THE UNIVERSITY OF AZAD JAMMU AND KASHMIR

Syllabus for BSc (part-wise)

Chemistry

Department of Chemistry

10/1/2016

<u>SHEME OF STUDIES</u>

Following scheme of studies was recommended in the Board of Studies held on September 04, 2016 in the Department of Chemistry for BSc 2-Year (Part-wise) Program offered in the affiliated colleges.

Old Scheme		New Scheme	
Paper (Written)	**Marks**	**Paper (Written)**	**Marks**
Physical Chemistry (Paper A)	50	Physical Chemistry (Paper I) 3rd Year	40
Inorganic Chemistry (Paper B)	50	Inorganic Chemistry (Paper II) 3rd Year	40
Organic Chemistry (Paper C)	50	Organic Chemistry (Paper III) 4th Year	40
		Applied Chemistry (Paper IV) 4th Year	40
Practical		**Practical**	
Physical, Inorganic, Organic	50	Chemistry Lab I (Physical + Inorganic) 3rd Year	20
		Chemistry Lab II (Organic + Applied) 4th Year	20

Course Contents for BSc 2-Year (Part-wise) Program

Paper-I Physical Chemistry   **(60 hours)**

Section-I

1. Elementary Mathematics

Functions and their graphs, limits of function, equation of straight line, continuous and discontinuous function, differentiation of elementary, algebric and trigonometric functions, use of quadratic equation, meaning of differentiation in terms of rate of change, simple methods of integration and their physical significance.

2. Physical States of Matter

1. Gases

General characteristics of gases, Gay Lussac's law, ideal gas equation, kinetic molecular theory of gases, molecular velocities (average velocity, mean square velocity, root mean square velocity, most probable velocity), ideal and real gases, deviation of gas from ideality, derivation of kinetic gas equation, molecular collisions, collision diameter, critical phenomenon of gases, liquefaction of gases, mean free path, Vander Waal's equation for real gases.

2. Liquid

General characteristics of liquids, physical properties like surface tension, viscosity, parachor value, rheochor value and their applications, refractive index, specific and molar refraction and their applications, optical activity, specific rotation, dipole moment and molecular structure.

3. Solids

General characteristics of solids, types of solids, isotropy and anisotropy, habit of a crystal, crystal lattice and unit cell, crystal systems, Bragg's equation and X-ray crystallography of sodium chloride crystal and Bravis lattices.

3. Quantum theory and structure of atom

Bohr's atomic model, defects of Bohr's atomic model, classical and quantum mechanics, failure of classical mechanics, the concept of quantization, dual nature of matter, de-Broglie's equation, Heisenberg's uncertainty principle, limitation of Heisenberg's uncertainty principle, wave function and derivation of time independent Schrodinger wave equation, concept of atomic orbitals, quantum numbers, Pauli exclusion principle, electronic distribution of elements.

4. Chemical Thermodynamics

Introduction, thermodynamic terms like system, surrounding, boundary of system, states and state function, internal energy, extensive and intensive properties, first law of thermodynamics, enthalpy of a system, relationship between free energy change and enthalpy change, heat capacity of gases at constant volume and at constant pressure, , heat capacities relationship, 2nd

law of thermodynamics, 2nd law of thermodynamics, concept of entropy, entropy change in phase transition, heat engine, Carnot heat engine and its efficiency, concept of Gibb's and Helmholtz's free energy, change in free energy and equilibrium constant.

Section-II

5. ### Chemical Kinetics

   Introduction, concept of rate of chemical reaction, rate law, velocity constant, elementary and complex reaction, order and molecularity of reaction, zero, first and second order reactions, derivation of kinetic equation for first order and 2nd order reaction when initial concentration of both reactants is same, various methods for determining the rate of chemical reaction, Arrhenius equation, Lindemann's theory for unimolecular reaction, introduction to transition state theory, transition state theory for bimolecular reaction.

6. ### Electrochemistry

   Introduction, conductors and insulators, electrolytic and electronic conduction, specific conductance, measurement of specific conductance, cell constant and its determination, molar & equivalent conductance and their determination, Ostwald's dilution law (dependence of degree of dissociation constant on dilution), electrochemical cells, types of cells, Faraday's laws of electrolysis and their significance, EMF and its measurement, the Nernst equation.

7. ### Surface Chemistry

   Absoption and adsorption, types of adsorption, characteristics and factors which affect adsorption, applications of adsorption, physical adsorption and chemisorptions, catalysis, types of catalysis, enzyme catalysis, characteristics of catalysis, Freundlich adsorption isotherm and Langmuir adsorption isotherm and their applications.

8. ### Solutions

   Introduction, types of solution, concentration units (%age, normal, molar, molal, ppm, ppb, et.), Raoult's law, ideal and non-ideal solutions, concept of zeotropic and azeotropic mixture, molecular interactions in solution, colligative properties (lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and their determination).

Recommended Books

1. Bhatti H.N. and K. Hussain, "Principles of Physical Chemistry", Carvan Book House, Lahore.
2. Chaudhary G.R, "A Text Book of Physical Chemistry", Imtiaz Book Depot, Lahore.
3. Akhtar M.N. & Ghulam Nabi, "A Text Book of Physical Chemistry".
4. Maron S.H. & B. Jerome, "Fundamentals of Physical Chemistry", macruthan Publishing Co. Inc. New York. (Also published by National Book Foundations).
5. Atkins P.W., "Principles of Physical Chemistry" Pitman Publishing Company (1990).

Physical Chemistry Practicals

1. Determination of surface tension and parachor value by stalagmometer.

2. Determination of percent composition of liquid solutions from surface tension measurements.
3. Determination of viscosity and Rhechor value of Liquids from viscosity measurements.
4. Determination of percent composition of liquid solutions viscometrically.
5. Determination of refractive index and specific refractivity by refractometer.
6. Determination of percent composition of liquid solutions by refractive index measurements.
7. Determination of heat of neutralization of an acid with a base.
8. Determination of heat of solution of salts by calorimetric method.
9. Determination of angle of rotation of an optically active substance.
10. Determination of percent composition of an optically active substance in solution.
11. Determination of equilibrium constant of KI + I_2 ---------------> KI.
12. Conductometric titration of strong acid and strong base.

Recommended Books

1- Levitt B. P., "Findlay's Practical physical Chemistry", 9th Ed., Longman Group Limited.
2- Das R. C. and B. Behera, "Experimental Physical Chemistry", Tata McGraw Hill Publishing Company Limited.
3- Crocleford H. D., H. W. Biard, F. W. Getzen & J. W. Nowell, "Laboratory Manual of physical Chemistry", 2nd Ed., John Wiley & Sons London.
4- Helpern Arthur M., "Experimental Physical Chemistry. A Laboratory Textbook" 2nd ed. Prentice Hall (1997).
5- Bassette J., Denney C., Jeffery G. H. and Mendham J. "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis". English Language Book Society. 4th ed. (1978).

Paper-II Inorganic Chemistry   **(60 hours)**

Section-I

1. **Periodicity**
   Modern periodic table, similarities and differences among first row elements, their diagonal and vertical relationship with other elements, group trends and periodic properties in s, p, d and f block elements i.e., atomic radii, ionic radii, ionization potentials, electron affinities, electronegativities and redox potential.

2. **Theories of Chemical Bonding**
   Nature and types of chemical bonding. Modern concept of valence bond theory (VBT) and molecular orbital theory (MOT) and their applications to homo and hetero di-and polyatomic inorganic molecules. Valence shell electron pair repulsion (VSEPR), theory, explaining the shapes of inorganic molecules (i.e. AB_2, AB_3, AB_2E, AB_4, AB_3E, AB_2E_2, AB_5 and AB_6). Directed valence bond theory (Hybridization), metallic bonds.

3. **Acid-Base Concept**

Theories of acids and bases, applications of soft and hard acid-base (SHAB) concept. pH, pKa, pKb and their significance. Relative strength of acids and bases based on pka values. Leveling effect. Buffers, indicators and theory of indicators.

<div align="center">**Section II**</div>

4. **Essentials of Chemical Analysis**

   Law of mass action and its applications, precipitation and solubility product, common ion effect and its application, co-precipitation, fractional precipitation.

5. **Chemistry of p-Block Elements**

   (a) Boron and Aluminum

   General characteristics, group anomalies, structure, bonding and properties of boron and aluminium hydrides.

   (b) Carbon and Silicon

   General characteristics, comparison of carbon and silicon, allotropic forms of carbon. Structure and industrial applications of carbides, silicates and silicones.

   (c) Nitrogen and Phosphorus

   General characteristics, group anomalies. Role of oxides of nitrogen in the environment, preparation of nitric acid and ortho phosphoric acid.

   (d) Oxygen and Sulphur

   General characteristics, group anomalies, role of oxides of sulphur in air pollution. Preparation of sulphuric acid. Preparation of Hypo and its use in photography.

   (e) Halogens

   General characteristics, anomalous behaviour of fluorine, industrial preparation and uses of fluorine. Structure and properties of Interhalogens and pseudohalogens.

   (f) Noble Gases

   Discovery of noble gases, structure and properties of xenon fluorides, Industrial uses of noble gases and their compounds.

6. **Chemistry of d-Block Elements**

   Electronic configuration and oxidation states of transition elements. Nomenclature of coordination compounds. Theories of coordination compounds; valence bond theory (VBT), molecular orbital theory (MOT) and crystal field theory (CFT) for tetrahedral and octahedral complexes. Applications of coordination compounds.

Recommended Books
1. Bhatti, H. N. and Rahman, R. 2013. "Text Book of Inorganic Chemistry". Caravan Book House Pakistan.
2. Iqbal, M. Z. 2013. "Textbook of Inorganic Chemistry". Ilmi Kitab Khana
3. Lee, J. D. 1996. "Modern Inorganic Chemistry". Chapmann Hall (5th Ed) England.
4. Shriver, D. F.; Atkins, P. W and Langford, C. H. 1996. Inorganic Chemistry, Oxford (2nd Ed) England.
5. G. D. Tuli, R. D. Madan, S. K. Basu and S. Prakash, "Advanced Inorganic Chemistry, Volume 1" S. Chand & Company Ltd, 2014.

Inorganic Chemistry Practical

1. Laboratory Ethics and Safety Measures

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative Analysis

Analysis of four ions (two cations and two anions) from mixture of salts.

3. Quantitative Analysis

1. Determine the %age purity of NaCl (rock salt) by Mohr's method.
2. Determination of number of water molecules (x) in $CuSO_4.XH_2O$ iodometrically.
3. Determination of amount/dm^3 of $FeSO_4.7H_2O$ with $K_2Cr_2O_7$ by both internal and external indicators.
4. Determination of %age of iron in Ferric alum $(NH_4)_2SO_4$ $Fe_2(SO_4)_3.24H_2O$ using $K_2Cr_2O_7$ by both internal and external indicators.
5. Standardization of EDTA solution by Magnesium Sulfate/Zinc Sulfate solution by complexometry.
6. Find out the amount of Ca^{2+} in the given sample of marble (lime stone) by complexometry.

4. Inorganic Preparations

1. Preparation of ferrous sulphate
2. Preparation of ferric alum
3. Preparation of barium sulphate

Recommended Books

1. Jefferey, G. H.; Bassett, Menclham, J. and Denney, R. C. 1989. Vogel's Text Book of Quantitative Chemical Analysis. Benjamin Cummings (5th Ed) UK.
2. Vogel, A. I. A. 1995. Text Book of Macro and Semi micro Qualitative Inorganic Analysis, Longamn Green & Co England.
3. Skoog, D. A.; West, D. M. and. Holler, F. J. 1994. Analytical Chemistry. Saunders College Publications (6th Ed).
4. Pass, G., Sutcliffe, II. 1975. Practical Inorganic Chemistry, Preparations, Reactions and Instrumental Methods, 2nd ed., Chapman and Hall England.

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Paper-III   Organic Chemistry (60 hours)

Section-I

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1. **Basic Concepts in Organic Chemistry**

   Hybridization of orbitals of carbon atoms in alkanes, alkenes, alkynes and arenes. Hybridization of orbitals of nitrogen, oxygen and sulphur atoms in various functional groups. Localized and delocalized chemical bonding. Conjugation and hyper conjugation. Resonance, rules of resonance, resonance energy, resonance hybrid, factor effecting the resonance; inductive effect, Applications of inductive effect and resonance on various properties of organic compounds; Steric effect and its applications, Hydrogen bonding and its effect on various properties of organic compounds, Tautomerism.

2. **Nomenclature of Organic Compounds**

Nomenclature of alkanes, alkenes, alkynes, cycloalkanes, bicycloalkanes, spiroalkanes, monofunctional and polyfunctional derivatives of open chain and cyclic compounds, polysubstituted benzenes, polycyclic hydrocarbons such as naphthalene, anthracene, phenanthrene and their derivatives and heterocyclic compounds.

3. **Aromatic Hydrocarbons**

Structure of benzene, Resonance energy of benzene, Aromaticity, Criteria for aromaticity, Evidences of aromaticity, Natural sources of aromatic hydrocarbons; Preparation of aromatic hydrocarbons by different methods.
Reactions of aromatic hydrocarbons: electrophilic aromatic substitution reactions i.e. nitration, halogenation, Friedal-Crafts reaction and its limitations, sulfonation; Orientation and reactivity of substituted benzenes;
Nucleophilic aromatic substitution reactions; reaction such as addition, hydrogenation, Birch reduction, and oxidation reactions of side chain.
Polycyclic aromatic hydrocarbons like naphthalene, anthracence and phenantharene, their resonance structures and realtive stablities. Synthesis of naphthalene, Electrophilic substitution reactons of naphthalene, Oxidation and reduction reactions, Brief description of orientation and reactivity of naphthalenes.

4. **Isomerism**

Conformational Isomerism: conformational analysis of ethane, *n*-butane, cyclohexane, mono- and di-substituted cyclohexanes.
Optical isomerism: optical activity, chirality and optical activity; enantiomers, diastreomers; recemates and their resolution; D, L and R, S conventions; Optical isomerism in cyclohexanes, biphenyls and allenes.
Geometrical isomerism: cis and trans isomers; E-Z convention; determination of configuration of the isomers; inter-conversion of geometrical isomers; geometrical isomerism in cyclic compounds.

Section-II

5. **Alkyl halides**

Preparation of alkyl halides from alcohols, carboxylic acids;
Chemical reactions: Aliphatic nucleophilic substitution reactions, SN_1 and SN_2 mechanism, effects of the nature of substrates, attacking nucleophile, leaving group and the nature of solvent. Elimination reactions, E_1 and E_2 mechanisms, orientation of elimination (Hoffmann and Sytzeff rules).
Grignard Reagents; synthesis, structure, and reactions with active hydrogen compounds carbonyl compounds such as aldehydes, ketones, esters, acid halides and CO_2; reaction with nitriles, ethylene oxides, sulphur and oxygen.

6. **Chemistry of Phenols and Ethers**

Phenols: Physical properties; Synthesis of phenols, reactions of phenols such as acylation, Friedal-Crafts reaction, Nitartion, Sulphonation, Carbonation, Formylation and Diazo coupling.

Ethers: Physical properties, Preparation of ether from alcohols, alkyl halides and alkenes; Reactions of ether, brief introduction of crown ethers and polyethers.

7. **Chemistry of Carbonyl Compounds**

   Preparation of aldehydes and ketones, by pyrolysis of calcium salts of acids, acylation of alkenes and arenes, reduction of acid halides and nitriles.

   Physical properties of aldehydes and ketones; Structure and reactivity of carbonyl group; Comparisionof the reactivity of aldehydes and ketones; Nucleophilic addition of water, alcohols, ammonia and its derivatives, hydrogen cyanide, bisulfite, reduction and oxidation reactions; Aldol condensation and related reactions, Cannizaro's reaction, Witting reaction, oxidation reactions, chaemical tests of aldehydes and ketones.

8. **Chemistry of Carboxylic Acids and their Derivatives**

   Physical propertis of carboxylic acids; Effects of different parametters on the acid strengths of aliphatic and aromatic carboxylic acids. Chemical properties like salt formation nucleophilic acyl substitution, reduction of carboxylic acids, decaronylation, Hunsdicker reaction, Kochi reaction, substitution at α-carbon. Preparations, properties and reactions of acids chlorides, acids anhydrides, amides, cyanides and esters; Maolnic and acetoacetic esters synthesis.

9. **Heterocyclic Compounds**

   Methods of preparation of pyrol and pyridine, their aromatic character and comparison with benzene. Important reactions of pyrrol and pyridine.

Organic Chemistry Practical

1. **Compound Analysis**

   Identification of organic compounds containing only one functional group with special emphasis on compounds containing following functional groups.

   -COOH, -OH, C=O, $-NH_2$ and $-CONH_2$

2. **Preparation of organic compounds**

   Preparation and techniques of purification of tribromophenol, nitrobenzene, aspirin, ethyl benzoate and benzoic acid from toluene, butyl chloride, acetanilide.

3. **Basic Experimental techniques used in organic chemistry**
   1. Simple distillation
   2. Solvent extraction
   3. Sublimation
   4. Re-Crystallization

4. **Estimation (Volumetric)**
   1. Determination of molecular weight of carboxylic acid.
   2. Estimation of amide group and glucose.

RECOMMENDED BOOKS

1. Younas, M., Text Book of Chemistry, Ilmi Kutab Khana, Lahore.
2. Rehman, A., Text Book of organic Chemistry, Karwan Book House, Lahore.
3. Bhatti, H. N. and Rahman, R. 2013. Text Book of Organic Chemistry. Caravan Book House Pakistan.
4. Bahl, A., and B. S. Bhat. "A Text Book of Organic Chemistry, 17th Edn, S."*Chand and Company, New Delhi ISBN*: 81-219.
5. March, J., Advance Organic chemistry, John Wiley & Sons, New York.
6. I. L. Finar, "Organic chemistry" , Vol. I, Pearson Education, L.P.E.

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Paper-IV   Applied Chemistry   **(60 hours)**

Section-I

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1. Chromatography

Introduction to chromatography, types of chromatography. Basic concepts, methodology and applications of Paper and thin layer chromatography.

2. Spectroscopy

Introduction of U.V. and visible spectroscopy, Beer-Lambert law. Instrumentation, methodology and applications of U.V. and visible spectroscopy. Introduction of infra-red spectroscopy, Instrumentation, methodology and applications of infra-red spectroscopy.

3. Environmental Chemistry

Composition of the atmosphere, greenhouse gases and greenhouse effect, role of oxides of sulphur and nitrogen in air pollution, ozone depletion. Water pollution, COD, BOD and other tests relevant to industrial emissions, acid rain.

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Section-II

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4. Nuclear Chemistry

Types of nuclear radiations. Detection and measurement of radioactivity. Stable and unstable isotopes. Artificial nuclear transformations. Application of radioactive isotopes. Nuclear hazards and safety measures, G M counter and cloud chamber. Brief description of nuclear reactors.

5. Introduction to Modern Materials

Introduction to polymers, classification of polymers, polymerization mechanism (chain growth, step growth etc.), organic polymers (nylon, polyethylene), applications of polymers. Introduction to composites, ceramics, fiber glass and liquid crystals.

6. Industries

Industries of glass, sugar and fertilizers (urea, calcium ammonium phosphate). Introduction to unit process in various chemical industries. Metallurgy of iron and copper.

7. Biochemistry and Biotechnology

Brief introduction to carbohydrates, proteins and lipids. Discuss biotechnology as science of many disciplines.

Recommended Books

1. Marson S.H. & B. Jerome. "Fundamentals of Physical Chemistry". Macruthan Publishing co. inc. New York (also Published by National Book Foundation)
2. Heald C. & A.C.K. smith. Applied Physical Chemistry English Language.
3. Shriver, D.F., P.W. Atkins and C.H. Langord," Inorganic Chemistry". Oxford, 2nd Edition (1984).
4. Sharpe, A.G., "Inorganic Chemistry" Longman, 3rd Edition(1992)
5. Younas, M. Organic Spectroscopy, A.H. Publisher, Lahore.
6. Text Book of Physical Chemistry for B.Sc. students by G. Nabi, Publishers; Ilmi Kitab Khana Urdu Bazar, Lahore.
7. Physical Chemistry by W. J. Moore, Longman Scientific and Technical.
8. Principles of Physical Chemistry by Marron and Pruffon, The Macmillan Company.
9. Physical Chemistry by Atkins, Oxford University Press.
10. Roger's Industrial Chemistry, Von Norstand Co. N. Y.
11. Introduction to biotechnology by W. J. Thieman and M. A. Palladino, published by Pearson Limited.
12. Essentials of Medical Biochemistry by Mushtaque Ahmed, Merit publishers Faisalabad.

Practicals Applied Chemistry

1. Preparation and standardization of molar and normal solutions (at least 6)
2. Identification of cations by paper chromatography.
3. $(Cu^{+2} + Ni^{+2})$, $(Al^{+3} + Fe^{+3})$, $(Cd^{+2} + Pb^{+2})$
4. Wet tests for carbohydrates
5. Separation of plastid pigments by TLC
6. Separation of mixture of Phenol and natural products by chromatography.

Recommended Books
1. Riegel's Handbook of Industrial Chemistry. Von Norstand Reeinhold Co. N. Y.
2. Vogel A. I. "A Text Book of Organic Analysis Edward Arnold, London.
3. Mann, F. G. and B.C. Saunders. Practical Organic Chemistry Longman London.
4. Amin, I. J. 2002. Theory and Practice of Chromatography, Higher Education Commission Pakistan,

Note:

For each paper 60 hour teaching is recommended. In order to ensure the maximum coverage of the course contents, the minimum class duration must be of 50 minutes.

Paper Pattern

For maximum coverage of syllabus following paper pattern is recommended.

Total No. of questions = 9

No. of questions to be attempted = 5

Section-I (2 questions to be attempted from 4 given questions)

Q1

Q2

Q3

Q4

Section-II (2 questions to be attempted from 4 given questions)

Q5

Q6

Q7

Q8

Section-III (Compulsory question)

Q9

Composition of Questions

- Q1-Q8 should consist of at least two parts each.
- The two parts of a question should be from two different chapters of the section. To discourage selective studies maximum overlap of chapters should be ensured within the section (for example **Q1** has part (a) from chapter 1 and part (b) from chapter 2. **Q2** has part (a) from chapter 2 and part (b) from chapter 3 and so on)
- Q9 should cover all/maximum chapters in the syllabus. It must have up to 8 short questions.

Sample Papers

Paper-I
Physical Chemistry

Time allowed: 3:00 Hours   Marks: 40

Note: Attempt two questions from section I and section II each. Question 9 is compulsory. All questions carry equal marks.

Section-I

1	a)	What is the difference between continuous and discontinuous functions? Also give their examples.	4
	b)	What is the physical significance of Vander Waal's constants? Also derive their units.	4
2	a)	What are quantum numbers? Discuss different types of quantum numbers in detail.	5
	b)	What is the concept of quantization?	3
3	a)	Define adiabatic process. Derive expression for work done in adiabatic expansion of gas.	5
	b)	What is the difference between critical temperature and critical pressure?	3
4	a)	Define viscosity of liquid. Discuss different factors affecting the viscosity of the liquid.	4
	b)	Differentiate extensive properties from intensive properties. Also give their examples.	4

Section-II

5	a)	Derive rate constant for a second order reaction with same concentration.	5
	b)	The rate of a reaction becomes four times, when temperature changes from 20 °C to 40 °C. Calculate energy of activation for the reaction.	3
6	a)	Define electrolytic conductance. Describe Wheatstone bridge method to measure electrolytic conductance.	5
	b)	What is the difference between physisorption and chemisorption?	3
7	a)	Describe fractional distillation of solutions showing negative deviation from Raoult's law.	4
	b)	What is the effect of dilution on specific and equivalent conductance? Discuss in detail.	4
8	a)	Prove that osmotic pressure is a colligative property.	5
	b)	What is the difference between zeotropic and azeotropic mixture?	3

Section-III

9	a)	Define specific rotation.	1
	b)	Why H_2 and He can't be liquefied by Linde's method of liquefaction of gases?	1
	c)	What is the limitation of Heisenberg's uncertainty principle?	1
	d)	What is second law of thermodynamics?	1

e)	Why heat capacity at constant pressure is greater than heat capacity at constant volume?		1
f)	The molecularity of the reaction can't become zero. Why?		1
g)	What do you know about electrochemical cells?		1
h)	Define transport number.		1

Paper-II
Inorganic Chemistry

Time allowed: 3:00 Hours   Marks: 40

Note: Attempt two questions from section I and section II each. Question 9 is compulsory. All questions carry equal marks.

Section-1

1	a)	What is ionization energy discuss its trends in the periodic table.	4
	b)	Briefly describe the structures of NH_3 and CCl_4 with the help of VSEPR theory.	4
2	a)	Draw MO energy level diagrams for C_2 and NO, calculate bond order for each and mention their magnetic character.	4
	b)	Discuss soft and hard acid-base (SHAB) concept.	4
3	a)	What are indicators? Discuss redox indicators in detail.	4
	b)	Describe redox potential and its trends in the periodic table.	4
4	a)	Discuss Band theory for metallic bonding. Differentiate among conductors, semiconductors and nonconductors with the help of band theory.	5
	b)	Briefly describe levelling effect.	3

Section-II

5	a)	Describe common ion effect and its application.	4
	b)	Discuss bonding in boron hydrides.	4
6	a)	What is the role of oxides of sulphur in air pollution.	3
	b)	Describe crystal field effects in octahedral complexes giving an example.	5
7	a)	Discuss significance of coordination compounds.	4
	b)	Describe solubility product and its significance.	4
8	a)	Discuss structure and properties of interhalogen compounds.	4
	b)	Write a note on fractional precipitation.	4

Section-III

9	a)	Why ionization energy of nitrogen is more than oxygen?	1
	b)	Bond angle in NF_3 is less than in NH_3, give the reason.	1
	c)	In liquid ammonia, acetic acid and sulphuric acid have equal strength, give the reason.	1
	d)	Define co-precipitation	1
	e)	Define smog	1

f)	Write electronic configuration of Cu^{+1}	1
g)	Why silicon can form more than four bonds but carbon cannot?	1
h)	First electron affinity is an exothermic process while second one is endothermic, give the reason.	1

Paper-III
Organic Chemistry

Time allowed: 3:00 Hours   Marks: 40
Note: Attempt two questions from section I and section II each. Question 9 is compulsory.

Section-1

1	a)	Differentiate between conjugation and hyperconjugation.	3
	b)	Write two methods for the preparation of aromatic hydrocarbons.	3
	c)	Define optical activity with example	2
2	a)	Describe rules of resonance.	3
	b)	Write IUPAC rules for naming spiroalkanes.	3
	c)	Explain Birch reduction	2
3	a)	Enlist different factors effecting resonance.	2
	b)	Describe orientation and reactivity of naphthalene.	3
	c)	Draw different conformations for *n*-butane.	3
4	a)	Explain steric effect and its applications	3
	b)	How will you convert benzene in to nitrobenzene? Explain with mechanism.	3
	c)	Differentiate between enantiomers and diastereoisomers	2

Section-II

5	a)	Discuss structure and reactivity of carbonyl group	3
	b)	Write two methods for the preparation of phenols.	2
	c)	Explain mechanism of Cannizaro,s reaction.	2
	d)	Write some physical properties of carboxylic acids.	1
6	a)	Compare E1 and SN1 reaction.	3
	b)	How we can prepare ethers from alcohols?	2
	c)	Explain Hunsdicker reaction.	2
	d)	Give one method for the preparation of pyrrol.	1
7	a)	Define Hoffmann and Sytzeff rules with examples.	2
	b)	What are crown ethers?	1
	c)	Give two examples of nucleophilic addition of water and ammonia to carbonyl compounds.	3
	d)	Describe aromatic character of pyridine.	2
8	a)	Explain reactivity of Grignard reagents.	3
	b)	Discuss diazocoupling reactions of phenol.	2
	c)	Differentiate between aldol condensation and crossed aldol condensation	2

	d)	What are active methylene compounds?	**1**

Section-III

9	a)	Define resonance energy.	**1**
	b)	Explain aromaticity.	**2**
	c)	How aldehydes and ketones can be differentiated chemically?	**2**
	d)	What do you mean by resolution of racemic mixture?	**2**
	e)	Differentiate between E2 and SN2 reaction	**1**

Paper-IV
Applied Chemistry

Time allowed: 3:00 Hours   Marks: 40

Note: Attempt two questions from section I and II each, question 9 is compulsory. All questions carry equal marks.

Section-I

1	a)	Differentiate between partition and adsorption chromatography.	**3**
	b)	Define spectroscopy and explain briefly Beer-Lambert law in details.	**5**
2	a)	Explain principle of IR spectroscopy.	**4**
	b)	Write a note on Green House effect	**4**
3	a)	What is the role of ozone in the environment? Describe various factors involved in ozone depletion.	**4**
	b)	Define and explain solvent front and locating agents.	**4**
4	a)	How -OH, -NH$_2$, -COOH, -COOMe groups can be identified by IR spectroscopy?	**4**
	b)	Write few applications of adsorption spectroscopy	**4**

Section-II

5	a)	Discuss applications of liquid crystals	**4**
	b)	Describe construction and functioning of G M counter.	**4**
6	a)	What are artificial nuclear transformations? Discuss in detail	**4**
	b)	Discuss various steps involved in the manufacture of calcium ammonium phosphate	**4**
7	a)	Briefly describe unit process in chemical industries	**4**
	b)	Discuss extraction of copper from copper-iron-sulfide ores	**4**
8	a)	Biotechnology is a science of many disciplines, discuss	**5**
	b)	Describe classification of polymers	**3**

Section-III

9	a)	Differentiate between ascending and descending chromatography.	**1**
	b)	Define bathochromic shift.	**1**
	c)	What is BOD value?	**1**
	d)	Define radioactivity.	**1**
	e)	Define thermotropic phase	**1**
	f)	Define Beer-Lambert Law	**1**
	g)	What are amino acids?	**1**
	h)	What is composition of soda lime glass?	**1**

Paper pattern for practical examination

Only one practical examination will be held each year i.e. practical of Physical and Inorganic Chemistry will be evaluated in Year-III while those of Organic and Applied Chemistry will be assessed in Year-IV.

Year-III (Lab-I)

Section-I (Only one question to be allotted)   8 Marks

Q1. Physical chemistry practical

Q2. Physical chemistry practical

Section-II

Q3. Mixture Analysis   5 Marks

Q4. Titrimetric Analysis/ Inorganic Preparation   3 Marks

Section-III

Q5. Note Books (Physical and Inorganic Chemistry)   2 Marks

Q6. Viva Voce   2 Marks

Year-IV (Lab-II)

Section-I

Q1. Analysis of given organic compound   5 Marks

Q2. Organic Preparation/ Organic Estimation/ Basic techniques   3 Marks

Section-II

Q3. Applied chemistry practical   4 Marks

Q4. Applied chemistry practical   4 Marks

Section-III

Q5. Note Books (Organic and Applied Chemistry)   2 Marks

Q6. Viva Voce   2 Marks

Sample Paper Lab-I

Group-I

BSc A/2017

Chemistry (Practical)   Time Allowed: 04:30 Hours

Paper: Lab-I   Marks: 20

Note: Write down method with supposed calculations for allotted experiment from section I (question 1 or 2) and question 3 within first forty minutes.

Section-I

1. Determine the percent composition of given liquid mixture (A) by refractive index method.   8
2. Determine the percent composition of given liquid mixture (B) by using viscometer.   8

Section-II

3. Determine the amount of $FeSO_4.7H_2O$ per 100 cm^3 in the given solution. You are provided 0.0167 M $K_2Cr_2O_7$ solution.   3
4. Qualitatively analyze the given inorganic mixture for two acid and two basic radicals.   5

Section-III

5. Note Books (Physical and Inorganic Chemistry)   2
6. Viva voce   2

Group-2

BSc A/2017

Chemistry (Practical)   Time Allowed: 04:30 Hours

Paper: Lab-I   Marks: 20

Note: Write down method with supposed calculations for allotted experiment from section I (question 1 or 2) and question 3 within first forty minutes.

Section-I

1. Determine the heat of solution of the given compound   8
2. Determine the heat of solution of given salt by calorimetric method   8

Section-II

3. Prepare a pure sample of ferric alum   3

4. Qualitatively analyze the given inorganic mixture for two acid and two basic radicals.   5

Section-III

5. Note Books (Physical and Inorganic Chemistry)   2

6. Viva voce   2

Sample Paper Lab-II

Group-I

BSc A/2017

Chemistry (Practical)   Time Allowed: 04:30 Hours

Paper: Lab-II   Marks: 20

Note: Write down method with supposed calculations for question 2 and 3 within first forty minutes.

Section-I

1   Identify the given organic compound 'A'   5

2   Prepare a pure sample of benzoic acid.   3

Section-II

3   Prepare 0.01 M Mohr's salt solution and standardize it by titrating against 0.01 M $KMnO_4$
    solution.   4

4   Identify the given mixture of cations by paper chromatography.   4

Section-III

5   Note Books (Organic and Applied Chemistry)   2

6   Viva voce   2

Group-2

BSc A/2017

Chemistry (Practical)   Time Allowed: 04:30 Hours

Paper: Lab-II   Marks: 20

Note: Write down method with supposed calculations for question 2 and 3 within first forty minutes.

Section-I

1.	Identify the given organic compound 'A'	5
2.	Organic estimation	3

Section-II

3.	Prepare 0.01 N KMnO$_4$ solution and standardize it by titrating against 0.02 N oxalic acid solution	4
4.	Separate plastid pigments using TLC	4

Section-III

5.	Note Books (Organic and Applied Chemistry)	2
6.	Viva voce	2