

# GONDWANA UNIVERSITY, GADCHIROLI

B.Sc: Part - II (Semester-III)

SUBJECT - CHEMISTRY

Paper-I (Inorganic Chemistry)

Total Lectures: 48

Marks:50

Note: Figures to the right hand side indicate number of lectures.

## Unit-I

**A) Ionic Solids:** Ionic structures, radius ratio effect & coordination number, Limitation of radius ratio rule, Lattice energy and Born-Haber cycle. Salvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rules.

[6L]

**B) Metallic Bonding:** Free electron theory and properties of metals, valance bond theory and Band theory to explain nature of conductors, insulators & semiconductors (intrinsic and extrinsic).

[3L]

**C) Hydrogen Bonding :** Classification and effect of hydrogen bonding on viscosity, solubility, Melting point and boiling point

[3L]

## Unit-II

**A) Chemistry Of First Transition Series Elements:** Properties of the elements of first transition series with reference to their electronic configuration, atomic and ionic radii, ionization potential, Variable oxidation state, Magnetic properties, Colour, Complex formation tendency and Catalytic activity. [8L]

**B) Chemistry Of Elements Of Second And Third Transition Series:** Electronic configuration of 4d and 5d transition series. Comparative treatment with 3d-analogous (Groups Cr-Mo-W, Fe-Rn-Os, Co-Rh-Ir, Ni-Pd-Pt) in respect of oxidation states, magnetic behavior and stereo chemistry.

[4L]

## Unit-III

**A) I) Errors In Chemical Analysis:** Random and systematic errors, explanation of terms accuracy and precision, uncertainty, absolute and relative errors, mean, median definition average and standard deviation, significant figures, Numeral problems.

**II) Statistical Test Of Data :** Q-test 2.5d and 4d rules for the rejection of data, Numerical problems. [6L]

### **B) Theory Of Volumetric Analysis**

**i) Acid-Base Titration:** Types of acid-base titration, theory of acid-base titration

a) Ostwald's theory b) Quinonied Theory, choice of suitable indicators for different acid-base titrations.

**ii) Redox Titration:** General principles involved in redox titrations. Theory of redox indicators- external and internal

**iii) Complexometric Titration:** Theory of complexometric titration, metallochrome indicator.

[6L]

### **Unit-IV**

**A) Non-aqueous solvent:** Classification of solvents and general characteristics reaction in Non-aqueous solvents with reference to liquid ammonia and liquid sulphur dioxide.

[3L]

**B) Fertilizers:** Classification, chemical fertilizers with examples, advantages and disadvantages of chemical fertilizers, manures and compost and their advantages over chemical fertilizers. [3L]

**C) Portland cement :** Raw materials, general composition of ordinary Portland cement, methods of manufacturing of cement i) Dry process ii) Wet process, reactions taking place in rotary kiln, properties of cement, additives for cement thermochemical changes taking place during cement formation, characteristics of constitutional compounds, composition of constitutional compounds, mortars, concrete and curing.

[6L]

**B.Sc : Part - II (Semester-III)**  
**Paper-II ( Physical Chemistry )**

**Unit-I**

**Thermodynamics -I**

(A) Recapitulation of thermodynamic terms: system, surrounding types of system (closed open & isolated), Thermodynamic, variables, intensive & extensive properties, thermodynamic processes (isothermal, adiabatic, isobaric, cyclic, reversible & irreversible) State function & path functions, properties of state functions (exact differential, cyclic rule), integrating factor, concept of heat & work. [3L]

(B) Statements of first law of thermodynamics, definition of internal energy & enthalpy, heat capacity at constant volume & at constant pressure, Joule-Thomson experiment, Joule Thomson coefficient & Inversion temperature, calculations of  $W, Q, \Delta E$  &  $\Delta H$  for expansion of gases for isothermal & adiabatic conditions for reversible process, carnot's cycle & its efficiency, thermodynamic scale of temperature.

[5L]

(C) **Thermochemistry:** Heat of reaction, standard states, relation between heat of reaction at constant volume & at constant pressure, Hess's law of constant heat of summation & its applications, bond dissociation energy & its calculations from thermochemical data, variation of heat of reaction with temperature (Kirchoff's equation).

[4L]

**Unit-II**

**Thermodynamics-II**

(A) **Second law of thermodynamics :** Need for second law of thermodynamics, statements of second law of thermodynamics, concept of entropy, entropy as a state function of  $V$  &  $T, P \& T$ , entropy change in phase change for ideal gas, entropy as criteria of spontaneity & equilibrium.

[4L]

(B) **Free energy functions:** Helmholtz free energy ( $A$ ) & Gibb's free energy ( $G$ ) & their properties, standard free energies, effect of temperature on free energy (Gibb's-Helmholtz equation) & its applications,  $A \& G$  as criteria for thermodynamic equilibrium.

[4L]

**(C) System of variable composition:** partial molar quantities, chemical potential, Van't-Hoff's reaction isotherm, relation between standard free energy change & equilibrium constant (thermodynamic derivation of law of mass action), effect of temperature on equilibrium constant (reaction isochore) [4L]

### Unit-III

#### Phase Equilibria

**(A) Phase rule:** statement of phase rule, definition of phase, component and degree of freedom, derivation of phase rule, Clapeyron equation & its application in deciding slopes of line for two phase equilibria, applications of phase rule to two phase equilibria of i) water system, ii) sulphur system & iii) Pb-Ag system. [6L]

**(B) Liquid-Liquid mixtures:** Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law, non-ideal systems, azeotropes: HCl-H<sub>2</sub>O & ethanol-water system.

**Partial miscible liquids:** Phenol-water system, trimethylamine-water, nicotine-water system, lower & upper consolute temperature, effect of impurity.

**Immiscible liquids:** Steam distillation, Nernst distribution law, Limitations, deviations & applications. [6L]

### Unit-IV

#### Solid State

##### Laws of crystallography-

- i) Law of constancy of interfacial angles
- ii) Law of rationality of indices
- iii) Law of symmetry, symmetry of elements in crystals.

Unit cell, space lattice, orientation of lattice plane (Miller indices).

Bravais lattices, crystal systems, X-ray diffraction by crystal, derivation of Bragg's equation.

Determination of crystal structure of NaCl, KCl and CsCl

Lane's method and powder method.

[12 L]

**B.Sc. Part – II**  
**Semester-III**  
**Chemistry Practical**

Time-4-5hrs

Total-30 Marks

**Inorganic Chemistry**

**Volumetric Analysis** (Preparation of standard solution by weighing is compulsory).

- 1) Calibration of fractional weights.
- 2) Preparation of standard solution by weighing
- 3) Preparation of 0.001 M solution from 0.1M solution by dilution
- 4) Estimation of Fe (II) by dichromate using internal indicator (n-phenyl Anthranilic acid)
- 5) Determination of acetic acid in commercial vinegar using NaOH
- 6) Determination of alkali content –antacid tablet using HCl.
- 7) determination of zinc by complexometric titration with EDTA
- 8) Determination of total hardness of water (permanent and temporary) by EDTA

**Physical Chemistry**

- 1) To determine heat of solution of  $\text{KNO}_3$
- 2) To determine heat of ionisation of weak acid (acetic acid)
- 3) To determine the solubility of benzoic acid at different temperature and to determine heat solution of benzoic acid.
- 4) To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change by using Born –Haber cycle.
- 5) To construct the phase diagram of three component system (Acetic acid –chloroform-water)
- 6) To determine the critical solution temperature of partially miscible liquids (phenol-water systems.)
- 7) To study the distribution of Iodine between water and carbon tetra chloride/kerosene.
- 8) To study molecular state of benzoic acid in benzene and water.

Inorg. Exp. (12Marks) + Physical Exp. (12Marks) + Viva (3 Marks) + Record (3Marks)=30 Marks

### Reference Books:

- 1) Principles of Inorganic Chemistry by Puri, Sharma and Kalia – *S Naginchand & Co, Delhi.*
- 2) Text book of Inorganic Chemistry by A.K. De, *Wiley East Ltd.*
- 3) Selected Topics in Inorganic Chemistry by Malik Tuli and Madan- *S Chand & co.*
- 4) Modern Inorganic Chemistry by R.C. Agrawal , *Kitab Mahal.*
- 5) Instrumental Methods of analysis by Chatwal and Anand *Himalaya Publishing House.*
- 6) Concise Inorganic Chemistry by J.D. Lee *ELBS.*
- 7) Inorganic Chemistry by J.E. Huheey- *Harper & Row*
- 8) Fundamental concepts of Inorganic Chemistry by E.S. Gilreath *McGraw Holl book co.*
- 9) Modern Inorganic Chemistry by W.L. Jolly *McGraw Holl Int.*
- 10) Chemistry Fact Patterns & Principles by Kneen Rogers and Simpson *ELBS.*
- 11) Theoretical Principles of Inorganic Chemistry by G.S. Manku *Tata McGraw Hill*
- 12) Inorganic complex compounds by Murmann *Chapman & Hall.*
- 13) Text book of Inorganic Chemistry by K.N. Upadhyaya, *Vikas Publishing House, Delhi.*
- 14) Advanced Practical Inorganic Chemistry by Gurdeep Raj, *Goel Pulishing House, Meerut.*
- 15) Co-ordination Chemistry by D. Banerjee, *TMH Publication.*
- 16) Elements of Analytical Chemistry-R. Gopalan, P.S. Subramanian, K. Rengarajan-S. *Chand and sons (1997)*
- 17) Fundamentals of Analytical Chemistry-D.A. Skoog and D.M. West-*Holt Reinhard and Winston Publication-IV Edition (1982)*
- 18) Instrumental Methods of Chemical Analysis-Chatwal-Anand-*Himalaya Publishing house- (2000)*
- 19) Analytical Chemistry-R. Gopalan-Sultan *S-Chand.*
- 20) Physico Chemical Techniques of Analysis – P.B. Janarthanam Vol – I & II- *Asian Publication.*
- 21) Instrumental Methods of Chemical Analysis \_ B.K. Sharma – *Goel Publication*
- 22) Robert de Lavie, A spreadsheet workbook for Quantitative Chemical Analysis, *Mcgraw-Hill*
- 23) Physical Chemistry: Walter, J. Moore, 5<sup>th</sup> edn., New Delhi.
- 24) Physical Chemistry: G.M. Barrow, *McGraw Hill, Indian Edn.*

- 25) Principles of Physical Chemistry: Maron and Prutton
- 26) Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
- 27) Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
- 28) Physical Chemistry: Levine.
- 29) Practical Physical Chemistry: Palit and De.
- 30) Practical Physical Chemistry: Yadao.
- 31) Practical Physical Chemistry: Khosla.
- 32) Laboratory Manual of Physical Chemistry W.J. Popiel.
- 33) S.Y. B.Sc. Inorganic Chemistry : Semester-III by Dr. S.B. Rewatkar, Dr. E.L. Ramteke, T. D. Kose – *Shell Publication, Nagpur.*
- 34) S.Y. B.Sc. Physical Chemistry : Semester-III by T.D. Kose, Dr. S.B. Rewatkar, Dr. E. L. Ramteke– *Shell Publication, Nagpur.*
- 35) S.Y. B.Sc. Practical Chemistry : Semester-III by Dr. S.B. Rewatkar, Y.P.Thawari , A. B. Dhote, Dr. K. R. Lanjewar – *Shell Publication, Nagpur.*