BHAKTA KAVI NARSINH MEHTA UNIVERSITY

FACULTY OF SCIENCE

Chemistry

B. Sc. SEMESTER – 5 & 6

Effective From June-2018

Bhakta Kavi Narsinh Mehta University

Junagadh-362263

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BhaktaKaviNarsinh Mehta University, Junagadh

B. Sc. Examination **Paper style New Course**
Effective from June - 2018 **Subject: Chemistry**

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-IV] **(4)**
(1)

Q. 4 (b) Answer any two questions out of three. [FROM UNIT-IV] **(10)**
(1)
(2)
(3)

Q. 5 (a) Answer the following question. [FROM UNIT-V] **(4)**
(1)

Q. 5 (b) Answer any two questions out of three. [From UNIT-V] **(10)**
(1)
(2)
(3)

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – V
EFFECTIVE FROM JUNE-2018

C – 501: INORGANIC AND INDUSTRIAL CHEMISTRY

4 CREDITS
100 MARKS

Unit - I

Chapter - 1 Crystal field theory - I [12 hours]

Introduction, Ligands, Concept of crystal field theory, splitting of d-orbitals in octahedral and tetrahedral complex with CFSE concept,

Weak and strong field ligands,

High spin and low spin complexes with pairing energy, Calculation of CFSE,

Factors affecting on splitting energy,

Magnetic behavior of transition metal complexes, (Equation for calculation of magnetic moment for d & f block elements)

Orbital angular momentum contribution in magnetic momentum of various crystal fields,

Application of magnetic momentum to determine the structure of the complexes with limitation,

Example based on CFSE, Pairing energy and Magnetic momentum.

Unit - II

Chapter - 2 Metal π- complexes [12 Hours]

Metal carbonyls:

Definition, preparation, physical and chemical properties,

Classification of metal carbonyls, 18-electron rule and Effective atomic number (EAN),

Nature of M-CO bond based on Molecular orbital model (with spectral support), Types of CO groups, (Terminal, doubly bridge, triply bridge and semi-bridge)

Application of IR spectroscopy for

(i) Determination of geometry of complex

(ii) Determination of bond order

(iii) Detection of terminal and bridging CO groups

Structure of

(i) $Ni(CO)_4$

(ii) $Fe(CO)_5$

(iii) $Fe_2(CO)_9$

(iv) $Fe_3(CO)_{12}$

(v) $Mn_2(CO)_{10}$

(vi) $Co_2(CO)_8$

Metal nitrosyls: Definition, preparation, physical and chemical properties, Complex compounds having simple NO ligand (neutral), Linear (NO^+) and Bent (NO^-), terminal M-NO bonding, bridging NO groups, IR study of metal nitrosyls.

Unit - III

Chapter - 3 Wave Mechanics [6 Hours]

Basic concepts, Operators algebra (addition, subtraction, multiplication), commutative property, linear operator, commutation operator, the operator DEL & DEL SQUERED, momentum operator, Hamiltonian operator,

Particle in one dimensional box; Wave equation and energy related to a particle moving in one dimensional box, Energy levels and interpretation of energy equation,

Normalization and orthogonally of wave function,

Particle in three dimensional box; Derivation of normalized wave equation,

Energy related with it,

Degeneracy,

Example based on energy of 1s orbital, normalization, orthogonally, particle in one and three dimensional box and degeneracy.

Chapter - 4 Glass [6 Hours]

Introduction,
Physical and chemical properties of glass,
Raw materials for manufacturing of glass,
Chemical reaction involved in manufacturing of glass,
Manufacture process; formation of batch materials, melting, shaping, annealing and finishing,
Types and uses of glass (high silica glass, fused silica glass, pyrex glass, photochromic glass, photosensitive glass, optical glass, lead glass, borosilicate glass, wool glass, rare earth glass, insulating glass, vitreosil glass, jena glass)

Unit-IV

Chapter - 5 Cement [12 Hours]

Introduction, Type of cement,
Raw material for manufacture,
Cement rock beneficiation.
Manufacturing Processes of Portland cement,
Setting and Hardening of Portland cement,
Properties and uses of cement,
Indian Standard Institute (ISI) specification of cement,
Mortar and concrete, curing and Decay of concrete,
RCC and its advantage,
Uses of cement

Unit-V

Chapter - 6 Fertilizers [12 Hours]

Introduction, Plant nutrients and its role, Classification and Properties of fertilizers,
Nitrogenous fertilizers
Ammonium nitrate:

(i) Manufacture by Prilling method

(ii) Manufacture by Stengel method

Ammonium sulphate:

Manufacture from gypsum (Sindri Process) & Action as fertilizer

Urea:

Manufacture from

(i) Ammonium carbide

(ii) Sindri process & Action as fertilizer

Calcium cyanamide:

Manufacture & Action as fertilizer

Phosphate fertilizer

Manufacture of

(i) Normal super phosphate

(ii)Triple super phosphate

Ammonium Phosphate:

Manufacture of

(i) Mono ammonium phosphate

(ii) Diammonium phosphate

Potassium fertilizer: Potassium chloride, Potassium sulphate and Potassium nitrate.

NPK fertilizer

Nomenclature

Reference books:

(1) UGC Inorganic Chemistry - H. C. Khera (PragatiPrakashan)

(2) Inorganic Chemistry - J. N. Gurtu& H. C. Khera

(3) Principles of Inorganic chemistry- B. R. Puri, L. R. Sharma and K. C. Kalia; Vallabh publications, Delhi.

(4) Concise Inorganic Chemistry - J. D. Lee

(5) Basic Inorganic Chemistry - Gurdeep&Chatwal

(6) Advanced Inorganic Chemistry - Raymond Chang
(7) Advanced Inorganic Chemistry- Cotton and Wilkinson
(8) Co-ordination Chemistry - Banerjee
(9) Quantum chemistry by A. K. Chandra
(10) Basic Concept of Quantum Chemistry by R. K. Prasad.
(11) Physical chemistry: A Molecular approach by McQuarrie
(12) Reigel's Handbook of Industrial Chemistry by James A. Kent
(13) Engineering Chemistry by Jain and Jain
(14) Industrial Chemistry by B.K. Sharma

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – V
EFFECTIVE FROM JUNE-2018

C – 502: ORGANIC CHEMISTRY AND SPECTROSCOPY

Unit-I

Chapter - 1Carbohydrates [12 Hours]

Introduction, classification and nomenclature, general reaction of monosaccharides (with reference to Glucose and Fructose)

Inter-conversions:

(a) Conversion of Aldose to the corresponding ketose

(b) Conversion of Aldose to the next higher Ketose (wolform method)

(c) Conversion of Aldose to the Ketose having two more carbon atoms (Sowden method)

(d) Conversion of Ketose to the corresponding Aldose

Step-up reaction (Ascending in Aldose series)

(a) Kiliani reaction

(b) Sowdennitromethane reaction

Step-down reaction (Descending in Aldose series – Aldohexose to Aldopentose) by Ruff's method

Configuration of monosaccharides

Ring structure of Aldoses

Determination of ring size of Glucose by

(a) Methylation method

(b) Periodic oxidation method

Mutarotation of D (+) glucose

Unit-II

Chapter - 2Molecular Symmetry [12 Hours]

Introduction to symmetry; symmetry elements and symmetry operations with illustrations; concept and properties of group; Products of symmetry operation; symmetry point group [C_1, C_s, C_i, $D_{\alpha h}C_{\alpha v,}$ Td, Oh,Ih, $C_{n,}C_{nh,}$ C_{nv}, S_2n,D_n, D_{nh}, D_{nd},]; Group multiplication tables for C_{2v}, C_{3v} and C_{2h} point groups.

Unit-III

Chapter - 3Synthetic Drugs, Dyes and Sweetening agents [6 Hours]

Drug: Definition, Introduction to methods of classification, Synthesis and applications of Ibuprofen, Atenlol and Adrenaline

Dyes: Definition, Introduction to methods of classification, Synthesis and applications of Orange II, Crysodine G, Auramine O

Sweetening agent: Introduction, Synthesis and applications of Saccharin, p-anisylurea and dulcin

Chapter - 4Heterocyclic Compounds – I [6 Hours]

Classification and nomenclature of mono heterocyclic compound based on size of ring

Aromaticity in 5 membered (Furan, Thiophene and Pyrrole)

Preparation of Furan, Thiophene, and Pyrrole

Chemical Properties (Electrophilic Substitution Reaction) of Furan, Thiophene and Pyrrole; Nitration, Sulphonation, Acetylation, Chlorination

Reaction with Organometallic Compounds

Aromaticity of Pyridine

Basicity of Pyridine

Relative basicity of Pyridine, Pyrrole and Aliphatic amines

Preparation of Pyridine from acetylene, Hantzsch’s synthesis

Chemical Properties of Pyridine

Electrophilic Substitution Reaction

Nucleophilic Substitution Reaction

Unit-IV

Chapter - 5Name reactions, Rearrangements and Reagent [3 Hours]

Reactions;

Arndt Eistert reaction

BischlerNapieralski reaction

Rearrangements;

Curtius rearrangement

Bayer-villiger oxidation

Reagent;

Lithium Aluminium hydride $LiAlH_4$

Sodamide

Chapter - 6Infrared Spectroscopy [9 Hours]

Introduction; Range of IR , theory of IR; Modes of fundamental vibration; IR active, force constant; Vibration coupling; Fermi resonance; Finger print region; Instrumentation; Application of IR; determination of structure of organic molecules From IR; Interpretation of IR for given molecules and problems.

Unit-V

Chapter –7 Alkaloids [6 Hours]

Introduction, Occurrence, classification, Isolation, General method of proving structure of alkaloids, Constitution, Properties and synthesis of

(a) Coniine

(b) Nicotine

(c) Papaverine

Chapter –8 Ultraviolet and Visible Spectra [6 Hours]

Instrumentation; types of transition in organic molecules; auxochrome; chromophore; explanation of bathochromic shift and hypsochromic shift; hyperchromic and hypochromic effects; calculation of λ_{max} of (i) dienes and conjugated dienes; (ii) enones and dienones (iii) aromatic carbonyl system; factor affecting of UV spectral bands; application of UV.

Reference Books (Organic Chemistry):

1. Undergraduate organic chemistry Vol-II, III by Jagdamba Singh and L. D. S. Yadav (A PragatiPrakashan)

2. Organic Reaction Mechanism (4^{th} edition) – V.K. Ahluwalia and R.K. Parasar.

3. Reaction Mechanism and Reagents in Organic Chemistry – Gurdeep R. Chatwal.

4. A Text Book of Organic Chemistry-R.K.Bansal, New Age International Pvt.Ltd.

4**th** edition (2003).

5. Organic Chemistry by J.Clayden, N. Greeves, S. Warren, P. Wothers, Oxford University Press (2000).

6. Name Reaction in Organic Synthesis, Foundation Books Pvt. Ltd. (2006)

7. Heterocyclic Chemistry-R.K. Bansal.

8. Heterocyclic Chemistry-R.R. Gupta, M.Kumar and V. Gupta, Springer.

9. Heterocyclic chemistry - J.A. Joule, K. Mills & G.F. Smith.

10. The Essence of Heterocyclic Chemistry, New Age International Publications,2013.

11. Organic chemistry of natural products by Gurudeep R. Chatwal (Himalaya Publishing House)

12. Chemistry of Organic Natural Products Vol. I by O. P. Agarwal (Goel Publishing House, Meerut)

13. Organic Chemistry Vol-II: Stereochemistry and the chemistry of natural Products (5th edition) by I. L. Finar (Pearson Education)

14.Spectrometric identification of organic compoundsBySilverstrinBassler (16th Editim)

15.Elementary organic spectroscopy by Y. R. Sharma.

16.Spectroscopy of organic compounds by P. S. Kalsi
17.Chemical Application of Group theory by F Albert Cotton
18.Molecular spectroscopy by B. K. Sharma.
19.Organic Chemistry by Morrison and Boyd

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – V
EFFECTIVE FROM JUNE-2018

C – 503: PHYSICAL AND ANALYTICAL CHEMISTRY

4 CREDITS
100 MARKS

Unit-I

Chapter –1 Second Law of Thermodynamics [12 Hours]

Limitations of first law of thermodynamics

Spontaneous process

Carnot cycle and theorem

Statements of second law of thermodynamics

Perpetual machine of second kind (briefly)

Concept of entropy and Definition of entropy

ΔS in reversible & irreversible (spontaneous) process

ΔS in ideal gases

ΔS of mixture of ideal gas

ΔS in physical transformations

Entropy and second law of thermodynamics

Physical significance of entropy

Numerical based on theory

Unit-II

Chapter –2 Free Energy and Chemical Equilibrium [8 Hours]

Work function: Its physical significance and variation with V and T

Free Energy: its significance and variation with P and T

ΔG for ideal gases,

Gibbs Helmholtz equation and its applications

Criteria for chemical equilibrium (According to $\Delta G = \Delta H - T\Delta S$)

Vant Hoff reaction isotherm (By equilibrium box and chemical potential method),

Law of active mass

Vant Hoff isochore,

Clausius - Clapeyron equation

Numericals

Chapter –3 Phase Rule [4 Hours]

Two components partially miscible liquid pairs (1) Maximum critical solution temperature (2) Minimum critical solution temperature (3) Maximum and Minimum critical solution temperature.

Influence of impurity on critical solution temperature

Three component partially miscible liquid system

Method of graphical presentation

Types of partially miscible three liquid systems:

One partially miscible pair: Effect of adding third component,Nature of tie line, Plait point, Binodal curve, Characteristics of diagram, A is added to binary system, A is constant and B and Cvaried.

Formation of two pairs of partially miscible liquid

Formation of three pairs of partially miscible liquid

Application of ternary liquid diagram

Unit-III

Chapter –4 Electrochemistry – I [8 Hours]

Introduction

Conventional sign and representation of cell

Reversible cell and Irreversible cell

Types of reversible electrodes

Half-cell, standard half-cell,

Measurement of emf

Standard cell

Standard electrode potential

Single electrode potential

Reference electrodes: (1) Primary reference electrode (2) Secondary reference electrodes (Calomel, Ag/AgCl and $Hg/HgSO_4$ electrodes)

Applications of emf series

Calculation of single electrode potential

Determination of equilibrium constant

Determination of ΔG, ΔS and ΔH from emf of cell

Determination of solubility sparingly soluble salt

Numerical based on theory

Chapter –5 Colourimetry [4 Hours]

Introduction

Definition of colourimeter

Explanation of terms: Transmittance and Absorbance (Optical Density)

Laws of Colorimetry (Grotthus - Draper, Lambert, Beer and Lambert-Beer laws)

Nature of Molar absorptivity and Absorbance

Deviation of Beer Law,

Instrumentation: Radiation source, Filter, Slit, Cell, and Detectors name.

Selection of filter

Application in quantitative analysis,

Spectrophotometer

Spectrophotometric Titrations: Introduction, Apparatus (Cell), Technique, Dilution Correction

Types of Spectrophotometric Titrations

Advantages of Spectrophotometric titrations

Numerical based on theory

Unit-IV

Chapter –6Conductometry [8 Hours]

Electric conductance in metals and in electrolyte solution,

Terms: Conductance, Specific resistance, Specific conductance, Equivalent conductance

Relationship between specific conductance and equivalent conductance

Effect of dilution on conductance, specific conductance and equivelant conductance

Conductivity cell and platinization of electrodes

Determination of cell constant

Coductivity water

Kohlrausch's law

Conductometric Titration: Introduction and dilution correction

Acid base titration:

Strong acid - strong base

Strong acid - Weak base

Weak acid – Strong base

Mixture of strong acid + Weak acid - strong base

Replacement Titration:

Salt of weak acid – strong acid

Salt of weak base – strong base

Precipitation Titration:

$AgNO_3$ – NaCl (2) $BaCl_2$ – K_2SO_4 (3) $Ba(OH)_2$ – $MgSO_4$

Determination of Degree or hydrolysis and Hydrolysis constant

Determination of solubility and solubility product of sparingly soluble salt

Numerical based on theory

Chapter –7 Introduction of Complexometry Titration [4 Hours]

Method of preparation of standard EDTA solution

Velcher's law explanation of Pm-$\rightarrow$ EDTA Vol. graph with stability constant value.

Types of EDTA titration (i) Direct, (ii) Back titration, (iii) Substitution titration (iv) Alklimetry titration mixture with the help of masking and demasking agent,

Principle of metal ion indicator,

Use of EBT, calcon, muroxide with structure and characteristics.

Unit-V

Chapter –8 Volumetric Analysis [12 Hours]

Ostwald's law for indicator, Necessary derivation and formula of indicator used in Neutralization, redox, precipitation titration,

Primary and secondary standard solution

Neutralization Titration with Graph:

Strong acid - Strong base titration

Weak acid - Strong base titration

Strong acid – Weak base titration

Poly protic acid - Strong base titration

Redox Titration:

Principle of external and internal indicator in redox titration.e.g.Diphenyl amine, starch &$K_3[Fe(CN)_6]$

Redox Titration with graph and calculation

Iodometry and Iodimetry titration

Preparation of standard sodium thiosulphate solution

Precipitation Titration:

Argentometric Titration (I) Mohr's method (II) Fajan's method (III) Volhard's method

Numerical based on pH, Normality, Molarity.

Reference Books for Physical Chemistry:

1. Elements of Physical Chemistry by Samuel Glasstone and D. Lewis
2. Principles of Physical Chemistry by S.H. Maron and C. F. Prutton
3. Thermodynamics for Chemists by Samuel Glasstone
4. Elements of Physical Chemistry by B. R. Puri, L. R. Sharma, M. S. Pathania
5. Advanced Physical Chemistry by J. N. Gurtu
6. Physical Chemistry by N. Kundu and S. K. Jain
7. Physical Chemistry by K. L. Kapoor
8. Physical Chemistry by B. K. Sharma
9. Thermodynamics by Gurudeeep Raj
10. Introduction to Electrochemistry by S. Gladstone

Reference Books for Analytical Chemistry:

1. Fundamental of Analytical Chemistry by Skoog and West
2. Instrumental Methods of Chemical Analysis by B. K. Sharma
3. Water Analysis and Water Pollution by V. P. Kudesia
4. Instrumental Method of Chemical Analysis by ChatwalAnand
5. Thin Layer Chromatography by Egal Stall
6. Book for Water Analysis by R. K. Trivedi, and V. P. Kudesia
7. Analytical Chemistry by Dick
8. A Textbook of Quantitative Inorganic Analysis by A. I. Vogel
9. Electrometric Methods of Analysis by Browning
10. Principle of Instrumental Methods of Analysis by Skoog

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – V
EFFECTIVE FROM JUNE-2018

C – 504: CHEMISTRY PRACTICALS

[Practical Exam. would be conducted for 1 ½ days]
[Total Marks: 150 marks]

6 CREDITS

1. Organic Separation (Mixture of two compounds) [30+5 marks]

[Minimum 12 mixtures should be done]
Separation & Analysis of an organic mixture containing

(a) Two solid components using water, $NaHCO_3$, NaOH and HCl for separation
(b) Liquid + liquid component - separation by physical method.
(c) Liquid + solid component - separation by physical method.
(d)

2. Inorganic Volumetric Analysis [30 marks]

[Minimum 8 exercises should be done]
For volumetric exercise all the standard solutions are to be prepared by the students.

i. Iodometry and Iodimetry

(a) Estimation of Cu^{+2} and $CuSO_4.5H_2O$ in the given $CuSO_4.5H_2O$ using 0.05N $Na_2S_2O_3.5H_2O$ solution.
(b) Estimation of As^{+3} and As_2O_3 in the given As_2O_3 using 0.05N $Na_2S_2O_3.5H_2O$ solution.

ii. Complexometric titration:

1. Estimation of the amount of Ni^{+2} in the given $NiSO_4.7H_2O$ solution using 0.02 N EDTA solutions.
2. Estimation of the amount of Mg^{+2} and Pb^{+2} in the given solution containing a mixture of Mg^{+2} and Pb^{+2} using 0.02 N EDTA solution
3. Estimation of the amount of Ca^{+2} and Zn^{+2} in the given solution containing a mixture of Ca^{+2} and Zn^{+2} using 0.02 N EDTA solution
4. Estimation of the amount of Fe^{+3} and Cr^{+3} in the given solution containing a mixture of Fe^{+3} and Cr^{+3} using 0.02 N/ 0.01 M $Pb(NO_3)_2$ and 0.02 N/ 0.01 M EDTA solution.

iii. Redox titration

1. Determination of the amount of NO_2^{-1} in the given $NaNO_2$ or KNO_2 solution by reduction method using 0.1 N $KMnO_4$ solutions.

iv. Water Analysis

1. To determine the amount of chloride in the given sample of water using 0.02 N $AgNO_3$

v. To determine the purity of $NaHCO_3$ in the given sample

3. Physicochemical Exercise [30 marks]

[Minimum 10 exercises should be done]

1. Conductometry

i. To determine normality and gms/lit of xN HCl and also determine specific conductance by conductometry.
ii. To determine normality and gms/lit of the mixture of $HCl+CH_3COOH$ by conductometry.
iii. To determine the normality of weak acid by conductometry
iv. To determine the concentration of Ni+2 using 0.1M EDTA solution.
v. To determine the normality of $xNAgNO_3$ using 0.5N NaCl by Conductometry.

2. Thermodynamics:

i. Calculate entropy of vaporization (ΔS_v) of a given liquid by plotting a graph of log (1/time) vs (1/temperature)

3. Refractometer

i. To determine specific refractivity and molecular refractivity of given pure liquid A, B, C, D.
ii. To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution.

4. Viscosity

i. To determine relative and absolute viscosity of pure liquid A, B, C, D by Ostwald's viscometer.
ii. Preparation three different 10%, 5%, 2.5% aqueous solution of glycerine, find viscosity of these three solutions as well as unknown concentration solution with the help Ostwald's viscometer.

5. Colourimetry

i. Find out the amount of Ni^{+2} in the given solution by colourimetry method.
ii. Find out the amount of Fe^{+3} in the given solution by colourimetry method.

6. Polarimeter

i. To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown.

ii. Study the inversion rate of sugar in presence of 1N HCl and determine the rate of reaction.

7. Viva. **[5+5=10 marks]**

Bhakta KaviNarsinh Mehta University, Junagadh

B. Sc. Semester - 6 Examination **Paper style New Course**
Effective from June - 2018 **Subject: Chemistry**

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. [FORM UNIT-I or II] **(4)**
(1)

Q. 4 (b) Answer any two questions out of three. [ONE EACH FORM 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.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – VI
EFFECTIVE FROM JUNE-2018
C – 601: INORGANIC AND INDUSTRIAL CHEMISTRY

4 CREDITS
100 MARKS

Unit – I

Chapter - 1 Multi electron systems [12 hours]

Introduction,

Quantum number,

Types of coupling: s-s coupling, *l-l* coupling for p^2, p^3 and d^2 electronic configuration with vector diagram, L-S coupling, j-j coupling,

Concept of spectral terms and term symbols,

Derivation of spectral term symbol for p^1 to p^6& d^1 to d^9,

Hund's rules for the determination of ground state spectral term,

Derive ground state spectral term for p^2 and d^2 electronic configuration.

Microstates: Definition and calculation of microstates for p^2 and d^2 electronic configuration,

Holepegion diagram of p^2 and d^1 electronic configuration,

Example based on calculation of S, M_S, L, M_L , J and M_J.

Unit - II

Chapter - 2 Crystal field theory - II [12 hours]

Jahn-Teller effect - Statement and explanation,

Strong and weak Jahn-Teller distortion,

Explanation of distorted tetrahedron structure due to Jahn-Teller effect with example,

Splitting of d-orbitals in square planar complexes with examples,

Hole formalism and Hole formalistic pair,

Splitting of D and F ground terms (using hole formalism),

Orgel Diagram of D and F states,

Selection rules for d-d transition,

Types of electronic transition in metal complexes,

Absorption spectrum of Ti^{+3},Cu^{+2}& Ni^{+2}.

Unit - III

Chapter - 3 Magneto chemistry [6 Hours]

Introduction,

Basic terminology: Magnetic field, Magnetic pole-dipole, Intensity of magnetization, Magnetic induction, Magnetic Permeability, Magnetic susceptibility,

Magnetic behavior; Paramagnetism, Diamagnetism, Ferro magnetism, Anti-ferro magnetism and ferri magnetism,

Effect of temperature on magnetic behavior of substances,

Equation for magnetic moment of diamagnetic and paramagnetic substances,

Methods for determination of magnetic susceptibility (Gouy method), Determination of magnetic susceptibility by using standard substance,

Application of magnetic susceptibility

Chapter - 4 Oils and Fats [6 Hours]

Introduction, Properties of oil and fats, Classification,

Manufacture of Cotton seed oil: (i) Solvent extraction method

(ii) Expression method

Hydrogenation of oil: (i) Optimum condition for the hydrogenation process (ii) Preparation of Nickel catalyst,

Process for hydrogenation of oil - (i) Dry process (ii) Wet process,

Analysis of oil and fats: (i) Saponification value (ii) Acid value (iii) Iodine value (WIJS method) (iv) Reichert – Meissl value.

Unit-IV

Chapter - 5 Soaps and Detergents [12 Hours]

Introduction, Raw materials for manufacture

Methods for manufacture of soap

(i) Batch process

(ii) Continuous process

Types of soap: Toilet soap, transparent soap, shaving soap, Neem soap, Liquid soap

Recovery of glycerin from spent lye,

Introduction to detergents, Principal group of synthetic detergents, Bio-degradability of surfactants

Classification of surface active agents,

Anionic detergents,

Manufacture of anionic detergents

(i) Oxo Process

(ii) Alfol Process

(iii) Welsh Process

Cationic detergents,

Non – Ionic detergents, amphoteric detergents,

Manufacturing of Shampoo

Unit-V

Chapter - 6 Environmental Chemistry [12 Hours]

Environment – definition and introduction, Segments of environment

(i) Atmosphere

(ii) Hydrosphere

(iii) Lithosphere

(iv) Biosphere,

Air Pollution:

Major sources of air pollution, Control of Air pollution,

Green House Effect,

Photochemical smog,

CFC and ozone depletion,

Acid rain, Sources and effects of NOX and SOX,

Water pollution:

Classification of water pollution

(i) Physical pollution

(ii) Chemical pollution

(iii) Biological pollution

(iv) Physiological pollution

Sources of water pollution

(i) Sewage and domestic waste

(ii) Industrial effluents

(iii) Agricultural discharges

(iv) Fertilizers

(v) Toxic metals

(vi) Siltation

(vii) Thermal pollutions

(viii) Radioactive materials

Water Pollution Control

Dissolved Oxygen (D.O.) determination

Chemical Oxygen Demand (C.O.D.) determination

Biological Oxygen Demand (B.O.D.) determination

Reference books:

(1) UGC Inorganic Chemistry - H. C. Khera (PragatiPrakashan)

(2) Inorganic Chemistry - J. N. Gurtu& H. C. Khera

(3) Concise Inorganic Chemistry - J. D. Lee

(4) Basic Inorganic Chemistry - Gurdeep&Chatwal

(5) Advanced Inorganic Chemistry - Raymond Chang

(6) Advanced Inorganic Chemistry- Cotton and Wilkinson

(7) Co-ordination Chemistry - Banerjee
(8) Magneto Chemistry by Shyamal&Datta
(9) Reigel's Handbook of Industrial Chemistry by James A. Kent
(10) Engineering Chemistry by Jain and Jain
(11) Industrial Chemistry by B.K. Sharma
(12) Environmental Chemistry by A.K. De
(13) Environmental Chemistry by Sharma &Kaur
(14) Environmental Solution of Analysis by S.M. Khopkar
(15) Inorganic inflictive analysis by Vogel and Gehani Parekh
(16) A Text Book of Petrochemicals by BhaskarRao
(17) Advanced Petrochemicals by Dr. G.N. Sarkar
(18) Chemicals from Petrochemicals by A.L. Waddam

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – VI
EFFECTIVE FROM JUNE-2018
C – 602: ORGANIC AND SPECTROCOPY

4 CREDITS
100 MARKS

Unit-I

Chapter - 1 Amino acids, Peptides and Proteins [12 Hours]

Introduction, Classification of amino acids name and formula

Synthesis of amino acids by:

a. Amination of α-halogen acids

b. Gabriel pthalimide synthesis

c. Erlenmeyer azlactone synthesis

d. Hydantoin method

Physical properties of amino acids, Chemical properties of amino acids, Isoelectric point

Introduction to Polypeptides, Synthesis of Polypeptides by:

a. Bergmann Method

b. Sheehan's Method (use of Phthaloyl group)

c. Fischer's Method (use of p-toluenesulphonylchloride)

Introduction and classification of proteins,

Constitution of Thyroxine, Synthesis of Thyroxine

Unit-II

Chapter - 2 Terpenoids [6 Hours]

Introduction, Occurrence, Isolation, General characteristics of Terpenoids, Isoprene Rule, Constitution and Synthesis of:

(a) Citral

(b) α-Terpineol

Chapter - 3 Synthetic Explosive, Perfumes and Insecticides [6 Hours]

Synthesis and uses of: Explosives:

RDX (Research Department Explosive)

TNT (Trinitrotoluene)

PETN (Pentaerythritoltetranitrate)

Perfumes:

Musk Xylene

Musk Ketone

Musk Ambrette

Insecticides:

Baygon

Carbendazim

Parathion

Unit-III

Chapter - 4 Polynuclear Aromatic Hydrocarbons [6 Hours]

Introduction, Classification of Polynuclear hydrocarbon, Synthesis and chemical properties:

a. Biphenyl
b. Diphenyl methane
c. Naphthalene
d. Anthracene

Chapter - 5 Heterocyclic Compounds [6 Hours]

Fisher indole synthesis, Madelung synthesis, Skrup synthesis, Friedlander's synthesis, Doebner Miller synthesis, Pomeranz-Fritsch reaction

Unit-IV

Chapter - 6 Nuclear Magnetic Resonance Spectroscopy [12 Hours]

Introduction; Principle; nuclear quantum number; equivalent and non-equivalent protons with illustrations; enantiotopic and diastereotopic protons; shielding and deshielding of protons; chemical shift and factors affecting it; anisotropic effect; intensity of signals; spin- spin coupling and coupling constant; Deuterium labeling; applications of NMR; problems based on determination of structure of organic molecules from NMR spectral data

Unit-V

Chapter - 7 Mass Spectroscopy [4 Hours]

Introduction, Basic principle; instrumentation; General fragmentation modes, important features for the mass spectra of alkanes (No problems)

Chapter - 8 Problem based on UV, IR and NMR Spectroscopy [4 Hours]

Chapter - 9 Conformational analysis of cyclic systems [4 Hours]

Cyclohexane, mono-substituted cyclohexane and di-substituted cyclohexane

Reference Books

1. Spectroscopy of Organic Copmpounds, P.S. Kalsi, New Age International Ltd.
2. Organic Spectroscopy by William Kemp.
3. Spectrometric Identification of Organic Compounds. (6th Edition) by Robert M. Silverstein & Francis X. Webster, Wiley.
4. Organic Spectroscopy: Principles and Applications, 2ndEdition by Jag Mohan, Alpha Science International Ltd., Harrow U. K.
5. Organic Chemistry by Morrison and Boyd (6^{th} edition)

6. 1. Undergraduate organic chemistry Vol-II, III by Jagdamba Singh and L. D. S. Yadav (A PragatiPrakashan)
7. Heterocyclic Chemistry-R.K. Bansal.
8. Heterocyclic Chemistry-R.R. Gupta, M.Kumar and V. Gupta, Springer.
9. Heterocyclic chemistry - J.A. Joule, K. Mills & G.F. Smith.
10. The Essence of Heterocyclic Chemistry, New Age International Publications,2013.
11. Organic chemistry of natural products by Gurudeep R. Chatwal (Himalaya Publishing House)
12. Chemistry of Organic Natural Products Vol. I by O. P. Agarwal (Goel Publishing House, Meerut)
13. Organic Chemistry Vol-II: Stereochemistry and the chemistry of natural Products (5th edition) by I. L. Finar (Pearson Education)
14. Stereochemistry conformation and mechanism by P.S. Kalsi 7^{th} edition
15. Stereochemistry of organic compounds by Eliel

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – VI
EFFECTIVE FROM JUNE-2018
C – 603: PHYSICAL AND ANALYTICAL CHEMISTRY

4 CREDITS
100 MARKS

Unit-I

Chapter - 1 Activity of Electrolytes [8 Hours]

Introduction to Ionic Activity

Derivation of $a_2 = a_+^{\nu+} a_-^{\nu-}$ and $a_2 = a_+ a_-$ for 1-1 electrolyte

Mean Activity $a_\pm$, its relation with a_+ and a_-

Relationship between a_2 and $a_\pm$ i.e. $a_2 = a_\pm^{\nu}$

Mean ionic activity coefficient $f_\pm$ and f_+, f_-

Ionic Strength: Definition, Explanation and Equation

Debye Huckel Limiting Law (Without derivation):

Derivation of $-\log f_\pm = Az_+z_-\mu^{1/2}$

Interpretation of Equation

Graph of $-\log f_\pm \rightarrow \mu^{1/2}$ and its explanation / discussion

Empirical correction of Debye Huckel Limiting Law for

Size of ion and (2) Orientation of solvent molecules

Methods to Determine Activity Coefficient:

(1) Solubility method

emf methods: Concentration cell without transference

Numerical based on theory.

Chapter - 2 Third law of Thermodynamics [4 Hours]

Introduction

Nernst heat theorem

Third law of thermodynamics

Determination of absolute entropies of solids, liquids and gases

Applications of third law of thermodynamics (ΔS^0, ΔG^0 and equilibrium constant of chemical reaction)

Tests of third law of thermodynamics

Residual entropy.

Unit-II

Chapter - 3 Electrochemistry - 2 [12 Hours]

Definition of Concentration cells

Types of concentration cell:

(1) Electrode concentration cells

(2) Electrolyte concentration cells

Concentration cells without transference

Concentration cells with transference

Liquid junction potential

Elimination of liquid junction potential.

Applications of emf measurements:

Solubility of sparingly soluble salts

Valency of metal ion

Dissociation constant of weak acid

Transport number of ion

Ionic product of water

Degree of hydrolysis

Numerical based on theory.

Unit-III

Chapter - 4 Partial Molar Properties [4 Hours]

Introduction

Definition of partial molar property

Concept of chemical potential

Physical significance (properties) of chemical potential

Derivation of Gibbs-Duhem equation

Variation of chemical potential with temperature and pressure

Determination of partial molar properties by method of intercept

Applications of chemical potential (Henry's law, Rault's law and Nernst's distribution law)

Numerical based on theory

Chapter - 5 Error and Statistics [8 Hours]

Introduction,

Types of errors, Determinate (Instrumental, Operative and Errors of method) and indeterminate errors; Additive and Proportional errors.

Minimization of errors (Calibration of instruments, Blank measurement, Independent method, Parallel method and Standard addition method)

Accuracy and precision,

Absolute error and Relative error,

Mean and Median

Deviation, Relative mean deviation, Width (Range), Standard deviation, Variance and Coefficient of variance

Explanation of Significant figure and its laws.

Gausian (Normal Distribution) curve and its explanation

Q – test and t -test (Student t-test)

Numerical based on theory

Unit-IV

Chapter – 6 Chromatography [12 Hours]

Introduction

Classification of chromatography - types of chromatography

Principle of Chromatography

Column chromatography: Principle, Adsorbents, Preparation of column, Method, Separation of green leaf pigment,

Paper chromatography: Introduction**,** Principle, Types of Paper Chromatography (Ascending and Descending, Two dimensional; Circular), Migration parameters (Rf value and Rx value), Spotting and Visualisation. Separation of amino acids and metal ions(Fe^{+} , Co^{+2}, $Ni^{+2)}$ mixture using spray reagent ninhydrine and aniline phthalate

TLC: Introduction,Principle, Method of preparation of chromplate, Experimental techniques, Superiority of TCL over other chromatographic Techniques, Application of TLC.

Gas chromatography; Introduction, Types, **P**rinciple of GLC and GSC,

Instrumentation, Carrier gas and Solvent, Column and Detectors (Briefly)

Advantages of gas chromatography

Ion Exchange chromatography: Introduction, Definition and Principle, Type of resins, Properties of ion exchange resins, Factors affecting separation of ions, Ion exchange capacity, Applications (Removal of interfering ion, Softening of water, Demineralization of water, Separation of lanthanides)

Unit-V

Chapter – 7 Basic Principle of Qualitative Analysis

[4 Hours]

Principle of Flame, Charcoal cavity and Borax bead tests,

Separation of the following ions in presence of each other

(i)	Cl^{-1}, Br^{-1} and I^{-1} ions	(ii)	NO_2^{-1}, NO_3^{-1} and Br^{-1} ions
(iii)	S^{-2}, SO_3^{-2} and SO_4^{-2} ions	(iv)	PO_4^{-3}, AsO_3^{-3} and AsO_4^{-3} ions
(v)	CO_3^{-2}, SO_3^{-2} and S^{-2} ions	(vi)	Cu^{+2} and Cd^{+2} ions

Chapter - 8 Potentiometry and pH metry [8 Hours]

Introduction and interpretation of pH metry and potentiometry.

Importance of indicator and reference electrode in the measurement of EMF and pH

E.M.F. method:

Study of acid-base Titration

Redox Titration

Argentometric titration include mixture of Cl^-, Br^-, I^- with graph and proper explanation.

pHmetry :

Definition, Interpretation of various methods of determining pH value like pH paper method, potentiometric method using only hydrogen electrode as indicator electrode and calomel electrode as reference electrode to determine pH value

Weak acid-strong base titration with curve and determination of dissociation constant (Ka) of weak acid.

Reference Books for Physical Chemistry:

1. Elements of Physical Chemistry by Samuel Glasstone and D. Lewis
2. Principles of Physical Chemistry by S.H. Maron and C. F. Prutton
3. Thermodynamics for Chemists by Samuel Glasstone
4. Elements of Physical Chemistry by B. R. Puri, L. R. Sharma, M. S. Pathania
5. Advanced Physical Chemistry by J. N. Gurtu
6. Physical Chemistry by N. Kundu and S. K. Jain
7. Physical Chemistry by K. L. Kapoor
8. Physical Chemistry by B. K. Sharma
9. Thermodynamics by Gurudeeep Raj
10. Introduction to Electrochemistry by S. Gladstone

Reference Books for Analytical Chemistry:

1. Fundamental of Analytical Chemistry by Skoog and West
2. Instrumental Methods of Chemical Analysis by B. K. Sharma
3. Instrumental Method of Chemical Analysis by ChatwalAnand
4. Thin Layer Chromatography by Egal Stall
5. Analytical Chemistry by Dick
6. Electrometric Methods of Analysis by Browning
7. Principle of Instrumental Methods of Analysis by Skoog

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
B. Sc. SEMESTER – VI
EFFECTIVE FROM JUNE-2018

C – 604: CHEMISTRY PRACTICALS

[Practical Exam. would be conducted for 1 ½ days]
[Total Marks: 150 marks]

6 CREDITS

1. Inorganic Qualitative Analysis (six radicals) [30 marks]

[Minimum 12 inorganic mixtures should be analyzed]
To analyze the given inorganic mixture containing six radicals

2. Organic Synthesis [35 marks]

(Percentage of yield, crystallization, melting point)
[Minimum 8 syntheses should be done]

i. Acetylation / Benzoylation

1. Acetylation of salicylic acid
2. Acelytation of aniline
3. Acelytation of phenol
4. Benzoylation of aniline
5. Benzoylation of phenol

ii. Aliphatic Electrophilic substitution

1. Preparation of iodoform from ethanol
2. Preparation of iodoform from acetone

iii. Aromatic Electrophilic Substitution

Nitration:

1. Preparation of m-dinitrobenzene,
2. Preparation of nitro acetanilide.

Halogenation:

1. Preparation of p-bromo acetanilide,
2. Preparation 2:4:6 -tribromo phenol

iv. Diazotization / Coupling

1. Preparation of methyl orange
2. Preparation of methyl red

v. Oxidation

Preparation of benzoic acid from benzaldehyde

3. Physicochemical Exercise [30 marks]

[Minimum 10 exercises should be done]

i. pH metry

1. To determine normality and gms/lit. of xN HCl by pH metry
2. To determine normality and dissociation constant of weak acid ($xNCH_3COOH$) by pH metry.
3. To determine normality and dissociation constant of dibasic acid (xN oxalic acid/malonic acid/maleic acid) using 0.1N NaOH solution.

ii. Potentiomentry

1. To determine normality and dissociation constant of benzoic acid used 0.1N NaOH.
2. To determine normality of given acid xN HCl using NaOH solution.
3. To determine concentration of xN FAS using $K_2Cr_2O_7$.
4. To determine normality of each halide in the mixture using 0.1N $AgNO_3$ solution.

iii. Surface tension:

1. Find the surface tension of the liquids A, B and C by using drop weight method. Find the value of parachor of liquid and CH_2 group.

iv. Chromatography

1. To determine Rf value of individual and mixture of amino acid by ascending paper chromatography.
2. To determine Rf value of individual and mixture of amino acid by circular paper chromatography.
3. To determine Rf value of individual and mixture of amino acid by thin layer chromatography (TLC).
4. To determine Rf value of individual and mixture of metal ions by ascending paper chromatography.
5. To determine Rf value of individual and mixture of metal ions by circular paper chromatography.

4. Viva (5+5) [10 Marks]

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C – 605: CHEMISTRY PROJECT

6 CREDITS
100 MARKS

Industrial Project Report

Or

Industrial Visit Report

- **Total Marks: 100 (60-Project report + 40 Presentations)**
- **Project report must be submitted in 40 to 50 pages.**
- **Power Point Presentation of 5 minutes.**