Mahatma Gandhi University, Kottayam

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B.Sc Chemistry (CBCSS) Syllabus

Prepared by

Board of Studies (UG) in Chemistry

&

Faculty of Science

May 2017

(iii) MODEL III B.Sc CHEMISTRY

A	**Programme Duration**	**6 Semesters**
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	8
D	Credits required from Core + Complementary + Vocational Courses including Project	109
e	Open Course	3
f	Minimum attendance required	75%

6.2. COURSES

There shall be three different types (models) of courses in Chemistry programme. The programme (Model I) consists of common courses with 38 credits, core course, Choice based course, and complementary courses with 79 credits and open course with 3 credits. The programme (Vocational -Model II) consists of common courses with 24 credits, core courses; Choice based courses, and complementary courses with 93 credits and open course with 3 credits. The programme (Model III) consists of common courses with 8 credits, core, Choice based course and complementary courses with 109 credits and open course with 3 credits.

6.3 SCHEME OF COURSES

The different types of courses and its number are as the following:

Model- I		**Model- II**		**Model- III**	
Courses	***No.***	***Courses***	***No.***	***Courses***	***No.***
Common Courses	10	Common Courses	6	Common Courses	2
Core Courses (Theory)	12	Core Courses (Theory)	12	Core Courses (Theory)	12
Project, Industrial Visit. and Comprehensive viva-voce	1	Project, Industrial Visit. and Comprehensive viva-voce	1	Project, Industrial Visit. and Comprehensive viva-voce	1
Core practical	6	Core Practical	6	First Core practical	6
Open Course	1	Open Course	1	Open Course	1
Choice based Course	1	Choice based Course	1	Choice based Course	1
		Vocational courses	6	Second core Courses	6
		Vocational practical	3	Second Core practical	2
		OJT	1	OJT	1
Complementary Courses	10	Complementary Courses	4	Complementary Courses	8
		Complementary practical	2	Complementary practical	2
Total	**41**	**Total**	**43**	**Total**	**42**

6.4. COURSE CODE

Every course in the programme should be coded with an eight digit alphanumeric code according to the following criteria. The first two letters of the code indicates the name of programme i.e. CH for Chemistry. One digit to indicate the semester. ie., CH1 (Chemistry, 1st semester). Two letters form the type of courses such as, CC for common courses, CR for core course, VO for vocational course, CM for Complementary courses, OP for Open Course,

CB for Choice based core, OJ for On the Job Training, OC for Optional Core, PR for project ie.., CH1CR (Chemistry,1st semester Core course). The letter T may be used to denote theory paper and the letter P may be used to denote practical papers. Two digits to indicate the paper's relative position in the programme, i.e., CH5CRT06 (Chemistry, 5th semester, Core course, Theory, sixth paper).

6.5. COURSES WITH CREDITS

Courses with Credits of different courses and scheme of examinations of the programme is the following:

Courses	**Credits**		
	Model I	**Model II**	**Model III**
Core Courses	46	46	46
Open Course	3	3	3
Choice Based Core	3	3	3
Project, I.V. & Viva	2	2	2
Vocational Courses	Nil	24	Nil
OJT	-	2	2
2nd Core Courses	Nil	Nil	24
Total	**54**	**80**	**80**
Complementary Courses I	14	16	16
Complementary Courses II	14	Nil	16
Total	**28**	**16**	**32**
Common Courses	38	24	8
Total	**38**	**24**	**8**
Grand Total	**120**	**120**	**120**

6.6. SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS FOR CORE COURSES

Semester	**Model I**		**Model II**		**Model III**	
	Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
First	2	2	6	4	6	4
Second	2	2	6	4	6	4
Third	3	2	9	6	10	4
Fourth	3	2	9	6	10	4
Fifth	15	10	15	10	15	10
Sixth	15	10	15	10	15	10

7. DURATION OF COURSE

- The duration of U.G. Programmes shall be **6 semesters**.
- A student may be permitted to complete the programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.
- Attendance: Students having a minimum of 75% average attendance for all the courses only, can register for the examination.

8. MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all papers (theory and practical) total percentage of marks of external examination is 80 and total percentage of marks of internal evaluation is 20.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:
Components of the internal evaluation and their marks are as below.

8. 1. FOR ALL THEORY PAPERS:

(a) Marks of external Examination : 60
(b) Marks of internal evaluation : 15

All the three components of the internal assessment are mandatory.

Components of theory Internal Evaluation	**MARKS**
Attendance	**5**
Assignment/Seminar/Viva	**2**
Test Paper(s) **(2×4)**	**8**
Total	**15**

8.2 FOR ALL PRACTICAL PAPERS (conducted only at the end of even semesters):

(a) Marks of external Examination : 40
(b) Marks of internal evaluation : 10

All the three components of the internal assessment are mandatory

Components of Practical-internal evaluation	**Marks**
Attendance	**2**
Test Paper (1x4)	**4**
Record*	**4**
Total	**10**

*Marks awarded for Record should be related to number of experiments recorded.

8.3 FOR PROJECTS, INDUSTRIAL VISIT AND COMPREHENSIVE VIVA-VOCE*:

(a) Marks of external Examination : 80
(b) Marks of internal evaluation : 20

Components of Project I.V. and Viva – Evaluation External	**Marks**
Dissertation and I.V. report (External)	50
Comprehensive Viva-voce (External)	30
Total	**80**

* Bonafide reports of the project work and Industrial Visit conducted shall be submitted at the time of examination.

All the four components of the internal assessment are mandatory.

Components of Project & I.V. - Internal Evaluation	Marks
Punctuality	5
Experimentation / Data Collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

8.4 OJT EVALUATION

For On the Job Training there is only internal evaluation.

8.5. ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all papers.

8.6 SEMINAR / VIVA

A student shall present a seminar in the 5th semester and appear for Viva- voce in the 6th semester for all papers.

8.7 INTERNAL ASSESSMENT TEST PAPERS

Two internal test- papers are to be attended in each semester for each paper. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for two years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the paper.

9. CONDUCT OF PRACTICAL EXAMINATIONS

9.1 PRACTICAL EXAMINATION

Practical examinations will be conducted only at the end of even semesters for all programmes.

9.2. PATTERN OF QUESTION PAPERS

Pattern of questions for external examination of practical papers will decided by the concerned Board of practical examination.

CONSOLIDATED SCHEME FOR I TO VI SEMESTERS
PROGRAMME STRUCTURE

1. B.Sc CHEMISTRY PROGRAMME – (MODEL - I)

Sem	Title with Course code	Course Category	Hours per week	Credits
I	English I	Common	5	4
	English/ Common Course I	Common	4	3
	Second Language I	Common	4	4
	CHICRT01 General and Analytical Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	-
	Complementary Mathematics	Complementary	4	3
	Complementary Physics	Complementary	2	2
	Complementary Physics Practical	Complementary	2	-
II	English II	Common	5	4
	English/ Common Course II	Common	4	3
	Second Language II	Common	4	4
	CH2CRT02 Theoretical and Inorganic Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	2
	Complementary Mathematics	Complementary	4	3
	Complementary Physics	Complementary	2	2
	Complementary Physics Practical	Complementary	2	2
III	English III	Common	5	4
	II Lang/Common Course I	Common	5	4
	CH3CRT03 Organic Chemistry-I	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	-
	Complementary Mathematics	Complementary	5	4
	Complementary Physics	Complementary	3	3
	Complementary Physics Practical	Complementary	2	-
IV	English IV	Common	5	4
	II Lang/ Common Course II	Common	5	4
	CH4CRT04 Organic Chemistry-II	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	2
	Complementary Mathematics	Complementary	5	4
	Complementary Physics	Complementary	3	3
	Complementary Physical Practical	Complementary	2	2
V	CH5CRT05 Environment, Ecology and Human Rights	Core	4	4
	CH5CRT06 Organic Chemistry-III	Core	3	3
	CH5CRT07 Physical Chemistry - I	Core	2	2
	CH5CRT08 Physical Chemistry - II	Core	2	3
	CH5OPT Open course	Open	4	3

	CH6CRP03 Qualitative Inorganic Analysis	Core	3	-
	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	-
	CH6CRP05 Physical Chemistry Practical	Core	3	-
	CH6PRP01Project	Core	2	-
VI	CH6CRT09 Inorganic Chemistry	Core	3	3
	CH6CRT10 Organic Chemistry-IV	Core	3	3
	CH6CRT11 Physical Chemistry - III	Core	3	3
	CH6CRT12 Physical Chemistry - IV	Core	3	3
	CH6CBT Choice Based Course	Core	3	3
	CH6CRP03 Qualitative Inorganic Analysis	Core	3	2
	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	2
	CH6CRP05 Physical Chemistry Practical	Core	3	2
	CH6CRP06 Gravimetric Analysis	Core	2	2
	CH6PRP01 Project & Industrial visit and comprehensive viva-voce	Core	-	2

OPEN COURSES:

Sl. No.	Semester	Course Code	Course Title
1	V	CH5OPT01	Chemistry in Everyday Life
2	V	CH5OPT02	Nanoscience and Nanotechnology
3	V	CH5OPT03	Forensic Science

CHOICE BASED COURSES:

Sl. No.	Semester	Course Code	Course Title
1	VI	CH6CBT01	Polymer Chemistry
2	VI	CH6CBT02	Nanochemistry and Nanotechnology
3	VI	CH6CBT03	Soil and Agricultural Chemistry

2. B.Sc CHEMISTRY PROGRAMME – (MODEL - II)

Sem	Title with Course code	Course Category	Hours per week	Credits
I	English I	Common	5	4
	Second Language I	Common	5	4
	CHICRT01 General and Analytical Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	-
	Complementary Mathematics	Complementary	5	3
	CH1VOT01 Industrial Aspects of Inorganic and Organic Chemistry	Core	4	3
	CH2VOP01 Vocational Practical	Core	2	-
II	English I	Common	5	4
	Second Language I	Common	5	4
	CH2CRT02 Theoretical and Inorganic Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	2
	Complementary Mathematics	Complementary	5	3
	CH2VOT02 Chemical Industries and Industrial Aspects of Physical Chemistry	Core	4	3
	CH2VOP01 Vocational Practical: Industrial Inorganic Chemistry (P)	Core	2	2
III	English III	Common	5	4
	CH3CRT03 Organic Chemistry-I	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	-
	Complementary Mathematics	Complementary	5	4
	CH3VOT03 Unit Operations in Chemical Industry	Core	3	4
	CH3VOT04 Unit Processes in Organic Chemicals Manufacture	Core	3	4
	CH2VOP02 Vocational Practical	Core	2	-
	CH2VOP03 Vocational Practical	Core	2	-
IV	English IV	Common	5	4
	CH4CRT04 Organic Chemistry-II	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	2
	Complementary Mathematics	Complementary	5	4
	CH4VOT05 Instrumental Methods of Chemical Analysis-I	Core	3	3
	CH4VOT06 Instrumental Methods of Chemical Analysis-II	Core	3	3
	CH2VOP02 Vocational Practical	Core	2	2
	CH2VOP03 Vocational Practical	Core	2	2
V	CH5CRT05 Environment, Ecology and Human Rights	Core	4	4
	CH5CRT06 Organic Chemistry-III	Core	3	3
	CH5CRT07 Physical Chemistry - I	Core	2	2
	CH5CRT08 Physical Chemistry - II	Core	2	3
	CH5OPT Open course	Open	4	3

	CH6CRP03 Qualitative Inorganic Analysis	Core	3	-
	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	-
	CH6CRP05 Physical Chemistry Practical	Core	3	-
	CH6PRP01Project	Core	2	-
VI	CH6CRT09 Inorganic Chemistry	Core	3	3
	CH6CRT10 Organic Chemistry-IV	Core	3	3
	CH6CRT11 Physical Chemistry - III	Core	3	3
	CH6CRT12 Physical Chemistry - IV	Core	3	3
	CH6CBT Choice Based Course	Core	3	3
	CH6CRP03 Qualitative Inorganic Analysis	Core	3	2
	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	2
	CH6CRP05 Physical Chemistry Practical	Core	3	2
	CH6CRP06 Gravimetric Analysis	Core	2	2
	CH6PRP01 Project, Industrial visit and comprehensive viva - voce	Core	-	2
	CH6OJP01 OJT	Core	-	2

On the Job Training All the students have to undergo on the job training in a chemical industry for a minimum period of 15 days and submit a project report. The period of 15 days need be at a single stretch. The vacation days may be utilized for this purpose. A report of the training should be submitted to the department during the sixth semester for internal evaluation.

OPEN COURSES:

Sl. No.	Semester	Course Code	Course Title
1	V	CH5OPT1.1	Chemistry in Everyday Life
2	V	CH5OPT1.2	Nanoscience and Nanotechnology
3	V	CH5OPT1.3	Forensic Science

CHOICE BASED COURSES:

Sl. No.	Semester	Course Code	Course Title
1	VI	CH6CBT1.1	Polymer Chemistry
2	VI	CH6CBT1.2	Nanochemistry and Nanotechnology
3	VI	CH6CBT1.3	Soil and Agricultural Chemistry

3. B.Sc CHEMISTRY PROGRAMME – (MODEL - III)

Sem	Title with Course code	Course Category	Hours per week	Credits
I	English I	Common	5	4
	CHICRT01 General and Analytical Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	-
	CH1PCT01 Petroleum Geology	Core	4	3
	CH2PCP01 Practical I	Core	2	-
	Complementary Mathematics	Complementary	5	3
	Complementary Computer Science	Complementary	3	2
	Complementary Practical –I	Complementary	2	-
II	English I	Common	5	4
	CH2CRT02 Theoretical and Inorganic Chemistry	Core	2	2
	CH2CRP01 Volumetric Analysis	Core	2	2
	CH2PCT02 Test Methods and Petroleum Processes	Core	4	3
	CH2PCP01 Practical I	Core	2	2
	Complementary Mathematics	Complementary	5	3
	Complementary Computer Science	Complementary	3	3
	Complementary Practical –I	Complementary	2	2
III	CH3CRT03 Organic Chemistry-I	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	-
	CH3PCT03 Production and Application of Compounds from Petroleum	Core	4	4
	CH3PCT04 Manufacture of Petrochemicals-I	Core	3	4
	CH4PCP02 Practical –II	Core	2	-
	Complementary Mathematics	Complementary	5	4
	Complementary Computer Science	Complementary	4	3
	Complementary Practical –II	Complementary	2	-
IV	CH4CRT04 Organic Chemistry-II	Core	3	3
	CH4CRP02 Qualitative Organic Analysis	Core	2	2
	CH4PCT05 Manufacture of Petrochemicals-II	Core	4	4
	CH4PCT06 Petroleum Industries in India	Core	3	4
	CH4PCP02 Practical –II	Complementary	2	2
	Complementary Mathematics	Complementary	6	4
	Complementary Computer Science	Complementary	3	3
	Complementary Practical –II	Core	2	2
V	CH5CRT05 Environment, Ecology and Human Rights	Core	4	4
	CH5CRT06 Organic Chemistry-III	Core	3	3
	CH5CRT07 Physical Chemistry - I	Core	2	2
	CH5CRT08 Physical Chemistry - II	Core	2	3
	CH5OPT Open course	Open	4	3
	CH6CRP03 Qualitative Inorganic Analysis	Core	3	-

	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	-
	CH6CRP05 Physical Chemistry Practical	Core	3	-
	CH6PRP01Project	Core	2	-
VI	CH6CRT09 Inorganic Chemistry	Core	3	3
	CH6CRT10 Organic Chemistry-IV	Core	3	3
	CH6CRT11 Physical Chemistry - III	Core	3	3
	CH6CRT12 Physical Chemistry - IV	Core	3	3
	CH6CBT Choice Based Course	Core	3	3
	CH6CRP03 Qualitative Inorganic Analysis	Core	3	2
	CH6CRP04 Organic Preparations and Basic Laboratory Techniques	Core	2	2
	CH6CRP05 Physical Chemistry Practical	Core	3	2
	CH6CRP06 Gravimetric Analysis	Core	2	2
	CH6PRP01 Project, Industrial visit and comprehensive viva-voce	Core	-	2
	CH6OJP01 OJT	Core	-	3

On the Job Training All the students have to undergo on the job training in a chemical industry for a minimum period of 15 days and submit a project report. The period of 15 days need be at a single stretch. The vacation days may be utilized for this purpose. A report of the training should be submitted to the department during the sixth semester for internal evaluation.

OPEN COURSES:

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CHOICE BASED COURSES:

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3	VI	CH6CBT1.3	Soil and Agricultural Chemistry

SYLLABUS FOR
CHEMISTRY CORE COURSES

SEMESTER I

CH1CRT01 – GENERAL AND ANALYTICAL CHEMISTRY

Credits: 2 (36 Hrs)

Unit 1: Methodology of Chemistry (7 Hrs)

Definition of Science. Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law. Falsification of hypothesis - inductive and deductive reasoning- revision of scientific theories and laws.

Evolution of Chemistry-ancient speculation on the nature of matter. Early form of chemistry-alchemy, origin of modern chemistry. Structure of chemical science: Scope, theory and experiment - branches of chemistry. Role of chemistry as a central science connecting physics, biology and other branches of science. Interdisciplinary areas involving chemistry: Nanotechnology and biotechnology.

Unit 2: Periodic Table and Periodic Properties (5 Hrs)

Modern periodic law – Long form periodic table. Diagonal relationship and anomalous behavior of first element in a group. Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity (electron gain enthalpy) – electronegativity. Electronegativity scales: Pauling and Mullikan scales. Effective nuclear charge – Slater rule and its applications – polarising power.

Unit 3: Analytical Methods in Chemistry (12 Hrs)

Molecular mass - mole concept – molar volume. Oxidation and reduction – oxidation number and valency – variable valency - equivalent mass.

Qualitative analysis: Applications of solubility product and common ion effect in the precipitation of cations. Principle of intergroup separation of cations. Interfering acid radicals and their elimination (oxalate, fluoride, borate and phosphate).

Titrimetric analysis - fundamental concepts. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm. and ppb. Primary and secondary standards, quantitative dilution – problems. Acid base titrations- titration curves – pH indicators. Redox titrations – titration curve –titrations involving MnO_4^- and $Cr_2O_7^{2-}$ - redox indicators. Complexometric titrations – EDTA titrations - titration curves – metal ion indicators. Gravimetric analysis: Unit operations in gravimetric analysis - illustrations using iron and barium estimation. Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.

Unit 4: Chromatographic Methods (7 Hrs)

Column Chromatography: Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thin Layer Chromatography: Principle, choice of adsorbent and solvent, preparation of Chromatoplates, Rf-values, significance of Rf values. Ion exchange chromatography: Principle and experimental techniques. Gas Chromatography: Principle and experimental techniques. High Performance Liquid Chromatography (HPLC): Principle and experimental techniques.

Unit 5: Evaluation of Analytical Data **(5 Hrs)**

Units, significant digits, rounding, scientific and prefix notation, graphing of data. Precision and accuracy-types of errors – ways of expressing precision – ways to reduce systematic errors - reporting analytical data. Statistical treatment of analytical data – population and samples – Mean and standard deviation – distribution of random errors.

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3. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
4. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
5. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
6. Satya Prakash, *Advanced Inorganic Chemistry, Volume 1*, 5th Edition, S. Chand and Sons, New Delhi, 2012.
7. J. Mendham, R.C. Denney, J. D. Barnes and M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, Noida, 2013.
8. R. Gopalan, *Inorganic Chemistry for Undergraduates*, Universities Press, Hyderabad, 2009.
9. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.

SEMESTER II

CH2CRT02 – THEORETICAL AND INORGANIC CHEMISTRY

Credits - 2 (36 hrs)

Unit 1: Atomic Structure (6 Hrs)

Introduction based on historical development (Dalton's atomic theory, Thomson's atom model Rutherford's atom model) - failure of classical physics – black body radiation - Planck's quantum hypothesis - photoelectric effect - generalization of quantum theory . Atomic spectra of hydrogen and hydrogen like atoms– Bohr theory of atom – Calculation of Bohr radius, velocity and energy of an electron - explanation of atomic spectra - limitations of Bohr theory - Sommerfeld modification. Louis de Broglie's matter waves – wave-particle duality - electron diffraction - Heisenberg's uncertainty principle.

Schrödinger wave equation (derivation not expected), wave functions – significance of ψ and ψ^2 – atomic orbitals and concept of quantum numbers - shapes of orbitals (*s*, *p* and *d*) - Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle – electronic configuration of atoms.

Unit 2: Chemical Bonding – I (9 Hrs)

Introduction – Octet rule and its limitations.

Types of bonds: Ionic bond - factors favouring the formation of ionic bonds - lattice energy of ionic compounds - Born- Lande equation with derivation - solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications – properties of ionic compounds - polarisation of ions – Fajan's rule and its applications.

Covalent Bond: Valence Bond Theory and its limitations. Concept of resonance - resonance structures of borate, carbonate and nitrate ions. Hybridization: Definition and characteristics – shape of molecules ($BeCl_2$, C_2H_2, BF_3, C_2H_4, CH_4, NH_3, H_2O, NH_4^+, H_3O^+, PCl_5, SF_6 and IF_7). VSEPR theory: Postulates - applications - shapes of molecules CCl_4, NH_3, H_2O, ClF_3, XeF_2, SF_6, IF_5, XeF_4, IF_7 and XeF_6.

Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure.

Unit 3: Chemical Bonding – II (9 Hrs)

Covalent Bond: Molecular Orbital Theory – LCAO - bonding and anti-bonding molecular orbitals – bond order and its significance. MO diagrams of homonuclear and heteronuclear diatomic molecules: H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO – comparison of bond length, magnetic behavior and bond energy of O_2, O_2^+, O_2^{2+}, O_2^- and O_2^{2-} . Metallic Bond: free electron theory, valence bond theory and band theory (qualitative treatment only) - explanation of metallic properties based on these theories.

Intermolecular forces: Hydrogen bond - intra and inter molecular hydrogen bonds – effect on physical properties. Van der Waals forces, ion-dipole, dipole-dipole, ion-induced dipole, dipole-induced dipole and induced dipole-induced dipole interactions

Unit 4: Chemistry of s and p Block Elements (3 Hrs)

Periodicity in s-and p- block elements with respect to electronic configuration, atomic and ionic size, ionization energy and electro negativity. Inert pair effect.

Unit 5: Chemistry of d and f Block Elements (9 Hrs)

Transition Metals: General characteristics: Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, colour, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows. Preparation, properties, structure and uses of $KMnO_4$ and $K_2Cr_2O_7$.

Lanthanides: Electronic configuration and general characteristics – Occurrence of lanthanides

Isolation of lanthanides from monazite sand - Separation by ion exchange method.

Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides.

References

1. R.K. Prasad, *Quantum Chemistry,* New Age International, 2001
2. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books.
3. I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,
4. ManasChanda, *Atomic structure and Chemical bonding in Molecular Spectroscopy"* Tata McGraw Hill.
5. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
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SEMESTER I AND II - CORE CHEMISTRY PRACTICALS

CH2CRP01 - VOLUMETRIC ANALYSIS

Credits: 2 (72 Hrs)

A. Acidimetry and Alkalimetry

1. Strong acid-Strong base
2. Strong acid – Weak base
3. Strong base – Weak acid
4. Estimation of $Na_2CO_3$and $NaHCO_3$ in a mixture
5. Estimation of NaOH and Na_2CO_3 in a mixture
6. Estimation of ammonia in ammonium salts by direct and indirect methods

B. Complexometric Titrations Using EDTA

1. Estimation of Zn
2. Estimation of Mg
3. Estimation of Mg and Ca in a mixture
4. Estimation of Ni
5. Determination of hardness of water

C. Oxidation – Reduction Titrations

(i) Permanganometry

1. Estimation of ferrous iron
2. Estimation of oxalic acid
3. Estimation of sodium oxalate
4. Estimation of calcium

(ii) Dichrometry

1. Estimation of ferrous iron using internal indicator
2. Estimation of ferrous iron using external indicator
3. Estimation of ferric iron using internal indicator
4. Estimation of ferric iron using external indicator

(iii) Iodimetry and Iodometry

1. Estimation of copper
2. Estimation of arsenious oxide

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