BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY
Dhanbad, Jharkhand - 828130
E-mail:- registrarbbmku@gmail.com

Notification

In exercise of the powers vested in him under the Jharkhand State Universities Act 2000 as amended up-to-date, the Vice-Chancellor is pleased to constitute a Board of Studies (BOS) for Under Graduate Syllabus of the Department of Chemistry, comprising of following members for a period of one year from the date of notification :

1. Dr. Leelawati Kumari,
   Head, University Department of Chemistry, BBMKU - Chairperson
2. Dr. Y. Jha,
   Retired Head, Department of Chemistry,
   P.K.R.M. College, Dhanbad. - External expert
3. Sri Rajendra Prasad Singh,
   University Department of Chemistry, BBMKU. -Member
4. Dr. Dharmendra Kumar Singh,
   University Department of Chemistry, BBMKU. -Member
5. Dr. Rajeev Pradhan,
   Head, Department of Chemistry,
   P.K.R.M. College, Dhanbad. -Member

By order of the Vice-Chancellor
Sd/-
Registrar

Memo No. BBMKU/R/1293./2022 Date 20.09.2022

Copy to: -
1. Persons concerned.
2. Dean, Faculty of Science, BBMKU.
3. Establishment Section, BBMKU, Dhanbad.
4. P.A. to VC/PVC/F.A./R for information to VC/PVC/F.A./R.
5. Guard File.

20/09/22
Registrar
BBMKU, Dhanbad.

19.09.22

Members of Board of Studies for Under Graduate Syllabus of the Department of Chemistry of Binod Bihari Mahto Koyalanchal University, Dhanbad, Jharkhand.

1	**Dr. Leelawati Kumari,** Head, University Department of Chemistry, BBMKU, Dhanbad	**CHAIRPERSON**	Kumari 28.9.2022
2	**Dr. Y. Jha,** Retired Head, Department of Chemistry, P.K.R.M. College, Dhanbad	**EXTERNAL EXPERT**	28-9-22
3	**Sri Rajendra Prasad Singh,** University Department of Chemistry, BBMKU, Dhanbad	**MEMBER**	28/9/22
4	**Dr. Dharmendra Kumar Singh,** University Department of Chemistry, BBMKU, Dhanbad	**MEMBER**	28/9/22
5	**Dr. Rajeev Pradhan,** Head Department of Chemistry, P.K.R.M. College, Dhanbad	**MEMBER**	28/9/22

SYLLABUS GUIDELINE: MAJOR COURSE

SUBJECT- CHEMISTRY

Courses of study for FYUG Programme under NEP-2020 2022 onwards

Semester wise Course Code, Paper Name and Credit Points:

SEMESTER	CODE	PAPER NAME	CREDITS
I	IRC	INTRODUCTORY CHEMISTRY (IRC-01)	03
	MJ-1	INORGANIC CHEMISTRY-01	06 [04+02]
II	MJ-2	PHYSICAL CHEMISTRY-01	06 [04+02]
III	MJ-3	ORGANIC CHEMISTRY-01	06 [04+02]
IV	MJ-4	INORGANIC CHEMISTRY-02	06 [04+02]
	MJ-5	PHYSICAL CHEMISTRY-02	06 [04+02]
V	MJ-6	ORGANIC CHEMISTRY-02	06 [04+02]
	MJ-7	INORGANIC CHEMISTRY-03	06 [04+02]
VI	MJ-8	PHYSICAL CHEMISTRY-03	06 [04+02]
	MJ-9	ORGANIC CHEMISTRY-03	06 [04+02]
VII	AMJ-1	TO BE SELECTED FROM THE LIST*	06 [04+02]
	AMJ-2	TO BE SELECTED FROM THE LIST*	06 [04+02]
VIII	AMJ-3	TO BE SELECTED FROM THE LIST*	06 [04+02]
	AMJ-4	TO BE SELECTED FROM THE LIST*	06 [04+02]

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*List of Advance Major (AMJ) Paper for Semester-VII and VIII to be selected by the students

01. Advance Inorganic Chemistry.

02. Advance Organic Chemistry.

03. Advance Physical Chemistry.

04. Applications of Computers in Chemistry.

05. Analytical Methods in Chemistry.

06. Green Chemistry.

07. Environmental Chemistry.

08. Spectroscopy.

09. Industrial Chemistry.

10. Bio-inorganic Molecules and Medicinal Chemistry.

11. Bio Chemistry.

12. Vitamins, Steroids, Hormones.

13. Synthesis of Natural Products.

14. Nanoscale Materials and their Applications.

15. Instrumental Methods of Chemical Analysis.

16. Polymer Chemistry.

17. Molecular Modelling and Drugs Design.

18. Research Methodology for Chemistry.

19. Chemistry of Food Nutrition and Preservation.

20. Fermentation Science and Technology.

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INTRODUCTORY REGULAR COURSE (IRC)-01

CHEMISTRY

LECTURE -45 CREDIT -03

FULL MARKS- 100

PASS MARKS- 40

UNIT: 1 Atomic Structure **07Lectures**

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglieequation, Heisenberg's Uncertainty Principle and its significance, Quantum numbers and their significance.Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and itslimitations, Variation of orbital energy with atomic number.

UNIT 2: Periodicity of Elements: 07 Lectures

Basic ideas of the following periodic properties-

(a) Effective nuclear charge, shielding or screening effect, Slater rules,

(b) Atomic radii

(c) Ionic and crystal radii.

(d) Covalent radii

(e) Ionization enthalpy.

(f) Electron gain enthalpy

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales.

UNIT 3: Chemical Bonding: 12 Lectures

Ionic bond: Defination, General characteristics, Factors favouring formation of ionic bond.

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonanceenergy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomicmolecules N_2, O_2, C_2, B_2, F_2, Valence shell electron pair repulsion theory (VSEPR),shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiplebonding (σ and π bond approach) and bond lengths.

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 characterfrom dipole moment and electronegativity difference.

Weak Chemical Forces: Hydrogen bonding: definition, types of hydrogen bond, Effect of hydrogen bonding on physical and chemical properties.

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UNIT 4: Basics of Organic Chemistry-I 05 Lectures

Organic Compounds: Classification and Nomenclature.

Electronic Displacements: Inductive, electromericresonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

UNIT 5: Basics of Organic Chemistry-II

05 Lectures

Reaction mechanism, Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges;

Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

UNIT 6: Ionic equilibria 09 Lectures

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization,ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts -applications of solubility product principle.

REFERENCES-

1. Inorganic Chemistry by J. D. Lee
2. Inorganic Chemistry by Puri Sharma Kalia
3. Organic Chemistry by A Bahl and B. S. Bahl
4. Organic Chemistry Volume-1 by I.L. FINAR
5.Physical Chemistry by Puri Sharma Pathania

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CHEMISTRY MAJOR -0I

INORGANIC CHEMISTRY – I

Theory - 60 LecturesCredit - 04

Full Mark - 75 **Pass Mark - 30**

Atomic Structure:

Bohr's theory, its limitations andatomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's UncertainityPrincipleand its significance, Schrodinger's wave equation, significance of $\Psi$and Ψ^2 .Quantum numbers and theirsignificance.Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s,p,d and f orbitals. Contour boundary and probability diagram.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, aufbau's principle and its limitations, Variation of orbital energy with atomic number.

(14 Lectures)

Periodicity of Elements:

s,p,d and f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block.

a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
b) Atomic radii (van der Waals)
c) Ionic and crystal radii
d) Covalent radii (octahedral and tetrahedral)
e) Ionization enthalpy, Succesive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
f) Electron gain enthalpy, trends of electron gain enthalpy.
g) Electronegativity, Pauling's/Mulliken's/ Allred Rachow's/ and Mulliken- Jaffee's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

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(16 Lectures)

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Chemical Bonding: Section A

i. Ionic bond : General characteristics, types of ions, size effects, radius ration rule and its limitations. Packing of ions in crytals. Born-Lande equations with derivation and importance of Kaustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its applications, Solvation energy.

ii. Covalent bond : Lewis structure, Valence Bond theory (Heitler –London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2 ,O_2 ,C_2 , B_2 ,F_2 ,CO, NO and their ions; HCl, BeF_2,CO_2 (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes osf simple molecules and ions containing lone pairs and σbond and π approach)irsf electrons and multiple bonding lengths.

Chemical Bonding: Section – B

Covalent character in ionic compounds, polarizing power and polarizability.Fajan's rule and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

iii. Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, instantaneous dipole-induced dipole interactions. Repulsive forces, hydrogen bonding (theories of hydrogen bonding, valence bond treatment), effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Principles involved in volumetric analysis to be carried out in class.

(30 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.
- Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
- Day,M.C. and Selbin, J. Theoritical Inorganic Chemistry, ACS Publications 1962.

MAJOR CHEMISTRY PRACTICAL -01

CREDITS- 02

FULL MARKS- 25 PASS MARKS-10

GROUP- A

30 LECTURES

(A) Titrimetric Analysis

(i) Calibration and use of apparatus

(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.

(ii) Estimation of carbonate and bicarbonate present together in a mixture.

(iii) Estimation of free alkali present in different soaps/detergents.

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator.

GROUP-B

30 LECTUTRES

1. Surface tension measurements.

a. Determine the surface tension by (i) drop number (ii) drop weight method.

b. Study the variation of surface tension of detergent solutions with concentration.

2. Viscosity measurement using Ostwald's viscometer.

a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) Sugar at room temperature.

b. Study the variation of viscosity of sucrose solution with the concentration of solute.

REFERENCES-

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References :-

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: N.Delhi (2011).

3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8 th Ed.;

McGraw-Hill: New York (2003).

4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3 rd Ed.; W.H. Freeman &

Co.: New York (2003)