DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2024-25
w.e.f. July, 2025-26
Certificate in Bioorganic and Chemical Analysis
1st Year / 1st Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
1.	B020101T/CH151	Fundamentals of Chemistry-I	T	Core Major	3	1	-	15	10	25	75	100	04	√		√					4
2.	B020102T/CH152	Fundamentals of Chemistry-II	T		3	1	-	15	10	25	75	100	04	√		√					4
3.	B190102P/CH133	Basic Analytical Methods	P		-	-	4	15	10	25	75	100	02	√	√	√					4
4.	B020102P/CH134	Quantitative Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√					4
5.	B000101V/CH137	Plastic Waste Management	T + P	Vocational	1	-	2	-	-	-	100	100	03	√	√	√		√			4, 13
6.	Z010101T/BE105	Food Nutrition and Hygiene	T	Co-curricular	2	-	-	15	10	25	75	100	02	√		√		√			3, 4
7.	A050101T/HM101	Rashtra Gaurav*	T	Audit Course	2	-	-	-	-	-	100	100	00					√	√	√	4
				TOTAL	**11**	**02**	**10**	**75**	**50**	**125**	**575**	**700**	**17**								

*Qualifying (Non-Credit Course)

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B020101T/CH151	**Title of the Course**	Fundamentals of Chemistry-I	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	5	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To impart fundamental knowledge of chemical bonding and periodic properties and trends across the periodic table, enabling students to predict elemental properties based on their position in periods and groups, and to develop a comprehensive understanding of stereochemistry, organic reaction mechanisms, and other fundamental concepts in organic chemistry.						

Course Outcomes	
CO1	Learners will be able to **explain** molecular polarity and weak chemical forces such as van der Waals forces, ion-dipole forces, dipole-dipole interactions, and induced dipole interactions, and **apply** current bonding models to predict the structures and bonding parameters of simple inorganic and organic molecules.
CO2	Learners will be able to **analyze** the periodic table as a tool for predicting elemental properties and **demonstrate** detailed insights into periodic trends.
CO3	Learners will be able to **evaluate** the fundamentals of chemical reactions, including reactive intermediates, transition states, and factors influencing bond formation, and **interpret** reactors, catalysts, stereochemistry, and the formation of major and minor products in organic reactions.
CO4	Learners will be able to **explain** stereochemistry, including two-dimensional and three-dimensional structures of molecules, and **analyze** their roles in reaction mechanisms.
CO5	Learners will be able to **describe** solutions and colligative properties, including Raoult's law, relative lowering of vapour pressure, molecular weight determination, and osmosis, and **apply** these principles in relevant contexts.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Molecular polarity	van der Waals forces, ion-dipole forces, dipole dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization.	8	1
2	General Periodic Properties	Electronic configurations of elements, types of radii (covalent, crystal and Vander Waal's radii), electron affinity, electronegativity, and ionization potential. Pauling scale, Mulliken electronegativity scale, Slater rules, Allred and Rochow scale, diagonal relationship.	8	2
3	Periodic properties of Atoms (with reference to s & p-block)	Brief discussion, factors affecting and variation trends of following properties in groups and periods (with reference to s & p-block) such as effective nuclear charge, shielding or screening effect, Atomic and ionic radii, Electronegativity, Ionization enthalpy, Electron gain enthalpy.	8	2
4	Mechanism of Organic Reactions	Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents electrophiles and nucleophiles.	6	3
5	Essentials of Isomerism	Concept of isomerism, Different types of isomerism, their nomenclature and associated physico chemical properties. Structural isomerism: chain isomerism, positional isomerism, functional isomerism and metamerism, keto-enol tautomerism.	6	3
6	Stereochemistry-I	Optical isomerism: elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.	8	4
7	Stereochemistry-II	Geometric isomerism: determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.	8	4
8	Solutions and Colligative Properties	Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.	8	5

Reference Books:

Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010

Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.

Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.

Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
Mukeherji, Singh, Kapoor, Organic Chemistry, Vol 1, New Age International 2014
e-Learning Source:
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
Activities: Assignments, quiz, discussion, presentation, etc.

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	3	-	-	-	-	1	3	3	2	1	2	3	4 (Quality Education)
CO2	2	-	-	-	-	1	3	2	2	1	2	2	
CO3	1	-	-	-	-	1	3	3	2	1	3	3	
CO4	3	-	-	-	-	1	3	2	2	1	2	3	
CO5	2	-	-	-	-	1	3	2	2	1	3	2	

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

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

B.Sc. Chemistry

Effective from Session: 2025-26							
Course Code	B020103T/CH152	**Title of the Course**	Fundamentals of Chemistry-II	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	5	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To provide fundamental and essential knowledge on the origin of chemistry, ancient Indian chemistry, principles of chemical calculations, weak chemical forces, classical and contemporary atomic structure theories, as well as thermodynamics, chemical equilibrium, and acids, and bases. Upon completion of this course, students would gain a thorough understanding of chemical forces, molecular polarity, periodic properties, and trends which will assist in the prediction of chemical forces, classical and modern atomic structure theories, as well as thermodynamics and the principles of chemical equilibrium for acids and bases.						

Course Outcomes	
CO1	Learners will be able to **explain** the origins of chemistry, including ancient Indian chemistry, perform fundamental chemical calculations, and **describe** weak chemical forces.
CO2	Learners will be able to **understand and apply** the concepts of matter waves, the de Broglie equation, Heisenberg's uncertainty principle, atomic orbitals, Schrödinger's wave equation and its significance (Ψ and Ψ^2), quantum numbers, radial and angular wave functions, probability distribution curves, shapes of s, p, and d orbitals, and interpret Aufbau principle, Pauli exclusion principle, Hund's rule, electronic configurations, and effective nuclear charge.
CO3	Learners will be able to **explain** the fundamentals of valence bond theory, valence shell electron pair repulsion (VSEPR) theory, molecular orbital theory for homonuclear and heteronuclear diatomic molecules (e.g., CO, NO), multicenter bonding in electron-deficient molecules, and **evaluate** bond strength and bond energy.
CO4	Learners will be able to **analyze** ionic structures using the radius ratio rule and coordination numbers, **evaluate** its limitations, describe lattice defects, semiconductors, lattice energy and the Born-Haber cycle, solvation energy, and solubility of ionic solids, and apply Fajan's rules to predict polarizing power and polarizability of ions.
CO5	Learners will be able to **explain** different concepts of acids and bases, theories of indicators (acid-base, redox, metal ion, adsorption), select appropriate indicators, and **evaluate** types of systems, intensive and extensive properties, thermodynamic processes, and the laws of thermodynamics.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	The beginning of chemistry	The history of chemistry, quantitative experiments by Lavoisier, Proust, and Dalton, the law of conservation of mass, and the law of multiple proportions. Avogadro's hypothesis. Introduction of ancient Indian chemistry, contribution of Indian chemists in context to the holistic development of modern science and technology.	8	1
2	Fundamentals of Chemical Calculations and Weak Chemical Forces	Atomic weight, molecular weight, equivalent weight, mole concept, percentage yield, composition of liquid mixtures and gaseous mixtures, molarity, molarity, morality, normality. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction.	8	1
3	Structure and Bonding	Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of Ψ and Ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, electronic configurations of the elements, effective nuclear charge.	8	2
4	Chemical Bonding-I	Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl^{-2} and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, Percentage ionic character from dipole moment and electro-negativity difference.	6	3
5	Chemical Bonding-II	Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and Ploarizability of ions, Fajan's rule, Metallic bond-free electron, valence bond and band theories.	8	3
6	Recapitulation of Basics of Organic Chemistry	Bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clatherates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications. Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples).	8	4
7	Acids and Bases	Lowery - Bronsted concept, Lewis's concept, hard and soft acids and bases, Lux- Flood acids and bases, theories of indicators, acid-base, redox, metal ion	6	4

		and adsorption indicators and choice of indicators.		
8	Thermodynamics and Chemical Equilibrium	System, surroundings etc. Types of systems, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work. Thermodynamic laws, enthalpy changes, entropy, processes and functions, free energy, partial molar quantities, activity co-efficient, and fugacity, effect of temperature and pressure on equilibrium constants in gaseous system.	8	5

Reference Books:
Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
Mukeherji, Singh, Kapoor, Organic Chemistry, Vol 1, New Age International 2014
e-Learning Source:
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
Activities: Assignments, quiz, discussion, presentation, etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	3	-	-	-	-	2	3	3	2	1	2	1	4 (Quality education)
CO2	2	-	-	-	-	2	3	2	2	1	3	2	
CO3	1	-	-	-	-	2	3	3	2	1	2	1	
CO4	3	-	-	-	-	2	3	2	2	1	1	2	
CO5	2	-	-	-	-	2	3	2	2	1	2	3	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B190102P/CH133	**Title of the Course**	Basic Analytical Methods	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	0	0	4	2
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To provide the key knowledge of a good laboratory practice (GLP), calibration apparatus, preparation of standard solutions, solutions of various concentrations, determination of viscosity, the surface tension of liquids, and simple laboratory techniques.						

Course Outcomes	
CO1	Learners will be able to **understand** and perform good laboratory practice (GLP).
CO2	Learners will be able to **understand** the basic analytical and technical skills needed to work effectively in the various fields of chemistry.
CO3	Learners will be able to **remember** to keep records of all experiments performed in the manner that is required in laboratories.
CO4	Learners will be able to **determine** the viscosity and surface tension of liquids.
CO5	Learners will be able to **prepare** standard solutions and solutions of various concentrations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Good Laboratory Practices (GLP)	Good laboratory practices, Calibration of thermometer and burette	15	1,2,3
2	Simple Laboratory Techniques	Crystallization, fractional crystallization, distillation, fractional distillation, melting point and boiling point determination.	15	2,3
3	Viscosity and Surface Tension of Liquids	Determination of relative viscosity of a liquid with water and determination of % composition of an unknown solution. Determination of the surface tension of an organic liquid and determination of % composition of an unknown mixture.	15	4
4	Preparation of Standard Solutions	Preparation of standard solution of $K_2Cr_2O_7$. To find out the concentration of unknown $K_2Cr_2O_7$ solution using $Na_2S_2O_3$ solution as an intermediate. Preparation of standard solution of copper sulphate. To find out the concentration of unknown copper sulphate solution using $Na_2S_2O_3$ solution as an intermediate. Preparation of standard $KMnO_4$ and ferrous ammonium sulphate solution. To find out the strength of unknown ferrous ammonium sulphate solution using as an intermediate.	15	5

Reference Books:
Saxena Ruchi, Srivastava Alok Kumar, "Read & Do Practical Chemistry", Kitab Mahal, New Delhi, India (2016).
Skoog D. A., West.D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia (2010).
G. Larry Hargis, "Analytical Chemistry: Principles and Techniques" Pearson© (1988)
B.Sc. Physics Practical Book By Cl Arora
e-Learning Source:
https://www.labster.com/chemistry-virtual-labs/
https://www.vlab.co.in/broad-area-chemical-sciences
http://chemcollective.org/vlabs
Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	3	1	1	1	1	2	2	2	3	2	1	2	**4 (Quality education)**
CO2	3	1	1	-	1	2	2	2	2	2	2	2	
CO3	3	1	1	1	1	2	2	2	3	2	3	3	
CO4	3	1	1	1	-	2	2	2	2	2	1	2	
CO5	3	1	1	1	1	2	2	2	3	2	1	2	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B020102P/CH134	**Title of the Course**	Quantitative Analysis	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	0	0	4	2
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To impart essential knowledge of laboratory techniques and tests for estimating metal ions, estimating the concentrations of acids and alkalis in commercial products, and evaluating the portability of water samples.						

Course Outcomes	
CO1	Learners will have the knowledge and skills to **understand** the laboratory methods and tests related to the estimation of metal ions and the estimation of acids and alkali contents in commercial products.
CO2	Learners will be able to **understand** and perform the portability tests of water samples.
CO3	Learners will be able to **estimate** metal ions.
CO4	Learners will be able to **estimate** the alkali and acid contents of samples.
CO5	Learners will be able to **estimate** the inorganic salts and hydrated water in samples.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Estimation of one Anion and Cation	To analyse the given salt for one cation and anion.	15	1,2
2	Estimation of Metals Ions	To estimate ferrous and ferric by dichromate method. To estimate copper using thiosulphate.	15	2,3
3	Estimation of Acids and Alkali Contents	Determination of acetic acid in commercial vinegar using NaOH. Determination of alkali content – antacid tablet using HCl. To estimate oxalic acid by titrating it with KMnO4.	15	2,4
4	Estimation of Inorganic Salts and Hydrated Water	To estimate sodium carbonate and sodium hydrogen carbonate present in a mixture. To estimate calcium content in chalk as calcium oxalate by permanganometry. To estimate water of crystallization in Mohr's salt by titrating with KMnO4.	15	2,5

Reference Books:

Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.

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

e-Learning Source:

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

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

http://chemcollective.org/vlabs

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	3	1	1	1	1	2	2	3	2	-	1	2	**4 (Quality education)**
CO2	3	1	1	1	1	2	2	3	2	2	2	3	
CO3	3	1	-	1	1	2	2	3	2	-	1	2	
CO4	3	1	-	1	1	2	2	3	2	-	3	1	
CO5	3	1	-	1	1	2	2	3	2	2	2	2	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B000101V/CH137	**Title of the Course**	Plastic Waste Management	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	1	0	2	3
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To equip students with fundamental knowledge of laboratory operations, including equipment calibration, preparation of standard solutions and solutions of various concentrations, and to develop their ability to solve qualitative and quantitative problems both independently and collaboratively, particularly in relation to the treatment of wastes such as plastics, pharmaceuticals, agrochemicals, and household wastes.						

Course Outcomes	
CO1	Learners will be able to **analysis** of plastic and industrial wastes qualitatively, along with comprehension of the fundamentals of their treatment, would enable students to evaluate their physical parameters effectively.
CO2	Learners will be able to **handle** and performance of sampling of plastic and industrial wastes following standard procedures would enable students to collect representative samples for analysis.
CO3	Learners will be able to **understand** of the handling and disposal of radioactive waste, along with measurement of conductivity, would enable students to interpret its significance in waste analysis.
CO4	Learners will be able to **conduct** electroanalytical procedures and performing potentiometric measurements would enable students to characterize wastes effectively.
CO5	Learners will be able to **perform** recycling processes and sustainability practices would enable students to apply environmental management strategies efficiently.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Managerial Skill on Waste Treatment/Water Treatment	Theory: Introduction of plastic and its classification; waste focusing on metal deduction. Practical: Qualitative Analysis	10	1,2
2	Supervisory and Technician Skill For Pharma/Chemical Industries	Theory: Sampling and handling of Industrial waste/ plastic waste. Practical: Sampling and digestion	10	1,2
3	Managerial (QA/QC) Skill for Cement/Plastic/Textile Industries /Waste Treatment Plant Industries	Theory: Principles of industrial waste treatment/ plastic waste treatment. Practical: Physical parameters of waste	10	1,2
4	Technician Skill/Radioactive Waste Handling Expertise for Nuclear Power Plant	Theory: Radioactive waste and its disposal, conductivity and its measurements. Practical: Conductivity measurement of different samples	10	1,3
5	Technician Skill for Sugar, Cement, Pharma Steel/Iron Foundries	Theory: Potentiometric measurements, electro analytical methods. Practical: pH measurement & Electrochemical measurements	10	1,4
6	QC Managerial Skill for Cosmetic/Pharma/Steel/Polymer/ Textile/Food and Dairy Products	Theory: Sustainability and the chemical industry. Practical: Recycle of wastes	10	1,5

Reference Books:

Industrial Chemistry by B.K Sharma, By Krishna Publications, GOEL Publishing House

Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut.

Water Pollution by V.P. Kudesia, 4th edition, (latest) Pragati Prakashan, Meerut.

Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education, sixth edition

e-Learning Source:

https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters

https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	3	2	3	3	-	3	3	3	3	3	2	1	4 (Quality education), & 13 (Climate Change)
CO2	3	2	3	3	-	2	3	2	3	2	2	2	
CO3	2	2	3	2	-	2	3	2	1	3	2	1	
CO4	3	2	3	3	-	2	3	2	3	3	2	2	
CO5	3	2	3	3	-	3	3	3	2	3	2	2	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	Z010101T/BE105	**Title of the Course**	Food, Nutrition and Hygiene	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	0	2
Pre-Requisite	-	**Co-requisite**	-				
Course Objectives	To learn the basic concept of food, nutrition, hygiene, common diseases prevalent in society along with 1000 days nutrition concept.						

Course Outcomes	
CO1	Learners will be able to understand the basic concept of the Food and Nutrition, and meal planning.
CO2	Learners will be able to analyse the macro and micronutrients and its RDA, sources, functions, deficiency, and excess.
CO3	Learners will be able to understand and evaluate the 1000 days Nutrition Concept and study the nutritive requirement during special conditions like pregnancy and lactation.
CO4	Learners will be able to manage common health issues in the society and to learn the special requirement of food during common illness.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Concept of Food and Nutrition	(a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food	8	1
2	Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of	(a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fiber	7	2
3	1000 days Nutrition	(a) Concept, Requirement, Factors affecting growth of child. (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirementand risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)	8	3
4	Community Health Concept	(a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition. (c) Immunity Boosting Food	7	4

Reference Books:

Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.

Sheel Sharma,Nutrition and Diet Therapy,Peepee Publishers Delhi,2014,First Edition.

1000Days-Nutrition Brief Brain-Think Babies FINAL.pdf

https://pediatrics.aappublications.org/content/141/2/e20173716

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/

e-Learning Source:

https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutrition Diploma in Human Nutrition-Revised Offered by Alison

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	1	-	-	2	2	3	2	3	3	2	2	-	3 (Good Health and Well-being), & 4 (Quality education)
CO2	1	-	-	3	2	3	2	3	3	2	2	-	
CO3	1	-	-	3	3	2	3	3	-	-	2	-	
CO4	2	-	3	3	3	3	3	3	3	2	3	-	

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	A050101T/ HM101	**Title of the Course**	RASHTRA GAURAV	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	0	2
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	The objective of the course on "Rashtra Gaurav" is to explore and critically analyze the multifaceted dimensions of national pride and glory, as depicted in the paper. Participants will delve into the historical, cultural, social, and political aspects that contribute to the concept of "Rashtra Gaurav" (National Pride) in the context of the specific themes and perspectives presented in the paper. Through in-depth discussions, readings, and interactive sessions, participants will gain a comprehensive understanding of the factors that shape and define a nation's sense of pride, and how these factors influence individual and collective identities. The course aims to foster a nuanced appreciation for the significance of "Rashtra Gaurav" in contemporary society, encouraging participants to critically evaluate its implications and applications within diverse global contexts.						

Course Outcomes	
CO1	Learners will be able to understand the basics of Indian Society and culture.
CO2	Learners will be able to analyze the fundamental issues in India.
CO3	Learners will be able to understand Indian Heritage.
CO4	Learners will be able to examine the philosophical and spiritual developments in India.
CO5	Learners will be able to evaluate the contributions of Major National Characters and Personalities.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Indian society & culture	• Unity in Diversity • Art forms, Literature, Culture from Ancient to Modern time. • National and International Awards & Awardees	05	01
2	Issues in India	• Issues of Gender Equality and role of Women Organisations • Issues of Poverty and Development • Social Empowerment through Social Movements in India	05	02
3	Indian heritage	• Cultural Heritage in India: Buddhist Monuments at Sanchi, Ajanta & Ellora Caves, Khajuraho, Taj Mahal • Tourist Places in India: Red Fort, Ambar Palace, Kaziranga National Park, Ram Mandir (Ayodhya)	04	03
4	Philosophical and spiritual developments	• Sufism & Bhakti Movement: Bulleh Shah, Data Ganj Baksh, Khwaja Moinuddin Chishti, and Nizamuddin Auliya.Tulsidas, Surdas, Meera, Nank & Kabir • Jainism: Mahavir's biography and education • Buddhism: The life of Buddha, Contributions of Buddhism to India's Culture	05	04
5	Major national characters and personalities	• Ashoka the Great and His Dhamma • Raja Ram Mohan Roy & Brahmo Samaj • Savitribai Phule: A Social Reformer and contribution in Women Education • Swami Vivekanand and his philosophies • Mahatma Gandhi: Role of Gandhi in Indian National Movement • Dr. Bhimrao Ambedkar: A Chief architect of the Indian Constitution	06	05

Reference Books:

Jawaharlal Nehru - "The Discovery of India"
B.R. Ambedkar - "Annihilation of Caste"
Ramachandra Guha - "India After Gandhi: The History of the World's Largest Democracy" Mahatma Gandhi – "My Experiment with Truth"
S C Dubey- "Indian Society"
Nadeem Hasnain – "Indian Society and Culture" G Shah- "Social Movements in India"

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

PO-PSO CO	PO1	PO2	PO3	PO4	P05	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	2	1	3	3	2	2	3	2	1	2	4 (Quality education)
CO2	3	2	2	3	1	2	3	1	2	1	
CO3	1	2	2	2	2	3	2	3	3	2	
CO4	1	3	2	3	2	3	2	3	1	3	
CO5	2	3	1	2	2	3	1	3	2	1	

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

Name & Sign of Program Coordinator	**Sign and seal of HoD**

DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2024-25
w.e.f. July, 2025-26
Certificate in Bioorganic and Chemical Analysis
1st Year / 2nd Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
1.	B020201T/CH139	Bioorganic and Materials Chemistry	T	Core Major	3	1	-	15	10	25	75	100	04	√		√					
2.	B020202T /CH160	Organic and Pharmaceutical Chemistry	T		3	1	-	15	10	25	75	100	04	√							
3.	B190202P/CH140	Materialistic Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√		√			
4.	B020202P/CH141	Biochemical Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√					
5.	• B030202T/MT148 • A040209T/LN109 • B150203T/ES135; B150204P/ES136 • -	• Basic Mathematics & Statics • Basics of Communication • Eco-restoration and Invaded Ecosystems; Ecosystems Dynamic Lab • BS	T + P	Minor (Elective)	3	1	4	15	10	25	75	100	06	√	√	√		√		√	
6.	B000201V/CH144	Laboratory Safety & Sample Handling	T + P	Vocational	1	-	2	-	-	-	100	100	03	√		√		√	√	√	
7.	Z020201T/NS110	First Aid and Health	T	Co-curricular	2	-	-	15	10	25	75	100	02	√		√		√	√	√	
8.	B020205T/CH159	Advanced Application of Artificial Intelligence in Chemical Sciences*	T	Audit Course	2	-	-	-	-	-	100	100	00	√	√	√					
				TOTAL	**14**	**03**	**14**	**90**	**60**	**150**	**650**	**800**	**23**								

*Qualifying (Non-Credit Course)

B.Sc. Chemistry

Effective from Session: 2025-26							
Course Code	B020101T/CH139	**Title of the Course**	Bioorganic and Materials Chemistry	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	5	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To provide the students with a basic theoretical and experimental understanding of carbohydrates, amino acids, proteins, nucleic acids, and medicinal chemistry along with the solid state, basic chemical calculation, units and dimensions, material balance, energy balance, and the basics of medicinal chemistry.						

Course Outcomes	
CO1	Learners will be able to **understand** the significance of biomolecules in the functioning of living organisms and explain the chemistry of carbohydrates.
CO2	Learners will be able to **explain** the physiological functions that regulate human growth and development and demonstrate understanding of the chemistry of proteins and nucleic acids.
CO3	Learners will be able to **understand** the fundamentals of solid-state chemistry, including space lattice, unit cells, laws of crystallography, and X-ray diffraction by crystals.
CO4	Learners will be able to **understand and apply** basic chemical calculations, including the concepts of atoms, moles, mole fractions, and methods of expressing composition; demonstrate knowledge of units, dimensions, and conversions; and perform material balance calculations for processes with and without chemical reactions, including multiple unit operations, recycle, and bypass systems.
CO5	Learners will be able to **understand** the forms of energy and perform energy balance calculations, including evaluating energy changes in physical processes and chemical reactions for various industrial and laboratory applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chemistry of Carbohydrates-I	Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses).	8	1
2	Chemistry of Carbohydrates-II	Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani Fischer method) and stepping–down (Ruff's &Wohl's methods) of aldoses; end-group interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose.)	8	1
3	Chemistry of Proteins	Classification of amino acids, zwitter ion structure and isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C– terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation. Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions).	8	2
4	Chemistry of Nucleic Acids	Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (nomenclature), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation	8	2
5	Solid State	Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry .X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (powder method).	8	3
6	Basic Chemical Calculation, Units and Dimensions	Introduction, Concept of atom, Mole and mole fraction, Methods of expressing the composition of mixtures (mass percent, volume percent, mole percent), equivalent weight, normality, molarity, molality. Introduction, Dimensions & Systems of Units, Fundamental quantities, Derived Quantities, Conversions & Problems.	8	4
7	Material Balance	Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, multiple unit processes, Recycle and bypass.	6	4
8	Energy Balance	Energy balance: Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations.	6	5

Reference Books:

Davis, B. G., Fairbanks, A. J., Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford University Press.

Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).

Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.

Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.

e-Learning Source:

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

https://nptel.ac.in/courses/104/105/104105124/

https://nptel.ac.in/courses/103/106/105106204/
https://nptel.ac.in/courses/104/105/104105034/
https://nptel.ac.in/courses/104/103/104103121/
Activities: Assignments, quiz, discussion, presentation, etc.

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	3	-	-	-	-	3	2	3	-	-	2	2	
CO2	3	-	-	-	-	2	2	2	-	2	1	1	
CO3	3	-	-	-	-	3	2	3	-	-	2	1	**4 (Quality education)**
CO4	2	-	-	-	-	1	2	1	-	-	1	2	
CO5	3	-	-	-	-	3	2	3	2	-	2	1	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B020202T/CH160	**Title of the Course**	Organic and Pharmaceutical Chemistry	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	5	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To study organic chemistry, which includes bonding, nomenclature, structure, and reactivity. It includes purification techniques, aliphatic and aromatic chemistry, and their pharmaceutical relevance. Emphasis is placed on herbal drug technology, microbial enzymes, and natural product synthesis. The course concludes with industry-focused skills in pharmaceutical documentation, regulations, and quality assurance.						

Course Outcomes	
CO1	Learners will be able to generate correct names, identify isomeric relationships, and distinguish between organic and inorganic compounds.
CO2	Learners will be able to purification techniques and organic compounds, students will apply suitable separation methods and evaluate the preparation, properties, and applications of key aldehydes, ketones, acids, esters, ethers, amines, and alkynes.
CO3	Learners will be able to key aromatic and pharmaceutical compounds, students will assess preparation, properties, and major therapeutic uses.
CO4	Learners will be able to herbal and microbial products, students will identify herbal materials, explain processing methods, and describe enzyme production and industrial applications.
CO5	Learners will be able to the principles of pharmaceutical documentation, students will explain key records and quality systems essential for regulatory compliance and product quality.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basic concepts of Organic chemistry	Introduction; Classification of organic compounds; Differentiate organic & inorganic compounds; functional group & homologous series; IUPAC system of nomenclature and Isomerism.	8	1
2	Purification of Organic Compounds	Simple crystallization, fractional crystallization, sublimation, simple distillation, fractional distillation, distillation under reduced pressure, steam distillation, azeotropic distillation.	7	2
3	Study of Aliphatic Compounds	Preparation, Properties & Uses: Formaldehyde & Acetaldehyde; Acetone & Ethanol; Acetic Acid & Oxalic Acid; Ethyl Acetate & Diethylether; Ethyl Amine, Acetylene	8	2
4	Study of Aromatic Compounds	Preparation, Properties & Uses of the following Aromatic compounds: Benzene, Toluene & Xylene; Nitrobenzene & Aniline; Phenol & Benzaldehyde and Benzoic Acid & Salicylic Acid.	8	3
5	Medicinal Chemistry	Evaluation and study of introduction, examples and uses of various antibiotics, antipyretics and analgesics, antimalarial and cardiovascular drugs.	7	3
6	Herbal Drug Technology	Definition of herbs, herbal medicine, herbal medicinal product, herbal drug preparation. Source of Herbs, selection, identification and authentication of herbal materials. Processing of herbal raw material. Herbal drugs industry: Present scope and future prospects.	8	4
7	Industrial Microbial Enzymology	Use of microbes in industry. Production of Enzymes- General consideration Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.	7	4
8	Document maintenance in pharmaceutical industry	Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	7	5

Reference Books:

1. Organic Chemistry, Textbook of Organic Chemistry, Arun Bahl & B.S. Bahl, S. Chand Publishing
2. Medicinal Chemistry, Medicinal Chemistry-I, Prof. R.D. Gupta & Dr. Santosh R. Kirtane, Thakur Publication
3. Herbal Drug Technology, Herbal Drug Technology, Dr. G. Arunachalam, Dr. V.E. Ida Christi, Dr. Prashant Kuma, Thakur Publication
4. Industrial Microbial Enzymology, Microbial Enzymes: Production, Purification, and Industrial Applications, Dinesh Yadav et al., Wiley-VCH (Indian contributors)
5. Pharmaceutical Documentation, Regulatory Affairs in the Pharmaceutical Industry, Javed Ali & Sanjula Baboota, Academic Press (Indian editors)

e-Learning Source:

1. https://onlinecourses.swayam2.ac.in/cec23_cy03/preview
2. https://onlinecourses.nptel.ac.in/noc25_cy22/preview
3. https://alison.com/course/drug-discovery-design-and-development

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	-	-	-	-	-	3	3	2	-	2	1	3 (Good Health and Well-being), & 4 (Quality Education)
CO2	3	-	-	-	-	-	3	3	3	-	1	2	
CO3	3	-	-	-	-	3	3	3	2	-	1	2	
CO4	3	-	-	-	-	2	3	3	2	2	1	1	
CO5	3	-	-	-	-	2	3	2	2	2	2	1	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-2026							
Course Code	B190102P/CH140	**Title of the Course**	Materialistic Analysis	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	4	2
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To teach students the fundamentals of creating solutions of various concentrations, calculating concentrations, extracting compounds from solutions, determining materials' refractive indices, understanding molar and specific reactivity of solutions, and performing chromatographic separations.						

Course Outcomes	
CO1	Learners will be able to prepare solutions of various concentrations and determination of their concentrations would enable students to extract compounds effectively from solutions.
CO2	Learners will be able to understand, and performance of basic analytical techniques would enable students to determine the molecular weight of compounds in solutions accurately.
CO3	Learners will be able to perform extraction processes would enable students to isolate and purify compounds effectively.
CO4	Learners will be able to analyse of the refractive index of liquids using Abbe's Refractometer would enable students to evaluate their optical properties systematically.
CO5	Learners will be able to understand and demonstration of chromatography techniques such as column chromatography, paper chromatography, and thin layer chromatography would enable students to separate and analyse compounds efficiently.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Analysis of Solution	Molecular weight determination by depression in freezing point and elevation in boiling points.	15	1,2
2	Extraction Process	Phase diagram, partition coefficient. To find out the partition coefficient of Iodine between CCl_4 and water, Acetic acid between water and benzene.	15	1,3
3	Refractometer	Determination of Refractive Index of a liquid by Abbe's refractometer. Determination of Molar refractivity and specific refractivity of a liquid by using Abbe's refractometer.	15	1,4
4	Chromatography	Column, paper, thin layer To separate and identify the amino acids by ascending paper chromatography. To separate and identify the organic compound by the use of thin layer chromatography. Separation of a mixture of organic compound by column chromatography.	15	1,5

Reference Books:

1. A.I. Vogel, A.R. Tatchell, B.S. Furnis ,A.J. Hannaford, P.W.G. Smith, Vogel's Textbook of Practical Organic chemistry (1989)
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell,. Vogel's Textbook of Practical Organic Chemistry, 5e, Pearson (2003).
3. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7e Pearson (2008).
4. G.D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York (2004).
5. Harris, D.C., Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman (2016).

e-Learning Source:

1. https://fac.ksu.edu.sa/sites/default/files/vogel_-_practical_organic_chemistry_5th_edition.pdf
2. http://faculty.chas.uni.edu/~manfredi/860-12T/ORG%20LAB%20MAN%20S08.pdf
3. https://www.ipinnovative.com/media/open-access-books/Practical_Lab_Manua__l_of_Pharmaceutical_Organic_Chemistry_-1_ Low.pdf
4. https://gtu.ge/Agro-Lib/Vogels_Textbook_Of_Quantitative_Chemical_Analysis_ 5th_ed_-_G_H_Jeffery.MsuCity.pdf

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	3	2	1	2	-	2	2	2	3	-	3	3	**4 (Quality education)**
CO2	2	1	1	1	1	-	3	2	2	1	2	2	
CO3	2	1	1	1	1	1	3	2	2	1	2	2	
CO4	3	2	1	2	-	1	3	2	3	-	3	3	
CO5	2	1	1	2	1	2	3	2	3	1	3	3	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-26							
Course Code	B020102P/CH141	**Title of the Course**	Biochemical Analysis	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	4	2
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To introduce students to the fundamental qualitative and quantitative experimental understanding of biomolecules, including simple drug creation and molecules made of carbohydrates, proteins, amino acids, and nucleic acids.						

Course Outcomes	
CO1	Learners will be able to development of qualitative and quantitative experimental skills for the analysis of biomolecules such as carbohydrates, proteins, amino acids, and nucleic acids would enable students to analyze their structural and chemical properties effectively.
CO2	Learners will be able to perform qualitative and quantitative analysis of carbohydrates would enable students to determine their composition and reactivity systematically.
CO3	Learners will be able to perform of qualitative and quantitative analysis of proteins, amino acids, and fats would enable students to evaluate their structural features and chemical behaviour.
CO4	Learners will be able to determine an identification of nucleic acids and their constituent components would enable students to understand their biological significance and chemical structure.
CO5	Learners will be able to perform synthesis of simple drug molecules would enable students to apply basic organic synthesis techniques in pharmaceutical chemistry.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Qualitative and Quantitative Analysis of Carbohydrates	Separation of a mixture of two sugars by ascending paper chromatography Application of TLC and PC for the identification of natural coloring materials such as Lycopene from Tomato and Chlorophyll from Spinach Differentiate between a reducing/ non reducing sugar Synthesis of Osazones.	15	1,2
2	Qualitative and Quantitative Analysis of Proteins, Amino Acids and Fats	Isolation of protein. Determination of protein by the Biuret reaction. TLC separation of a mixture containing 2/3 amino acids Paper chromatographic separation of a mixture containing 2/3 amino acids 5. Action of salivary amylase on starch To determine the concentration of glycine solution by formylation method. To determine the saponification value of an oil/fat. To determine the iodine value of an oil/fat	15	1,3
3	Determination and Identification of Nucleic Acids	Determination of nucleic acids Extraction of DNA from onion/cauliflower	15	1,4
4	Synthesis of Simple Drug Molecules	To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC. Synthesis of barbituric acid Synthesis of propranolol	15	1,5

Reference Books:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
3. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7e Pearson (2008).
4. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
5. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009). 9. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical
6. Biochemistry, Heinemann.

e-Learning Source:

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

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	2	1	1	1	1	2	2	2	2	1	1	1	**4 (Quality education)**
CO2	3	-	1	-	1	1	2	2	2	1	1	2	
CO3	3	1	1	1	1	2	2	2	2	2	1	1	
CO4	2	1	-	1	1	1	2	2	2	1	2	1	
CO5	3	1	1	1	-	1	2	2	2	1	1	2	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-2026							
Course Code	B000201V/CH144	**Title of the Course**	Laboratory Safety & Sample Handling	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	1	0	2	3
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To impart the fundamental understanding of laboratory safety, managerial abilities for waste reduction, a basic understanding of chemistry, laboratory equipment, reagents, and solutions, as well as expertise in using high- tech equipment for any pharma/chemical company/testing lab, etc.						

Course Outcomes	
CO1	Learners will be able to understand an adherence to safety procedures and protocols in a science laboratory would enable students to perform experiments safely and confidently.
CO2	Learners will be able to understand the application of waste management skills in laboratory practices would enable students to handle and dispose of chemical wastes effectively.
CO3	Learners will be able to demonstrate elementary knowledge of chemistry concepts would enable students to explain fundamental principles in theoretical and practical contexts.
CO4	Learners will be familiar with laboratory instruments, reagents, and solutions, along with working confidently in a chemistry laboratory, would enable students to perform experiments efficiently.
CO5	Learners will be able to handle of sophisticated instruments used in pharmaceutical industries, chemical companies, and testing laboratories would enable students to operate analytical equipment with competence.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Safety In Science Laboratory	Theory: General Safety; Safe Handling of Chemicals and Glass wares; Working in Chemo-Safety/ Bio-Safety areas. Practical: Quantitative analysis; Determination of physical parameters of wastewater and solid waste. Temperature, Colour, Odour, pH, etc.	10	1
2	Managerial Skill in Minimizing Wastes	Theory: Four "Rs"- Reuse, Rework, Reduce, Recycle. Practical: Handling of different kinds of wastes and reuse. BOD, COD, & DO measurement.	10	1,2
3	Elementary Knowledge of Chemistry	Theory: Elementary knowledge of inorganic chemistry; Elementary knowledge of organic chemistry; Elementary knowledge physical chemistry. Practical: Study of Physico- chemical characteristics of e waste.	10	3
4	Laboratory Instruments	Theory: Principle and working of basic laboratory instruments Autoclave, Hot air oven, Incubator, pH meter, water bath, centrifuge, Refrigerator, colorimeter, Balance, Flame photometer, Microscope, Electrophoresis etc. Practical: Wastewater analysis and its treatment including primary, secondary, and tertiary treatment.	10	1,4
5	Reagents and Solutions	Theory: Molar solutions, normal solutions; Buffer solutions, solutions, saturated solutions, standard solutions. Dilution of the concentrated solution to desired concentration. Practical: Soil Sampling and its digestion; Physico-chemical characteristics of soil.	10	1,4
6	Handling Sophisticated Instruments	Expertise in Handling Sophisticated Instruments for Any Pharma/Chemical Companies/ Testing Labs etc.: Theory: Sustainability and the Chemical Industry; Chromatography and separation Techniques. Practical: TLC and Paper chromatographic techniques	10	1,5

Reference Books:

Industrial Chemistry by B.K Sharma, By Krishna Publications, GOEL Publishing House

Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut.

Environmental Chemistry by A. K.De , New Age International Publishers, (9th edition)

Water Pollution by V.P. Kudesia, 4th edition, (latest) Pragati Prakashan, Meerut.

e-Learning Source:

https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters

https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352

https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	3	1	2	1	1	3	3	3	3	3	3	3	**4 (Quality Education) 13 (Climate Action)**
CO2	3	1	2	1	1	3	3	3	2	3	3	3	
CO3	2	1	1	1	1	1	3	3	3	-	3	3	
CO4	3	1	1	1	1	1	3	3	3	-	2	2	
CO5	3	2	1	1	1	2	3	3	3	3	3	3	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-2026							
Course Code	Z020201T/NS110	**Title of the Course**	First Aid and Health	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	0	2
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	This course aims to educate fundamental and essential understanding of first aid and sex education.						

Course Outcomes	
CO1	Learn the skill needed to assess the ill or injured person and learn the skills to provide CPR to infants, children and adults.
CO2	Learn the skills to handle emergency childbirth and learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.
CO3	Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.
CO4	Help to understand natural changes of adolescence
CO5	Learn the skill to identify Mental Health status and Psychological First Aid

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of First Aid-I	A. Basic First Aid • Aims of first aid & First aid and the law. • Dealing with an emergency, Resuscitation (basic CPR). • Recovery position, Initial top to toe assessment. • Hand washing and Hygiene • Types and Content of a First aid Kit B. First AID Technique • Dressings and Bandages. • Fast evacuation techniques (single rescuer). • Transport techniques. C. First aid related with respiratory system • Basics of Respiration • No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, • Swelling within the throat, Suffocation by smoke or gases and Asthma. D. First aid related with Heart, Blood and Circulation • Basics of The heart and the blood circulation. • Chest discomfort, bleeding. E. First aid related with Wounds and Injuries • Type of wounds, Small cuts and abrasions • Head, Chest, Abdominal injuries • Amputation, Crush injuries, Shock F. First aid related with Bones, Joints Muscle related injuries • Basics of The skeleton, Joints and Muscles. • Fractures (injuries to bones).	8	1,2
2	Fundamentals of First Aid-II	G. First aid related with Nervous system and Unconsciousness • Basics of the nervous system. • Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. H. First aid related with Gastrointestinal Tract • Basics of The gastrointestinal system. • Diarrhea, Food poisoning. I. First aid related with Skin, Burns • Basics of The skin. • Burn wounds, Dry burns and scalds (burns from fire, heat and steam). • Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke. • Frost bites (cold burns), Prevention of burns, Fever and Hypothermia. J. First aid related with Poisoning • Poisoning by swallowing, Gases, Injection, Skin K. First aid related with Bites and Stings • Animal bites, Snake bites, Insect stings and bites L. First aid related with Sense organs • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. • Swallowed foreign objects. M. Specific emergency satiation and disaster management • Emergencies at educational institutes and work • Road and traffic accidents. • Emergencies in rural areas. • Disasters and multiple casualty accidents. • Triage. • Emergency Child birth	8	2.3
3	Fundamentals of Sex Education-I	Basic Sex Education • Overview, ground rules, and a pre-test • Basics of Urinary system and Reproductive system. • Male puberty — physical and emotional changes • Female puberty — physical and emotional changes • Male-female similarities and differences	7	4

		• Sexual intercourse, pregnancy, and childbirth • Facts, attitudes, and myths about LGBTQ+ issues and identities • Birth control and abortion • Sex without love — harassment, sexual abuse, and rape • Prevention of sexually transmitted diseases.		
4	Fundamentals of Sex Education-II	• Mental Health and Psychological First Aid • What is Mental Health First Aid? • Mental Health Problems in the India • The Mental Health First Aid Action Plan • Understanding Depression and Anxiety Disorders • Crisis First Aid for Suicidal Behavior & Depressive symptoms • What is Non-Suicidal Self-Injury? • Non-crisis First Aid for Depression and Anxiety • Crisis First Aid for Panic Attacks, Traumatic events • Understanding Disorders in Which Psychosis may Occur • Crisis First Aid for Acute Psychosis	7	5

Reference Books:

Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf

Red Cross First Aid/CPR/AED Instructor Manual

https://mhfa.com.au/courses/public/types/youthedition4

Finkelhor, D. (2009). The prevention of childhood sexual abuse. Durham, NH: Crimes Against Children Research Center.

Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.

e-Learning Source:

https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online

www.unh.edu/ccrc/pdf/CV192. pdf

https://www.firstaidforfree.com/

https://www.coursera.org/learn/psychological-first-aid

https://www.coursera.org/learn/mental-health

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	SDGs Mapping
CO1	3	1	-	-	-	-	-	2	-	-	2	1	3 (Good Health and Well-being), & 4 (Quality education)
CO2	1	3	-	-	-	-	-	2	-	-	3	3	
CO3	2	3	-	-	-	-	-	3	-	-	2	2	
CO4	3	2	-	-	-	-	-	1	-	-	3	3	
CO5	3	3	-	-	-	-	-	3	-	-	2	3	

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

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

B.Sc. Chemistry/B.Sc. Industrial Chemistry

Effective from Session: 2025-2026							
Course Code	B020205T/CH159	**Title of the Course**	Advanced Application of Artificial Intelligence in Chemical Sciences	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	To explain the students with the origin of artificial intelligence, its evolution, scope, and significance. The idea is to know about the probable applications of AI in chemical sciences and how they can be implemented in reaction designing, synthesis, molecular prediction, reaction outcome prediction, template selection, molecular designing, and property prediction.						

Course Outcomes	
CO1	Learners will be able to acquire knowledge of the history, evolution, scope, and significance of Artificial Intelligence would enable students to describe its fundamental concepts and development.
CO2	Learners will be able to apply problem-solving techniques using Artificial Intelligence which would enable students to solve complex tasks efficiently.
CO3	Learners will be able to analysis and evaluate different types of neural networks and deep learning approaches, including supervised and unsupervised learning, feature selection and engineering, and learning from observation, would enable students to select appropriate AI models for specific problems.
CO4	Learners will be able to understand an application of machine learning and data analysis techniques in chemistry, including database utilization and deep learning applications, would enable students to interpret chemical data effectively.
CO5	Learners will be able to design and implement AI applications in chemical synthesis, molecular prediction, prediction of reaction outcomes, designing of new reactions, reactant and template selection, molecular designing, and property prediction would enable students to innovate in chemical research and development.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to artificial intelligence and problem solving through AI	*Introduction:* History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. *Problem solving through AI:* Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search.	7	1, 2
2	Machine Learning Basics and Natural Language Processing	*Machine Learning:* Neural networks and deep learning, Supervised and unsupervised learning, feature selection and engineering, learning from observation, knowledge in learning. *Natural Language Processing:* Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system.	8	2,3
3	AI in Chemistry	Concept of Artificial intelligence, machine learning, Machine learning applications to data analysis in chemistry, databases, deep learning in chemistry, cheminformatics, molecular dynamics and simulation, chemical representation of atoms and molecules with molecular graph representation and Simplified Molecular Input Line Entry System (SMILES)	7	4
4	Applications of AI in Synthetic and Medicinal Chemistry and ethical issues:	Artificial intelligence in synthesis, molecular prediction, prediction of reaction outcomes and designing of new reactions, reactant and template selection, molecular designing and property prediction, computer-assisted synthesis design and prediction of biochemical pathways and new drug targets. Regulatory science, ethical consideration related to use of AI in chemical sciences	8	5

Reference Books:

Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers by Prateek Joshi

Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation By Patrick D. Smith

Machine Learning in Chemistry: The Impact of Artificial Intelligence Edited by Hugh M Cartwright

Artificial Intelligence in Chemistry: Structure Elucidation and Simulation of Organic Reactions, Volume 73 Z. Hippe

e-Learning Source:

https://www.youtube.com/watch?v=Q_gWTkh5pEY

https://www.youtube.com/watch?v=HbfFS7bA5M0

Activities: Assignments, quiz, discussion, presentation, etc.

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	**SDGs Mapping**
CO1	2	-	-	-	-	2	3	2	2	2	1	2	**4 (Quality Education), & 9 (Industry, Innovation, and Infrastructure)**
CO2	2	-	-	-	-	2	3	1	2	2	1	1	
CO3	2	-	-	-	-	2	3	1	2	2	1	2	
CO4	2	-	-	-	-	2	3	2	2	2	2	1	
CO5	2	-	-	-	-	2	3	2	2	2	2	1	

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

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

Effective from Session: 2025-2026							
Course Code	B030202T/MT148	**Title of the Course**	Basic Mathematics & Statistic	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To impart basic and key knowledge of elementary mathematics. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able to explore subject into their respective dimensions						

Course Outcomes	
CO1	Learners will be able to interpret limits and continuity of functions. Also, they can find differential coefficient, differentiation of functions including function of a function, differentiation of parametric form, simple and successive differentiation.
CO2	Learners will evaluate and interpret integration as an inverse of differentiation; They will be able to find indefinite integrals of standard form,integration by parts, by substitution and by partial fraction method. They can evaluate definite integrals.
CO3	Learnerscan describe the basic concepts of simple random sampling and stratified random sampling. They can understand and find measures of central tendency (mean, median and mode), measures of variation (mean deviation and standard deviation), measure of coefficient if variation. Student will be able to understand and evaluate covariance and correlations, Karl Pearson's Coefficient of correlation and Spearman's coefficient of rank correlation. They can also be able to find regression by method of least squares.
CO4	Learners can interpret the fundamental principle of counting. They will also be able to find permutations, permutations under certain conditions, combinations, combinatorial identities. They can also apply Binomial theorem (without proof)
CO5	Learners will be able to understand the random experiment and associated sample space, events. They can also find probability and can use addition and multiplication theorems for finding probability (without proof). They will be able to understand probability distributions, and will be able to find Binomial, Poisson, and Normal distributions.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Limit and Continuity	Set and functions, left hand limit and right-hand limit, limits of function, continuity of function.	7	1
2	Differentiabilit y	Definition of differential coefficient, differentiation of function including function of a function, differentiation of parametric form, simple and successive differentiation, Leibnitz rule.	8	1
3	Integrations	Integration as inverse of differentiation, indefinite integrals of standard form, integration by parts, substitution method and partial fraction method, evaluation of definite integrals.	8	2
4	Univariate Statistics	Basic concepts of simple random sampling and stratified random sampling, measures of central tendency (mean, median and mode), measures of variation (mean deviation, quartile deviation and standard deviation), coefficient of variation.	7	3
5	Bivariate Statistics	Covariance, correlations, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's coefficient of rank correlation, regression and its coefficient, estimation of regression lines by the method of least square.	7	3
6	Permutations and Combinations	Fundamental principle of counting, permutations, permutations under certain conditions, combinations, combinatorial identities, Binomial theorem (without proof), some applications of Binomial theorem.	7	4
7	Probability theory	Random experiment and associated sample space, events, definition of probability, algebra of events, addition and multiplication theorems on probability (without proof), conditional probability, Baye's theorem.	8	5
8	Probability Distributions	Probability distribution, probability mass function, probability distribution function, expectations, Binomial, Poisson, normal distributions and their mean and variance, fitting the expected frequency of Binomial and Poisson distributions.	8	5

Reference Books:

1. Murray R. Spiegel, 1980, Probability and Statistics, Schaum's (Outline Series) McGraw-Hill Book Co.
2. Q. S. Ahmad, V. Ismail and S. A. Khan: Biostatistics, Laxmi Publications Pvt. Ltd.
3. E. Kreyszig, "Advanced Engineering Mathematics", 5th Edition, Wiley Eastern, 1985.

e-Learning Source:

1. NPTEL, MOOC

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Effective from Session: 2024-2025							
Course Code	A040209- LN109	**Title of the Course**	Basic of Communication	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To enhance basic communication skill among the students. Students will also learn about the fundamentals of linguistics and Grammars.						

Course Outcomes	
CO1	Basic understanding of Communication and professional communication
CO2	Basic knowledge of structural and functional Grammar. Learning language through literature.
CO3	Basic tools of communication and improvement in communicative competence.
CO4	Understanding the basic grammar and basic structure of language.
CO5	Students will gain a fundamental understanding of the nature, branches, and history of Linguistics.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Professional Communication	Professional Communication: Its Meaning and Importance, Essentials of Effective Communication, Barriers to Effective Communication.	8	1
2	Language through Literature	A. Essays: 1. The Effect of Scientific Temper on Man by Bertrand Russell, 2. The Aim of Science and Humanities by Moody E Prior. B. 1. The Meeting Pool by Ruskin Bond, 2. The Portrait of a Lady by Khushwant Singh	8	2
3	Basic Vocabulary	Euphemism, One-word Substitution, Synonyms, Antonyms, Homophones, Idioms and Phrases, Common Mistakes, Confusable Words and Expressions.	8	3
4	Basic Grammar	Articles, Prepositions, Tenses, Concord, (Subject-Verb agreement), Modal Auxiliaries, Verbs: its Kinds and uses, Degrees of Comparison, Punctuation	8	4
5	Language and Linguistics	Language: Definition, characteristics and importance of Language Linguistics: Definition, nature, scope, branches, levels and types of Linguistics, Linguistics versus Traditional Grammar.	8	5

Reference Books:
Effective Communication Skills
Improve Your Communication Skills
Communication Skills Training
e-Learning Source:
www.ignou.com
www.swayam.com
www.coursera.com

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

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

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

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	**B150203T/ES135**	**Title of the Course**	**Eco-Restoration and Invaded Ecosystems**	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	**II**	**4**	**0**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**	NONE				
Course Objectives	The aim of the course is to define the principles of ecological restoration and ecotourism and investigate the complex and dynamic interactions between humans and their environment. This advanced ecosystem management course will begin with an overview of the ecological basis for plant invasions in managed forests and terrestrial ecosystems, and then focus on methods for restoration of invaded and formerly invaded systems. Management tools and techniques for prevention, control, and restoration will be discussed, and plant invasions						

Course Outcomes

CO1	Be able to interpret and critically assess theories related to restoration ecology, biotic interactions, and ecological succession
CO2	Predict the issues related to the environmental ecosystem degradation and Eco restoration
CO3	Understand how to use modern tools, methods, and traditional knowledge to prevent and control plant invasions and to restore formerly invaded ecosystems.
CO4	Predict the issues related to the environmental ecosystem degradation and Eco restoration
CO5	Develop skills and demonstrate how to integrate ecological concepts into management efforts

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Restoration Concept**	Concepts of restoration, single vs. multiple endpoints; ecosystem reconstructions; physical, chemical, biological, and biotechnological tools of restoration. Various approaches to Restoration Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems.	8	CO1
2	**Restoration of Ecosystems & Biodiversity**	Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota. Restoration of contaminated soils and soil fertility, mine spoil restoration. Restoration in the context of Sustainability, Globalization and Sustainability	8	CO2
3	**Role of Local people, Organization, and collaboration**	Community participation in eco-restoration traditional sacred land restoration, water restoration its techniques, practices regulation concept of traditional knowledge and transmission and maintenance of traditional knowledge on eco restoration over generations, ecosystem services and human wellbeing, NGO's, educational, research institutions and other agencies.	8	CO3
4	**Eco restoration Ethics**	Ethics in Eco-restoration: virtue, utilitarian and deontological theories; Religion and ethics; Political ecology; Ownership and intellectual property rights; Codes of conduct.	6	CO3
5	**Invasion theories and mechanism**	Introduction, Theories and Mechanisms for Invasion, Dispersal Mechanisms, Dispersal Mechanisms, Biotic interactions (competition, facilitation, mutualism)	6	CO4
6	**Ecological Impacts following Invasion and Ecosystem reclamation**	Impacts to ecological processes (nutrient cycles), Impacts to ecological processes (fire and water), Impacts to plant communities (biodiversity vs saturation), Eco remediation techniques, general principles, bioremediation, phytoremediation in eco-restoration	8	CO4
7	**Management and Restoration of Invaded Ecosystems**	Management and Restoration of Invaded Ecosystems, Techniques for control I- Integrating plant biology into control, Restoration of invaded ecosystem I- restoring plant communities, Restoration of invaded systems II- restoring ecosystem function, Restoration of invaded systems II- case studies and efficacy, Invasive species management and restoration in a changing environment	8	CO5
8	**Case Studies**	Ecological Restoration of Lantana-Invaded. Landscapes in Corbett Tiger Reserve, Restoration of Lake Kukkarahalli in Mysore, Mangrove restoration, Land reclamation and restoration of natural ecosystem: a case study from opencast mines of northeastern Coalfields of India.	8	CO5

Reference Books:

1. Agarwal, A. N (1980) Indian Agriculture, Vikas publishing House, New Delhi,
2. Weaver, D. B (2001) The Encyclopedia of Ecotourism, CABI, Publishing, U.K.
3. Byrne, P. 1999. The Philosophical and Theological Foundations of Ethics. 2d ed. Palgrave Macmillan, London, UK.
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000282/M027568/ET/1519296718Paper12_EM_Module28_etext.pdf
5. Sinha, P. C (2003) Encyclopedia of Ecotourism, Vol – I, II & III, Anmol publications Pvt. Ltd, New Delhi.
6. Ecological Restoration, Second Edition: Principles, Values, and Structure of an Emerging Profession (Society for Ecological Restoration) Paperback – Import, 28 February 2013 by Andre F. Clewell (Author), James Aronson (Author)
7. Google book: International principles and standards for the practice of ecological restoration. Second edition George D. Gann ,Tein McDonald ,Bethanie Walder ,James Aronson ,Cara R.Nelson ,Justin Jonson ,James G. Hallett ,Cristina Eisenberg ,Manuel R. Guariguata ,Junguo Liu ,First published: 04 September 2019,https://doi.org/10.1111/rec.13035

e-Learning Source:

1. SWAYAM
2. Virtual Labs
3. MOOC

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	PSO6
CO1	3	2	1	1	1	3	2						3	3	3	2	1	-
CO2	3	2	2	1	1	3	2						3	3	3	2	1	-
CO3	3	2	2	2	2	3	2						3	3	3	2	1	-
CO4	3	2	2	1	1	3	2						3	3	3	2	2	-
CO5	2	3	1	1	1	3	2						3	3	3	2	2	-

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

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

Integral University, Lucknow
Department of Environmental Science

Effective from Session: 2024-2025							
Course Code	**B150204P/ES136**	**Title of the Course**	**Ecosystem Dynamic Lab**	**L**	**T**	**P**	**C**
Year	**Ist**	**Semester**	**II**	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	None				
Course Objectives	This course provides knowledge about the various type of invasive species its establishment, area extent, influence of biotic and abiotic factor etc. Further, student will explore the advance tool and techniques of eco restoration of terrestrial and aquatic ecosystem.						

Course Outcomes	
CO1	To identify the invasive plant species.
CO2	Student will explore the landscape ecology in term of degraded area extant, population and community ecological changes.
CO3	To study about the ecological succession steps.
CO4	Students will explore the advance techniques for environmental monitoring.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Field visit**	Explore the invasive species in the focused area	15	CO1
2	**Landscape Ecosystem**	Identification of degraded areas/landscape/ecosystems Study the population and community ecology changes in the area	15	CO2
3	**Ecological Succession**	Specific areas of focus include effects of abiotic and biotic disturbances on vegetation and animals.	15	CO3
4	**Ecosystem Disturbance**	Identify the disturbing factors in and ecosystem viz. natural disasters, climate change, invasion, anthropogenic activities. To study about the forest fire area extent using environmental monitoring techniques namely RS and GIS, ecological methods, surveys, and ground studies	15	CO4

Reference Books:

1. Gardner, R.H., Robert,V., O'Neill, T.irner,M.G. 2001. Landscape Ecology in Theory & Practice. Pattern and Process. Springer-Verlag, USA
2. Agarwal, A. N (1980) Indian Agriculture, Vikas publishing House, New Delhi,
3. Bharucha, E. 2003. Biodiversity of India. The. Mapin Publishing, India
4. Egan,D. and Howell, E.A. (eds.) 2001. The Historical Ecoogy Handbook : A Restorationist's Guide to Reference Ecosystems. Island Press, Washington DC USA

e-Learning Source:

1. SWAYAM
2. MOOC
3. https://www.youtube.com/watch?v=3GfoRRxpVVA

	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	1	1	1	3	2						2	3	3	2	1
CO2	3	2	2	1	2	3	2						3	3	3	1	1
CO3	2	1	1	1	1	3	1						3	3	3	1	1
CO4	3	2	1	1	1	3	2						3	3	3	1	3

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

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