Annexure D

FACULTY OF SCIENCES

SYLLABUS

of

Chemistry

for

Bachelor of Science (Semester V)

(Credit Based Continuous Evaluation Grading System (CBCEGS)

(12+3 System of Education)

Session: 2025-26

The Heritage Institution

KANYA MAHA VIDYALAYA

JALANDHAR

(Autonomous)

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

Credit Based Continuous Evaluation Grading System (CBCEGS)

Bachelor of Science (Session: 2025-26)

Bachelor of Science (Semester V)												
Course Name	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credit**	**Course Code**		**Course Type**	**Total marks**		**Paper**	**Ext.**		**CA**	**Examination Time (in Hours)**
										L	**P**		
Chemistry	2-0-0	2-0-0	7	BSMM-5084	I	C	175	50	Chemistry (Inorganic Chemistry)	40	-	10	3
	3-0-0	3-0-0			II			75	Chemistry (Physical Chemistry)	60	-	15	3
	0-0-4	0-0-2		BSNM-5084	P			50	Chemistry (Practical)	-	40	10	3

Bachelor of Science
(SEMESTER–V)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-5084(I)
COURSE TITLE: CHEMISTRY (INORGANIC CHEMISTRY)

Course outcomes:

Students will be able to

CO1: Explain the crystal field theory and associated concepts such as orbital splitting, crystal field stabilization energy (CFSE), spectrochemical series, and Jahn-Teller distortion in coordination complexes.

CO2 : Analyze the magnetic properties and thermodynamic stability of transition metal complexes using magnetic susceptibility methods and substitution reaction mechanisms, including the trans-effect.

CO3 : Interpret electronic spectra of transition metal complexes using term symbols, Orgel diagrams, and LS coupling, and apply these concepts to real metal ion systems such as Cr^{3+}, Co^{2+}, Mn^{2+}, and Ni^{2+}.

CO4 : Describe the structure, bonding, classification, and applications of organometallic compounds including alkyllithium, organoaluminium, metal-olefin, and metal carbonyl complexes.

Bachelor of Science
(SEMESTER–V)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-5084(I)
COURSE TITLE: CHEMISTRY (INORGANIC CHEMISTRY)

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

Credit(L-T-P): 2-0-0 **(Theory: 40, CA: 10)**

Instructions for the Paper Setter

Eight questions of equal marks (8 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

1. Metal-ligand Bonding in Transition Metal Complexes (8 Hrs)

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, crystal field stabilization energy for d-orbital electrons in tetrahedral and octahedral complexes, Spectrochemical series, factors affecting the crystalfield parameters, Structural and Thermodynamic effects of inner orbital splittings, Jahn-Teller effects.

Unit II

2. Magnetic Properties of Transition Metal Complexes (8 Hrs)

Types of magnetic behaviour, methods of determining magnetic susceptibility by Gouy's and Faraday method. Variation of magnetic susceptibility with temperature, ferromagnetic and antiferromagnetic substances, spin-only formula. L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for characterization of 3d-metal complexes. Temperature independent paramagnetism, anomalous magnetic moment, paramagnetic and diamagnetic equilibrium.

3. Thermodynamic and Kinetic Aspects of Metal Complexes

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, Nucleophilic Substitution reactions in square planar complexes: rate law, Trans- effect, Mechanism of nucleophilic substitution in square planar complexes.

Unit III

4. Electronic Spectra of Transition Metal Complexes **(7 Hrs)**

Term symbols and coupling scheme, LS coupling, calculation of ground term state, microstates, 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 (d^1, d^4, d^6 & d^9) and two electron-two hole system (d^2, d^3, d^7 & d^8) in octahedral and tetrahedral complexes.

Study of electronic transition in Cr^{3+} (octahedral), Co^{2+} (octahedral & tetrahedral), Mn^{2+} (octahedral), Ni^{2+} (octahedral) complexes. Limitation of Orgel diagram.

Unit IV

5. Organometallic Compounds: **(7 Hrs)**

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 alkyllithium 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
(SEMESTER–V)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-5084(II)
COURSE TITLE: CHEMISTRY (PHYSICAL CHEMISTRY)

Course outcomes:

Students will be able to

CO1 : Understand and apply the principles of ionic conductivity, ion transport, and electrochemical cell operations to analyze and calculate electrochemical parameters such as EMF, transport number, and thermodynamic quantities.

CO2 : Explain electrochemical phenomena such as polarization and concentration cells, and demonstrate understanding of nuclear properties, radioactive decay, and their applications in nuclear reactions and radioactivity detection.

CO3 : Analyze rotational spectra of diatomic molecules using rigid and non-rigid rotor models to determine molecular parameters like bond length and isotope effects.

CO4 : Interpret vibrational, Raman, and electronic spectra based on quantum mechanical models to deduce structural and bonding information of molecules.

(SEMESTER–V)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-5084(II)
COURSE TITLE: CHEMISTRY (PHYSICAL CHEMISTRY)

Exam Time: 3Hrs. **Max.Marks:75**

Credit (L-T-P): 3-0-0 **(Theory: 60, CA: 15)**

Instructions for the Paper Setter

Eight questions of equal marks (12 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

Electrochemistry – I **(12 hrs.)**

Conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Migration of ions, Transport number: definition and determination by Hittorf method and moving boundary method, factors affecting transport number. Applications of conductivity measurements: determination of degree of dissociation, determination of Ka of acids, determination of solubility product of sparingly soluble salt, conductometric titrations.

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.

Unit–II

Electrochemistry – II **(11 Hrs.)**

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.

Nuclear Chemistry

Introduction: Radioactivity, Nuclear Structure, Size of Nucleus, Mass Defects and Binding Energy, Nuclear Stability, Nuclear Forces, Nuclear Spin and Moments of Nuclei, Nuclear Models, Nuclear Decay Processes, The Laws of Radioactive Decay, Soddy-Fajans Group Displacement Law, Rate of Nuclear Decay and Half Life Time (Kinetics of Radioactive Decay), Induced Nuclear Reactions, Types of Nuclear Processes, High Energy Nuclear Reactions, Nuclear Reaction Cross-Section, Artificial radioactivity, Detection and Measurement of Radioactivity, Nuclear Fission, Nuclear Fusion, Applications of Radioactivity.

Unit–III

Spectroscopy **(11 Hrs.)**

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi classical principles), selection rules, spectral intensity and position of lines, distribution using population distribution (Maxwell- Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Unit–IV

Vibrational Spectrum **(11 Hrs.)**

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the spectrum, vibration-rotation spectra, P, Q and R branches, structural information from IR spectra, idea of vibrational frequencies of different functional groups.

Raman Spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, O, Q and S branches. Comparison with IR spectra.

Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle. Qualitative description of σ, π, and n M.O., their energy levels and the respective transitions.

Books suggested:

1. Atkins, P., Paula, J.de, Atkins Physical Chemistry; 8th edition, Pubs: Oxford University Press, 2008.
2. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2nd edition, Pubs: Oxford University Press, 2000.
3. Albert, R.A., Silbey, R.J., Physical Chemistry; 1st edition, Pubs: John Wiley & Sons Inc., 1992.
4. Levine, I.N., Physical Chemistry; 5th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd, 2002.
5. Moore, W. J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd, 1983.
6. Metz, C.R., Theory and problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs: McGraw-Hall Book Company, 1989.
7. W. Kemp, "Organic Spectroscopy".
8. C.N. Banwell "Fundamentals of Molecular Spectroscopy".
9. D.L. Pavia, G.M. Lampan and G. S. Kriz, Introduction to Spectroscopy" Hartcourt College Publishers, 2001

Bachelor of Science
(SEMESTER–V)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-5084(P)
COURSE TITLE: CHEMISTRY PRACTICAL

Course outcomes:

Students will be able to

CO1: Develop skills in synthesizing coordination compounds such as sodium trioxalatoferrate(III), Ni-DMG, and transition metal complexes, and understand their structural features and ligand interactions.

CO2: Perform conductometric and pH-metric titrations to determine acid-base properties, mixture composition, and dissociation constants, interpreting the data to identify end points and reaction behaviors.

CO3: Determine molecular weights using Rast's method and analyze phase equilibria by calculating distribution coefficients, gaining insights into colligative properties and solute-solvent interactions.

CO4: Measure refractive indices using Abbe refractometry and calculate specific and molar refraction to identify compositions of liquid mixtures, linking optical properties to molecular structure.

Bachelor of Science
(SEMESTER–V)
SESSION: 2025-26

COURSE CODE: BSMM/BSNM-5084(P)
COURSE TITLE: CHEMISTRY PRACTICAL

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

Credit(L-T-P): 0-0-2 **(Theory: 40, CA: 10)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

(I) Synthesis and Analysis

(a) Preparation of Sodium trioxalatoferrate (III)

(b) Preparation of Ni-DMG Complex

(c) Preparation of Copper tetrammine complex

(d) Preparation of cis-bisoxalatodiaquachromate (III) ion

(II) Physical Chemistry

(a) Conductometric Titrations

(i) Determine the end point of the following titrations by the conductometric methods.

Strong acid-Strong base

Weak acid-Strong base

(ii) Determine the composition of a mixture of acetic acid and the hydrochloric acid by conductometric titration.

(b) Molecular Weight Determination of acetanilide, napthalane, using camphor as solvent **(Rast's methods).**

(c) pH metric titration :

(i) strong acid with strong base,

(ii) weak acid with strong base and determination of dissociation constant of a weak acid.

(d) Phase Equilibria to determine the distribution coefficient of iodine between CCI_4 and water.

(e) **Refractometry**

(i) Determination of refractive index of a liquid by Abbe refractometer, and hence the specific and molar refraction.

(ii) To determine the composition of unknown mixture of two liquids by refractive index measurements.

Books suggested:

1. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
2. Handbook of preparative Inorganic Chemistry, Vol. I & II, Brauer, Academic Press.
3. Inorganic Synthesis, McGraw Hill.
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.

SYLLABUS

of

Chemistry

For

Bachelor of Science

(Semester VI)

(Credit Based Continuous Evaluation Grading System (CBCEGS)

Session: 2025-26

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

SCHEME AND CURRICULUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2025-26)

Bachelor of Science

Bachelor of Science (Semester VI)													
Course Name	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credit**	**Course Code**		**Course Type**	**Total marks**		**Paper**	**Ext.**		**CA**	**Examination Time (in Hours)**
										L	**P**		
Chemistry	3-0-0	3-0-0	7	BSMM-6084	I	C	175	75	Chemistry (Molecular Spectroscopy)	60	-	15	3
	2-0-0	2-0-0			II			50	Chemistry (Physical Chemistry)	40	-	10	3
	0-0-4	0-0-2		BSNM-6084	P			50	Chemistry (Practical)	-	40	10	3

Bachelor of Science

(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(I)
COURSE TITLE: CHEMISTRY (INORGANIC CHEMISTRY)

Course outcomes:

Students will be able to

CO1: understand the principle and applications of ultraviolet and apply Woodward Fisher Rule to calculate λ_{max}

CO2: understand the concepts of Vibrational spectroscopy, Vibrational coupling overtones and Fermi resonance and its application in Organic Chemistry

CO3: know about the Nuclear magnetic resonance spectroscopy. Proton chemical shift, spin-spin coupling, coupling constants and its applications to determine organic structures

CO4: to understand different cleavage patterns of organic compounds in Mass spectrometry and apply the knowledge for interpretation of the spectrum of an unknown compound.

SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(I)
COURSE TITLE: CHEMISTRY (ORGANIC CHEMISTRY)

Exam Time: 3Hrs. **Max.Marks:75**

Credit(L-T-P): 3-0-0 **(Theory: 60, CA: 15)**

Note: Instructions for the Paper Setter

Eight questions of equal marks (12 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

Energy and ElectromagneticSpectrum **(10 Hrs)**

Introduction, electromagnetic spectrum and Units, Regions of the spectrum,Statement of Born-Oppenheimer approximation, Degree of freedom, Frank Condon Principle, Fluorescence and Phosphorescence.

Ultraviolet and Visible Spectroscopy

The energy of electronic excitation, Measurement techniques, Beer-Lambert Law, Molar extinction coefficient. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, Auxochromes, Absorption and intensity shifts, Factors affecting λ_{max} , Effect of steric hindrance to coplanarity, Solvent effects.

UNIT – II

Infrared Spectroscopy **(10 Hrs)**

Vibrational energy levels, Selection rules, Force constant, Fundamental vibration frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect) of different functional groups, Sampling techniques.

Applications of UV and IR Spectroscopy

Applications of UV spectroscopy, Woodward Fieser rules for calculating λ_{max} of conjugated polyenes and α,ß -unsaturated carbonyl compounds. Applications of IR spectroscopy, Absorption of Common functional Groups, Interpretation of simple IR spectra, Finger print regions. Simple numerical problems based on UV and IR spectroscopy.

UNIT-III

Proton Magnetic Resonance spectroscopy (^{1}HNMR) **(13 Hrs)**

The Nuclear spin, Larmor frequency, the NMR isotopes, Population of nuclear spin level, Spin and Spin lattice relaxation, Measurement techniques (CW and FT method), Solvent used, Reference compounds, Chemical shift, nuclear shielding and deshielding, chemical shift, spin-spin splitting and coupling constants, Anisotropic effect, Application of structure elucidation of simple organic molecules.

UNIT- IV

Mass Spectrometery **(12 Hrs)**

Basic Principles, Elementary theory, Molecular ions, isotope ions, Fragment ions of odd and even electron types, Nitrogen rule, Factors affecting cleavage patterns, Simple cleavage, Cleavages at a hetero atom, Multicentre fragmentations, Rearrangements, Diels – Alder fragmentation, Mc Lafferty rearrangement, Interpretation of the spectrum of unknown simple molecules.

Books Suggested:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, NewYork
2. D.H. Williams and I. Fleming. Spectroscopic Methods in OrganicChemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein and F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing CompanyInc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M .Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning.

Bachelor of Science
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(II)
COURSE TITLE: CHEMISTRY (PHYSICAL CHEMISTRY)

Course outcomes:

Students will be able to

CO1: understand schrodinger wave equation (S.W.E) and its applications to partical in one, two and three dimensional boxes.

CO2: understand the applications of S.W.E to rigid rotator, harmonic oscillators, hydrogen and hydrogen like atoms, quantum numbers.

CO3: acquire knowledge about unit cell,space lattice, miller indices, symmetry operations, Bragg equation, powder method.

CO4: understand photophysical, photo chemical, radioative and non-radiative processes, quantum yield, energy transfer processes.

Bachelor of Science
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(II)
COURSE TITLE: CHEMISTRY (PHYSICAL CHEMISTRY)

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

Credit(L-T-P): 3-0-0 **(Theory: 40, CA: 10)**

Note: Instructions for the Paper Setter

Eight questions of equal marks (8 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

1. Quantum Mechanics-I **(12 Hrs)**

Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box, quantization of energy levels, extension to two and three dimensional boxes, degeneracy.

UNIT–II

2. Quantum Mechanics-II **(12 Hrs)**

Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. Rigid rotator model of rotation of diatomic molecules transformation to spherical polar coordinates spherical harmonics and their discussion. Qualitative investigation H-atom, setting up Schrodinger equation, radial and angular part, radial distribution functions of 1s, 2s, 2p, 3s, 3p and 3d.

UNIT–III

3. Solid State **(10 Hrs)**

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.

UNIT-IV

4. Photochemistry (11Hrs)

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus–Drapper law, Stark–Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of flourescence, phosphorescence, non–radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions–energy transfer processes (simple examples).

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 Company Inc., 1996.
4. Rao, C.N.R., University General Chemistry; Pubs: Macmillan of 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; I edition, Pubs: John Wiley and Sons Inc., 1992.
7. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems, Pubs: Wiley Eastern Ltd., 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. Metz, C.R., Theory and Problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs:McGraw-Hall Book Company, 1989.
11. Banwell, C.N., McCash, E.M., Fundamentals of Molecular Spectroscopy; 4th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd., 1999.
12. Atkins, P. Friedman, R., Molecular Quantum Mechanics; 4th edition Pubs: Oxford University Press, 2007.
13. Levine, I.N., Quantum Chemistry; 5th edition, Pubs: Prentice Hall International Inc., 2000.
14. Inorganic Chemistry, W.W. Porterfield Addison-Wesley.
15. Inorganic Chemistry, A.G. Sharpe, ELBS.

Bachelor of Science
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(P)
COURSE TITLE: CHEMISTRY PRACTICAL

Course outcomes:

Students will be able to

CO1 : Demonstrate proficiency in column chromatography for the separation of organic compounds such as isomers, pigments, and dyes, and interpret separation based on polarity and adsorption principles.

CO2 : Synthesize standard organic compounds like p-nitroacetanilide and p-bromoacetanilide, applying concepts of electrophilic substitution and functional group transformations.

CO3 : Apply green chemistry principles in the synthesis of organic compounds (e.g., benzilic acid, nitrated salicylic acid), emphasizing eco-friendly reagents and reaction conditions.

CO4 : Perform synthesis of azo dyes such as methyl orange and methyl red, and understand the chemical basis and practical relevance of dye formation reactions.

Bachelor of Science
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BSMM/BSNM-6084(P)
COURSE TITLE: CHEMISTRY PRACTICAL

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

Credit(L-T-P): 0-0-2 **(Theory: 40, CA: 10)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

(I) Organic Chemistry Laboratory Techniques

(a) Column Chromatography

a) Separation of o & p nitrophenol

b) Separation of Leaf pigments from Spinach leaves

c) Separation of o & p nitro aniline

d) Separation of dyes.

(b) Synthesis of Organic Compounds

a) Preparation of p-nitroacetanilide

b) Preparation of p-bromoacetanilide

c) Green Chemistry Experiment: Preparation of benzilic acid from Benzyl-using green approach.

d) Preparation of Methyl Orange, Methyl Red

e) Nitration of Salicyclic Acid by green approach (using ceric ammonium nitrate).

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.

FACULTY OF LIFE SCIENCES

SYLLABUS

of

Chemistry

for

Bachelor of Science (Biotechnology)

(Semester VI)

(Credit Based Continuous Evaluation Grading System (CBCEGS)

(12+3 System of Education)

Session: 2025-26

The Heritage Institution

KANYA MAHA VIDYALAYA

JALANDHAR

(Autonomous)

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

Credit Based Continuous Evaluation Grading System (CBCEGS)

Bachelor of Science (Biotechnology)

(Session: 2025-26)

Bachelor of Science (Biotechnology) Semester-VI										
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	
BBTL-6085	Chemistry-III	C	2-0-0	2-0-0	2	50	40	-	10	3
BBTP-6065	Lab in Chemistry-III	C	0-0-2	0-0-1	1	25	-	20	05	3

Bachelor of Science (Biotechnology)
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BBTL-6085
COURSE TITLE: CHEMISTRY-III

Course outcomes:

Students will be able to

CO1: Understand and apply the laws of thermodynamics to evaluate energy changes, spontaneity, and equilibrium in chemical systems, including simple mixtures.

CO2: Analyze solution behavior and equilibrium systems using thermodynamic principles, including colligative properties and Le Chatelier's principle.

CO3: Determine reaction rates and mechanisms by applying kinetic theories and rate laws, and explain the role of catalysts in various chemical processes.

CO4: Interpret electrochemical behavior of electrolytes through conductance, ionic equilibria, and buffer systems, and apply this understanding to conductometric titrations and pH analysis.

Bachelor of Science (Biotechnology)
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BBTL-6085
COURSE TITLE: CHEMISTRY-III

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

Credit (L-T-P): 2-0-0 **(Theory: 40, CA: 10)**

Instructions for the Paper Setter

Eight questions of equal marks (eight 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

CHEMICAL THERMODYNAMICS:

Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics : First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion. Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff's equation. Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle).Entropy. Entropy changes of an ideal gas with changes in P,V, and T. Free energy and work functions. Gibbs-Helmholtz Equation. Criteria of spontaneity in terms of changes in free energy. Third law of thermodynamics: Absolute entropies. Thermodynamics of Simple Mixtures: Partial molar quantities and their significance. Chemical potential and its variation with T and P. Fugacity function and its physical significance. Concept of activity and activity coefficient.

Unit II

SOLUTIONS:

Ideal and non- ideal solutions, method of expression concentrations of solution, activity and activity coefficients, dilute solution, Osmotic pressure, its law and measurements, Elevation of boiling point and depression of freezing points. Chemical Equilibrium : General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant Van't Hoff equation, homogeneous & heterogreneous equilibria, Le Chetalier's principle.

Unit III

CHEMICAL KINETICS AND CATALYSIS: Scope, rate of reaction, influencing factors such as concentration, temperature, pressure, solvent etc. theories of chemical kinetics. Arrhenius equation, concept of activation energy. Rates of reactions, rate constant, order and molecularity of reactions. Chemical Kinetics: Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy. Reaction mechanism. Steady state hypothesis. Catalysis : Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.

Unit IV

ELECTRO-CHEMISTRY: Specific conductance, molar conductance and their dependence on electrolyte concentration. Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes. Mean ionic activity coefficient and ionic strength. Transport number and its relation to ionic conductance and ionic mobility. Conductometric titrations. pH scale. Buffer solutions, salt hydrolysis.Acid-base indicators.

Books Recommended :

1. Physical Chemistry by Peter Atkius 10th edition.
2. Thermodynamics for chemists by Samuel Glasstone 2009
3. Chemical Kinetics by Keith J. Laidler 10th edition.
4. Modern Electrochemistry by John O'M Backris and K.N. Reddy 10th edition.

Bachelor of Science (Biotechnology)
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BBTP-6065
COURSE TITLE: Lab in Chemistry-III

Course outcomes:

Students will be able to

CO1: Apply principles of calorimetry to determine thermodynamic parameters such as heat of neutralization and heat of solution for various substances.

CO2: Utilize conductometric methods to determine cell constant, specific/equivalent conductance, and perform titrations for precipitation and acid-base reactions.

CO3: Analyze concentration and absorbance relationships using photometric techniques and validate Lambert-Beer's law.

CO4: Measure and interpret pH values to study buffer solutions, determine ionization constants, and analyze acid-base mixtures using pH metry and polarimetry.

Bachelor of Science (Biotechnology)
(SEMESTER–VI)
SESSION: 2025-26
COURSE CODE: BBTP-6065
COURSE TITLE: Lab in Chemistry-III

Exam Time: 3Hrs. **Max.Marks:25**

Credit(L-T-P): 0-0-1 **(Theory: 20, CA: 05)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

1. Calorimetry:

a) Determination of Heat of neutralization

(i) Strong acid-strong base

(ii) Weak acid-strong base.

b) Determination of Heat of solution of KCl, NH_4Cl, KNO_3

2. Conductometry:

a) Determination of cell constant.

b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).

c) Precipitation titration of Na_2SO_4 vs. $BaCl_2$.

d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.

3. Photometry.

Verification of Lambert beer's law for solution of $CoCl_2H_2O$ (in water) and $K_2Cr_2O_7$ (in water)

4. a) pH of buffer solution

b) Acid base titration HCl vs. NaOH.

c) Determination of ionization constant of a weak acid (CH_3COOH)

5. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

6. Polarimetry: Determine the % age composition of an optically active solution.

Books Recommended :

1. Findlay's Practical Physical Chemistry, 9^{th} Edition, Revised by B.P. Levitt.

2. Experimental Physical Chemistry by RC DAS and B. Behera 9^{th} Edition.