GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I

SYLLABUS

for

Three-Year/Four-Year (Honours) B.Sc. Programme

in

Major-Chemistry
With
Minor-Mathematics

Under Curriculum and Credit Framework for
Undergraduate Programmes (CCFUP)
as per NEP, 2020
(With effect from the session 2023-2024)

Semester-I

Course Type	*Title of the Course*	*Credit*	*Full Marks*	*Lecture Hour*
Major Course **CHEM101-1**	**Basic Chemistry-I**	**4** (Theory-03, Practicals-01)	**75** (Theory-40, Practical–20, Internal Assessment–15)	**75** (Theory-45, Practical-30)
Minor Course **MATH1021**	**Calculus, Geometry &Vector Calculus**	**4** (Theory-04)	**75** (Theory-60, Internal Assessment–15)	**60** (Lecture -45, Tutorial – 15)
Multi/ Interdisciplinary **ENGL1031**	**CommunicationSkills**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**45**
AEC (L1-1 MIL) **BENG1041**	**Sahityer Bodh O Bichar**	**2** (Theory-02)	**50** (Theory-40, Internal Assessment–10)	**30**
SEC **CHEM105-1**	**Drugs and pharmaceuticals**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**45**
Common Value-Added Course	**Environmental Science / Education**	**4** (Theory-04)	**100**	**60**
		Total Credit = 20	***Total Marks = 400***	

Semester-I

Chemistry MAJOR
Paper code: CHEM101-1
Paper title: Basic Chemistry-I

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Theory (Marks-40)

***Course Objective:* This will offer the basic ideas and familiarity throughout chemistry.**

1. Atomic structure

Bohr's theory- its limitations and atomic spectra of hydrogen atom, Sommerfeld's theory, wave mechanics- de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2, quantum numbers and their significance, Radial and angular wave functions for hydrogen atom, radial and angular distribution curves, shapes of s, p, d and f orbitals, Pauli's exclusion principle, Hund's rules and multiplicity, exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number up to 30.

2. Periodic properties

Modern IUPAC periodic table, effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction; ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities, group trends and periodic trends in these properties in respect of s-, p- and d-block elements, secondary periodicity, relativistic Effect, inert pair effect

3. Acids and bases

Acid-Base concept- Arrhenius concept, theory of solvent system (in H_2O, NH_3, SO_2 and HF); Bronsted-Lowry's concept, relative strength of acids, Pauling's rules, Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects, thermodynamic acidity parameters, Drago-Wayland equation, super acids, gas phase acidity and proton affinity, HSAB principle, acid-base equilibria in aqueous solution (proton transfer equilibria in water), pH, buffer, acid-base neutralisation curves, indicator, choice of indicators, concept of organic acids and bases, effect of structure, substituent and solvent on acidity and basicity, proton sponge, gas-phase acidity and basicity

4. Chemical Bonding-I

Ionic bond: general characteristics, types of ions, size effects, radius ratio rule and its application and limitations, packing of ions in crystals Born-Landé equation with derivation4 and importance, Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, solvation energy, solubility energetics

of dissolution process. Covalent bond: polarizing power and polarizability, ionic potential, Fazan's rules,Lewis structures, formal charge, Valence Bond Theory- hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and nonequivalent hybrid orbitals, Bent's rule, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach)

5. Fundamentals in organic chemistry

Electron displacement phenomena and physical properties: inductive effect, field effect, hyperconjugation, mesomeric effect, resonance energy, bond polarization and bond polarizability, electromeric effect, steric effect, steric inhibition of resonance, influence of hybridization on bond properties, bond dissociation energy (BDE) and bond energy, bond distances, bond angles, concept of bond angle strain (Baeyer's strain theory), melting point/boiling point and solubility of common organic compounds in terms of covalent & noncovalent intermolecular forces, polarity of molecules and dipole moments, relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation, calculation of formal charges and double bond equivalent (DBE)

Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes, benzynes and nitrenes, generation and stability, structure using orbital picture and electrophilic/nucleophilic behaviour of the reactive intermediates (elementary idea)

Concept of aromaticity: Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring), concept of antiaromaticity and homoaromaticity, non-aromatic molecules, Frost diagram, elementary idea about α and β, measurement of delocalization energies in terms of β for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene

6. Kinetic theory of gases

Kinetic Theory of gases: Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), wall collision and rate of effusion Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions, kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases. Real gas and virial equation: Deviation of gases from ideal behaviour, compressibility factor, Boyle temperature, Andrew's and Amagat's plots, van der Waals equation and its features, its derivation and application in explaining real gas behaviour, Dietrici equation of state, existence of critical state, critical constants in terms of van der Waals constants, law of corresponding states, virial equation of state, van der Waals equation expressed in virial form and significance of second virial coefficient, intermolecular forces (Debye, Keesom and London interactions, Lennard-Jones potential - elementary idea)

7. Thermodynamics-I

Zeroth and 1st law of Thermodynamics: intensive and extensive variables, state and path functions, isolated, closed and open systems, zeroth law of thermodynamics, concept of heat q, work wand internal energy U, statement of first law, enthalpy H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions, Joule's experiment and its consequence

Thermochemistry: standard states, heats of reaction, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions, adiabatic flame temperature, explosion temperature

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.
4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).
5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.
6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).
9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).
11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.6
12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
16. Morrison, R. T. Study guide to organic Chemistry, Pearson.
17. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
18. Castellan, G. W., Physical Chemistry, Narosa Publishing House.

Chemistry MAJOR
Paper code: CHEM101-1
Paper title: Basic Chemistry-I

Practical (Marks-20)

***Course Objective:* This will provide the preliminary knowledge on laboratory experiment and familiarise with the various equipment.**

(1) Separation, purification, and melting point determination Separation of components of a binary solid mixture based on solubility by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc., purification of any one of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types:
Benzoiacid, toluidine,p-nitrotolune/anisidine,benzoicacid/benzophenone,urea/benzophenone,salicylic acid/p-nitrotoluene, etc.

(2) Determination of boiling point

Boiling points of common organic liquid compounds e.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, etc.

[Boiling points of the chosen organic compounds should preferably be less than 160°C]

(3) Identification of a pure organic compound by chemical test(s)

Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose and salicylic acid.

Liquid Compounds: acetic acid, ethyl alcohol, acetone, aniline and nitrobenzene

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. A.K. Manna, Practical Organic Chemistry, Books & Allied (P) Ltd.

Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, santra Publication (P) Ltd.

MINOR COURSES

Course Code: MATH121
Course Name: Calculus, Geometry &Vector Calculus
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives: To study calculus, geometry, and vector calculus

Learning outcomes: On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. higher order derivatives and its applications, concavity of curves, asymptotes, and curve tracing techniques.

ii. reduction formula for integration of functions like sin nx, sin$m$ x sin$n$ x etc., area of surface of revolution, parametric curves etc.

iii. classification of conics and conicoid, polar equation of conics.

iv. vector valued functions and vector calculus.

Skills: The students would be able to

I. parametrize curves, sketch functions and plot them.

II. visualize standard quadratic surfaces like cone, ellipsoid etc.

III. apply calculus on vector valued functions.

IV. find gradient of scalar functions, divergence, and curl of vector valued functions.

General competence: The students would gain

i. a general idea of advance calculus and its applications.

ii. the idea of solving complex problems using vector calculus and geometry.

iii. analytical and reasoning skills, which improve their thinking power and enhance their problem solving ability.

Contents:

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $eax + b\ sin\ x$, $eax + b\ cos\ x$, $ax + b\ n\ sinx$, $ax + b\ n\ cosx$, indeterminate forms, L'Hospital's rule, concavity of curves, points of inflection, envelopes, asymptotes, curve tracing in Cartesian

coordinates, tracing in polar coordinates of standard curves.

[L-12H& T-4H]

Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sin\ nx$, cos nx, $tan\ nx$, $sec\ nx$, $log\ x\ n$, sin$n\ x$ sinm x, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

[L-10H& T-3H]

Reflection properties of conics, translation and rotation of axes, general equation of second-degree, classification of conics, polar equations of conics, spheres, cylindrical surfaces. central conicoid, paraboloids, plane sections of conicoid, generating lines, classification of quadrics**.**

[L-11H & T-4H]

Triple product of vectors, introduction to vector functions, algebraic operations on vector-valued functions, limits and continuity of vector functions, differentiation and partial differentiation of vector functions, gradient of a scalar function, divergence and curl of vector functions.

[L-12H& T-4H]

Reading References:

Textbooks:

1. Calculus - G.B. Thomas and R.L. Finney, 9th Ed., (Pearson Education, Delhi, 2005).

2. Calculus - M.J. Strauss, G.L. Bradley and K. J. Smith, 3rd Ed., (Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007).

3. Integral Calculus - K. C. Maity and R. K. Ghosh.,(New Central Book Agency (P) Limited, 1999).

4. An Elementary Treatise on Coordinate Geometry of three-Dimensions–R.J.T. Bell, (MacMillan & Co.).

5. The Elements of Coordinate Geometry- S.L. Loney, (MacMillan & Co.).

6. Vector Analysis- K. C. Maity and R. K. Ghosh, (New Central Book Agency (P) Ltd. Kolkata, 1999).

Reference Books:

1. Calculus- T. M. Apostol, (Volumes I and II. Vol-I, 1966, Vol-II, 1968).

2. Calculus- H. Anton, I. Bivens and S. Davis, 7th Ed., (John Wiley and Sons (Asia) P. Ltd., Singapore, 2002).
3. Introduction to Calculus and Analysis - R. Courant and F. John, (Volumes I & II), (Springer Verlag, New York, Inc., 1989).
4. Analytical Geometry of two and three-dimensions- N. Dutta and R. N. Jana, (Shreedhar Prakashani).
5. Calculus and Mathematical Analysis- S. Goldberg, 1989.
6. Vector Calculus- J. Marsden, and Tromba, (McGraw Hill, 1987).
7. Schaum's outline of Vector Analysis- M.R. Spiegel, (McGraw Hill, 1980).

Multi/ Interdisciplinary Course

Course Code: ENGL1031
Course Name: CommunicationSkills

Credit-03

Full Marks:50 (Theory-40, Internal Assessment–10)

INTERDISCIPLINARY COURSE 1

Communication Skills

Introduction to Communication Skills

Listening:

listening to casual conversations; listening to lectures; listening to instructions; listening to theatrical or movie dialogues; listening to news bulletins

Speaking:

speaking during casual conversations; speaking to a gathering; delivering a formal speech; offering instructions / advice; speaking as a presenter on television and radio; speaking during group discussions; speaking while facing an interview board

Reading:

Reading for pleasure; reading for examinations; reading for research; reading in a group; reading newspapers

Writing:

Writing formal letters; writing emails; writing messages on social media; writing for popular magazines; report writing for newspapers; feature writing for newspapers; writing a resume, writing applications for jobs, writing memos

AEC (L1-1 MIL)

Course Title: সাহিত্যের বোধ

Course Code: BENG1041

Course Credit: 2

Course Lecture Hour: 30

Full Marks:50 (Theory-40, Internal Assessment–10)

Objective of the Course: এই কোর্সের উদ্দেশ্য ভাষা এবং সাহিত্য বোধ ও সাহিত্য বিচারের প্রাথমিক ধারণা দেওয়া। কোনো সাহিত্যিক নিদর্শনকে শিক্ষার্থী তার বোধ ও বিচারশক্তি দিয়ে কীভাবে আয়ত্ত করতে পারে, সেটাই এই কোর্সে তাকে শেখানো হবে।

একক ১: ভাষা অংশ (Lecture Hour: 10)

ক. বোধপরীক্ষা: (নিম্নলিখিত পাঁচটি প্রবন্ধ পাঠ্য)

১. স্বদেশী সমাজ - রবীন্দ্রনাথ ঠাকুর

২. বাঙ্গালা ভাষা - স্বামী বিবেকানন্দ

৩. বই পড়া - প্রমথ চৌধুরী

৪. স্ত্রী জাতির অবনতি - বেগম রোকেয়া

৫. অপবিজ্ঞান – রাজশেখর বসু

একক ২: সাহিত্য অংশ (Lecture Hour: 20)

ক. কবিতার ভাবসৌন্দর্য বিশ্লেষণ

রবীন্দ্রনাথ ঠাকুরের নৈবেদ্য গ্রন্থের চারটি কবিতা পাঠ্য - (বৈরাগ্যসাধনে মুক্তি সে আমার নয়, শতাব্দীর সূর্য আজি, চিত্ত যেথা ভয়শূন্য, শক্তি দম্ভ স্বার্থ লোভ)

খ. ছোটোগল্পের শিল্পসার্থকতা বিচার

রবীন্দ্রনাথ ঠাকুরের গল্পগুচ্ছ থেকে তিনটি গল্প পাঠ্য – ছুটি, বলাই, মণিহারা

Outcome of the Course: এই কোর্স পড়ার পর শিক্ষার্থী সাহিত্যের বিষয় অনুধাবনের পাশাপাশি তার শিল্পসার্থকতা ও ভাবসৌন্দর্য বিশ্লেষণ করতে শিখল।

SKILL ENHANCEMENT COURSE (SEC)

Paper code: CHEM105-1

Paper title: Drugs and pharmaceuticals

Credits-03

Course time hour:45

***Full Marks*:50 (Theory-40, Internal Assessment–10)**

Theory (Marks-40)

***Course Objective:* This will enrich students by the clear knowledge of drugs, its discovery, and its applications.**

Contents:

Drug discovery, design and development,synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (aspirin, paracetamol, ilbuprofen), antibiotics (penicillin, chloramphenicol), antibacterial and antifungal agents (sulphonamides, sulphanethoxazol, sulphacetamide, trimethoprim); antiviral agents (acyclovir), central nervous system agents (phenobarbital, diazepam), cardiovascular (glyceryl trinitrate), antilaprosy (dapsone), HIV-AIDS related drugs(AZTZidovudine)

Reference Books:

1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.

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

4. El-Mansi, E.M.T., Bryce, C.F.A., Ddemain, A.L., Allman, A.R., Fermentatias Microbiology and Biotechnology, 2nd Ed. Taylor & Francis.

5. Prescott & Dunn's Industrial Microbiology, 2004, CBS Publisher.

Course Outcome: ***Students understand the distinction between drugs & medicines and in addition to it they acquire ideas on the utilities of medicine and its preparation in laboratory.***

DEPARTMENT OF CHEMISTRY
GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN

for

Paper code: CHEM101-1
Paper title: Basic Chemistry-I

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Theory (Marks-40)

Module-I ***Atomic structure***		
Bohr's theory- its limitations and atomic spectra of hydrogen atom, Sommerfeld's theory, wave mechanics-de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2, quantum numbers and their significance, Radial and angular wave functions for hydrogen atom, radial and angular distribution curves, shapes of s, p, d and f orbitals, Pauli's exclusion principle, Hund's rules and multiplicity, exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number up to 30.		
Module Objectives: 1. This unit aims to offer basic knowledge on structure of atom and fundamentals of atomic structure which provides the clear picture of the outermost electronic distribution of atom as well as the constituents of the nucleus. 2. From this portion students can get a clear idea about the structure of both Hydrogen like and polyelectronic atoms and ions with the use of various common existing principles guiding electronic configurations.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Bohr's theory, its limitations and atomic spectrum of hydrogen atom	
Lecture-2.	Sommerfeld's Theory	

Lecture-3.	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance	
Lecture-4.	Schrödinger's wave equation, significance of ψ and ψ^2	
Lecture-5.	Quantum numbers and their significance	
Lecture-6.	Radial and angular wave functions for hydrogen atom	
Lecture-7.	Radial and angular wave functions for hydrogen atom	
Lecture-8.	Shapes of s, p, d and f orbitals	
Lecture-9.	Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations	
Lecture-10.	Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations	
Lecture-11.	Ground state Term symbols of atoms and ions for atomic number upto 30	
Lecture-12.		Discussion on simple problems.
Lecture-13.		Solutions of previous year questions
Lecture-14.		Tutorial assignment – 1
Lecture-15.		Tutorial assignment – 2

Module-II

Periodic properties

CONTENTS

Modern IUPAC Periodic table, Effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. Secondary periodicity, Relativistic Effect, Inert pair effect.

Module Objectives:

1. From this portion students can acquire thorough background knowledge about the periodic trends of elements and their Compounds.
2. Periodic table and periodic properties, which helps the students to study the subject systematically. The chemistry of elements which make up the entire material world will be understood from the perspective of the periodic table.

Lecture Serial	Topics of Discussion	Remarks
Lecture-16.	Modern IUPAC Periodic table	

Lecture-17.	Effective nuclear charge, screening effects and penetration	
Lecture-18.	Slater's rules	
Lecture-19.	Atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction	
Lecture-20.	Atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction	
Lecture-21.	Ionization potential and electron affinity	
Lecture-22.	Electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities	
Lecture-23.	Electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities	
Lecture-24.	Group trends and periodic trends in these properties in respect of s-, p- and d-block elements	
Lecture-25.	Group trends and periodic trends in these properties in respect of s-, p- and d-block elements	
Lecture-26.	Secondary periodicity, Relativistic Effect, Inert pair effect	
Lecture-27.		Discussion on simple problems.
Lecture-28.		Solutions of previous year questions

Lecture-29.		Tutorial assignment
Lecture-30.		Tutorial assignment

Module-III ***Acids and bases***		
CONTENTS Acid-Base concept- Arrhenius concept, theory of solvent system (in H2O, NH3, SO2 and HF); Bronsted-Lowry's concept, relative strength of acids, Pauling's rules, Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects, thermodynamic acidity parameters, Drago-Wayland equation, super acids, gas phase acidity and proton affinity, HSAB principle, acid-base equilibria in aqueous solution (proton transfer equilibria in water), pH, buffer, acid-base neutralization curves, indicator, choice of indicators, concept of organic acids and bases, effect of structure, substituent and solvent on acidity and basicity, proton sponge, gas-phase acidity and basicity		
Module Objectives: Idea of acids and bases along with ionic equilibria helps students to identify various compounds in terms of acid and base and also to compare their relative strength. Concept of pH helps them quantify the acidity of a reaction medium, which is extremely important to understand various chemical phenomena.		
Lecture Serial	Topics of Discussion	Remarks
Lecture-31.	Acid-Base concept: Arrhenius concept theory of solvent system (in H_2O, NH_3, SO_2 and HF)	
Lecture-32.	Bronsted-Lowry's concept, relative strength of acids, Pauling's rules	
Lecture-33.	Bronsted-Lowry's concept, relative strength of acids, Pauling's rules	
Lecture-34.	Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects	
Lecture-35.	Thermodynamic acidity parameters, Drago-Wayland equation	
Lecture-36.	Superacids, Gas phase acidity and proton	

Lecture-37		Discussion on simple problems.
Lecture-38.		Tutorial assignment – 5

Module-IV

Chemical Bonding-I

CONTENTS

1. Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Solubility energetics of dissolution process.

2. Covalent bond: Polarizing power and polarizability, ionic potential, Fazan's rules. Lewis structures, formal charge. Valence Bond Theory. The hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, Dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach).

Module Objectives:

Chemical bonding in covalent compounds gives the most fundamental idea of why a compound is formed. Students will acquire the knowledge of ionic bond & covalent bond formation and its features.

Lecture Serial	Topics of Discussion	Remarks
Lecture-39.	General characteristics of Ionic bonds, types of ions, size effects etc	
Lecture-40.	Radius ratio rule and its application and limitations	
Lecture-41.	Packing of ions in crystals	
Lecture-42.	Born-Landé equation with derivation	
Lecture-43.	Importance of Kapustinskii expression for lattice energy	
Lecture-44.	Madelung constant	
Lecture-45.	Born-Haber cycle and its application	
Lecture-46.	Born-Haber cycle and its application & Solvation energy. Solubility energetics of dissolution process	

Lecture- 47.	Polarizing power and polarizability, ionic potential, Fazan's rules Bent's rule and Dipole moments & VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs and multiple bonding	
Lecture-48.	Polarizing power and polarizability, ionic potential, Fazan's rules	
Lecture-49.		Tutorial assignment

Module-V

Fundamentals in organic chemistry

CONTENTS

Electron displacement phenomena and physical properties: inductive effect, field effect, hyperconjugation, mesomeric effect, resonance energy, bond polarization and bond polarizability, electromeric effect, steric effect, steric inhibition of resonance, influence of hybridization on bond properties, bond dissociation energy (BDE) and bond energy, bond distances, bond angles, concept of bond angle strain (Baeyer's strain theory), melting point/boiling point and solubility of common organic compounds in terms of covalent & noncovalent intermolecular forces, polarity of molecules and dipole moments, relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation, calculation of formal charges and double bond equivalent (DBE)

Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes, benzynes and nitrenes, generation and stability, structure using orbital picture and electrophilic/nucleophilic behaviour of the reactive intermediates (elementary idea)

Concept of aromaticity: Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring), concept of antiaromaticity and homoaromaticity, non-aromatic molecules, Frost diagram, elementary idea about α and β, measurement of delocalization energies in terms of β for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene

Module Objectives:

This unit aims to offer basic knowledge on bonding in organic molecules and others physical parameters and stability factors. Students will also understate about aromaticity and delocalization.

Lecture Serial	Topics of Discussion	Remarks
Lecture-50.	Valence Bond Theory: Concept of hybridisation, shapes of molecules	
Lecture-51.	resonance (including hyperconjugation)	

Lecture-52.	Electronic displacements: inductive effect, field effect,	
Lecture-53.	mesomeric effect, resonance energy	
Lecture-54.	bond polarization and bond polarizability; electromeric effect	
Lecture-55.	steric effect, steric inhibition of resonance	
Lecture-56.	MO theory: qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about σ, σ*, π, π *, n – MOs;	
Lecture-57.	basic idea about Frontier MOs (FMO); concept of HOMO, LUMO and SOMO;	
Lecture-58.	interpretation of chemical reactivity in terms of FMO interactions; sketch and energy levels of π MOs of i) acyclic p orbital system (C=C, conjugated diene, triene)	
Lecture-59.	sketch and energy levels of π MOs of allyl and pentadienyl systems	
Lecture-60.	ii) cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems)	
Lecture-61.	Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring)	

Module-VI

Kinetic theory of gases

CONTENTS

Kinetic Theory of gases: Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), wall collision and rate of effusion Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions, kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases. Real gas and virial equation: Deviation of gases from ideal behaviour, compressibility factor, Boyle temperature, Andrew's and Amagat's plots, van der Waals equation and its features, its derivation and application in explaining real gas behaviour, Dietrici equation of state, existence of critical state, critical constants in terms of van der Waals constants, law of corresponding states, virial equation of state, van der Waals equation expressed in virial form and significance of second virial

coefficient, intermolecular forces (Debye, Keesom and London interactions, Lennard-Jones potential - elementary idea)

Module Objectives:

1. This unit aims to offer basic knowledge on Kinetic Theory of gases and it gives the sound knowledge about the gases in molecular level.
2. From this chapter, students have the clear concept about the gases

Lecture Serial	Topics of Discussion	Remarks
Lecture-62.	Concept of pressure and Temperature	
Lecture-63.	Collision of gas molecules	
Lecture-64.	Collision diameter; Collision number and mean free path	
Lecture-65.	Frequency of binary collisions (similar and different molecules)	
Lecture-66	Wall collision and rate of effusion	
Lecture-67	Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions	
Lecture-68.	Kinetic energy distribution in one, two and three dimensions, calculations of average	
Lecture-69	root mean square and most probable values in each case; Calculation of number of molecules having energy $\geq \varepsilon$	
Lecture- 70	Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases.	

Lecture-71	Deviation of gases from ideal Behavior	
Lecture- 72	compressibility factor; Boyle temperature; Andrew's and Amagat's plots	
Lecture- 73	van der Waals equation and its features; its derivation and application in explaining real gas behaviour, other equations of state (Berthelot, Dietrici);	
Lecture- 74	Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states	
Lecture- 75	virial equation of state; van der Waals equation expressed in virial form and significance of second virial coefficient	
Lecture- 76	Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea)	
Lecture-77		Discussion on simple problems.

Module-VII

Thermodynamics-I

CONTENTS

Zeroth and 1st law of Thermodynamics: intensive and extensive variables, state and path functions, isolated, closed and open systems, zeroth law of thermodynamics, concept of heat q, work wand internal energy U, statement of first law, enthalpy H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions, Joule's experiment and its consequence

Thermochemistry: standard states, heats of reaction, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions, adiabatic flame temperature, explosion temperature

Module Objectives:

1. From this portion students can acquire thorough background knowledge about preliminary thermodynamics.

2. It helps the students to develop the basic idea about the change of the heat and other important parameters along with the progress of the reaction.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-78	Zeroth and 1st law of Thermodynamics:Intensive and extensive variables; state and path functions; isolated,closed and open systems;zeroth law of thermodynamics	
Lecture-79.	Concept of heat, work, internal energy and statement of first law	
Lecture-80	enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions	
Lecture-81.	Joule's experiment and its consequence.	
Lecture-82.	Calculations of the change of enthalpy of the thermochemical reaction.	
Lecture-83.		Discussion on simple problems
Lecture-84.		Solutions of previous year questions
Lecture-85.		Solutions of previous year questions
Lecture-86.		Tutorial assignment
Lecture-87.		Tutorial assignment
Lecture-88.		Tutorial assignment

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).
9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).
11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.6
12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
16. Morrison, R. T. Study guide to organic Chemistry, Pearson.
17. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
18. Castellan, G. W., Physical Chemistry, Narosa Publishing House.

DEPARTMENT OF CHEMISTRY

GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I

LESSON PLAN

for

Paper code: CHEM101-1
Paper title: Basic Chemistry-I

***Credits:* 3(Theory)+1(Practical)**

***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Practical (Marks-40)

Module-I Separation		
CONTENTS Based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc., of components of a binary solid mixture; purification of any one of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/p-Toluidine; p- Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/p-Anisidine. **15 classes**		
Module Objectives: Students will experience hand on training regarding quantitative separation of organic compounds using several techniques. These classes may help students to develop their skills regarding laboratory experiments of various RNDs and research.		
Lecture Serial	**Title of the Experiment**	**Remarks**
Lab 1	Laboratory Instructions and guidance on Lab notebook preparation	
Lab 2	Theoretical discussion about the reactions involved in this course	
Lab 3	Skill development on weighing and glass instruments	
Lab 4	Training to Detect MP of some common organic compounds	
Lab 5	Separation of two component from the mixture of Benzoic acid/p-Toluidine	
Lab 6	Continuation	
Lab 7	Purification of benzoic acid through crystallization	
Lab 8	Detection of MP of benzoic acid	
Lab 9	Separation of two component from the mixture of p-Nitrobenzoic acid/p-Aminobenzoic acid	

Lab 10	Continuation	
Lab 11	Purification of p-Nitrobenzoic acid through crystallization	
Lab 12	Detection of MP of p-Nitrobenzoic acid	
Lab 13	Separation of two component from the mixture of p-Nitrotolune/p-Anisidine	
Lab 14	Purification of p-Nitrotolune acid through crystallization	
Lab 15	Detection of MP of p-Nitrotolune	

Module-II

Determination of boiling point

CONTENTS

Determination of boiling point of common organic liquid compounds e.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]. **3 classes**

Module Objectives:

Students will get training on determination of boiling point with some common organic solvents. It will help to detect proper solvent for a particular reaction in their future.

Lecture Serial	Title of the Experiment	Remarks
Lab 16	Apparatus set up and showing the process	
Lab 17	Determination of BP of ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone	
Lab 18	Determination of BP of acetylacetone, anisole, crotonaldehyde, mesityl oxide	

Module-III

Identification of a Pure Organic Compound by Chemical Test(s)

CONTENTS

Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose and salicylic acid. Liquid Compounds: acetic acid, ethyl alcohol, acetone, aniline and nitrobenzene. **12 classes**

Module Objectives:

Students will experience hand on training regarding and skill development for identification of Organic Compounds by Chemical Tests which will help to detect the nature of compounds and their chemical behavior.

Lecture Serial	Title of the Experiment	Remarks
Lab 19	Identification of oxalic acid	
Lab 20	Identification of succinic acid	
Lab 21	Identification of resorcinol	
Lab 22	Identification of urea	
Lab 23	Identification of glucose	
Lab 24	Identification of salicylic acid	
Lab 25	Identification of acetic acid	
Lab 26	Identification of ethyl alcohol	
Lab 27	Identification of acetone	
Lab 28	Identification of aniline	
Lab 29	Identification of nitrobenzene	
Lab 30		Practice

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

Department of Chemistry

Government General Degree College, kalna-I

LESSON PLAN

for

SKILL ENHANCEMENT COURSE (SEC)

Paper code: CHEM105-1

Paper title: Drugs and pharmaceuticals

Credits-03

Course time hour:45

***Full Marks*:50 (Theory-40, Internal Assessment–10)**

Theory (Marks-40)

Module-I Drugs & Pharmaceuticals		
CONTENTS Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).		
Module Objectives: Medicinal/Pharmaceutical chemistry deals with the discovery, design, development and both pharmacological and analytical characterization of drug substances. The chapter describes stages of drug development followed by a summary of the phases of drug activity relating to a drug's formulation. Finally, classification systems for marketed drug substances are presented, with an emphasis on their structure, synthesis and use.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Drug discovery, design and development (part 1)	
Lecture-2.	Drug discovery, design and development (part 2)	
Lecture-3.	Drug discovery, design and development (part 3)	

Lecture-4.	Drug Targets, Mechanism of drug action (part 1)	
Lecture-5.	Drug Targets, Mechanism of drug action (part 2)	
Lecture-6.	Definition and classification of analgesics agents, antipyretic agents, anti-inflammatory agents	
Lecture-7.	Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen)	
Lecture-8.	Comparative discussion on activity and use of Aspirin, paracetamol, ibuprofen	

Lecture-9.	antibiotics (Chloramphenicol)	
Lecture-10.	antibacterial and antifungal agents: Sulphonamides; Sulphanethoxazol	
Lecture-11.	antibacterial and antifungal agents: Sulphacetamide, Trimethoprim	
Lecture-12.	antiviral agents (Acyclovir)	
Lecture-13.	Central Nervous System agents (Phenobarbital, Diazepam)	
Lecture-14.	Cardiovascular (Glyceryl trinitrate)	
Lecture-15.	antilaprosy (Dapsone)	
Lecture-16.	HIV-AIDS related drugs (AZT- Zidovudine)	
Lecture-17.		Discussion on Problems
Lecture-18.		Question-Answer

Reference Books:

1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.

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

4. El-Mansi, E.M.T., Bryce, C.F.A., Ddemain, A.L., Allman, A.R., Fermentatias Microbiology and Biotechnology, 2nd Ed. Taylor & Francis.

5. Prescott & Dunn's Industrial Microbiology, 2004, CBS Publisher.