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***	

<h1 style="text-align:center">Semester-I</h1>

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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.

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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. NaHCO3, 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 $\sin nx$, $\cos nx$, $\tan nx$, $\sec nx$, $\log x\, n$, $\sin^n x$ $\sin^m x$, 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
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:

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.

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	

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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.

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-II

Course Type	Title of the Course	Credit	Full Marks	Lecture Hour
Major Course CHEM201-1	Basic Chemistry-II	4 (Theory-03, Practicals-01)	75 (Theory-40, Practical–20, Internal Assessment–15)	75 (Theory-45, Practical-30)
Minor Course MATH2021	Introductory Algebra & Number Theory	4 (Theory-04)	75 (Theory-60, Internal Assessment–15)	60 (Lecture -45, Tutorial – 15)
Multi/ Interdisciplinary ENGL2031	Technical Writing	3 (Theory-03)	50 (Theory-40, Internal Assessment–10)	45
Ability Enhacement Course [L2-1] Code: ENGL2041	Functional English	2 (Theory-02)	50 (Theory-40, Internal Assessment–10)	30
SEC CHEM205-1	Basic Analytical Chemistry	3 (Theory-03)	50 (Theory-40, Internal Assessment–10)	45
Value Added (VA) Course Code: CVA2061	Health & Wellness, Yoga Education, Sports and Fitness	4 (Theory-04)	100	60
		Total Credit = 20	Total Marks = 400	

Semester-II

Chemistry MAJOR
Paper code: CHEM201-1

Paper title: Basic Chemistry-II   Credits 3+1

Theory   Credits 3

1. 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 derivation 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 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)   *6 Hours*

2. Redox Reactions and Precipitation Reactions

Balancing of redox reactions: ion-electron method, elementary idea on standard redox potentials- Nernst equation (without derivation), influence of complex formation, precipitation and pH, formal potential

Redox titrations: feasibility, redox potential at the equivalence point, redox indicators, redox potential diagram (Latimer and Frost diagrams) of common elements and their applications Disproportionation and comproportionation reactions (typical examples), solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides   *4 Hours*

3. Stereochemistry-I

Bonding geometries and representation of carbon compounds: tetrahedral nature of carbon and concept of asymmetry: Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations

Chirality and symmetry: symmetry elements and point groups (C_v, C_{nv}, C_{nh}, C_n, D_h, D_{nh}, D_{nd}, D_n, S_n (C_s, C_i), molecular chirality and centre of chirality, asymmetric and dissymmetric molecules, enantiomers and diastereomers, epimers, stereogenicity,

chirotopicity and pseudoasymmetry, chiral centres and number of stereoisomerism, systems involving 1/2/3-chiral centre(s)- AA, AB, ABA and ABC types

Relative and absolute configuration: D/L and R/S descriptors, erythro/threo and meso nomenclature of compounds, syn/anti nomenclatures for aldols, E/Z descriptors- C=C, conjugated diene, triene, C=N and N=N systems, combination of R/S- and E/Z-isomerisms
Optical activity compounds: optical rotation, specific rotation and molar rotation, racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates), resolution of acids, bases and alcohols via diastereomeric salt formation, optical purity and enantiomeric excess.   *6 Hours*

4. General Treatment of Reaction Mechanism

Free energy profiles: one-, two- and three-step reactions, catalyzed reactions-electrophilic and nucleophilic catalysis, kinetic control and thermodynamic control of reactions, isotope effect- primary and secondary kinetic isotopic effect (k_H / k_D), principle of microscopic reversibility

Tautomerism: prototropy (keto-enol, amido-imidol, nitroso-oximino, diazo-amino and enamine-imine systems) and ring-chain tautomerism, composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3-dicarbonyl systems, phenols and related systems), factors affecting keto-enol tautomerism, application of thermodynamic principles in tautomeric equilibria   *6 Hours*

5. Substitution and Elimination Reactions

Nucleophilic substitution reactions: substitution at sp3 centre- mechanisms (with evidence), relative rates, stereochemical features, S_N^1, S_N^2, $S_N^{2'}$, $S_N^{1'}$ (allylic rearrangement) and S_N^i, effects of solvent, substrate structure, leaving group and nucleophiles (including ambient nucleophiles, cyanide & nitrite), electrofuges and nucleofuges, substitutions involving NGP, role of crown ethers and phase transfer catalysts [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides]

Elimination reactions: E_1, E_2, E_1cB and Ei (pyrolytic syn eliminations), formation of alkenes and alkynes, mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity, comparison between substitution and elimination
                                                                    6 Hours

6. 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. *5 Hours*

7. Liquid state

Viscosity: General features of fluid flow (streamline and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; temperature variation of viscosity of liquids and comparison with that of gases

Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; work f cohesion and adhesion, spreading of liquids over other surfaces; vapour pressure over curved surface; temperature dependence of surface tension, principle of surface tension measurement *6 Hours*

8. Thermodynamics-II

Second Law: its need and statement, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine and refrigerator, Kelvin – Planck and Clausius statements and their equivalence in entropic formulation, Carnot's theorem,values of §dQ/T and Clausius inequality, entropy change of systems and surroundings for various processes and transformations, entropy and unavailable work, auxiliary state functions (G and A) and their variations (with T, P and V), criteria of spontaneity and equilibrium

Thermodynamic relations: Maxwell's relations, Gibbs- Helmholtz equation, Joule-Thomson experiment and its consequences, inversion temperature, Joule-Thomson coefficient for a van der Waals gas, general heat capacity relations. *6 Hours*

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.

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. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.

16. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).

17. Morrison, R. T. Study guide to organic Chemistry, Pearson.

18. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.

19. Castellan, G. W. Physical Chemistry, Narosa Publishing House.

20. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.

21. Laidler, K. J. Chemical Kinetics, Pearson.

22. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.

23. Rakshit, P.C., Physical Chemistry, Sarat Book House.

24. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas.

25. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.

26. Nasipuri, D.Stereochemistry of Organic Compounds, New Age International (P) Ltd.

27. Sengupta,S. Basic Stereochemistry of Organic Molecules, Oxford University Press

28. Manna, A.K. Organic Molecular Spectroscopy, Books and Allied (P) Ltd.

29. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.

30. Engel, T. & Reid, P. Physical Chemistry, Pearson.

31 Levine, I. N. Physical Chemistry, Tata McGraw-Hill.

32. Ball, D. W. Physical Chemistry, Thomson Press.

33. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher

34. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education

35. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.

Practical   Credit 1

1. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate

2. Study of kinetics of decomposition of H_2O_2 by KI

3. Determination of pH of unknown strong alkali and acid solution by colour matching method

4. Determination of pH of unknown buffer solution by colour matching method

5. Study of viscosity of unknown liquid (glycerol, sugar) with respect to water

6. Determination of surface tension of a liquid using Stalagmometer

30 Hours

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Nad, Mahapatra, Ghosal, An Advance course in Practical Chemistry, New Central Book Agency (P) Ltd.

3. K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.

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

5. Poddar and Ghosh, Degree Practical Chemistry, Book Syndicate (P) Ltd.

Course Code: MATH2021
Course Name: Introductory Algebra and Number Theory
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives
To present a systematic introduction to number theory and basic course on algebra.

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. number theory which has wide applicability in advanced mathematics and also in various practical field, e.g., cryptography, computer science and many competitive exams.
   ii. complex number and its properties which are equally indispensable tools for advanced studies and different practical field.
   iii. a basic introduction to modern algebra which has wide applicability in different branch of sciences.

Skills:
The students would be able to
   i. access and also generate different tricky examples and counter examples involving integers during their advanced study of ring theory and field theory.
   ii. simplify a mathematical problem in different field of science using complex number.
   iii. motivate themselves for future research after getting the glimpse of gateway of modern algebra from classical algebra and number theory and relate use of group, ring and field in different field of science.

General competence: The students would gain
   i. descriptive idea of various properties of complex number.
   ii. knowledge of richness in number theory.
   iii. understanding in basic concepts of group, ring and field.
   iv. expertise in solving many tricky problems in number theory, complex numbers.

Contents:
Algebra
Complex Numbers: De Moivre's theorem for rational indices and its applications.
Theory of equations: Fundamental Theorem of Algebra (Statement), Relation between roots and coefficients, Transformation of equation, Descarte's rule of signs, Cubic and biquadratic equations, Reciprocal equation, separation of the roots of equations, Strum's theorem.

Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality. [L-**10H & T-4H**]

Partial order, total order relations, partitions of a set and its connection with equivalence relation, greatest lower bound, least upper bound, maximal, minimal elements, lattice, bounded lattice, modular lattice, distributive lattice, complemented lattice, statement of Zorn's lemma.
[L-**5H & T-2H**]

Semigroups, Monoids, Groups – examples including permutation group, Matrix groups $(M_{n \times n}(\mathbb{R}), GL_n(\mathbb{R}), SL_n(\mathbb{R}))$, Z_n, elementary properties of groups, generators and relations, order of an element of a group, Subgroups and examples of subgroups, cosets, normal subgroup, center of a group, cyclic groups, Lagrange's theorem, Rings, subrings, Ideals (left, right and two sided), integral domain, field, subfield – examples and basic properties, characteristic of a ring and field.
[L-**10H & T-4H**]

Number Theory
Well ordering principle of set of natural numbers, pigeon-hole principle, division algorithm, greatest common divisor (gcd), Euclidean algorithm, least common multiple (lcm), Linear Diophantine equation, prime numbers, relatively prime numbers and related properties including Euclid's lemma, fundamental theorem of arithmetic and its applications, perfect square and square free integers, congruences, solution of congruences, Binary and decimal representation of integer, Chinese remainder theorem and its application. Fermat's little theorem, Wilson's theorem, sum of two squares, Arithmetic function-$\phi(n), d(n), \sigma(n)$. [L-**20H & T-5H**]

Reading References:
Text books:
1. Classical Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
2. Topics in Abstract Algebra – M.K. Sen, S. Ghosh, P. Mukhopadhyay, S. K. Maity, 3rd Edition (University Press).
3. Higher Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
4. An introduction to Theory of Numbers- Niven, Ivan, S. Zuckerman Herbert, L. Montogomery Hugh,5th Edition, (Willey).
5. Elementary Number Theory- D. M. Burton, (Mc Graw Hill Education).
Reference Books:
1. Topics in Algebra – I. N. Herstein,2nd Edition, (Wiley).
2. Contemporary Abstract Algebra - Gallian, A. Joseph, Standard Edition, (Cengage India Private Limited).
3. Higher Algebra - S. Barnards, J. M. Child, (Arihant).
4. Algebra - M. Artin, 2nd Edition, (Pearson Education, India).
5. A first course in Abstract Algebra - J. B. Fraleigh7th Edition, (Pearson Education, India).

INTERDISCIPLINARY COURSE

ENGL2031: Technical Writing
[3 Cr, Full Marks: 50 (Theory: 40 + IA: 10), LH: 45 hrs]

COURSE OBJECTIVE:

Technical writing is a necessary requirement in many professions, and this course is designed to make students aware ofthe various forms of such writing. The objective is to equip students to face the challenges of technical writing in professional life.

Introducing Technical Writing(LH: 15)
What is technical writing?
Difference between technical writing and other forms of writing
Roles and responsibilities of technical writers
Qualities and qualifications of technical writers

Forms and Styles of Technical Writing(LH: 30)
Styles in technical writing
Forms of discourse, audience analysis, persuasion
Grammar in technical writing, revising a written document
Clarity, precision, coherence and logic in technical writing
Collecting notes, writing summaries and drafts, writing minutes and resolutions of meeting
Designing and reviewing documents
Document formats, differences between hard and soft copy versions
Web content writing
Collaborative writing
Professional Ethics, plagiarism, and copyright

COURSE OUTCOME:

It is expected that students emerging from this course will be capable of handling the demands and challenges of technical writing in the course of their professional careers in government and private sectors as well as in transactions of business.

ABILITY ENHANCEMENT COURSE

ENGL2041: Functional English
[2 Cr, Full Marks: 50 (Theory: 40 + IA: 10), LH: 30 hrs]

COURSE OBJECTIVE:

The importance of functional English at the present moment cannot be over-emphasized. Recognizing this importance, the course seeks to acquaint students with the various uses of English in today's world, with particular focus on developing one's conversational and writing skills together with the ability to comprehend English speech and writing.

What is functional English? (LH: 1)
Aims and objectives of functional English (LH: 1)
Functional English and formal English/ literary English (LH: 1)
Types and modes of Communication (LH: 1)
Language of communication (LH: 1)
Conversational skills (LH: 1)
Verbal and Non-verbal communication(LH: 1)
Personal, social and business communication (LH: 1)
Understanding English language films, songs, documentaries, news bulletins, sports commentaries (LH: 4)
Comprehension skills (LH: 2)
Paraphrasing difficult passages (LH: 2)
Analysis and Interpretation (LH: 1)
Writing for classified advertisements (LH: 2)
Using idioms and phrases (LH: 2)
One-word substitution (LH: 1)
Figures of speech: simile, metaphor, irony, personification, hyperbole (LH: 3)
Reading online content (LH: 1)
George Bernard Shaw: "Spoken English and Broken English" (LH: 4)

COURSE OUTCOME:

Besides developing the student's ability to comprehend the English that one hears and reads, the course will also enhance the student's skills at using English in speech and in various forms of writing. Thus, the course shall fulfil to a large extent an intensely felt need in today's professional world.

SKILL ENHANCEMENT COURSE

Paper title: CHEM205-1

Paper code: Basic Analytical Chemistry   Credits 3

Theory

1. **General principle**

Introduction to analytical chemistry and its interdisciplinary nature, concept of sampling, importance of accuracy, precision and sources of error in analytical measurements, presentation of experimental data and results, role of significant figures   *8 Hours*

3. **Analysis of soil**

Composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators   *6 Hours*

3. **Analysis of water**

Definition of pure water, contaminants (different types), water sampling methods, water purification methods   *6 Hours*

4. **Analysis of food products**

Nutritional value of a food, idea about food processing and food preservations, and adulteration

6 Hours

5. **Chromatography**

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc., column chomatography, ion-exchange chromatography, etc., determination of ion exchange capacity of anion /cation exchange resin   *10 Hours*

6. **Analysis of cosmetics**

Major and minor constituents of cosmetics and their functions, analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate   *9 Hours*

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.

3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction sixth Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).

4. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.

5. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.

6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.

7. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).

8. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).

9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.

10. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

12. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

Semester-II	Course Type with Code	Name of the Course	Credit	Lect.	Tuto.	Pract./ Viva-voce	Full Marks	Distribution of Marks		
								Theory	Pract./ Viva-	Internal Assessment
	Value Added (VA) Course Code:CVA2061	Health & Wellness, Yoga Education, Sports and Fitness	4	3	0	1	100	60	20	20

Value Added (VA) Course

Course Name: Health & Wellness, Yoga Education, Sports and Fitness
Course Code: CVA2061   **Total Lecture Hours (Theory) :** 45
Credit: 4   **Total Lecture Hours (Practical):** 30

Unit- 1: Concepts of Wellness and Illness   (15 Lecture Hours)

Concept of health (Modern and Ancient View); Concept of Wellness and Illness (Modern and Ancient View); Concept of Body (Pancha Kosha according to Taittiriya Upanisada); Potential causes of illness according to Yoga Vasishta- Concept of Adhi and Vyadhi and their consequences on the body

Unit- 2: Yogic Concept on Holistic Health   (15 Lecture Hours)

Total Human Development through Yogic practices for Pancha Kosha (Annamaya Khosha, Pranamaya Kosha, Manomaya Kosha, Vijnanamaya Kosha and Ananda Maya Kosha) and its integration with Ashtanga Yoga of Patanjali.

Unit- 3: Yoga as Preventive Health Care   (15 Lecture Hours)

Concept of stress according to modern science and yoga; Stress as the cause for illness; Role of Yoga in Stress Management: Holistic approach of catering to moderation in eating (yogic Diet), Sleeping (rhythm of the nature), Working (the sense of duty as per BG), Entertainment (moderation), Change in life style;

Unit-4 (Practical) : Asana   (30 Lecture Hours)

Pranayama: Anulome-Vilome, Suryabhidana, Chancrabhedana, Ujjai, Sitali

Meditation: A-U-M Meditation, Yog Nidra

Reference Books:

1. Ajith 'Yoga Pravesh' Rastrotana Paruhad Bangalore.

2. Bachelor of Sports Management Syllabus (Revised) 2008.

3. B. C. Rai Health Education and Hygiene, Published by Prakashana Kendra, Lucknow.

4. B.K.S. Iyenger 'Yoga The Path of Holistic Health', Dorling Kindersley, Delhi 2001.

5. Dixit Suresh (2006) Swasthya Shiksha Sports Publication, Delhi.

6. Puri, K. Chandra, S.S (2005) Health and Physical Education, New Delhi, Surjeet Publication.

7. A Text Book on Physical Education & Health Education Fitness, Wellness and Nutrition, Dr. A. K. Uppal, Dr. P. P. Ranganathan.

8. Warner W. K. Oeger & Sharon A. Hoeger, Fitness & Wellness, Morton Publishing Co., 1990

9. Robert Malt. 90 day Fitness Plan, D. K. Publishing, Inc. 95, Madison Avenue, New York 2001.

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