DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2024-25
w.e.f. July, 2025-26
Diploma in Chemical Dynamics and Analytical Techniques
2nd Year / 3rd 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.	B020301T/CH232	Chemical Dynamics & Coordination Chemistry	T	Core Major	3	1	-	15	10	25	75	100	04	√		√					
2.	B020302T/CH261	Chemical Analysis Techniques: Principles and Applications	T		3	1	-	15	10	25	75	100	04	√		√					
3.	B190302P/CH233	Industrial Chemical and Instrumentation Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√		√			
4.	B020302P/CH234	Physical Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√					
5.	B000301V/CH237	Food Testing and Quality Control	T + P	Vocational	1	-	2	-	-	-	100	100	03	√		√		√	√	√	
6.	• H040304T/ LN230 • H040305T/LN231	• Functional Hindi (कार्यात्मक हिंदी)* OR • Amozish e urdu*	T	Co-curricular	2	-	-	15	10	25	75	100	02	√		√		√	√	√	
				TOTAL	**09**	**02**	**10**	**75**	**50**	**125**	**475**	**600**	**17**								

* Regional Language, any one from Hindi, Urdu, Awadhi, Sanskrit etc.

B.Sc. Chemistry

Effective from Session: 2025-26							
Course Code	B020301T/CH232	**Title of the Course**	Chemical Dynamics & Coordination Chemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	5	1	0	4
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To develop a comprehensive understanding of the characteristics and physical properties of the three states of matter through kinetic theory and crystallography, and to equip students with knowledge of liquid crystals and physicochemical techniques such as conductometric, potentiometric, optical methods, polarimetry, and spectrophotometry for studying chemical kinetics and equilibrium, along with developing insights into metal-ligand bonding in transition metal complexes and understanding their thermodynamic and kinetic behaviour.						

Course Outcomes	
CO1	Students will be able to **analyze** the rate and order of chemical reactions, evaluate concentration dependence, apply mathematical expressions for reaction order determination, and interpret the effects of temperature using the Arrhenius equation, activation energy concepts, collision theory, transition state theory, and thermodynamic parameters related to rate constants.
CO2	Students will be able to **interpret** equilibrium constants, relate them to free energy changes, apply Le-Chatelier's principle to predict shifts in equilibrium, and **analyze** phase equilibria using the reaction isotherm, reaction isochore (Clapeyron-Clausius equation), derive the Gibbs phase rule, and **evaluate** phase equilibria in one-component (H_2O, CO_2, O_2) and two-component systems (solid-liquid equilibria and simple eutectic systems).
CO3	Students will be able to **explain** the kinetic theory of gases, apply the van der Waals equation to real gases, describe critical phenomena, interpret PV isotherms, continuity of states, the law of corresponding states, the reduced equation of state, and analyze Maxwell's distribution of molecular velocities. They will also compare the liquid state with other states of matter, explain intermolecular forces, liquid structure, and differentiate liquid crystals, their types, structures, phases, and examine gels, including their classification, preparation, properties, and applications.
CO4	Students will be able to **describe** the basics of Werner's theory of coordination complexes, classify ligands and chelates, determine coordination numbers, apply IUPAC nomenclature (up to dinuclear complexes), and **differentiate** types of isomerism (constitutional, stereoisomerism, geometrical, and optical) in square planar and octahedral complexes.
CO5	Students will be able to **analyze** electronic spectra of transition metal complexes, explain d-d transitions, interpret spectroscopic ground states, construct Orgel and energy-level diagrams, and evaluate the electronic spectrum of the $[Ti(H_2O)_6]^{3+}$ ion. They will also **assess** magnetic properties, identify different types of magnetic behavior, apply methods to determine magnetic susceptibility, calculate magnetic moments using the spin-only formula and L-S coupling, and use magnetic data to interpret the behavior of 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. *Gaseous State:* Postulates of the kinetic theory of gases: deviation from ideal behaviour, van der Waals equation of state. ii. *Critical phenomena:* 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. *Molecular Velocities:* Qualitative discussions of Maxwell's distribution of molecular velocities, collision number, mean free path, and collision diameter.	7	3
5	Liquid State	i. *Liquid State:* Intermolecular forces and the structure of liquids (a qualitative description) Structural differences between solids, liquids, and gases. ii. *Liquid crystals:* 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 valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral, and square planner complexes, the John Teller effect, and factors affecting the crystal-field parameters. ii. *Thermodynamic and kinetic aspects of metal complexes:* 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	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 $[Ti(H_2O)_6]^{3+}$ complex ion. 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.	8	5

Reference Books:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Cotton,F.A, Wilkinson,G and Gaus,P. L ,Basic Inorganic Chemistry,3rd Edition ,Wiley 1995
4. Lee,J.D, Concise Inorganic Chemistry 4th Edition ELBS,1977
5. Douglas,B, McDaniel ,D and Alexander,J ,Concepts of Models of Inorganic Chemistry, John Wiley & Sons; 3rd edition , 1994
6. Shriver,D.E Atkins,P.W and Langford, C .H, Inorganic Chemistry ,Oxford University Press, 1994.
7. Porterfield, W.W, Inorganic Chemistry,Addison Wesley 1984.
8. Sharpe,A .G, Inorganic Chemistry, ELBS,3RD edition ,1993; Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
9. Miessler,G.L,Tarr,D.A, Inorganic Chemistry, 2nd edition , Prentice Hall, 2001; Bahl and Bahl, Essential of Physical Chemistry, S.Chand
10. R Gopalan& V Ramalingam, Concise Coordination Chemistry, Vishal publishing house; Tn Srivastva and Pc Kampoj, Systematic Nalytical Chemistry, Shoban Lal Nagin Chand

e-Learning Source:

1. https://swayam.gov.in/
2. https://www.coursera.org/learn/physical-chemistry
3. https://www.mooc-list.com/tags/physical-chemistry
4. https://www.openlearning.com/courses/introduction-to-physical-chemistry/
5. https://www.my-mooc.com/en/categorie/chemistry
6. https://onlinecourses.swayam2.ac.in/nce19_sc15/preview
7. https://swayam.gov.in/
8. 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	PSO1	PSO2	**SDGs Mapping**
CO1	2	3	-	-	-	1	2	2	2	4 (Quality education)
CO2	3	2	-	-	-	1	2	2	2	
CO3	2	3	-	-	-	1	2	2	2	
CO4	3	3	-	-	-	1	2	2	2	
CO5	2	2	-	-	-	1	2	2	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation1

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

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

Effective from Session: 2025-26							
Course Code	B020302T/CH261	**Title of the Course**	Chemical Analysis Techniques: Principles and Applications	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	5	1	0	4
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To understand the importance of separation techniques and to explore the principles and procedures of chromatographic techniques, and to delve into the principles and instrumentation of UV/Visible spectrophotometry, electron microscopy and their application in quantitative and qualitative chemical analysis and to comprehend the principles and applications of electroanalytical analysis.						

Course Outcomes	
CO1	Students will be able to **explain** the theoretical principles of chromatographic separation and **analyze** their typical applications for evaluating unknown samples.
CO2	Students will be able to **apply** electroanalytical and thermogravimetric techniques for the **identification** and analysis of chemical substances.
CO3	Students will be able to **interpret** the concepts of solvent extraction and utilize them in the analysis of unknown samples.
CO4	Students will be able to **explain** the theoretical principles of selected instrumental methods and **apply** spectrophotometric techniques for chemical analysis.
CO5	Students will be able to **analyze** the principles of electron microscopy and evaluate morphological features to design and characterize new materials.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chromatography-I	Classification of chromatographic methods, principle of migration, adsorption phenomenon, nature of adsorbents, and solvent systems. Thin layer Chromatography (TLC): Advantages, preparation of plates, development of chromatogram, Detection of the spots, factors affecting Rf values and applications. Paper Chromatography: Choice of paper and solvent systems, development of chromatogram-ascending, descending, radial and two-dimensional chromatography and applications.	7	1
2	Chromatography-II	Column Chromatography: Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase (solvents) for eluting, polar, non-polar compounds and its applications. Ion exchange chromatography: Cation and anion exchange resins, its application in separation of ions. Gas Chromatography: Theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase). High performance liquid chromatography: Theory and instrumentation, stationary phases and mobile phases.	8	1
3	Electroanalytical methods-I	Potentiometry: Principle, Electrochemical cell, Electrodes- (i) Indicator and (ii) Reference electrodes – Normal Hydrogen Electrode, Quinhydrone Electrode, Saturated Calomel Electrode. Application of Potentiometry	8	2
4	Electroanalytical methods-II	Voltametry- Introduction to types of voltametric techniques, micro electrodes, overpotential and Polarization. Conductometry, Conductivity Cell, Specific Conductivity, Equivalent Conductivity. Applications of conductometry.	8	2
5	Thermal methods of analysis	Theory of thermogravimetry (TG), basic principle, instrumentation and applications	8	2
6	Separation techniques	Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: Extraction by solvation and chelation. Techniques of extraction: batch, continuous and counter-current extractions.	7	3
7	Colorimetry and Spectrophotometry	General features of absorption-spectroscopy, transmittance, absorbance, and molar absorptivity. Beer Lambert's law and its limitations, the difference between Colorimetry and Spectrophotometry. Instruments – Single beam UV-Visible Spectrophotometer, Double beam UV-Visible Spectrophotometer. Lamps used as energy sources.	8	4
8	Microscopic techniques	Principles and Applications of optical and electron microscopy (SEM and TEM)	6	5

Reference Books:

1. Mendham, J. et al.: Vogel's Text Book of Quantitative Chemical Analysis; 6th Ed. Pearson Education.
2. Christian, Gary D: Analytical Chemistry, 6th Ed. Wiley India (P) Ltd.
3. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, 6th Ed. Thomson Asia Pvt. Ltd. Singapore
4. Mikes, O. and Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
5. Khopkar, S.M.: Basic Concepts of Analytical Chemistry, 3rd Ed. New Age, International Publisher

e-Learning Source:

1. https://thesciencenotes.com/chromatography-definition-principle-types-application/
2. https://www.worldscientific.com/doi/pdf/10.1142/9789814452304_0001
3. https://chemistnotes.com/analytical_chemistry/solvent-extraction-principle/
4. https://scienceinfo.com/scanning-electron-microscopy-sem/
5. https://chemistrywithwiley.com/thermogravimetric-analysis/

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	SDGs Mapping
CO1	3	2	1	3	-	2	3	3	3	2	3 (Good Health and Well-being), & 4 (Quality Education)
CO2	3	2	1	3	-	2	3	3	3	2	
CO3	3	2	1	3	-	2	3	3	3	2	
CO4	3	2	1	3	-	2	3	3	3	2	
CO5	3	2	2	3	-	2	3	3	3	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	B190302P/CH233	**Title of the Course**	Industrial Chemical and Instrumental Analysis	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	-	-	4	2
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To develop a fundamental understanding of laboratory calibration procedures, preparation of standard solutions, analysis of solutions with varying concentrations, determination of liquid surface tension, and to equip students with essential basic laboratory techniques.						

Course Outcomes	
CO1	Students will be able to **operate** laboratory instruments such as the colorimeter, flame photometer, pH meter, potentiometer, and conductometer.
CO2	Students will be able to **perform** tests to determine the physical properties of plastics and rubber, including Young's modulus, and their optical, thermal, mechanical, and electrical properties.
CO3	Students will be able to **estimate** barium as barium sulphate, sulphate as $BaSO_4$, silver as silver chloride, chloride as AgCl, zinc as zinc oxide, and copper as cupric oxide using gravimetric methods.
CO4	Students will be able to **estimate** iron as ferric oxide, aluminum as Al_2O_3, chromium as chromic oxide (Cr_2O_3), and lead as lead sulphate.
CO5	Students will be able to **analyze** common industrial raw materials such as phenol, aniline, formaldehyde, hydrogen peroxide, and acetone as per industrial specifications.

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_2O_3, chromium as chromic oxide, Cr_2O_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:

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

e-Learning Source:

1. https://www.labster.com/chemistry-virtual-labs/
2. 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**	**PSO1**	**PSO2**	**SDGs Mapping**
CO1	3	2	1	-	-	-	2	2	2	4 (Quality education)
CO2	3	2	1	-	-	-	2	2	2	
CO3	3	2	2	3	-	2	2	2	2	
CO4	3	2	2	2	-	2	2	2	2	
CO5	3	2	1	2	-	2	2	2	2	

1- 1Low 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	B020302P/CH234	**Title of the Course**	Physical Analysis	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	-	-	4	2
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To provide practical knowledge of how to prepare solutions of various concentrations, know the strengths of solutions, estimate components through volumetric analysis, surface tension, and viscosity, as well as perform dilatometric experiments: one- and two-component phase equilibrium experiments.						

Course Outcomes	
CO1	Students will be able to **demonstrate** proficiency in calibrating laboratory equipment, performing solution dilutions (e.g. converting 0.1 M to 0.001 M solutions), and **apply** concepts of molecular weight, formula weight, equivalent weight, and various concentration units.
CO2	Students will be able to **determine** experimentally the surface tension and viscosity of pure liquids or solutions.
CO3	Students will be able to **identify** the boiling points of organic compounds with boiling points below 180°C.
CO4	Students will be able to **determine** the transition temperature of substances using thermometric or dilatometric methods.
CO5	Students will be able to **analyze** the effect of solutes on critical solution temperature and construct corresponding 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 dialometric method (e.g. $MnCl_2.4H_2O$ or $SrBr_2.2H_2O$)	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:

1. G. D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York (2004).
2. D.C. Harris, Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman (2016).
3. E. Stocchi, Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
4. J. A. Kent, (ed) Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi, (1997).
5. Pani, B. Textbook of Environmental Chemistry, I.K. International Publishing House, (2017).
6. A. K. De, Environmental Chemistry, New Age International Pvt, Ltd, New Delhi (2012).
7. S. M .Khopkar,., Environmental Pollution Analysis, New Age International Publishe (2010)

e-Learning Source:

1. https://www.labster.com/chemistry-virtual-labs/
2. 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**	**PSO1**	**PSO2**	**SDGs Mapping**
CO1	2	2	-	2	-	2	2	2	2	4 (Quality education)
CO2	2	2	-	1	-	-	2	2	2	
CO3	2	2	-	2	-	-	2	2	2	
CO4	2	2	-	2	-	-	2	2	2	
CO5	2	2	-	1	-	-	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	B000301V/CH237	**Title of the Course**	Food Testing and Quality Control	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	1	-	2	3
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To enable students to comprehend the significance and evolution of food, understand the functions of food, identify and analyze plant and animal sources of food, gain knowledge of food processing from diverse plant sources, develop insights into milk and its products, understand the different types of food, and acquire comprehensive knowledge of the food industry.						

Course Outcomes	
CO1	Students will be able to **explain** the fundamentals of food chemistry, including its history, water structure, and the interactions among food components.
CO2	Students will be able to **describe** the foundations of carbohydrates (monosaccharides, oligosaccharides, and polysaccharides), starch and cellulose derivatives as food constituents, and evaluate the nutritional value of sugars and related products; they will also be able to explain the components of lipids, food lipids and their health implications, and the role of antioxidants.
CO3	Students will be able to **explain** the basics of protein structure and functions, enzyme structure and functions, vitamin structure, types and functions, minerals and their nutritional aspects, as well as the bioavailability of nutrients in vegetables and fruits.
CO4	Students will be able to **describe** the basics of food pigments and colours, and identify common preservatives and food adulterants.
CO5	Students will be able to **evaluate** food quality parameters and interpret food 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	Protein's structure and functions, enzyme's structure and functions, vitamin's 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, flavouring 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:

1. Voet D and Voet JG. Principles of Biochemistry. John Wiley and sons New York.
2. Moat AG and Foster J. W. Microbial Physiology. John Wiley and Sons, New York.
3. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology, McGraw Hil
4. U. Satyanarayan. Biochemistry, Elsevier; Robinson Dairy Microbiology.
5. Jay JM Modern Food Microbiology. Van Nostraaand Reinhold Co., New York.
6. Andrew Proctor Alternatives to conventional food processing, RSC pub.
7. Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York.; Srilakshmi B Food Science, New Age Publication

e-Learning Source:

1. https://www.bing.com/videos/search?q=Evaluation+of+food+quality
2. https://www.youtube.com/watch?v=g-Pp4UybXXo
3. https://www.bing.com/videos/search?q=Carbohydrates+and+Lipids&&view=detail&mid=
4. https://www.bing.com/videos/search?q=Structure+and+function+of+Proteins+%26+Vitamins&&view=detail&mid=
5. 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**	**PSO1**	**PSO2**	**PSO3**	**SDGs Mapping**
CO1	2	3	-	1	-	-	2	1	-	-	3 (Good Health and Well-being), & 4 (Quality Education)
CO2	3	2	-	1	-	-	2	2	-	-	
CO3	3	3	-	1	-	-	2	2	-	-	
CO4	2	3	-	2	-	2	2	3	-	-	
CO5	2	3	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: 2025-26 Regional Language Co-Curricular							
Course Code	**H040304T/ LN230**	**Title of the Course**	**कार्यात्मक हिंदी / Functional Hindi**	**L**	**T**	**P**	**C**
Year	**NA**	**Semester**	**NA**	**2**	**0**	**0**	**2**
Pre-Requisite	**10+2 (Any Discipline)**	**Co-requisite**	**None**				
Course Objectives	**After the completion of course, the students will:** • **Master the Hindi Language Skills.** • **Develop LSRW Skills in Hindi** • **Cultivate essential tool for accessing the precious heritage of our ancient culture.** • **Be acquainted with Hindi Knowledge System.** • **Be able to utilize functional aspects of Hindi.** • **Learn the translation aesthetics of the language.** • **Get acquainted with the major works in vast Hindi literature.**						

Total No. of Lectures: 45 **Minimum Marks: 100**

Course Outcomes	
CO1	To introduce the knowledge system of Hindi Language.
CO2	To equip students with the basics of Hindi Grammar.
CO3	To highlight the descriptive use of Hindi Grammar and its analysis.
CO4	To familiarize students with functional use of Hindi through literature.
CO5	To acquaint students with the influence of Hindi Literature on Ancient Indian Culture and Aesthetics.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**भाषा एवं भाषिक संरचना तथा स्तर**	भाषा : परिभाषा, स्वरुप, अभिलक्षण भाषाविज्ञान: परिभाषा, प्रकार, क्षेत्र, शाखाएं ध्वनि, शब्द, रूप, वाक्य, प्रोक्ति, अर्थ	**09**	CO1
2	**हिंदी भाषा की उत्त्पत्ति तथा विकास**	पृष्टभूमि अपभ्रंश अवहट्ट पुरानी हिंदी मानक हिंदी	**09**	CO2
3	**हिंदी शब्द सम्पदा और उसके मूल स्त्रोत**	हिंदी ध्वनियों का वर्गीकरण आधार- स्थान, प्रयत्न, इन्द्रिय या करण	**09**	CO3
4	**हिंदी साहित्य**	हिंदी साहित्य का उद्गम: आदि काल भक्ति काल रीती काल आधुनिक काल नव्योत्तर काल	**09**	CO4
5	**प्रमुख हिंदी साहित्यकार**	सूर्यकांत त्रिपाठी 'निराला' (कवि) प्रेमचन्द (हिन्दी गद्यकार) भीष्म साहनी (नाटककार)	**09**	CO5

Reference Books:

Hindi Sahitya ka Itihas by Dr. Nagendra

Karyalay Karya Vidhi by Ramchandra Singh Sagar

Anuvaad Vigyaan by Bholanath Tiwari

Bhasha Vigyan ki Bhoomika by Acharya Devendranath Sharma

Hindi Basha Ka Itihas by Dr Ramkishor Sharma

Loksahitya or Sanskriti by Dr Dinneshwar Prasad

E-Resources

https://www.youtube.com/watch?v=yh9J2XCde3c

https://www.youtube.com/watch?v=1lrz11BbqCA

https://www.youtube.com/watch?v=TeDB2qSNz1Y

Course Articulation Matrix (POs PSOs COs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	3	3	3	3	3	3	2	3	2	3
CO2	2	3	1	2	3	3	2	3	3	1	3	1	3
CO3	1	2	1	2	3	3	3	3	2	2	3	2	3
CO4	3	3	2	2	3	3	2	2	3	1	2	1	2
CO5	2	3	2	2	3	3	3	3	2	3	2	3	2
CO6	2	3	1	1	3	3	3	2	3	2	2	2	2
CO7	3	2	3	3	3	3	3	2	2	2	3	2	3

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

Integral University, Lucknow
Department of Languages
W.E.F- 2025-26
Syllabus
Regional (languages) as co-curricular Subject

Program: Designed as per NEP 2020 for all the UG Programs		**Year: 2**		**Semester: III**
Course code: H040305T/ LN231		Course Title: Amozish –e- Urdu آموزشِ اردو		
L	T	P		Credits
2		0		2
Major ()	Minor ()	Vocational ()		Co-curricular (✔)
Pre-requisite (If any)	None 10+2			
Course Objectives	1.	2. Language Proficiency Development 3. Literary Engagement 4. Communication Skills 5. Preservation of Linguistic Identity 6. Translation and Interpretation Skills 7. Support for Multilingualism.		

Course Outcomes: (COs)

CO1	The student will be introduced to the Urdu alphabet, consonants, vowels, aspirated & retroflexed letters, and other forms of alphabet.
CO2	The students will be able to read and write the Urdu text.
CO3	Students will be introduced to everyday Urdu idioms and be able to use them in their daily conversation. They will also learn Urdu suffixes and prefixes.
CO4	Students will be able to write letters and applications in Urdu Language and will be able to use the Introductory dialogue and etiquette in the Urdu language with Jargons.

Max. Marks: 25+75 **Min. Passing Marks:** 10+25

Total No. of Lectures- 30

Unit	Topics	Contact Hrs.	Mapped CO
I	**Introduction of Alphabet.** Urdu alphabet, consonant, vowels, aspirated & retroflexed letters, doted & non doted letters and their forms putting letters together. Reading practice of Urdu words, practicing of writing Urdu words, combines letters to write two-letter, three-letter, and four-letter words, and writing Urdu in the Nastaliq script.	1	1
II	**Reading & Dictation:** Prose: Tote ki chalaki, Guftgu ke aadaab, KahawateN, Urdu news. Poetry: Sari Dunya ke Malik, Barsaat, Lab pe aati hai. Shaam. Urdu writings dictation	2	2
III	***Jargons and Idioms:*** Privileged Urdu idioms & proverbs Use of suffixes & prefixes,Urdu writings dictation	3	3
IV	**Compositions:** *Urdu Letters & applications writings skills* *Introductory dialogue & etiquette in the Urdu language*	4	4

Suggested Readings:

1.Ibtedai Urdu: I, II& III (NCERT Book, Class I,II&III)
2. Urdu ki pahli kitab by Ismail Merathi.
3 Amozish –e- Urdu
5.Muhawairat w Zerbul Amsaal By Hafiz Asadurrahmaan Chisthi

This course can be opted as an elective by the students of the following subjects: **Open for all**

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignments and Class Tests. The marks shall be as follows:

Overall performance throughout the Semester (includes Attendance, Behaviour, Discipline, Participation in Different Activities) (05 marks)

Suggested equivalent online courses:

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

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

Course outcome	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	1	2	-	2	-
CO2	2	1	1	2	2	-	1	1	1
CO3	2	2	2	2	2	1	-	2	2
CO4	3	2	2	2	1	1	2	2	1

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

IntegralUniversity,Luckno
w Department ofLanguages

StudyandEvaluationScheme

Co-Curricular (Regional Language) (Theory)

As per NEP 2020

Wef. 2025-2026

Program:All NEP STUDENTS **Year: II** **Semester: III**

S.No.	Course code	CourseTitle	Type ofPaper	Period Per Hr./Week/UE			EvaluationScheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ASE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	ProfessionalEthics
							CT	TA												
THEORY																				
1.	H040305T/ LN231	Amozish –e- Urdu آموزش اردو	Co-Curricular (Regional Languages)	2	0	0	15	10	25	75	100	2:0:0	2	✓	✓	✓			✓	✓
Total				2	0	0	15	10	25	75	100	2:0:0	2							

L=Lecture,**T**=Tutorial,P=Practical,**CA**=ContinuousAssessment,**CT**=Class Test.**TA**=Teacher'sAssessment,**ESE**=End Semester Examination;**CA=CT+TA**; **SubjectTotal=CA+ ESE**.

اردو نصاب برائے تھرڈ سمسٹر
حسب ہدایات نیشنل ایجوکیشن پالیسی

Syllabus of Urdu for III Semester Urdu
National Education Policy (NEP)
With the effect from
2025-26- Odd Semester

Total Units: 04		مجموعی اکائیاں:04
Credits 02:		کریڈیٹس:02

Unit I

Introduction of Alphabet:

1.1 Urdu alphabet, consonant, vowels, aspirated & retroflexed letters, and the recognition of different forms of the letters.
1.2 Reading practice of Urdu words, practicing of writing Urdu words, combines letters to write two-letter, three-letter, and four-letter words, and writing Urdu in the Nastaliq script.
1.3 Exercises and activities

اکائی اول

تعارف علم ہجا

۱.۱: حروف تہجی، مصوتے/مصمتے، حروف ہکاری یا ہائیہ، حروف حلقی، حروف منقوط و غیر منقوط، حرکات و سکنات، حروف علت حروف کی اشکال کی پہچان

۱.۲: کتابت: حروف ہجا کی مشق، دو حرفی، سہ حرفی اور چہار حرفی الفاظ کے حروف کو ملا کر لکھنے کی مشق، اردو نستعلیق کے لکھنے کی مشق۔

۱.۳: لکھنے اور پڑھنے کی مشق و سرگرمیاں:

Unit II

Reading & Dictation:

2.1 a) Prose: Tote ki chalaki, Guftgu ke aadaab, KahawateN, Urdu news. (NCERT Book, Class III)
b) Poetry: Sari Dunya ke Malik, Barsaat, Lab pe aati hai. Shaam. (NCERT Book, Class III)
2.2 Urdu writings dictation
2.3 Exercises and activities

اکائی دوم

اردو عبارت خوانی و املانویسی

۲.۱: مجوزہ اردو متن نظم و نثر، اخبار و رسائل

نثر: طوطے کی چالاکی، گفتگو کے آداب، کہاوتیں، اردو خبریں (این سی آر ٹی بک، درجہ سوم)،

نظم: ساری دنیا کے مالک، برسات کی رات، لب آتی ہے، شام، (این سی آر ٹی بک، درجہ سوم)

۲.۲: اردو املانویسی، و نقل نویسی کی مشق

۲.۳: لکھنے اور پڑھنے کی مشق و سرگرمیاں:

Unit III

Jargons and Idioms:

3.1 Urdu idioms, their kinds and examples.
3.2 Use of suffixes & prefixes, Urdu writings dictation
3.3 Exercises and activities

اکائی سوم

اردو محاورات، سابقے ولاحقے:

۳.۱: مروجہ اردو محاوروں اور ضرب الامثال کی مشق
۳.۲۔ سابقے اور لاحقے کا استعمال
۳.۳: لکھنے اور پڑھنے کی مشق اور سرگرمیاں

Unit IV

Compositions:

4.1 Urdu Letters & applications writings skills
4.2 Introductory dialogue & etiquette in the Urdu language
4.3 Exercises and activities

اکائی چہارم

خط وکتابت و درخواست نویسی

۴.۱: اردو خط وکتابت اور درخواست نویسی کی مشق
۴.۲: تعارف، نشست وبرخاست میں استعمال ہونے والے اردو جملے ومکالمے
۴.۳: لکھنے اور پڑھنے کی مشق اور سرگرمیاں

DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2024-25
w.e.f. July, 2025-26
Diploma in Chemical Dynamics and Analytical Techniques
2nd Year / 4th 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.	B020401T/CH239	Quantum Mechanics and Analytical Techniques	T	Core Major	3	1	-	15	10	25	75	100	04	√		√					
2.	B020402T/CH262	Concepts in Instrumental Techniques	T		3	1	-	15	10	25	75	100	04	√		√					
3.	B190402P/CH240	Qualitative and Synthetic Methods	P		-	-	4	15	10	25	75	100	02	√	√	√					
4.	B020402P/CH241	Instrumental Analysis	P		-	-	4	15	10	25	75	100	02	√	√	√					
5.	• B030402T/MT237 • A040405T/LN234 • B040401T/BS275; B040402P/BS276 • -	• Numerical Analysis & Testing of Hypothesis • Effective Professional Communication Skills • Economic Botany, Ethnomedicine & Phytochemistry; Commercial Botany & Phytochemical Analysis • EVS	T + P	Minor (Elective)	3	1	4	15	10	25	75	100	06	√	√	√			√	√	
6.	B020405R/CH259	Chemistry Summer Internship	P	Internship	-	-	6	-	-	-	100	100	03	√	√	√		√			
7.	Z040401T/PH201	Physical Education and Yoga	T	Co-curricular	2	-	-	15	10	25	75	100	02	√	√	√		√	√	√	
				TOTAL	11	03	18	90	60	150	550	700	23								

B.Sc. Chemistry

Effective from Session: 2025-26							
Course Code	B020401T/CH239	**Title of the Course**	Quantum Mechanics and Analytical Techniques	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	5	1		4
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To provide students with a fundamental understanding of atomic structure, elementary quantum mechanics, the Schrödinger wave equation and its applications, molecular orbital theory, and molecular spectroscopy (rotational, vibrational, electronic) with relevance to photochemistry and kinetics, while emphasizing the principles and societal applications of analytical chemistry in pharmaceuticals, industry, environment, diagnostics, food safety, forensics, and research.						

Course Outcomes	
CO1	Students will be able to **analyze and apply** the fundamental concepts of elementary quantum mechanics to explore new areas of research in chemistry and allied fields of science and technology.
CO2	Students will be able to work effectively in interdisciplinary teams, applying their knowledge of molecular spectroscopy to solve complex scientific problems.
CO3	Students will **develop** problem-solving skills, critical thinking, and analytical reasoning by interpreting data obtained from various spectroscopic techniques.
CO4	Students will learn to **determine and elucidate** the structure of organic molecules using IR, NMR, and mass spectrometry.
CO5	Students will **develop** practical skills in purification techniques, including solvent extraction, thin-layer chromatography (TLC), and column chromatography, for effective separation and analysis of compounds.

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, 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.	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 cycloprpanone, 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:

1. Alberty,R A, Physical Chemistry,4 theditionWiley Eastern Ltd ,2001; Atkins,PW,the elements of physical chemistry,Oxford ,1991
2. 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
3. Lee,J.D, Concise Inorganic Chemistry 4th Edition ELBS,1977; Clayden, J., Greeves, N., Warren, S., Organic Chemistry, Second edition, Oxford University Press 2012.
4. Silverstein, R. M., Bassler, G. C., Morrill, T. C. Spectrometric Identification of Organic Compounds, John Wiley and Sons, INC, Fifth edition.
5. 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.
6. 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.
7. Mukherji, Singh,Kapoor, Organic Chemistry, Vol 1 and 2. New Age International 2014; Rl Madan, Chemsitry For Degree Students Elective Sem V/Vi As Per Cbs Quantum And Spectroscopy, S Chand Publishing
8. Y.R.Sharma, Elementary Organic Spectroscopy Vol 4, S Chand; Gurdeep Raj, Advanced Physical Chemsitry, Krishna Publishing
9. Pavia, D. L. et al. Introduction to Spectroscopy, 5th Ed. Cengage Learning India Ed.
10. K.L.Kapoor, A Textbook Of Physical Chemistry - Quantum Chemistry And Molecular Spectroscopy, Volume 4, Macmillan; Tn Srivastva And Pc Kampoj, Systematic Nalytical Chemistry, Shoban Lal Nagin Chand

e-Learning Source:

1. https://www.coursera.org/courses?query=chemistry&languages=en
2. https://www.mooc-list.com/tags/physical-chemistry
3. https://www.coursera.org/learn/physical-chemistry
4. https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/
5. http://heecontent.upsdc.gov.in/Home.aspx
6. https://nptel.ac.in/courses/104/108/104108078/
7. https://nptel.ac.in/courses/104/106/104106122/
8. 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	PSO1	PSO2	PSO3	SDGs Mapping
CO1	2	2	1	1	-	-	2	2	2	-	4 (Quality education)
CO2	3	2	1	2	-	-	2	2	2	-	
CO3	2	3	3	3	-	-	2	2	2	-	
CO4	3	3	2	3	-	-	2	2	2	-	
CO5	3	3	2	2	-	3	2	2	2	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation1

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

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

Effective from Session: 2025-26							
Course Code	B020402T/CH262	**Title of the Course**	Concepts in Instrumental Techniques	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	5	1	0	4
Pre-Requisite	Certificate	**Co-requisite**					
Course Objectives	To develop a strong foundation in Analytical Chemistry by exploring its interdisciplinary applications and fundamental principles such as sampling techniques, accuracy, precision, and error analysis; to equip students with practical expertise in analyzing soil, water, and cosmetic samples using classical titrations, complexometric methods, spectrophotometry, and flame photometry; to emphasize the use of instrumental techniques including UV-Vis, IR, NMR, Mass Spectrometry, and Atomic Absorption Spectrophotometry for interpreting chemical compositions and assessing environmental and consumer safety; and to enable students to gain proficiency in data representation, pH measurement, and quantification of macro and micronutrients for advanced chemical analysis and research applications.					

Course Outcomes	
CO1	Students will be able to **apply** sampling principles, evaluate data reliability, and analyze soil and water samples through pH measurement, complexometric titrations, and pollutant detection using interdisciplinary analytical chemistry methods.
CO2	Students will be able to **identify** constituents in cosmetic and environmental samples, perform titrations, forensic analyses, and nutrient estimations using instrumental methods to enhance analytical precision and critical thinking skills.
CO3	Students will be able to **interpret** UV-Vis and IR spectral data, apply Woodward–Fieser rules, and analyze vibrational frequencies to characterize organic compounds and their interactions with electromagnetic radiation.
CO4	Students will be able to **analyze** NMR spectra, differentiate proton environments, interpret chemical shifts and coupling patterns, and determine the structures of organic compounds using NMR instrumentation.
CO5	Students will be able to **interpret** mass spectral fragmentation patterns, apply atomic absorption spectrophotometry (AAS) methodologies with calibration techniques, and quantify trace elements in diverse samples using advanced analytical instrumentation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Analytical Chemistry	Introduction Analytical Chemistry and its interdisciplinary nature; Concept of sampling; Importance of accuracy, precision and sources of error in analytical measurements; Analysis of soil: Composition of soil; Concept of pH and pH measurement; Complexometric titrations; Chelation, Chelating agents, use of indicators; Determination of pH of soil samples; Estimation of Calcium and Magnesium ions as carbonate by complexometric titration.	8	1
2	Analysis of Water	Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods; Determination of pH, acidity and alkalinity of a water sample; Determination of dissolved oxygen (DO), free chlorine and chloride ion of a water sample.	7	1
3	Analysis of Cosmetics	Major and minor constituents and their function; Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration. Applications (Anyone): To study the uses of phenolphthalein in trap cases: (i)To analyze arson accelerants;(ii) To carry out analysis of gasoline. Instrumental demonstrations: Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry(i) Spectrophotometric determination of Iron in Vitamin / Dietary Tablets; (ii)Spectrophotometric Identification and Determination of Caffeine and Benzoic acid in Soft Drink.	8	2
4	UV Spectroscopy	Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated dienes and polyenes.	8	3
5	IR Spectroscopy	Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.	8	3
6	NMR Spectroscopy	Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling, Interpretation of NMR spectra of some representative compounds.	7	4
7	Mass Spectrometry	Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters, acids, anhydrides), molecular ion peak, metastable peak, Mclafferty rearrangements, Nitrogen rule.	7	5
8	Atomic Absorption Spectrophotometry	Introduction, Principle, Instrumentation, Sample preparation, Internal standard and standard addition, calibration and applications of AAS.	7	5

Reference Books:

1. Fundamentals of Analytical Chemistry by Skoog, West, Holler & Crouch Widely
2. Analysis of Cosmetic Products, L.R. Pires Kassab.

3. Herbal and Cosmetic Analysis, T.K. Reddy Konatham et al.
4. Instrumental Methods of Chemical Analysis by B.K. Sharma
5. Quantitative Chemical Analysis by Daniel C. Harris
e-Learning Source:
1. https://onlinecourses.nptel.ac.in/noc25_cy71/preview
2. https://epgp.inflibnet.ac.in/
3. https://www.classcentral.com/subject/analytical-chemistry
4. https://lab-training.com/free-e-courses/
5. https://www.ciisindia.in/course/regular/msc-distance-education/analyticals-chemistry/

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	SDGs Mapping
CO1	2	3	2	3	-	2	3	3	2	2	4 (Quality Education), & 6 (Clean Water and Sanitation)
CO2	2	3	2	3	-	2	3	3	2	2	
CO3	3	2	2	3	-	3	2	3	3	-	
CO4	3	2	2	3	-	3	2	3	3	-	
CO5	3	2	2	3	-	3	2	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	B190402P/CH240	**Title of the Course**	Qualitative and Synthetic Methods	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV			4	2
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To 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	Students would be able to **understand** the flash point, ignition point of liquids, and smoke point of a fuel.
CO2	Students would be able to **understand and analyse** nitration, sulphonation, Friedel-Crafts reaction, esterification, hydrolysis, oxidation, halogenation, chlorosulphonation, reduction, and amination.
CO3	Students would be able to **comprehend** that TLC keeps an eye on each step of the reaction. 4-bromo aniline, 3-nitroaniline, sulphanilamide, 4-Amino benzoic acid, 4-Nitro benzoic acid, dihalobenzenes, and nitrohalobenzenes
CO4	Students would be able to monitor and **analyse** chemical reactions with the help of TLC.
CO5	Students would be able 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:

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. Organic Chemistry, Prentice-Hall, 5th edition (1996).
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman (1960).
5. Harris, D.C.Exploring Chemical Analysis, 9thEd. New York, W.H. Freeman (2016).
6. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher (2009).
7. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education (2012).
8. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson (2009).

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

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

PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**SDGs Mapping**
CO1	2	2	1	2	-	-	2	2	2	1	**4 (Quality education)**
CO2	3	2	2	2	-	-	2	2	2	1	
CO3	2	3	1	1	-	-	2	2	1	2	
CO4	2	3	2	1	-	2	2	2	2	2	
CO5	3	2	1	1	-	2	2	2	1	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	B020402P/CH241	**Title of the Course**	Instrumental Analysis	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV			4	2
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	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 effectively as members of an interdisciplinary problem-solving team, applying their knowledge of spectrophotometry to **analyze** and interpret experimental data.
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	Students will be able to develop and **evaluate** 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:

1. 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.
2. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004; Harris, D.C.Exploring Chemical Analysis, 9th Ed. New York,
3. W.H. Freeman, 2016; Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
4. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition.
5. Mikes, O. &Chalmes, R.A. Laboratory Handbook of Chromatographic &AlliedMethods, Elles Harwood Ltd. London.
6. Ditts, R.V. Analytical Chemistry: Methods of separation. Van Nostrand, New York, 1974.

e-Learning Source:

1. https://www.youtube.com/watch?v=xHQM4BbR040&pp=ygUcc3BlY3Ryb3Bob3RvbWV0ZXIgZXhwZXJpbWVudA%3D%3D
2. https://www.youtube.com/watch?v=LbsNI3WgUso&pp=ygUMc3BlY3Ryb3Njb3B5

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

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

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	B020405R/CH259	**Title of the Course**	Chemistry Summer Internship	**L**	**T**	**P**	**C**
Year	II	**Semester**	iv	0	0	6	3
Pre-Requisite	Certificate	**Co-requisite**	-				
Course Objectives	To provide the industrial exposure and enhance technical skills of students						

Course Outcomes	
CO1	Hands on training
CO2	Integrate classroom theory with laboratory practice.
CO3	Understanding professional ethics of industry and code of conduct.
CO4	Essential training in laboratory safety procedures
CO5	Compilation of data and report writing

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	**SDGs Mapping**
CO1	1	2	3	1	2	1	2	2	2	1	4 (Quality Education), & 5 (Gender equality)
CO2	2	1	1	2	1	2	2	2	-	1	
CO3	1	1	3	3	1	3	2	2	-	1	
CO4	1	3	2	1	1	1	2	2	-	1	
CO5	2	2	1	3	3	1	2	2	-	1	

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

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

Effective from Session: 2025-26							
Course Code	Z040401T/PH201	**Title of the Course**	Physical Education and Yoga	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	2			2
Pre-Requisite	Certificate	**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. iii. Management of Obesity. iv. 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. Vajrasan, 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 GamesGilli- 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.

BrajBilari Nigam, Yoga Power "TheKpath of Personal achievement" Domen and Publishers, New Delhi, 2001.

Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Domenand Publishers, New Delhi - 2001.

Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.

Janice Jerusalim, "A Guide To Yoga" Parragon Bath, Baiihe-2004.
नारंग, प्रियंकर, परम्परागत भारतीय खेल, " स्पोर्ट्स पब्लिके शन" , 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**

Effective from Session: 2025-26

Course Code	B030402T/MT237	**Title of the Course**	Numerical Analysis & Testing of Hypothesis	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**3**	**1**	**0**	**4**
Pre-Requisite		**Course Type**	Minor				
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of numerical and statistical analysis. Numerical and statistical analysis plays very important role for higher studies. After successfully completion of this course, the student will able to explore subject into their respective dimensions.						

Course Outcomes

CO1	Students will be able to calculate and analyze errors in numerical computations. Students will also be able to find the solutions of algebraic and transcendental equations by different methods.
CO2	Students will be able to interpolate the polynomial functions.
CO3	Students will be able to obtain the numerical solutions to the problems of mathematics. e.g. numerical differentiation and integration, solution of ordinary differential equations.
CO4	Students will able to apply various statistical techniques in time series data.
CO5	Students will be able to perform a test of hypothesis as well as understand the applications of different types of tests.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Numerical Solution of Algebraic and Transcendental Equations	Error and their analysis, Solution of algebraic and transcendental equations by iteration methods, namely: Bisection method, False position method, Iterative method, Newton-Raphson method and their convergence.	8	1
2	Interpolation	Forward and backward differences, Newton-Gregory forward and backward interpolation formula, Gauss forward and backward interpolation formula, Stirling's formula, Bessel's formula and Lagrange's Interpolation formula.	8	2
3	Numerical Differentiation and Integration	Numerical differentiation, Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, Simpson's3/8 rule, Boole's rule, Weddle's rule.	8	3
4	Numerical Solution of Ordinary Differential Equations	Taylor's series method, Euler's method, Modified Euler's method, Runge-Kutta method.	6	3
5	Time Series and Forecasting	Introduction to time series data, Application of time series data, Components of time series, Method of moving averages, Forecasting models and methods.	8	4
6	Testing of Hypothesis	Statistical hypothesis, Simple and Composite hypothesis, Null and Alternative hypothesis, Critical region, Types of errors, Level of significance, Power of the test, *p*-value.	7	5
7	Test of Samples	Small and large sample tests, Assumptions, t-test, Chi-square test, F-test and z-test.	8	5
8	Analysis of Variance (ANOVA)	Introduction to ANOVA, Assumptions for ANOVA test, One-way classification, Two-way classification.	7	5

Reference Books:

1. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, Delhi, 5th Ed, 2012.
2. P. Kandasamy , "Numerical Methods", S. Chand and Company, New Delhi.
3. Balaguruswamy , "Numerical Methods" , T.M.H., New Delhi.
4. Kendall M. G. (1976): Time Series, Charles Griffin.
5. Goon A.M., Gupta M.K.Dasgupta B (2001):Fundamentals of Statistics (Vol.2), Word Press.
6. Gupta, S.C. and Kapoor, V. K. (2014): Fundamentals of Applied Statistics, 4 th Edition, Sultan Chand & Sons.

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

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

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