ANNEXURE C

FACULTY OF SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science/Honours

(Offered under 4 Year U.G. Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester III

Session: 2025-26

The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR
(AUTONOMOUS)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)
SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER GRADUATE DEGREE PROGRAMME

Bachelor of Science/Honours

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2025-26)

Bachelor of Science/Honours (Semester III)										
Course Name	**Hours Per Week L-T-P**	**Credits L-T-P**	**Course Code**	**Course Type**	**Total marks**	**Paper**	**Ext.**		**CA**	**Examination Time (in Hours)**
							L	**P**		
Chemistry	4-0-0	4-0-0	BSNL/BSML-3084	C	100	Chemistry (Physical Chemistry-I)	70	-	30	3
	0-0-4	0-0-2	BSNP/BSMP-3084	C	50	Chemistry (Physical Chemistry-I Lab)	-	35	15	3

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2024-25)
(Semester I)
COURSE CODE: BSNL/BSML-3084
COURSE TITLE: Chemistry (Physical Chemistry-I)

Course Outcomes:

Students will be able to

CO1: Explain the fundamental principles governing the gaseous and liquid states, including kinetic theory, van der Waals equation, critical phenomena, and molecular velocity distributions.

CO2: Describe the properties and classification of colloids and crystals, analyze colloidal stability, and interpret crystal structures using X-ray diffraction techniques.

CO3: Apply the concepts of ideal and non-ideal solutions to determine colligative properties, calculate molecular weights, and explain deviations using thermodynamic and experimental methods.

CO4: Analyze electrochemical systems using concepts like conductivity, electrode potentials, Nernst equation, and concentration cells, and evaluate electrochemical parameters such as EMF, ΔG, ΔH, and equilibrium constants.

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2024-2025)
(Semester I)
COURSE CODE: BSNL/BSML-3084
COURSE TITLE: Chemistry (Physical Chemistry-I)

Exam Time: 3Hrs. **Max. Marks: 100**
Credit(L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Instructions for the Paper Setters: Eight questions of equal marks (fourteen marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT I (15 Hrs.)

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of State. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation, relationship between critical constants and van der Waals constants, the law of Corresponding states, reduced equation of state. Molecular Velocities: Root mean square, average and most probable velocities. Qualitative Discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter. Liquefaction of gases.
Liquid State: Intermolecular forces, surface tension and viscosity of liquids and its determination. Structure of liquids (a qualitative description). Structural differences between solids, liquids and gases.

UNIT II (15 Hrs.)

Colloidal State: Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical properties, stability of colloids, protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers. General applications of colloids.
Solid State: Definition of space lattice and unit cell, Law of crystallography- (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices, (iii) Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's Law in Reciprocal space. Determination of crystal structure of NaCl, KCl by use of Powder method; Laue's method. Liquid crystals, Classification, structure of nematic and cholestric phases.

UNIT III (15 Hrs.)

Solutions, Dilute Solutions and Colligative Properties: Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, non-ideal system, azeotropes-HCl-H2O and ethanol-water system. Relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Electrochemistry–I: Specific conductance and equivalent conductance, measurement of equivalent conductance, Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations.

UNIT IV (15 Hrs.)

Electrochemistry–I: Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Migration of ions, Transport number, Applications of conductivity measurements, Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Standard electrode potential, standard hydrogen electrode, reference electrodes, sign conventions, electrochemical series and its significance. Nernst equation, derivation of cell E.M.F. and single electrode potential. EMF of a cell and its measurements. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Types of reversible electrodes: gas- metal ion, metal ion, metal insoluble salt-anion and redox electrodes. Electrode reactions. EMF of reversible electrodes.

Electrochemistry–II: Polarization, over potential, hydrogen overvoltage and its application. Concept of activities and activity coefficient. Concentration cells with and without transference, liquid junction potential, application of concentration cells, valency of ions, solubility product and pH determination, potentiometric titrations.

Books Suggested

1. Atkins, P., Paula, J.de, Atkins Physical Chemistry; 8th edition, Pubs: Oxford University Press, 2008.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., Principles of Physical Chemistry; 43rd edition, Pubs: Vishal Publishing Co., 2008.
3. Barrow, G.M., Physical Chemistry; 6th edition, Pubs: McGraw Hill Inc, 1996.
4. Rao, C.N.R., University General Chemistry; Pubs: Macmillan India, 1985.
5. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2nd edition, Pubs: Oxford University Press, 2000.
6. Albert, R.A., Silbey, R.J., Physical Chemistry; 1st edition, Pubs: John Wiley & Sons Inc., 1992.
7. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems; Pubs: Wiley Eastern Limited, 1991.
8. Levine, I.N., Physical Chemistry; 5th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd., 2002.
9. Moore, W. J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd, 1983.
10. University General Chemistry, C.N.R. Rao, Macmillan.
11. Metz, C.R., Theory and problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs: McGraw-Hall Book Company, 1989.

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester III)
COURSE CODE: BSNP/BSMP-1084
COURSE TITLE : Chemistry (Physical Chemistry – I: Lab)

Course outcomes

Students will be able

CO1: Perform acid-catalyzed hydrolysis of esters and evaluate the specific reaction rate and effect of acid strength, applying principles of chemical kinetics.

CO2: Determine physical properties of liquids such as viscosity, surface tension, and refractive index using standard laboratory techniques and calculate related molecular parameters.

CO3: Analyze and interpret crystallographic data from X-ray powder diffraction patterns for crystal system identification and indexing.

CO4: Prepare buffer solutions and perform pH metric titrations to determine dissociation constants, enhancing understanding of acid-base equilibria and solution chemistry.

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2024-2025)
(Semester III)
COURSE CODE: BSNP/BSMP-3084
COURSE TITLE : Chemistry (Physical Chemistry – I: Lab)

Time: 3 Hrs **Marks: 50**
Credits: 0-0-2 **(Practical: 35, CA: 15)**

1. To determine the specific reaction rate of hydrolysis of ethyl acetate catalysed by acid at room temperature.
2. To study the effect of acid strength on hydrolysis of an ester.
3. To find the relative and absolute viscosity of given liquid at room temperature. (n-butyl alcohol, sucrose, and glycerine solution in water)
4. To study the surface tension of liquids by drop number and drop weight methods.
5. To determine the Refractive indices of given liquids (water, acetone, methanol, ethyl acetate, cyclohexane) by Abbe's refractometer & calculate their molecular refractivity.
6. To determine the composition of unknown mixture of two liquids by refractive index measurements.
7. Indexing of a given powder diffraction pattern of a cubic crystalline system.
8. Preparation of buffer solutions of different pH (a) Sodium acetate-acetic acid (b) Ammonium chloride-ammonium hydroxide
9. pH metric titration of (a) strong acid vs. strong base, (b) weak acid vs. strong base.
10. Determination of dissociation constant of a weak acid.

Books Suggested

1. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
3. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
4. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
5. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
6. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
7. Advanced Experimental Chemistry, Vol. I, Physical, J.N. Guru and R. Kapoor, S. Chand & Co.
8. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghosh & Sons.
9. Experiments Physical Chemistry, J.C. Ghosh, Bharati Bhavan.
10. Findlay's Practical Physical Chemistry, Author: Alexander Findlay, Publisher: Wiley, 1972, ISBN-10:0470258853.
11. Advanced Practical Physical Chemistry, Author: J. B. Yadav, Publisher: Krishna Prakashan Media (P) Ltd (2015), ISBN-10:8182835925.

FACULTY OF SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science/Honours

(Offered under 4 Year U.G. Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester IV

Session: 2025-26

The Heritage Institution
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Bachelor of Science/Honours

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2025-26)

Bachelor of Science/Honours (Semester IV)										
Course Name	**Hours Per Week L-T-P**	**Credits L-T-P**	**Course Code**	**Course Type**	**Total marks**	**Paper**	**Ext.**		**CA**	**Examination Time (in Hours)**
							L	**P**		
Chemistry	4-0-0	4-0-0	BSNL/BSML-4084	C	100	Chemistry (Inorganic Chemistry-II)	70	-	30	3
	0-0-4	0-0-2	BSNP/BSMP-4084	C	50	Chemistry (Inorganic Chemistry-II Lab)	-	35	15	3

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester II)
COURSE CODE: BSNL/BSML-4084
COURSE TITLE: Chemistry (Inorganic Chemistry-II)

Course outcomes:

Students will be able to

CO1 : Explain the periodic trends, chemical properties, and structures of p-block elements and their compounds, including sulphur and halogen oxoacids, interhalogens, and industrial processes like the Contact Process for sulphuric acid.

CO2 : Compare and contrast the electronic structure, oxidation states, and magnetic properties of d- and f-block elements, including the effects of lanthanide and actinide contraction and their analytical applications.

CO3 : Analyze the structure, bonding, stability, and stereochemistry of coordination compounds using Werner's theory, valence bond theory, and ligand field considerations.

CO4: Interpret electronic spectra of transition metal complexes using Orgel diagrams and selection rules, and describe the structure, bonding, and reactivity of organometallic compounds including their role in catalysis

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester IV)
COURSE CODE: BSNL/BSML-4084
COURSE TITLE: **Chemistry** (**Inorganic Chemistry-II)**

Exam Time: 3Hrs. **Max. Marks: 100**
Credit(L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Instructions for the Paper Setters: Eight questions of equal marks (fourteen marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdividedinto parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

UNIT -I (15 Hrs.)

p–Block Elements: Group 16: General characteristics: atomic radii, Ionisation energies, Melting and boiling point, Electron affinity, Oxidation state, Catenation, Elemental state, Allotropy, Hydrides of group 16, Chemical properties of SO_2, structure of SO_2 & SO_3, Oxoacid of sulphur: structure and basicity. Preparation of sulphuric acid by contacts process and its chemical properties

Group 17: General characteristics: atomic radii, Ionisation energies, melting and boiling point, Electron affinity, Electronegativity, Non-metallic character, colour, Oxidation state and reactivity**,** Hydrides of group 17, Relative acidic strength of hydro acids and Oxoacids of group 17, structure of interhalogen compounds and polyhalides.

Important compounds of p-block: Carbides, fluorocarbons, Silicones and phosphazenes, triphosphazenes.

UNIT -II (15 Hrs.)

Chemistry of Transition Elements: General characteristics of Transition Elements. Properties of the elements of the first transition series, Relative stability of their oxidation state. Coordination number and geometry. General characteristics of elements of Second and Third Transition Series. Difference in the properties of first transition elements with second and third transition series elements in respect of ionic radii, oxidation states, magnetic behaviour.

***f*-block elements**: Lanthanoids: Electronic configurations, oxidation states, ionic radii, lanthanide contraction, colour, spectral and magnetic properties, lanthanum compounds. Actinoids: electronic configurations, oxidation states, ionic radii, actinide contraction, colour, spectral and magnetic properties. Comparison of lanthanoids and actinoids and their analytical applications.

UNIT-III (15 Hrs.)

Coordination Compounds: Nomenclature of coordination compounds, Werner's coordination theory, effective atomic number, polydentate, chelating ligands and chelation, factors affecting stability of chelates, structural and stereoisomerism in coordination compounds with co-ordination number 4 and 6, resolution of racemic mixture, Valence bond theory of transition metal complexes, hybridization and geometry of complexes of Cr, Fe, Co, Cu and its ions, Magnetic properties and colour of coordination compounds.

Transition Metal complexes: an elementary idea of crystal field theory, Jahn-Teller effects. methods of determining magnetic susceptibility by Gouy's and Faraday method. L-S coupling, correlation of μs and μeff values, Nucleophilic Substitution reactions in square planar complexes

UNIT-IV (15 Hrs.)

Electronic Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules and relaxations, splitting of Russel-Saunder states in octahedral and tetrahedral, spectrochemical series, Orgel diagram of one electron-one hole system and two electron-two hole system in octahedral and tetrahedral complexes. Limitation of Orgel diagram.

Organometallic Compounds: Definition, nomenclature and classification of organometallic compounds. σ and π complexes, types of organoligands, EAN rule, bonding in organometals, Preparation, properties, bonding and applications of alkyl lithium and organoaluminium compounds (AlR_3). Metal olefin complexes, bonding in metal-ethylenic complexes, Mechanism of homogeneous hydrogenation reactions of alkene. Metal carbonyls: examples and bonding.

Books suggested

1. Cotton, F.A., Wilkinson, G., Gaus, P.L., Basic Inorganic Chemistry; 3rd edition, Pubs: John Wiley Sons. 1995.
2. Lee, J.D., Concise Inorganic Chemistry; 4th edition, Pubs: Chapman Hall Ltd., 1991.
3. Shriver, D.E., Alkins, P.W., Langford, C.H., Inorganic Chemistry; 4th edition, Oxford Publisher: Oxford University Press, 2006.
4. Douglas, B. McDamiel, D., Alexander, J., Concepts and Models of Inorganic Chemistry; 3rd edition, Pubs: John Wiley and Sons Inc., 1994.
5. Porterfield, W.W., Wesley, A., Inorganic Chemistry; Pubs: Addison-Wesley Publishing Company, 1984.
6. Miessler, G.L., Larr, D.A., Inorganic Chemistry; 3rd edition, Pubs: Pearson Education Inc., 2004.
7. Jolly, W.L., Modern Inorganic Chemistry; 2nd edition, Pubs: McGraw-Hill Publishing Company Limited, 1991.
8. Purcell, K.F., Kotz, J.C., Inorganic Chemistry; Pubs: W.B. Saunders Company, 1977.
9. Puri, B.R., Sharma, L.R., Kalia, K.C., Principles of Inorganic Chemistry; 30th edition, Pubs: Milestones Publisher, 2006-07.
10. Inorganic Chemistry, W.W. Porterfield Addison-Wesley.
11. Inorganic Chemistry, A.G. Sharpe, ELBS.

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester IV)
COURSE CODE: BSNP/BSMP-4084
COURSE TITLE : Chemistry (Inorganic Chemistry-II Lab)

Course outcomes:
Students will be able to analyze the given organic compound through

CO1: Perform volumetric titrations for the quantitative analysis of substances such as acetic acid, antacids, and water hardness using appropriate indicators and standard solutions.

CO2: Apply redox titration techniques (e.g., permanganometry, dichromate method, iodometry) to estimate metal ions like calcium, iron, and copper with accuracy and precision.

CO3: Execute gravimetric analysis procedures for the estimation of metal ions like copper, nickel, and silver through selective precipitation and weighing of pure compounds.

CO4: Synthesize and characterize simple inorganic compounds such as Prussian Blue, potash alum, and copper acetylacetonate, demonstrating understanding of coordination chemistry and crystallization techniques

Bachelor of Science/Honours
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester IV)
COURSE CODE: BSNP/BSMP-4084
COURSE TITLE : Chemistry (Inorganic Chemistry-II Lab)

Time: 3 Hrs **Marks: 50**
Credits: 0-0-2 **(Practical: 35, CA: 15)**

Volumetric Analysis

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Determination of alkali content-antacid tablet using HCI.
3. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
4. Standardisation of EDTA with $Pb(NO3)2$ / $ZnSO4.7H2O$ and Estimation of hardness of water by EDTA.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using sodium thiosulphate.

Gravimetric Analysis

Analysis of Cu as CuSCN; Ni as Ni (dimethylgloxime) and Determination of silver(I) as its chloride

Inorganic Preparations

Synthesis of Iron(III) Hexacyanoferrate(II) $Fe4[Fe(CN)6]3$ (Prussian Blue).

Preparation of Potassium Aluminum Sulfate $KAl(SO_4)\cdot 12\ H_2O$ (Potash Alum)

Preparation of bis Acetylacetonate Copper(II) $Cu(O_2C_5H_7)_2$.

Books Suggested

1. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mandham, ELBS.
2. Standard Methods of Chemical. Analysis, W.W. Scott: The Technical Press.
3. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
4. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
5. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
6. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
7. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Marr, G. and Rockett, B.W. Practical Inorganic Chemistry, 1972.

FACULTY OF LIFE SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester III

Session: 2025-26

The Heritage Institution
KANYA MAHA VIDYALAYA
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KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)
SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER GRADUATE DEGREE PROGRAMME

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2025-26)

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Semester-III

Course Code	Course Title	Course Type	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Marks				Examination time (in Hours)
						Total	Th	P	CA	
BBTM-3085	Chemistry-I	C	3-0-0	3-0-0	3	100	50	-	30	3
BBTM-3085(P)	Chemistry-I (Practical)	C	0-0-2	0-0-1	1		-	20		3

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester III)

COURSE CODE: BBTM-3085

COURSE TITLE: Chemistry-I

Course Outcomes:

Students will be able to

CO1: Explain the fundamental concepts of coordination chemistry, including Werner's theory, nomenclature, coordination numbers, stereochemistry, and isomerism in coordination compounds.

CO2: Apply valence bond theory to analyze the bonding in coordination complexes, distinguish between inner and outer orbital complexes, and evaluate its limitations.

CO3: Assess the stability of metal-ligand complexes and explain the role of macrocyclic ligands, crown ethers, and cryptands in coordination chemistry.

CO4: Apply crystal field theory to predict d-orbital splitting patterns, calculate crystal field stabilization energies (CFSE), and interpret spectroscopic properties of d-block metal complexes.

Bachelor of Science (Biotechnology) Three Year Degree Programme
Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester III)
COURSE CODE: BBTM-3085
COURSE TITLE: Chemistry-I

Exam Time: 3Hrs. **Max. Marks: 50**
Credit(L-T-P): 3-0-0

Instructions for the Paper Setters: Eight questions of equal marks (ten marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT I **(12 Hrs.)**

Introduction, Werner's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12. Factors affecting co-ordination numbers and stereo-chemistry, Isomerism in coordination compounds.

UNIT II **(11 Hrs.)**

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro- neutrality and back bonding, limitations of V.B. theory.

UNIT III **(11 Hrs.)**

Stability of co-ordination compounds
Introduction Factors affecting the stability of metal ion complexes with general ligands
Alkali metal and alkaline earth metal chelators : Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers & cryptands.

UNIT IV **(11 Hrs.)**

Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculations of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value.
Spectroscopic terms for d1-d 2 electronic configurations.

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4. Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH

Bachelor of Science (Biotechnology) Three Year Degree Programme
Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme
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(Under NEP 2020)
(Session: 2025-26)
(Semester III)
COURSE CODE: BBTM-3085 (P)
COURSE TITLE: Chemistry-I (Practical)

Course Outcomes:

Students will be able to

CO1: Perform iodimetric and iodometric redox titrations and accurately determine the concentration of oxidizing and reducing agents.

CO2: Conduct redox titrations using potassium dichromate ($K_2Cr_2O_7$) and potassium permanganate ($KMnO_4$) and interpret titration results in terms of reaction stoichiometry.

CO3: Apply complexometric titration techniques using EDTA for quantitative estimation of Ca^{2+} and Mg^{2+} ions and analyze water hardness.

CO4: Identify inorganic cations and anions using systematic qualitative analysis including preliminary and confirmatory tests based on classical inorganic methods.

Bachelor of Science (Biotechnology) Three Year Degree Programme
Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme
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(Under NEP 2020)
(Session: 2025-26)
(Semester III)
COURSE CODE: BBTM-3085 (P)
COURSE TITLE: Chemistry-I (Practical)

Time: 3 Hrs **Marks: 20**
Credits: 0-0-1

Volumetric Analysis:

Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and $KMnO_4$.

Complexometric titration using EDTA Ca^{2+},Mg^{2+}: in context with study of

hardness of water. Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dry heating test, charcoal cavity test,

$Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis: metal ions

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4. Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH.

FACULTY OF LIFE SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

(Offered under 4 Year U.G. Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester IV

Session: 2025-26

The Heritage Institution
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SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER GRADUATE DEGREE PROGRAMME

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Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2025-26)

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Semester-III

Course Code	Course Title	Course Type	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Marks				Examination time (in Hours)
						Total	Th	P	CA	
BBTM-4085	Chemistry-II	C	3-0-0	3-0-0	3	100	50	-	30	3
BBTM-4085(P)	Chemistry-II (Practical)	C	0-0-2	0-0-1	1		-	20		3

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BBTM-4084

COURSE TITLE: Chemistry-II

Course Outcomes:

Students will be able to

CO1: Identify and explain the structure, stability, and reactivity of organic reactive intermediates and analyze bonding concepts including resonance, hybridization, and electronic effects.

CO2: Apply the concept of aromaticity and reaction mechanisms to predict outcomes of electrophilic substitution reactions and side-chain transformations in aromatic compounds.

CO3: Understand molecular chirality and apply stereochemical principles to distinguish between enantiomers and diastereomers, assign configurations, and analyze stereochemical outcomes of reactions.

CO4: Differentiate between SN1 and SN2 mechanisms based on kinetics, stereochemistry, and reaction conditions, and evaluate competing substitution and elimination pathways.

Bachelor of Science (Biotechnology) Three Year Degree Programme

Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BBTM-4084

COURSE TITLE: Chemistry-II

Exam Time: 3Hrs. **Max. Marks: 50**

Credit (L-T-P): 3-0-0

Instructions for the Paper Setters: Eight questions of equal marks (ten marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT I (12 Hrs.)

Reactive intermediates

Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species

Bonding

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Waals interactions, resonance, hyperconjugation, hydrogen bonding and Inductive and electrometric effects.

UNIT II **(11 Hrs.)**

Aromaticity

Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes.

UNIT III (11 Hrs.)

Stereochemistry:

Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Prelog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereoisomers, Resolution of enantionmers, chiral centres other than carbon, prochirality.

UNIT IV (11 Hrs.)

Functional group transformation by nucleophilic substitution, the biomolecular (SN2), mechanism of nucleophilic substitution , stereochemistry of SN2 reactions, how SN2 reactions occur, steric effect in SN2reactions, nucleophiles and nucleophilicity, the unimolecular (SN1) mechanism of nucleophilies substitution, carbocation stability and the rate of substitution, by the SN1 mechanism sterochemistry of SN1reactions, carbocation real arrangements in SN1 reactions, solvent effects, subtitution and elimination as competing reactions.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV ed. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
3. Schaum's Outlines Series, Theory and Problems of Organic chemistry.
4. I.L. Finar, Problems and their solution in Organic chemistry.
5. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
6. D. J. Cram and G. S. Hammond, Organic chemistry.
7. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry

Bachelor of Science (Biotechnology) Three Year Degree Programme
Bachelor of Science/Honours (Biotechnology) Four Year Degree Programme
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester IV)
COURSE CODE: BBTM-4084 (P)
COURSE TITLE: Chemistry-II (Practical)

Course outcomes:

Students will be able to

CO1:understand the basics of Qualitative analysis

CO2: detect of elements (N, S and halogens) in organic compounds.

CO3:detect of functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines,amides, nitro and anilide) in simple organic compounds

CO4: prepare the derivatives of organic compounds

Bachelor of Science (Biotechnology) Three Year Degree Programme
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Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2025-26)
(Semester IV)
COURSE CODE: BBTM-4084 (P)
COURSE TITLE: Chemistry-II (Practical)

Time: 3 Hrs **Marks: 20**

Credits: 0-0-1

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Amides
- Amines
- Carboxylic acids and phenols.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV ed. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
3. Schaum's Outlines Series, Theory and Problems of Organic chemistry.
4. I.L. Finar, Problems and their solution in Organic chemistry.
5. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
6. J. Cram and G. S. Hammond, Organic chemistry.
7. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry.

FACULTY OF SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science Home Science
(Three Year Degree Programme)
Bachelor of Science (Honours) Home Science
(Four Year Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester III

Session: 2025-26

The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR
(AUTONOMOUS)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)
SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER GRADUATE DEGREE PROGRAMME

Bachelor of Science Home Science (Three Year Degree Programme)
Bachelor of Science (Honours) Home Science (Four Year Degree Programme)

Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2025-26)

Bachelor of Science Home Science (Three Year Degree Programme) Bachelor of Science (Honours) Home Science (Four Year Degree Programme) Semester-III										
Course Code	**Course Title**	**Course Type**	**Hours Per Week** **L-T-P**	**Credits L-T-P**	**Total Credits**	**Marks**				**Examination time (in Hours)**
						Total	Th	P	CA	
BHSL-3083	Basic Nutritional Biochemistry	C	3-0-0	3-0-0	3	100	70	-	30	3

Bachelor of Science Home Science (Three Year Degree Programme)

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Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester III)

COURSE CODE: BHSL-3083

COURSE TITLE: Basic Nutritional Biochemistry

Course outcomes:

Students will be able to:

CO1: Explain the structural formulae of monosaccharides, disaccharides, and polysaccharides, and relate their structure to biological function.

CO2 : Interpret the structural composition of fatty acids, triglycerides, and phospholipids, and evaluate factors affecting fat stability including rancidity, acid value, and saponification value.

CO3 : Illustrate the major pathways of carbohydrate and lipid metabolism, including glycolysis, TCA cycle, gluconeogenesis, and fatty acid biosynthesis and oxidation.

CO4 : Describe the metabolic roles and regulatory mechanisms of inorganic elements such as calcium, phosphorus, magnesium, and iron in the human body.

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Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester III)

COURSE CODE: BHSL-3083

COURSE TITLE: Basic Nutritional Biochemistry

Exam Time: 3Hrs. **Max. Marks: 100**
Credit (L-T-P): 3-0-0 **(Theory: 70, CA: 30)**

Instructions for the Paper Setters: Eight questions of equal marks (fourteen marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT I

Structural formulae of monosaccharaides, disaccharides and polysaccharides.

UNIT II

Structural formula of fatty acids, triglycerides and phospholipids.

Rancidity of fat & its prevention.

Acid value and saponification value of fat.

Essential fatty acid.

UNIT III

Intermediary Metabolism of Carbohydrates

Glycolysis TCA Cycle, Gluconeogenesis.

Study of intermediary metabolism of fat oxidation and biosynthesis of fatty acids.

UNIT IV

Metabolism of inorganic elements calcium, phosphorus, magnesium and iron

Books Suggested

1) Nelson, D. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry* (8th ed.). W.H. Freeman and Company.
2) Berg, J. M., Tymoczko, J. L., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman and Company.
3) Satyanarayana, U., & Chakrapani, U. (2021). *Biochemistry* (5th ed.). Elsevier India.
4) Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2020). *Textbook of biochemistry for medical students* (9th ed.). Jaypee Brothers Medical Publishers.
5) Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., & Weil, P. A. (2018). *Harper's illustrated biochemistry* (31st ed.). McGraw-Hill Education.
6) Champe, P. C., & Harvey, R. A. (2018). *Lippincott's illustrated reviews: Biochemistry* (7th ed.). Wolters Kluwer.
7) Chatterjea, M. N., & Shinde, R. (2020). *Textbook of medical biochemistry* (9th ed.). Jaypee Brothers Medical Publishers.
8) Joshi, S. A. (2016). *Nutrition and dietetics* (5th ed.). McGraw-Hill Education.
9) Voet, D., Voet, J.G. (2012*). Fundamentals of Biochemistry*, John Wiley and Sons, New York.
10) Jain, J. L., Jain, S. and Jain. N. (2016). *Fundamentals of Biochemistry*, S. Chand & Company Ltd., New Delhi.

FACULTY OF SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science Home Science
(Three Year Degree Programme)
Bachelor of Science (Honours) Home Science
(Four Year Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester IV

Session: 2025-26

The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR
(AUTONOMOUS)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)
SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER GRADUATE DEGREE PROGRAMME

Bachelor of Science Home Science (Three Year Degree Programme)
Bachelor of Science (Honours) Home Science (Four Year Degree Programme)

Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2025-26)

Bachelor of Science Home Science (Three Year Degree Programme) Bachelor of Science (Honours) Home Science (Four Year Degree Programme) Semester-IV										
Course Code	**Course Title**	**Course Type**	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credits**	**Marks**				**Examination time (in Hours)**
						Total	Th	P	CA	
BHSM-4085	Applied Nutritional Biochemistry	C	3-0-2	3-0-1	4	100	50	20	30	3+3

Bachelor of Science Home Science (Three Year Degree Programme)

Bachelor of Science (Honours) Home Science (Four Year Degree Programme)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BSNL-4085

COURSE TITLE: Applied Nutritional Biochemistry

Course outcomes:

Students will be able to:

CO1: Explain the structure of amino acids and proteins, their metabolic pathways, and evaluate nitrogen balance and protein quality indicators.

CO2: Describe the concept of Basal Metabolic Rate (BMR), the factors influencing it, and the thermogenic effect of different nutrients.

CO3: Classify enzymes based on their function, explain their specificity, and analyze the factors that affect enzyme activity.

CO4: Interpret the normal and abnormal composition of urine and explain the mechanisms of water and electrolyte balance and the effects of dehydration.

Bachelor of Science Home Science (Three Year Degree Programme)

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Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BSNL-4085

COURSE TITLE: Applied Nutritional Biochemistry

Exam Time: 3Hrs. **Max. Marks: 50**
Credit (L-T-P): 3-0-0

Instructions for the Paper Setters: Eight questions of equal marks (ten marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT I

Structural formulae of amino acids peptide bonds. Hydrolytic breakdown of protein & essential amino acids, Nitrogen balance**,** Protein efficiency ratio and biological value of protein. Elementary study of general metabolism of protein, building up of amino acid pool. General reaction of amino acid metabolism, Urea Cycle, Essential amino acids.

UNIT II

B.M.R. – Meaning and factors affecting B.M.R. specific dynamic action of good stuffs.

UNIT III

Enzymes – definition, classification and specificity of enzymes, Factors affecting enzyme activity.

UNIT IV

Urine composition, normal and abnormal constituents of urine, Water and electrolyte balance, water and electrolyte losses and their replenishment effect of dehydration.

Books Suggested

1) Nelson, D. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry* (8th ed.). W.H. Freeman and Company.
2) Satyanarayana, U., & Chakrapani, U. (2021). *Biochemistry* (5th ed.). Elsevier India.
3) Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2020). *Textbook of biochemistry for medical students* (9th ed.). Jaypee Brothers Medical Publishers.
4) Chatterjea, M. N., & Shinde, R. (2020). *Textbook of medical biochemistry* (9th ed.). Jaypee Brothers Medical Publishers.
5) Joshi, S. A. (2016). *Nutrition and dietetics* (5th ed.). McGraw-Hill Education.
6) Sharma, D. C. (2017). *Nutritional Biochemistry*, CBS Nursing Publishers.
7) Voet, D., Voet, J.G. (2012*). Fundamentals of Biochemistry*, John Wiley and Sons, New York.
8) Jain, J. L., Jain, S. and Jain. N. (2016). *Fundamentals of Biochemistry*, S. Chand & Company Ltd., New Delhi.

Bachelor of Science Home Science (Three Year Degree Programme)

Bachelor of Science (Honours) Home Science (Four Year Degree Programme)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BSNL-4085(P)

COURSE TITLE: Applied Nutritional Biochemistry (Practical)

Course outcomes:

Students will be able to:

CO1: Perform qualitative tests to identify monosaccharides, disaccharides, and polysaccharides in various samples.

CO2: Estimate glucose concentration quantitatively using standard biochemical methods.

CO3: Analyze the presence of proteins, fats, and carbohydrates in common food items such as bread, milk, and eggs using biochemical tests.

CO4: Interpret experimental results and demonstrate basic proficiency in biochemical laboratory techniques related to food and biomolecule analysis.

Bachelor of Science Home Science (Three Year Degree Programme)

Bachelor of Science (Honours) Home Science (Four Year Degree Programme)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Under NEP 2020)

(Session: 2025-26)

(Semester IV)

COURSE CODE: BSNL-4085(P)

COURSE TITLE: Applied Nutritional Biochemistry (Practical)

Exam Time: 3Hrs. **Max. Marks: 20**
Credit (L-T-P): 0-0-1

1. Qualitative analysis of monosaccharide, disaccharide and polysaccharide.
2. Quantitative estimation of Glucose.
3. To test the reaction of protein fats and carbohydrate in bread, milk and egg.

Books Suggested

1) Oser, B. L. (2014). *Hawk's physiological chemistry* (14th ed.). Tata McGraw-Hill.
2) Plummer, D. T. (2017). *An introduction to practical biochemistry* (3rd ed.). McGraw-Hill Education.
3) Jayaraman, J. (1981). *Laboratory manual in biochemistry*. Wiley Eastern Ltd.
4) Sawhney, S. K., & Singh, R. (2019). *Introductory practical biochemistry* (2nd ed.). Narosa Publishing House.