MAR IVANIOS COLLEGE (AUTONOMOUS)
THIRUVANANTHAPURAM

SCHEME AND SYLLABUS
(OUTCOME BASED)

COMPLEMENTARY CHEMISTRY COURSES FOR

FIRST DEGREE PROGRAMMES UNDER CBCSS

(For PHYSICS, BOTANY and ZOOLOGY Majors)

2022 ADMISSION ONWARDS

MAR IVANIOS COLLEGE (AUTONOMOUS)

COMPLEMENTARY CHEMISTRY COURSES

(OFFERED TO FIRST DEGREE PROGRAMMES)

COMPLEMENTARY CHEMISTRY COURSES UNDER CBCSS OFFERED TO OTHER MAJORS

The Complementary Chemistry Syllabus has been designed to motivate students of other majors of **PHYSICS, BOTANY and ZOOLOGY** towards chemistry with a potential to contribute to the academic and industrial requirements of the society, in hand with their major discipline. The new, updated syllabus is in accordance with the OUTCOME BASED EDUCATION (OBE) which aim at acquiring advanced knowledge in different branches of Chemistry, in an interdisciplinary way. The **CORSE OUTCOME (CO)** for each course is specified as **CO1, CO2** etc in terms of cognitive levels achieved by each course.

Complementary Courses in Chemistry aim at certain Programme Specific Outcome (PSO) in consistent with those of the major courses. **PSO1**: Obey Lab safety instructions, develop qualities of punctuality, regularity, and scientific attitude, outlook and scientific temper (GOOD LAB PRACTICES)
PSO2: Develop skill in safe handling of chemicals and glass wares, take precaution against accidents and follow safety measures.
PSO3: Avoid random usage of dangerous chemicals and use chemicals in a critical way
PSO 4: Acquire a comprehensive knowledge of Chemistry, its impact on human, society and the environment to lead a better life in harmony with nature.

DISTRIBUTION OF HOURS AND CREDITS

TOTAL NUMBER OF SEMESTERS -4

COMPLEMENTARY CHEMISTRY LECTURE COURSES-4

COMPLEMENTARY CHEMISTRY LAB COURSE-1

(Two hours/week in all semesters, One Semester–18 Weeks)

TOTAL CREDITS–14

Semester	Hours per week		Number of Credits	*Course Code	Instructional Hours
	Theory	Lab			
1	2	2	2	AUCH131.2d	2×18 = 36 2×18 = 36
2	2	2	2	AUCH231.2d	2×18 = 36 2×18 = 36
3	3	2	3	AUCH331.2d	3×18 = 54 2×18 = 36
4	3	2	3 4	AUCH431.2d AUCH431.2dPI	3×18 =54 2×18 = 36

***Applicable to Physics Major**

GENERAL ASPECTS OF EVALUATION

MODE OF EVALUATION COMMON TO COMPLEMENTARY COURSES

Evaluation of each course shall involve Continuous Evaluation (CE) with 20 marks and End Semester Evaluation (ESE) with 80 marks.

<u>CONTINUOUS EVALUATION FOR LECTURE COURSES (CE)</u>

The Continuous evaluation will have 20 marks and will be done continuously during the semester.

CE components are

(i) Attendance for lecture and laboratory sessions (to be noted separately where both lecture and laboratory hours have been specified within a course);

(ii) Assignment /seminar and

(iii) Test

Components for CE marks

No	Component	Marks
1	Attendance	5
2	Assignment / Seminar	5
3	Tests	10
	Total	**20**

EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The topic selection by the student for assignments/seminar will be with the approval of the course teacher

The assignment can be

1. A report of about 4-6 pages in A4 size paper
2. The topic can be presented either as oral or as power point for 10 minutes duration using audio-visual aids if available. The seminar is to be conducted within the contact hour allotted for the course.
3. Preparing Charts on assigned topic
4. Making static or working models.

   The submitted report /chart /models should be submitted for assignment marks

QUESTION PAPER PATTERN FOR CONTINIOUS EVALUATION TEST

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C, D.
3. Section A contains ten questions. Each question carries 1 mark. The questions may be in the forms – one word/one sentence.
4. Section B contains twelve questions. Out of these twelve questions, the students have to answer 8 questions. Each question carries 2 marks. Each answer should contain four points. (Short Answer type).
5. Section C contains nine questions of which the candidate has to answer 6 questions. Each question carries 4 marks. The answer must contain 8 points (Short Essay type).
6. Section D contains four questions of which the candidate has to answer 2 questions. Each question carries 15 marks. The answer must contain adequate points (Long essay type).

   Question paper should contain 20% hard, 60% medium and 20% easy questions

Question Paper Pattern for CE Test		
Question No	Type of Question	Marks
Section A: 1-10	All / one word/one sentence	1X10=10
Section B: 11-22	7out of 12; Short Answer	7 X2=14
Section C: 23-31	4 out of 9; Short Essay	4 X4= 16
Section D: 32-35	2 out of 4; Long Essat	15 X2=30
TOTAL		80 marks

CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation for LAB COURSE will have 20 marks. The ESE of LAB COURSE will be done only in the IV semester. But the
corresponding CE are calculated from all the semesters in which there is attendance for laboratory sessions.

No	Component	Marks
1	Attendance	5
2	Lab test	5
3	Lab report/Record	5
4	Punctuality	5
	Total	**20**

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EVALUATION OF THE RECORD

On completion of each experiment, a report should be submitted to the course teacher. All experiments should be recorded as Lab report in a bound volume. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures and tables of data collected, equations, calculations, graphs, and other diagrams and the final results. The Certified RECORD is compulsory for the LAB COURSE ESE.

CE for Laboratory Record		
No.	**Sub component**	**Marks**
1	Punctual submission and Neat presentation	All four sub-components present & satisfactory 5 Only three : 4 Only two : 3 Only one :2
2	Record of more than 90% experiments in the syllabus	
3	Calculations and absence of errors/mistakes	
4	Accuracy of the result	

LAB RECORD of experiments certified by the tutor and HoD should be submitted for verification by the External Examiner at the ESE.

END SEMESTER EVALUATIONS (ESE)

QUESTION PAPER PATTERN &

GUIDELINE FOR QUESTION PAPER SETTERS

1. The theory examination has a duration of 3 hours
2. Each question paper has four sections: A, B, C and D
3. Section A contains ten questions. Each question carries1mark. The questions may be in the forms – one word/one sentence. Students have to answer all questions.
4. Section B contains twelve questions of which the students have to answer eight questions. Each question carries 2 marks. Each answer should contain four points. (Short Answer type).
5. Section C have nine questions of which the candidate has to answer only six questions. Each question carries 4 marks. The answer must contain 8 points (Short Essay type).
6. Section D contains four questions of which the candidate has to answer any two. Each question carries **three subdivisions** amounting to a total of 15 marks.
7. The total marks for the entire questions to be answered is 80marks.
8. Question paper should contain 20% Remember, 60% Understanding and 20% application level according to OUTCOME BASED EVALUATION.
   Question paper setter shall submit a detailed scheme of evaluation along with question paper.

Question Paper Pattern for Test		
Question No	Type of Question	Marks
Section A: 1-10	10 one word/one sentence	10
Section B: 11-22	8 out of 12; Short Answer	16
SectionC: 23-31	6 out of 9; Short Essay	24

Section D: 32-35	2 out of 4; Essay	30
Total		**80 marks**

ESE FOR LAB COURSES

THE SCHEME OF EXAMINATION FOR LAB COURSES MAY BE FRAMED BY THE PRACTICAL CHEMISTRY BOARD OF EXAMINERS.

SYLLABUS OF COMPLEMENTARY CHEMISTRY COURSES (FOR PHYSICS MAJORS) DISTRIBUTION OF HOURS & CREDITS

Seme -ster	Hours/Week		No. of Credits	Course Code	Instructio-nal Hours
	Theory (L)	Lab(P)			
I	2	2	2 -	AUCH131 .2d	2x18=36 2x18=36
II	2	2	2 -	AUCH231 .2d	2x18=36 2x18=36
III	3	2	3 -	AUCH331 .2d	3x18=54 2x18=36
IV	3	2	3 4	AUCH431 .2d AUCH431.2dPI	3x18=54 2x18=36

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY CHEMISTRY

FOR PHYSICS MAJORS

2022 Admission onwards

SEMESTER	I
COURSE	1
COURSE NAME	THEORETICAL AND ANALYTICAL CHEMISTRY
COURSE CODE	AUCH131.2d
CREDIT	2
L-T-P	2-0-2
TOTAL HOURS	36

CO No.	**COURSE OUTCOME** ***Upon completion of this course, students,***	**Cognitive Level**
1	Discuss the rules for filling electrons in atomic orbitals	U
2	Correlate stability of atoms with electronic configuration	U
3	Discuss theories of chemical bonding and their limitations	U
4	Predict geometry of molecules from the type of hybridisation	U, A
5	Recognise fundamentals of thermodynamics and the predict spontaneity of reactions	U, A
6	Derive thermodynamic properties of systems in equilibrium	A
7	Critically select suitable indicators for acid base and redox titrations	E, A

8	Appreciate the application of common ion effect and solubility product in precipitation and intergroup separation of cations	A
9	Discuss the basic principles of paper chromatography and thin layer chromatography	U
10	Solve numerical problems on bond order, molarity, normality and Lattice energy	A

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I:PERIODIC CLASSIFICATION OF ELEMENTS (9 hrs)

Quantum numbers and their significance, Concept of orbitals. Orbital wise electron configuration, energy sequence rule – Pauli's principle, Hund's rule, stability of filled and half filled orbitals, Electronic configuration and classification of elements into s,p,d and f blocks. Periodic properties, Ionisation energy, Electronegativity and Electron affinity. Diagonal relationship. Important characteristics of representative elements: valency, oxidation states, ionic and covalent bond formation. Important characteristics of transition elements: variable valency and oxidation states, formation of Complex compounds.

MODULE - II:CHEMICAL BONDING (9hrs)

Energetic of bond formation – Types of Chemical bonds – Energetics of ionic bond formation – Lattice energy – Born Haber Cycle - Fajan's rules. Polarity of covalent bonds, its relation with electronegativity. Electronegativity scales – Pauling's and Mullikan's approaches, factors influencing polarity Dipole moment – its relation to geometry. Hydrogen bond – inter and intra molecular – its consequences on boiling point, volatility and solubility.

Concept of Hybridisation– sp, sp^2, SP^3, dsp^2, dSP^3, sp^3d^2, and sp^3d^3 with examples Explanation of bond angle in water and ammonia- VSEPR theory, geometry of molecules with bond pairs of electrons , bond pairs and lone pairs of electrons, limitations of VSEPR Theory. A brief review of molecular orbital approach, LCAO method – bond order, bond distance and stability of O_2, O_2^{2+}, O_2^{2-} ,NO, NO^+, CO and HF.

MODULE–III: THERMODYNAMICS (9 hrs)

First law of thermodynamics, mathematical form, intrinsic energy, enthalpy, reversible, process and maximum work, work of expansion of an ideal gas in a reversible isothermal process. Heat capacity of gases at constant volume and constant pressure, derivation of CP – CV = R. Second law of thermodynamics, entropy and free energies. Significance of Δ G, Δ H and available work. Criteria of equilibrium, and spontaneity on the basis of entropy and free energy – Gibbs Helmholtz equation.

MODULE -IV: ANALYTICAL PRINCIPLES (**9 Hrs)**

Analytical methods in Chemistry – Principles of volumetric analysis, primary standard, standard solution, Calculation of normality, molality and molarity of solutions Theory of acid- base titrations: Strong acid-Strong Base, Strong acid-weak base, Weak acid Strong base and weak acid-strong base (Explanation with titration curves) Indicators, Redox titrations: Permanganometry- $KMnO_4$ oxalic acid, Mohr's salt estimations. Dichrometry-Fe^{2+} and $K_2Cr_2O_7$, Theory of acid – base and redox indicators.

Inorganic qualitative analysis, common ion effect- solubility product- precipitation and inter group separation of cations. Salting out process

Chromatography- principle and applications of paper and thin layer chromatography.

Lab Safety, MSDS. Accuracy, precision, Errors in experiments -determinate and indeterminate errors, classification of errors.

Text books/References

1. B.R Puri, L R Sharma K C Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand Co. New Delhi
2. Manas Chanda, Atomic structure and Chemical bonding in molecular spectroscopy, Tata Mc Graw Hill
3. S. Glasstone , Thermodynamics for Chemists, Affiliated Eat West Publishers
4. J D Lee, Concise Inorganic Chemistry, ELBS
5. R P Rastogi and R R Misra, An Introduction to Thermodynamics
6. D.A Skoog, D M West, F J, Holler, S R Crouch, Fundamentals of Analytical Chemistry, 8th Edn., Brooks/Cole, Thomson Learning, Inc, USA,2004
7. B K Sharma, Chromatography, Goel Publishing House, Meerut

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester-I, B.Sc. Degree Examination Model Question Paper
Complementary Chemistry for Physics Major

Course code AUCH131.2d Credit 2

THEORETICAL AND ANALYTICAL CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Give the electronic configuration of Copper (atomic number 29)
2. The quantum numbers n = 2 and l = 1 correspond to which orbital?
3. What are the shapes of molecules with sp and sp^3 hybridization?
4. Calculate the bond order of an H_2 molecule.
5. What do you mean by solubility product?
6. Give the mathematical expression for the first law of thermodynamics.
7. What is the significance of entropy?
8. Define Molality.
9. Which indicator do you suggest for the volumetric titration of NH_4OH by HCl?
10. Name a primary standard substance for estimation of NaOH.

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. Give one example each for the stability of half filled and fully filled atomic orbitals.
12. Write down the MO configuration of the O_2 molecule.
13. Define lattice energy.
14. What are the limitations of VSEPR Theory?
15. What are polar and nonpolar covalent bonds?

16. Mention the rules for adding electrons to molecular orbitals?

17. Explain redox titrations with an example.

18. How would you prepare 100 ml of 0.05M Mohr's salt solution?

19. Why is methyl orange not a suitable indicator for the titration of weak acid with strong base?

20. What is the application of Gibbs Helmholtz equation?

21. What is the principle of paper chromatography?

22. What is the theory of pH indicators?

(1x10=10 marks)

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. Discuss the Born Haber cycle for the formation of NaCl.

24. Identify the hybridization in H_2O and NH_3. How will you account for the geometry of these molecules?

25. Give an account of acid base indicators.

26. Discuss the theory of Acid – Base indicators.

27. Explain the energetics of ionic bond formation.

28. Define hybridization. Mention the types of hybridization involved in SF6, PCl5, BF3.

29. Explain Born-Haber Cycle considering the formation of NaCl as an example.

30. Write a note on spontaneity of a chemical reaction.

31. Explain briefly the principle and application of thin layer chromatography.

(4x6=24 marks)

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a) Discuss the basis of periodic classification into different blocks.

(b)What are quantum numbers? Give its significance.

(c) Explain various rules regarding electronic configuration. (5+5+5)

33. (a) Define heat capacity of gases at constant temperature and pressure. How are they related?

(b)What are the criteria for equilibrium? Discuss.

(c) Discuss on the work of expansion of an ideal gas in a reversible isothermal process.

(5+5+5)

34. (a) Write a note on Hydrogen bonding and its consequences.

(b) How is the electronic configuration of molecules related to molecular behavior? Explain.

(c) Explain Fajan's Rule. (5+5+5)

35. (a) Discuss the titration curves for the titration of strong acid with strong base and weak acid with strong base.

(b)Explain the theory of redox indicators.

(c)Calculate the concentration in terms of normality and molarity of a solution of 8g of NaOH in 100 mL NaOH solution. (5+5+5)

(15x2=30 marks)

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY

CHEMISTRY FOR STUDENTS OF PHYSICS MAJORS

2022 Admission onwards

SEMESTER	**II**
COURSE	**2**
COURSE NAME	**PHYSICAL AND INDUSTRIAL CHEMISTRY**
COURSE CODE	**AUCH231.2d**
CREDIT	**2**
L-T-P	**2-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** ***Upon completion of this course, students,***	**Cognitive Level**
1	Define enthalpies of formation, combustion, neutralization, solution and hydration reactions	R,U
2	Apply Hess's law for thermochemical calculations	A
3	Predict the effect of temperature pressure and concentration on a system in equilibrium based on Le Chatelier principle	U
4	Classify acidic and basic compounds in accordance with different concepts.	U
5	Suggest method for determination of pH	A
6	Discuss petrochemicals and their applications	
7	Realise the depletion of petroleum products and the need for alternate sources of energy.	U
8	Recognise the necessity of sustainable development	U
9	Appreciate the role of solar energy in photosynthesis and discuss methods of solar energy harvesting	U

10	Become responsible in the consumption of natural resources and avoid factors affecting the harmony of nature from the equilibrium concept.	A
11	Discuss and the Illustrate general methods and techniques in metallurgy	U,A
12	Predict methods of concentration, extraction metals from their ores	A
13	Discuss the applications of Van Arkel method and zone refining in metallurgy	e U

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I: THERMOCHEMISTRY (9 hrs)

Enthalpies of formation, combustion, neutralization, solution and hydration. Relation between heat of reaction at constant volume and constant pressure, variation of heat of reaction with temperature. Kirchoff's equation, Hess's law as an application of First Law of thermodynamics and its application Bond dissociation energies and bond energies of different types of bonds, their calculation and enthalpies of reaction. (Numerical problems to be worked out)

MODULE - II : CHEMICAL AND IONIC EQUILIBRIUM (9 hrs)

Reversible reactions – K_P, K_C, and K_X and their interrelationships – Free energy change and chemical equilibrium (thermodynamic derivation) Influence of pressure and temperature on the following reactions.

(i) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (ii) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ (iii) $2SO_2 + O_2 \rightleftharpoons 2SO_3$

Le Chatelier's principle and the discussion of the above reactions on its basis.

Concepts of Acids and Bases, Arrhenius, Lowry-Bronsted, and Lewis concepts.

HSAB Principle. Levelling effect.

pH and its determination by potentiometric method.

Buffer solutions – Henderson equation, Acidic and basic buffers-examples.

Hydrolysis of salts – degree of hydrolysis and hydrolytic constant,

Derivation of relation between Kw and Kh for salts of strong acid – weak base, weak acid - strong base and weak acid – weak base.

MODULE- III : PETROCHEMICALS AND ALTERNATE SOURCES (9hrs)

Petrochemicals: Introduction, Natural gas-CNG, LNG and LPG.

Coal: classification based on carbon content- Carbonisation of coal

Crude oil: constitution and distillation, composition and uses of important Fractions

Ignition point, flash point and octane number-cracking Usage and depletion of petroleum products.

Need for alternative fuel and Green Chemistry approaches for sustainable development:

Introduction, Solar energy harvesting- photosynthesis

Photovoltaic cell, conventional solar cells, nano structured solar cells,

Hydrogen as the future fuel

MODULE- IV: METALLURGY (9 Hrs)

General principles of occurrence and extraction of metals
Concentration of ores- roasting, calcination and smelting
General Methods of extracting metal from concentrated ore, examples
Electro metallurgy-Metallurgy of Aluminium, Sodium-Pyrometallurgy
Refining of crude metals: Distillation, Liquation, electrolytic and zone refining
Chromatographic techniques and vapour phase refining (Mond's process and Van Arkel process)
Metallurgy of titanium, cobalt, nickel, thorium and uranium.

TEXT BOOKS /REFERENCES

1. B.R Puri, L R Sharma K C Kalia, Principles of Inorganic Chemistry , S. Chand & Co. New Delhi
2. B.R Puri, L R Sharma, M S Pathania, Principles of Inorganic Chemistry, Vishal Publishing Co. New Delhi 2013
3. B K Sharma, H. Gaur, Industrial Chemistry, Goel Publishing House, New Delhi
4. K S Tewari, N K Vishnoi, Organic Chemistry, 3rd Edn. Vikas Publishing House

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester-II B.Sc Degree Examination

Model Question Paper Complementary Course for Physics Major

Course code AUCH 231.2d Credit 2 PHYSICAL AND INDUSTRIAL CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Write one example for an exothermic reaction
2. Name a natural way of harvesting solar energy.
3. Mention two different forms in which natural gas is available.
4. What do you mean by ionic product of water?
5. Semiconductor grade Silicon is made by the technique--------
6. Identify the Lewis acid (HCl, NaOH, ,BF_3, NH_3)
7. Name the chemicals which can form an acidic buffer.

8. What is meant by carbonization of coal?
9. Give one example each for a Proton donor and a proton acceptor.
10. Name an oxide ore and a sulphide ore
11. What is the advantage of photovoltaic cells?
12. What is the application of the Van Arkel method?

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

13. One mole of an ideal gas at 25oc is allowed to expand isothermally and reversibly form a volume of 10 liters to 20 liters. Calculate the work done by the gas?
14. Give one application of the first law of thermodynamics.
15. Write the relation between ΔG, ΔH and ΔS. What is the condition for spontaneity of a process?
16. Calculate the enthalpy of hydrogenation, C_2H_4 (g) + H_2(g) to obtain C_2H_6 (g).
17. Given that bond energy of H-H= 433kJ, C=C =615kJ and C-C= 347kJ and C-H = 413kJ.
18. What is bond dissociation energy?
19. What is an isochoric process?
20. What are the characteristics of equilibrium constant?
21. What is the enthalpy of hydration?
22. What is a reversible process? Give an example.
23. Define Lewis acid and base
24. What is an ionic product of water?
25. What is the importance of pyrometallurgy?

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

26. Calculate the bond energy of the HBr bond, given that the enthalpy of formation of HBr is -36.2kJ mol^{-1}. The bond energies of H-H and Br-BR bonds are 431k mol^{-1} and 188kJ mol^{-1} respectively.
27. Write a note on the HSAB principle.
28. Differentiate between ignition point and flash point.
29. Discuss n Mond's process and Van Arkel method.

30. Write a note on nanostructured solar cells.

31. How will you differentiate between liquidation and distillation processes in metallurgy?

32. Give an account of crude oil, its distillation products and their applications.

33. Comment on the use of hydrogen as a future fuel.

34. What is smelting? Give an example

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

35. (a) Explain pH determination by potentiometric method
(b)Differentiate between hard and soft acid
(c) Write a note on the levelling effect of solvents on acids. (5+5+5)

36. (a) Discuss the effect of pressure, temperature and concentration and mention the optimum conditions in the following reaction under equilibrium i) dissociation of PCl_5 into PCl_3 and Cl_2 ii) formation of SO_3 from SO_2 and O_2
(b) Illustrate the role roasting and calcination in metallurgy. (10+5)

37. (a) Discuss spontaneity or feasibility of a process.
(b) State and explain Hesse's law. When one mole of ethanol melts at its melting point, the entropy change is $29.4JK^{-1}$ mol^{-1}. If the enthalpy of fusion of ethanol is 4.6 $kJmol^{-1}$, what is the melting point of ethanol?

38. (a) Discuss metallurgy of titanium
(b) Compare between aluminothermy and hydrometallurgy.
(c) Write notes on concentration of an oxide ore and a sulphide ore?

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY

CHEMISTRY FOR STUDENTS OF PHYSICS MAJORS

2022 Admission onwards

SEMESTER	**III**
COURSE	**3**
COURSE NAME	**PHYSICAL CHEMISTRY**
COURSE CODE	**AUCH331.2d**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	**COURSE OUTCOME** ***Upon completion of this course, the students will:***	**Cognitive Level**
1	Discuss on electrochemical cells and emf measurements	U
2	Apply the principles of physical Chemistry in Catalysis and photochemistry	A
3	Draw unit cells and structure of crystals	U
4	Understand the effect of temperature on molecular velocities of gases	R
5	Calculate cell emf and electrode potentials	A
6	Construct electrochemical cells	A
7	Classify between Photochemical reactions	U
8	Relate electrolyte concentration with emf	E

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- 1: GASEOUS STATE **(9 HRS)**

Maxwell's distribution of molecular velocities (No derivation) average, most probable and rms velocities, collision number and collision frequency, mean free path, deviation of gases from ideal behaviour – Boyle temperature, derivation of Van der Waals constants and critical constants and its determinations-Andrew's and Thomson's experiments– Law of corresponding states – reduced equation of state, Joule Thomson effect, liquefaction of gases – Linde's and Claude's processes

MODULE- II: CRYSTALLINE STATE **(9 HRS)**

Isotropy and anisotropy – symmetry elements in crystals – the seven crystal systems. Miller indices, Bravais lattices, primitive, bcc and fcc of cubic crystals – Representation of lattice planes of simple cubic crystal - Density from cubic lattice dimension – calculation of Avogadro number - Bragg equation, diffraction of X rays by crystals – single crystal and powder method. Detailed study of structures of NaCI and KCl crystals.

MODULE- III: ELECTRO CHEMISTRY **(9 HRS)**

Transport number – definition, determination by Hittorf's method and moving boundary method, application of conductance measurements. Conductometric titrations involving strong acid – strong base, strong acid – weak base, weak acid – strong base and weak acid – weak base.

EMF – Galvanic cells, measurement of emf, cell and electrode potential, IUPAC sign convention, Reference electrodes, SHE and calomel electrode, standard electrode potential, Nernst equation, anion and cation reversible electrodes, redox electrode with examples, quinhydrone electrode, glass electrode concentration cell without transference, potentiometric titration, Fuel cells – H_2 – O_2 and hydrocarbon – O_2 type.

MODULE -IV: CATALYSIS AND PHOTOCHEMISTRY **(9 HRS)**

General Characteristics of catalytic reactions. Different types of catalysis – examples – theories of catalysis (Outline of intermediate compound formation theory and adsorption theory). Enzyme catalysis – Michaelis-Menten mechanism.

Photo Chemistry**:** - Laws of Photo Chemistry, Grothus – Drapter law, Beer Lambert's law, Einstein's laws, quantum yield, H_2 – Cl_2 reaction, H_2 – Br_2 reaction – Fluorescence and phosphorescence, chemiluminescence and photo sensitization.

MODULE – V: CHEMICAL KINETICS **(9 HRS)**

Rates of reaction, various factors influencing rates of reactions – order and molecularity – Zero, first, second and third order reaction, derivation of integrated rate equation, fractional life time, units of rate constants, influence of temperature on reaction rates. Arrhenius equation, calculation of Arrhenius parameters – collision theory of reaction rates.

MODULE- VI:GROUP THEORY **(9 HRS)**

Group theory- elements of symmetry- proper and improper axis of symmetry- plane of symmetry-center of symmetry- identity elements, combination of symmetry elements point group- C_{2v}, C_{3v} and D_{3h}- group multiplication table of C_{2v}- determination of point group of simple molecules like water, NH_3, BF_3

REFERENCES

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Edn Vishal Publishing Co. NewDelhi
2. J E Huheey, E A Keiter, R L Keiter, O K Medhi, Inorganic Chemistry, 4th Edn. Pearson
3. F A Cotton and Wilkinson, Advanced Inorganic Chemistry, John Wiley, New York
4. PL Soni, O P Dharmarsha, U N Dash, Textbook of Physical Chemistry, 23rd Edn, Sultan Chand & Sons, New Delhi, 2011
5. Gurudeep Raj , Advanced Physical Chemistry
6. L V Azaroff, Introduction to solids
7. N B Hannay ,Solid state chemistry
8. F Daniel and R A Alberty, Physical Chemistry
9. A Salahuddin Kunju and G Krishnan Group theory and its applications in chemistry-

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester-III, B.Sc, Degree Examination Model Question Paper

Complementary Course for Physics Major

Course Code: AUCH331.2d, Credit 3

PHYSICAL CHEMISTRY (2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. What is the ratio of observed molar volume to ideal molar volume is?
2. Define Boyle temperature?
3. How many unit cell are possible in cubic crystal?
4. Why amorphous solids are said to be isotropic?
5. In a Galvanic cell electron flows from …… to ……
6. What is the potential of SHE.
7. What is the quantum yield of H_2-Cl_2 reaction?
8. Define chemiluminescence
9. What is the order of the reaction with rate constant $2x10^{-2}$ $molL^{-1}s^{-1}$
10. NH_3 belongs to which point group?

SECTION B

*(Answer **any eight** questions. Each question carries **2** mark)*

11. Define critical temperature and explain its significance?
12. What is virial equation of states?
13. Explain the term Space lattice and Unit cell.
14. Both NaCl and KCl have fcc structures but KCl behaves towards X-rays like simple cubic lattice. Why?
15. What is liquid junction potential? How can it be eliminated?
16. What are reference electrodes? Give their significance?
17. State Einstein's law of photochemical equivalence?
18. What is meant by chemiluminescence?
19. What is meant by autocatalysis?

20. Define order and molecularity of a reaction?
21. A substance decomposes following first order kinetics. The half life period of a reaction is 35 minutes. What is the rate constant of the reaction?
22. What is meant by point group?

SECTION C

*(Answer **any six** questions. Each question carries **4** mark)*

23. What is the law of corresponding states? How is it derived from the Van der Waals equation?
24. Calculate the constants a and b, if Tc=31 ^{0}C, Pc=72. 8atm and R=0.082lit atm/K?
25. What are the Miller indices? How are they determined?
26. EMF of a standard Daniel Cell is 1.01832 V at 298K. Temperature coefficient of the cell is -5x10^{-5}V/K. Calculate ΔG, ΔH, and ΔS of the cell reaction?
27. Write a brief note on Calomel electrode?
28. State and explain Beer-Lambert's law? What are its limitations?
29. Explain pseudo-order reactions with suitable examples?
30. Give the group multiplication table for C_{2V}
31. Explain the different symmetry elements?

SECTION D

*(Answer **any two** questions. Each question carries **15** mark)*

32. (i) Explain Linde's and Claude's method of liquefaction of gases?

    (ii) Do all gases obey gas laws? Discuss some experimental results to explain the deviation and point out the causes which account for this behavior?

    (iii) explain the terms: collision frequency and collision diameter.
33. (i) Derive Bragg's equation for the diffraction of of X-rays by crystal lattice? How is this equation used in elucidating the crystal structure? (ii) In fcc lattice of NaCl the distance between Na^+ and Cl^- ions is 281 pm and the density of NaCl is 2.165g/cm ^{3}. Compute Avogadro's no. from the given data. The molar mass of NaCl is 58.5g/mol. (iii) Assign the point groups of the molecule BF_3 and H_2O
34. (i) Write a brief note on fuel cells? (ii) State and explain Nernst equation (iii) Explain the principle of potentiometric titrations?
35. (i) What is catalysis? What are the general characteristics of catalyst? (ii) Derive an expression for rate constant of a first order reaction? (iii) Explain the influence of temperature on reaction rates?

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY CHEMISTRY FOR STUDENTS OF PHYSICS MAJORS

2022 Admission onwards

SEMESTER	**IV**
COURSE	**3**
COURSE NAME	**SPECTROSCOPY AND ADVANCED MATERIALS**
COURSE CODE	**AUCH 431.2d**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students will:*	**Cognitive Level**
1	Discuss the principle and applications of rotational, vibrational, electronic and NMR spectroscopy.	U
2	Illustrate isomerism, geometry and bonding in co - ordination complexes	A
3	Appreciate the use of coordination compounds in qualitative and quantitative analysis	U
4	Solve numerical problems relating to nuclear chemistry	R
5	Appreciate the use of biodegradable polymers	A
6	Apply the importance energy and environment conservation	U
7	Get insight to the emerging area of nano and advanced materials	A

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE -I: SPECTROSCOPY -I **(9 hrs)**

Regions of electromagnetic spectrum – different units to represent energy such as erg, joule, calorie, cm^{-1}, Hz and eV, their interconversions – interaction of radiation with matter, different types of energy levels of molecules – rotation, vibration and electronic levels. Rotation spectroscopy Microwave spectrum of diatomic molecules – expressions for rotational energy, selection rule – frequency separation and determination of bond length – vibrational spectrum – harmonic oscillator, equation for frequency of vibration, expression for vibrational energy, selection rule, frequency separation, calculations of force constant,

Electronic spectroscopy –types of transition and regions where they absorb.

MODULE- II: SPECTROSCOPY- II **(9 hrs)**

Raman spectroscopy – stokes and anti stokes lines, quantum theory of Raman spectrum – advantages and disadvantages of Raman spectrum, rotational Raman spectrum, selection rules and frequency separation. Vibrational Raman spectrum – Complementary with IR spectrum, mutual exclusion principle, NMR spectroscopy, principle of NMR spectroscopy, nuclear spin, interaction with external magnet, energy spacing, transition between nuclear energy levels in hydrogen nucleus, low resolution spectrum, chemical shift, spin – spin coupling – fine structure spectrum, application to simple molecule

MODULE- III: COORDINATION CHEMISTRY **(9 hrs)**

Double salts and complex salts, Werner's coordination theory, Types of ligands,

Chelating ligands- bidentate and polydentate- EDTA, Stability of chelates

Valence bond theory of bonding in octahedral and tetrahedral complexes, Drawbacks of valence bond theory

Crystal field theory of octahedral and tetrahedral complexes, examples high and low spin complexes, magnetic properties, applications of coordination compound in qualitative and quantitative volumetric analysis.

MODULE-IV: NUCLEAR CHEMISTRY **(9 hrs)**

Nuclear Chemistry general introduction– stability of Nucleus – n/p ratio, radioactivity, artificial transmutation and artificial radio activity. Detection of radio activity by Wilson's cloud chamber and Geiger Muller Scintillation counter – units of radio activity – Curie and Rutherford – Radio Carbon dating , Rock dating, Neutron activation analysis Applications in agriculture and medicine. A brief study of pathological and genetic damage due to radiation , Dosimetry – Units – rad, gray and Roentgen. Fricke dosimeter and ceric sulphate dosimeter. Mass defect, binding energy, atomic fission and fusion Energy production in stars, Evolution of elements in stars.

MODULE-V : CHEMISTRY OF NANO MATERIALS (9 hrs)

Evolution of Nano science – Historical aspects – preparations containing nano gold in traditional medicine, Lycurgus cup – Faraday's divided metal etc.

Nano systems in nature.

Preparation of Nano particles – Top – down approach and bottom – top approach, sol – gel synthesis, colloidal precipitations, Co- precipitation, combustion technique.

Properties of nano particles: optical, magnetic and mechanical properties.

Tools for measuring nano structure – XRD, Atomic force Microscopy (AFM), Scanning Tunnelling Microscopy (STM), and Scanning Electron Microscopy (SEM) Transmission Electron Microscopy (TEM) . Applications of nano materials in electronics, robotics, computers, sensors, mobile electronic devices, Medical applications (use Au, Ag, ZnO and ZnO_2 as examples)

MODULE-VI: ADVANCED MATERIALS (9 hrs)

Magnetic materials-classification- applications and examples Piezo electric and pyroelectric materials, examples Conducting polymers- polyacetylene- polyanilines- synthesis- applications Bio degradable polymers: PLA, PGA and PHBV Polymeric sulphur nitrogen compounds $(SN)_x$ as one dimensional conductors.

Photo conducting polymers-examples-super conducting materials

Liquid crystals – mesomorphic state, types of liquid crystals, applications and examples. Ceramics: Introduction, types of clay products, properties and applications

REFERENCE

1. C.N. Banwell, Fundamentals of molecular spectroscopy, Tata Mc GRaw Hill CO. Ltd.
2. B R Puri, L R Sharma and K C Kalia, Principles of Inorganic Chemistry, Mile stone Publishers. New Delhi
3. G M Barrow, Physical Chemistry, 5th Edn. Tata McGraw Hill Education, NewDelhi,2006
4. J E Huheey, E A Keiter, R L Keiter, O K Medhi, Inorganic Chemistry, 4th Edn. Pearson
5. F A Cotton and Wilkinson, Advanced Inorganic Chemistry, John Wiley, New York
6. V R Gowarikar, Polymer Chemistry, New Age International (P) Ltd. New Delhi 2010
7. T Pradeep, A Text book of Nanoscience and Nanotechnology, Mc Graw Hill, New Delhi

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester IV ,B.Sc. Degree Examination Model Question Paper

Complementary Course for Physics Major

Course code AUCH431.2d, Credit 3

SPECTROSCOPY AND ADVANCED MATERIALS

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark*

1. Which of the following give pure rotational spectrum: H_2, N_2, CO_2, HCl?
2. What is Rayleigh scattering?
3. What is the selection rule for vibrational transition?
4. What is the condition for a molecule to be NMR active?
5. What is Wilkinson's catalyst?
6. What is nano shells?
7. Write an example for a chelate.
8. What are the ores of titanium?
9. Name the nano material used in semiconductors?
10. What are ferromagnetic materials?

SECTION B

*(Answer **any eight** questions. Each question carries **2** mark)*

11. What is Born Oppenheimer approximation?
12. The force constant of HF molecule is 970Nm-1. Calculate the fundamental vibrational frequency as well as the zero point energy?
13. What is Raman Effect? What is the cause of Raman effect?
14. Explain the terms shielding and deshielding with regard to NMR spectroscopy.
15. What is chemical shift?
16. Explain the effect of solvent in UV spectroscopy.
17. What is the difference between a double salt and a complex compound?
18. $[Fe(CN)_6]^{3-}$ is paramagnetic. Why?
19. Give an example for artificial transmutation of elements
20. What is half life?
21. What is STM and its basic principle?
22. Explain the synthesis of polyaniline from aniline.

SECTION C

*(Answer **any Six** questions. Each question carries **4** mark)*

23. Why are anti-stokes lines intense than the stokes lines in the Raman spectrum?
24. Taking the example of HCl show how rotation of the molecule causes dipole moment fluctuations?
25. State and illustrate the Frank-Condon principle.
26. Define the terms: Bathochromic shift, Hypsochromic shift, Hyperchromic shift, Hypochromic shift.
27. Discuss Werner's theory of coordination compounds.
28. Explain the formation of low spin and high spin complexes with the help of crystal field theory.
29. Write a note on Geiger Muller counter.
30. Explain the properties of nano particles.
31. Give a short note on superconducting materials.

SECTION D

*(Answer **any two** questions. Each question carries **15** mark)*

32. (i) Derive an expression for allowed energies of rotational levels in a diatomic molecule.
(ii)Show that for a rigid diatomic rotor the moment of inertia is given by $I= \mu r^2$.

    (iii) Discuss the quantum theory of Raman spectroscopy

33. (i) Explain the underlying principle in an NMR spectrum.
(ii)What are the different kinds of protons indicated in an NMR spectrum. How do they produce their characteristics signals?

    (iii)How can the NMR method be used to distinguish between the structures of 1-propanol and 2-propanol?

34. (i) Give an account of crystal field theory?
(ii) What are applications of coordination compounds in qualitative analysis?

    (iii) Radio carbon in wood decays with a half-life of 5770 years. What is the rate constant (in $year^{-1}$) for the decay? What fraction would remain after 11540 years?

35. (i) Explain the applications of nanomaterials in electronic and robotics. (ii) Explain working principle of SEM and TEM. (iii)Give a note radioactive disintegration series.

MAR IVANIOS COLLEGE (AUTONOMOUS) SYLLABUS OF LAB COURSE IN CHEMISTRY FOR STUDENTS OF PHYSICS MAJORS

2022 Admission onwards

SEMESTER	**I, II, III & IV**
COURSE	**5**
COURSE TITLE	**COURSE V: LAB COURSE FOR PHYSICS**
COURSE CODE	**AUCH432.2dPI**
CREDIT	**2**
L-T-P	**0-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students*	**Cognitive Level**
1	Obey Lab safety instructions, develop qualities of punctuality, regularity and scientific attitude, outlook and scientific temper (GOOD LAB PRACTICES)	E, U
2	Develop skill in safe handling of chemicals, take precaution against accidents and follow safety measures	A
3	Develop skill in observation, prediction and interpretation of reactions	U, A
4	Apply the principle of common ion effect and solubility product in the identification and separation of ions	A
5	Develop skill in weight calculation for preparing standard solutions	A

6	Perform volumetric titrations under acidimetry-alkalimetry, permanganometry, dichrometry, iodimetry-iodometry, cerimetry, argentometry and complexometry	A
7	Determine physical constants	A

I. REACTIONS OF THE FOLLOWING CATIONS:

Hg^{+}, Pb^{2+}, Ag^{+}, Hg^{2+}, Bi^{3+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sn^{4+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Mn^{2+}, Zn^{2+}, Ni^{2+}, Cd^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+} and NH_4^{+}.

II. SYSTEMATIC ANALYSIS OF TWO CATIONS IN A MIXTURE

The cations must be provided in solutions. A student must analyse at least ten mixtures containing two cations each.

III. VOLUMETRIC ANALYSIS

A. Acidimetry and Alkalimetry

a. Preparation and standardization of 0.05N HCl using sodium carbonate as primary standard
b. Estimation of a strong base and a weak base using standardized HCl
c. Estimation of sodium hydroxide using (i)Std. oxalic acid and (ii) Std. HCl
d. Preparation and standardization of 0.05N NaOH using oxalic acid as primary standard
e. Estimation of a strong acids using standardized NaOH
f. Determination of sodium hydroxide, and sodium hydroxide and sodium carbonate in a mixture (indicator method)

B. Permanganometry

a. Standardisation of $KMnO_4$ by oxalic acid sodium oxalate and Mohr's salt
b. Estimation of oxalic acid / sodium oxalate
c. Estimation of Mohr's Salt.
d. Estimation of calcium

C. Dichrometry

a. Preparation of Std. $K_2Cr_2O_7$ and estimation of ferrous iron by external and internal indicators.

b. Estimation of ferric iron by reduction with stannous chloride (internal indicator).

D. Iodometry and Iodimetry

a. Standardization of sodium thiosulphate using std. potassium dichromate.

b. Estimation of copper in a solution

c. Estimation of iodine

E. Complexometric titrations

a. Standardisation of EDTA using std Mg or Zn^{2+} ion solution
Estimation of any one metallic ion from Ca^{2+} , Mg^{2+}, Zn^{2+} or Ni^{2+}

A student has to carry out at least twelve experiments in this class.

VI. GRAVIMETRIC ANALYSIS

a. Estimation of water of hydration in barium chloride crystals.

b. Estimation of barium chloride solution.

V. DETERMINATION PHYSICAL CONSTANTS NOT FOR ESE)

a. Determination of boiling points of common solvents (b.pt range 100 ^{0}C- 130 ^{0}C)

b. Determination of melting points of organic substances (m.pt range 100 ^{0}C- 130 ^{0}C)

COMPLEMENTARY CHEMISTRY FOR BOTANY MAJORS

Complementary Courses -4 Total Credits – 14

(One Semester – 18 Weeks)

Seme -ster	Hours/Week		No. of Cre dits	Course Code	Instructi onal Hours
	Thoery (L)	Lab (P)			
I	2	2	2	AUCH131.2a	2x18=36 2x18=36
II	2	2	2	AUCH231.2a	2x18=36 2x18=36
III	3	2	3	AUCH331.2a	3x18=54 2x18=36
IV	3	2	3 4	AUCH431.2a AUCH432.2a PI	3x18=54 2x18=36

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY CHEMISTRY FOR STUDENTS OF BOTANY MAJORS

2022 Admission onwards

SEMESTER	**I**
COURSE	**2**
COURSE TITLE	**ANALYTICAL AND ENVIRONMENTAL CHEMISTRY**
COURSE CODE	**AUCH131.2a**
CREDIT	**2**
L-T-P	**2-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students,*	**Cognitive Level**
1	Discuss Bohr atom model and represent electronic configuration of elements	U
2	Predict structure of simple molecules based on the concept of hybridisation	A
3	Identify hydrogen bonding in relation to physical and chemical properties	U
4	List the various chemical bonds	R
5	Apply the VSEPR theory to explain the geometry of molecules	A

6	Discuss the theory of volumetric analysis	U
7	Become aware of threat of chemical pollutants air , water and soil	A

*R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I: ATOMIC STRUCTURE (9 Hrs)

Atomic spectrum of Hydrogen – different series, Rydberg equation

Bohr theory – postulates – statement of Bohr energy equation – derivation of spectral frequency from Bohr equation.

Schrodinger wave equation (no derivation, mention only) - concept of orbitals, the four quantum numbers and their significances.

Orbital wise electron configuration, energy sequence rule – Pauli's Principle, Hund's rule, stability of filled and half filled orbitals

MODULE-II: CHEMICAL BONDING (9 Hrs)

Energetics of bond formation –Born Haber cycle
Hybridisation and structure of molecules – sp, sp^2 sp^3, dsp^2, dsp^3, sp^3d^2, and sp^3d^3 hybridisation with examples- Explanation of bond angle in water and ammonia

VSEPR theory with regular and irregular geometry

Hydrogen bond – inter and intra molecular – its consequences on boiling point –volatility and solubility

Partial covalent character of the ionic bond- Fajan's rules-

A brief review of molecular orbital approach-

LCAO method – bond order, bond distance and stability of O_2, O_2^{2+}, NO^{2-}, NO^+

MODULE-III: ANALYTICAL PRINCIPLES (9 Hrs)

Principles of volumetric analysis- primary standard - standard solutions- normality and molarity - theory of acid - base titrations, permanganometric and dichrometric titrations, iodometric and complexometric titrations-

Theory of acid – base and redox indicators-

Beer- Lambert law- Principles of colorimetry – Estimation of Iron and phosphate

MODULE-IV: ENVIRONMENTAL CHEMISTRY (9 Hrs)

Nature of environmental threats and role of chemistry-

Green house effect, ozone layer and its depletion-

Water pollution: Various factors affecting purity of water, sewage water, industrial waste, agricultural pollution such as pesticides, fertilizers, detergents, treatment of industrial waste water using activated charcoal, synthetic resins, reverse osmosis, electrodialysis

Dissolved oxygen-BOD, COD

Text Books / References

1. Atomic structure and chemical bonding with introduction to molecular spectroscopy – Manas Chanda
2. Concise Inorganic Chemistry – J.D. Lee
3. Environmental Chemistry A. K. De
4. Modern Inorganic Chemistry A.D. Madan
5. A. I. Vogel, “Text book of Qualitative Analysis”
6. A. I. Vogel, “Text book of Quantitative Inorganic Analysis”.
7. S. K. Banerji, “Environmental Chemistry”.
8. A. K. De “Environmental Chemistry - An introduction”
9. B. K. Sharma “Air Pollution”.
10. V. K. Ahluwalia “Environmental Chemistry”
11. G.W. van Loon and S. J. Duffy “Environmental Chemistry: A global perspective”

MAR IVANIOS COLLEGE (AUTONOMOUS)

First semester, B.Sc. Degree Examination Model question paper Complementary course for Botany Majors Course Code AUCH131.2a Credit 2

(2022 admission onwards)

ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Give the electronic configuration of Copper (atomic umber 29)
2. The quantum numbers n = 2 and l = 1 corresponds to which orbital?
3. What are the shapes of molecules with sp and sp3 hybridization?
4. Calculate the bond order of H2 molecule.
5. Give the structure of XeO3.
6. What is Lattice Energy?
7. What is meant by primary standards?
8. Define Molality.
9. What is the optimum value of DO for good water quality?
10. What is meant by BOD?

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. What is Bohr Bury's rule?
12. Write down the Schrodinger Equation and explain the terms involved.
13. Explain the failures of Bohr's theory?

14. What are the limitations of VSEPR Theory?

15. What are polar and non polar covalent bonds?

16. Mention the rules for adding electrons to molecular orbitals?

17. What are dichrometric titrations?

18. How would you prepare 100ml of 0.05M Mohr's salt solution?

19. Why is methyl orange not a suitable indicator for the titration of weak acid with strong base?

20. Which are the green house gases? Mention their sources.

21. What is reverse osmosis? How it is useful in the purification of waste water?

22. What are chief factors responsible for water pollution?

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. If the energy difference between two electronic states of hydrogen atom is 214.68 KJmol-1. What will be the frequency of light emitted when the electrons jump from the higher to the lower level?

24. Explain the stability of half filled and completely filled orbitals.

25. Give an account of permanganometric titrations.

26. Discuss the theory of Acid – Base indicators.

27. Explain the energetic of ionic bond formation.

28. Define hybridization. Mention the types of hybridization involved in SF6, PCl5, BF3.

29. Explain Born-Haber Cycle considering the formation of NaCl as an example.

30. Write a note on agricultural pollution.

31. Explain briefly the different methods for the treatment of industrial waste water.

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a) Discuss Bohr Theory, highlighting its merits and demerits. (b)What are quantum numbers? Give its significance. (c) Explain various rules regarding electronic configuration.

33. (a) Discuss the titration curves for the titration of strong acid with strong base and weak acid with strong base. (b) Explain the theory of redox indicators. (c) Explain Beer's Law, Lambert's Law and Beer – Lambert Law.

34. (a) Write a note on Hydrogen bonding and its consequences. (b) How electronic configuration of molecules related to molecular behavior? Explain. (c) Explain Fajan's Rule.

35. (a) Discuss the formation and importance of ozone layer. (b) What is meant by pollution and pollutants? Explain the classification of air pollutants. (c) What are the sources of important air pollutants?

MAR IVANIOS COLLEGE (AUTONOMOUS)

Complementary Chemistry for Botany Majors

2022 Admission onwards

SEMESTER	**II**
COURSE	**2**
COURSE NAME	**INORGANIC & BIOINORGANIC CHEMISTRY**
COURSE CODE	**AUCH 231.2a**
CREDIT	**2**
L-T-P	**2-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students,*	**Cognitive Level**
1	Understand the biological and environmental aspects of organic compounds	U
2	Comprehend the meaning of stability of nucleus	R
3	Summarise the applications of radioactivity	U

4	Predict the properties of transition metal complexes	A
5	Apply complexation reactions in qualitative and quantitative analysis	U
6	Appreciate biological processes like photosynthesis, respiration etc	E
7	Realise the use of trace elements in biochemical processes	A

R-Remember, U-Understand, A-Apply, E-Evaluate

MODULE- I :ORGANOMETALLICS (9 Hrs)

Definition and classification, Organo metallic compounds of Mg, Sn, Li, Hg, Fe and their synthesis, applications

Biological and environmental aspects of organic compounds – Organometallic compounds in medicines – organomercury, organoboron, organosilicon and organo arsenic compounds – outline of preparation and uses

Antitumour drugs, silylated derivatives of bioactive organic compounds in agriculture and horticulture

Environmental aspects of Organometallic compounds

MODULE- II: NUCLEAR CHEMISTRY (9 Hrs)

Natural radioactivity, modes of decay, Geiger–Nuttal rule-

Artificial transmutation and artificial radioactivity-

Nuclear stability, n/p ratio, mass defect and binding energy, nuclear fission and nuclear fusion-

14

Applications of radioactivity- C dating, rock dating, neutron activation analysis and isotope as tracers

MODULE- III: COORDINATION CHEMISTRY (9 Hrs)

Nomenclature, Coordination number and geometry - chelates – isomerism – structural and stereo isomerism

Valence bond theory of bonding in octahedral and tetrahedral complexes – drawbacks of valence bond theory – high and low spin complexes – colour and magnetic properties of transition metal complexes

Application of metal complexes in qualitative and quantitative analysis

MODULE- IV: BIO INORGANIC COMPOUNDS (9 Hrs)

Metalloporphyrins – cytochromes –

Chlorophyll - photosynthesis and respiration –

Haemoglobin and myoglobin, mechanism of O_2 – CO_2 transportation

Nitrogen fixation, carbon fixation and carbon cycle

Biochemistry of iron toxicity and nutrition, essential and trace elements in biological systems

TEXT BOOKS /REFERENCES

1. Bosolo and Johns, Co-ordination Chemistry
2. Rochoco,Chemistry of Organometallics
3. J.D. Lee ,Concise Inorganic Chemistry
4. Puri, Sharma and Kalia, “Inorganic Chemistry”
5. A.D. Madan ,Modern Inorganic Chemistry

Semester II ,B.Sc Degree Examination Model question paper

Complementary Course for Botany Majors

Course Code: AUCH231.2a , Credit 2

INORGANIC AND BIOINORGANIC CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Give the structure of Zeisel's salt.
2. Write any one of the preparation methods of organolithium compounds.
3. What is ferrocene? How is it synthesized?
4. What are alpha particles?
5. Define the term radioactivity.
6. Write the IUPAC name of $K_3[Co(NO_2)_4Cl_2]$
7. What are low spin complexes?
8. What do you mean by chelate?
9. What are metalloporphyrins?
10. Give an example of anaerobic respiration.

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. What is Reformatsky reaction?
12. What is cisplatin? Give its significance.
13. How are organomercurials prepared?

14. Explain Geiger Nuttal Rule.

15. What are half life period and average life period?

16. Define mass defect and binding energy.

17. Write the postulates of Werner's Coordination Theory.

18. What are poly dentate ligands? Give an example.

19. Explain the colours of transition metal complexes.

20. Differentiate respiration and photosynthesis.

21. What are trace elements?

22. What is the role of chlorophyl in photosynthesis?

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. Write a note on organotin compounds.

24. Write a brief note on the applications of organometallic compounds in agriculture and horticulture.

25. One microgram of phosphorus- 32 was injected into a living system for biological tracer studies. The half life period of P-32 is 14.3 days. How long will it take for the radioactivity to fall to 10% of the initial value?

26. Explain the relation between nuclear stability and n/p ratio.

27. Write the biological effects of radiation.

28. Suggest the structure of [NiCl4] on the basis of Valence Bond Theory.

29. Explain the magnetic properties of octahedral complexes with suitable examples.

30. Discuss briefly the biochemistry of iron toxicity and nutrition.

31. Metal ions play a variety of roles in biological systems. Explain.

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a) Explain the synthesis and applications or Grignard reagent (5 marks)

(b)What are Frankland reagents? Give its significance (5 marks)

(c) Explain about organosilicon compounds in medicine (5 marks)

33. (a) Explain carbon dating and rock dating (5 marks)

(b)Give the principle of neutron activation analysis (5 marks)

(c)Explain the terms nuclear fission and fusion with suitable examples (5 marks)

34 (a) Write a note on Crystal Field Theory (5 marks)

(b) Explain the applications of complexes in qualitative analysis (5 marks)

(c) Write a brief note on isomerism in coordination complexes (5 marks)

35. (a) Give brief outline of carbon cycle (5 marks)

(b)Explain nitrogen Fixation (5 marks)

(c) Write a short note on haemoglobin (5 marks)

MAR IVANIOS COLLEGE (AUTONOMOUS)

COMPLEMENTARY CHEMISTRY FOR BOTANY MAJORS

2022 Admission onwards

SEMESTER	**III**
COURSE	**4**
COURSE TITLE	**PHYSICAL CHEMISTRY**
COURSE CODE	**AUCH331.2a**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	**COURSE OUTCOME** ***Upon completion of this course, the students,***	**Cognitive Level**
1	Classify reactions on the basis of order and molecularity	A
2	Understand the effect of temperature on reaction rates	U
3	Understand the theories of catalysis	U
4	Categorize compounds into acids and bases	U
5	Discuss the principle and application of UV and NMR spectroscopy.	U & A
6	Understand the properties of colloids and their application	U

*R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I: CHEMICAL KINETICS (9 Hrs)

Rates of reactions, various factors influencing rates of reactions order and molecularity - Zero, first, second and third order reactions

Derivation of integrated rate equation, fractional life time, units of rate constants Influence of temperature on reaction rates – Arrhenius equation, calculation of Arrhenius parameters – Collision theory

Catalysis- Different types of catalysis- intermediate compound formation theory and adsorption theory

MODULE- II: IONIC EQUILIBRIUM (9 Hrs)

Concepts of Acids and Bases-ionization of weak electrolytes-Influence of solvent on acid strength – levelling effect –

pH and its determination - potentiometric method-

Buffer solutions and calculations of the pH- Henderson equation -

Hydrolysis of salt – degree of hydrolysis and hydrolytic constant, derivation of relation between Kw and Kh for salts of strong acid – weak base, weak acid - strong base and weak acid – weak base

MODULE-III: SOLUTIONS (9 Hrs)

Completely miscible liquid pairs, vapour pressure - composition curve, boiling point-composition curve- ideal and non-ideal solutions, fractional distillations, azeotropes

Partially miscible liquids - CST, phenol- water, nicotine-water system- Effect of impurities on miscibility and CST,

Immiscible liquid pairs, steam distillation- Distribution law and its limitations, applications of solvent extractions.

MODULE- IV: UV AND NMR SPECTROSCOPY (9 Hrs)

UV-Visible Spectroscopy- absorption, types of electronic transitions, effect of conjugation-

Concept of chromophore, auxochrome, bathochrome, hypochromic shifts, hyperchromic and hypochromic effects.

UV-Visible spectra of enes - Calculation of λmax

Applications of UV spectroscopy - conjugation, functional group and geometrical isomerism

Principle of NMR, nuclear spin, chemical shift, spin-spin coupling, τ and δ, PMR of simple organic molecules $CHBr_2CH_2Br$, CH_3CH_2Br and CH_3CH_2OH

Principle of MRI

MODULE-V: DILUTE SOLUTIONS **9 Hrs**

Molarity, molality and mole fraction

Colligative property – relative lowering of vapour pressure – elevation in boiling point – depression in freezing point – osmotic pressure – experimental determination of osmotic pressure – Isotonic solution – reverse osmosis - abnormal molecular mass - van't Hoff factor. (Numerical Problems to be worked out)

MODULE-VI: COLLOIDS- **9 Hrs**

Colloidal state- Types of colloids

Preparation of colloids-Purification of colloids – ultra filtration and electrodialysis, Kinetic, optical and electrical properties of colloids

Ultra microscope, Electrical double layer and zeta potential

Coagulation of colloids, Hardy-Schulz rule

Micelles and critical micelle concentration, sedimentation

Application of colloids – Cottrell precipitator, purification of water and delta formation

REFERENCES

1. Chatwal, Gurdeep.R Organic Chemistry of Natural Products, , Himalaya Publications
2. Puri Shrama Pathania Principles of Physical chemistry, , Vishal
3. P.S. Kalsi, Chemistry of natural products, New Age International Private Ltd
4. Y.R Sharma, Elementary organic spectroscopy, S Chand & Company

5. B.R. Puri, R.L. Sharma & Pathania Principles of Physical Chemistry, Vishal Publishing
6. B.S. Bahl., G.D. Tuli & Arun Bahl , Essentials of Physical Chemistry, , S. Chand & Co., N Delhi.
7. R.L. Madan, G.D. Tuli Simplified Course in Physical Chemistry, S. Chand & Co.
8. B.K .Sharma ,Chromatography, GOEL Publishing house, Meerut

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester III B.Sc Degree Examination Model question paper

Complementary course for Botany Majors

Course Code AUCH331.2a Credit 3

PHYSICAL CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. What are the units of rate constants for first and second order reactions?
2. Give one example of a reaction in which order and molecularity have different values.
3. Define pH.
4. State Hardy-Schulze rule.
5. Distinguish between lypophilic colloids and lypophobic colloids.
6. Define chemical shift.
7. Explain chromophore with an example.
8. What is meant by a buffer solution? Give one example each for acid buffer and basic buffer solution.
9. What is meant by the term ideal solution?
10. Define Van't Hoff factor.

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. What are the factors which affect the rate of a chemical reaction?
12. Write down the expression that gives the dependence of the rate constant of a chemical reaction on the absolute temperature and explain the terms involved.
13. Explain briefly Lewis concept of acids and bases with two examples
14. What is zeta potential? How does it arise?
15. What is critical micelle concentration? Discuss the structure of micelles in polar and non polar media
16. Tetra Methyl Silane (TMS) is chosen as a reference compound in NMR studies. Give reasons
17. What are the different types of electronic transitions?
18. Differentiate between molarity and molality.
19. A solution containing 7g of a non volatile solute in 250g of water boils at 373.26 K. Find the molecular mass of the solute (K_b for water is 0.52K/m)
20. Explain the terms: Degree of hydrolysis and hydrolysis constant.
21. Explain reverse osmosis.
22. Calculate the mole fraction of alcohol, C_2H_5OH and water in a solution made by dissolving 9.2g of alcohol in 18 g of water.

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. What is energy of activation? What happens to the energy of activation in presence of a catalyst?
24. Explain Half life period of a reaction. A first order reaction has a specific reaction rate of $2.31 \times 10^{-3}\ s^{-1}$. Calculate the half life period of the reaction.
25. Calculate the pH of a buffer solution containing 0.2 mole of NH_4Cl and 0.1mole of NH_4OH per litre. K_b for NH4OH = 1.85×10^{-5}.
26. Derive the relation between K_h, K_w and K_a.
27. Give an account of applications of colloids
28. Explain ultra filtration and electro-dialysis techniques used for the purification of colloids
29. Which of the following will show spin- spin coupling in their NMR spectra? If coupling is observed, give the spin multiplicity : (a) $ClCH_2CH_2Cl$ (b) CH_3COCH_3 (c) CH_3CHO (d) $ClCH_2CH_2I$
30. What is osmotic pressure? How will you determine the molecular mass of a substance with this method?
31. Explain the principle of Fractional Distillation

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a)Differentiate between Molecularity and order of a reaction with examples (5 marks)
(b)Discuss the Kinetic, optical and electrical properties of colloids (5 marks)

(c)Explain the protective action of colloids(5 marks)

33. (a) Which of the following has the highest osmotic pressure: 0.1M sucrose, 0.1M acetic acid, 0.1M KCl and 0.1M Na_2SO_4 all in water? Why?

(b) Why do you get abnormal molecular masses of the substances by using colligative properties of the solution.

(c) Discuss in detail about the determination of molecular mass of a non volatile compound from elevation in boiling point and depression in freezing point

34. (a) Discuss the factors responsible for deviation from Raoult's law by taking suitable examples.

(b) Define critical solution temperature. Explain systems having upper and lower CST using examples

(c) Explain the applications of UV spectroscopy

35. (a) Discuss the advantages of Bronsted-Lowry concept over Arrhenius concept and also the limitations of the Bronsted-Lowry concept.

(b)The salt of strong acid and strong base does not undergo hydrolysis. Explain.

(c) Explain the underlying principle in an NMR spectrum and interpret the low resolution NMR spectrum of ethanol molecule.

MAR IVANIOS COLLEGE (AUTONOMOUS)

Complementary Chemistry for Botany Majors

SEMESTER	**IV**
COURSE TITLE	**ORGANIC CHEMISTRY**
COURSE CODE	**AUCH431.2a**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	**COURSE OUTCOME** ***Upon completion of this course, the students,***	**Cognitive Level**
1	Discuss the principle and applications of chromatography and electrophoresis	U
2	Classify amino acids, proteins, carbohydrates and vitamins. Identify and distinguish the structure of amino acids, peptides, proteins and nucleic acids.	U
3	Summarise the concept of optical isomerism.	U and A
4.	Categorise crude drugs and explain the method of evaluating crude drugs.	U
5.	Draw the structure of amino acids, carbohydrates, simple optical isomers	R
6.	Explain the preparation and reactions of amino acids and carbohydrates	U

7.	Discuss the extraction process and general properties of natural products -oils, fats, terpenes and alkaloids.	U

*R-Remember, U-Understand, A-Apply

MODULE- I: CHROMATOGRAPHY (9 Hrs)

Outline study of adsorption and partition chromatography-

Principle and applications of paper, thin layer, ion exchange and gas chromatography

Principle, instrumentation and applications of HPLC

R_f and R_t value of various chromatographic techniques

Electrophoresis – Principle and application of Zone and Capillary electrophoresis

MODULE-II: STEROCHEMISTRY (9 Hrs)

Optical Isomerism : Chirality and elements of symmetry; DL notation and Enantiomers

Optical isomerism in glyceraldehydes, lactic acid and tartaric acid

Diastereoisomers and mesocompounds

Cahn-Ingold-Prelog rules – R-S notations for optical isomers with one and two asymmetric carbon atoms

Racemic mixture, resolution and methods of resolution

MODULE-III: AMINO ACIDS AND PROTEINS (9 Hrs)

Amino acids: - Classification, structure and stereochemistry of amino acids
Essential and non-essential amino acids, zwitter ion, isoelectric point

General methods of preparation and reactions of amino acids

Peptides: structure and synthesis-Carbobenzoxy and Sheehan method

Proteins: - Structure of proteins, denaturation and colour reactions

Nucleic acids: - Classification and structure of DNA and RNA- Replication of DNA, Genetic Codes- Translation- Transcription

MODULE- IV: OILS, FATS, ALKALOIDS, VITAMINS AND TERPENES (9 Hrs)

Oils and Fats: Occurrence and extraction-Analysis of oils and fats- saponification value, iodine value and acid value

Alkaloids: - Extraction and structural elucidation of coniine and importance of quinine, morphine and codeine

Terpenes: Classification- Isoprene and special isoprene rule-Isolation of essential oils- citral and geraniol (No structural elucidation)

Vitamins: - Classification and structure, functions and deficiency diseases (structures of vitamin A, B_1 and C but no structural elucidation).

MODULE- V: CARBOHYDRATES (9 Hrs)

Classification- Configuration of glyceraldehyde, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose

Preparation and properties of glucose and fructose (oxidation, reduction and reaction with phenylhydrazine only)

Pyranoside structures of glucose and fructose, furanoside structure of fructose (structure elucidation not expected)

Mutarotation and epimerization- Conversion of glucose into fructose and vice versa Structure of starch and cellulose (structure elucidation not expected)

MODULE- VI: PHYTOCHEMICALS AND CRUDE DRUGS 9 Hrs

Pharmacognacy – Scope and importance, scheme for pharmacognotic studies of crude drugs Phytochemicals. Crude drugs: Morphological, pharmacological and chemical classification

Collection and processing of crude drugs – collection and harvesting, drying, garbling, packing

Processing of drugs: Method of preparation – decotion, maceration and infusion

Methods of drug evaluation: Moisture content, volatile content, solubility, optical rotation, ash values and extracting, spectroscopic analysis, chromatographic method and foreign organic matter (Mention only)

Phytoconstituents of therapeutic values: Carbohydrates, glycosides (saponin glycosides and cardiac glycosides), alkaloids (quinoline, isoquinoline, indole alkaloids and steroidal alkaloids) volatiles oils and phenols (Mention its sources, important compounds in each class and therapeutic importance)

Text Books / References

1. Organic Chemistry of Natural Products, Chatwal, Gurdeep.R, Himalaya Publications
2. Chemistry of natural products, P.S. Kalsi, New Age International Private Ltd
3. Chromatography, .B.K .Sharma, GOEL Publishing house, Meerut
4. Pharmacognosy, A. Roseline, MJP publishers, 2011.
5. A textbook of Organic Chemistry, K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, Vikas Publishing House (Pvt) Ltd., New Delhi.
6. Modern Organic Chemistry, S.C. Sharma and M.K .Jain, Vishal Publishing Company, New Delhi.
7. Stereochemistry of Organic Compounds: Principles and Applications, D. Nasipuri, New Age International Publishers, New Delhi.

Semester IV B.Sc. Degree Examination Model question paper

Complementary course for Botany Majors

Course Code: AUCH431.2a, Credit 3

ORGANIC CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. What is meant by Rf value?
2. Define Racemic mixture.
3. Represent the configurations of D and L glyceraldehyde.
4. Give two examples of essential amino acids.
5. Describe a colour test for proteins.
6. Define Iodine value.
7. Name a phytochemical.
8. State Special isoprene rule?
9. Write an example for volatile oil .
10. Give the deficiency disease of Vitamin C.

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. Give the principle of adsorption chromatography.
12. What is meant by denaturation of proteins.
13. Discuss the importance of Morphine.
14. Which of the following are optically active ? Why?

    (i) 2-chloropropane (ii)2-chlorobutane (iii)3-chloropentane
15. Give four differences between enantiomers and diastereoisomers.
16. Write a note on the different types of RNA and its functions.

17. How are alkaloids extracted from natural sources?
18. Give the classification of Vitamins.
19. What happens when glucose is treated with Br_2 water?
20. Define moisture content and extraction value.
21. Name four anticancer compounds from plants.
22. Explain saponification.

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. Discuss the optical isomerism of tartaric acid.
24. Write a note on DNA replication .
25. Give the synthesis of Tryptophan.
26. Comment on zwitter ion and isoelectric point.
27. Determine the R & S notations of meso tartaric acid and L- glyceraldehyde.
28. Give a brief account on Thin Layer Chromatography.
29. Write a note on the methods of isolation of terpenoids.
30. Describe the structure of starch and cellulose.
31. Mention the source and therapeutic value of the alkaloid phytoconstituent.

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a)Explain Ion exchange Chromatography.
    (b)Elucidate the structure of Coniine.
    (c)Describe the structure of DNA.
33. (a)Discuss briefly the structure of Protein.
    (b)Explain Sheehan's method of peptide synthesis.
    (c)What are crude drugs? Discuss its classification
34. (a)What is resolution? Explain any three methods of resolution.
    (b)What are meso compounds? Are they optical active? Explain with a suitable example.
    (c)Discuss the isolation, structure and uses of geraniol.
35. (a) Differentiate mutarotation and epimerization
    (b) Define Oils and fats and discuss the different methods of extraction.

(c)Discuss on the pyranoside structure of glucose and furanoside structure of fructose.

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF LAB COURSE IN CHEMISTRY FOR STUDENTS OF BOTANY MAJORS

2022 Admission onwards

SEMESTER	**I, II, III & IV**
COURSE NAME	**COURSE V : LAB COURSE FOR BOTANY**
COURSE CODE	**AUCH 432.2a PI**
CREDIT	**2**
L-T-P	**0-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students*	**Cognitive Level**
1	Obey Lab safety instructions, develop qualities of punctuality, regularity and scientific attitude, out look and scientific temper (GOOD LAB PRACTICES)	R,U,A
2	Develop skill in safe handling of chemicals, take precaution against accidents and follow safety measures	U,A
3	Develop skill in observation, prediction and interpretation of reactions	U,A
4	Prepare organic compounds, Purify and recrystallise	U,A
5	Develop skill in weight calculation for preparing standard solutions	E,A
6	Perform volumetric titrations under acidimetry-alkalimetry,	A

	permanganometry, dichrometry, iodimetry-iodometry,cerimetry, argentometry and complexometry	
7	Conduct chromatographic separation of mixtures	A

SYLLABUS FOR LABORATORY COURSE

FOR COMPLEMENTARY CHEMISTRY FOR BOTANY MAJORS

Course Code AUCH 432.2a PI Credit 2

I.QUALITATIVE ANALYSIS

Systematic analysis with a view to identify the organic compound (aromatic – aliphatic, saturated – unsaturated, detection of elements and detection of functional groups) – glucose, alcohols, phenols, halogen compounds, nitro compounds, amino compounds, aldehydes, ketones, carboxylic acids, amides, urea, thiourea and esters. Only monofunctional compounds are to be given. A student has to analyse at least twelve organic compounds.

II.ORGANIC PREPARATIONS

1. Acetanilide from aniline
2. Metadinitrobenzene from nitro benzene
3. Benzoic acid from benzyl chloride

III.VOLUMETRIC ANALYSIS

A. Acidimetry and Alkalimetry

a. Preparation and standardization of 0.05N HCl using sodium carbonate as primary standard

b. Estimation of a strong base and a weak base using standardized HCl

c. Estimation of sodium hydroxide using (i)Std. oxalic acid and (ii) Std. HCl

d. Preparation and standardization of 0.05N NaOH using oxalic acid as primary standard

e. Estimation of a strong acids using standardized NaOH

f. Determination of sodium hydroxide, and sodium hydroxide and sodium carbonate in a mixture (indicator method)

B. Permanganometry

a. Standardization of $KMnO_4$ by oxalic acid/sodium oxalate and Mohr's salt

b. Estimation of oxalic acid/sodium oxalate

c. Estimation of Mohr's salt

d. Estimation of calcium

C. Dichrometry

a. Preparation of Std. $K_2Cr_2O_7$ and estimation of ferrous iron by external and internal indicators.

b. Estimation of ferric iron by reduction with stannous chloride (internal indicator).

D. Iodimetry and Iodometry

a. Standardisation of sodium thiosulphate using std potassium dichromate

b. Estimation of copper in a solution

c. Estimation of iodine

E. Complexometric titrations

a. Standardisation of EDTA using std Mg^{2+} or Zn^{2+} ion solution.

b. Estimation of any one metallic ion from Ca^{2+}, Mg^{2+}, Zn^{2+} or Ni^{2+} A student has to carry out at least twelve experiments in this class.

IV.GRAVIMETRIC ANALYSIS

1. Estimation of water of hydration in barium chloride crystals
2. Estimation of barium in barium chloride solution.

V.CHROMATOGRAPHY

TLC of simple organic compounds- cresol, napthol, nitrobenzene

This laboratory based course reinforces the qualitative and quantitative chemical analysis that the student has learned in the 1^{st} ,2^{nd} , 3^{rd} and 4^{th} semesters

COMPLEMENTARY CHEMISTRY FOR ZOOLOGY MAJORS

This Complementary Course has 4 theory courses and 1 practical course.

The Hour allotments and Credits for all are given in the table.

COMPLEMENTARY COURSES -4

TOTAL CREDITS – 14

ONE SEMESTER = 18 WEEKS

Semester	Hours per week		Number of Credits	Course Code	Instructional Hours
	Theory	Lab			
1	2	2	2	AUCH131.2e	2×18 = 36 2×18 = 36
2	2	2	2	AUCH231.2e	2×18 = 36 2×18 = 36
3	3	2	3	AUCH331.2e	3×18 = 54 2×18 = 36
4	3	2	3 4	AUCH431.2e AUCH43 .2e PI	3×18 =54 2×18 = 36

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY COURSE FOR STUDENTS OF ZOOLOGY MAJORS

2022 Admission onwards

SEMESTER	**I**
COURSE	**1**
COURSE NAME	**THEORETICAL CHEMISTRY**
COURSE CODE	**AUCH131.2e**
CREDIT	**2**
L-T-P	**2-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students,*	**Cognitive Level**
1	Differentiate particle nature and wave nature of matter	U
2	Associate wave concept with microscopic matter	A
3	Understand the relevance of periodic classification of elements	U
4	Describe the various types of chemical bonds	R
5	Apply the VSEPR theory to explain the geometry of molecules	E,A
6	Comprehend the meaning of stability of nucleus	R
7	Summarise the applications of radioactivity	U
8	Recognize the factors affecting environment and solutions for it	E

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I: ATOMIC STRUCTURE **(9 Hrs)**

Atomic spectrum of Hydrogen – different series, Rydberg equation

Bohr theory – postulates – statement of Bohr energy equation – derivation of spectral frequency from Bohr equation.

Schrodinger wave equation (no derivation, mention only) - concept of orbitals, the four quantum numbers and their significances.

Orbital wise electron configuration, energy sequence rule – Pauli's Principle, Hund's rule, stability of filled and half filled orbitals

MODULE- II: CHEMICAL BONDING (9 Hrs)

Energetics of bond formation –Born Haber cycle
Hybridisation and structure of molecules – sp, sp^2 sp^3, dsp^2, dsp^3, sp^3d^2, and sp^3d^3 hybridisation with examples- Explanation of bond angle in water and ammonia

VSEPR theory with regular and irregular geometry

Hydrogen bond – inter and intra molecular – its consequences on boiling point –volatility and solubility

Partial covalent character of the ionic bond- Fajan's rules-

A brief review of molecular orbital approach-

LCAO method – bond order, bond distance and stability of O_2, O_2^{2+}, NO^{2-}, NO^+

MODULE-III: NUCLEAR CHEMISTRY (9 Hrs)

Natural radioactivity, modes of decay, Geiger–Nuttal rule-

Artificial transmutation and artificial radioactivity-

Nuclear stability, n/p ratio, mass defect and binding energy, nuclear fission and nuclear fusion-

Applications of radioactivity- C^{14} dating, rock dating, neutron activation analysis and isotope as tracers

MODULE-IV: ENVIRONMENTAL CHEMISTRY (9 Hrs)

Nature of environmental threats and role of chemistry-

Green house effect, ozone layer and its depletion-

Water pollution: Various factors affecting purity of water, sewage water, industrial waste, agricultural pollution such as pesticides, fertilizers, detergents, treatment of industrial waste water using activated charcoal, synthetic resins, reverse osmosis, electrodialysis

Dissolved oxygen-BOD, COD

Text Books / References

1. Atomic structure and chemical bonding with introduction to molecular spectroscopy – Manas Chanda
2. Concise Inorganic Chemistry – J.D. Lee
3. Environmental Chemistry A. K. De
4. Modern Inorganic Chemistry A.D. Madan
5. A. I. Vogel, “Text book of Qualitative Analysis”
6. A. I. Vogel, “Text book of Quantitative Inorganic Analysis”.
7. S. K. Banerji, “Environmental Chemistry”.
8. A. K. De “Environmental Chemistry - An introduction”
9. B. K. Sharma “Air Pollution”.
10. V. K. Ahluwalia “Environmental Chemistry”
11. G.W. van Loon and S. J. Duffy “Environmental Chemistry: A global perspective”

Semester-I B.Sc. Degree Examination Model question paper
Complementary course for Zoology Majors

Course Code: AUCH131.2e, Credit 2

THEORETICALCHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Give the electronic configuration of Copper (atomic umber 29)
2. The quantum numbers n = 2 and l = 1 corresponds to which orbital?
3. What are the shapes of molecules with sp and sp3 hybridization?
4. Calculate the bond order of H2 molecule.
5. Give the structure of XeO3.
6. What is Lattice Energy?
7. What is meant by primary standards?
8. Define Molality.
9. What is the optimum value of DO for good water quality?
10. What is meant by BOD?

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. What is Bohr Bury's rule?
12. Write down the Schrodinger Equation and explain the terms involved.
13. Explain the failures of Bohr's theory?

14. What are the limitations of VSEPR Theory?

15. What are polar and non polar covalent bonds?
16. Mention the rules for adding electrons to molecular orbitals?

17. What are dichrometric titrations?

18. How would you prepare 100ml of 0.05M Mohr's salt solution?

19. Why is methyl orange not a suitable indicator for the titration of weak acid with strong base?

20. Which are the green house gases? Mention their sources.

21. What is reverse osmosis? How it is useful in the purification of waste water?

22. What are chief factors responsible for water pollution?

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. If the energy difference between two electronic states of hydrogen atom is 214.68 KJmol-1. What will be the frequency of light emitted when the electrons jump from the higher to the lower level?

24. Explain the stability of half filled and completely filled orbitals.

25. Give an account of permanganometric titrations.

26. Discuss the theory of Acid – Base indicators.

27. Explain the energetic of ionic bond formation.

28. Define hybridization. Mention the types of hybridization involved in SF6, PCl5, BF3.

29. Explain Born-Haber Cycle considering the formation of NaCl as an example.

30. Write a note on agricultural pollution.

31. Explain briefly the different methods for the treatment of industrial waste water.

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a) Discuss Bohr Theory, highlighting its merits and demerits.

(b)What are quantum numbers? Give its significance.
(c) Explain various rules regarding electronic configuration.

33. (a) Discuss the titration curves for the titration of strong acid with strong base and weak acid with strong base.

(b) Explain the theory of redox indicators.

(c) Explain Beer's Law, Lambert's Law and Beer – Lambert Law.

34. (a) Write a note on Hydrogen bonding and its consequences.

(b) How electronic configuration of molecules related to molecular behavior? Explain.

(c) Explain Fajan's Rule.

35. (a) Discuss the formation and importance of ozone layer.

(b) What is meant by pollution and pollutants? Explain the classification of air pollutants.

(c) What are the sources of important air pollutants?

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS FOR COMPLEMENTARY CHEMISTRY OF FOR ZOOLOGY MAJORS

2022 Admission onwards

SEMESTER	II
COURSE	2
COURSE NAME	INORGANIC CHEMISTRY
COURSE CODE	AUCH231.2e
CREDIT	2
L-T-P	2-0-2
TOTAL HOURS	36

CO No.	**COURSE OUTCOME** ***Upon completion of this course, the students,:***	**Cognitive Level**
1	Understand the biological and environmental aspects of organic compounds	U
2	Comprehend different segments of titrations	U
3	Apply the principles of colorimetry to estimate ions and elements	A
4	Predict the properties of transition metal complexes	A
5	Understand the applications of metal complexes	U
6	Learn to appreciate biological processes like photosynthesis, respiration etc	E
7	Discuss the biochemistry of trace elements	U,E

R-Remember, U-Understand, A-Apply, E- Evaluate

MODULE- I: ORGANOMETALLICS (9 Hrs)

Definition and classification, Organometallic compounds of Mg, Sn, Li, Hg, Fe and their synthesis, applications

Biological and environmental aspects of organic compounds – Organometallic compounds in medicines – organomercury, organoboron, organosilicon and organo arsenic compounds – outline of preparation and uses

Antitumour drugs, silylated derivatives of bioactive organic compounds in agriculture and horticulture

Environmental aspects of Organometallic compounds

MODULE-II: ANALYTICAL PRINCIPLES (9 Hrs)

Principles of volumetric analysis- primary standard - standard solutions- normality and molarity - theory of acid - base titrations, permanganometric and dichrometric titrations, iodometric and complexometric titrations-

Theory of acid – base and redox indicators-

Beer- Lambert law- Principles of colorimetry – Estimation of Iron and phosphate

MODULE III - COORDINATION CHEMISTRY (9 Hrs)

Nomenclature, Coordination number and geometry - chelates – isomerism – structural and stereo isomerism

Valence bond theory of bonding in octahedral and tetrahedral complexes – drawbacks of valence bond theory – high and low spin complexes – colour and magnetic properties of transition metal complexes

Application of metal complexes in qualitative and quantitative analysis

MODULE-IV: BIO INORGANIC COMPOUNDS (9 Hrs)

Metalloporphyrins – cytochromes –

Chlorophyll - photosynthesis and respiration –

Haemoglobin and myoglobin, mechanism of $O_2 - CO_2$ transportation

Nitrogen fixation, carbon fixation and carbon cycle

Biochemistry of iron toxicity and nutrition, essential and trace elements in biological systems

References

1. Co-ordination Chemistry – Bosolo and Johns
2. Chemistry of Organometallics – Rochoco.
3. Concise Inorganic Chemistry – J.D. Lee
4. Puri, Sharma and Kalia “Inorganic Chemistry”
5. Modern Inorganic Chemistry A.D. Madan

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester II, B.Sc. Degree Examination Model question paper

Complementary course for Zoology Majors

Course Code: AUCH231.2e. Credit 2

INORGANIC CHEMISTRY

(2022 Admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. Give the structure of Zeisel's salt.
2. Write any one of the preparation methods of organolithium compounds.
3. What is ferrocene? How is it synthesized?
4. What are alpha particles?
5. Define the term radioactivity.
6. Write the IUPAC name of $K_3[Co(NO_2)_4Cl_2]$
7. What are low spin complexes?
8. What do you mean by chelate?
9. What are metalloporphyrins?
10. Give an example of anaerobic respiration.

SECTION B

*(Answer any **eight** questions. Each question carries 2 marks)*

11. What is Reformatsky reaction?
12. What is cisplatin? Give its significance.

13. How are organomercurials prepared?

14. Explain Geiger Nuttal Rule.

15. What are half life period and average life period?

16. Define mass defect and binding energy.

17. Write the postulates of Werner's Coordination Theory.

18. What are poly dentate ligands? Give an example.

19. Explain the colours of transition metal complexes.

20. Differentiate respiration and photosynthesis.

21. What are trace elements?

22. What is the role of chlorophyl in photosynthesis?

SECTION C

*(Answer any **six** questions. Each question carries 4 marks)*

23. Write a note on organotin compounds.
24. Write a brief note on the applications of organometallic compounds in agriculture and horticulture.

25. One microgram of phosphorus- 32 was injected into a living system for biological tracer studies. The half life period of P-32 is 14.3 days. How long will it take for the radioactivity to fall to 10% of the initial value?

26. Explain the relation between nuclear stability and n/p ratio.

27. Write the biological effects of radiation.

28. Suggest the structure of [NiCl4] on the basis of Valence Bond Theory.

29. Explain the magnetic properties of octahedral complexes with suitable examples.

30. Discuss briefly the biochemistry of iron toxicity and nutrition.

31. Metal ions play a variety of roles in biological systems. Explain.

SECTION D

*(Answer any **two** questions. Each question carries 15 marks)*

32. (a) Explain the synthesis and applications or Grignard reagent. (5 marks)

    (b)What are Frankland reagents? Give its significance. (5 marks)

    (c) Explain about organosilicon compounds in medicine. (5 marks)

33. (a) Explain carbon dating and rock dating. (5 marks)

    (b)Give the principle of neutron activation analysis. (5 marks)

    (c) Explain the terms nuclear fission and fusion with suitable examples. (5 marks)

34. (a) Write a note on Crystal Field Theory. (5 marks)

    (b) Explain the applications of complexes in qualitative analysis. (5 marks)

    (c) Write a brief note on isomerism in coordination complexes. (5 marks)

35. (a) Give brief outline of carbon cycle. (5 marks)

    (b) Explain nitrogen Fixation. (5 marks)

    (c) Write a short note on haemoglobin. (5 marks)

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY CHEMISTRY FOR ZOOLOGY MAJORS

2022 Admission onwards

SEMESTER	**III**
COURSE	**3**
COURSE NAME	**ORGANIC CHEMISTRY**
COURSE CODE	**AUCH331.2e**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	COURSE OUTCOME *Upon completion of this course, the students,*	Cognitive Level
1	Classify carbohydrates, amino acids, proteins, nucleic acids, lipids, polymers and drugs.	**U**
2	Summarize optical, geometrical and conformational isomerism Draw the structure of simple carbohydrates	U
3	Discuss the structure of proteins	U
4	Explain the synthesis of amino acids, peptide, drugs	U
5	Predict absolute configuration of stereo centers	A

R-Remember, U-Understand, A-Apply

MODULE- I: STEREOCHEMISTRY (9 Hrs)

Optical isomerism – chirality, Enantiomers, racemisation- Optical isomerism of lactic and tartaric acid- Resolution and methods of resolution

Relative and absolute configuration, Enantiomeric excess, asymmetric synthesis

Geometrical isomerism, geometrical isomerism in maleic and fumaric acid, E and Z nomenclature- Aldoximes and ketoximes

Conformational isomerism-Rotation about carbon – carbon single bond, conformation of ethane, butane cyclohexane, axial and equatorial bonds

MODULE-II: CARBOHYDRATES (9 Hrs)

Classification. Configuration- glyceraldehyde, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose Preparation and properties of glucose and fructose

Pyranoside structures of glucose and fructose, furanoside structure of fructose (structure elucidation not expected) Mutarotation and epimerization

Properties and structure of sucrose. (structure elucidation not expected) Structure of starch and cellulose (Elementary idea only)

MODULE-III: AMINO ACID AND PROTEINS (9 Hrs)

Classification and properties of aminoacids

Synthesis of glycine, alanine and tryptophan

Polypeptides and proteins, peptide linkage, peptide synthesis

Primary, secondary, tertiary and quarternary structure of proteins

Test for proteins

Enzymes – Characteristics, catalytic action, theory of enzyme catalysis – Michaelis – Menton theory- Co-enzymes

MODUL- IV: NUCLEIC ACIDS AND LIPIDS 9 Hrs

RNA, DNA – their biological role, hydrolysis of nucleoproteins, elementary idea regarding the structure of nucleic acids

Replication of DNA- Transcription and Translation - Genetic code

Lipids – Classification oils, fats and waxes, iodine value and saponification value, properties of oils and fats – phospholipids

MODULE-V: POLYMERS (9 Hrs)

Classification with example – natural and synthetic polymers – condensation and addition polymerization- Elastic fibres, thermoplastics and thermosetting plastics

Terpenes – classification, isoprene rule, essential oils, elementary study of citral and geraniol (structure elucidation not required)

Rubber - structure – Vulcanisation of rubber – synthetic rubber – neoprene, butyl rubber, Buna S, Buna N.

MODULE-VI: DRUGS (9 Hrs)

Classification of drugs- analgesic, antipyretic, antibiotic, hypnotics, sulphadrugs, antacids, antimalarials

Mode of action of sulpha drugs

Synthesis of aspirin, sulphaguanidine, Paracetamol

Drugs of plant origin- anticancer compounds from plants

MAR IVANIOS COLLEGE (AUTONOMOUS)

III Semester, B.Sc Degree Examination Model question paper

Complementary course for Zoology Majors

Course Code: AUCH331.2e, Credit 3

ORGANIC CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)* 1) Give an example of a Sulpha drug.

2) Write the structure of aspirin.

3) Draw the most stable conformer of cyclohexane.

4) Write the epimer of D-Glucose.

5) What are polysaccharides?

6) What are zwitter ions?

7) Relationship between the base sequence in DNA and the amino acid sequence in protein is known as ……..

8) Write the structure of tryptophan.

9) Name the monomer of natural rubber.

10) Name the purine bases present in DNA.

SECTION B

*(Answer **any 8** question. Each question carries 2 Marks)*

11) What is atropisomerism?

12) How will you prepare sulfaguanidine?

13) What is asymmetric synthesis? Illustrate.

14) Explain racemisation.

15) What is inversion of cane sugar?

16) What are copolymers?

17) Explain saponification value.

18) What is zwitter ion?

19) Draw the structure of D-Arabinose, D-Ribose, L-Glyceraldehyde and L-Erythrose.

20) What are phospholipids?

21) Name the products of hydrolysis of nucleoproteins.

22) What do you understand by the term Buna-N?

SECTION C

*(Answer **any 6** question. Each question carries 4 Marks)* 23) Write a note on the mode of action of sulpha drugs.

24) Explain the E & Z notation of geometrical isomers with examples.

25) Explain mutarotation and epimerization.

26) Explain the following denaturation and colour reactions of protein.

27) Explain isoprene and special isoprene rule

28) What are lipids? Give examples. Enumerate their functions.

29) Describe the synthesis of Paracetamol.

30) What are enzymes? Give their general characteristics.

31) What is iodine value? Write its importance.

SECTION D

*(Answer **any 2**question. Each question carries 15 Marks)*

32) (a) What are drugs? How are they classified

(b)Explain enzyme catalysis using Michaelis – Menton theory.

(c) Assign the R and S configuration of D- & L- Lactic acid. (6+4+5)

33) (a) What is resolution? Explain any two methods.

(b) Explain the geometrical isomerism in maleic and fumaric acid.

(c) Discuss the ring structure of glucose. (5+5+5)

34) (a) Explain two methods of synthesizing peptides.

(b) Discuss primary and secondary structure of proteins.

(c) Comment on the structure of starch and cellulose. (5+5+5)

35) (a) Describe the classification of oils.

(b) Discuss the structure of DNA.

(c) How glucose reacts with the following (i) Br_2 water (ii) Phenylhydrazine (iii) CH_3OH and dry Conc. HCl.

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF COMPLEMENTARY CHEMISTRY FOR ZOOLOGY MAJORS

SEMESTER	**IV**
COURSE	**4**
COURSE NAME	**PHYSICAL CHEMISTRY**
COURSE CODE	**AUCH431.2e**
CREDIT	**3**
L-T-P	**3-0-2**
TOTAL HOURS	**54**

CO No.	**COURSE OUTCOME** ***Upon completion of this course, the students,***	**Cognitive Level**
1	Classify reactions on the basis of order and molecularity	U
2	Discuss different concepts of acids and bases	R,U
3	Understand different techniques used for the study of colloids	U
4	Calculate rate and order of reactions	E,A
5	Review the principles underlying the working of sophisticated instruments	U

*R-Remember, U-Understand, A-Apply

MODULE-I: CHEMICAL KINETICS (9 Hrs)

Rates of reactions, various factors influencing rates of reactions

Order and molecularity - Zero, first, second and third order reactions

Derivation of integrated rate equation, fractional life time, units of rate constants Influence of temperature on reaction rates – Arrhenius equation, calculation of Arrhenius parameters – Collision theory

Catalysis- Different types of catalysis- intermediate compound formation theory and adsorption theory

MODULE- II: IONIC EQUILIBRIUM (9 Hrs)

Arrhenius, Lowry- Bronsted concepts of Acids and Bases- Kw & pH pH of strong acid and weak acid

K_a & K_b,

Mechanism of Buffer action- Henderson equation –pH of Buffer

Hydrolysis of salt – degree of hydrolysis and hydrolytic constant

MODULE-III: COLLOIDS (9 Hrs)

Colloidal state- Types of colloids

Preparation of colloids-Purification of colloids – ultra filtration and electrodialysis, Kinetic, optical and electrical properties of colloids

Ultra microscope, Electrical double layer and zeta potential

Coagulation of colloids, Hardy-Schulz rule

Micelles and critical micelle concentration, sedimentation

Application of colloids – Cottrell precipitator, purification of water and delta formation

MODULE-IV: SPECTROSCOPY (9 Hrs)

UV-Visible Spectroscopy- absorption, types of electronic transitions, effect of conjugation-

Concept of chromophore, auxochrome, bathochrome, hypochromic shifts, hyperchromic and hypochromic effects.

UV-Visible spectra of enes - Calculation of λmax

Applications of UV spectroscopy - conjugation, functional group and geometrical isomerism

Principle of NMR, nuclear spin, chemical shift, spin-spin coupling, τ and δ, PMR of simple organic molecules $CHBr_2CH_2Br$, CH_3CH_2Br and CH_3CH_2OH
Principle of MRI

MODULE-V: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS (9 Hrs)

Principle – instrumentation and applications of Atomic absorption spectroscopy- flame emission spectroscopy

Thermal methods - thermogravimetry (TG) - Differential thermal analysis (DTA)

Gas Chromatography- HPLC

Introduction to zone electrophoresis and capillary electrophoresis

MODULE-VI: SOLUTIONS (9 Hrs)

Liquid-Liquid system:- Completely miscible, ideal and non-ideal mixtures

Raoult's law, vapour pressure- composition and temperature-composition curves, fractional distillation, deviation from Raoult's law

Azeotropic mixtures, partially miscible liquid system, critical solution temperature, Conjugate layers, example for upper, lower and upper cum lower CST, Theory of steam distillation

Text Books /References

1. Organic Chemistry of Natural Products, Chatwal, Gurdeep. R, Himalaya Publications

2. Principles of physical chemistry, Puri Sharma Pathania, Vishal
3. Chemistry of natural products, P.S. Kalsi, New Age International Private Ltd
4. Elementary organic spectroscopy, Y.R Sharma, S Chand & Company
5. Principles of Physical Chemistry, B.R. Puri, R.L. Sharma & Pathania, Vishal Publishing
6. Essentials of Physical Chemistry, B.S. Bahl., G.D. Tuli & Arun Bahl , S. Chand & Co., New Delhi.
7. Simplified Course in Physical Chemistry, R.L. Madan, G.D. Tuli , S. Chand & Co.
8. Chromatography, B.K .Sharma, GOEL Publishing house, Meerut

MAR IVANIOS COLLEGE (AUTONOMOUS)

Semester IV, B.Sc Degree Examination Model question paper
Complementary course for Zoology Majors
Course Code: AUCH431.2e, Credit 3
PHYSICAL CHEMISTRY

(2022 admission onwards)

Time: Three Hours **Maximum Marks: 80**

SECTION A

*(Answer **all** questions. Each question carries **1** mark)*

1. What are the units of rate constants for first and second order reactions?
2. Give one example of a reaction in which order and molecularity have different values.
3. Define P^H.
4. State Hardy-Schulze rule.
5. Distinguish between lypophilic colloids and lypophobic colloids.
6. Define chemical shift
7. Explain chromophore with an example.
8. What is meant by a buffer solution? Give one example each for acid buffer and basic buffer solution.
9. What is meant by the term ideal solution?
10. Write a short note on zone electrophoresis

SECTION B

*(Answer **any 8** question. Each question carries 2 Marks)*

11. What are the factors which affect the rate of a chemical reaction?
12. Write down the expression that gives the dependence of the rate constant of a chemical reaction on the absolute temperature and explain the terms involved.
13. Explain briefly Lewis concept of acids and bases with two examples
14. What is zeta potential? How does it arise?

15. What is critical micelle concentration? Discuss the structure of micelles in polar and nonpolar media
16. Tetramethyl silane (TMS) is chosen as a reference compound in NMR studies. Give reasons
17. What are the different types of electronic transitions?
18. Explain the working of Hollow Cathode Lamp
19. What is the difference between GC and HPLC?
20. Explain the terms Degree of hydrolysis and hydrolysis constant.
21. What are the conditions at which the solutions deviate from ideal behaviour?
22. Calculate the mole fraction of alcohol, C_2H_5OH and water in a solution made by dissolving 9.2g of alcohol in 18g of water.

SECTION C

*(Answer **any 6** question. Each question carries 4 Marks)*

23. What is energy of activation? What happens to the energy of activation in presence of a catalyst.
24. Explain Half life period of a reaction. A first order reaction has a specific reaction rate of $2.31x10^{-3}$ s^{-1}. Calculate the half life period of the reaction.
25. Calculate the pH of a buffer solution containing 0.2 mole of NH_4Cl and 0.1mole of NH_4OH per litre. Kb for NH4OH = $1.85x10^{-5}$.
26. Derive the relation between K_h, K_w and K_a.
27. Give an account of applications of colloids
28. Explain ultra filtration and electrodialysis techniques used for the purification of colloids
29. Which of the following will show spin- spin coupling in their NMR spectra? If coupling is observed, give the spin multiplicity : (a) $ClCH_2CH_2Cl$ (b) CH_3COCH_3 (c) CH_3CHO (d) $ClCH_2CH_2I$
30. Briefly explain TGA taking suitable example
31. Explain the principle of Fractional Distillation

SECTION – D

(*Answer **any 2** question. Each question carries 15 marks*)

32. (a)Differentiate between Molecularity and order of a reaction with examples

    (b) Discuss the Kinetic, optical and electrical properties of colloids

    (c) Explain the protective action of colloids

33. (a) Discuss the principle and applications of AAS

    (b) Distinguish between AAS and FES

    (c) Explain the applications of TGA and DTA

34. (a) Discuss the factors responsible for deviation from Raoult's law by taking suitable examples.

    (b) Define critical solution temperature. Explain systems having upper and lower CST using examples

    (c) Explain the applications of UV spectroscopy

35. (a) Discuss the advantages of Bronsted-Lowry concept over Arrhenius concept and also the limitations of the Bronsted-Lowry concept.

    (b) The salt of strong acid and strong base does not undergo hydrolysis. Explain.

    (c) Explain the underlying principle in an NMR spectrum and interpret the low resolution NMR spectrum of ethanol molecule.

MAR IVANIOS COLLEGE (AUTONOMOUS)

SYLLABUS OF LAB COURSE IN CHEMISTRY FOR STUDENTS OF ZOOLOGY MAJORS

2022 Admission onwards

SEMESTER	**I, II, III & IV**
COURSE TITLE	**COURSE V : LAB COURSE FOR ZOOLOGY**
COURSE CODE	**AUCH43.2e PI**
CREDIT	**2**
L-T-P	**0-0-2**
TOTAL HOURS	**36**

CO No.	**COURSE OUTCOME** *Upon completion of this course, the students*	**Cognitive Level**
	Obey Lab safety instructions, develop qualities of punctuality, regularity and scientific attitude, out look and scientific temper (GOOD LAB PRACTICES)	R,U,A
	Develop skill in safe handling of chemicals, take precaution against accidents and follow safety measures	U,A
	Develop skill in observation, prediction and interpretation of reactions	U,A
	Prepare organic compounds, Purify and recrystallise	U,A
	Develop skill in weight calculation for preparing standard solutions	E,A

	Perform volumetric titrations under acidimetry-alkalimetry, permanganometry, dichrometry, iodimetry-iodometry,cerimetry, argentometry and complexometry	A
	Conduct chromatographic separation of mixtures	A

SYLLABUS FOR LABORATORY COURSE FOR COMPLEMENTARY CHEMISTRY

(FOR ZOOLOGY MAJORS)

Course Code AUCH43.2e.PI , Credit 2

I. QUALITATIVE ANALYSIS

A. Reactions of organic compound

B. (aromatic – aliphatic,

C. saturated – unsaturated,

D. detection of elements

E. Detection of functional group glucose, alcohols, phenols, halogen compounds, nitro compounds, amino compounds, aldehydes, ketones, carboxylic acids, amides, urea, thiourea and esters.

II. Systematic analysis with a view to identify the Only monofunctional compounds are to be given. A student has to analyse at least twelve organic compounds.

III. ORGANIC PREPARATIONS

1. Acetanilide from aniline
2. Metadinitrobenzene from nitro benzene
3. Benzoic acid from benzyl chloride

IV. VOLUMETRIC ANALYSIS

A. Acidimetry and Alkalimetry

a. Preparation and standardization of 0.05N HCl using sodium carbonate as primary standard

b. Estimation of a strong base and a weak base using standardized HCl

c. Estimation of sodium hydroxide using (i)Std. oxalic acid and (ii) Std. HCl

d. Preparation and standardization of 0.05N NaOH using oxalic acid as primary standard

e. Estimation of a strong acids using standardized NaOH

f. Determination of sodium hydroxide, and sodium hydroxide and sodium carbonate in a mixture (indicator method)

B. Permanganometry

a. Standardization of $KMnO_4$ by oxalic acid/sodium oxalate and Mohr's salt

b. Estimation of oxalic acid/sodium oxalate

c. Estimation of Mohr's salt

d. Estimation of calcium

C. Dichrometry

a. Preparation of Std. $K_2Cr_2O_7$ and estimation of ferrous iron by external and internal indicators.

b. Estimation of ferric iron by reduction with stannous chloride (internal indicator).

D. Iodimetry and Iodometry

a. Standardisation of sodium thiosulphate using std potassium dichromate

b. Estimation of copper in a solution

c. Estimation of iodine

E. Complexometric titrations

a. Standardisation of EDTA using std Mg^{2+} or Zn^{2+} ion solution.

b. Estimation of any one metallic ion from Ca^{2+}, Mg^{2+}, Zn^{2+} or Ni^{2+} A student has to carry out at least twelve experiments in this class.

V. GRAVIMETRIC ANALYSIS

1. Estimation of water of hydration in barium chloride crystals
2. Estimation of barium in barium chloride solution.

VI.CHROMATOGRAPHY

TLC of simple organic compounds- phenol, napthol, nitrobenzene

This laboratory based course reinforces the qualitative and quantitative chemical analysis that the student has learned in semesters I-IV