BHAKTA KAVI NARSINH MEHTA UNIVERSITY

JUNAGADH 362263

SYLLABUS

Faculty of Science

B.Sc.- Chemistry

Semester III and IV

Under Choice Based Credit System (CBCS)

Effective from June - 2019

Bhakta Kavi Narsinh Mehta University

Scheme of Instruction and Examinations

B.Sc. Chemistry

SEMESTER -III and IV

Effective from June - 2019

Sr. No.	Level	SEM	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours/ Week	Internal Marks	External Marks	Practical Internal Marks	Practical External Marks	Total Marks/ Passing
								Total/ Passing	Total/ Passing	Total/ Passing	Total/ Passing	
1	UG	3	Core	Chemistry	C-301	4	6	30/12	70/28	-	-	100/40
2	UG	3	Practical	Practical chemistry	C-302	3	3	-	-	15/06	35/14	50/20
3	UG	4	Core	Chemistry	C-401	4	6	30/12	70/28	-	-	100/40
4	UG	4	Practical	Practical chemistry	C-402	3	3			15/06	35/14	50/20

Bhakta Kavi Narsinh Mehta University
Junagadh-362263

Website: www.bknmu.edu.in

B.Sc. Chemistry Semester III & IV

Effective from June - 2019

Hours of Instruction-Unit wise Distribution

Unit-I	Inorganic Chemistry	[20-hours]
Unit-II	Organic Chemistry	[20-hours]
Unit-II	Physical Chemistry	[20-hours]
	Total	**: 60 hours**

Semester III
B.Sc. Chemistry
Chemistry: C-301

UNIT-I [Chapter-1 & 2]

Chapter-1: Wave mechanics and MO theory [10 hours]

- Introduction of wave Mechanics,
- Postulates of wave Mechanics,
- Interpretation of ψ, ψ^2, $\psi\psi^*$,
- Derivation of Schrodinger's equation in three dimensions (Cartesian Coordinates),
- Eigen function & Eigen value,
- Orthogonal & Normalized wave function,
- Concept of Molecular Orbital Theory,
- Characteristic of Molecular Orbital,
- Wave function of H_2^+ & H_2,
- Potential energy and Schrodinger's equation for H_2^+ & H_2,
- Derivation of normalized wave function of H_2^+ based on M.O.T.,
- Derivation co efficient of wave function of sp, sp^2 & sp^3 Hybridization with bond angle.

Chapter-2: Chemistry of the elements of First transition series and First Inner transition series [10 hours]

First (3d) transition series;

- Introduction,
- Position in the periodic table,
- Electronic configuration,
- Reversal of energies of 3d and 4s orbitals,
- Physical properties such as atomic properties (atomic radii, Ionic radii, Ionization potential), Oxidation states, metallic conductivity, melting point & boiling point, density,
- Reducing properties,
- Tendency of formation of alloys,
- Catalytic properties,
- Magnetic and spectral properties,
- Oxides and Oxoanions of transition metals,
- Calculation of magnetic moment of ion of 3d series metal.

First (4f) Inner transition series;

- Introduction,
- Position in the periodic table,
- Occurrence & Important ores,
- Individual Isolation by (A) Ion Exchange Method (B) Solvent Extraction Method,
- Electronics Configuration with necessary Explanation,
- Oxidation State & their Stability, Magnetic properties, Color, Isotopes, Spectral properties,

- Lanthanide Contraction, Misch Metal,
- Uses of Lanthanides & their Compounds.

UNIT-II [Chapter-3,4,5 & 6]

Chapter-3: Aryl halides **[4-hours]**

- Basic IUPAC nomenclature of aryl halide,
- Preparation (including preparation from diazonium salts),
- Nucleophilic aromatic substitution (SNAr),
- Benzyne mechanism,
- Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Chapter-4: Alcohols, Phenols, Ethers and Epoxides **[6-hours]**

- Basic IUPAC nomenclature of alcohol, phenol and ether,

Alcohols:

- Preparation (by the reduction of aldehyde, ketone, carboxylic acid, ester and Grignard reaction),
- Chemical properties(Reaction with sodium metal, Relative reactivity of 1°, 2°, 3° alcohols (Lucas test), Esterification and Oxidation by periodic acid and lead tetraacetate)

Phenols:

- Preparation (Dow process and Cumene process),
- Chemical Properties; Electrophilic substitution reaction (Nitration, sulphonation and bromination)
- Relative acidity of phenol, alcohol and carboxylic acid, Factors affecting on acidity of phenol.

Ethers:

- Preparation(Williamson synthesis) and Chemical reactions (with Cl_2 in light and dark, with conc. H_2SO_4, with hot and cold HI, hydrolysis)

Epoxides:

- Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

Chapter-5: Nitrogen Containing Functional Groups **[6-hours]**

- Basic IUPAC nomenclature of amine, nitro compounds, nitriles and isonitriles.

Amines:

- Effect of substituent and solvent on basicity;
- Distinction between 1°, 2° and 3° amines with Hinsberg reagent,
- Preparation (from nitro compound, alkyl halide and Hoffmann degradation of amides)
- Chemical properties:, Reaction with acid chloride, aryl halide and nitrous acid.
- Chemical reaction of aniline (nitration, sulphonation and bromination)
- Diazonium Salts: Preparation and their synthetic applications.
- Preparation and important reactions of nitro compounds, nitriles and isonitriles.

Chapter-6:Reactions and Rearrangement **[4-hours]**

Name Reaction:

- Reimer-Tiemann,

- Kolbe's Schmidt,
- Carbylamine reaction,
- Hoffmann's exhaustive methylation

Rearrangement:

- Pinacol-Pinacolone Rearrangement,
- Fries Rearrangement,
- Claisen Rearrangement,

UNIT-III [Chapter-7, 8 & 9]

Chapter-7: Equilibrium **[8 hours]**

- Introduction,
- Criteria of phase equilibrium,
- Explanation of terms: Phases, Components and Degrees of freedom of a system,
- Gibbs Phase Rule,
- Limitations of Phase Rule,
- Phase diagrams of one-component systems (Water, Sulphur)
- Two component systems: Condensed Phase Rule, Eutectics system (Lead-Silver) and Park method of desilverization, Congruent melting point system (Mg – Zn) and Incongruent melting point system (Na - K).

Chapter-8: Solutions **[8 hours]**

- Introduction,
- Factors affecting solubility,
- Types of solutions,
- Types of liquid –liquid solutions

Miscible Liquid Pair:

- Ideal solutions and Raoult's law, Deviations from Raoult's law (Non-ideal solutions),
- Vapour pressure - composition curves of ideal and non-ideal solutions,
- Temperature - composition curves of ideal and non-ideal solutions.
- Distillation of ideal and non-ideal solutions,
- Lever rule, Fractional column and Bubble cap tower, Azeotropes.

Immiscible Liquid Pair:

- Introduction, Principle of steam distillation and its applications. Numericals,

Solution of Gas in Liquid:

- Factors affecting solubility of a gas,
- Effect of pressure (Henry's Law), Numericals.

Chapter-9: Nernst Distribution Law **[4 hours]**

- Introduction,
- Nernst Distribution Law and its limitations,
- Modified Nernst Distribution Law [Solute associate in the solvent, Solute dissociate in the solvent, Solute enters into chemical reaction with solvent]
- Applications, Solvent extraction Numericals

Reference book:

1. Principles of Inorganic chemistry – Puri, Sharma & Kalia
2. Concise Inorganic Chemistry - J. D. Lee
3. Advanced Inorganic Chemistry- Cotton and Wilkinson
4. Basic Inorganic Chemistry - Gurdeep & Chatwal
5. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
6. A Text Book of Organic Chemistry (II Edition) by Raj K. Bansal
7. Name Reactions in Organic Synthesis by Dr. A.R.Parikh et. al
8. Reactions and Rearrangements by Gurdeep Chatwal
9. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co.. New Delhi
10. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar
11. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
12. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.

Semester - III
B.Sc. Chemistry
Chemistry Practicals: C-302

1. Organic Qualitative Analysis [Minimum 10 Practicals]

[Minimum six bifunctional Organic Compounds should be given]

Identification of an organic compound through the functional group analysis and determination of melting point or boiling point

(Bifunctional organic compounds)

2. Organic Volumetric Estimation: [Standard solution to be given]

1. To determine the amount of $-CONH_2$ in the given Acetamide solution
2. To determine the amount of Phenol / m-cresol in the given solution
3. To determine the amount of Aniline / p-toludine in the given solution
4. To determine the amount of Ester in the given solution
5. To determine the amount of Glucose in the given solution
6. To determine the amount of –COOH in the given carboxylic acid

Semester IV
B.Sc. Chemistry
Chemistry: C-401

Unit-I [Chapter-1, 2 & 3]

Chapter-1 Organometallic compounds [05 hours]

- Introduction, Classification based on nature of M-C Bond and hepticity,
- Preparation, Properties and uses of Organo Lithium compounds and Organo magnesium compounds,
- Preparation, bonding & structure of (1) Zeise's Salts, (2) Tri Methyl Aluminium (dimer) and (3) Ferrocene.

Chapter-2 Bio-Inorganic Chemistry [05 hours]

- Metalloporphyrins,
- Structure and roll of Haemoglobin in biological system,
- Myoglobin,
- Structure of chlorophyll and its importance,
- Toxicity of arsenic, mercury, lead and cadmium,
- Reason for toxicity.

Chapter-3 Basics of Co-ordination chemistry [10 hours]

- Coordination compounds,
- Double salt, mixed salt and complex compounds,
- Types of complex compounds,
- Classification of ligands (Based on charge and denticity),
- π-acid ligands, Ambidentate ligands, Chelating ligands, Bridge ligands and Flexi dentate ligands,
- Coordination number, coordination polyhedron, Oxidation number of central metal atom,
- IUPAC Nomenclature of coordination compounds
- Warner coordination theory and its failure,
- Co-ordination number and geometry related to co-ordination number,
- Isomerism in coordination compounds; 1) Structural isomerism 2) Stereo isomerism
  In structural isomerism-
  1) ionization 2) hydration 3) co-ordination 4) co-ordination positions 5) polymerization 6) linkage isomerism 7) Ligand isomerism,
  In stereo isomerism-
  1) Geometrical; Cis-trans isomerism in ML_4 and ML_6 types of complex
  2) Optical isomerism
- Application of coordination compounds in biological systems, analytical chemistry, extraction of gold and silver, purification of metals, industry, medical field.

Unit-II [Chapter-4, 5, 6 & 7]

Chapter-4 Active methylene compounds: [3-hours]

- Keto-enol tautomerism,
- Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Chapter-5 Aldehydes and ketones [5-hours]

- Introduction,
- constitution of carbonyl group and reactivity,
- preparation of aldehydes and ketones;
- Nucleophilic addition reactions (HCN, Grignard, Alcohol, $NaHSO_3$)
- Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism;
- oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$,);

Chapter-6 Carboxylic Acids and their Derivatives: [5-hours]

- Preparation,
- Physical properties and reactions of monocarboxylic acids:
- Preparation and reactions of acid chlorides, anhydrides, esters and amides;
- Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters,
- Claisen condensation,
- Dieckmann reaction.

Chapter-7 Reaction and Rearrangement-II: [7-hours]

Name Reaction:

- Aldol condensation,
- Cannizzaro Reaction,
- Benzoin condensation,
- Knoevenagel condensation,
- Claisen-Schmidt,
- Perkin Reaction,
- Wittig reaction,
- Haloform reaction,
- Baeyer Villiger oxidation
- Meerwein Ponndorf Verley reduction.

Rearrangement:

- Beckmann Rearrangement,
- Benzil-Benzilic acid Rearrangement,
- Hofmann bromamide degradation.

Unit-III [Chapter-8 & 9]

Chapter-8 Physical Properties and Molecular Structure: [8-hours]

- **Introduction**
- **Types of Physical Properties:** Additive and Constitutive Properties
- **Molar Volume:** Kopp's Law, Atomic Volume
- **Surface Tension:** Explanation of Surface Tension, Name of Methods to Determine Surface Tension, The Drop Weight Method

- **Parachor:** Macleod Equation and $P_1/P_2 = V_1/V_2$, Atomic Parachor, To Determine Structure of (i) Quinine (ii) Benzene (iii) Isocyanides group (iv) Nitro group
- **Viscosity:** Explanation (Briefly), Unit and Factors Affecting the Viscosity, Measurement of Viscosity (Derivation of $\eta_1 / \eta_2 = d_1t_1 / d_2t_2$), Ostwald's Viscometer
- **Refractive Index and Refractivity:** Introduction, Specific and Molecular Refractivity, Abbe Refractometer, Molecular Refractivity and Chemical Constitution
- **Optical Activity:** Polarization of Light, Optical Activity,Factors Affecting Angle of Rotation, Specific Rotation, Polarimeter
- **Dipole Moment:** Polar and Non-polar molecule, Electric Polarization (Polarizability of Molecules), The Mosotti Clausious Equation, Kinds of Molar Polarization [Electron & Nuclear Polarization, Orientation Polarization (Permanent Dipole Moment)]; Application of Dipole Moment: Identification of Polar and Non-polar molecules, Molecular Structure : (i) Mono atomic molecules, (ii) Diatomic molecules (iii) Triatomic molecules (CO_2, H_2O, SO_2) (iv) Tetratomic molecules (NH_3, BCl_3) (v) Aromatic Compounds (Benzene) (vi) Resonance Structure (N_2O), Cis-Trans Isomer (viii) Orientations in Organic Molecules (o, m and p substitution),
- **Numericals**

Chapter-9: Thermodynamics: [12 hours]

- Introduction,
- Limitations and Advantages of Thermodynamics,
- Types of Systems,
- Properties of System: Intensive and Extensive Properties,
- Types of Processes,
- State and Path Functions,
- Exact and Inexact Differential Concept of Heat, Work and Internal Energy,
- First Law of Thermodynamics: Statements, Mathematical derivation,
- Heat absorbed at constant volume,
- Perpetual Machine of First Kind, Enthalpy,
- Heat Capacity: Its types and derivation of relation (Cp – Cv = R),
- Isothermal Reversible and Irreversible Work of Ideal Gas,
- Proof of: $W_{rev} > W_{irr}$
- Relations between P – V, V – T and T – P for Adibatic Process,
- Adiabatic Reversible and Irreversible work of Ideal Gas,
- Joule Thomson Effect, Joule Thomson Coefficient of Ideal Gas.
- Zeroth Law (Only Statement and Explanation),
- Variation of Enthalpy with Temperature (Kirchhoff Equation),
- Flame and Explosion Temperature,
- Numericals

Reference book:

1. Quantum chemistry by A. K. Chandra
2. Basic Concept of Quantum Chemistry by R. K. Das.
3. Molecular Physical Chemistry by McQuarrie
4. Principles of Inorganic chemistry – Puri, Sharma & Kalia.
5. Concise Inorganic Chemistry - J. D. Lee
6. Advanced Inorganic Chemistry- Cotton and Wilkinson
7. Basic Inorganic Chemistry - Gurdeep & Chatwal
8. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
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10. Name Reactions in Organic Synthesis by Dr. A.R.Parikh et. al
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12. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co.. New Delhi.
13. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
14. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
15. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
16. Elements of Physical Chemistry, Samuel Glasstone and David Lewis, Macmillan & Co.

Semester - IV
B.Sc. Chemistry
Chemistry Practicals: C-402

1. Inorganic Qualitative Analysis:

[Minimum ten inorganic mixtures should be given]

Qualitative Analysis of an inorganic mixture containing four radicals
(Including soluble PO_4^{-3}),
[Excluding PO_4^{-3} (insoluble), CrO_4^{-2}, $Cr_2O_7^{-2}$, AsO_3^{-3}, AsO_4^{-3}, BO_3^{-3} and S^{-2}]

2. Physicochemical Exercise

1. To determine the specific reaction rate of the hydrolysis of methyl acetate / Ethyl acetate catalyzed by H^+ ion at room temperature.
2. To study the rate of reaction between $K_2S_2O_8$ and KI.
3. To study the rate of reaction between $KBrO_3$ and KI.
4. To determine the temperature coefficient and Energy of activation for the hydrolysis of ester at two different temperatures.
5. To determine the temperature coefficient and Energy of activation for the reaction between $K_2S_2O_8$ and KI at two different temperatures
6. To determine the rate of adsorption of the given organic acid using animal charcoal.
7. Distribution Law: To study the partition co-efficient of benzoic acid between water and benzene / kerosene and hence study the molecular condition of benzoic acid in the solution.
8. To study the partition co-efficient of acetic acid between water and chloroform and hence study the molecular condition of acetic acid in the solution.

Bhakta Kavi Narsinh Mehta University, Junagadh

Question Paper Pattern -Theory

B. Sc. Chemistry

SEM 3 & 4 (New Course) effective from June-2019

Total mark: 70 Time: 2:30 hours

All the questions are compulsory

……

Q. 1 (a) Answer the following question. [UNIT-I] **(4)**

(1)

Q. 1 (b) Answer any two questions out of three. [UNIT -I] **(10)**

(1)

(2)

(3)

Q. 2 (a) Answer the following question. [UNIT-II] **(4)**

(1)

Q. 2 (b) Answer any two questions out of three. [UNIT -II] **(10)**

(1)

(2)

(3)

Q. 3 (a) Answer the following question. [UNIT-III] **(4)**

(1)

Q. 3 (b) Answer any two questions out of three. [UNIT -III] **(10)**

(1)

(2)

(3)

Q. 4 (a) Answer the following question. [From UNIT-I or II] **(4)**

(1)

Q. 4 (b) Answer any two questions out of three. [One Each From UNIT –I, II & III] **(10)**

(1)

(2)

(3)

Q. 5 (a) Answer the following question. [From UNIT-II or III] **(4)**

(1)

Q. 5 (b) Answer any two questions out of three. [One Each From UNIT-I, II & III] **(10)**

(1)

(2)

(3)

NOTE: Question no. 4-(a) & 5 (a) should not be asked from same unit.

B.Sc. Chemistry

Question Paper Pattern for Practical

SEM – III

Time: 03:30 **Total Marks: 50**

I. Organic Qualitative Analysis: Identification of the chemical nature of compound should be performed without Lab Manual in first 30 minutes and its result to be noted by examiner. [**20 Marks]**

II. Organic Volumetric Estimation: **[15 Marks]**

III. Continuous Internal Assessment: **[15 Marks]**

Two batch per each day
1st batch Time: 10:00 to 13:30
2nd batch Time: 14:00 to 17:30

SEM – IV

Time: 03:30 **Total Marks: 50**

I. Inorganic Qualitative Analysis: Dry Tests should be performed without Lab Manual in first 45 minutes and its result to be noted by examiner. [**20 Marks]**

II. Physicochemical Exercise: **[15 Marks]**

III. Continuous Internal Assessment: **[15 Marks]**

Two batch per each day
1st batch Time: 10:00 to 13:30
2nd batch Time: 14:00 to 17:30