. Ion selective electrodes - crystallineand non crystallineelectrodes - glass electrode for pH measurements, mechanismofelectroderesponseandevaluationofselectivity coefficient, asymmetrypotential,alkalineandaciderrors,applicationsofionselectiveelectrodes.Chronoamperometryand Chronopotentiometry. Potentiometric titrations -manualand automatic titrators, titrations including differential methodstitrationsinnon-aqueoussystems,titrationswithpolarizedelectrodes.Bipoteniometry - principle, instrumentation and applications. Amperometric andPotentiometricsensors-GasSensors,Biosensors.Impedancespectroscopy,  RDE,RRDE,sensors | | | | |
| **UNIT:3** | | **VOLTAMETRICTECHNIQUES** | **15hours** | |
| Voltammetry–Polarography-DME,polarograms,currentsinpolarography,polarographic maxima,effectofdissolvedoxygenandapplicationtochemicalanalysis, amperometeric titrations, pulse polarography – normal anddifferential pulse, square wave polarography, stripping methods – cathodicand anodic stripping, linear sweep voltammetry, cyclic voltammetry, typesof electrodes and chemically modified electrodes. Coulometric analysis - Theory,Faraday’s laws, types of coulometres, coulometric titrations; Electrogravimetry –Theory,electrogravimetry,orderof deposition, constant potential, constantcurrentdepositionanddepositionofcomplexions | | | | |
|  | | **TotalLecturehours** | **45hours** | |
| **TextBook(s)** | | | | |
| 1. | DouglasA.Skoog,DonaldM.West,F.JamesHoller,StanleyR.Crouch,FundamentalsofAnalyticalChemistry,8thEdition | | | |
| 2. | A.M.Bond,ModernpolarographicmethodsinAnalyticalChemistry,MarcelDeckerInc.,1980 | | | |
| 3. | PrinciplesofInstrumentalAnalysis–DouglasA.Skoog,F.Holler,StanleyCrouch,7thEdnBrooks/Colepublish;7thedition,2017 | | | |
| 4. | E.Gileadi,E.Kirowa-EisnerandJ.Penciner,3.InterfacialElectrochemistry:  An Experimental Approach, Addison-Wesley Publishing Company,Massachusetts,1975. | | | |
| 5. | P.T.KissingerandW.R.Heineman,8. Laboratory Techniques inElectroanalyticalchemistry,MarcelDeckerInc.,1984 | | | |
| **ReferenceBooks** | | | | |
| 1. | JohnO'M.Bockris,AmulyaK.N.Reddy,“ModernElectrochemistry”,Vol.I  andII,PlenumPublishing,2008 | | | |
| 2. | JohnO’M.Bockris&A.K.N.Reddy,ModernElectrochemistry–Fundamentals  ofElectrodics,PlenumPublishers,NewYork,2000. | | | |
| 3. | Willard,H.H.;Merritt,L.L.Jr.;Dean,J.A.;Settle,F.A.Jr.,CBSPublishers& | | | |

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|  | Distributors;7thedition(2004). |
| 4. | ModernpolarographicmethodsinAnalyticalChemistry-A.MBond,MarcelDeckerInc.,1980 |
| 5. | LaboratoryTechniquesinElectroanalyticalchemistry–P.T.Kissingerand  W.R.Heineman,MarcelDeckerInc.,1984 |
| 6. | Chemical Instrumentation – H.A. Stoubel, Addison- Wesley, 1976 Strippinganalysis–J.Wang,VCHPublication,1985 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** | |
| 1. | <https://www.youtube.com/watch?v=3olOk_xNq8g> |

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| **MappingwithProgrammeOutcomes\*** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | S | S | M | M | S | M | M | L | S |
| **CO2** | S | M | S | S | S | M | S | M | M | L |
| **CO3** | S | S | S | M | L | M | S | L | L | L |
| **CO4** | M | S | S | S | M | S | M | L | M | S |
| **CO5** | S | S | S | M | S | L | S | M | L | L |

\*S-Strong;M-Medium;L-Low

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