Department of Chemistry

Study and Evaluation Scheme

Program: Master of Science (Chemistry) Year: First / Semester: First

S. No.	Course code	Course Title	Type of Paper	Period/ hr./week			Evaluation Scheme				Subject Total	Total Credits	Attributes							United Nations Sustainable Development Goals (SDGs)	
				L	T	P	CA	TA	Total	ESE			Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics		
THEORIES																					
1.	CH401	Physical Chemistry	Foundation Course	03	01	00	40	20	60	40	100	4	✓		✓		✓			Clean and Affordable Energy	7 AFFORDABLE AND CLEAN ENERGY
2.	CH402	Inorganic Chemistry	Foundation Course	03	01	00	40	20	60	40	100	4	✓		✓					-	-
3.	CH403	Organic Chemistry	Foundation Course	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓			-	-
4.	CH404	Environmental Chemistry	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓	✓		Climate Action	13 CLIMATE ACTION
5.	CH405	Modern Analytical Techniques	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓					No Poverty	1 NO POVERTY
PRACTICALS																					
6.	CH419	Chemistry LabPracticals-1	Core	00	00	08	40	20	60	40	100	4	✓	✓	✓		✓			Clean Water and Sanitation	6 CLEAN WATER AND SANITATION
			Total	**15**	**05**	**08**	**240**	**120**	**360**	**240**	**600**	**24**									

L = **Lecture,** T = **Tutorial,** P = **Practical,** CA = **Continuous Assessment,** TA = **Teacher's Assessment,** ESE = **End Semester Examination;** Sessional = **CT+TA;** Subject Total = **Sessional + ESE**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH401	**Title of the Course**	Physical Chemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	The purpose of this postgraduate course is to impart basic and fundamental knowledge of physical chemistry. It is applied in almost all the field starting from Chemistry to biology, information technology as well as the engineering. After the successfully completion of the course, the students are provided sound foundation to take up Ph.D. course in the future						

Course Outcomes	
CO1	Students would analyze the idealized version of a gas, a perfect gas and shows how its equation of states may be assembled experimentally
CO2	Students would able to develop the concept of conservation of energy; assess the energy changes during physical and chemical process
CO3	Students would differentiate between spontaneous and non-spontaneous process and understand how Gibbs free energy is related to maximum non-expansion work.
CO4	Students would explore the rate of chemical reactions and analyzed how rate of a chemical reaction is varying with change of concentration, pressure and temperature.
CO5	Students would develop the concept of photochemistry and get inside of Lambert-Beer Law, Grothus – Drapper law, Stark – Einstein law, quantum Efficiency and its determination.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Properties of Gases	The states of gases, gases laws and deviation from ideal behavior, Vander Waals equation of state; Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, means free path and collision diameter.	8	1
2	Classical Thermodynamics	System & surroundings, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work. First Law of Thermodynamics; Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure, Joule's law – Joule Thomson coefficient and inversion temperature. Second Law of Thermodynamics: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases, Maxwell's relations.	8	2
3	Entropy and Free energy	Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P,V and T. Nernst heat theorem, statement and concept of residual entropy. Chemical Potential and partial molar properties: Gibbs-Duhem equation, concept of fugacity and its determination.	8	3
4	Chemical Kinetics	Rate of a reaction, factors influencing the rate of a reaction; mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half-life and mean life, Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon, Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.	8	4
5	Photochemistry	Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law Jablonski diagram depicting various processes occurring in the excited state, Lambert-Beer Law: quantum Efficiency and its determination, Qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), photosensitized reactions – energy transfer processes (simple examples), Kinetics of Photo chemical reaction. (Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of Dimerization of Anthracene).	8	5

Reference Books:

Physical Chemistry, P.W. Atkins,ELBS

Thermodynamics – J. Rajaram and J.C. Kuriacose – Educational Publishers.

Quantum Chemistry – Eyring, Walter,Kinball

Statistical Physics (Part I) (Course of Theoretical Physics Vol. 5) – L.D. London. & E.M. Lefshitz Perganion Z-press, London.

Principles of Physical Chemistry by Puri, Sharma and Pathan.

e-Learning Source:

http://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm

https://nptel.ac.in/courses/115103113/

https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-27.pdf

http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Engineering%20Chemistry%201/TOC-mainM6.htm

https://www.youtube.com/watch?v=SgTuWj9Tj80

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	1	1	3	3	1	1	1	1
CO2	3	1	-	-	-	2	1	3	3	1	1	2	1
CO3	3	1	-	-	-	2	1	3	3	1	1	2	2
CO4	3	1	-	-	-	3	1	3	3	2	2	2	2
CO5	3	1	-	-	-	3	2	3	3	1	2	2	2

1- Low Correlation; 2- Moderate Correlation;3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	CH402	**Title of the Course**	Inorganic Chemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	The purpose of this course is to develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements, bioinorganic chemistry and process in human and to gain the knowledge of basics of instrumental spectroscopic techniques.						

Course Outcomes	
CO1	Students will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and understand technical literature related to the discipline.
CO3	Students will be able to know about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.
CO4	Students will be able to understand the metal component in protein structure and molecular modeling, including the use of the computer program. Transport mechanisms across cell membranes.
CO5	Students will be able to understand the basic and advanced instrumental techniques used in inorganic synthesis including spectroscopic and analytical techniques for identification and characterization of complex molecules.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Coordination Compounds	General characteristic properties of transition elements, Werner's theory, Effective atomic number, Bonding in transition metal complexes; Valence bond theory, Crystal field theory; Octahedral complexes, effects of crystal field splitting, Jahn-Teller Distortion (static and dynamic), Square planar arrangements, tetrahedral complexes, chelates, magnetism, Molecular orbital theory.	8	1
2	Nomenclature And Isomerism In Coordination Compounds	Nomenclature of co-ordination compounds, isomerism in coordination compounds; Polymerization, Ionization, Hydrate, Linkage, Coordination, Coordination position isomerism. Stereoisomerism; Geometrical and optical isomerism. Metal carbonyls: Synthesis of metal carbonyls, structure bonding and IR spectroscopy, metal clusters, Wade mingos rule.	8	2
3	Organometallic Chemistry Of Transition Elements	Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, Reactions in organometallic chemistry (Oxidative addition, reductive elimination, migratory insertion), Organometallic catalysis: Wilkinson catalysis, Hydrogenation, hydroformylation, polymerization, Monsanto acetic acid Zeiglar Natta catalysis.	8	3
4	Bioinorganic Chemistry	Metals and their biological activity, photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation,	8	4
5	Characterization Of Inorganic Compounds	Characterization of inorganic compounds by IR, Raman, NMR, ESR (Drago's rule, Kramer's degeneracy) Mossbauer and microscopic techniques.	8	5

Reference Books:

F. Albert Cotton, Geoffery Wilkinson, Carlos A. Murillo and Manfred Bochmann. Advanced Inorganic chemistry, Sixth edition, Wiley IndiaPvt.Ltd.

J. D. Lee, Concise Inorganic Chemistry, Fifth edition, Wiley India Pvt.Ltd.

J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York(1972).

e-Learning Source:

https://freevideolectures.com/course/3412/co-ordination-chemistry

http://wwwchem.uwimona.edu.jm/courses/IC10Kiso.pdf

https://nptel.ac.in/courses/104101091/

https://nptel.ac.in/courses/104104109/

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106074/lec24.pdf

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	-	2	1	3	3	2	-	2	3	3
CO2	3	1	1	-	2	2	2	2	2	-	2	-	3
CO3	3	-	2	-	2	2	3	3	2	-	2	3	3
CO4	3	-	2	-	2	2	2	3	3	3	2	3	3
CO5	3	-	1	-	2	2	3	3	3	3	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH403	**Title of the Course**	Organic Chemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	Students will be able to gain knowledge of Generation, stability and reactivity of intermediates, Name reactions. pericyclic reactions, concerted pi electron shift and minimize environmental pollution through without use of solvents concepts of stereochemistry of acyclic & cyclic compounds, stereo chemic properties and their applications.						

Course Outcomes	
CO1	Analyze and compare reactivity and stability of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes and addition reactions with electrophilic, nucleophilic or radical species
CO2	Comprehension of types of Organic reaction mechanisms involving elimination and substitution reactions with electrophilic, nucleophilic or radical species
CO3	Able to evaluate different types of Name reactions and its mechanism
CO4	Know about Pericyclic reactions, types of Pericyclic reactions, stereochemistry, thermal and photochemical cyclisation, Cope and Claisen rearrangement
CO5	Understand the Principles of stereochemistry, Configurational and conformational isomerism in acyclic and cyclic compounds, stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Reactive intermediates	Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes. Organic reaction mechanisms involving addition reactions with electrophilic, nucleophilic or radical species.	8	1
2	Reaction mechanisms and Name reactions	Organic reaction mechanisms; involving, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Neighbouring group participation, elimination: E2 vs E1, elimination vs substitution. Aldol condensation, Cannizzaro reaction, Hofmann, Beckmann and Fries rearrangements, Reimer-Tiemann reaction.	8	2
3	Name reactions	Reformatsky and Grignard reactions, Michael addition, Friedel-Crafts reaction, Witting reaction, Oppenaur oxidation, Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Ponndorf Verley reduction and birch reduction, hydroboration-oxidation, oxymercuration and deoxymercuration.	8	3
4	Pericyclic, Electrocyclic, Cycloaddition reactions and Sigmatropic rearrangements	Pericyclic reactions: Introduction, π molecular orbital of ethylene and 1, 3-butadiene. Electrocyclic reactions: Introduction, stereochemistry for the ring opening and ring closing electrocyclic reactions, thermal and photochemical cyclisation of (4n) and (4n+2) system. Cycloaddition reactions: Introduction, Thermal andphotochemical induced (2+2) and (4+2) cycloaddition reactions. Sigmatropic rearrangements: Introduction, classification, Cope and Claisen rearrangement.	8	4
5	Principles of stereochemistry	Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity.	8	5

Reference Books:

Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Inter science Publication.

A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication.

Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication.

Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication.

e-Learning Source:

https://nptel.ac.in/courses/104105104/

https://nptel.ac.in/courses/104101005/

https://nptel.ac.in/courses/104103023/

https://nptel.ac.in/courses/104106077/

https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	-	-	2	3	2	3	-	3	3	3
CO2	3	1	2	-	-	2	3	2	3	-	3	3	3
CO3	3	1	2	-	-	2	3	2	3	-	3	3	3
CO4	3	1	2	-	-	2	3	2	3	-	3	3	3
CO5	3	1	2	-	-	2	3	2	3	-	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH404	**Title of the Course**	Environmental Chemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	The main objectives of this course are to study various types of pollutants, their sources, effects on living and non-living species and related control measures.						

Course Outcomes	
CO1	Understand the fundamental concepts of Environmental chemistry.
CO2	Evaluate different types of air pollutants, their harmful effects on living and non living species, their control measures; Study of Global Warming, Green House Effect and Ozone Layer Depletion.
CO3	Analyze the various factors of water quality assessment parameters, water pollutants and their sources.
CO4	Understand the importance of soil composition; Analyze various types of soil pollutants, their control and related standards.
CO5	Understand the Principles of commonly used analytical methods in environmental quality assessment

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Chemistry For Environment	Fundamental of environmental chemistry: Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change, thermodynamics, Electrochemistry and redox reactions, Gibbs' free energy; Chemical potential; chemical kinetics and chemical equilibrium. Sources of natural and artificial radiations. Applications and handling of isotopes and other radionuclides in environment.	8	1
2	Atmospheric Chemistry	Chemical composition of air, Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. CFC's and Ozone chemistry, chemistry of air pollutants, photochemical smog.	8	2
3	Environmental aspects of water-chemistry	Structure and properties of water, Water quality parameters, Physicochemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonate system in water, total hardness and redox reactions	8	3
4	Environmental aspects of soil-chemistry	Soil formation, composition and classification; Soil profile; Soil erosion; Inorganic and Organic components of soil -Nitrogen pathways in soil; NPK in soils.	8	4
5	Principles of commonly used analytical methods in environmental quality assessment	Titrimetry; Gravimetry; Colorimetry; Spectrophotometry; Flame photometry; Atomic absorption spectrophotometry; Basic Chromatography; GC; GLC, HPLC; Electrophoresis; X-Ray fluorescence, X-Ray diffraction; Inductive coupled plasma spectroscopy.	8	5

Reference Books:

Environmental Chemistry Manahan, Stanley E, 2004, Taylor & Francis Ltd.

Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition, CRC-Press

Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy, Oxford Univ Pr (Sd).

Introduction to Environmental Chemistry, Reid, Brian J. Blackwell ScienceLtd.

Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hall publication

e-Learning Source:

http://textofvideo.nptel.ac.in/104105033/lec39.pdf.

http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf

https://www.youtube.com/watch?v=1jRo5fTg0KY

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	3	3	2	3	2	3	2	2
CO2	3	2	3	3	3	3	3	2	2	2	-	1	3
CO3	3	1	3	3	3	3	3	3	3	2	-	2	2
CO4	3	2	3	3	2	3	3	2	3	2	-	1	2
CO5	3	2	3	3	3	3	3	2	2	2	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH405	**Title of the Course**	Modern Analytical Techniques	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	The course aims at providing knowledge of principles and instrumentations of UV, IR, NMR, Atomic absorption spectroscopy and Mass spectrometry. Make the students able to interpret and assign spectroscopic data as a tool for structural elucidation.						

Course Outcomes	
CO1	Explain the effect of conjugation, solvent polarity and non-bonding electrons on a UV/Vis absorption spectrum. Evaluate the utility of UV/Vis spectroscopy as a qualitative and quantitative method. Application of correct Woodward-Fieser rules to calculate wavelength of maximum absorption of organic compounds.
CO2	Comprehension of factors affecting vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides, interpret and assign IR spectroscopic data as a tool for structural elucidation.
CO3	Argue how nuclear spins are affected by a magnetic field, and be able to explain what happens when radiofrequency radiation is absorbed. Identify the number of proton and carbon NMR signals expected from a compound given its structure, splitting pattern in the proton NMR spectrum of a compound given its structure, to assign peaks with the aid of a chart of chemical shifts from 1H and 13C NMR in an NMR spectrum to specific protons and carbons in a compound.
CO4	Become familiar with the mass spectrometric technique, different types of ionization techniques and sketch components of a mass spectrometer and functions of each. Application of a mass spectrometric technique, distinguish fragmentation methods. Interpretation of mass spectra.
CO5	Comprehension of principle, instrumentation, interferences and Sample preparation, Applications of AAS.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	UV Spectroscopy	Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, effect of solvents on electronic transitions, formation and designation of absorption bands, conjugated systems and transition energies, unsaturated carbonyl compounds, dienes and conjugated polyenes, Woodward – Fieser rules	8	1
2	IR Spectroscopy	Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, calculation of vibrational frequencies, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, fingerprint region, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides), applications of infrared spectroscopy.	8	2
3	NMR Spectroscopy	Introduction, theory of NMR spectroscopy, Instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling and stereostructure, proton exchange reactions, nuclear overhauser effect (NOE), shift reagents, principle of C-13 NMR spectroscopy, Relaxation and dynamic processes - Spin lattice relaxation (T1) and Spin - spin relaxation (T2) measurements. Interpretation of NMR spectra of some representative compounds.	8	3
4	Mass Spectrometry	Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, various modes of ionization (EI, CI, FD and FAB) and their applications, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols, amines, ketones, aldehydes, esters, acids and anhydrides), molecular ion peak, metastable peak, Mclafferty rearrangements, Nitrogen rule.	8	4
5	Atomic Absorption	Spectrophotometry: Introduction, Principle, Instrumentation, Interferences- Spectral, Ionization, Physical and Refractory compound formation, Sample preparation, Internal standard and standard addition calibration and applications of AAS.	8	5

Reference Books:

Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.

Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V EditionTata Mc Grawhills

Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications

e-Learning Source:

https://www.youtube.com/watch?v=tbUx-RaZS7M

https://nptel.ac.in/courses/103108139/

https://nptel.ac.in/courses/104108078/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	2	1	2	3	2	2	2	3
CO2	3	1	-	-	-	3	1	2	3	2	3	3	3
CO3	3	1	-	-	-	3	1	2	3	2	3	3	3
CO4	3	1	-	-	-	3	1	2	3	2	3	3	3
CO5	3	1	-	-	-	3	1	2	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH419	**Title of the Course**	Chemistry Lab Practicals-1	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**0**	**0**	**8**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	To develop practical and technical skills for better understanding of theory. To develop transferrable skills and enhancing communication skills of students.						

Course Outcomes	
CO1	Perform accurate and precise analysis in the field of industrial chemistry.
CO2	Able to examine water quality parameters (DO, COD, BOD and TDS) and argue about water quality.
CO3	Explain the principles of chromatographic techniques, UV spectroscopy and viscosity measurements.
CO4	Organize the records of all performed experiments in the manner which is required in laboratory.
CO5	Analyze the importance of personal safety and care of equipments and chemicals.

Exp. No.	Title of the Experiment	Content of unit	Contact Hrs.	Mapped CO
1	Determination of Viscosity	To determine the percentage composition of the given mixture consisting of two liquids A and B by viscosity method.	2	1
2	Determination of surface tension	To determine the relative surface tension of a liquid by Stalagnometer.	2	1
3	Determination of molecular weight	To determine the molecular weight of non-volatile solute cryscopically using water as solvent.	2	1
4	Extraction of metal	Selective extraction of iron metal cation from mixture of iron and magnesium for determination of their respective concentration.	4	3
5	Paper Chromatography	Paper chromatography separation of metalion.	4	3
6	Determination of metal	Determination of copper and nickel in the givens ample.	2	3
7	Thin layer chromatography	Separation of amino acid by thin layer chromatography.	2	3
8	Thin layer chromatography	Separation of mixture of carbohydrate by thin layer chromatography.	2	3
9	Column chromatography	Separation of mixture of dyes by column chromatography.	4	3
10	Synthesis of compound	Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone.	2	3
11	Determination of dissolved oxygen	Determination of Dissolved Oxygen (D.O.) in the given water sample.	2	2
12	Determination of conductivity	Determination of Conductivity of the water sample.	2	2
13	Determination of TDS	Determination of Total Dissolved Solid (T.D.S.) in the given water sample.	2	2
14	Determination of concentration of KMnO4	Determination of concentration of KMnO4 by UV-Visible Spectrophotometer.	2	3
15	Determination of iron content	Determination of iron content in the given water sample by UV-Visible Spectrophotometer.	2	3
16	Determination of Chlorophyll	Determination of Chlorophyll in olive oil by UV-Visible Spectroscopy.	2	3
17	Separation of plant pigment	Separation of plant pigment from green leaves by column chromatography.	2	3

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.

Practical Organic Chemistry, A.I.Vogel.

Experimental Inorganic Chemistry –W.G.Palmer.

e-Learning Source:

https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf

https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

https://www.stem.org.uk/resources/collection/3959/practical-chemistry

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	3	3	3	3	1	1	1	2
CO2	3	1	-	-	-	2	3	3	3	1	2	2	3
CO3	3	1	-	-	-	3	2	3	3	1	3	3	2
CO4	3	1	-	-	-	3	3	2	3	1	2	2	2
CO5	3	1	-	-	-	3	2	2	3	1	2	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Department of Chemistry

Study and Evaluation Scheme

Program: Master of Science (Chemistry) Year: First / Semester: Second

S. No.	Course code	Course Title	Type of Paper	Period/ hr./week			Evaluation Scheme				Subject Total	Total Credits	Attributes							United Nations Sustainable Development Goals (SDGs)	
				L	T	P	CA	TA	Total	ESE			Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics		
THEORIES																					
1.	CH408	Modern Instrumental Methods of Analysis & Computational Techniques	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓		✓	Industry Innovation and Infrastructure	
2.	CH409	Chemistry of Natural Products	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓			Good Health and Well-being	
3.	CH411	Pharmaceutical Chemistry	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓			Good Health and Well-being	
4.	CH420	Surface Chemistry and Electrochemistry	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓			-	-
5.	CH421	Coordination and Organometallic Chemistry of Transition Elements	Core	03	01	00	40	20	60	40	100	4	✓	✓	✓		✓			-	-
PRACTICALS																					
6.	CH422	Chemistry LabPracticals-2	Core	00	00	08	40	20	60	40	100	4	✓	✓	✓		✓			Good Health and Well-being	
			Total	**15**	**05**	**08**	**240**	**120**	**360**	**240**	**600**	**24**									

L = **Lecture,** T = **Tutorial,** P = **Practical,** CA = **Continuous Assessment,** TA = **Teacher's Assessment,** ESE = **End Semester Examination;** Sessional = **CT+TA;** Subject Total = **Sessional + ESE**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH408	**Title of the Course**	Modern instrumental methods of analysis and computational techniques	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	Elementary Mathematics				
Course Objectives	This course is designed for postgraduate students of chemistry and industrial chemistry as a broad base introduction to analytical instrumentation techniques for the measurement of different chemical and physical properties of compounds and materials (composition, structure, etc.). After successfully completion of course, the student will able understand the working principal and applications of various modern analytical techniques as well as their operation.						

Course Outcomes	
CO1	Students would able to analyze the data by applying different type of statistical methods and would also understand the different between systematic and random errors.
CO2	Students evaluate fundamentals of electrochemistry and recognize the electrochemical processes. They got sound inside of different type of polarographic and voltammetric methods and their applications.
CO3	Students would develop the concept of thermogravimetric analysis, differential analysis and differential scanning calorimetry methods and their applications.
CO4	Students would restate difference between different modes of chromatographic separation; apply knowledge of qualitative and quantitative analysis in various fields of chemical, pharmaceutical industry etc
CO5	Students would able to illustrate how the computer and software are used in analytical laboratory and got springboard for further study.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Errors and Evaluation	Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, relative error, types of error in experimental data, determinate (systematic), indeterminate (random) and gross, sources of errors and their effects upon the analytical results, statistical evaluation of data-normal distribution, interval estimation, methods of least squares.	8	1
2	Polarographic Techniques and Voltammetry	Polarography; Theory, Instrumentation and its working; Advantages of using dropping mercury electrode, Derivation of Ilkovic equation, Factors affecting the limiting current, The half wave potential, Criterion of reversibility, Applications of polarography, Square-wave polarography, Differential pulse polarography and cyclic voltammetry showing cyclic voltammetric excitation.	8	2
3	Thermal Methods	Thermogravimetric analysis, Instrumentation and Applications, Differential thermal analysis, General principles and applications with special reference to polymers; Differential scanning calorimetry, Theory and different types of thermal scanning calorimetry, Instruments, Power compensated DSC instrument, Heat flux DSC instrument and modulated DSC instrument, DSC data analysis and applications.	8	3
4	Chromatography	Chromatographic mechanism, Classification of chromatography, principles, types, techniques of column chromatography and techniques of elution, thin layer chromatography, Gas chromatography, Applications of gel permeation and ion exchange chromatography. Introduction of HPLC, instrumentation, reverse phase HPLC, industrial applications of HPLC.	8	4
5	Computer application	Elements of computer system set-up, components of computer system, generation of computer and computer languages, personnel computers, PC-software packages, an introduction, disk operating system and windows, text processing software, introduction to a spreadsheet software, creation of spreadsheet software, creation of spreadsheet applications, range, formulas, function, data base functions in spreadsheets, graphics on spreadsheet, presentation graphics, creating a presentation on a PC, data communications, networking: Lan & Wans, software system, softw are development process, file design & report design, Data files: types/organization, master & transaction file, relevance of database management systems and integration of applications, basic of data processing, flow charting, input-process- output analysis, report generation and label generation	8	5

Reference Books:

Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F.James Holler, 7th edition, Harcourt college publications.

Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication.

Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.

Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.

Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F.James Holler, 7th edition, Harcourt college publications.

e-Learning Source:

https://www.youtube.com/watch?v=HEgl0JyX80U

https://www.youtube.com/watch?v=d1vv7ww8xtA

https://www.youtube.com/watch?v=NzbDEjI8IKE

https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	-	-	3	1	3	3	3	3	3	2
CO2	3	1	-	-	-	2	1	3	3	1	2	1	2
CO3	3	1	-	-	-	3	1	3	3	2	2	2	2
CO4	3	1	-	-	-	3	1	3	3	1	2	1	2
CO5	3	2	-	-	-	3	1	3	3	2	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH409	**Title of the Course**	Chemistry Of Natural Products	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	Students gain the knowledge of secondary plant metabolites such as terpenoids, alkaloids, carbohydrates, Amino Acid, Peptides & Proteins, steroids, Synthesis and medicinal uses of; caffeine, theophylline, theobromine and Phyto-pharmaceuticals.						

Course Outcomes	
CO1	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol.
CO2	Evaluate the general method of isolation, structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann'sexhaustive methylation, Emde's degradation and Von Braun's method).
CO3	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids
CO4	Know about, classification, general method of preparation, properties and reactions of amino acids, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins. Understand the Synthesis and medicinal uses of; caffeine, theophylline, theobromine.
CO5	Phyto-pharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of noveltherapeutic leads from natural products.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Terpenoids	Introduction, nomenclature, occurrence, general properties, classification, isolation and general methods of structure determination of terpenoids, isoprene rule; Stereochemistry, constitution and synthesis of Citra land Menthol. Carotenoids; Introduction, classification, isolation and general method of structure determination of carotenoids.	8	1
2	Alkaloids	Introduction, nomenclature, classification, isolation, physiological action, occurrence and general methods of structure elucidation of alkaloid, specially based onnitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method)..	8	2
3	Carbohydrates & Steroids	Introduction, classification, general reactions, constitution of glucose & fructose; Conformations of monosaccharides. Steroids; Introduction, Diel's hydrocarbon, nomenclature, stereochemistry and configuration of the nucleus of steroids.	8	3
4	Amino Acid, Peptides & Proteins	Introduction, nomenclature, classification, general method of preparation, properties and reactions of amino acids .Introduction occurrence, nomenclature, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.	8	4
5	Phyto-pharmaceuticals	Synthesis and medicinal uses of; caffeine, theophylline, theobromine. Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products	8	5

Reference Books:

Natural products: Chemistry and Biological Significance, J.Mann, R.S.Davidson,J.B.Hobbs,d.V. Banthrope and B.Harborne, Longman,Essex.

Organic Chemistry, Vol 2, I. L. Finar, ELBS.

Chemistry of natural products, S.V.Bhat, B.A.Nagasampagi, M. Sivakumar.

Natural products from plants, Peter B. Kaufman, Leland J. Creke, Sara Warber, James A. Dupe, Harry L. Brielmann ,CRC publication

Organic chemistry of natural products, Vol. I and II , Gurdeep Chatwal, Himalya Publishing house.

e-Learning Source:

https://www.intechopen.com/books/terpenes-and-terpenoids/introductory-chapter-terpenes-and-terpenoids

https://www.intechopen.com/books/alkaloids-their-importance-in-nature-and-human-life/introductory-chapter-alkaloids

https://study.com/academy/lesson/steroids-structure-function.html

http://chemistry.creighton.edu/~jksoukup/lec5-aminoacidsSTUD.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	1	2	-	-	3	-	3	3	3
CO2	3	1	2	3	1	2	-	-	3	-	3	3	3
CO3	3	1	2	3	1	2	-	-	3	-	3	3	3
CO4	3	1	2	3	1	2	-	-	3	-	3	3	3
CO5	3	1	2	3	1	2	-	-	3	-	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH411	**Title of the Course**	Pharmaceutical Chemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	Students to understand the Synthesis, uses and mode of action of Antibiotics and Sulpha Drugs ,Antipyretics analgesics, Anesthetic drugs, cardiovascular drugs, Drug Design.						

Course Outcomes	
CO1	Evaluate the concept of antibiotics. Classification, synthesis, mode of action and uses of different types of antibiotics.
CO2	Analyze classification, structure, synthesis and uses of analogues of p-aminophenol, Salicylic acid, Pyrazolones and Pyrazolodinones.
CO3	Create the basic knowledge, Classification, Synthesis and mode of action of Inhalation, Intravenous anesthetics and Basal anesthetics.
CO4	Analyze classes, structure, synthesis and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs, Antiarrhythmic agents.
CO5	Comprehension of analogues and prodrugs; concept of lead; factors governing drug design; rational approach to drug design; revolutions in drug discovery, research and development strategies.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Antibiotics and Sulpha Drugs	Introduction and classification of antibiotics; beta lactam antibiotics: penicillins, its structure and mode of action, synthesis of Penicillin-v. Cephalosporins: classification, structure and mode of action of first, second, third and fourth generation cephalosporins. Aminoglycoside antibiotics: structure and mode of action of Streptomycin, Neomycin and Kenamycin. Chloramphenicol: its structure, synthesis and mode of action. Synthesis and uses of sulphathiazole, sulphaguanidine, sulphadiazine, sulphamethazine and sulphaacetamide.	8	1
2	Antipyretics analgesics	Introduction,classification,structure,synthesisandusesofanaloguesofp-aminophenol:Paracetamol,Phenacetinandantifebrin;Salicylicacidanalogues:Aspirin,Salol, Salsalate and benorilate; Pyrazolones and Pyrazolodinones analogues: Antipyrine, Aminopyrin, Dipyrone, Phenylbutazone, Oxyphenbutazone and Sulphinpyrazone	8	2
3	Anesthetic drugs	Introduction, Classification, Synthesis and mode of action of; Inhalation anesthetics: Vinyl ether, Cyclopropane and Fluoroxene; Intravenous anesthetics: Thiopental Sodium&MethohexitalSodium;Basalanesthetics:Procaninehydrochloride,Tetracainehydrochloride,Butacainehydrochloride,Benzaminehydrochlorideand Pyrocanine hydrochloride.	8	3
4	Cardiovascular drugs	Introduction, classification, structure and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs: structure, synthesis and modeofactionofLosartan,Clonidine,Hydralazine,MethyldopaandDiazoxide;Antiarrhythmicagents:structure,synthesisandmodeofactionofDiisopyramide, Procainamide, Propranolol, Beritylium Tosilate; Vasopressor drugs: structure, synthesis and mode of action of Isoxsupurine, Prenyl amine.	8	4
5	Drug Design	Introduction; analogues and prodrugs; concept of lead; factors governing drug design; rational approach to drug design; Drug design: the method of variation; Drug design and development: preamble, revolutions in drug discovery, research and development strategies.	8	5

Reference Books:

Burger's Medicinal Chemistry: Mangrove E. Wolff, 4th Edition, John Wiley and Sons

Medicinal Chemistry by Asutosh Kar , New Age International publication

Principles of Medicinal Chemistry: W.O.Foye.

The Pharmacological Basis of Theraputics : L.S. Goodman and A.Gilman

Wilson's Medicinal Chemistry The Organic Chemistry of Drug Synthesis: D. Lednicer and L.A.Mitscher

e-Learning Source:

https://www.youtube.com/watch?v=NGwP471sehI

https://www.youtube.com/watch?v=Ac6yMWno6yk

https://www.youtube.com/watch?v=-UD0y4jdKuc

http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf

https://www.youtube.com/watch?v=2vLDzMSo2Tc&list=PLg8Xhs-vwgxLSKf7XRqynIrY6aGHseZry&index=43

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	2	3	2	3	3	-	3	3	3
CO2	3	1	-	-	2	2	2	2	3	-	3	3	3
CO3	3	1	-	-	2	3	2	3	3	-	3	3	3
CO4	3	1	-	-	2	3	3	2	3	-	3	3	3
CO5	3	1	-	-	2	3	2	1	3	-	3	3	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH420	**Title of the Course**	Surface Chemistry and Electrochemistry	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	Elementary Mathematics				
Course Objectives	The main objective of this postgraduate course is to impart fundamental knowledge of surfaces and electrochemistry. The course will help the students to get the sound insight of process at surface and interface and develop the concept of electrical double layer. The course will give an insight into elementary electrochemistry and also discuss the important modern electrochemical theories and their applications.						

Course Outcomes	
CO1	Students would develop concept of monolayer and multilayer adsorption; perceive the different theory of adsorption viz, Langmuir, Freundlich and Gibbs adsorption isotherm and their applications. They also got insight the importance of various techniques to characterize surface of different system.
CO2	Students would able to recognize the role of surface active reagents and thermodynamics of micellization, stabilization, microemulsion, reverse micelles and get sound insight of potential develop between solid and liquid i.e. zeta potential.
CO3	Students would able to differentiate between ionic and molar conductivity for strong and weak electrolyte and understand the concept of electrical double layer and Butler –Volmer equation
CO4	Students would able to distinguish difference between galvanic and electrolytic cell; perceive the concept of Nernst equation and thermodynamics of electrochemical cell. They also got the sound understanding of polarization and overvoltage.
CO5	Students would able to understand the role of electrochemistry for analysis of corrosion phenomenon and identify the different electrochemical energy resources.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Process at Solid Surface	Growth and structures of solid surfaces, Physisorption and Chemisorption, Freundlich, Langmuir and BET isotherms, Gibbs Adsorption isotherm, dissociative adsorption, temperature dependence of adsorption, sticking probability. Surface analytical techniques, spectroscopies (Auger, photoelectron and vibrational) temperature programmed techniques, Surface imaging electron microscopy.	8	1
2	Surface and Interface	Surface active reagents, classification of surface active reagents, micellization, hydrophobic and hydrophilic interaction, critical micelle concentration(CMC), kraft temperature, factors affecting CMC of surfactant, counter ion binding to micelle, thermodynamics of micellization, stabilization, microemulsion, reverse micelles, surface films(electrokinetics phenomenon) Zeta potential.	8	2
3	Conductance and Ionization	Ionic conductance, drift speed, electrical force, molar conductivity, strong and weak electrolytes and their molar conductance, law of independent migration of ions: Kohlraush's law, Ostwald's dilution law, conductometric and potentiometric titrations. Electrical double layer, ficks first and second law of diffusion, Tafel plot, process at electrode-Butler-Volmer equation and its applications.	8	3
4	Electrochemical Cells	Daniell reversible and irreversible cells, cell representations and half cell reactions, E.M.FF., Thermodynamics of electrochemical systems: Nernst equations, varieties of electrodes, standard electrode potential. Type of boundary between half cell and liquid junction potentials, Concentration cells, Applications of EMF measurements-determination of activity coefficient, composition of complex ions, solubility products, measurement of pH and pKa (Hydrogen, Quinhydrone, Glass electrodes), Polarization, Overvoltage.	8	4
5	Corrosion and Conversion of Electrochemical Energy	Introduction, definition and types, mechanism of electrochemical corrosion, methods of prevention of corrosion , dry cells, lead batteries, alkaline cells (Edison cell), Fuel cells, Biological energy and conversions.	8	5

Reference Books:

Bard A J Faulkner LR , Electrochemical Methods: Fundamentals and APPLICATIONS 2nd Edition John Willy & Sons New York 2002.

Bockris J O M, Reddy A K N, Modern Electrochemistry 1: Ionic 2nd Edition Springer 1998.

Atkins P, Paula J Diver and Atkins Physical Chemistry 8th Edition Oxford 2016.

Puri, Sharma, L.R., and Pathania, M.S.,Principles of Physical Chemistry 50th Edition, Vishal publishing Co.

Bard A J Faulkner LR , Electrochemical Methods: Fundamentals and Applications, 2nd Edition John Willy & Sons New York 2002.

e-Learning Source:

https://nptel.ac.in/content/storage2/courses/103103026/pdf/mod2.pdf

https://www.youtube.com/watch?v=zdhDei1JolI

https://www.youtube.com/watch?v=R2UhAdqiXbs

http://www.umich.edu/~chem260/fall01/lecture37.pdf

http://www.griet.ac.in/nodes/EC_UNIT_2.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	3	1	3	3	1	3	3	2
CO2	3	1	-	-	-	3	1	3	2	1	3	3	3
CO3	3	1	-	-	-	2	1	3	2	1	2	2	2
CO4	3	1	-	-	-	2	1	3	2	1	1	1	2
CO5	3	1	-	-	-	1	3	3	3	1	3	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2019-2020							
Course Code	CH421	**Title of the Course**	Coordination And Organometallic Chemistry Of Transition Elements	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	The purpose of this course is to develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements, bioinorganic chemistry and process in human and to gain the knowledge of basics of instrumental spectroscopic techniques. Students will have a firm foundation in have a basic understanding of magnetism of the inorganic complexes. Students will have a firm foundation on the organometallic compounds in catalysis of the various organic synthetic reactions.						

Course Outcomes	
CO1	Students will have a firm foundation in the approaches of fundamental atomic structure and the periodicity of transition elements in the periodic table.
CO2	Students will have a firm foundation in have a basic understanding of nomenclature for transition metal complexes, chelate / chelation, MoT of the octahedral complxes, prediction of molecular geometries of selected molecular species.
CO3	Students will have a firm foundation in have a basic understanding of magnetism of the complexes.
CO4	Students will be able understand the knowledge in fundamentals of organometallic compounds.
CO5	Students will be able to create the pathways for the organometallic compounds as industrial catalytic applications in the various organic synthesis.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basics of Coordination Chemistry	General characteristics properties of transition elements werner's theory effective atomic number shape of d orbitals bonding in transition metal complexes nomenclature of coordination compounds isomerism in coordination compounds polymerization ionisation hydrate linkage coordination position isomerism stereoisomerism geometrical and optical isomerism.	8	1
2	d-Block Metal Chemistry	valence bond theory and hybridization crystal field theory and splitting TD and c4 v system spectrochemical series and effect of covalency Crystal Field stabilization energy high and low spin octahedral complexes John teller distortion that crystal field and the square planar Crystal Field crystal field theory uses and limitation microstates and term symbols Russell saunders coupling i.e spin orbit coupling ground state of element with z=1-10, spin Crossover.	8	2
3	Bonding and Properties of Complexes	High and low spin states, molecular orbital theory, octahedral complexes, nephelauxetic series back bonding involving pi donor and acceptor ligands pi in seo2 and o3 sf6 and HF to organ and tenable sugano diagram electronic absorption spectra of octahedral and tetrahedral complexes charge transfer spectra interpretation of electronic absorption spectra of use of reach parameters magnetic properties of transition metal complexes spin-orbit coupling the effect of temperature on ferromagnetism and antiferromagnetism and ferrimagnetism.	8	3
4	Organometallic Chemistry of Transition Elements	Organometallic compounds, ligand hapticity ,18 electron rule in metal carbonyls: homiletic and heteroleptic complexes synergistics effort factor affecting the magnitude of stretching frequency synthesis and structure of Fe carbonyl complexes fruits of unity reaction of organometallic compound oxidative addition reductive eliminations, Alkyl ,carbine ,alkene, alkyne,allyl and buta 1-3 diene complexes.	8	4
5	Application of Organometallic Chemistry	Application of Organometallic Chemistry:- organometallics: organolithium magnesium zinc copper and titanium reagents . Catalytic cycle of wacker process. Homogenneuos catalysis: alkene (olefin) and alkaline metal, Wikinsons catalytic cycle, hydroformylation (oxo-process) , Heterogeneous catalysis: commercial application: Ziegler-Natta catalysis and haber process	8	5

Reference Books:

F. Albert cotton, Geoffrey Wikinson, Carlos A,Murillo and Manfred Bochmann. Advanced inorganic chemistry, 6th edition, wiley India Pvt LTD.

J.D Lee. Concise inorganic Chemistry, 5th edition, Wiley India Pvt LTD.

JH Huheey , inorganic chemistry- principles, structure and reactivity , Harper and Row publisher Inc . New York(1972).

e-Learning Source:

https://nptel.ac.in/courses/104/101/104101121/

https://nptel.ac.in/content/syllabus_pdf/104101090.pdf

http://www.ncert.nic.in/ncerts/l/lech109.pdf

https://nptel.ac.in/courses/104103022/

https://nptel.ac.in/courses/104103071/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	-	2	-	3	3	-	3	2	-
CO2	2	-	-	-	-	2	-	3	2	-	3	2	-
CO3	3	-	-	-	-	2	-	3	2	-	3	2	-
CO4	2	-	-	-	-	2	-	3	3	-	3	2	-
CO5	2	-	-	-	-	2	-	3	2	-	3	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session:2019-2020							
Course Code	CH422	**Title of the Course**	Chemistry Lab Practical-2	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**0**	**0**	**8**	**4**
Pre-Requisite	BSc. with Chemistry	**Co-requisite**					
Course Objectives	Imparting of scientific methodology, Development of practical/technical skills, The ability to work effectively and safely in a laboratory environment, Developing transferable skills (team work, time management), and Enhancing communication skill.						

Course Outcomes	
CO1	Understand the basic analytical and technical skills to work effectively in the various fields of chemistry
CO2	Able to detect adulterants in the given food sample.
CO3	Know the determination of strength of acid, optical rotation of cane sugar. Saponification value of oil, acid value of oil. Isolation of lycopene, nicotine, lactose and casein, lecithin Caffeine from tea. Preparation of Acetanilide, Aspirin, Paracetamol.
CO4	Remember to keep records of all performed experiments in the manner, which is required in laboratory.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals

Exp. No.	**Title of the Experiment**	**Content of unit**	**Contact Hrs.**	**Mapped CO**
1	Determination of strength of acid	Determination of strength of acid against strong base by pH meter.	2	1
2	Measurement of surface tension	Measurement of surface tension of a liquid by capillary rise method	2	1
3	Determination of optical rotation	Determination of optical rotation of cane sugar.	2	1
4	Determination of saponification	Determination of saponification value in the given oil.	2	3
5	Determination of acid value	Determination of acid value in the given oil.	2	3
6	Estimation of amino acid	Estimation of amino acid.	2	3
7	Estimation of Glucose	Estimation of Glucose.	2	3, 5
8	Separation of essential oils	Separation of essential oils by soxhlet extractor.	2	3
9	Isolation of Lycopene	Isolation of Lycopene fromtomato.	2	3
10	Isolation of Nicotine	Isolation of Nicotine fromtobacco.	2	3
11	Isolation of Lactose and caesin	Isolation of Lactose and caesin from milk.	2	3
12	Isolation of lecithin	Isolation of lecithin from egg yolk.	2	3
13	Isolation of Caffeine	Isolation of Caffeine from tea.	4	3
14	Preparation of Magnesium bisilicate	Preparation of Magnesium bisilicate (antacid).	4	3
15	Preparation of Paracetamol	Preparation of Paracetamol.	4	3, 5
16	Preparation the iron complex	To prepare the iron(III) ethylenediaminetetraacetalato complex, Na[Fe(EDTA)]·3H2O	4	4

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.

Practical Organic Chemistry, A.I.Vogel.

Experimental Inorganic Chemistry –W.G.Palmer.

e-Learning Source:

https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf

https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

https://www.stem.org.uk/resources/collection/3959/practical-chemistry

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	3	3	3	3	1	1	1	2
CO2	3	1	-	-	-	2	3	3	3	1	2	2	3
CO3	3	1	-	-	-	3	2	3	3	1	3	3	2
CO4	3	1	-	-	-	3	3	2	3	1	2	2	2
CO5	3	1	-	-	-	3	2	2	3	1	2	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**