SYLLABUS

FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUG)

AS PER

NATIONAL EDUCATION POLICY-2020 (2.2)

&

CURRICULUM AND CREDIT FRAMEWORK

FOR UNDERGRADUATE PROGRAMMES-2022

B.A./B.Sc. Honours (CHEMISTRY)

(w. e. f. 2025-26)



DEPARTMENT OF CHEMISTRY

GURUKULA KANGRI (DEEMED UNIVERSITY) HARIDWAR

2025

Detailed B.Sc. Course (2025-26)

PROGRAM OUTCOMES OF B.SC. COURSE IN CHEMISTRY

Following Program outcomes are mapped with Course Outcomes in Each course.

PO1. To develop interest among students for chemistry and its application in various fields.

PO2. To help students in attaining basic concepts with balanced knowledge of chemistry.

PO3. To develop and enhance the practical chemistry skills among students.

PO4. To create awareness about nature, society and market with respect to environment, chemicals and pollutants in students.

PO5. To build confidence among students in solving research problems independently.

PO6. To link student's chemical knowledge with Modern Trends.

PO7. To encourage students with skills towards employment or higher education in multidisciplinary areas.

PO8. To upgrade student's knowledge about analysis of industrial products for better industrial employment

SEMESTER-WISE STRUCTURE

SEM	SL. NO	CLASSIFICATION		PAPER CODE	PAPER TITLE	CREDITS	L	T	P	LEVEL
I	1.	Major	MJ	BCH25-MJ101	Inorganic Chemistry-I	3	30	15		100
	2.	Major	MJ	BCH25-MJ151	Lab Course-I	1			45	100
I	3.	Vocational*	VC	BCH25-VC101	Polymer Chemistry	4	45	15		100
I	4.	Ability Enhancement Course	AEC	---25-AE101	Other Subject	4	45	15		100
I	5.	Multi-Disciplinary Course**	MDC	BCH25-MD101	Elementary Inorganic Chemistry	3	30	15		100
I	6.	Skill Enhancement Course	SEC	BCH25-SE101	Chemistry of Milk & Analysis	3	30	15		100
I	7.	Value Added Course	VAC	---24-VA101	Other Subject	2				100
I	8.	Value Added Course	VAC	---24-VA102	Other Subject	2				100
Note: ****Only three vocational courses to be completed by the end of 6th Semester. The remaining courses will be from the category of Minor Courses*** *** Students are not allowed to choose or repeat courses already undergone at the higher secondary level(12th class) in the proposed major and minor stream under the category of Multi-Disciplinary Course*										
II	9.	Major	MJ	BCH25-MJ201	Organic Chemistry-I	3	30	15		100
	10	Major	MJ	BCH25-MJ251	Lab Course-II	1			45	
II	11	Vocational	VC	BCH25-VC201	Fundamentals of Renewable and non-renewable energy	4	45	15		100
II	12	Ability Enhancement Course	AEC	---24-AE201	Other Subject	4				100
II	13	Multi-Disciplinary Course	MDC	BCH25-MD201	Elementary Organic Chemistry	3	30	15		100
II	14	Skill Enhancement Course	SEC	BCH25-SE201	Basics of water analysis and management	3	30	15		100
II	15	Value Added Course	VAC	---24-VA201	Other Subject	2				100
II	16	Value Added Course	VAC	---24-VA202	Other Subject	2				100
EXIT OPTION-I		**UG CERTIFICATE**		**ESSENTIAL ADDITIONAL REQUIREMENT: INTERNSHIP**		**CREDITS: 4**				
III	17	Major	MJ	BCH25-MJ301	Physical Chemistry-I	4	45	15		200
III	18	Major	MJ	BCH25-MJ351	Lab Course-III	4	45	15		200
III	19	Vocational	VC	BCH25-VC301	Commercial chemical products	4	45	15		200 & above
III	20	Ability Enhancement Course	AEC	---24-AE301	Other Subject	2				200

III	21	Multi-Disciplinary Course	MDC	BCH25-MD301	Elementary Physical Chemistry	3	45	15		200
III	22	Skill Enhancement Course	SEC	---25-SE301	Other Subject	3				200
III	23	Value Added Course	VAC	---24-VA201	Other Subject	2				200
IV	24	Major* Online Course	MJO	BCHOC-MJ401	_	4	45	15		200
IV	25	Major	MJ	BCH25-MJ402	Physical Chemistry-II	4	45	15		200
IV	26	Major	MJ	BCH25-MJ451	Lab Course-IVA	4			120	200
IV	27	Major	MJ	BCH25-MJ452	Lab Course-IVB	4			120	200
IV	28	Minor	MI	BCH25-MI401	Basic Inorganic Chemistry	4	45	15		200 & above
IV	29	Community Engagement/ OR Internship	CE IN	BCH25-CE471 BCH25-IN471	Community Engagement/ OR Internship	2 2			60 60	200 200
EXIT OPTION-II			**UG DIPLOMA**		**ESSENTIAL ADDITIONAL REQUIREMENT: INTERNSHII**	**CREDITS: 4**				
V	30	Major	MJ	BCH25-MJ501	Organic Chemistry-III	4	45	15		300
V	31	Major* Online Course	MJO	BCHOC-MJ502	_	4	45	15		300
V	32	Major	MJ	BCH25-MJ503	Physical Chemistry-III	4	45	15		300
V	33	Major	MJ	BCH25-MJ551	Lab Course-V	4			120	300
V	34	Minor	MI	BCH25-MI501	Basic Physical Chemistry	4	45	15		200 & above
V	35	Internship	IN	BCH25-IN571	Internship	2			60	200
VI	36	Major	MJ	BCH25-MJ601	Physical Chemistry-IV	4	45	15		300
VI	37	Major	MJ	BCH25-MJ602	Inorganic Chemistry-III	4	45	15		300
VI	38	Major* Online Course	MJO	BCHOC-MJ603	_	4	45	15		300
VI	39	Major	MJ	BCH25-MJ651	Lab Course-VI	4			120	300
VI	40	Minor	MI	BCH25-MI601	Basic Organic Chemistry	4	45	15		200 & above
VI	41	Project	PR	BCH25-PR671	Project	2			60	200
EXIT OPTION-III: THREE YEARS UG DEGREE										

VII	42	Major	MJ	BCH25-MJ701	Inorganic Chemistry-IV	4	45	15		400
VII	43	Major	MJ	BCH25-MJ702	Organic Chemistry-IV	4	45	15		400
VII	44	Major	MJ	BCH25-MJ703	Research Ethics & Methodology	4	45	15		400
VII	45	Major	MJ	BCH25-MJ751	Lab Course-VII	4			120	400
VII	46	Major* Online Course	MIO	BCHOC-MI701	_	4	45	15		300 & above
VII	47	Research Based Project/ **OR** Major	PR MJ	BCH25-PR771 BCH25-MJ704	Project /**OR** Computer in Chemistry	2 2			60 60	400 400
VIII	48	Major	MJ	BCH25-MJ801	Inorganic Chemistry-V	4	45	15		400
VIII	49	Major	MJ	BCH25-MJ802	Organic Chemistry-V	4	45	15		400
VIII	50	Major	MJ	BCH25-MJ803	Physical Chemistry-V	4	45	15		400
	51	Major	MJ	BCH25-MJ804	Basics of Phytochemistry	2	15	15		400
VIII	52	Minor	MI	BCH25-MI801	Chemical Society & technology	4	45	15		300 & above
VIII	53	Major	MJ	BCH25-MJ851	Lab Course-VIII	4			120	400
COURSE COMPLETION OPTION-I: FOUR YEAR UG HONOURS										
***Note:* Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year.**										
VIII	54	Major	MJ	BCH25-MJ802	Organic Chemistry-V	4	45	15		400
VIII	55	Major	MJ	BCH25-MJ805	Basics of Phytochemistry	2	15	15		400
VIII	56	Minor	MI	BCH25-MI801	Chemical Society & technology	4	45	15		300 & above
VIII	57	Dissertation	DI	BCH25-DI871	Dissertation	12			360	400
COURSE COMPLETION OPTION-II: FOUR YEAR UG HONOURS WITH RESEARCH										

* In B.Sc., NEP-2020 (2.0) programme student should opt online course either from Swayam/ MOOCs/NPTL.

The online course opted should not be similar to any other online/offline course of B.Sc. programme.

Course Title : Inorganic Chemistry-1 w.e.f. 2025-26	Classification : Major (MJ)
Class : B.Sc. Pt.-I/ Semester-I	Course Code : BCH25-MJ101
Lecture : 45	Total Credits : 03
MM : 100	Exam Hrs : 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic idea of quantum mechanics for atomic structure and quantum numbers.

CO2: To learn the concept of quantum numbers and rules for filling electrons in various orbitals.

CO3: Classify different concepts involved in ionic bonding

CO4: Compare theories pertaining to covalent bonding like VB approach& VSEPR theory.

CO5: Study the resonance & basic idea of MO approach.

CO6: Discuss about solutions, their nature and use in analysis.

UNITS	CONTENTS	L	T	P	Total Hours
1	Quantum mechanics. Meaning & Significance of ψ and ψ^2 in Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbital) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation).	6	3		9
2	Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.	6	3		9
3	*Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé-equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.	6	3		9
4	*Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions based on VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.	6	3		9
5	MO Approach: Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	6	3		9
	Total Theory (Hrs)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Theory:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, EL. B. S.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiterand Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
5. ArunBahland B. S. Bahl: *Advanced Physical Chemistry,* S. Chand Puri, Sharma, Kalia, Principles of Inorganic

chemistry, Vishal Publications.
6. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
7. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	X	X			X		X	
CO:2	X	X		X	X			
CO:3	X	X						X
CO:4	X	X						
CO:5	X	X		X				
CO:6	X	X	X					

Course Title :Inorganic Chemistry-1 w.e.f. 2025-26	Classification : Major (MJ)
Class:B.Sc. Pt.-I/ Semester-I	Course Code : BCH25-MJ151
Lecture:30	Total Credits:01
MM:50	ExamHrs: 02

COURSE OUTCOMES:

CO1: To Learn about solutions, their nature and use in analysis.
CO2: To study the standardization procedure.
CO3: To Analyze the procedure of titrations

UNITS	CONTENTS	L	T	P	Total Hours
1	**List of Experiments:** 1. Safety measures to be taken in Chemical laboratory. 2. Calibration and use of apparatus. 3. Preparation of solutions of different Molarity / Normality. 4. Preparation and standardization of Primary standard (Oxalic acid) and Secondary standard (NaOH solution). 5. Estimation of strong acid by titrating it with strong base. 6. Estimation of oxalic acid by titrating it with $KMnO_4$. 7. Estimation of water of crystallization in Mohr's salt by titrating it with$KMnO_4$. 8. Estimate a mixture of Na_2CO_3 and $NaHCO_3$ by acid based titration.	-	-	30	30
	Total (Hrs.)				30

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Practicals:

Marks allotted for continuous assessment – 20
Marks allotted for Practical examination –30
Maximum marks -50

CO-PO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X	X	X					
CO:2	X	X	X					
CO:3	X	X	X					

Course Title:Polymer Chemistry w.e.f. 2025-26	Classification : Vocational (VC)
Class: B.Sc. Pt.-I/ Semester-I	Course Code : BCH25-VC101
Lecture:60	Total Credits: 04
MM:100	Exam Hrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the fundamental concept of polymers and classify polymers accordingly.

CO2: To assess the importance of the process of polymerization in relation to the concept of functionality of polymers.

CO3: To evaluate various parameters associated with the process of polymerization.

CO4: To categorize the biopolymers and compare their properties based on their utility.

CO5: Define and tabulate different methods associated with the process of polymer degradation.

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction and history of polymeric materials, Different Schemes of Classification of Polymers, Natural and Synthetic Polymers, homopolymers and copolymers.	9	3		12
2	Functionality and its importance Criteria for synthetic polymer formation, classification of polymerization processes, functionality and degree of polymerization.	9	3		12
3	Molecular weight of polymers, Determination of molecular weight of polymers (Mn, Mw, etc), by viscometry, light scattering and osmotic pressure methods. Polydispersity	9	3		12
4	Biopolymers: Classification, properties and application of biopolymers and polysaccharides	9	3		12
5	Polymer Degradation: Process of degradation, Random and chain end degradation, methods of degradation, Thermal, mechanical, oxidative, hetrolytic and chemical degradation.	9	3		12
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for End Semesters examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.
2. Gowariker, V. R., Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub.
3. Seymour Polymer Chemistry, Marcel Dekker, Inc.
4. G. Odian: Principle Of Polymerisation, John Wiely.
5. F.W. Billmeyer: Text Book of Polymer Science, John wiely.
6. P. Ghosh: Polymer Science & Technology, Tata Megraw-Hill.
7. R.W. Lenz: Organic Chemistry of Synthesis High Polymers

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X	X						
CO:2	X	X		X			X	X
CO:3	X				X			X
CO:4	X	X		X			X	X
CO:5	X	X			X		X	X

Course Title :Chemistry of Milk and Analysis w.e.f. 2025-26	Classification : Skill Enhancement (SEC)
Class: B.Sc. Pt.-I/ Semester-I	Course Code : BCH25-SE101
Lecture:45	Total Credits:03
MM:100	Exam Hrs: 02

Course Outcomes:

After the completion of this course, a student should be able to:

CO1: Understand the basic principles and methods of milk analysis.

CO2: Determine theoretically how to prepare milk samples for analysis.

CO3: Detect and quantify a variety of substances in milk, including cane sugar, starch, cellulose, urea, ammonium compounds, sulphates, glucose, nitrates, anionic detergents, skimmed milk powder.

CO4: Learn how to perform the alkaline phosphatase test, turbidity test, and determination of total solids.

UNITS	CONTENTS	L	T	P	Total Hours
1.	Introduction to Milk Analysis Overview of milk composition and properties	3	2		5
2.	Different types of milk analysis	3	1		4
3.	Sampling and sample preparation	6	3		9
4.	Detection and Quantification of Specific Substances in Milk: Cane sugar, Starch, Cellulose, Urea, Ammonium compounds, Sulphates, Glucose, Nitrates, Anionic detergents, Skimmed milk powder.	12	6		18
5.	Other Tests for Chemical Analysis of Milk: Alkaline phosphatase test, Turbidity test, Determination of total solids	6	3		9
	Total (in Hrs)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination –60

Maximum marks -100

SUGGESTED READINGS:

1. M. K. Shrivastava: Handbook on Analysis of Milk. CBS Publishers & Distributors Pvt. Ltd.
2. Henry Leffmann: Analysis of Milk and Milk Products. Forgotten Books
3. Wanklyn James Alfred: Milk-Analysis: A Practical Treatise on the Examination of Milk and Its Derivatives, Cream, Butter, and Cheese.Hardpress Publishing

CO-PO-PSO MAPPING

Course Outcomes (Cos) / Program Outcomes (Pos)	1	2	3	4	5	6	7	8
CO:1	X	X					X	X
CO:2	X			X			X	X
CO:3		X	X		X		X	X
CO:4		X		X	X		X	X

Course Title: Elementary Inorganic Chemistry w.e.f. 2025-26	Classification : Multi disciplinary (MDC)
Class: B.Sc. Pt.-I/ Semester-I	Course Code : BCH25-MD101
Lecture:45	Total Credits:03
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Classify basic nature of matter in reference to scientific terms.
CO2: To generalize various factors originating from human activities leading to environmental pollution and ways to conserve our nature.
CO3: Understand the interdependence of various components of ecosystem.
CO4: Associate measurement in chemistry with different types of units and their derived forms.
CO5: Distinguish between acids and bases on the basis of pH scale and correlate pH with practical usage in daily life.

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UNITS	CONTENTS	L	T	P	Total Hours
1	Matter and its Types: Nature of Matter, Physical and chemical states of matter, Particle Nature	6	3		9
2	Green Chemistry: Introduction, Greenhouse Effect, Global warming Ozone depletion	6	3		9
3	Natural Resources: Definition, Types, Nitrogen Cycle, Oxygen Cycle Water Cycle	6	3		9
4	Unit of Measurements in Chemistry: Introduction, Measurement and Numbers- Quantity and its SI unit, Base Units and Derived Units	6	3		9
5	Acid, Base and Salts: General Introduction and Definition of Acid, Base and Salts, Amphoteric Nature, pH scale	6	3		9
	Total (in Hrs)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:
Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Science NCERT class 9th.
2. S. Chand Inorganic Chemistry.
3. Puri, Sharma, Kalia, Principles of Inorganic chemistry, Vishal Publications.
4. BalramPani, Textbook of Environmental Chemistry, I.K. International publications

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X		X		X		X	
CO:2		X	X	X				X
CO:3	X			X	X			X
CO:4	X	X	X				X	
CO:5		X		X				

Course Title :Organic Chemistry-1 w.e.f. 2025-26	Classification : Major (MJ)
Class: B.Sc. Pt.-I/ Semester-II	Course Code : BCH25-MJ201
Lecture:45	Total Credits:03
MM:100	Exam Hrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Explain the various phenomenon's in organic molecules and their effect

CO2: Understand the .nature of organic reactions through reactive intermediates.

CO3: Stereo chemical behavior, isomerism and the applications in organic molecules in natural system.

CO4: Idea of synthesis and properties of commercially important alkanes

CO5: Idea of synthesis and properties of commercially important alkenes and their effects

CO6: To know about organic compounds, their nature and method of their identification.

UNITS	CONTENTS	L	T	P	Total Hours
1	**Fundamentals of Organic Chemistry-I** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Nucleophiles and electrophiles.	6	3		9
2	**Fundamentals of Organic Chemistry-II** Reactive Intermediates: Structure, stability and generation of Carbocations, Carbanions and free radicals. Aromaticity: Benzenoids and Hückel's rule.	6	3		9
3	**Stereochemistry** Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems).	6	3		9
4	**Aliphatic Hydrocarbons Alkanes:** (Upto3Carbons). Preparation and reactions: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Free radical Substitution, Halogenation.	6	3		9
5	**Alkenes:** (Upto 3 Carbons) Preparation, Elimination reactions: Dehydration of alkenes and dehydro halogenation of alkyl halides (Saytzeff's rule); cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis.	6	3		9
	Total Theory (Hrs.)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Theory:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS: (Theory)

1. T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient a. Longman.
3. E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
4. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
6. ArunBahland B. S. Bahl: *Advanced Organic Chemistry,* S. Chand
7. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
8. Practical Organic Chemistry, F. G. Mann. &B. C. Saunders, Orient Longman, 1960.

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1		X			X			X
CO:2	X			X	X			X
CO:3	X		X	X			X	
CO:4		X	X	X			X	
CO:5	X		X	X			X	X
CO6:	X	X	X					

Course Title :Organic Chemistry-1 w.e.f. 2025-26	Classification : Major (MJ)
Class: B.Sc. Pt.-I/ Semester-II	Course Code : BCH25-MJ251
Lecture:30	Total Credits:01
MM:50	Exam Hrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: To know about organic compounds, their nature and method of their identification.

CO2:

UNITS	CONTENTS	L	T	P	Total Hours
1	**List of Experiments:** **1.** Preliminary examination of organic compound like solubility, ignition test, melting point determination, unsaturation test etc. **2.** Determination of functional groups (containing oxygen only) in organic compounds.	-	-	30	30
	Total (Hrs.)				30

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Practicals:

Marks allotted for continuous assessment – 20

Marks allotted for Practical examination –30

Maximum marks -50

CO-PO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1:	X	X	X					

Course Title :Fundamentals of Renewable and Non-renewable Energy w.e.f. 2025-26	Classification : Vocational (VC)
Class: B.Sc. Pt.-I/ Semester-II	Course Code : BCH25-VC201
Lecture:60	Total Credits:04
MM:100	Exam Hrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic concepts and forms of energy, including renewable and non-renewable sources.

CO2: Learn about the utilization and environmental impacts of fossil fuels.

CO3: Explore the technologies and applications of major renewable energy sources.

CO4: Grasp the principles and safety considerations of nuclear energy.

CO5: Evaluate emerging energy trends and the impact of energy policies on sustainable development.

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Energy : Basic concepts of energy, forms, units, and conversion, Overview of renewable and non-renewable energy sources	9	3		12
2	Introduction to fossil fuels: coal, oil, natural gas. Utilization of fossil fuels.	9	3		12
3	Solar Energy: solar radiation, photovoltaic technology. Wind energy: wind turbines, wind farms, and potential. Biomass energy: sources, conversion technologies, and applications. Hydropower: principles, types, and environmental considerations	9	3		12
4	Basics of nuclear energy: fission, reactors, and fuel cycle. Safety, waste management, and public perception.	9	3		12
5	Overview of emerging renewable energy technologies. Energy policy: Government regulations, incentives, and challenges	9	3		12
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. "Introduction to Renewable Energy" by Vaughn Nelson and Kenneth L. Starcher, CRC Press.
2. "Energy and the Environment" by Robert A. Ristinen and Jack J. Kraushaar
3. Renewable Energy: Sources and Methods" by Anne Maczulak
4. Renewable Energy Sources and Emerging Technologies" by D.P. Kothari, K.C. Singal, and Rakesh Ranjan, PHI India
5. "Non-Conventional Energy Resources" by B.H. Khan, McGraw Hill Education (India) Pvt. Ltd.

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X			X			X	X
CO2	X			X				X
CO3				X			X	X
CO4				X				X
CO5				X				
CO6				X				

CourseTitle :Basics of Water Analysis & Management w.e.f. 2025-26	Classification : Skill Enhancement (SEC)
Class:B.Sc. Pt.-I/ Semester-II	Course Code : BCH25-SE201
Lecture:45	Total Credits:03
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic principles of water quality.

CO2: Learn about key physical and chemical parameters of water quality.

CO3: Gain knowledge of essential water analysis techniques.

CO4: Explore fundamental strategies for water resource management.

CO5: Develop the ability to assess and interpret water quality data.

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Water Analysis and Management, Importance of water quality, Introduction to water management, Introductory idea of Water Quality Parameters: Temperature, Turbidity, Color, Taste, Odor, pH, Dissolved oxygen, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD).	6	3		9
2	Basics of Water Sampling: Methods of water sampling, sample preservation and handling. Water Quality Standards and Regulations: National and international water quality standards, regulatory bodies, and guidelines.	6	3		9
3	Water Pollution Sources and Impacts: Point and non-point sources of pollution, impact of pollutants on ecosystems and human health.	6	3		9
4	Basics of Water Treatment Methods: Physical treatment (sedimentation, filtration), chemical treatment (coagulation, disinfection), biological treatment (activated sludge, biofiltration)	6	3		9
5	Management and Sustainable Practices: Water Resource Management, sustainable water practices including water conservation techniques, reuse, and recycling of water.	6	3		9
	Total (in Hrs)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. "Water Quality: An Introduction" by Claude E. Boyd
2. "Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems" by Mark Benjamin
3. "Introduction to Water Resources and Environmental Issues" by Karrie Lynn Pennington and Thomas V. Cech

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X			X			X	X
CO2	X			X				X
CO3				X			X	X
CO4				X				X
CO5				X				
CO6				X				

CourseTitle :Elementary Organic Chemistry w.e.f. 2025-26	Classification : Multi Disciplinary (MDC)
Class :B.Sc. Pt.-I/ Semester-II	Course Code : BCH25-MD201
Lecture :45	Total Credits :03
MM :100	Exam Hrs : 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Idea of role of carbon and its compound along with allotropes.
CO2: About Understanding the general organic chemistry and hydrocarbons.
CO3: To understand the common organic compounds and their uses.
CO4: To understand the oils and fats and their applications.
CO5: To understand the concepts of soap, detergent and their formation as well as effects.

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UNITS	CONTENTS	L	T	P	Total Hours
1	Carbon and its compounds: Allotropes of carbons; its basic properties & applications	6	3		9
2	Basic organic chemistry: Hydrocarbon: Nomenclature of hydrocarbons, Saturated and unsaturated hydrocarbons .	6	3		9
3	Organic Compounds. Introduction to aliphatic and aromatic compounds. Uses of ethyl alcohol, methyl alcohol, benzene and urea.	6	3		9
4	Introduction to oils and fats. saturated and Unsaturated fats, trans fats. Functions and applications of oil and fats. Introduction to essential oil.	6	3		9
5	Soap and detergents (structure, limitation), difference between soap and detergents, hazards of soaps & detergents.	6	3		9
	Total (in Hrs)	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Bansal, R.K; A Textbook of organic Chemistry, 6th Ed., New Age Int. Pub. (2016)
2. NCERT Chemistry 11th& 12th Std. (2022)
3. Singh, L. & Kaur, M., Science Part-2 (Chemistry), 10th std. S. Chand (2016)

CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X	X		X			X	X
CO2		X		X			X	
CO3	X	X		X				X
CO4	X	X		X			X	X
CO5		X	X	X			X	X

CourseTitle :Physical Chemistry-1 w.e.f. 2026-27	**Classification : Major (MJ)**
Class :B.Sc. Pt.-II/ Semester-III	**Course Code : BCH25-MJ301**
Lecture :60	**Total Credits : 04**
MM :100	**Exam Hrs : 02**

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Explain the various Laws of Thermodynamics.

CO2: Understand the important principles and definitions of thermochemistry.

CO3: Understand theVariation of enthalpy of a reaction with temperature.

CO4: Idea of Chemical Equilibrium Free energy change in a chemical reaction

CO5: Idea of Ionic Equilibria and pH scale for acids and bases.

CO6: To know about Buffer solutions. Solubility and solubility product and solve numerical probulems.

UNITS	CONTENTS	L	T	P	Total Hours
1	Chemical Energetics Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution	9	3		12
2	Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy ofa reaction with temperature– Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.	9	3		12
3	Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG andΔGo, Le Chatelier'sprinciple. Relationships between *Kp, Kc*and*Kx*for reactions involving ideal gases.	9	3		12
4	Ionic Equilibria: Strong,moderate and weakelectrolytes, degreeofionization, factors affecting degree of ionization, ionization constantand ionic product of water. Ionization of weak acids and bases, pHscale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts	9	3		12
5	Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Numerical question based on Solubility and solubility product.	9	3		12
		45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for contineous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. G. M. Barrow: *Physical Chemistry* Tata McGraw--Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J.C. Kotz, P.M. Treichel &J.R. Townsend: *General Chemistry* Cengage Lening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R.H.Petrucci:*GeneralChemistry*5thEd.MacmillanPublishingCo.:New York, (1985).

CO-PO-PSO MAPPING

Course Outcomes/Programs outcomes	1	2	3	4	5	6	7	8
CO1	X	X	X	X				
CO2	X	X		X	X	X	X	
CO3	X	X		X	X			X
CO4	X	X	X	X	X		X	
CO5	X	X		X	X		X	

CourseTitle :Lab Course-III w.e.f. 2026-27	Classification : Major (MJ)
Class:B.Sc. Pt.-II/ Semester-III	Course Code : BCH25-MJ351
Lecture:120	Total Credits:04
MM:100	ExamHrs: 04

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic idea of Qualitative Organic Analysis.
CO2: To understand the concept functional groups
CO3: Classify different amino acids bonding
CO4: Understanding the glycine, starch and effect of temperature
CO5: To understand about reducing/non reducing sugar and use in analysis.

UNITS	CONTENTS	L	T	P	Total Hours
	Physical Chemistry (I) Surface tension measurement (use of organic solvents excluded). a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer. b) Study ofthe variation of surface tension of a detergent solution with concentration. c) Determination of percentage composition of Alcohol water mixture by using stalagmometer (II) Viscosity measurement (use of organic solvents excluded). a) Determination of the relative viscosity of a liquid or dilute solution using an Ostwald's viscometer. b) Studyofthevariationofviscosityofanaqueoussolutionwithconcentrationof solute. c) Determination of percentage composition of Alcohol water mixture by using Ostwald's viscometer (III) Thermochemistry a) Determination of heat capacity of calorimeter for different volumes. b) Determination of Heat of Neutralization of strong acid and strong base by using water calorimeter c) Determination of Heat of Neutralization of weak acid and strong base by using water calorimeter (IV) Distribution Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$ $Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)x]^{2+}$ (V) Phase equilibria a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves. b) Determination of the critical solution temperature and composition of the phenol water systemand study of the effect of impurities on it.			120	120
	Practical (Hrs.)			120	120

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Practicals:

Marks allotted for continuous assessment – 40
Marks allotted for Practical examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. A.I. Vogel:Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
2. F. G. Mann &B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
3. B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
4. Ahluwalia, V.K. &Aggarwal, R. *ComprehensivePracticalOrganicChemistry,* Universities Press.

CO-PO-PSO MAPPING

Course Outcomes/Programs outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	X	X	X	X				
CO2	X	X		X	X	X	X	
CO3	X	X		X	X			X
CO4	X	X	X	X	X		X	
CO5	X	X		X	X		X	

CourseTitle :Commercial Chemical Products w.e.f. 2026-27	Classification : Vocational (VC)
Class:B.Sc. Pt.-II/ Semester-III	Course Code : BCH25-VC301
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO:1Understandtheconcept ofpesticides andreasons fortheirneed.
CO:2 Differentiate the various types of pesticides, classified on the basis of different criteria.
CO:3Designthesynthesisoftypicalandcommon pesticideslikeBaygon,Sevin,Pyrethroidsetc.
CO:4 Understand the basic chemistry and analysis of oils and fats.
CO:5Understand the basic chemistry and analysis of soaps and detergents.

UNITS	CONTENTS	L	T	P	Total Hours
1	Pesticides: Generalintroductiontopesticides:natural(Pyrethroids-Pyrethrins,Jasmoline,Cinerin;Rotenone,Nicotinoids, Ryania, Neem) and synthetic (Inorganic and Organic pesticides), classification, benefits andadverseeffects, toxicity.	9	03		60
2	Synthesisandtechnicalmanufacture and uses of representative pesticides in the following classes:Organochlorines (DDT, Gammexene); Carbamates(Carbofuran,Baygonandcarbaryl); General and classification of Organophosphorous pesticides, Organophosphates, phosphonates and thiophosphates (Parathion,TEPP,Schradan,Dimefox).	12	04		
3	Oils and Fats: General idea, Classification, Occurrence, Basic idea of the function of oils and fats, Physical and chemical properties of oils and fats, Applications of oils and fats. Significance of Iodine value, Saponification value.	12	04		
4	Soaps and Detergents: Idea of common soaps, Cleansing action of soaps, Varities of soaps and their uses, Idea of detergents, Hazards of soaps and detergents. Effect of sodium carbonate on the foaming capacity of soap.	12	04		
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Practicals:

Marks allotted for continuous assessment – 40
Marks allotted for Practical examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. R.Cremlyn:*Pesticides*,JohnWiley
2. MethodsofSamplingandTestforoilsandfats,I.S.I,NewDelhi
3. MethodsofSamplingandTestforsoapsanddetergents, I.S.I,NewDelhi

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	×	×		×				
CO:2		×		×				
CO:3		×		×				
CO:4		×		×				×
CO:5			×					

CourseTitle :Elementary Physical Chemistryw.e.f. 2026-27	Classification : Multi Disciplinary (MDC)
Class :B.Sc. Pt.-II/ Semester-III	Course Code : BCH25-MD301
Lecture:45	Total Credits:03
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1. Gain knowledge about atoms and molecules and their laws and concepts of writing formulae.
CO2. Understand the role of matter around us and study pure and impure substances present in nature.
CO3. Understand the fundamental concept of liquid state and their properties
CO4. Understand the fundamental concept of solid, gas state and their properties.
CO5: Study about the structure of the atom.

Units	Contents	L	T	P	Total Hours
1	Atoms and molecules:Definition, Laws of Chemical Combination, Writing chemical formulae	6	3		9
2	Matter Around us pure: Pure and impure substances, Elements and their types, Mixtures and their types, Solutions and its basic properties	6	3		9
3	Liquid State: Definition, Properties of liquid state Types of liquid state	6	3		9
4	Solid and Gas State:Definition, Properties of solid, gas state, Types of solid-state and gas state	6	3		9
5	Atomic Structure: Definition, Electrons, protons, and neutron study, Atomic Number, Atomic Mass, Isotopes and Isobars	6	3		9
	Total (in hrs)	30	15		45

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Lakhmir Singh, Manjit Kaur: Class 9th Chemistry, S. Chand Publication.
2. Puri Sharma Pathania: Principles of Physical Chemistry, Vishal Publications.
3. D.N Bajpai: Advanced Physical Chemistry, S. Chand Publications.
4. A S Negi, S C Anand: A textbook of Physical Chemistry, New age international publishers.
5. Dr. S.C. Kheterpal: Physical Chemistry, Pradeep's Publications.

CO-PO-PSO MAPPING

Course Outcomes/Programs outcomes	1	2	3	4	5	6	7	8
CO1	X	X	X	X				
CO2	X	X		X	X	X	X	
CO3	X	X		X	X			X
CO4	X	X	X	X	X		X	
CO5	X	X		X	X		X	

CourseTitle :Physical Chemistry-1I w.e.f. 2026-27	Classification : Major (MJ)
Class:B.Sc. Pt.-II/ Semester-IV	Course Code : BCH25-MJ402
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO:1Helpedstudentsinattainingbasicconceptswithabalancedknowledgeof*s*-andp-BlockElements
CO:2Created awarenessabout Transition Elements(3d series)
CO:3 Developed interest among students for Coordination Chemistryand its application
CO:4Upgradestudents'knowledgeaboutbasicconceptsof KineticTheoryofGases.
CO:5DevelopedandenhancedknowledgeabouttheintroductionUnderstandingtheviscosityandsurfacetensionvalues, as well asthe elementsthat influenceandapplytoliquids
CO:6Createdawarenessaboutthesolidstatestructure.
CO:7Createdtheunderstandchemicalkineticsinvestigationsformoleculeandconceptresearch
CO:8Created chemicalknowledgein chemical kinetics

UNITS	CONTENTS	L	T	P	Total Hours
1	**Solutions** Thermodynamics of ideal solutions: Ideal solutions and Raoult'slaw, deviations from Raoult'slaw – non-ideal solutions. Vapour pressure-composition and temperature-compositioncurvesofidealandnon-idealsolutions.Distillationofsolutions.Leverrule. Azeotropes. Partialmiscibilityofliquids:Criticalsolutiontemperature;effectofimpurityonpartial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solventextraction.	09	3		12
2	**Phase Equilibrium** Phases,componentsanddegreesoffreedomofasystem,criteriaofphaseequilibrium. GibbsPhaseRuleanditsthermodynamicderivation.DerivationofClausius–Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems(waterandsulphur)andtwocomponentsystemsinvolvingeutectics,congruent and incongruentmelting points (lead-silver, KI-H_2O and Na-K only).	09	3		12
3	**Electrochemical Cells and EMF** Reversible and Irreversible Cells Concept and Measurement of EMF of a Cell. Nernst Equation and Its Importance. Types of Electrodes. Standard Electrode Potential and Electrochemical Series	09	3		12
4	**Thermodynamics and Equilibrium in Electrochemistry** Thermodynamics of a Reversible CellCalculation of Thermodynamic Properties (ΔG, ΔH, ΔS) from EMF DataCalculation of Equilibrium Constant from EMF DataConcentration Cells Without TransferenceLiquid Junction Potential and Salt Bridge	09	3		12
5	**Conductance** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independentmigration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications ofconductancemeasurements: determination of degree of ionization of weak electrolyte, solubility and solubility productsofsparinglysolublesalts,ionicproductofwater,hydrolysisconstantofasalt. Conductometrictitrations (only acid-base).	09	3		12
	Total Theory (Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:
Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. G. M. Barrow: *Physical Chemistry* Tata McGraw--Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Ed. Narosa (2004).
3. J. C. Kotz, P. M. Treichel, J. R. Townsend, *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. B. H. Mahan: *University Chemistry*, 3rd Edn. Narosa (1998).
5. R. H. Petrucci, *GeneralChemistry*, 5th Edn., Macmillan Publishing Co.: New York (1985).

6. Morrison,R.T.&Boyd,R.N.*OrganicChemistry*,DorlingKindersley(India) Pvt. Ltd. (Pearson Education).
7. Finar,I.L.*OrganicChemistry*(*Volume1*),DorlingKindersley(India)Pvt.Ltd.
(Pearson Education).
8. Finar,I.L.*OrganicChemistry*(*Volume2)*,DorlingKindersley(India)Pvt.Ltd.
a. (Pearson Education).
9. Nelson,D.L.&Cox,M.M.*Lehninger'sPrinciplesofBioch*emistry*7th Ed.,*W. H. Freeman.
10. Berg, J. M., Tymoczko, J. L. &Stryer, L. *Biochemistry 7th Ed.,* W. H. Freeman
11. V.K. Goyal, R.L. Pitaliya, O.P. verma , R.K. Upadhyay. Physical chemistry , CBH publication

CO-PO-PSO MAPPING

CourseOutcomes/Programoutcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	X				X			X
CO:2				X				X
CO:3	X		X					
CO:4		X		X			X	
CO:5				X				X
CO:6	X				X			
CO:7		X	X				X	
CO:8						X		

CourseTitle :Lab Course-IVAw.e.f. 2026-27	Classification : Major (MJ)
Class:B.Sc. Pt.-II/ Semester-IV	Course Code : BCH25-MJ451
Lecture:120	Total Credits:04
MM:100	ExamHrs: 04

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic idea of Semi-microqualitativeanalysis.
CO2: To understand the concept of analysis of cations and anions.
CO3: Classify different cations and anions
CO4: Understanding concept of surface tension, viscosity and kinetics
CO5: Compare theories pertaining to surface tension and viscosity with practical approach.
CO6: To understand the kinetics of process.

UNITS	CONTENTS	L	T	P	Total Hours
1 2 3 4 5 6 7	**List of Experiments:** Systematic Qualitative Organic Analysis ofOrganic Compounds possessing monofunctionalgroups(-COOH,phenolic,aldehydic,ketonic,amide,nitro,amines)and preparation of one derivative. Separation of amino acids by paper chromatography Determination of theconcentration of glycine solution by formylation method. Titration curve of glycine Action of salivary amylase on starch Effect of temperature on theaction of salivary amylase on starch. Differentiation between a reducing/nonreducing sugar			120	120
	Practical (Hrs.)			120	120

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for Practical examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X	X			X		X	
CO:2	X	X		X	X			
CO:3	X	X						X
CO:4	X	X						
CO:5	X	X		X				
CO:6	X	X	X					

CourseTitle: Lab Course-IVBw.e.f. 2026-27	Classification : Major (MJ)
Class:B.Sc. Pt.-II/ Semester-IV	Course Code : BCH25-MJ452
Lecture:120	Total Credits:04
MM:100	ExamHrs: 04

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Analyse the quality of water in terms of DO, COD, BOD etc.
CO2: Analyse the acidity and alkalinity of water.
CO3: Study of air pollutants and SPM.
CO4: Preparation of industrial products.
CO5: Compare available chlorine in bleaching powder samples.

UNITS	CONTENTS	L	T	P	Total Hours
	1. Percentage of available chlorine in bleaching powder. 2. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate). 3. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method. 4. Measurement of dissolved CO_2. 5. Study of some of the common bio-indicators of pollution. 6. Preparation of buffers (acidic and basic) and determination of pH of water samples. 7. Determination of total solids and volatile solids of water sampkles. 8. Determination of rate constant of first order reactions.				
	Practical (Hrs.)			120	120

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for Practical examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis HorwoodLtd. UK.
2. R.M. Felder, R.W. Rousseau: *ElementaryPrinciples ofChemicalProcesses*, Wiley Publishers, New Delhi.
3. J. A. Kent:Riegel's*Handbook of Industrial Chemistry*, CBS Publishers, New
   a. Delhi.
4. S. S. Dara: *A TextbookofEngineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age InternationalPvt., Ltd, New Delhi.
6. S. M. Khopkar, *EnvironmentalPollutionAnalysis*:WileyEastern Ltd, New Delhi.

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X	X			X		X	
CO:2	X	X		X	X			
CO:3	X	X						X
CO:4	X	X						
CO:5	X	X		X				

CourseTitle :Basic Inorganic Chemistry w.e.f. 2026-27	Classification : Minor (MI)
Class:B.Sc. Pt.-II/ Semester-IV	Course Code : BCH25-MI401
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Understand the basic idea of atomic structure, quantum numbers.

CO2: To understand the concept of quantum numbers and rules for filling electrons in various orbitals.

CO3: Classify different concepts involved in ionic bonding

CO4: Compare theories pertaining to covalent bonding like VB approach& VSEPR theory.

CO5: Understanding resonance & basic idea of MO approach.

1	Basic structure of atom, Theories related to the atomic structure: Dalton's atomic theory, Rutherford' model, Bohr's model, Concept of Atomic symbol, Atomic number, Atomic mass and Mole concept	10	2		12
2	Significance of quantum numbers, Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy.	10	2		12
3	*Ionic Bonding:* General characteristics of ionic bonding, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan'srules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.	10	2		12
4	*Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions based on VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.	10	2		12
5	MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	10	2		12
	Total (Hrs)	50	10		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Theory:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, EL. B. S.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiterand Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
5. ArunBahland B. S. Bahl: *Advanced Physical Chemistry,* S. Chand Puri, Sharma, Kalia, Principles of Inorganic chemistry, Vishal Publications.
6. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
7. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.

CO-PO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	**X**	**X**			**X**		**X**	
CO:2	**X**	**X**		**X**	**X**			
CO:3	**X**	**X**						**X**
CO:4	**X**	**X**						
CO:5	**X**	**X**		**X**				

CourseTitle :Organic Chemistry-III w.e.f. 2027-28	Classification : Major (MJ)
Class:B.Sc. Pt.-III/ Semester-V	Course Code : BCH25-MJ501
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Give information about functional group and carboxylic acid

CO2: Acquire Knowledge about synthesis and reaction of Carboxylic acid derivatives

CO3: To understand the concept of amines and benzene diazonium salts: Synthesis and its rolein various organic conversion

CO4: Various process for Amino Acids, Peptides and Proteins

CO5: Different type of Carbohydrates: structure and Mutarotation

UNITS	CONTENTS	L	T	P	Total Hours
1	Functional group approach for the following reactions (preparations &reactions) to be studied in context to their structure. Mono Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction.	09	3		12
2	Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity ofacyl derivatives. Reformatsky Reaction, Perkin condensation.	09	3		12
3	**Amines and Diazonium Salts** AliphaticAmines (Upto 5 carbons), Aromatic Amines *Preparation*:fromalkylhalides,Gabriel'sPhthalimidesynthesis,HofmannBromamide reaction. *Reactions:* Hofmann vs. Saytzeffelimination, Carbylaminetest, Hinsbergtest, with HNO_2,Schotten–BaumannReaction.Electrophilicsubstitution(caseaniline):nitration, bromination, sulphonation. **Benzene Diazonium salts**: *Preparation:* fromaromaticamines.*Reactions:* conversion to benzene, phenol, dyes.	09	3		12
4	Amino Acids, Peptides and Proteins: PreparationofAminoAcids:Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric pointand Electrophoresis.Reactions of Amino acids: ester of –COOH group, acetylation of –NH_2group, complexation with Cu^{2+}ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Introduction to peptide & polypeptide, relationship with proteins	09	3		12
5	**Carbohydrates**: Classification, and General Properties, Glucose and Fructose (open chainandcyclicstructure),DeterminationofconfigurationofGlucose, Mutarotation,Osazone formation. Drawing the Structure onlyof disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structureelucidation.	09	3		12
	Total Theory (Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. R. H. Petrucci, GeneralChemistry, 5th Edn., Macmillan Publishing Co.: NewYork (1985).
2. Morrison,R.T.&Boyd,R.N.OrganicChemistry,DorlingKindersley(India) Pvt. Ltd. (Pearson Education).
3. Finar,I.L.OrganicChemistry(Volume1),DorlingKindersley(India)Pvt.Ltd.
4. (Pearson Education).
5. Finar,I.L.OrganicChemistry(Volume2),DorlingKindersley(India)Pvt.Ltd.
6. (Pearson Education).
7. Nelson,D.L.&Cox,M.M.Lehninger'sPrinciplesofBiochemistry7thEd.,W. H. Freeman.
8. Berg, J. M., Tymoczko, J. L. &Stryer, L. Biochemistry 7thEd., W. H. Freeman

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1		X			X		X	
CO:2	X		X	X	X			
CO:3		X				X		X
CO:4					X			
CO:5	X	X		X	X	X		
CO:6	X	X	X					

CourseTitle :Physical Chemistry- III w.e.f. 2027-28	Classification : Major (MJ)
Class:B.Sc. Pt.-III/ Semester-V	Course Code : BCH25-MJ503
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

On successful completion of the course with General Physical Chemistry, the student will be able to:
CO1: Understand the laws and principles to know the behavior of gases.
CO2: Able to know reasons behind the different molecular motions.
CO3: Grasp the Properties of liquids, their determination and effect of temperature on them.
CO4: Understands about crystal tics and laws related to it.
CO5: Understand the basic principles of Kinetics.

UNIT	Contents	L	T	P	Total Hours
1	**Kinetic Theory of Gases:** Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from vander Waals equation. Andrews's isotherms of CO_2.	09	3		12
2	**Molecular Motion and Distribution Laws:** Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.	09	3		12
3	**Liquids:** Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)	09	3		12
4	**Solids:** Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only).	09	3		12
5	**Kinetics:** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of orders. Arrhenius equation; activation energy. Collision theory of reaction rates,	09	3		12
	Total (Hrs)	45	15		60

L: Lectures T: TutorialsP: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. G. M. Barrow: *Physical Chemistry* Tata McGraw--Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J.C.Kotz,P.M.Treichel&J.R.Townsend:*General Chemistry*CengageLening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R.H.Petrucci:*GeneralChemistry*5thEd.MacmillanPublishingCo.:NewYork(1985).
6. J. D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
7. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry,* John Wiley.
8. D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
9. Gary Wulfsberg: *Inorganic Chemistry,* Viva Books Pvt. Ltd.
10. V.K. Goyal, R.L. Pitaliya, O.P. verma , R.K. Upadhyay. Physical chemistry , CBH publication

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X				X		X	
CO:2	X	X	X	X	X			X
CO:3		X	X			X		X
CO:4		X	X					
CO:5	X	X		X			X	

Class:B.Sc. Pt.-III/ Semester-V	Course Code : BCH25-MJ551
Lecture:120	Total Credits:04
MM:100	ExamHrs: 04

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1: To illustrate the Elevation of B.P., different type of Adsorption

CO2: To understand the Rate of Reaction, Rate Constant, Molecularity and order of reaction. Methods for determination of Rate of reaction. Different type of Heat changes.

UNITS	CONTENTS	L	T	P	Total Hours
	Hands On Experiments in: **(A) Physical Chemistry:** **List of** Experiments related to following techniques: (1) Ebullioscopy a) Determination of molecular weight of non-volatile substance by Landsberger method. (2) Adsorption a) To investigate the adsorption of the oxalic acid by activated charcoal. b) To prove the validity of Freundlich and Langmuir's adsorption isotherm. (3) Chemical Kinetics a) To study the kinetics of hydrolysis of an ester and find out the 1st order rate constant by kinetics equation and graphical method both at room temperature. b) To determine the relative strength of two acids by studying the hydrolysis of an ester. **(B) Inorganic Chemistry** (a) Preparation of the following complexes and determination of their composition by volumetric and Gravimetric techniques: (i) Nickle complexes with ethylene diammine and mono ordiketones. (ii) Cobalt Pentammine Chloride. $[Co(NH_3)_5\ Cl]Cl_2$ (b) Volumetric Analysis 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with $KMnO_4$. 3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$. 4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$using internal indicator. 5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.			120	120
	Practical (Hrs.)			120	120

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS :

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1		X	X		X			X
CO 2				X	X		X	X

CourseTitle :Basic Physical Chemistryw.e.f. 2027-28	Classification : Minor (MI)
Class:B.Sc. Pt.-III/ Semester-V	Course Code : BCH25-MI501
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Explain the various Laws of Thermodynamics.

CO2: Understand the important principles and definitions of thermochemistry.

CO3: Understand theVariation of enthalpy of a reaction with temperature.

CO4: Idea of Chemical Equilibrium Free energy change in a chemical reaction

CO5: Idea of Ionic Equilibria and pH scale for acids and bases.

CO6: To know about Buffer solutions. Solubility and solubility product and solve numerical probulems.

UNITS	CONTENTS	L	T	P	Total Hours
1	Chemical Energetics Review of thermodynamics and First and Second law of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, enthalpy of solution and enthalpy of dolution.	09	3		12
2	Solutions: Different types of solutions (Saturated solution, Unsaturated solution, Supersaturated solution). Homogenous solution, Heterogenous solution (True solution, Colloidal solution Suspension). Expression of concentration of solutions viz: Molarity, Normality, Molality and Mole fraction. Ideal and non-ideal solutions	09	3		12
3	Conductance Concept of conductance, electrolytes, specific conductance, equivalent conductance and Molar conductance, effect of dilution on specific conductance, equivalent conductance and Molar conductance. Kohlrausch's law, weak and strong electrolytes.	09	3		12
4	Ionic Equilibria: Strong,moderate and weakelectrolytes, degreeofionization, factors affecting degree of ionization, ionization constantand ionic product of water. Ionization of weak acids and bases, pHscale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts	09	3		12
5	Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Numerical question based on Solubility and solubility product.	09	3		12
	Total (in hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. G. M. Barrow: *Physical Chemistry* Tata McGraw--Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J.C. Kotz, P.M. Treichel &J.R. Townsend: *General Chemistry* Cengage Lening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R.H.Petrucci:*GeneralChemistry*5thEd.MacmillanPublishingCo.:New York, (1985).

CO-PO-PSO MAPPING

Course Outcomes/Programs outcomes	1	2	3	4	5	6	7	8
CO1	X	X	X	X				

CO2	X	X		X	X	X	X	
CO3	X	X		X	X			X
CO4	X	X	X	X	X		X	
CO5	X	X		X	X		X	

CourseTitle :Physical Chemistry- IVw.e.f. 2027-28	**Classification : Major (MJ)**
Class:B.Sc. Pt.-III/ Semester-VI	**Course Code : BCH25-MJ601**
Lecture:60	**Total Credits:04**
MM:100	**ExamHrs: 02**

Course Outcomes (COs):

On successful completion of the course with General Physical Chemistry, the student will be able to:

CO1: Comprehend the principles of chemical kinetics, including the derivation and application of rate laws, and analyze factors affecting reaction rates.

CO2: Understand the behavior of complex reactions, including parallel, consecutive, and reversible reactions, and evaluate the impact of salt and solvent effects on these processes.

CO3: Use linear free energy relationships to connect reaction kinetics and thermodynamics and predict reaction outcomes using Hammett and Taft equations.

CO4: Understand the mechanisms of catalysis, including homogeneous, heterogeneous, and enzymatic processes, and recognize their significance in chemical and biological systems.

CO5: Grasp the fundamentals of photophysical and photochemical processes and apply these principles to analyze photochemical reactions and their applications.

CO6: Understand the synthesis, structure, and behavior of macromolecules, including their physical properties and relevance in various scientific and industrial applications.

UNITS	Contents of Theory Course	L	T	P	Total Hours
1	**Chemical Kinetics- I:** Derivation of IIIrd order kinetic equation, collision theory for uni, bi and termolecular reactions, Steric factor, Theory of absolute reaction rates, Entropy of activation. Experimental techniques for the study of kinetics of slow and fast reactions. Potential energy surfaces (two-dimentional and 3-dimentional diagrams), P.E. surface for $H + H_2$ reaction, Concept of COL and Contour diagram.	09	3		12
2	**Chemical Kinetics- II:** Opposing, Consecutive, Side and Induced reactions, Induction period. Chain reactions and explosion limits. Reactions in solution, Factors affecting the rates in solutions, effect of solvation and Internal pressures, Double and Single sphere models, Effect of ionic strength, Bronsted-Bjerrum equation, Numerical Problems.	09	3		12
3	**Linear Free Energy Relationships:** Effect of substituents on reaction rates, Basic idea of linear free energy relationships particularly Hammett, Taft, Brown and Okamoto, Sekigawa and Van - Bakkum plots (Introductory treatment only).	09	3		12
4	**Catalysis and Photochemistry:** Acid- Base catalysis, Acidity function, Enzyme - catalysis, Michaelis-Menten equation. **Photochemistry:** Jabolinskii diagram, fluorescence, phosphorescence, chemiluminiscence and photosensitization, photophysical kinetics of unimolecular process.	09	3		12
5	**Macromolecules:** Explaining the terms Isotactic, Atactic, Syndiotactic, Copolymers, Block copolymers, Linear, Branched and Cross linked polymers, Addition and condensation polymerisation. Degree of polymerisation and length of polymer chains. Requirement of purity for synthesis. Molecular weights and their distribution. Polydispersity. Determination of molecular weight by Osmotic pressure, Viscosity, light scattering and sedimentation equilibrium methods.	09	3		12
	Total (in hrs)	45	15		60

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS :

1. Chemical Kinetics by: K.J. Laidler
2. Enzyme Kinetics by: D.V. Roberts
3. Text book of Physical Chemistry by: S. Glasstone
4. Chemical Kinetics by: Ralphe Jr. Westron and A.S. Harold
5. Physical Chemistry by: G.M. Barrow
6. Physical Chemistry by: G.W. Castellan
7. Introductory Polymer Chemistry by: G.S. Misra

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X	X	X					X

CO:2			X	X				X
CO:3				X	X	X		
CO:4	X				X		X	
CO:5								
CO:6								

CourseTitle :Lab Course - Vw.e.f. 2025-26	**Classification : Major (MJ)**

Course Outcomes (COs):

CourseTitle :Inorganic Chemistry-1II w.e.f. 2027-28	**Classification : Major (MJ)**
Class:B.Sc. Pt.-III/ Semester-VI	**Course Code : BCH25-MJ602**
Lecture:60	**Total Credits:04**
MM:100	**ExamHrs: 02**

COURSE OUTCOMES (COs):

On successful completion of the course with industrialchemicalsand environment, the student will be able to:

CO1: Have basic knowledge of fission and fusion.

CO2: Gain knowledge about hazards and safety measures in the production and handling of industrial gases and inorganic chemicals

CO3: Understand the basic concepts of air pollution and various environmental factors that affect air pollution. Educated in various measurements and monitoring techniques of air pollution.

CO4: Understand the basic concepts of water pollution and various water purification methods. Educated in various measurements and monitoring techniques of industrial waste management.

CO5:Gain knowledge about the nuclear disaster and its management.

UNITS	Contents	L	T	P	Total Hours
1	**Industrial Gases and Inorganic Chemicals** Industrial Gases: Hazards and safety measuresin large scale production (excluding manufacturing process), uses and storage of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.	09	3		12
2	Inorganic Chemicals: Hazards and safety measures (excluding manufacturing process) in the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chromium, potassium dichromate, and potassium permanganate.	09	3		12
3	**Environment and its segments:** Ecosystems. Biogeochemical cycles of carbon, nitrogen, and sulphur. Air Pollution: Major regions of the atmosphere. Chemical and photochemical reactions in the atmosphere. Airpollutants:types,sources,particle size, andchemicalnature; Dust, Smoke, and particulates, smog andits constituents. Environmental effects of ozone. Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Instrumental methods of estimation of CO, NOx, Soxand control procedures. EffectsofairpollutiononlivingorganismsandvegetationGreenhouseeffectandGlobal warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur fromcoal. Control of particulates.	09	3		12
4	**WaterPollution:** Sources andnatureofwaterpollutants,Techniquesformeasuringwaterpollution,Impactsofwater pollution on hydrologicaland ecosystems. Waterpurificationmethods.Effluent treatment plants (primary, secondary and tertiary treatment).	09	3		12
5	Industrial effluents from the following industries and their treatment:electroplating,textile,tannery,dairy,petroleumandpetrochemicals,agro,fertilizer,etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification(reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.	09	3		12
	Total (in hrs)	45	15		60

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi
3. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

CO-PO-PSO MAPPING

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
CO:1	X				X		X	
CO:2	X	X	X	X	X			X
CO:3		X	X			X		X
CO:4		X	X					
CO:5	X	X		X			X	

CourseTitle :Lab Course - VIw.e.f. 2027-28	**Classification : Major (MJ)**
Class:B.Sc. Pt.-III/ Semester-VI	**Course Code : BCH25-MJ651**
Lecture:120	**Total Credits:04**
MM:100	**ExamHrs: 04**

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1: Develop the key practical skills in pH-metry, Conductometry.

CO 2: Recognize types of electrodes and determine when they should use each one. Learn pH meter and how does it work, including the functions of the parts of the sensor.

CO 3: Analyze drugs related to allopathic origin to establish their purity and their compatibility for human consumption.

UNITS	CONTENTS	L	T	P	Total Hours
	Hands On Experiments: **A. Experiments related to following techniques:** (1) CONDUCTOMETRY: i. Handling of conductometers and resistance meters. ii. To determine cell constant of given cell. iii. To determine the solubility of sparingly soluble salt in water. iv. To find out normality of given strong acid by conductometric titration. v. To find out normality of given weak acid by conductometric titration. (2) pH-METRY: i. Handling of pH meter. ii. Preparation of buffers from tablets as well as HCl,Na_2HPO_4,Citric acid, Acetic acid, Sodium Acetate, NaCl, H_3BO_3. iii. To determine pH of given solution by pH meter. iv. To determine strength of HCl solution by pH metric titration. v. To determine dissociation constant of given weak acid pH metrically. **B.** The experiments related to the qualitative and quantitative analysis of different Allopathic Drugs. **C.** Complexometric titrations using EDTA. **D.** Preparation of boric acid/borax.			120	120
	Practical (Hrs.)			120	120

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS :

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1		X	X		X			X
CO 2		X	X		X			X
CO 3		X	X	X	X	X		X

CourseTitle :Basic Organic Chemistryw.e.f. 2027-28	Classification : Minor (MI)
Class:B.Sc. Pt.-III/ Semester-VI	Course Code : BCH25-MI601
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Explain the various phenomenon's in organic molecules and their effect

CO2: Understand the .nature of organic reactions through reactive intermediates.

CO3: Stereo chemical behavior, isomerism and the applications in organic molecules in natural system.

CO4: Idea of synthesis and properties of commercially important alkanes

CO5: Idea of synthesis and properties of commercially important alkenes and their effects

CO6: To know about organic compounds, their nature and method of their identification.

UNITS	CONTENTS	L	T	P	Total Hours
1	**Organic Compounds:Introduction and effects** InductiveEffect,ElectromericEffect,Resonanceand.Cleavageof Bonds:Homolysisand Heterolysis. Nucleophilesandelectrophiles.	07	2		45
2	**ReactiveIntermediates:** Structure, stability and generation ofCarbocations,Carbanions andfreeradicals.	07	2		
3	**Isomerism** **Introduction,Types of isomerism** Conceptofchirality, Geometrical and Opticalisomerism; *cis - trans* nomenclature	07	2		
4	**AliphaticHydrocarbonsAlkanes:** Introduction, Nomenclature,Preparation and reactions,Wurtz reaction	07	2		
5	**Alkenes:** Introduction,Nomenclature,Preparation and properties of ethylene. Propylene,Saytzeff'srule and Markownikoff's rule	07	2		
	Total (in Hrs)	35	10		45
6,	**List of Experiments:** **1.** Preliminary examination of organic compound like solubility, ignition test, melting point determination, unsaturation test etc. **2.** Determination of functional groups (containing oxygen only) in organic compounds.	-	-	30	30
7.	**Total Theory & Practical (Hrs.)**				75

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient a. Longman.
3. E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
4. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
6. ArunBahland B. S. Bahl: *Advanced Organic Chemistry,* S. Chand
7. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
8. Practical Organic Chemistry, F. G. Mann. &B. C. Saunders, Orient Longman, 1960.

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1		X			X			X
CO:2	X			X	X			X
CO:3	X		X	X			X	
CO:4		X	X	X			X	
CO:5	X		X	X			X	X
CO6:	X	X	X					

CourseTitle :Project w.e.f. 2027-28	**Classification : (PR)**
Class:B.Sc. Pt.-III/ Semester-VI	**Course Code : BCH25-PR671**
Work Hours :60	**Total Credits:02**
MM:50	**ExamHrs: 02**

The student will undertake project work at Department of Chemistry, Gurukul Kangri(DU) under the supervision of a teaching staff member and submit the same for evaluation.

The student shall present the work before a panel of two examiners consisting of the supervisor concerned and an expert/examiner appointed by the University.

MODES OF SEMESTER ASSESSMENT:
Marks allotted for pre-submission presentation – 20
Marks allotted for End Semester presentation – 30
Maximum marks -50

CourseTitle :Inorganic Chemistry-IV w.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VII	Course Code : BCH25-MJ701
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: The application of theories like crystal field theory (CFT) and ligand field theory (LFT) to predict and explain the properties of metal complexes.

CO2: How to analyze and interpret UV-Vis spectra for complexes using spectrochemical series and d-d transitions.

CO3: Techniques to measure and interpret magnetic susceptibility and its application in determining spin states and oxidation states.

CO4: The application of group theory in determining molecular vibrations, spectra, and chemical bonding.

CO5: The importance of metal ions in biological processes, including their roles in metalloenzymes, electron transport, and catalysis.

CO6: The mechanisms of oxygen binding, release, and transport in metal-based oxygen carriers.

UNITS	CONTENTS	L	T	P	Total Hours
1	Coordination chemistry: Distortion in Complexes**,** Molecular orbital theory (M.O.T.) as applied to octahedral complexes, π - bonding in octahedral complexes, inert and labile complexes based on various theories, ligand substitution reaction in octahedral and square planar complexes, electron transfer reaction in coordination compounds.	9	3		12
2	Electronic spectra of complexes: Term symbols S,P,D,F, in a cubic field; splitting of term for d configuration; spectra of Transition metal complexes, selection rules and intensities of the transitions, nature of Electronic transitions in complexes, orgel energy level diagram, tanabe-sugano diagram. Calculation of Dq, B' and β for Cr III and Ni II complexes. Structural Evidence from Electronic spectra, charge-transfer spectra.	9	3		12
3	Magnetochemistry: Contribution of magnetic properties, Effect of the ligand field on spin-orbit coupling, measurement of magnetic properties, methods of magnetic susceptibility determination, temperature dependence of magnetism, application of magnetic data.	9	3		12
4	Molecular symmetry: Symmetry elements, Symmetry operations, and point groups, Character Tables(C_{2V}), and applications.	9	3		12
5	Oxygen carriers: Hemoglobin; non-porphyrin and porphyrin oxygen carriers, synthetic oxygen carriers. Recent trends in Nitrogen fixation, photosynthesis PS- 1 & PS - 11, superoxide Dismutase.	9	3		12
	Total (in hrs)	45	15		60

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. Inorganic Chemistryby: James E. Huheey
2. Text Book of Inorganic chemistry by: Cotton and Wilkinson 5th Edition
3. Physical Methods in Inoganic Chemistry by: R.S.Drago
4. Selected Topics in Inorganic Chemistry by: Malik, Tuli & Madan
5. Bioinorganic and Supramolecular Chemistry by: A.K.Bhagi, G.R.Chatwal

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X		X					
CO2				X				X
CO3					X			
CO4	X						X	
CO5		X					X	
CO:6				X				X

CourseTitle :Organic Chemistry-IV w.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VII	Course Code : BCH25-MJ702
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1: Understand the different organic reactions and their mechanism.
CO 2: Familiarize the various types of substitution reaction and their mechanism.
CO 3: Learn the concept of Reaction Intermediates.
CO 4: Explain the pericyclic reactions and its classification.
CO 5: Describe the versatile knowledge of rearrangements.

UNIT	CONTENT	L	T	P	Total Hours
1	**Organic reaction and mechanism** **(a) Substitution or Displacement Reactions:** Introduction of Nucleophilic and electrophilic substitutions with mechanism (SN and SE), Halogenation, Nitration, Sulphonation, Friedel-Craft reactions, Reimer-Tiemann reaction. **(b) Addition Reactions**: Introduction of Electrophilic and nucleophilic additions with mechanism, Michael addition, aldol, Perkin, Cannizaro reaction.	09	3		12
2	**Reaction Intermediates:** Carbocations, carbanions, free radicals, Nitrenes and Benzyne their formation, stability and reactions. **Molecular rearrangements:** Introductionof different types of rearrangement reactions viz:electron deficient carbon, nitrogen and oxygen. Pinacol-pinacolone, Wagner-Meerwein, Hofman, Curtius, Beckmann rearrangements & Bayer-Villiger oxidation of ketones.	09	3		12
3	**Heterocyclic Compounds:** Aromaticity of heterocyclic compounds, synthetic methods and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis.	09	3		12
4	**Pericyclic reactions:** Classification of Pericyclic reactions**,** Selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts. Sommelet-Hauser, Cope and Claisen rearrangements, Ene reaction.	09	3		12
5	**Stereochemistry:** Optical activity and Optical isomerism, Racemic mixture, Resolution, R-S nomenclature. Geometrical isomerism in the compounds containing C = C and C = N bonds, elementary idea of geometrical isomerism in cyclic compounds. E-Z nomenclature. Asymmetric induction, prochiral relationships.	09	3		12
	Total	45	15		60

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Organic Chemistry by: Boyd and Morrison
2. Organic Chemistry by: I.L.Finar
3. Organic Chemistry by: Kapoor, Singh and Mukherjee
4. Organic Chemistry by: Bruice
5. Organic Chemistry by: Pine
6. A Guide Book to Organic Reaction Mechanism by: Peter Sykes

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1	X				X		X	X
CO 2	X		X		X		X	X
CO 3	X						X	X
CO 4	X		X				X	X
CO 5	X				X		X	X

CourseTitle :Research Ethics and Methodology w.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VII	Course Code : BCH25-MJ703
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: Students will gain a solid understanding of research concepts, types, and methodologies.

CO2: Students will develop skills in conducting literature surveys, critically evaluating sources, and synthesizing findings to identify research gaps and inform the development of research questions.

CO3: Students will comprehend the ethical principles of scientific conduct and research integrity.

CO4: Students will acquire knowledge of publication ethics, including the responsibilities of authorship, peer review, and conflict of interest management.

CO5: Students will understand the key research databases and citation metrics enabling them to effectively navigate and utilize these tools for tracking research impact and citation analysis.

CO6: Students will be able to produce good quality research dissertations, demonstrating proficiency in topic selection, research design, data collection, writing, referencing, and revision.

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Research -What is Research?: Definition of research, types of research, and the role of research in society -Basic research methods: Qualitative vs. quantitative research -Importance of research in academic and professional contexts	6	2		8
2	Literature survey -What is literature survey -Finding and Selecting Relevant Literature Reading and Analyzing Literature Writing the Literature Review	9	3		12
3	Scientific Conduct and Research Integrity -Ethics in science and research - Intellectual honesty and research integrity - Scientific misconducts: falsification, fabrication, and plagiarism (FFP)	6	2		8
4	Publication Ethics -Publication ethics: definition and importance -Best practices and guidelines -Conflicts of interest in publication -Authorship, contributorship, and violation of publication ethics	6	2		8
5	Research Databases and Metrics -Indexing databases and citation databases (Google Scholarand Open Access Resources.) -Research metrics: Impact Factor, h-index	9	3		12
6	Writing a Dissertation -Choosing a research topic -Structure and components of a dissertation -Conducting research and data collection -Writing the dissertation: introduction, literature review, methodology, results -Referencing and citation practices -Editing and proofreading for submission	9	3		12
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2018). Research methods: A process of inquiry (10th ed.). Pearson Education.

2. Ary, D., Jacobs, L.C., Sorensen, C.K. and Walker, D. (2014) Introduction to Research in Education. 9th Edition, Wadsworth, London.

3. Wager, E. (2017). Publication ethics: A guide for authors. Wiley-Blackwell.
4. Bell, J. (2014). Doing your research project (6th ed.). McGraw-Hill Education.
5. American Psychological Association. (2020). Publication manual of the American Psychological Association (7th ed.). American Psychological Association.
6. Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). Sage Publications.
7. Kothari, C. R. (2019). Research Methodology: Methods and Techniques (4th ed.). New Age International Publishers
8. Kumar, R. (2019). Research Methodology: A Step-by-Step Guide for Beginners (4th ed.). Sage Publications India.

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	X	X			X		X	
CO2	X			X			X	
CO3			X	X	X		X	
CO4				X			X	
CO5				X				
CO6				X		X		X

CourseTitle :Lab Course - VIIw.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VII	Course Code : BCH25-MJ751
Lecture:120	Total Credits:04
MM:100	ExamHrs: 04

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1: Illustrate the preparation of inorganic complexes.

CO 2: Develop the skills to separate organic compounds from mixture by laboratory separation techniques and apply their applications in compound analysis

CO 4: Determine the amount of a reactant quantitatively using gravimetric procedure.

UNITS	CONTENTS	L	T	P	Total Hours
	Hands On Experiments **A. Inorganic Chemistry:** (a) Gravimetric analysis of two metal ions given in a mixture. (b) Qualitative Inorganic Chemistry Semi-microqualitativeanalysisusingH2Sofmixtures-notmorethanfourionicspecies(two anions and two cations and excluding insoluble salts) out of the following: Cations:NH_4^+,Pb^{2+},Ag^+,Bi^{3+},Cu^{2+},Cd^{2+},Sn^{2+},Fe^{3+},Al^{3+},Co^{2+},Cr^{3+},Ni^{2+},Mn^{2+},Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^- *(Spottests should be carried out wherever feasible)* **B. Organic Chemistry:** (a) Separation and identification of organic compounds in a given binary mixture. (b) Preparations of the organic compounds involving few reactions like: oxidation, reduction, hydrolysis, nitration, azotization etc. (c) Estimation of: (i) Carboxylic group. (ii) Glycine (iii)Glucose.			120	120
	Practical (Hrs.)			120	120

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS :

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1		X	X					X
CO 2		X	X		X			X
CO 3		X			X			X

CourseTitle :Computers and its Applications in Chemistryw.e.f. 2025-26	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VII	Course Code : BCH25-MJ704
Lecture:30	Total Credits:02
MM:50	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO:1 The computers and its different parts.

CO:2 The programming languages especially C-Language

CO:3 The applications of computers in chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
1	**Introduction to Computers:** Block diagram of computers; Input and output devices-key board, mouse, scanner, VDU, plotter, Types of printers; Primary & secondary memory - RAM, ROM, Secondary Memory devices-Hard Disk, CD, Flash Drive and Memory card; Volatile and non-volatile memory; CPU - ALU and control unit; Hardware & software, Software - system software and application software.	6	2		8
2	**C Programming:**Introduction; Style of C language; Character set; keywords, data types, variables and constants in C; Operators-Arithmetic, Relational, Logical, Input and output statements in C language.	9	3		12
3	**Computer applications in Physical and Analytical Chemistry:** Listing the C- program for the following: Determination of rate constant of first order reactions, determination of rate constant for second order reactions, Determination of Normality and Molarity of solutions, Determination of concentration using Beer- Lambert's law.	6	2		8
4	**Computer applications in Inorganic and Organic Chemistry:** Listing the C-program for the following: Determination of half-life and average life of a radioactive nucleus, Determination of molecular weights of organic compounds, Determination of molecular weights of organic compounds by Cryoscopic and ebullioscopic method.	6	2		8
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

Suggested Readings:

1. **Fundamentals of computer by V. Rajaraman**
2. **Programming in C (Schaum series outline) by Gotterfried.**
3. **"Computers in Chemistry" by K.V. Raman**
4. **Application of Computers in Modern Chemical Analysis by R.K.Shukla**
5. **Computer fundamentals and programming in C by Reema Thareja (2nd Edition)**

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X	X			X		X	
CO2	X			X			X	
CO3			X	X	X		X	

CourseTitle :Project w.e.f. 2028-29	**Classification : PR (Only for B.Sc. Hons. With Research Students)**
Class:B.Sc. Pt.-IV/ Semester-VII	**Course Code : BCH25-PR771**
Work Hours :60	**Total Credits:02**
MM:50	**ExamHrs: 02**

The student will undertake project work at Department of Chemistry, Gurukul Kangri (DU) under the supervision of a teaching staff member and submit the same for evaluation.

The student shall present the work before a panel of two examiners consisting of the supervisor concerned and an expert/examiner appointed by the University.

MODES OF SEMESTER ASSESSMENT:
Marks allotted for pre-submission presentation – 20
Marks allotted for End Semester presentation – 30
Maximum marks -50

CourseTitle :Inorganic Chemistry-V w.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VIII	Course Code : BCH25-MJ801
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1: Categorize units of radioactivity on the basis of their practical utility. At the same time acquaintance to apparatus for detection and measurement of radioactivity enhancing the knowledge in the field of nuclear chemistry.

CO 2: Understand the principle Recognize all components of the following instruments: ESR spectrophotometer, Atomic Absorption spectrophotometer, Nephelo-turbidimeter and inductively coupled plasma and interpret data from them.

CO 3: Know the capability and disadvantages of above mentioned techniques so as to be able to choose the most suitable technique, and optimize the conditions for sample. The analytical thinking ability gets feed by studying various spectroscopic techniques.

UNIT	CONTENT	L	T	P	Total Hours
1	**Interaction of radiation with matter:** Units of Radioactivity (Ci, Ru, Bq, Specific activity), units of radiation energy (rad, Gray,Röntgen, RDE, REM, Sievert),Measurements of activity, Geiger Muller counter, Proportional and scintillation counters.	09	3		12
2	Fundamentals of ESR spectrum, E.S.R. spectra of transition metal complexes, Instrumentation and application of E.S.R. spectroscopy.	09	3		12
3	Principle, instrumentation and applications of atomic absorption spectroscopy and atomic emission spectroscopy, flame photometric methods of estimation of alkali and alkaline metals.	09	3		12
4	Principle, instrumentation and applications of Nephelometry and Turbidimetry.	09	3		12
5	**Inductively coupled plasma:** Principle, Technique, Instrumentation and Applications. Analysis of mineralogical samples, Analysis of water, Applications in biological systems.	09	3		12
	Total	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Instrumental Methods of Chemical Analysis by: G.W.Ewing, Mc Graw Hill Book Company
2. A Text book of Quantitative Inorganic Analysis by: A.I.Vogel
3. Inorganic Thermogravimetric Analysis by: Duval
4. Modern Methods of Chemical Analysis by: R.L.Pecsok and L.D.Shields
5. Thermal Analysis by: Antonin Blazek

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1	X		X		X	X		X
CO 2	X		X		X		X	X
CO 3			X		X		X	X

CourseTitle :Organic Chemistry Vw.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VIII	Course Code : BCH25-MJ802
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSEOUTCOMES:

Oncompletionofthiscourse, studentshallbeableto:

CO1:RecognizethebasicconceptofElectronicandI.R.spectroscopy.
CO 2: To understand the valuable concept of NMR spectroscopy for structure elucidation of molecules
CO3: To learn theknowledgeabout Mass spectrometrytechnique.
CO 4: Explain the application of XRD, SEM and TEM techniques.
CO 5: Predictthe structure of unknownmolecule byusingdifferentspectral data.

UNITS	CONTENTS	L	T	P	Total Hours
1	**UV-Vis Spectroscopy:** Electromagnetic spectrum, electronic band spectra (UV and Vis region), laws ofabsorption (Beer's-Lambert law), molar extinction coefficient. Types of electronic transitions, Elementaryideaofchromophores,auxochromes,bathochromicandhypsochromicshifts,hyperchromicandhypochromic effects, Instrumentations and technique of UV-VIS Spectroscopy, Woodward-Fieser rules,solvent effects on π-π* and n- π* transitions, steric hinderance and coplanarity, Applications of UV-VISspectroscopy.	09	03		12
2	**IR spectroscopy:** Vibrational rotational spectra- Principle, absorption of infrared radiation & molecularvibration-rotations. Fundamental vibration, overtones and combination tones.finger print region, infraredvibration - active and forbidden (selection rules). Instrumentation, factors affecting vibrational frequencies,spectralstudyofdifferentfunctionalgroups.	09	03		12
3	**NMRspectroscopy:** H^1-NMR;Basicconcept,instrumentation,FTNMR,chemicalshift,shielding&deshielding, homotopic and diasteriotopic protons,spin-spin coupling, coupling constant, AX and AX_2type spectra, spin decoupling, lanthanide shift reagents.	09	03		12
4	**Mass spectrometry:** Basic principle, fragmentation pattern of major functional groups, instrumentation,Mclaffertyrearrangement,metastableions,retroDiels-Alderreaction,generalapplications.	09	03		12
5	Ideaofrotationalspectrum. C^{13}-NMR spectroscopy, off-resonance decoupling.Applications Problemspertainingtothestructureelucidationoforganiccompoundsusing UV-Vis., IR, Mass andNMRspectroscopictechniques.	09	03		12
	Total Theory (Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SuggestedReadings:

1. Spectroscopyby:C. J.Benwell
2. SpectroscopicIdentificationofOrganicCompoundsby:Silverstein,Bassler,Morrill
3. OrganicChemistryby:Kapoor,Singh,and Mukherjee
4. OrganicChemistryby:BoydandMorrison
5. Organic Spectroscopyby: W. Kemp
6. OrganicSpectroscopyby:Jagmohan

CO-PO-PSO MAPPING

Courseoutcomes/ Programmeoutcomes	1	2	3	4	5	6	7	8
CO1	X	X	X				X	X
CO2	X	X	X		X		X	X
CO3	X	X	X				X	X
CO4		X	X				X	X
CO 5								

CourseTitle :Physical Chemistry-V w.e.f. 2028-29	Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VIII	Course Code : BCH25-MJ803
Lecture:60	Total Credits:04
MM:100	ExamHrs: 02

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1: To discuss about the accuracy, precision, errors, significant figures and criteria about the rejeton of data.
CO2:To describe signal to noise ratio, sensitivity and detection limit and FT in emission spectroscopy
CO3:To understand the concept of polarization, overvoltage and polarographic technique in analysis in qualitative and quantitative analysis.
CO4: Familiar with ion exchange and solvent extraction technique for the analysis of various samples of daily use.
CO5: Able to gain knowledge of basic principle, technique and applications of conductometric, potentiometric and pH-metric titrations.
CO6: To explain principle, experimental technique and simple and general applications of paper, column, thin layer, gas solid, gas liquid and high performance liquid chromatography.

UNITS	CONTENTS	L	T	P	Total Hours
1	**Treatment of Data in Quantitative Analysis :** Accuracy, Precision, Methods for expressing the accuracy and precision, Standard deviation, Types of errors, Elimination and minimization of errors, Significant figures, Criterion for the rejection of data.	09	3		12
2	Elementary idea of signal to noise ratio, Sensitivity and detection limits, Types and sources of noise (Thermal, shot, Flicker and Environmental noise). Eliminations/Minimization of noise, Basic idea and applications of Fourier transformation.	09	3		12
3	**Polarisation and Overvoltage**: Theories of Hydrogen overvoltage, Ilkovic equation, d.m.e., Half wave potential, Diffusion current, Polarography and its simple and general applications.(Specific applications not required) **Ion Exchange:** Cation and Anion exchangers, their Stability, Selectivity and Characteristics, General applications including Ion Exchange Chromatography.	09	3		12
4	Theory, technique and applications of Conductometric, Potentiometric and pH- metric titrations. Solvent Extraction: Principles, Techniques and applications.	09	3		12
5	**Chromatographic Techniques :**Basic principles, Experimental techniques, Simple and general applications of Column, Paper, Thin layer, Gas-solid, Gas- liquid and High-Performance Liquid Chromatography (excluding specific applications).	09	3		12
	Total (in hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. Instrumental Methods of Analysis by: Willard Merit, Dean and Seatle
2. Instrumental Methods of Chemical Analysis by: G. W. Ewing
3. Text book Physical Chemistry by: S. Glasstone
4. Hand Book of Chromatography for Chemists and Engineers by: M. K. Shingari
5. Analytical Chemistry by: I. M. Kolthoff
6. Quantitative Analysis by: Vogel
7. Qualitative Analysis by: Vogel
8. Mathematics and Statistics for Chemists by: C. J. Brooks, I. G. Betteley and S. M. Lexsten
9. Molecular Spectroscopy by: C. J. Benwell

CO-PO-PSO MAPPING

	1	2	3	4	5	6	7	8
CO:1	X				X		X	
CO:2	X	X	X	X	X			X
CO:3		X	X					X
CO:4		X	X					
CO:5	X	X		X			X	
CO:6								

CourseTitle :Basics of Phytochemistry w.e.f. 2028-29 Classification : Major (MJ)
Class:B.Sc. Pt.-IV/ Semester-VIII Course Code : BCH25-MJ804
Lecture:30 Total Credits:02
MM:50 ExamHrs: 02

COURSE OBJECTIVES:

1. **Classification and Constituents of Crude Drugs**
2. **Extraction processes of Phytochemicals**
3. **Isolation of Phytochemicals and Ayurvedic drugs**

UNIT	CONTENTS	L	T	P	Total Hours
1.	**Phytochemistry (Defintion), Phytochemicals and their working in human systems. Classification and Constituents of Crude Drugs: Brief and introductory idea of drug constituents and their Morphological, Chemical and Pharmacological classification.**	08	04		12
2	**Extraction Processes of phytochemicals: Maceration, Digestion, Decoction and Soxhlet Extraction technique.Isolation and separation by using various Chromatographic techniques.**	07	04		11
3	**Isolation method of some phytochemicals: especially Nicotine from tobacco, starch from potato, Caffeine from Tealeaves, Piperine from black piper and curcumine from turmeric.**	08	04		12
4	**Ayurvedic Drugs and Herbal medicines: General idea of Single and compounded Ayurvedic/Herbal medicines with examples. Qualitative chemical analysis of alkaloids and carbohydrates.**	07	03		10
	Total	30	15		45

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:
Marks allotted for continous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS:

1. History of Hindu Chemistry by: P. C. Ray
2. Indian Alchemy by: Dr. S. Mahdihassan
3. Ayurvedic Pharmacopoea
5. Ancient Scientists of India by Satya Prakash
6. Phytochemistry by R.K. Shukla
7. Phytochemical Methods by: J. B. Harborne (Chapmann & Hall)

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X	X	x		X			X
CO:2	X			X	X	X		X
CO:3	X			X			X	

CourseTitle :Chemical Society and Technology w.e.f. 2028-29	**Classification : Minor (MI)**
Class:B.Sc. Pt.-IV/ Semester-VIII	**Course Code : BCH25-MI801**
Lecture:60	**Total Credits:04**
MM:100	**ExamHrs: 02**

COURSE OUTCOMES:

After the completion of this course, a student should be able to:

CO1. Students shall be able to understand the different type of separation techniques and their uses so that they will be able to choose the appropriate technique according to their applications.

CO2. The students will understand the working principles of various equipments used in the chemical industries including reactors, distillation columns, extruders, pumps, mills.

CO3. Students when approaching the chemical industry will be able to know the seriousness of handling these equipments.

CO4. Awareness about scientific literacy will be there among students.

CO5. The importance of the renewable energy sources in the current time will also be understood by the students so that they can be able to aware the society about this fold of energy.

CO6. Awareness to minimize the pollution and its causes can be distributed into the society by the students after studying the course.

UNITS	CONTENTS	L	T	P	Total Hours
1	Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption.	10	05		15
2	An introduction into the scope of different types ofequipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators.	12	03		45
3	Scaling up operations in chemical industry.Introduction to clean technology	7	02		09
4	Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water; energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues.	11	04		15
5	Effect of pollution on society.	5	01		06
	Total (in Hrs)	45	15		60

L: Lectures ***T: Tutorials*** ***P: Practicals***

MODESOF SEMESTER ASSESSMENT:

Marks allotted for continous assessment – 40

Marks allotted for End Semester examination – 60

Maximum marks -100

SUGGESTED READINGS:

1. JohnW.Hill,TerryW.McCreary&DorisK.Kolb,*Chemistryforchangingtimes*13th Ed.

CO-PO-PSO MAPPING

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X			X			X	X
CO2	X			X				X
CO3				X			X	X
CO4				X				X
CO5				X				
CO6				X				

CourseTitle :Lab Course - VIIIw.e.f. 2028-29	**Classification : Major (MJ)**
Class:B.Sc. Pt.-IV/ Semester-VIII	**Course Code : BCH25-MJ851**
Lecture:120	**Total Credits:04**
MM:100	**ExamHrs: 02**

COURSE OUTCOMES:

On completion of this course, student shall be able to:

CO 1:Learn to draw calibration curve and to calculate Angle of rotation, Refractive Index.
CO 2: Analyze samples using techniques as Polarimetry, Refractometry,Turbidimetry/ Nephelometry, D.O. analyzer.
CO 3: Gain knowledge of basic principle, instrumentation and separation byColumn chromatography& Paper chromatography.

UNITS	CONTENTS	L	T	P	Total Hours
	Hands On Experiments: List of experiments involving the extensive handling of apparatus and equipment related to the following techniques: (A) POLARIMETRY: 1. Handling of polarimeter. 2. To determine the specific rotation of cane sugar solution. 3. To determine the concentration of unknown solution of cane sugar in water. (B) REFRACTROMETRY: 1. Handling of Abb's Refractometer, and to find out Instrumental error. 2. To find out the R.I of given liquids. 3. To determine the concentration of given cane sugar solution of water. (C) TURBIDIMETRY: 1. Handling of turbidimeter/Nephelometer and preparation of stock solution. 2. To determine the turbidity of given solution in N.T.U. in the range 0 to 1 N.T.U. 3. To determine the turbidity of given solution in N.T.U. in the range 0 to 10 N.T.U. 4. To determine the turbidity of given solution in N.T.U. in the range 0 to 100 N.T.U. 5. To determine the turbidity of given solution in N.T.U. in the range 0 to 1000 N.T.U. 6. To determine the turbidity of given solution (when turbidity range is not known). (D) DISSOLVED OXYGEN ANALYSIS: 1. Handling of D.O. analyzer. 2. Preparation of D.O. probe. 3. To determine D.O. in the given solution. (E) PAPER CHROMATOGRAPHY: 1. Separation of components of red ink. 2. Separation of components of blue ink. 3. Separation of components of blue and red ink. 4. Separation of mixture of indicators. 5. Separation of mixture of Ni^{++},Cu^{++},Co^{++},Mn^{++},Zn^{++} ions. (F) COLUMN CHROMATOGRAPHY: 1. Separation of red ink components. 2. Separation of blue ink components 3. Separation of mixture of blue and red ink components 4. Separation of indicators. 5. Separation of mixture of Ni^{++},Fe^{++},Co^{++},Mn^{++},Zn^{++} ions. (G) THIN LAYER CHROMATOGRAPHY			120	120
	Practical (Hrs.)			120	120

L: Lectures T: Tutorials P: Practicals

MODES OF SEMESTER ASSESSMENT:

Marks allotted for continuous assessment – 40
Marks allotted for End Semester examination – 60
Maximum marks -100

SUGGESTED READINGS :

1. G.W.Ewing, Instrumental Methods of Chemical Analysis, MC Graw Hill Book Company
2. A.I. Vogel, A Text book of Quantitative Inorganic Analysis, Pearson Education.
3. M.K. Shingari, Hand Book of Chromatography for Chemists and Engineers.

CO-PO-PSO MAPPING

Course outcomes/ Programme outcomes	1	2	3	4	5	6	7	8
CO 1	X	X	X				X	X
CO 2	X	X	X				X	X

CO 3	X	X	X				X	X
CO 4	X	X	X	X	X	X		X	X

CourseTitle :Dissertation w.e.f. 2028-29	**Classification : Di (Only for B.Sc. Hons. With Research Students)**
Class:B.Sc. Pt.-IV/ Semester-VIII	**Course Code : BCH25-DI871**
Work Hours :360	**Total Credits:12**
MM:300	

The student will undertake Dissertation work at Department of Chemistry, Kanya Gurukul/Gurukul Kangri (DU) under the supervision of a teaching staff member and submit the same for evaluation.

The student shall present the work before a panel of two examiners consisting of the supervisor concerned and an expert/examiner appointed by the University.

MODES OF SEMESTER ASSESSMENT:
Marks allotted for pre-submission presentation – 120
Marks allotted for End Semester presentation – 180
Maximum marks -300