



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190401T/CH238	Title of the Course	Process Chemistry	L	T	P	C
Year	Second	Semester	Fourth	3	1		4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students gain knowledge and skills in various organic chemistry processes, including nitration, sulphonation, halogenation, oxidation, hydrogenation, alkylation, ammination, esterification, and hydrolysis. Pharmaceuticals, drug molecules, and other industrially significant organic compounds are synthesized using these organic chemical processes.						

Course Outcomes	
CO1	Students understand the mechanisms and examples of nitration and halogenation reactions on various compounds such as paraffin hydrocarbons, benzene, chlorobenzene, acetanilide, and toluene; learning about nuclear and side chain halogenations, introduction to nitrating agents and halogenation reagents, and commercial production of chlorobenzene, chloral, monochloroacetic acid, and chloromethanes.
CO2	Students know sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, naphthalene, and alkylbenzene.
CO3	Students understand the types of oxidation reactions, oxidizing agents, mechanism of oxidation of naphthalene, phthalamide and anthracene, liquid phase oxidation and vapour phase oxidation, commercial manufacture of benzoic acid, maleicanhydride, phthalic anhydride, acetaldehyde, acetic acid.
CO4	Students understand the thermodynamics and catalysts involved in hydrogenation reactions, the production of methanol from carbon monoxide and hydrogen, and catalytic reforming, as well as the types of alkylation, alkylating agents, and the mechanism behind alkylation reactions, leading to the manufacture of phenyl ethyl alcohol and alkyl benzenes for detergent production.
CO5	Students will have gained knowledge on the principles and mechanisms of esterification, hydrolysis, reduction, and aminolysis reactions, including practical applications such as the commercial manufacture of various chemicals using these reactions.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Nitration	Introduction, nitrating agents, mechanism, and nitration of paraffin hydrocarbons - benzene to nitrobenzene and m-dinitrobenzene, chlorobenzene to o- & p- nitro chlorobenzenes, acetanilide to p-nitro acetanilide and toluene.	8	1
2	Halogenation	Introduction, reagents for halogenations, halogenations of aromatics-side chain and nuclear halogenations, commercial manufacture of chlorobenzene, chloral, monochloroacetic acid and chloromethanes.	8	1
3	Sulphonation	Introduction, sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, naphthalene, alkylbenzene.	7	2
4	Oxidation	Introduction, types of oxidation reactions, oxidizing agents, mechanism of oxidation of naphthalene, phthalamide and anthracene, liquid phase oxidation and vapour phase oxidation, commercial manufacture of benzoic acid, maleicanhydride, phthalic anhydride, acetaldehyde, acetic acid.	7	3
5	Hydrogenations	Introduction, thermodynamics of hydrogenation reactions, catalysts for hydrogenation reactions, hydrogenation of vegetable oils, manufacture of methanol from carbon monoxide and hydrogen, catalytic reforming.	7	4
6	Alkylation	Introduction, types of alkylation, alkylating agents, thermodynamics and mechanism of alkylation reactions, manufacture of phenyl ethyl alcohol and alkyl benzenes (for detergent manufacture).	7	4
7	Esterification and Hydrolysis	Introduction, esterification reactions by organic acids, commercial manufacture of ethyl acetate, vinyl acetate, cellulose acetate. Introduction, hydrolyzing agents, mechanism of hydrolysis.	8	5
8	Amination	i. By reduction: Introduction, methods of reduction, metal and acid, catalytic sulfide, electrolytic, metal and alkali sulfites, metal hydrides, sodium metal, conc. caustic oxidation- reduction, commercial manufacture of aniline, m-nitroaniline, p-aminophenol. ii. By aminolysis: Introduction, aminating agents, factors affecting.	8	5

Reference Books:

- R. N. Morrison & R. N. Boyd, Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- P. A. Sykes, Guidebook to Mechanism in Organic Chemistry, Pearson Education (2003).
- F. A. Carey, Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education (2012).
- G. M. Loudo, Organic Chemistry, Fourth edition, Oxford University Press, 2008.
- J. Clayden, N. Greeves & S. Warren, Organic Chemistry, 2nd edition, Oxford University Press (2012).
- T.W. Graham Solomons & C. B. Fryhle, Organic Chemistry, John Wiley & Sons, Inc.
- J. G. Smith, Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
- J. March, Advanced Organic Chemistry, Fourth edition, Wiley.
- Alok Kumar Srivastava, "Organic Chemistry-II", Mahaveer Publication, Dibrugarh, Assam, India (2021).

e-Learning Source:

- <http://heecontent.upsdc.gov.in/Home.aspx>
- <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxJml/intro1.htm>
- <https://nptel.ac.in/courses/104/103/104103071/#>
- <https://swayam.gov.in/>
- https://www.youtube.com/watch?v=Gzk21Q_fv88

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	2	-	-	-	-	-	-	-	-	1	-	-	1	2
CO2	2	2	2	1	-	-	-	-	-	-	-	-	2	-	-	2	1
CO3	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-	1	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	1	-	-	1	2
CO5	3	1	1	2	-	-	-	-	-	-	-	-	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: 2023-24							
Course Code	B020401T/CH239	Title of the Course	Quantum Mechanics and Analytical Techniques	L	T	P	C
Year	Second	Semester	Fourth	3	1		4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	<p>The students learn about the atomic structure, elementary quantum mechanics, wave function and its significance; the Schrodinger wave equation and its applications; Molecular orbital theory, basic ideas – Criteria for forming molecular orbitals from atomic orbitals; Molecular Spectroscopy, Rotational Spectrum, vibrational Electronic Spectrum: photochemistry and kinetics. Analytical chemistry plays an enormous role in our society, such as drug manufacturing, process control in industry, environmental monitoring, medical diagnostics, food production, and forensic surveys. It is also of significant importance in different research areas. Analytical chemistry is a science that creates and develops knowledge to improve chemical analysis to respond to increasing or new demands.</p>						

Course Outcomes	
CO1	Students will be able to explore new areas of research in both chemistry and the allied fields of science and technology. This is especially in elementary quantum mechanics.
CO2	Students will be able to function as members of an interdisciplinary problem-solving team in molecular spectroscopy.
CO3	Students will be skilled at problem solving, critical thinking, and analytical reasoning as applied to scientific problems. This is done with the help of various spectroscopic techniques.
CO4	Students will learn how to determine the structure of organic molecules using IR, NMR, and mass spectroscopic techniques.
CO5	To develop the basic skills required for purification, solvent extraction, TLC, and column chromatography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Elementary Quantum Mechanics	Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de-Broglie hypothesis. Heisenberg uncertainty principle, Hamiltonian Operator. Schrödinger wave equation (time dependent and time independent) and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one-dimensional box. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Molecular orbital theory, basic ideas – Criteria for forming MO from AO, construction of MO by LCAO- H ₂ ⁺ ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ , σ^* , π , π^* orbitals and their characteristics.	10	1
2	Molecular Spectroscopy	Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom	5	2
3	Rotational Spectrum, Vibrational Spectrum and Raman spectrum	i. Diatomic molecules, Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect. ii. Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups. iii. Concept of polarizability, pure rotational and pure vibrational, Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules.	10	3
4	UV-Visible Spectroscopy	Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. Types of electronic transitions, λ max, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; application of Woodward Rules for calculation of λ max for the conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems distinction between cis and trans isomers (Cis and trans stilbene).	5	3
5	Infrared Spectroscopy (IR Spectroscopy)	Fundamental and non-fundamental molecular vibrations; Hooke's law selection rule, IR absorption positions of various functional groups (C=O, OH, NH, COOH and nitrile), Effect of H- bonding, conjugation, resonance and ring size of cyclic ketones and lactones on IR absorptions; Fingerprint region and its significance; application in functional group analysis and interpretation of I.R. Spectra of simple organic compounds. Identification of the Carbonyl group in Ketones, Aldehydes, Carboxylic acids, Esters, and Amides using IR Spectroscopy.	8	4
6	¹ H-NMR Spectroscopy (PMR)	NMR Spectroscopy: introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; choice of solvent and internal standard; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of first-order multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds; interpretation of NMR spectra of simple	8	4

		compounds. Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules such as Ethanol, Ethyl acetate, acetone, acetaldehyde, dimethylformamide, Cis and trans 1,2- dimethyl cyclopropanone, propene, vinyl chloride, acetophenone, benzaldehyde, phenol, Toluene and ethyl benzene.		
7	Introduction to Mass Spectrometry	Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, fragmentation process, McLafferty rearrangement.	6	4
8	Separation Techniques: Solvent extraction	Classification, principle, and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non- aqueous media. Chromatography: Classification, principle, and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution, and displacement methods.	8	5

Reference Books:

Alberty, R A, Physical Chemistry, 4th edition Wiley Eastern Ltd, 2001; Atkins, P.W, the elements of physical chemistry, Oxford, 1991

Barrow, G .M, International student Edition .McGraw Hill, McGraw-Hill, 1973; Cotton, F.A, Wilkinson, G and Gaus, P. L , Basic Inorganic Chemistry, 3rd Edition , Wiley 1995

Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS, 1977; Clayden, J., Greeves, N., Warren, S., Organic Chemistry, Second edition, Oxford University Press 2012.

Silverstein, R. M., Bassler, G. C., Morrill, T. C. Spectrometric Identification of Organic Compounds, John Wiley and Sons, INC, Fifth edition.

Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988; Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.; Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.

Mukherji, Singh, Kapoor, Organic Chemistry, Vol 1 and 2. New Age International 2014; RI Madan, Chemistry For Degree Students Elective Sem V/Vi As Per Cbs Quantum And Spectroscopy, S Chand Publishing

Y.R.Sharma, Elementary Organic Spectroscopy Vol 4, S Chand; Gurdeep Raj, Advanced Physical Chemistry, Krishna Publishing

Pavia, D. L. et al. Introduction to Spectroscopy, 5th Ed. Cengage Learning India Ed.

K.L.Kapoor, A Textbook Of Physical Chemistry - Quantum Chemistry And Molecular Spectroscopy, Volume 4, Macmillan; Tn Srivastva And Pc Kampoj, Systematic Analytical Chemistry, Shoban Lal Nagin Chand

e-Learning Source:

<https://www.coursera.org/courses?query=chemistry&languages=en>

<https://www.mooc-list.com/tags/physical-chemistry>

<https://www.coursera.org/learn/physical-chemistry>

<https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/>

<http://heecontent.upsdc.gov.in/Home.aspx>

<https://nptel.ac.in/courses/104/108/104108078/>

<https://nptel.ac.in/courses/104/106/104106122/>

<https://nptel.ac.in/courses/104/108/104108124/>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	-	-	-	-	-	-	-	-	1	-	-	1	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-	1	1
CO3	2	3	2	3	-	-	-	-	-	-	-	-	3	-	-	3	3
CO4	3	3	2	3	-	-	-	-	-	-	-	-	2	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-	2	1

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190402P/CH240	Title of the Course	Qualitative and Synthetic Methods	L	T	P	C
Year	Second	Semester	Fourth			4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students gain knowledge and skills related to this paper as follows: Utilities in the chemical industry include distillation, evaporation, and absorption; filtration and extraction; drying; crystallization and polymorphism; fluid flow; and heat transfer.						

Course Outcomes	
CO1	Student become able to determination of the flash point, ignition point of liquids, and smoke point of a fuel.
CO2	Students can analyze nitration, sulphonation, Friedel-Crafts reaction, esterification, hydrolysis, oxidation, halogenation, chlorosulphonation, reduction, and amination.
CO3	Each step of the reaction is monitored by TLC. 4-Bromo aniline, 3-Nitroaniline, Sulphanilamide, 4-Amino benzoic acid, 4-Nitro benzoic acid, Dihalobenzenes, Nitrohalobenzenes
CO4	Students can monitor chemical reactions with the help of TLC.
CO5	To perform limit tests for chlorine, arsenic, and heavy metals (Pb, As, Hg, Fe, and ash content) identification.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Analysis of fuel	Determination of the flash point, ignition point of liquids, and smoke point of a fuel.	10	1
2	Chemical process	One or two examples of each of the following unit processes Nitration, sulphonation, Friedel-Crafts reaction, esterification, hydrolysis, oxidation, halogenations, chlorosulphonation, reduction, and amination	15	2, 3
3	Synthesis of common industrial compounds	TLC monitors each step of the reaction. 4-Bromo aniline, 3-Nitroaniline, Sulphanilamide, 4-Amino benzoic acid, 4-Nitro benzoic acid, Dihalobenzenes, Nitrohalobenzenes	20	4
4	Limit tests	Limit tests for chlorine, arsenic, and heavy metals (Pb, As, Hg, Fe, and ash content)	15	5

Reference Books:

- A.I. Vogel, A.R. Tatchell, B.S. Furnis , A.J. Hannaford, P.W.G. Smith, Vogel's Textbook of Practical Organic chemistry(1989).
 B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 5e, Pearson (2003).
 Organic Chemistry, Prentice-Hall, 5th edition (1996).
 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman (1960).
 Harris, D.C. Exploring Chemical Analysis, 9thEd. New York, W.H. Freeman (2016).
 Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher (2009).
 Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education (2012).
 Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson (2009).

e-Learning Source:

- <https://www.labster.com/chemistry-virtual-labs/>
<https://www.vlab.co.in/broad-area-chemical-sciences>
<http://chemcollective.org/vlabs>

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
	CO1	2	2	1	2	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	2	1	-	-
CO3	2	3	1	1	-	-	-	-	-	-	-	-	-	1	2	-	-
CO4	2	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B020402P/CH241	Title of the Course	Instrumental Analysis	L	T	P	C
Year	Second	Semester	Fourth			4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students will be able to perform, design, interpret, and document laboratory experiments using critical thinking and scientific inquiry. This is at a level suitable to succeed in an entry-level position in the chemical industry or a chemistry graduate program.						

Course Outcomes	
CO1	Students will be able to explore new areas of research in both chemistry and allied fields of science and technology, basically in molecular weight determination.
CO2	Students will be able to function as members of an interdisciplinary problem-solving team in spectrophotometer.
CO3	Students will be skilled in problem solving, critical thinking, and analytical reasoning as applied to scientific problems, especially spectroscopy.
CO4	Students will gain an understanding of how to determine the structure of organic molecules using IR and NMR spectroscopic techniques.
CO5	To develop the basic skills required for purification, solvent extraction, TLC, and column chromatography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Molecular Weight Determination	i. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method. ii. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.	15	1
2	Spectrophotometry	i. To verify Beer – Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement ii. Determination of pKa values of indicator using spectrophotometry.	15	2
3	Spectroscopy	i. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; characteristic bending vibrations are included. Spectra to be provided). ii. Assignment of labelled peaks in the 1H NMR spectra of the known organic compounds explaining the relative δ -values and splitting pattern. iii. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).	15	3, 4
4	Chromatographic Separations	i. Paper chromatographic separation of following metal ions: Ni (II) and Co (II); Cu(II) and Cd(II) ii. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC) iii. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the Rf values TLC separation of a mixture of dyes (fluorescein and methylene blue).	15	5

Reference Books:

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009; Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004; Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016; Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.

Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition.

Mikes, O. & Chalmes, R.A. Laboratory Handbook of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

Ditts, R.V. Analytical Chemistry: Methods of separation. Van Nostrand, New York, 1974.

e-Learning Source:

<https://www.youtube.com/watch?v=xHQM4BbR040&pp=ygUcc3BIY3Ryb3Bob3RvbWV0ZXIgaXhwZXJpbWVudA%3D%3D>

<https://www.youtube.com/watch?v=LbsNI3WgUso&pp=ygUMc3BIY3Ryb3Njb3B5>

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-	-	2	1	-	-
CO3	3	3	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO4	2	3	3	1	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	-

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190403T/CH242	Title of the Course	Industrial Waste Treatment & Management	L	T	P	C
Year	Second	Semester	Fourth	3	1		4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Basic knowledge of industrial waste management technologies, acquaintance with basic waste treatment technologies and environmental legislations to curb hazardous wastes will be taught to students.						

Course Outcomes	
CO1	Students understand sources, characteristics, and waste treatment flow sheets for selected industries such as textiles, tanneries, pharmaceuticals, dairy, sugar, paper, distilleries, steel plants, and thermal power plants; wastewater reclamation concepts.
CO2	Students understand physical and chemical treatment, solidification, incineration, and secure landfills. Types of waste, management of solid waste, treatment, and disposal of non-toxic solid waste (landfills, scrubbing, flue gas cleaning, incineration, heat drying, wet oxidation, biodegradation, etc.), treatment of hazardous waste, and e-waste treatment.
CO3	Students know heavy metals, biosorption by fungi, algae, and bacteria; factors affecting biosorption; bioreactors for biosorption: packed bed reactor, fluidized bed reactor, rotating disc reactor, sequential reactor.
CO4	Student will be able to understand biotechnological applications for environmental management cover various areas, including composting, carbon sequestration, bioenergy and biofuels, anaerobic digestion for methane production, as well as the assessment and feasibility of industrial pollution prevention, waste management, and recycling, waste disposal by incineration, and ultimate disposal.
CO5	Students will be able to understand the toxic chemicals in the environment including fertilizers, insecticides, pesticides, plastics, toxic metals, dyes, surfactants, and their toxicity; international and national standards and control; biochemical effects of mercury and lead, carcinogens, vector-borne and water-borne diseases, pollution, and public health issues.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Pollution From Major Industries	Sources, characteristics, and waste treatment flow sheets for selected industries such as textiles, tanneries, pharmaceuticals, dairy, sugar, paper, distilleries, steel plants, and thermal power plants; wastewater reclamation concepts.	8	1
2	Hazardous Waste Management	Hazardous wastes: physical and chemical treatment, solidification, incineration, secures landfills.	7	2
3	Solid Waste Management	Types of waste, management of solid waste, treatment, and disposal of non-hazardous solid waste (landfills, scrubbing, flue gas cleaning, incineration, heat drying, wet oxidation, biodegradation etc.), treatment of hazardous waste, E-waste treatment.	8	2
4	Biosorption of Metals	Introduction, heavy metals, Biosorption by fungi, algae and bacteria, factors affecting biosorption, bioreactors for Biosorption- Packed bed reactor, fluidized bed reactor, rotating disc reactor, sequential reactor.	7	3
5	Biotechnological Intervention in Environmental Management	Biotechnological application to the management of the environment: composting, carbon sequestration, bioenergy and biofuels, anaerobic digestion for methane production, factors affecting biogas production.	8	4
6	Industrial Pollution Prevention	Assessment of Industrial Pollution Prevention, Feasibility of Industrial Pollution Prevention, Feasibility Implementation, Waste Management, Recycling, Waste Disposal by Incineration, Ultimate Disposal	8	4
7	Agricultural Pollutants	Fertilizers, insecticides, pesticides, plastics, toxic metals, dyes, surfactants, and their toxicity; international and national standards; control.	7	5
8	Chemical Toxicology	Toxic chemicals in the environment, biochemical effects of mercury and lead, carcinogens, vector-borne disease, water-borne disease, pollution, and public health issues.	7	5

Reference Books:

Chemical Thermodynamics by R.P.Rastogi et al; Simplified course in Physical Chemistry, Madan&Tuli, S. Chand & Co. Ltd.
 Principles of physical chemistry by Puri Sharma and Pathan; Atkin's Physical Chemistry, Atkin, Oxford Press.
 Essentials of Physical Chemistry, Bahl&Tuli, S. Chand & Co. Ltd.; Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co.

e-Learning Source:

<https://condorchem.com/en/industrial-wastewater-treatment/>; https://www.water.wa.gov.au/data/assets/pdf_file/0008/4040/89343.pdf
<https://www.chemicalprocessing.com/articles/2018/understand-industrial-wastewater-treatment/>
<https://www.encyclopedia.com/environment/encyclopedias-almanacs-transcripts-and-maps/industrial-waste-treatment>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1																	
CO2																	
CO3																	
CO4																	
CO5																	

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190404P/CH243	Title of the Course	Industrial Waste Analysis	L	T	P	C
Year	Second	Semester	Fourth			4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students gain knowledge and skills related to this paper as follows: instrumental methods of analysis, material testing, water analysis, and use of transducers for measuring flow control, and flow measuring devices (floats).						

Course Outcomes	
CO1	Student will be able to determine phenolphthalein alkalinity, methyl alkalinity; total alkalinity, total hardness, calcium hardness, and acidity of the given water sample and express the results in moles per liter and mg/L as CaCO ₃ for hardness parameters, and in equivalence/L and mg/L as CO ₂ for acidity.
CO2	Student will be able to determine the available chlorine percentage, chloride content, and pH of the given chlorine solution sample and each water sample.
CO3	Student will be able to determine the dissolved oxygen, 3-day BOD, and COD of the given sample of water.
CO4	Student become able to measure the total solids (T.S.) and total dissolved solids (T.D.S.) as well as the conductivity of a given water sample.
CO5	Student will be able to determine the potassium content in the provided water sample and to measure the amount of matter present in the air.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Alkalinity determination	i. To determine phenolphthalein alkalinity, methyl alkalinity, and total alkalinity in the given sample. ii. To determine total hardness and calcium hardness in the given water. Express your result in moles per liter and mg/L as CaCO ₃ . iii. To determine the acidity of the given sample of water. Express your result in equivalence/L and mg/L as CO ₂ .	15	1
2	Chloride content determination	i. To determine the percentage of available chlorine in the given chlorine solution sample. ii. To determine the chloride content in each sample of water. iii. To determine the pH of the given sample of water.	15	2, 3
3	DO, BOD, and COD	i. To determine the dissolved oxygen in the given sample of water. ii. To determine the 3-day BOD of the given sample of water. iii. To determine the COD of the given wastewater sample.	15	3, 4
4	Total solids, total dissolved solids, and potassium content determination	i. To determine total solids (T.S.) and total dissolved solids (T.D.S.) in the given sample of water. ii. To determine the conductivity of the sample of water. iii. To find out the potassium in the given sample of water. iv. To find out matter in the air.	15	4, 5

Reference Books:

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

Practical Organic Chemistry, A. I. Vogel.

Practical Physical Chemistry: B. Viswanathan and P.S. Raghavan.

Experimental Inorganic Chemistry –W. G. Palmer.

e-Learning Source:

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

<http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf>

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

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

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	-	2	3	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	-	3	1	-	-
CO5	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: 2023-24							
Course Code	B000401V/CH244	Title of the Course	Organic Farming	L	T	P	C
Year	Second	Semester	Fourth	1		2	3
Pre-Requisite	-	Co-requisite	-				
Course Objectives	This paper aims to impart knowledge about different organic farming approaches and organic farming's importance. After completing this program, participants will be able to: produce organic crops; grow and manage organic crops; maintain the quality of organic produce; and become knowledgeable about environmental health and safety.						

Course Outcomes	
CO1	Students understand organic farming, development of organic farming, concept of organic farming, organic concept, holistic concept, living soil concept, healthy plant concept.
CO2	Students know concepts and principles of organic farming, including the principles of health, ecology, fairness, and care.
CO3	Students know constraints for organic farming, potential customers for organic products in the domestic market, key indicators for organic farming, sustainable agriculture, and climate change.
CO4	Students understand input management, compost production, vermicomposting, compost quality, compost utilization, and marketing.
CO5	Students understand quality analysis of organic skill foods antioxidants and their natural sources, organic food, and human health standards for organic food and marketing.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	The science of modern farming	Definition of Students understand organic farming, development of organic farming, concept of organic farming, organic concept, holistic concept, living soil concept, healthy plant concept.	10	1
2	Introduction and principles	Introduction to organic farming and its significance; concepts and principles of organic farming, including the principles of health, ecology, fairness, and care.	10	2
3	Major organic products from India and key indicators	Constraints for organic farming, potential customers for organic products in the domestic market, key indicators for organic farming, sustainable agriculture, and climate change.	10	3
4	Management and marketing	Input management, compost production, vermicomposting, compost quality, compost utilization, and marketing.	10	4, 5
5	Organic crop management	Organic crop management: field skill crops, horticulture, and plantation crops; plant protection measures; biopesticides; natural predators; cultural practice.	10	4, 5
6	Quality analysis	Quality analysis of organic skill foods antioxidants and their natural sources, organic food, and human health standards for organic food and marketing.	10	5

Reference Books:	
Alvarcs, C.,1996. The Organic Farming Source Book. The other India Press, Mapusa, Goa.	
Gupta, M.,2004. Organic Agriculture Development in India. ABD publishers, Jaipur, India.	
e-Learning Source:	
https://www.bing.com/videos/riverview/relatedvideo?&q=organic+farming&&mid=	
https://www.bing.com/videos/riverview/relatedvideo?&q=organic+farming&&mid=	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	1	-	-	-	-	-	-	-	-	2	1	1	1	2
CO2	1	1	2	1	-	-	-	-	-	-	-	-	1	1	2	1	1
CO3	2	1	1	2	-	-	-	-	-	-	-	-	2	1	1	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1	2
CO5	1	2	1	1	-	-	-	-	-	-	-	-	2	1	1	2	1

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	Z040401T	Title of the Course	Physical Education and Yoga	L	T	P	C
Year	Second	Semester	Fourth	2			2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Equip students with a comprehensive understanding of physical education, fitness, and wellness. Gain knowledge in physical education, fitness, wellness, weight management, and lifestyle choices. Explore the relationship between yoga and mental health. Emphasize the value of education. Delve into traditional games, their cultural significance, and their benefits. Apply knowledge for physical fitness, mental well-being, and a balanced lifestyle. Develop critical thinking, problem-solving skills, communication skills, and appreciation for traditional games as part of cultural heritage and physical activity promotion.						

Course Outcomes	
CO1	Students understand the fundamental concepts and principles of physical education and can explain the concept of fitness and wellness and its significance in maintaining a healthy lifestyle.
CO2	Students can demonstrate knowledge of weight management techniques and strategies for maintaining optimal body weight as well as identify and analyze various aspects of an individual's lifestyle and its impact on overall health and well-being.
CO3	Students can recognize the relationship between yoga and mental health and understand how yoga practices contribute to mental well-being. Comprehend the importance of value education and its role in personal and social development.
CO4	Students can evaluate the traditional games of India and their cultural significance, highlighting their physical and mental benefits. Apply theoretical knowledge and practical skills acquired during the course to promote physical fitness, mental well-being, and a balanced lifestyle. Develop critical thinking and problem-solving abilities related to physical education and wellness.
CO5	Students can communicate effectively about the importance of physical education, fitness, wellness, and traditional games, both orally and in written form. Foster an appreciation for Indian traditional games and their role in preserving cultural heritage and promoting physical activity. Engage in teamwork, cooperation, and leadership skills through practical activities and group projects related to physical education and wellness.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Physical Education	i. Meaning, Definition, Aim and Objective. ii. Misconception About Physical Education. iii. Need, Importance and Scope of Physical Education in Modern Society. iv. Physical Education Relationship with General Education. v. Physical Education in India before Independence. vi. Physical Education in India after Independence.	15	1
2	Concept of Fitness and Wellness, Weight Management, and Lifestyle	i. Meaning, Definition and Importance of Fitness and Wellness. ii. Components of Fitness. iii. Factor Affecting Fitness and Wellness. i. Meaning and Definition of Obesity. ii. Causes of Obesity. iv. Management of Obesity. v. Health problems due to Obesity. i. Meaning, Definition, Importance of Lifestyle. ii. Factor affecting Lifestyle. iii. Role of Physical activity in the maintains of Healthy Lifestyle.	15	2, 3
3	Yoga and Meditation	i. Historical aspect of yoga. ii. Definition, types of scopes & importance of yoga. iii. Yoga is related to mental health and value education. iv. Yoga is related to Physical Education and sports. v. Definition of Asana, differences between asana and physical exercise. vi. Definition and classification of pranayama. vii. Difference between pranayama and deep breathing. viii. Practical: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, ix. Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. x. Pranayam: Anulom, Vilom.	15	3, 4
4	Traditional Games of India and Recreation in Physical Education	i. Meaning. ii. Types of Traditional Games Gilli- Danda, Kanche, Stapu, Gutte, etc. iii. Importance/ Benefits of Traditional Games. iv. How to Design Traditional Games. i. Meaning, Definition of Recreation. ii. Scope and Importance of Recreation. iii. General Principles of Recreation. iv. Types of Recreational Activities. v. Aerobics and Zumba (Fir India Movement).	15	4, 5

Reference Books:
Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006; Patel, Shri Krishna, Physical Education, "Agrawal Publishers", Agra, 2014-15
Panday, Preeti, Sharirik Shiksha Sankalan, "Khel Sanskriti Prakashan, Kanpur
Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications; B.K.S. Yengar, "Light and Yog. Yoga Deepika", George Allen of Unwin Ltd., London, 1981.
Braj Bilari Nigam, Yoga Power & "The Kpath of Personal achievement"; Doman and Publishers, New Delhi, 2001.
Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Doman Publishers, New Delhi - 2001.
Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.

Janice Jerusalem, "A Guide To Yoga" Parragon Bath, Baiihe-2004.

नारंग, प्रियंका, परम्परागत भारतीय खेल, " स्पोर्ट्स पब्लिकेशन", नई दिल्ली, 2007.

e-Learning Source:

<https://www.bing.com/videos/search?q=yoga&&view=detail&mid=599A4C4B7C3D09CF4930599A4C4B7C3D09CF4930&&FORM=VRDGAR&ru=%2Fvideos%2Fsearch%3Fq%3Dyoga%26FORM%3DHDRSC4>

<https://www.bing.com/videos/search?q=yoga&&view=detail&mid=C44E1F48814EBF788F1DC44E1F48814EBF788F1D&&FORM=VRDGAR&ru=%2Fvideos%2Fsearch%3Fq%3Dyoga%26FORM%3DHDRSC4>

<https://www.youtube.com/watch?v=s2NQhpFGIOg>

https://www.youtube.com/watch?v=3p4r_ad2Y7g

<https://www.youtube.com/watch?v=JYg0Vu6-RUk>

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	-	-	-	-	-	-	-	-	1	-	-	1	2
CO2	1	2	1	1	-	-	-	-	-	-	-	-	2	-	-	1	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-	2	2
CO4	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	1	1	1	1	-	-	-	-	-	-	-	-	1	-	-	2	1

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190301T/CH231	Title of the Course	Process Instrumentation and Industrial Chemical Analysis	L	T	P	C
Year	Second	Semester	Third	3	1	0	4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	On successful completion of students will gain the knowledge of important topics of industrial chemistry such as chromatography, thermal instrumentations, pressure measuring devices, liquid level measuring instruments, Industrial analysis, Modern instrumental analysis, spectroscopic methods, Effluent treatment, and wastewater management.						

Course Outcomes	
CO1	Students learn fundamental and how to apply chromatography techniques and their principles.
CO2	Students able to explore a range of temperature measuring instruments (glass thermometers, bimetallic thermometers, pressure spring thermometers, vapor field thermometers, resistance thermometers, and radiation pyrometers) and pressure measuring instruments (manometers, barometers, bourdon pressure gauges, diaphragm type pressure gauges, Macleod gauges, and Pirani gauges).
CO3	Students gain knowledge in level measurement techniques, viscosity, surface tension, density measurements, sampling procedures for solids, liquids, and gases, data processing, particle size determination, rheological properties of liquids, and plastics analysis.
CO4	Students know the fundamentals of pH and conductivity measurements with special reference to water and soil analysis, optical rotation of chiral compounds, and spectrophotometers. Furthermore, Bio-transformations: enzyme-catalyzed reactions, microwave-induced reactions principle, conditions, and advantages.
CO5	Students can explore principles and equipment for aerobic and anaerobic treatment, including anaerobic high-rate treatment, UASB reactors, EGSB reactors, EGSB/IC reactors, industrial treatment examples, as well as adsorption, filtration, sedimentation, bag filters, electrostatic precipitators, and sewage treatment plants (STPs).

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chromatography	Principles, methods, and applications of various chromatographic techniques such as Paper, TLC, GLC, HPLC, GLC, and GPC.	7	1
2	Temperature measuring instruments	Glass thermometers, bimetallic thermometers, pressure spring thermometers, vapor field thermometers, resistance thermometers, and radiation pyrometers.	7	2
3	Pressure measuring instruments:	Pressure gauges, manometers, barometers, pirani gauges, macleod gauges, and diaphragm type pressure gauges.	7	2
4	Liquid level measuring instruments	Direct-indirect level measurements, float type liquid level gauges, ultrasonic level gauges; bubbler systems, viscosity (Ostwald viscometer), surface tension (stalagmometer), and density (pycnometer) measurements.	7	3
5	Industrial analysis	Sampling procedures, sampling of bulk materials, techniques of sampling solids, liquids, and gases, collecting and processing of data, particle size determination, rheological properties of liquids and plastics, and their analysis.	8	3
6	Modern instrumental methods of analysis	pH and conductivity measurements with special reference to water and soil analysis, optical rotation of chiral compounds, and spectrophotometer.	8	4
7	Techniques in Organic Synthesis	<i>Bio-transformations:</i> enzyme-catalyzed reactions, microwave-induced reactions Principle, conditions, and advantages over conventional heating methods Applications, sonication	8	4
8	Effluent treatment, wastewater management	Principles and equipment for aerobic and anaerobic treatment, like i) anaerobic high-rate treatment of industrial wastewater and its reuse in industries ii) UASB reactors iii) EGSB reactors iv) EGSB/IC reactors v) industrial treatment examples Adsorption, filtration, sedimentation, bag filters, electrostatic precipitators, and sewage treatment plants (STPs).	8	5

Reference Books:

- Metcalfe and Eddy, Wastewater Engineering Publisher - McGraw-Hill (2013).
- H.S. Peavy, D.R. Rowe and G. Tchobanoglous; Environmental Engineering Publisher - McGraw-Hill (2015).
- M. M. Benjamin, D. F. Lawler, Water Quality Engineering: Physical / Chemical Treatment Processes by La - John Wiley & Sons (2013).
- V. Ranade V. Bhandari Industrial Wastewater Treatment, Recycling and Reuse, Elsevier (2014)
- Reynolds P. Richard, Unit Operations and Processes in Environmental Engineering by T.D. Publisher-CL Engineering (1996).
- Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher (2009).
- Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York (2004).
- Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman (2016).
- Pavia, D. L. et al. Introduction to Spectroscopy, 5th Ed. Cengage Learning India Ed.
- Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California USA (1988).

e-Learning Source:

- <https://www.mooc-list.com/tags/physical-chemistry>
- <https://www.coursera.org/learn/physical-chemistry>
- <https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/>
- <http://heecontent.upsdc.gov.in/Home.aspx>
- <https://nptel.ac.in/courses/104/108/104108078/>
- <https://nptel.ac.in/courses/104/108/104108124/>
- <https://nptel.ac.in/courses/104/106/104106122/>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	-	-	-	-	-	-	-	-	1	-	-	2	3
CO2	3	1	1	1	-	-	-	-	-	-	-	-	2	-	-	1	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	3	-	-	2	2
CO4	2	3	2	1	-	-	-	-	-	-	-	-	2	-	-	3	1
CO5	1	2	1	1	-	-	-	-	-	-	-	-	3	-	-	2	1

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

<p>Name & Sign of Program Coordinator</p>	<p>Sign & Seal of HoD</p>
--	--------------------------------------



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B020301T/CH232	Title of the Course	Chemical Dynamics & Coordination Chemistry	L	T	P	C
Year	Second	Semester	Third	3	1	0	4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Upon successful completion of this course, students should be able to describe the characteristics of the three states of matter and the different physical properties of each state of matter. Kinetic theory of gases, laws of crystallography, liquid state, and liquid crystals, conductometric, potentiometric, optical methods, polarimetry, and spectrophotometer techniques to study chemical kinetics and chemical equilibrium. After the completion of the course, students will be able to understand. Metal-ligand bonding in transition metal complexes, thermodynamic and kinetic aspects of metal complexes.						

Course Outcomes	
CO1	Students can explore the rate of reaction, order of reaction, concentration dependence, mathematical characteristics, and determination of reaction order, temperature effects, Arrhenius equation, activation energy, collision theory, transition state theory, rate constant expression, and thermodynamic aspects.
CO2	Students understand equilibrium constant, free energy, thermodynamic derivation of the law of mass action, Le-Chatelier's principle, reaction isotherm, reaction isochore-Clapeyron Clausius equation, phase terms (phase, component, degree of freedom), Gibbs phase rule derivation, phase equilibria of one component systems (water, CO ₂ , O ₂), and phase equilibria of two component systems (solid-liquid equilibria, simple eutectic systems).
CO3	Students understand kinetic theory of gases, van der Waals equation, critical phenomena, PV isotherms, continuity of states, law of corresponding states, reduced equation of state, and Maxwell's distribution of molecular velocities. Furthermore, Students able to explore liquid state, intermolecular forces, structure of liquids, differences between solids, liquids, and gases; study liquid crystals, their classification, structure, and phases; investigate liquids in solids (gels), their classification, preparation, properties, and applications.
CO4	Students are knowing the fundamentals of Werner's theory of coordination complexes, ligand classification, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature (up to two metal centers), isomerism in coordination compounds (constitutional, stereo, geometrical, and optical), focusing on square planar and octahedral complexes.
CO5	Explore electronic spectra, d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagrams, and the electronic spectrum of the [Ti(H ₂ O) ₆] ³⁺ complex ion. Study magnetic properties, types of behavior, methods for determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ effective values, orbital contribution to magnetic moments, and applications of magnetic moment data for 3d-metal complexes.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chemical Kinetics & Theories of chemical kinetics	i. Rate of a reaction, molecularity and order of reaction, concentration dependence of rates, 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, half-life method, and isolation method. ii. Effect of temperature on rate of reaction; Arrhenius equation; concept of activation energy; Simple collision theory based on the hard sphere model, transition state theory (equilibrium hypothesis); Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation).	8	1
2	Chemical Equilibrium	Equilibrium constant and free energy; thermodynamic derivation of the law of mass action; Le-Chatelier's principle, reaction isotherm, and reaction isochore-Clapeyron Clausius equation and its applications.	7	2
3	Phase Equilibrium	Statement and meaning of the terms phase, component, and degree of freedom; derivation of Gibbs phase rule, phase equilibria of one component system—water, CO ₂ , and O ₂ systems Phase equilibria of two component systems: Solid-liquid equilibria, simple eutectic (Bi-Cd, Pb Ag systems)	7	2
4	Kinetic theories of gases	i. <i>Gaseous State</i> : Postulates of the kinetic theory of gases: deviation from ideal behaviour, van der Waals equation of state. ii. <i>Critical phenomena</i> : PV isotherms of real gases, continuity of states, the isotherms of the Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state. iii. <i>Molecular Velocities</i> : Qualitative discussions of Maxwell's distribution of molecular velocities, collision number, mean free path, and collision diameter.	7	3
5	Liquid State	i. <i>Liquid State</i> : Intermolecular forces and the structure of liquids (a qualitative description) Structural differences between solids, liquids, and gases. ii. <i>Liquid crystals</i> : Difference between liquid crystal, solid, and liquid; classification and structure of the nematic and cholesterol phases. iii. Liquids in solids (gels): Classification, preparation, and properties, inhibition, general application.	7	3
6	Coordination Chemistry	Werner's theory of coordination complexes, classification of ligands, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, and geometrical and optical isomerism in square planar and octahedral complexes.	8	4
7	Theories of Coordination Chemistry	i. Metal-ligand bonding in transition metal complexes, limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral, and square planar complexes, the Jahn Teller effect, and factors affecting the crystal-field parameters. ii. <i>Thermodynamic and kinetic aspects of metal complexes</i> : a brief outline of the thermodynamic stability of metal complexes; the concept of hard and soft acids and bases and factors affecting their stability; the stability constants of complexes and their determination; substitution reactions of square planar complexes	8	4

8	Inorganic Spectroscopy and Magnetism	<p>i. Electronic spectra of transition metal complexes Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagrams for d1 and d9 states, and discussion of the electronic spectrum of the $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex ion.</p> <p>ii. Magnetic properties of transition metal complexes, types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ effective values, orbital contribution to magnetic moments, application of magnetic moment data for 3d- metal complexes.</p>	8	5
---	--------------------------------------	--	---	---

Reference Books:

Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).

Ball, D. W. Physical Chemistry Thomson Press, India (2007).

Cotton, F.A, Wilkinson, G and Gaus, P. L. Basic Inorganic Chemistry, 3rd Edition, Wiley 1995

Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS, 1977

Douglas, B, McDaniel, D and Alexander, J, Concepts of Models of Inorganic Chemistry, John Wiley & Sons; 3rd edition, 1994

Shriver, D.E Atkins, P.W and Langford, C. H, Inorganic Chemistry, Oxford University Press, 1994.

Porterfield, W.W, Inorganic Chemistry, Addison Wesley 1984.

Sharpe, A. G, Inorganic Chemistry, ELBS, 3RD edition, 1993; Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

Miessler, G.L, Tarr, D.A, Inorganic Chemistry, 2nd edition, Prentice Hall, 2001; Bahl and Bahl, Essential of Physical Chemistry, S.Chand

R Gopalan & V Ramalingam, Concise Coordination Chemistry, Vishal publishing house; Tn Srivastva and Pc Kampoj, Systematic Analytical Chemistry, Shoban Lal Nagin Chand

e-Learning Source:

<https://swayam.gov.in/>

<https://www.coursera.org/learn/physical-chemistry>

<https://www.mooc-list.com/tags/physical-chemistry>

<https://www.openlearning.com/courses/introduction-to-physical-chemistry/>

<https://www.my-mooc.com/en/categorie/chemistry>

https://onlinecourses.swayam2.ac.in/nce19_sc15/preview

<https://swayam.gov.in/>

<https://www.coursera.org/browse/physical-science-and-engineering/chemistry>

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	1	-	-	-	-	-	-	-	-	1	-	-	1	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	-	-	2	1
CO3	2	3	1	1	-	-	-	-	-	-	-	-	1	-	-	2	1
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-	1	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	1	-	-	1	2

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

<p>Name & Sign of Program Coordinator</p>	<p>Sign & Seal of HoD</p>
--	--------------------------------------



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190302P/CH233	Title of the Course	Industrial Chemical and Instrumentation Analysis	L	T	P	C
Year	Second	Semester	Third	-	-	4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students learn instrumental methods of analysis, material testing, water analysis, use of transducers for flow control, and flow measuring devices-floats are discussed.						

Course Outcomes	
CO1	Students can use a colorimeter, flame photometer, pH meter, potentiometer, and conducto-meter.
CO2	Students are able to perform testing of plastics and rubber, young's modulus, optical, thermal, mechanical, and electrical properties.
CO3	Students can estimate barium as barium sulphate, sulphate as BaSO ₄ , silver as AgCl, chloride as silver chloride, zinc as zinc oxide, and copper as cupric oxide.
CO4	Students can estimate iron as ferric oxide, aluminum as Al ₂ O ₃ , chromium as chromic oxide, Cr ₂ O ₃ , and lead as lead sulphate.
CO5	Students are able to analyze common raw materials as per industrial specifications, such as phenol, aniline, formaldehyde, hydrogen peroxide, acetone, etc.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Instrumental methods of analysis	Use of a colorimeter, flame photometer, pH meter, potentiometer, and conducto-meter	10	1
2	Material testing	Testing of plastics and rubber, young's modulus, optical, thermal, mechanical, and electrical properties.	10	2
3	Gravimetric analysis	Students can estimate barium as barium sulphate, sulphate as BaSO ₄ , silver as AgCl, chloride as silver chloride, zinc as zinc oxide, copper as cupric oxide, iron as ferric oxide, aluminum as Al ₂ O ₃ , chromium as chromic oxide, Cr ₂ O ₃ , and lead as lead sulphate.	30	3, 4
4	Industrial analysis	Analysis of common raw materials as per the industrial specifications, such as phenol, aniline, formaldehyde, hydrogen peroxide, acetone, etc.	10	5

Reference Books:

- G. D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York (2004).
 D.C. Harris, Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman (2016).
 E. Stocchi, Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK. (1990).
 J. A. Kent, (ed) Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi, (1997).
 Pani, B. Textbook of Environmental Chemistry, I.K. International Publishing House, (2017).
 A. K. De, Environmental Chemistry, New Age International Pvt, Ltd, New Delhi (2012).
 S. M. Khopkar., Environmental Pollution Analysis, New Age International Publishe (2010)
 B. D. Khosla., V. C. Garg., &A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
 C. W. Garland., Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
 A. M. Halpern, & M cBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman& Co.: New York (2003)

e-Learning Source:

- <https://www.labster.com/chemistry-virtual-labs/>
<https://www.vlab.co.in/broad-area-chemical-sciences>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	-	3	2	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	-	-

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B020302P/CH234	Title of the Course	Physical Analysis	L	T	P	C
Year	Second	Semester	Third	-	-	4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students who successfully complete this course should be able to calibrate instruments and prepare solutions of various concentrations, estimate components through volumetric analysis, as well as perform dilatometric experiments: one- and two-component phase equilibrium experiments.						

Course Outcomes	
CO1	Students able to demonstrate proficiency in the following concepts: calibration of laboratory equipment; dilution of solutions, including the conversion of 0.1 M to 0.001 M solutions; Understanding of the molecular concept and concentration units, including molecular weight, formula weight, and equivalent weight, and knowledge of various concentration units.
CO2	Students can determine experimentally the surface tension and viscosity of a pure liquid or solution.
CO3	Students identify boiling points of five organic compounds with boiling points under 180 °C.
CO4	Student becomes able to determine the transition temperature of the substance using thermometric or dilatometric methods.
CO5	Students learn the solutes' effect on critical solution temperature and construct phase diagrams.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Strengths of Solution	i. Calibration of fractional weights, pipettes, and burettes. Preparation of standard solutions. ii. Dilution: 0.1 M to 0.001 M solutions. iii. Mole Concept and Concentration Units: Mole Concept, molecular weight, formula weight, and equivalent weight. iv. Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, pH, pOH, milli equivalents, Milli moles	20	1
2	Surface Tension and Viscosity	i. Determination of the surface tension of a pure liquid or solution ii. Determination of the viscosity of a pure liquid or solution	10	2
3	Boiling point and Transition Temperature	i. Boiling point of common organic liquid compounds (any five): n-butyl alcohol, cyclo-hexanol, ethyl methyl ketone, cyclo-hexanone, acetylacetone, isobutyl methyl ketone, isobutyl alcohol, acetonitrile, benzaldehyde, and acetophenone [The boiling points of the chosen organic compounds should preferably be within 180 °C.] ii. Transition Temperature: Determination of the transition temperature of the given substance by thermometric or dilatometric method (e.g. MnCl ₂ .4H ₂ O or SrBr ₂ .2H ₂ O)	20	3, 4
4	Phase Equilibrium	i. To study the effect of a solute (e.g., NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g., phenol-water system) and to determine the concentration of that solute in the given phenol-water system. ii. To construct the phase diagram of a two-component (e.g., diphenylamine-benzo-phenone) system by the cooling curve method.	10	5

Reference Books:

G. D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York (2004).

D.C. Harris, Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman (2016).

E. Stocchi, Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).

J. A. Kent, (ed) Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi, (1997).

Pani, B. Textbook of Environmental Chemistry, I.K. International Publishing House, (2017).

A. K. De, Environmental Chemistry, New Age International Pvt, Ltd, New Delhi (2012).

S. M .Khopkar,., Environmental Pollution Analysis, New Age International Publishe (2010)

e-Learning Source:

<https://www.labster.com/chemistry-virtual-labs/>

<https://www.vlab.co.in/broad-area-chemical-sciences>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	2	3	-	-
CO4	2	3	1	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO5	2	2	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190303T/CH235	Title of the Course	Chemical Process and Unit Operation in Industry	L	T	P	C
Year	Second	Semester	Third	3	1	-	4
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students are able to utilize knowledge of cement chemistry and characteristics to address construction and manufacturing issues. Identify various cement types and properties, including compressive strength, durability, and curing time. Describe the chemical reactions associated with cement production and the function of additives in enhancing its qualities. Comprehend the idea of setting duration and the variables that impact it, such as temperature, humidity, and water-cement proportion.						

Course Outcomes	
CO1	Aim to provide students with knowledge on the dangerous effects of some commercial methods and suggest alternative solutions, as well as analyzing the feasibility of different commercial preparations of essential organic substances.
CO2	Students able to analyze the advantages and disadvantages of batch and continuous organic preparations in the context of manufacturing, determining the application and mechanism of common organic reactions in commercial chemicals' manufacture.
CO3	An interest in organic synthesis in context with industrial chemistry is created among students.
CO4	Students will develop an understanding of the design and application of an analysis related to a question of relevance based on their experience in separation techniques.
CO5	Students will gain an understanding of the connection between common approximation methods and standard chemical adsorption and absorption.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Synthetic Nitrogen Products	Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control, Hazards and safety and Effluent management.	8	1
2	Alkali Industrial Products	Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammonium phosphate, superphosphate, triple superphosphate. Lime, gypsum, Silicon, calcium carbide.	8	1
3	Cement	Introduction, Composition, Types of cement, Portland cement; raw Materials, manufacture of Cement by wet & Dry process, Reaction in the Kiln, setting of cement, Testing & Uses of cement.	7	2
4	Carbon Nanotubes	Synthesis, Single walled carbon nanotubes, Structure and characterization, Mechanism of formation, chemically modified carbon nanotubes, Doping, Functionalizing nanotubes, and Applications of carbon nanotubes.	7	2
5	Distillation	Introduction, Bath and continuous distillation, Separation of azeotropes, Plates columns and packed columns Absorption: Introduction: Equipment's- packed columns spray Columns, bubble columns, packed bubble columns, mechanically agitated contractors.	8	3
6	Evaporation	Introduction, Equipment -short tube (standard) Evaporator forced circulation evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporator.	7	4
7	Filtration	Filtration: Introduction, filter media and filter aids, equipment's, plate and frame filter press, nutch filter, rotary drum filter, sparkler filter, candle filter, bag filter, centrifuge Drying: Introduction, free moisture, bound moisture drying curve; equipment's, tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer.	7	4
8	Crystallization And Extraction	Introduction: solubility, super-saturation nucleation, crystal growth; Equipment- tank crystallizer, agitated crystallizer, evaporator, crystallizer, draft tube crystallizer. Introduction: selection of solvent; Equipment's- Spray column, packed column rotating disc column, mixer-settler. Mixing- Introduction; mixing of liquid-liquid solid- Solid, liquid-solid systems.	8	5

Reference Books:

- Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960
- Groggins P.M., Unit Process in Organic Synthesis, 5th edition, international student edition, Pubs: McGraw-Hill Book Co., New York, 1998
- Dryden's outlines of Chemical Technology edited and revised by GopalaRao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.
- Industrial Chemistry B.K.Sharma, goel publishing house.
- Chemical process industries N.R Nerrishreve.
- Chemical process principales: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)
- Shrev's Chemical process Industries: 5th edition – George T. Austin, McGraw Hill.
- Chemical Thermodynamics by R.P.Rastogi et al; Principles of physical chemistry by Puri Sharma and Pathan
- Essentials of Physical Chemistry, Bahl&Tuli, S. Chand & Co. Ltd.; Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co.
- Simplified course in Physical Chemistry, Madan&Tuli, S. Chand & Co. Ltd.; Atkin's Physical Chemistry, Atkin, Oxford Press.

e-Learning Source:

- <https://encyclopedia2.thefreedictionary.com/chemical+process+industry>
- <https://www.youtube.com/watch?v=RjZJjneJ5fk>
- <https://www.chemicalprocessing.com/>
- <https://www.britannica.com/science/phosphorus-chemical-element>
- <https://sites.google.com/a/sdsentnil.com/chemical-technology/chemical-processing-unit-operation>
- <https://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st4/c5/lec%201.pdf>
- <https://www.unibo.it/en/teaching/course-unit-catalogue/course-unit/2016/367440>
- https://www.youtube.com/watch?v=H_Nc7SJwDco

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	-	-	-	-	-	-	-	-	2	-	-	2	1
CO2	3	2	2	2	-	-	-	-	-	-	-	-	1	-	-	1	2
CO3	2	2	2	1	-	-	-	-	-	-	-	-	3	-	-	1	2
CO4	2	2	1	2	-	-	-	-	-	-	-	-	2	-	-	3	1
CO5	3	3	1	2	-	-	-	-	-	-	-	-	1	-	-	1	3

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

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



Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190304P/CH236	Title of the Course	Chemical Preparation and Analysis	L	T	P	C
Year	Second	Semester	Third			4	2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Students will be able to work effectively and safely in a laboratory environment with practical, technical, and communication skills and concepts to solve qualitative and quantitative problems, as well as transferable skills like the ability to work in teams as well as independently.						

Course Outcomes	
CO1	Students able to determine the density or specific gravity of an unknown liquid and to determine the solubility product of calcium hydroxide through the common ion effect of sodium hydroxide or any other strong alkali.
CO2	Students able to analyze the water equivalent of calorimeter.
CO3	Students able to demine the strengths of a given hydrochloric acid and acetic acid solution were determined through conductometric titration using a standard solution of sodium hydroxide.
CO4	Students able to prepare Borax/boric acid and chrome alum, and the level of calcium in chalk are estimated through permanganometry.
CO5	Student able to investigate the absorption of acid by activated charcoal and determine the pH of a HCl solution with a pH meter.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Experiments in Density, and Solubility	i. Determine the density or specific gravity of an unknown liquid. ii. Determined the solubility product of calcium hydroxide using common ion effect of sodium hydroxide or of any other strong alkali. iii. Determined the solubility of KNO ₃ above room temperature by gravimetric method.	20	1
2	Water Equivalent and Conductometric Titration	i. To determine the water equivalent of calorimeter. ii. Conductometric titration. a. Determined the strength of a given hydrochloric acid by using standard solution of sodium hydroxide. b. Determined the strength of a given acetic acid solution by using standard solution of sodium hydroxide.	20	2, 3
3	Borax/Boric Acid, Chrome Alum, and Calcium Estimation	i. Preparation of borax/ boric acid. ii. Preparation of chrome alum. iii. Estimation of Calcium in Chalk by permagnatometry.	10	4
4	Acid Absorption by Activated Charcoal and pH Determination	i. To study the absorption of acid and activated charcoal. ii. To determine the pH of given HCl solution by using pH meter.	10	5

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition.
 Practical Organic Chemistry, A. I. Vogel.
 Practical Physical Chemistry: B. Viswanathan and P. S. Raghavan.
 Experimental Inorganic Chemistry –W. G. Palmer
 Practical Chemistry: For B.Sc. I, II And III Year by S. Chand's

e-Learning Source:

<https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf>
<http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf>
<https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbac71dd17732-original.pdf>
<https://www.stem.org.uk/resources/collection/3959/practical-chemistry>
<http://pioneer.netserv.chula.ac.th/~sanongn1/processing.pdf>

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	-	3	2	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	-	2	3	-	-
CO5	2	2	2	1	-	-	-	-	-	-	-	-	-	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: 2023-24							
Course Code	B000301V/CH237	Title of the Course	Food Testing and Quality Control	L	T	P	C
Year	Second	Semester	Third	1		2	3
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Student able to comprehend the significance and evolution of food basics, understand the functions of food, identify and analyze plant and animal sources of food, gain knowledge of food processing from diverse plant sources, gain insight into milk and its products, comprehend the different types of food and acquire sufficient knowledge about the food industry.						

Course Outcomes	
CO1	Students understand the fundamentals of food chemistry, history, water structure, and relations among food components.
CO2	Students are able to know the foundations of carbohydrates: monosaccharide, oligosaccharides, and polysaccharides; starch and cellulose derivatives as food constituents; sugar and related products nutritional value; lipids: components, food lipids, and health; antioxidants.
CO3	Students know the basics of protein structure and functions, enzyme structure and functions, vitamin structure, types, and functions, minerals and nutritional aspects, vegetables and fruits, and the bioavailability of nutrients.
CO4	Students know the basics of food pigments, colours, preservatives, and adulteration.
CO5	Students understand and evaluate food quality, laws, and standards.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction and history	Food chemistry, history, water structure and relations in food components.	10	1
2	Carbohydrates and Lipids	Carbohydrates: monosaccharide, oligosaccharides and polysaccharides, starch and cellulose derivatives as food constituents, sugar and related products nutritional value, lipids: components, food lipids and health, antioxidants.	10	2
3	Structure and function of Proteins & Vitamins	Proteins structure and functions, enzymes structure and functions, vitamins structure, types and functions, minerals and nutritional aspects, vegetables and fruits, bioavailability of nutrients	10	3
4	Food pigments and colors	Food oxidants, food pigments, natural and synthetic food colours, flavoring agents, sweeteners, emulsifiers and stabilizers, spices and herbs	10	4
5	Food preservatives and Adulteration of food	Food preservatives, organic foods, advantages and disadvantages of organic food, food fortification. Food adulteration, types of adulteration: intentional adulteration, incidental adulteration.	10	4
6	Evaluation of food quality, laws & standards	Evaluation of food quality, sensory tests, types of tests, objective evaluation and instruments used for texture evaluation Food laws, food standardization and regulation agencies in India, national standards, international standards.	10	5

Reference Books:	
Voet D and Voet JG. Principles of Biochemistry. John Wiley and sons New York.	
Moat AG and Foster J. W. Microbial Physiology. John Wiley and Sons, New York.	
Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology, McGraw Hill	
U. Satyanarayan. Biochemistry, Elsevier; Robinson Dairy Microbiology.	
Jay JM Modern Food Microbiology. Van Nostraaand Reinhold Co., New York.	
Andrew Proctor Alternatives to conventional food processing, RSC pub.	
Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York.; Srilakshmi B Food Science, New Age Publication	
e-Learning Source:	
https://www.bing.com/videos/search?q=Evaluation+of+food+quality	
https://www.youtube.com/watch?v=g-Pp4UybXXo	
https://www.bing.com/videos/search?q=Carbohydrates+and+Lipids&&view=detail&mid=	
https://www.bing.com/videos/search?q=Structure+and+function+of+Proteins+%26+Vitamins&&view=detail&mid=	
https://www.youtube.com/watch?v=C7RtgEe8o9Y	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO21	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	1	-	-	-	-	-	-	-	-	1	-	-	1	1
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-	2	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	2	-	-	3	2
CO4	2	3	2	2	-	-	-	-	-	-	-	-	3	-	-	1	3
CO5	2	3	2	2	-	-	-	-	-	-	-	-	1	-	-	1	1

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

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



Integral University, Lucknow

Effective from Session:							
Course Code	Z030301T/ES225	Title of the Course	Human Values and Environment studies	L	T	P	C
Year	Second	Semester	Third	2			2
Pre-Requisite	-	Co-requisite	-				
Course Objectives	Upon finishing the course, students will be able to come up with ethical reasoning for decision-making, frame ethical issues, and operationalize ethical choices. The course integrates various facets of human values and the environment.						

Course Outcomes	
CO1	Students can build fundamental knowledge of the interplay of markets, human value, ethics, and law and understand various challenges faced by individuals to counter unethical issues.
CO2	Students look at core concepts for business ethics as well as core concepts for anti-corruption.
CO3	Students look at core concepts for a morally articulate solution evolver to management issues in general, issues of sustainable development for a better environment, and know how environmental degradation has taken place.
CO4	Students should be aware of negotiations and international efforts to save the environment. How to develop sustainably Efforts taken up by the UN in Sustainable Development.
CO5	Students also know the efforts taken by India in sustainable development and the various environmental laws.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Human Values, Present Practices and Principles of Ethics	i. <i>Introduction:</i> Values, Characteristics, Types, Developing Value Systems in Indian Organizations, Values in Business Management, Value-Based Organizations, and Trans-cultural Human Values in Management Swami Vivekananda's philosophy of character building, Gandhi's concept of the Seven Sins, and APJ Abdul Kalam's view on the role of parents and teachers. ii. <i>Human Values and Present Practices:</i> Issues: Corruption and Bribe, Privacy Policy in Web and social media, Cyber Threats, Online Shopping, etc. Remedies: UK Bribery Act, Introduction to Sustainable Policies and Practices in the Indian Economy. iii. <i>Principles of Ethics:</i> Secular and Spiritual Values in Management: Introduction, Secular and Spiritual Values, Features, and Levels of Value Implementation Features of spiritual values. iv. <i>Corporate Social Responsibility:</i> Nature, Levels, Phases, Phases and Models of CSR, Corporate Governance CSR and Modern Business Tycoons Ratan Tata, Azim Premji, and Bill Gates.	07	1, 2
2	Holistic Approach in Decision making, Discussion through Dilemmas and Case Studies	i. <i>Holistic Approach in Decision Making:</i> Decision Making, the Decision-Making Process, The Bhagavad Gita: Techniques in Management, Dharma, and Holistic Management. ii. <i>Discussion through Dilemmas:</i> Dilemmas in Marketing and Pharma Organizations, Moving from Public to Private Monopoly Context Dilemma of privatization, Dilemma on liberalization, Dilemma on social media and cyber security Dilemma on Organic Food, Dilemma on Standardization, Dilemma on Quality Standards. iii. <i>Case Studies</i>	08	2, 3
3	Ecosystem and Biodiversity	i. <i>Concept, structure, and functions of ecosystems:</i> producer, consumer, decomposer, food web, food chain, energy flow, ecological pyramids. ii. <i>Conservation of Biodiversity:</i> In-situ and Ex-situ Conservation of Biodiversity Role of individuals in pollution control Human Population and Environment Sustainable Development India and the UN Sustainable Development Goals Concept of circular economy and entrepreneurship.	07	4
4	Environmental Laws, Quality, and Management	Environmental Laws, International Advancements in Environmental Conservation, Role of the National Green Tribunal, Air Quality Index, Importance of Indian Traditional Knowledge on the Environment, Bioassessment of Environmental Quality, Environmental Management System, Environmental Impact Assessment, and Environmental Audit.	08	5

Reference Books:
A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal et.al.
JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
Human Values by A. N. Tripathi New Age International.
Environmental Management by N.K. Uberoi.
e-Learning Source:
https://www.un.org/sustainabledevelopment/sustainable-development-goals/
https://www.india.gov.in/my-government/schemes/
https://www.legislation.gov.uk/ukpga/2010/23/contents/
Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1	2	1
CO2	2	3	2	2	-	-	-	-	-	-	-	-	2	1	1	1	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	1	2	2	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1	1	1

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

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