Dual Degree B.Sc. (Hons)-M.Sc. in Chemistry Semester-II Inorganic Chemistry–II	
Paper Code: DCH 102	**Credits: 03**
03 Hrs /week	**External Marks: 75**
Total: 45 Hrs	**Sessional Marks: 25**
	Duration of Exam: 03 Hrs

OBJECTIVES:

1. To review the basic concepts of Chemical Bonding.
2. To develop an understanding of covalent bond, metallic bond and weak chemical forces.
3. To describe the general characteristics of the alkali metals and alkaline earth metals and their compounds.
4. To explain how different elements combine with hydrogen to form ionic, molecular and non stoichiometric compounds.
5. To explain the general principles of metallurgy.
6. To explain the substances as acids or bases according to Lewis, hard and soft. Pearson's HSAB concept.

OUTCOME:

- Able to understand the different type of chemical bonding (covalent bond, metallic bond and weak chemical forces), geometry of molecules, and different types of hybridization.
- Able to understand general characteristics of the alkali metals and alkaline earth metals compounds and their industrial importance.
- Able to understand the properties of hydrogen to the production of useful substances, and new technologies.
- Able to explain the general principles of metallurgy.
- Able to classify substances as acids or bases according to Lewis, hard and soft. Pearson's HSAB concept, and explain the theoretical basis of hardness and softness.

Books Suggested:

1. Cotton F.A., Wilkinson G.W. and Gaus P.L., Basic Inorganic Chemistry, Pubs: John Wiley &Sons ,1987.
2. Lee J.D., Concise Inorganic Chemistry, 4th edition, Pubs: ELBS,1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., Inorganic Chemistry : Principles of Structures and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.
4. Greenwood N.N. and Earnshaw A., Chemistry of the Elements, 2nd edition., Pubs: Butterworth/Heinemann, 1997.

5. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc., 1999.
6. Shriver D.F., Atkins F.W. and Langford C.M., Inorganic Chemistry; 3rd Edition, Pubs: Oxford University Press, 1999.
7. Douglas B., Daniel D. Mc and Alexander J., Concepts of Models of Inorganic Chemistry, Pubs: John Wiley,1987.

LECTUREWISE PROGRAMME: **(From 08.01.18 to 27.04.18)**

Dual Degree B.Sc. (Hons)-M.Sc. in Chemistry Semester-II Inorganic Chemistry–II	
Paper Code: DCH 102	**Credits: 03**
03 Hrs /week	**External Marks: 75**
Total: 45 Hrs	**Sessional Marks: 25**
	Duration of Exam: 03 Hrs

Note: The question paper will consist of *nine* questions. The candidates will be required to attempt *five* questions in all. The Question No. 1 will be *compulsory* and comprising short answer type questions of equal marks spread over the whole syllabus. The candidate shall attempt four more questions selecting at least one from each Unit. All questions will carry equal marks.

LECTUREWISE PROGRAMME : (from 08.01.18 to 27.04.18)

UNIT-I (from 08.01.18 to 02-02.18)

Chemical Bonding III: Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.
Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.
Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, Instantaneous dipole-induced dipole. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process.

UNIT-II (from 05.02.18 to 28.02.18)

The *s*-Block Elements:Production and uses of metals; chemical reactivity and trends in alkali and alkaline earth metals; structure and properties of oxides, halides and hydroxides, coordination complexes, Organometallic compounds of alkali metals, Crown and Crypts, Behaviour of solutions in liquid ammonia.

Hydrogen: Its unique position in the periodic table, isotopes, ortho and para hydrogen, Industrial
production, Hydrides and their chemistry; Heavy water, Hydrates.

UNIT-III (from 01.03.18 to 30.03.18)

General Principles of Metallurgy Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, van Arkel-de Boer process and Mond's process, Zone refining.

UNIT-IV (from 02.04.18 to 27.04.18)

Acids &Bases: Various definitions of acids and bases, A generalized acid-base concept, Measurement of acid-base strength, Lewis interactions in non-polar solvents, Systematics of Lewis acid-base interactions, Bond energies, steric effects, solvation effects and acid-base anomalies, Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

Home Assignments: 4 –5 assignments are given during the semester.
Evaluation Procedure

1.	Assignment / Performance in the Class	05Marks
2.	Minor Tests (Two tests having equal weightage) Minor Test I : 14-16 Feb, 2018 Minor Test II : 4 -6 April, 2018	20 Marks (10 marks each minor test)
3.	University Examination	100 Marks

Award of Grades Based on Absolute Marks: The University is following the system of grading based on absolute marks (after applying moderation if any). Following grading will be done based on the % of marks obtained in all the components of evaluation part of the subject.
A+ (90% - 100 %), A (80% - 89%), B+ (70% - 79%) , B(62% - 69%), C+ (55% - 61%), C (46% - 54%), D (40% - 45), F (Less than 40 %)

For F grade, a candidate shallbe required to appear in the major test of concerned course only in the subsequent examination(s) to obtain the requisite marks/grade.

Attendance Record – Candidate should attend at least75% attendance of the total classes held of the subject

Counselling hour: The student can contact in any vacant period.

Dual Degree B.Sc. (Hons)-M.Sc. in Chemistry Semester-II Physical Chemistry-II	
Paper Code: DCH 106	**Credits: 03**
03 Hrs/week	**External Marks: 75**
Total: 45 Hrs	**Sessional Marks: 25**
	Duration of Exam: 03 Hrs

Course Objectives: This course is designed to provide the concepts of partial molar properties & thermodynamics of the mixtures physical chemistry, stressing ideal & non ideal gases, equation of state, properties of liquids, thermodynamics. Physical chemistry expands upon the elementary notions of interactions, equilibrium, bonding, heat, entropy and energy. This area of chemistry uses extensive mathematical tools (differential and integral calculus) to probe the intricate interactions involved in chemical systems. Thus, in order to succeed in this course, problem-solving skills would be practiced and developed.

Outcome:

- Able to apply the concept of partial molar properties to mixtures.
- Able to explain the characteristics of chemical equilibrium.
- Able to solve the numerical problems and find application related to one and two component phase equilibria, electrolytic solution as well as colligative properties.

Note: The question paper will consist of *nine* questions. The candidates will be required to attempt *five* questions in all. The Question No. 1 will be *compulsory* and comprising short answer type questions of equal marks spread over the whole syllabus. The candidate shall attempt four more questions selecting at least one from each Unit. All questions will carry equal marks.

UNIT I

08.01.2018-31.01.2018

Partial Molar Properties and Fugacity and Thermodynamics of Simple Mixtures: Partial molar properties. Chemical potential of a perfect gas, dependence of chemical potential on temperature and pressure, Gibbs-Duhem equation, real gases, fugacity, its importance and determination, standard state for gases. Stability of phases, Clapeyron equation. Clausius-Clapeyron equation and its application to solid-liquid, liquid-vapour and solid-vapour equilibria. Thermodynamic functions for mixing of perfect gases. Chemical potential of liquids. Raoult's law, Henry's law. Thermodynamic functions for mixing of liquids (ideal solutions only). Mixtures of volatile liquids, vapour pressure

diagrams. Lever's rule, distillation diagrams. Real solutions and activities, standard states for solvent and solute.

UNIT-II

01.02.2018-28.02.2018

Phase Equilibria: Phase rule and its thermodynamic derivation. One component systems-water, sulphur, carbon dioxide, helium. Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems. A simple system involving chemical reaction. Eutectics, freezing mixtures, ultra purity, zone refining.

UNIT-III

01.03.2018-30.03.2018

Chemical Equilibrium and Thermodynamics of Electrolytic Solutions: Direction of spontaneous change in a chemical reaction, extent of reaction, stoichiometric coefficients, equilibrium constant in terms of G. Temperature and pressure dependence of equilibrium constant, homogeneous and heterogeneous equilibria.

True and potential electrolytes, Activities of ions in solutions, a model of ions in a solution, qualitative idea of Debye-Huckel theory, ionic strength, mean ionic activity coefficient and the Debye-Huckel limiting law for activity coefficients.

UNIT-IV

01.04.2018-27.04.2018

Colligative Properties and Electrochemical Cells: Solutions of non-volatile solutes: colligative properties, elevation in boiling point, depression in freezing point, osmosis and osmotic pressure

Interfacial potential difference, the electrodes, potential at interfaces, electrode potentials, galvanic cells, emf, direction of spontaneous reactions. Concentration dependence of emf, equilibrium Constant from electrode potential, standard electrode potentials and their determination. Measuring activity co-efficient, thermodynamic data from cell emf. The temperature dependence of

emf. Applications of emf. Measurements–solubility product, potentiometric titrations, pK and pH measurements of pK and pH. Acid-base titrations. Concentration cells with & without transference.

Suggested Books

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006.
2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.
3. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
4. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.
5. Physical Chemistry by R. J. Silbey, R. A. Albert & Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005.

Dual Degree B.Sc. (Hons)-M.Sc. in Chemistry Semester-II Inorganic Chemistry–II	
Paper Code: DCH 112	**Credits: 04**
03 Hrs /week	**External Marks: 75**
Total: 45 Hrs	**Sessional Marks: 25**
	Duration of Exam: 03 Hrs

OBJECTIVES:

7. To explain the basic concept of chemical thermodynamics and chemical equilibrium.
8. To describe the general characteristics of chemical equilibrium, and thermodynamic derivation.
9. To explain the concept of grouping elements in accordance to their properties led to the development of periodic table and understand the periodic law.
10. To describe the general characteristics of the alkali metals and alkaline earth metals and their compounds.
11. To explain the chemistry of p-block elements and importance of their compounds in day to day life.

OUTCOME:

- Able to explain the different thermodynamics law.
- Able to explain the characteristics of chemical equilibrium.
- Able to use scientific vocabulary appropriately to communicate ideas related to certain important properties of atoms e.g., atomic/ ionic radii, ionization enthalpy, electronegativity, electron gain enthalpy, valence of elements.
- Able to understand general characteristics of the alkali metals and alkaline earth metals compounds and their industrial importance.
- Able to explain the chemistry of P-block elements and structures of their compounds with their enumerate the uses in the daily life.

Books Suggested:

1. Mahan B.H., University Chemistry, Pubs: Norosa Publishing House,1998.
2. Puri B.R., Sharma L. R. and Pathania M. S., Principles of Physical Chemistry, Pubs: Vishal Publishing Company, 2003.
3. Sienko M.J. and Plane R.A., Chemistry principles and properties, Pubs: Mc Graw-Hill, New York 1975.
4. Lippincott W.T., Carett A.R. and F.H. Chemistry, A Study of Matter, Pubs:John Wiely, New York ,1977.
5. Dickerson R.E., Gray H.B., Derensburg M.Y. and D.S. Darensbourg, Chemical Principles, Pubs:Benjamin-Cummings Menlo Park ,1984.
6. McQuarrie D.A. and Rock P., General Chemistry, Pubs:W.H. Freeman, New York, 1984.
7. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
8. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
9. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
10. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
11. R. Sarkar, *General & Inorganic ChemistryPart I*, New Central Book Agency (P) Ltd., 2012.

LECTUREWISE PROGRAMME: **(From 08.01.18 to 27.04.18)**

Dual Degree B.Sc. (Hons)-M.Sc. in Chemistry Semester-II Inorganic Chemistry–II	
Paper Code: DCH 112	**Credits: 04**
03 Hrs /week	**External Marks: 75**
Total: 45 Hrs	**Sessional Marks: 25**
	Duration of Exam: 03 Hrs

Note: The question paper will consist of *nine* questions. The candidates will be required to attempt *five* questions in all. The Question No. 1 will be *compulsory* and comprising short answer type questions of equal marks spread over the whole syllabus. The candidate shall

attempt four more questions selecting at least one from each Unit. All questions will carry equal marks.

LECTUREWISE PROGRAMME : (from 08.01.18 to 27.04.18)

UNIT-I (from 08.01.18 to 28.02.18)

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

UNIT-II (from 01.03.18 to 27.04.18)

Chemical Equilibrium and Thermodynamics of Simple Mixtures: Partial molar quantities and their significance. Chemical potential and its variation with T and P. Fugacity function and its physical significance. Concept of activity and activity coefficient. General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant-Van't Hoff equation, homogeneous & heterogreneous equilibria, Le Chetalier's principle.

UNIT-III (from 08.01.18 to 28.02.18)

The Periodic Table and Chemical Periodicity: The relationship between chemical periodicity and electronic structure of the atom. Thelong form of the periodic table – Classification of elements in s,p,d and f block ofelements. Periodicity in oxidation state of valence, metallic/non-metallic character,oxidizing or reducing behaviour; acidic and basic character of oxides; trends in bond typewith position of element and with oxidation state for a given element; trends in thestability of compounds and regularities in methods used for extraction of elements fromtheir compounds; Trends in the stability of coordination complexes. Anomalous behaviour of elements of 2nd short period (Li to F) compared to other members in the same groups of s & p block elements; The diagonal behaviour between elements, theinert pair effect; variability of oxidation states of transition elements, colour, magnetic properties and other characteristics of transition elements.

UNIT-IV (from 01.03.18 to 27.04.18)

The s-block elements: Production and uses of metals; chemical reactivity and trends in alkali and alkaline earthmetals; structure and properties of oxides, halides and hydroxides, coordinationcomplexes, Organometallic compounds of alkali metals, Crown and Crypts, Behaviour ofsolutions in liquid ammonia.

The *p*-Block Elements: Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group. Structure of oxides and oxiacids of N, P, S and Cl.

Home Assignments: 4 –5 assignments are given during the semester.
Evaluation Procedure

1.	Assignment / Performance in the Class	05Marks
2.	Minor Tests (Two tests having equal weightage) Minor Test I : 14-16 Feb, 2018 Minor Test II : 4 -6 April, 2018	20 Marks (10 marks each minor test)
3.	University Examination	100 Marks

Award of Grades Based on Absolute Marks: The University is following the system of grading based on absolute marks (after applying moderation if any). Following grading will be done based on the % of marks obtained in all the components of evaluation part of the subject.
A+ (90% - 100 %), A (80% - 89%), B+ (70% - 79%) , B(62% - 69%), C+ (55% - 61%), C (46% - 54%), D (40% - 45), F (Less than 40 %)

For F grade, a candidate shallbe required to appear in the major test of concerned course only in the subsequent examination(s) to obtain the requisite marks/grade.

Attendance Record – Candidate should attend at least75% attendance of the total classes held of the subject
Counselling hour: the student can contact in any vacant period.