UNIVERSITY OF KERALA

First Degree Programme in Chemistry

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

CHEMISTRY    COMPLEMENTARY    COURSES

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
Complementary Chemistry offered to Physics Majors

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

**B Sc Chemistry Complementary**

**Complementary Courses - 4 Total Credits – 14**

**One Semester – 18Weeks**

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours\ Week</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
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**GENERAL ASPECTS OF EVALUATION**

**MODE OF EVALUATION - COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSES**

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25 % and End Semester evaluation (ESE) with a weightage of 75 % . A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
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<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
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<td>3.50-4.00</td>
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<tr>
<td>Very Good</td>
<td>B</td>
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<td>2.50-3.49</td>
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<td>Good</td>
<td>C</td>
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<td>Average</td>
<td>D</td>
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<td>0.50-1.49</td>
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<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
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I. 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lecture Courses</th>
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I. 1.1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding
grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.

<table>
<thead>
<tr>
<th>Mode of Assignments / Seminar Evaluation</th>
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<tr>
<td><strong>No</strong></td>
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The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

<table>
<thead>
<tr>
<th>Guidelines for Assignments / Seminar Evaluation</th>
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I. 1.2. **Details of the Class Test**

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word-answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).
7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
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<tbody>
<tr>
<td><strong>Question No</strong></td>
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<tr>
<td>Part A: I. 1-4; II. 4-8</td>
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<tr>
<td>Part B: 9-12</td>
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<td>Part C: 13,14</td>
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<td>Part D: 15,16</td>
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Total = 10

I. 2. **Continuous Evaluation For Laboratory Courses**

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each
set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
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The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

**I. 2. 1. EVALUATION OF THE EXPERIMENT (LAB) REPORT**

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of EXPERIMENT (LAB) Report Evaluation</th>
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</table>
I. 2. 2. Evaluation of the Lab Skill

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
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<tbody>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
<td>All four sub-components :</td>
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<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
<td>A</td>
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<td>3</td>
<td>Prompt and neat recording of observations in lab note book</td>
<td>Only three : B</td>
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<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td>Only two : C</td>
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<td>Only one : D</td>
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<td>None : E</td>
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I. 2. 3. Evaluation of the Lab Quiz/Test

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. End Semester Evaluation for Lecture Courses

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II. 1. 1. End Semester Question Paper Pattern

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word-answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
SYLLABUS OF COMPLEMENTARY COURSE
(For students of Physics Majors)
I B.Sc Complementary CHEMISTRY
PRINCIPLES OF CHEMISTRY I

SEMESTER I Complementary Course N o. – 1 Course Code- CH1131 .1 Credit-2

Total Hour 36  L–T-P2-0-2

Module – I: Atomic Structure

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 9 Hrs


Module III – Thermodynamics

First law of thermodynamics, mathematical form, intrinsic energy, enthalpy, reversible, process and maximum work, work of expansion of an ideal gas in reversible isothermal process. Heat capacity of gases at constant volume and constant pressure, derivation of C_p – C_v = R. Second law of thermodynamics, entropy and free energies,
significance of $\Delta G, \Delta H$ and available work – criteria of equilibrium, and spontaneity, on the basis of entropy and free energy. 9 Hrs

**Module IV** Thermochemistry 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 and application – bond dissociation energies and bond energies of different types of bonds, their calculation and enthalpies of reaction. 9 hrs

**References**

1. Atomic structure and chemical bonding with introduction to Molecular spectroscopy – Manas Chanda.
2. Concise Inorganic Chemistry – J.D. Lee
3. Elements of Nuclear Chemistry – Arnikar

**Model Question. B.Sc complementary Chemistry - offered to physics majors Course Code - CH1131.1 Semester I Course - I Principles of Chemistry I**

**Time : Three Hours**

**Total Weightage : 30**

**Section A. weightage 1 each (answer in one word \ sentence)**

Answer all questions.

I. 1. The angular momentum of the electron according to the Bohr model is an integral multiple of ………
2. A subshell with n=6 and l=3 is designated as …………..
3. For a reversible adiabatic process….is equal to zero
4. At constant temperature if $\Delta H = T\Delta S$, the process is said to be………..

II. 5. A process in which temperature is kept constant is called…………
6. For a spontaneous process the change in Gibbs Free energy is…..
7. The state of hybridization of Boron in BCl3 is………..
8. The N-O bondorder in NO3- ion is………..

III. 9. For elementary substances in their standard state, enthalpy is equal to …………..
10. Thermochemical equations represent……………….changes accompanying chemical reactions.
11. Deexcitation of electron from outer shell to the second shell produces ________ series of lines.
12. Give the relationship between heat of reaction at constant volume and at constant pressure.
IV. 13. The power of an atom to attract the shared pair of electron in covalent bond is called…………..

14. The number of antibonding electrons in nitrogen molecule is…….

15. __________ principle deals with the distribution of electrons in various orbitals based on energy.

16. Write Kirchoff’s equation.  

Section B,  weightage 1 each  (short answer type).

Answer any 8 questions from the following. Each answer must contain 4 points

17. State and explain Pauli’s exclusion principle.

18. Name two types of hydrogen bonding with example.

19. State and explain Fajan’s rule.

20. Define(1) work function (2) Gibb’s free energy function.

21. State and explain Hess’s law.

22. Define standard enthalpy of formation of a compound.

23. Calculate the wavelength of radiation emitted when the electron in the hydrogen atom jumps from n=4 to n=2 level.

24. Define the terms Cp and Cv of an ideal gas. How are they related?

25. Define enthalpy of neutralization.

26. Give Schrodinger wave equation and explain the terms.

27. Explain VSEPR theory with examples of regular and irregular geometry.

28. State the second law of thermodynamics.

Section C,  weightage 2 each  (short essay)

Answer any 5 questions from the following. Each answer must contain 8 points.

29. Distinguish between bond dissociation energy and bond energy.

30. Distinguish between diathermic work and adiabatic work.

31. Derive Kirchoff’s equation. Calculate the heat of formation of ethane from the following data:
   C2H6(g)+31/2O2(g)……>2CO2 (g) +3H2O(l) ΔH=-1560KJ
   C+O2(g)….>.CO2(g) ΔH=-393.5KJ
   H2(g)+1/2O2(g)……>H2O(l)  ΔH=-284.5KJ

32. Explain Hund’s rule of maximum multiplicity.

33. Explain dsp2 and dsp3 hybridisation with examples.

34. Write the postulates of Bohr theory.

35. Explain reversible process and maximum work.

36. Explain electronegativity scales of Pauling and Mulliken.

Section D,  weightage 4 each  (long essay).

Answer any two questions

37. What are the postulates of M.O.T. Compare bonding molecular orbital and antibonding molecular orbital.

38. Write briefly on the four quantum numbers and their significances.

39. Derive an expression for the work done in reversible isothermal expansion of an ideal gas. Calculate the work done when 5 moles of an ideal gas is expanded isothermally and reversibly from a pressure of 10 atm to 2 atm at 270 c.


1×4 = 4

1×8 = 8

2× 5 = 10

4×2 = 8
SYLLABUS OF COMPLEMENTARY COURSE
(For students of Physics majors)
PRINCIPLES OF CHEMISTRY II

SEMESTER II Complementary Course No.- 2 Course Code-CH1231 .1Credit – 2
Total Hours - 36  L-T-P 2-0-2

Module – I: Radio Activity
Radio active equilibrium (qualitative only) 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 the biological effects of radiation such as pathological and genetic damage, Dosimetry – Units – rad, gray and roentgen. Fricke dosimeter and ceric sulphate dosimeter. Nuclear Chemistry – stability of Nucleus – n/p ratio, artificial transmutation and radio activity, mass defect, binding energy, atomic fission and fusion. 9 Hrs

Module II Spectroscopy
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.

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 9 Hrs

**Module III**  Electro Chemistry


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, over voltage and passivity, corrosion of metals – prevention of corrosion, Fuel cells – H₂ – O₂ and hydrocarbon – O₂ type. 9 Hrs

**Module IV**  Analytical Method


Evaluation of analytical data – accuracy and precision, classification of errors. Detection and correction of determinate errors, standard deviation, variance and coefficient of variation. 9 Hrs

**References**

1. Atomic structure and chemical bonding with introduction to Molecular spectroscopy – Manas Chanda.
2. Concise Inorgantic Chemistry – J.D. Lee
3. Elements of Nuclear Chemistry – Arnikar
Section A, weightage 1 each (answer in one word \ sentence)
Answer all questions.

I. 1. The energy needed for separating the nucleons from the nucleus is ………
   2. The reciprocal of decay constant is called ………
   3. Radiation of wavelength 600 nm falls in…………..region.
   4. Shift towards longer wavelength region is termed………………

II. 5. ………..is known as zero point energy.
    6. Which among the molecules O2,H2and Hcl is microwave active.
    7. Elastic collisions cause ……………
    8. Which of the following will show Raman spectrum HCl,CS2,CCl4,Br2.

III. 9. Conductance of unit volume of conductor is called………..
    10. Equivalent conductance…………..with dilution.
    11. Ionic product of water is equal to…………
    12. The standard electrode potential of Zn and Ag are -0.80v and -0.76v respectively. The standard EMF of the cell is ………..

IV. 13. A saltbridge eliminates the …………………
    14. The tendency of an electrode to gain electrons is called its………………
    15. Phenolphthalein is not suitable for titration of strong acid against……
    16. A solution of accurately known concentration is known as a………solution.

Section B, weightage 1 each (short answer type)
Answer any 8 questions from the following. Each answer must contain 4 points

17. What is meant by artificial transmutation ?
18. Define(1) Chromophore (2) Auxochrome (3) hyperchromic effect (4) Hypochromic effect.
19. What are the different types of electronic transitions?
20. What is Raman effect?
21. Explain the rule of mutual exclusion.
22. Define transport number of an ion
23. The equivalent conductance of 0.05N solution of acetic acid is106ohm-1cm2 eq-1. Calculate the degree of dissociation of acetic acid at this concentration, given that the ionic conductance of H +and CH3COO- are 349.5 and 40 ohm-
   1cm2eq-1.
24. What are redox titrations?
25. Calculate the normality of 10 percent solution of NaOH
26. What is electromagnetic spectrum?
27. What is a primary standard?
28. What are the units of radioactivity? Explain.

Section C, weightage 2 each . (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Sketch and explain the low resolution and high resolution spectra of ethanol.
30. How will you determine the transport number by moving boundary method?
31. Write a note on Rotational Raman spectrum.
32. How are errors classified?
33. Write briefly on over voltage.
34. Explain carbon dating.
35. In weak base-strong acid titration methyl orange is used while in strong base-weak acid titration phenolphthalein is used. Why?
36. Explain mass defect and binding energy.

Section D, weightage 4 each (long essay)

Answer any two questions.

37. Briefly explain the working of H2-O2 and hydrocarbon –O2 fuel cell.
38. Write a note on conductometric titrations.
39. Write notes on (1) Neutron activation analysis. (2) Fricke Dosimeter.

SYLLABUS OF COMPLEMENTARY COURSE

(For students of Physics Majors)

PHYSICAL AND INORGANIC CHEMISTRY I

SEMESTER III Course-3 Credit-3 Course Code – CH1331.1

L-T-P 3-0-2 54 Hrs

Module 1: Gaseous State

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 – Law of corresponding states – reduced equation of state, Joule Thomson effect, liquefaction of gases – Linde’s and Claude’s processes

9 Hrs

Module II – Crystalline State


9 Hrs

Module III – Chemical Equilibrium

Reversible reactions – $K_P$, $K_C$, and $K_X$ and their inter relationships – Free energy change and chemical equilibrium – Van’t Hoff reaction, isotherm and isochore - 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) $2SO_2 + O_2 \rightleftharpoons 2 SO_3$
Le Chatelier’s principle and the discussion of the above reactions on its basis. 9 Hrs

**Module IV – Ionic Equilibrium**


**Module V – Metallurgy**

General principles of occurrence and extraction of metals – purification, roasting, calcination and smelting, reduction to metal, different method with examples, refining of metals- electrolytic and zone refining. Van – Arkel method. Metallurgy of titanium, cobalt, nickel, thorium and uranium. 9 Hrs

**Module VI – Chemistry of Nano Materials**

Evolution of Nano science – Historical aspects – preparations containing nano gold in traditional medicine, Lycurgus cup – Faraday’s divided metal etc. Nanosystems 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 Tunneling Microscopy (STM), and Scanning Electron Microscopy (SEM) Transmission Electron Microscopy (TEM). Applications of nano materials in electronics, robotics, computers, sensors, mobile electronic devices, Vehicles Medical applications (use Au, Ag, ZnO and ZnO₂ as examples. 9 hrs

**References**

Section A, weightage 1 each (answer in one word/sentence)
Answer all questions
I. 1. The gas which obeys all gas laws under all conditions of temperature and pressure is ________.
2. Mathematical expression of Joule Thomson Coefficient is ___________
3. ________ is a process for the liquefaction of gases.
4. van der Waals gas equation is __________
II. 5. What is the coordination number of bcc lattice.
6. Name a nanosensor.
7. Name a liquid crystal.
8. What is Bragg’s equation?
III. 9. The relation between kp and kc is ______
10. van’t Hoff reaction isotherm is ________
11. According to ________ concept acids are proton donors.
12. The relation connecting hydrolysis constant and dissociation constant of weak acid is __________
IV. 13. During roasting ore undergoes __________.
14. What is the expansion of SEM?
15. During isothermal process __________ is kept constant.
16. What is AFM. 1×4 = 4

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Define Boyle temperature.
18. State reduced equation of state.
19. What is mesomorphic state?
20. Define Miller indices.
21. What is free energy change?
22. What is an isochoric process?
23. Define pH.
24. Write Henderson equation.
25. Explain zone refining.
26. What is calcination?
27. Explain co-precipitation.
28. What is TEM. 1×8 = 8

Section C, weightage 2 each (short essay)
Answer any five questions from the following. Each answer must contain 8 points.
29. What is law of corresponding state?
30. Define the terms, collision number and collision frequency.
31. What are the applications of liquid crystals?
32. Explain symmetry elements in crystals.
33. Explain the effect of temperature and pressure on the equilibrium \( N_2 + 3H_2 \rightarrow NH_3 \)
34. Derive Henderson equation for the hydrolysis of a salt of weak base and strong acid.
35. Explain the metallurgy of Cobalt.
36. Explain the applications of nano materials in electronics and robotics. \( 2 \times 5 = 10 \)
   Section D, weightage 4 each (long essay)
   Answer any two questions
37. Explain Linde’s and Claude’s processes for the liquefaction of gases.
38. Explain diffraction of X-rays by crystals.
39. Explain the preparation of nano particles in detail. \( 4 \times 2 = 8 \)

SYLLABUS OF COMPLEMENTARY COURSE
(For students of Physics Majors)

Physical and Inorganic Chemistry II

SEMESTER IV Course-4 Credit-3Course Code – CH1431 .1

L-T-P 3-0-2 Total 54hrs

Module – I: Chemical Kinetics

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. 9 Hrs

Module II – Catalysis and Photo Chemistry

General Characteristics of catalytic reactions. Different types of catalysis –
examples – theories of catalysis (Outline of intermediate compound formation theory and
adsorption theory).
Photo Chemistry: Laws of Photo Chemistry, Grothus – Draper law, Beer Lambert’s
law, Einstein’s laws, quantum yield, \( H_2 – Cl_2 \) reaction, \( H_2 – Br_2 \) reaction photo
sensitization, chemiluminescence. 9 Hrs

Module III – Phase Equilibria

Phase rule - Explanation of terms, the relationship \( F = C – P + 2 \), application of
phase rule to one component systems. Phase diagram of water and sulphur. General
discussion of simple eutectic, lead – silver systems, Pattinson’s process. Construction of
phase diagram by cooling curve method, salt – water systems and freezing mixture (KI – water, FeCl₃ -, H₂O only). 9 hrs

Module IV: Binary Liquid systems

Completely miscible liquid pairs vapour pressure composition and temperature – composition curves of ideal and non ideal systems, azeotropes, fractional distillation. Partially miscible systems, critical solution temperature, phenol – water system. Immiscible liquid pairs, steam distillation, determination of molecular mass. Distribution law: Explanation, principle of solvent extraction. 9 hrs

Module V: Coordination Chemistry

Types of ligands, Werner’s coordination theory, 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 ,application in qualitative and quantitative analysis. 9 hrs

Module VI: Colloidal State

Kinetic, optical and electrical properties of colloids – ultra microscope – determination of avogadro number by Brownian movement – Electrical double layer and zeta potential. Gels – inhibition and syneresis. Miscelles, critical miscelle concentration, sedimentation and streaming potentials, Application of colloids Cottrell precipitator – purification of water, coagulation, reverse osmosis, electro dialysis. 9 Hrs

References

MODEL QUESTION  Fourth Semester CH1431 .1 Complementary Chemistry  for
Physics Majors
Course –IV Physical and Inorganic Chemistry  II
Time : Three Hours                                             Total Weightage : 30

Section A, weightage 1 each  (answer in one word \ sentence)
Answer all questions

I  1.  Arrhenius equation is _______________
2.  Half life period of a first order reaction is ____________
3.  Unit of second order rate constant is ________
4.  Name the optical property of colloids.

II. 5.   Name the two types of catalysis.
6.  Give an example of a low spin comlex.
7.  What is the quantum yield of H2- Cl2 reaction  ?
8.  Write an example of chemiluminascence.

III. 9.  Phase rule expression is F= ___________
10. Water is a ______ component system.
11.  An example of a completely miscible liquid pair is __________
12.  Coordination theory was proposed by _________

IV  13.  Write an example of a gel.
14.  What is the common magnetic property of  high spin complexes ?
15.  What type of a system is lead-silver system?
16.   Name one  law of photochemistry.                      1×4 = 4

Section B ,   weightage 1 each   (short answer type)
Answer any eight questions from the following.  Each answer must contain 4 points.
17.  Define a zero order reaction.
18.  What are the factors influencing the rate of the reactions ?
19.  What is intermediate compound formation theory of catalysis.
20.  Explain H2 – Br2 photochemical reaction.
21.  What is Pattinson’s process of desilverisation of lead  ?
22.  Apply phase rule expression to sulphur system.
23.  What are ideal and non ideal solutions ?
24.  What is the principle of solvent extraction ?
25.  What is Werner’s coordination theory ?
26.  What are the drawbacks of Valence Bond Theory ?
27.  What is Brownian movement ?
28.  Define streaming potential  ?                          1×8 = 8

Section C,     weightage 2 each   (short essay)
Answer any five questions from the following. Each answer must contain 8 points.
29.  What is the collision theory of reaction rate  ?
30.  Derive an expression for the first order rate constant  ?
31.  Define quantum yield and photosensitisation  .
32.  Explain adsorption theory of catalysis.
33.  Draw the phase diagram of FeCl3 – water system.
34.  Explain critical solution temperature and fractional distillation.
35.  Demonstrate how crystal field theory is applied to octahedral complexes.
36. What are the application of colloids. \[2 \times 5 = 10\]

Section D, weightage 4 each (long essay)
Answer any two questions

37. (a) What are the general characteristics of catalysts?
(b) Explain the influence of temperature on reaction rates.

38. (a) How will you construct the phase diagram by cooling curve method?
(b) Explain steam distillation.

39. (a) What are MISCELLES?
(b) What are inhibition and syneresis? \[4 \times 2 = 8\]

SYLLABUS FOR LABORATORY COURSES FOR B.Sc COMPLEMENTARY CHEMISTRY

Course V Course Code CH1432 1 Credit 2 For Physics & Geology Majors
Semesters 1, 2, 3 & 4

Reactions and identification of cations: Hg\(^+\), Pb\(^{2+}\), Ag\(^+\), Hg\(^{2+}\), Bi\(^{3+}\), Cd\(^{2+}\), As\(^{3+}\), Sb\(^{3+}\), Sn\(^{2+}\), Sn\(^{4+}\), Fe\(^{3+}\), Al\(^{3+}\), Cr\(^{3+}\), Mn\(^{2+}\), Zn\(^{2+}\), Ni\(^{2+}\), Cd\(^{2+}\), Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), Mg\(^{2+}\), and NH\(_4\)^+

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

Volumetric analysis

A. Acidimetry and Alkalimetry
   a. Preparation and standardization of decinormal HCl using sodium carbonate as primary standard
   b. Estimation of sodium hydroxide using (i) Std. oxalic acid and (ii) Std. Hcl
   c. 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**

e. Preparation of Std. K₂Cr₂O₇ and estimation of ferrous iron by external and internal indicators.

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

**D. Iodometry and Iodimetry**

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

h. Estimation of copper in a solution

i. Estimation of iodine

**E. Complexometric titrations**

j. Standardisation of EDTA using std Mg²⁺ or Zn²⁺ ion solution

k. Estimation of any one metallic ion from Ca²⁺, Mg²⁺, Zn²⁺ or Ni²⁺

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

**Gravimetric Analysis**

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

2. Estimation of barium chloride solution.

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

**COURSE OFFERING AND CREDITS**

Semester IV; credits: Two
COURSE OBJECTIVES

To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

COURSE TRANSACTION FORMAT

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

MODE OF EVALUATION

Continuous Evaluation: The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
<td><strong>Component</strong></td>
<td><strong>Grades</strong></td>
</tr>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥90%</td>
<td>- A</td>
</tr>
<tr>
<td>&lt;90 - ≥85%</td>
<td>- B</td>
</tr>
<tr>
<td>&lt;85 - ≥80%</td>
<td>- C</td>
</tr>
<tr>
<td>&lt;80 - ≥75%</td>
<td>- D</td>
</tr>
<tr>
<td>&lt;75%</td>
<td>- E</td>
</tr>
<tr>
<td>A-E</td>
<td></td>
</tr>
<tr>
<td>A-E</td>
<td></td>
</tr>
</tbody>
</table>

Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations,
calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

### Mode of Experiment (Lab) Report Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctual submission and Neat presentation</td>
<td>All four sub-components:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Inclusion of aim, materials, procedure etc.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Calculations and absence of errors/mistakes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Accuracy of the result</td>
<td></td>
</tr>
</tbody>
</table>

### Mode of Lab Skill Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
<td>All four sub-components:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td></td>
</tr>
</tbody>
</table>

Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.
**End Semester Evaluation:** 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics/geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3- hr duration.

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Components in General</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>4</td>
<td>A-E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>8</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>12</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record</td>
<td>6</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below.

**Semester IV Course Code CH1432 .1 1.Inorganic Qualitative Analysis**

Analysis of a mixture of two cations. For Physics/Geology majors

Examination in 4th semester with 3- hrs duration. Total weightage for ESE is 30 and for CE is 4.
## Sub-Components for End Sem Evaluation of Inorganic Qualitative Analysis

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Weight</th>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
</table>
| 1  | Principle and Procedure | 2      | i. Principle of the experiment stated  
ii. Aim of the experiment stated 
iii. Separation Scheme stated 
iv. Materials & apparatus specified. | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 2  | Experiment Report & Lab Skill | 4      | i. Preliminary experiments done  
ii. Preliminary reports correct  
iii. Satisfactory skill in experimentation  
iv. Neatness of data and result presentation | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 3  | Calculations & Result | 6      | i. 4 correct tests for the two ions  
ii. 3 tests correctly for the ions  
iii. 2 correct tests  
iv. 1 correct test  
v. 0 correct test | A  
B  
C  
D  
E |
| 4  | Lab Course Record Book | 3      | i. Required No: of Experiments done  
ii. Data and experimental details sufficient  
iii. Correctness of results reported  
iv. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |

If necessary this table may be modified by the Board of Examiners
2. Inorganic Quantitative Analysis (Volumetric Analysis)

Estimation of ion or salt in Volumetric Analysis.

To all complementary Courses

| Sub-Components for End Sem Evaluation of Quantitative Volumetric Analysis |
|-----------------------------|-----------------------------|-----------------------------|
| **N o** | **Main Component** | **Weight tag** | **Sub-Components** | **Grades** |
| | | | | |
| 2 | Experiment Report & Lab Skill | 4 | i. Standardization Calculation Correct ii. Estimation Calculation correct iii. Unknown Weight Calculation correct iv. Neatness of data and result presentation | All 4 subcomponents : A Only three : B Only two : C Only one : D None : E |
| 3 | Calculations & Result | 6 | i. $\leq 1\%$ ii. $1-1.4$ iii. $1.4 - 1.8$ iv. $1.8 - 2.2$ v. $> 2.2$ | A B C D E |
| 4 | Lab Course Record Book | 3 | i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A Only three : B Only two : C Only one : D None : E |

If necessary this table may be modified by the Board of Examiners
CE for each half practical course (volumetric, cations, organic)

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>( \geq 90% ) - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(&lt; 90 ) - ( \geq 85% ) - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(&lt; 85 ) - ( \geq 80% ) - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(&lt; 80 ) - ( \geq 75% ) - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(&lt; 75% ) - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME IN CHEMISTRY
UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
**Complementary Chemistry offered to Geology Majors**

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

**Chemistry Complementary**

**Complementary Courses - 4 Total Credits – 14**

**One Semester – 18Weeks**

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours\Week</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
<th>Instructional Hours</th>
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<tr>
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<td>2</td>
<td>2</td>
<td>CH1131 .2</td>
<td>2×18 = 36 2×18 = 36</td>
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<tr>
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<td>2</td>
<td>2</td>
<td>CH1231 .2</td>
<td>2×18 = 36 2×18 = 36</td>
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<tr>
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<td>2</td>
<td>3</td>
<td>CH1331 .2</td>
<td>3×18 = 54 2×18 = 36</td>
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<tr>
<td>4</td>
<td>3</td>
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<td>3</td>
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<td>3×18 =54 2×18 = 36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>CH1432 .2</td>
<td></td>
</tr>
</tbody>
</table>

**GENERAL ASPECTS OF EVALUATION**

**Mode of Evaluation - Common to core, elective, complementary and foundation Courses**

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25 % and End Semester evaluation (ESE) with a weightage of 75 %. A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
<td>4</td>
<td>3.50-4.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>B</td>
<td>3</td>
<td>2.50-3.49</td>
</tr>
<tr>
<td>Good</td>
<td>C</td>
<td>2</td>
<td>1.50-2.49</td>
</tr>
<tr>
<td>Average</td>
<td>D</td>
<td>1</td>
<td>0.50-1.49</td>
</tr>
<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>
I. 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

| Components of CE For Lecture Courses
<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>A &gt;90%</td>
</tr>
<tr>
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<td></td>
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<td>C &lt;85 - &gt;80%</td>
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<td>E &lt;75%</td>
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<td>Assignment / Seminar</td>
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<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Test paper</td>
<td>2</td>
<td>A-E</td>
</tr>
</tbody>
</table>

I. 1. 1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.
### Mode of Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td>2</td>
<td>Content &amp; grasp of the topic</td>
<td>Only three : B</td>
</tr>
<tr>
<td>3</td>
<td>Lucidity / Clarity of presentation</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
</tbody>
</table>

The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

### Guidelines for Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>N</th>
<th>Main Component</th>
<th>Sub-Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>i. Punctual submission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Adequate length/duration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Inclusion of Introduction, Discussion &amp; Summary sections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv. Absence of errors/mistakes</td>
</tr>
<tr>
<td>2</td>
<td>Content &amp; grasp of the topic</td>
<td>i. Coverage of topic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Understanding of topic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Logical organization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv. Originality (No copying from a source or plagiarism)</td>
</tr>
<tr>
<td>3</td>
<td>Lucidity / Clarity</td>
<td>i. Clarity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Effective presentation/delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Neatness of presentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv. Inclusion of appropriate diagrams /equations /structures etc</td>
</tr>
<tr>
<td>4</td>
<td>References / Interaction/Overall effort</td>
<td>i. Listing of references</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii. Use of more than one reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source/Use of Web resource</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii. Correct Response to quiz /questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv. Overall effort in preparing assignment/seminar</td>
</tr>
</tbody>
</table>
I. 1. 2. **DETAILS OF THE CLASS TEST**

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).
7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question No</strong></td>
</tr>
<tr>
<td>Part A: I. 1-4; II. 4-8</td>
</tr>
<tr>
<td>Part B: 9-12</td>
</tr>
<tr>
<td>Part C: 13,14</td>
</tr>
<tr>
<td>Part D: 15,16</td>
</tr>
<tr>
<td>Total = 10</td>
</tr>
</tbody>
</table>

I. 2. **CONTINUOUS EVALUATION FOR LABORATORY COURSES**

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.
### Components of CE For Lab Courses

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>2</td>
<td>≥90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - ≥85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - ≥80% - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>2</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>2</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>4</td>
<td>A-E</td>
</tr>
</tbody>
</table>

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

### I. 2. 1. Evaluation of the Experiment (Lab) Report

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>N o</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctual submission and Neat presentation</td>
<td>All four sub-components:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Inclusion of aim, materials, procedure etc.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Calculations and absence of errors/mistakes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Accuracy of the result</td>
<td></td>
</tr>
</tbody>
</table>
I. 2.2. **Evaluation of the Lab Skill**

<table>
<thead>
<tr>
<th>N o</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
<td>All four sub-components :</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three : B</td>
</tr>
<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td></td>
</tr>
</tbody>
</table>

I. 2.3. **Evaluation of the Lab Quiz/Test**

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. **End Semester Evaluation for Lecture Courses**

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II. 1.1. **End Semester Question Paper Pattern**

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word-answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight $= 1$ (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight $= 2$. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight $= 4$. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
SYLLABUS OF COMPLEMENTARY COURSE
(For students of Geology Majors)

PRINCIPLES OF CHEMISTRY I

SEMESTER I Complementary Course No. – 1 Course Code- CH1131 .2 Credit-2

TotalHours36L–T-P2-0-2

Module – 1: Atomic Structure

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 9 Hrs

Module II - Chemical bonding – Energetic of bond formation – Types of Chemical bonds – Energetics of ionic bond formation – Lattice energy – Born Haber Cycle – partial covalent nature of ionic bond – Fajan’s rules, polarity of covalent bond its relation with electronegativity – electro negativity scales – Paulings and Mullikan’s approaches, factors influencing polarity, dipole moment – its relation to geometry. Hydrogen bond – inter and intra molecular – its consequences on boiling point –vapourility and solubility. Hybridisation and structure of molecules – SP, SP\(^2\), SP\(^3\), dSP\(^2\), dSP\(^3\), SP\(^3\)d\(^2\), and SP\(^3\)d\(^3\) hybridisation with examples. Explanation of bond angle in water and ammonia VSEPR theory, geometry of molecules with bond pairs of electrons only, geometry of molecules containing bond pairs and lone pairs of electrons, limitations. A brief review of molecular orbital approach, LCAO method – bond order, bond distance and stability of O\(_2\),O\(_2^+\),O\(_2^-\);NO,NO+,COandHF. 9hrs

Module III – Thermodynamics

First law of thermodynamics, mathematical form, intrinsic energy, enthalpy, reversible, process and maximum work, work of expansion of an ideal gas in reversible isothermal process. Heat capacity of gases at constant volume and constant pressure, derivation of C\(_p\) – C\(_v\) = R. Second law of thermodynamics, entropy and free energies, significance of \(\Delta G, \Delta H\) and available work – criteria of equilibrium, and spontaneity, on the basis of entropy and free energy. 9 Hrs
Module IV Thermochemistry  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 and application – bond dissociation energies and bond energies of different types of bonds, their calculation and enthalpies of reaction. 9 hrs

References
1. Atomic structure and chemical bonding with introduction to Molecular spectroscopy – Manas Chanda.
2. Concise Inorganic Chemistry – J.D. Lee
3. Elements of Nuclear Chemistry – Arnikar

Model Question. complementary Chemistry - offered to Geology majors Course Code - CH1131 2 Semester I Course – I Principles of Chemistry I

Time : Three Hours Total Weightage : 30

Section A, weightage 1 each (answer in one word/sentence)

Answer all questions.

I. 1. The angular momentum of the electron according to the Bohr model is an integral multiple of ………
2. A subshell with n=6 and l=3 is designated as …………..
3. For a reversible adiabatic process…is equal to zero
4. At constant temperature if ΔH=TΔS, the process is said to be………..

II. 5. A process in which temperature is kept constant is called………..
6. For a spontaneous process the change in Gibbs Free energy is…..
7. The state of hybridization of Boron in BCl3 is………..
8. The N-O bond order in NO3- ion is………..

III. 9. For elementary substances in their standard state, enthalpy is equal to…………..
10. Thermochemical equations represent…………..changes accompanying chemical reactions.
11. Deexcitation of electron from outer shell to the second shell produces _______ series of lines.
12. Give the relationship between heat of reaction at constant volume and at constant pressure.

IV. 13. The power of an atom to attract the shared pair of electron in covalent bond is called………..
14. The number of antibonding electrons in nitrogen molecule is………..
15. __________ principle deals with the distribution of electrons in various orbitals based on energy.

16. Write Kirchoff’s equation. \[ 1 \times 4 = 4 \]

Section B, weightage 1 each (short answer type).

Answer any eight questions from the following. Each answer must contain 4 points.

17. State and explain Pauli’s exclusion principle.
18. Name two types of hydrogen bonding with example.
19. State and explain Fajan’s rule.
20. Define (1) work function (2) Gibb’s free energy function.
21. State and explain Hess’s law.
22. Define standard enthalpy of formation of a compound.
23. Calculate the wavelength of radiation emitted when the electron in the hydrogen atom jumps from \( n=4 \) to \( n=2 \) level.
24. Define the terms \( C_p \) and \( C_v \) of an ideal gas. How are they related?
25. Define enthalpy of neutralization.
26. Give Schrodinger wave equation and explain the terms.
27. Explain VSEPR theory with examples of regular and irregular geometry.
28. State the second law of thermodynamics. \[ 1 \times 8 = 8 \]

Section C, weightage 2 each (short essay).

Answer any 5 questions from the following. Each answer must contain 8 points.

29. Distinguish between bond dissociation energy and bond energy.
30. Distinguish between diathermic work and adiabatic work.
31. Derive Kirchoff’s equation. Calculate the heat of formation of ethane from the following data:
   - \( \text{C}_2\text{H}_6(g) + \frac{3}{2}\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(l) \) \( \Delta H = -1560 \text{KJ} \)
   - \( \text{C} + \frac{1}{2}\text{O}_2(g) \rightarrow \text{CO}_2(g) \) \( \Delta H = -393.5 \text{KJ} \)
   - \( \text{H}_2(g) + \frac{1}{2}\text{O}_2(g) \rightarrow \text{H}_2\text{O}(l) \) \( \Delta H = -284.5 \text{KJ} \)
32. Explain Hund’s rule of maximum multiplicity.
33. Explain dsp2 and dsp3 hybridisation with examples.
34. Write the postulates of Bohr theory.
35. Explain reversible process and maximum work.
36. Explain electronegativity scales of Pauling and Mulliken. \[ 2 \times 5 = 10 \]

Section D, weightage 4 each (long essay).

Answer any two from the following.

37. What are the postulates of M.O.T. Compare bonding molecular orbital and antibonding molecular orbital.
38. Write briefly on the four quantum numbers and their significances.
39. Derive an expression for the work done in reversible isothermal expansion of an ideal gas. Calculate the work done when 5 moles of an ideal gas is expanded isothermally and reversibly from a pressure of 10 atm to 2 atm at 270 c. \[ 4 \times 2 = 8 \]
SYLLABUS OF COMPLEMENTARY COURSE
(For students of Geology Majors)

PRINCIPLES OF CHEMISTRY II

SEMESTER II Complementary Course No.- 2 Course Code-CH1231 .2Credit – 2

Total Hours - 36 L-T-P 2-0-2

Module – I: Radio Activity

Radio active equilibrium (qualitative only) 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 the biological effects of radiation such as pathological and genetic damage, Dosimetry – Units – rad, gray and roentgen. Fricke dosimeter and ceric sulphate dosimeter. Nuclear Chemistry – stability of Nucleus – n/p ratio, artificial transmutation and radio activity, mass defect, binding energy, atomic fission and fusion.

9 Hrs

Module II Spectroscopy

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.

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** Electro Chemistry


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, over voltage and passivity, corrosion of metals – prevention of corrosion, Fuel cells – H₂ – O₂ and hydrocarbon – O₂ type.

**Module IV** Analytical Method


Evaluation of analytical data – accuracy and precision, classification of errors. Detection and correction of determinate errors, standard deviation, variance and coefficient of variation.

**References**

1. Atomic structure and chemical bonding with introduction to Molecular spectroscopy – Manas Chanda.
2. Concise Inorganic Chemistry – J.D. Lee
3. Elements of Nuclear Chemistry – Arnikar
Model Question complementary Course - II for Geology majors
Semester II Course CodeCH1231 .2
Principles of Chemistry II

Time : Three Hours                                             Total Weightage : 30
Section A, weightage 1 (answer in one word / sentence)
Answer all questions.

I. 1. The energy needed for separating the nucleons from the nucleus is ………
2. The reciprocal of decay constant is called ………
3. Radiation of wavelength 600 nm falls in………….region.
4. Shift towards longer wavelength region is termed…………

II. 5. ………..is known as zero point energy.
6. Which among the molecules O2,H2and Hcl is microwave active.
7. Elastic collisions cause …………..
8. Which of the following will show Raman spectrum HCl,CS2,CCl4,Br2.

III. 9. Conductance of unit volume of conductor is called………..
10. Equivalent conductance………….with dilution.
11. Ionic product of water is equal to…………
12. The standard electrode potential of Zn and Ag are -0.80v and -0.76v respectively. The standard EMF of the cell is ………..

IV. 13. A saltbridge eliminates the ……………….
14. The tendency of an electrode to gain electrons is called its…………..
15. Phenolphthalein is not suitable for titration of strong acid against……
16. A solution of accurately known concentration is known as a………solution.

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. What is meant by artificial transmutation ?
18. Define(1)Chromophore (2)Auxochrome (3)hyperchromic effect (4)Hypochromic effect.
19. What are the different types of electronic transitions?
20. What is Raman effect?
21. Explain the rule of mutual exclusion.
22. Define transport number of an ion
23. The equivalent conductance of 0.05N solution of acetic acid is106ohm-1cm2 eq-1.Calculate the degree of dissociation of acetic acid at this concentration,given that the ionic conductance of H +and CH3COO- are 349.5 and 40 ohm-1cm2eq-1.
24. What are redox titrations?
25. Calculate the normality of 10 percent solution of NaOH
26. What is electromagnetic spectrum?
27. What is a primary standard?
28. What are the units of radioactivity? Explain.

Section C, weightage 2 each. (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.

29. Sketch and explain the low resolution and high resolution spectra of ethanol
30. How will you determine the transport number by moving boundary method?
31. Write a note on Rotational Raman spectrum.
32. How are errors classified?
33. Write briefly on over voltage.
34. Explain carbon dating.
35. In weak base-strong acid titration methyl orange is used while in strong base-weak acid titration phenolphthalein is used. Why?
36. Explain mass defect and binding energy. \(2 \times 5 = 10\)

**Section D, weightage 4 each (Long essay)**

Answer any two questions

37. Briefly explain the working of H2-O2 and hydrocarbon –O2 fuel cell.
38. Write a note on conductometric titrations.
39. Write notes on (1) Neutron activation analysis.(2)Fricke Dosimeter. \(4 \times 2 = 8\)

**Complementary Chemistry**

(For Geology Majors)

**Physical, Analytical and Inorganic Chemistry**

**Semester III Course-3 Credit-3 Course Code – CH1331.2**

L-T-P 3-0-2 Total 54 hrs

**Module I** – Gascous State

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 Vander Waal’s constants and critical constants, law of corresponding states – reduced equation of state, Joule Thomson coefficient, liquefaction of gases –Linde’s and Claudes process. 9 Hrs

**Module II** – Crystalline State

Isotropy and anisotropy – symmetry elements in crystals – the seven crystal systems – Miller indices, Bravais lattices, primitive, bcc and fcc lattices of cubic crystals – Bragg equation - diffraction of X rays by crystals – single crystal and powder method. Detailed study of structure of NaCl and KCl crystals. Liquid crystals – mesomorphic state, types of liquid crystals, application and examples. 9 hrs

**Module III** – Chemical Cycles and Group Properties

Carbon, Sulphur, Nitrogen, phosphorous and hydrologic cycle.

Group properties (reactions) of anions in common minerals – Carbonate, Sulphate, Phosphate, Sulphides and fluorides.

Classification of oxides – Acidic, Basic, Amphoteric and neutral 9 hrs
Module IV  Coordination Chemistry
Types of ligands, Werner’s co-ordination theory, 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. 9hrs

Module V  Inorganic Polymers
General properties of inorganic polymer, phosphazenes – preparation of linear and cyclo phosphazene with examples, properties, and application, silicones – General methods of preparation and properties examples. Application of Silicones, Silicone rubber, silicone resins. 9 Hrs

Module VI – Soil and Water Chemistry
Soil – Composition, mineral matter in soil process of soil formation, weathering – physical (mention), chemical (detail) + biological (mention)
Saline and alkaline soil (brief explanation) Rocks – different types (Igneous, sedimentary and Metamorphic.) Analysis of lime stone qualitative treatment only.
Water Analysis Water quality parameters COD, BOD, main quality characteristics of water (alkalinity, hardness, total solids and oxidation)
Water treatment including chemical (Precipitation, aeration, osonisation, chlorination) and physical methods of sterilization. 9 hrs

References
1) Physical Chemistry-Rakshit
2) Principles of Physical Chemistry- Puri, Sharma, Pathania
3) Instrumental methods of Chemical Analysis- B.K. Sharma
4) Vogel’s Text book of Quantitative Chemical Analysis –VI Edition
5) Atomic structure with introduction to Molecular Spectroscopy – Manas Chanda
6) Physical Chemistry- N.M. Kapoor
7) Soil and Noise pollution- B.K. Sharma
Section A, weightage – 1 each (answer in one word / sentence)
Answer all questions.

I 1. The average distance travelled by the gas molecules between two successive collisions is called -----.
2. Theoretical pressure correction for n moles of an ideal gas is _____.
3. Theoretical temperature above which a gas can not be liquified by the application of Pressure is __________.
4. __________ is an example of a high spin complex of manganese.

II 5. The geometry of the crystal if the radius ratio is in the range 0.414-0.732
6. The coordination number in CsCl is-------
7. Total number of Bravais lattice in crystal systems is __________.
8. Number of atoms per unit cell of a FCC crystal is -----.

III 9. The pH of saline soil is -----
10. Gypsum is ------
11. ------ is more scientific than biological oxygen demand
12. The general formula of silica is __________.

IV 13. Al₂O₃ is --------- in nature
14. The major source of nitrogen
15. Atmospheric nitrogen is converted into ----- by nitrogen fixing bacteria
16. Stalagmite is deposits of ------- 1×4 = 4

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Distinguish between most probable velocity and average velocity.
18. State law of corresponding states
19. Differentiate between isotropy and anisotropy.
20. Find the Miller indices of a crystal plane with intercepts 2a,2b and 3c.
21. Explain COD and BOD.
22. How will you analyse limestone qualitatively?
23. Distinguish between primary and secondary valencies in Werner’s coordination theory.
24. Explain the hybridization and geometry of [Co(NH₃)₆]Cl₃
25. Give the structure of (NPCl₃)₃
27. What is Bragg’s equation?
28. What is Joule-Thomson coefficient?  1×8 = 8

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. What are the causes for the deviation of real gases from ideality? How is it solved?
30. Explain symmetry elements in crystals..
31. Give an account of weathering with emphasis to chemical weathering.
32. How would you explain the splitting of d orbitals in an octahedral field? Explain with diagrams.
33. Give any one method for the preparation of silicones. What are the important applications of silicones?
34. Give an account of carbon cycle.
35. Explain Crystal field theory of octahedral complexes.
36. Explain Linde’s process of liquefaction of gases. $2 \times 5 = 10$

Section D, weightage 4 each (Long essay)
Answer any two questions.
37. Explain liquid crystals with examples for each type.
38. Explain high spin and low spin complexes with examples.
39. Give an account of the preparation, properties and important applications of inorganic polymers. $4 \times 2 = 8$

Semester IV – Geology Majors

Physical and Analytical Chemistry -II

Course-4 Credit -3 Course Code – CH1431 .2
L-T-P 3-0-2 Total 54 Hrs

Module I Metallurgy

Metallurgy of Titanium, Iron, cobalt, Nickel, Thorium, Uranium. Extraction of lanthanides. 9 Hrs

Module II- Petro Chemicals

Introduction to crude oil, exploratory methods, constitution of crude oil, natural gas - constituents. Distillation of crude oil, separation of natural gas and different fractions. Meaning of terms such as ignition point, flash point, octane number. Types of hydrocarbon fuels and their characteristics. Cracking – catalytic cracking, hydro cracking, isomerisation, reforming, sulphur, hydrogen, petroleum, coke and nitrogen compounds from petroleum. 9 Hrs

Module III Chemical Kinetics

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 Arrhenices parameters – Collision theory of rates. 9 hrs
Module IV: Catalysis and Photo Chemistry
Theories of catalysis, outline of intermediate compound formation theory and adsorption theory.

Photo Chemistry: Laws of photo Chemistry. Grothus Draper Law, Einstein’s law, Beer lambert law, Photo Chemical equivalence and quantum yield, explanation for high and low quantum yields, H₂-Cl₂ reaction, H₂-Br₂ reaction, Photosensitisation and Chemiluminescence. 9hrs

Module V: Chemical Equilibrium
Reversible reactions, KP, Kc and Kx and their interrelationship – Free energy change and equilibrium, Van’t Hoff reaction isotherm and isochore. Influence of pressure and temperature on the following reactions
1) N₂+3H₂ ⇌ 2NH₃  2) P Cl₅ ⇌ P Cl₃·Cl₂  3) 2SO₂+O₂ ⇌ 2SO₃  Le-chatelier’s principle and the discussion of the above reactions on its basis. 9 hrs

Module VI: Instrumental methods of analysis
Spectral methods – Atomic Absorption Spectroscopy (AAS) principle, measurement, advantages, disadvantages, and applications. Flame Emission Spectroscopy (FES) principle, measurement, (single beam method) applications.
Thermal methods: Themogravimetric analysis (TG) principle and method, Factors affecting thermogravimetric analysis, Application, Differential Thermal Analysis (DTA) –principle, method, factors affecting DTA Applications. 9 hrs

References
1. Physical Chemistry-Rakshit
2. Principles of Physical Chemistry- Puri, Sharma, Pathania
3. Instrumental methods of Chemical Analysis- B.K. Sharma
5. Atomic structure with introduction to Molecular Spectroscopy – Manas Chanda
6. Physical Chemistry- N.M. Kapoor
7. Soil and Noise pollution- B.K. Sharma
Model Question Paper Chemistry (complementary) for Geology major
Semester IV/Course Code CH1431.2 Course-IV
Physical and Analytical Chemistry II

Time: Three Hours Total Weightage: 30

Section A, weightage 1 each (answer in one word \ sentence)
Answer all questions.

I 1. The rate law for a reaction is \( r = k[A][B]^2 \). The order of the reaction with respect to B is -------

2. Ore of thorium found in beach sands of Kerala is -------

3. Acid hydrolysis of ester is -------order reaction

4. In a multistep reaction the -------step is the rate determining step

II 5. Give an example of a negative catalyst with the chemical reaction which it catalyses

6. ________ is an example of a hydrocarbon fuel.

7. __________ is the expression for Beer-Lambert’s law

8. Catalyst used in the oxidation of SO\(_2\) to SO\(_3\) is ________

III 9. \( K_p \) is related to \( K_c \) by the reaction ________.

10. Give the relationship between free energy change and equilibrium constant

11. ________ is an ore of iron.

12. Theoretical catalyst in the Haber process for the manufacture of ammonia is ________.

IV 13. In thermogravimetric analysis ______ of a sample is recorded against time or temperature

14. The most widely used flame in atomic absorption spectroscopy is ________.

15. Heat evolved or absorbed versus temperature is studied in-------

16. In atomic absorption spectroscopy ________-law is obeyed over a wide range of Concentration.

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points

17. What is the influence of temperature on reaction rate?

18. A substance decomposes following first order kinetics. The half life period of the reaction is 35 minutes. What is its rate constant?

19. State Einstein’s law of photochemical equivalence

20. Define quantum yield of a photochemical reaction.

21. Explain van’t Hoff reaction isotherm

22. What is the influence of pressure and temperature in the following reaction
\( 2\text{SO}_2 + \text{O}_2 \leftrightarrow 2\text{SO}_3 \)

23. Write the principle of AAS.

24. How do you differentiate a TG curve from a DTA curve?

25. What is smelting.

26. Distinguish between order and molecularity?

27. What is Grotthus-Draper law?

28. Explain chemiluminescence.

\( 1\times8 = 8 \)
Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.

29. Give the Arrhenius equation. How will you determine the Arrhenius parameters?
30. Explain photosensitization reaction with an example
31. State and explain Le Chatelier principle with an example
32. What is the principle of flame emission spectroscopy? Mention its important applications.
33. What are the general methods for refining of metals
34. Give an account of different types of hydrocarbon fuels and their characteristics.
35. Distinguish between isotherm and isochore.
36. Explain quantum yield in terms of H₂-Cl₂ reaction.  

Section D, weightage 4 each (long essay)
Answer any two questions.

37. a. Derive the expression for the rate constant of a first order reaction.
   b. How will you express the units of rate constant for reactions of order 1, 2 and 3?
38. Discuss the factors affecting TG curve.
39. Give a note on the applications of TG and DTA

SYLLABUS FOR LABORATORY COURSES FOR COMPLEMENTARY
CHEMISTRY Course Code CH1432 .2 Credit 2 For Physics & Geology Majors

Semesters 1, 2, 3 & 4

Reactions and identification of cations: Hg⁺, Pb²⁺, Ag⁺, Hg²⁺, Bi³⁺, Cd²⁺, As³⁺, Sb³⁺, Sn²⁺, Sn⁴⁺, Fe³⁺, Al³⁺, Cr³⁺, Mn²⁺, Zn²⁺, Ni²⁺, Cd²⁺, Ba²⁺, Sr²⁺, Ca²⁺, Mg²⁺ and NH₄⁺

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

Volumetric analysis

C. Acidimetry and Alkalimetry

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

   b. Estimation of sodium hydroxide using (i) Std. oxalic acid and (ii) Std. Hcl
c. Determination of sodium hydroxide, and sodium hydroxide and sodium carbonate in a mixture (indicator method)

D. Permanganometry

a. Standardisation of KMnO₄ 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

e. Preparation of Std. K₂Cr₂O₇ and estimation of ferrous iron by external and internal indicators.

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

D. Iodometry and Iodimetry

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

h. Estimation of copper in a solution

i. Estimation of iodine

E. Complexometric titrations

j. Standardisation of EDTA using std Mg²⁺ or Zn²⁺ ion solution

k. Estimation of any one metallic ion from Ca²⁺, Mg²⁺, Zn²⁺ or Ni²⁺

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

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

2. Estimation of barium chloride solution.

**COURSE OFFERING AND CREDITS**

Semester IV; credits: Two

**COURSE OBJECTIVES**

To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

**COURSE TRANSACTION FORMAT**

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

**MODE OF EVALUATION**

Continuous Evaluation: The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes/tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz/Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Component</td>
<td>≥90%</td>
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<tr>
<td></td>
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<td>&lt;90 - ≥85%</td>
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<td>&lt;85 - ≥80%</td>
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<td></td>
<td>&lt;80 - ≥75%</td>
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<tr>
<td></td>
<td></td>
<td>&lt;75%</td>
</tr>
</tbody>
</table>

- Attendance: 1
- Experiment (Lab) Report: 1
- Laboratory Skill: 1
- Quiz / Test: 1

Total Weightage: 4
Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of Experiment (Lab) Report Evaluation</th>
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<tbody>
<tr>
<td><strong>N o</strong></td>
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<td>4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of Lab Skill Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N o</strong></td>
</tr>
<tr>
<td>1</td>
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<td>4</td>
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</tbody>
</table>

Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted.
for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

*End Semester Evaluation*: 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics\geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3- hr duration.

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>Main Components of ESE For Lab Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
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<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
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<tr>
<td>3</td>
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<tr>
<td>4</td>
</tr>
</tbody>
</table>

*If necessary this table may be modified by the Board of Examiners*

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below.

**Semester IV Course Code CH1432 .2**  
1.**Inorganic Qualitative Analysis**

Analysis of a mixture of two cations. Physics\Geology majors  
Examination in 4th semester with 3- hrs duration. Total weightage for ESE is 30 and for CE is 4.
## Sub-Components for End Sem Evaluation of Inorganic Qualitative Analysis

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Weightage</th>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
</table>
| 1  | Principle and Procedure | 2 | i. Principle of the experiment stated  
ii. Aim of the experiment stated  
iii. Separation Scheme stated  
iv. Materials & apparatus specified. | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 2  | Experiment Report & Lab Skill | 4 | i. Preliminary experiments done  
ii. Preliminary reports correct  
iii. Satisfactory skill in experimentation  
v. Neatness of data and result presentation | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 3  | Calculations & Result | 6 | i. 4 correct tests for the two ions  
ii. 3 tests correctly for the ions  
iii. 2 correct tests  
v. 1 correct test  
v. 0 correct test | A  
B  
C  
D  
E |
| 4  | Lab Course Record Book | 3 | i. Required No: of Experiments done  
ii. Data and experimental details sufficient  
iii. Correctness of results reported  
v. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |

If necessary this table may be modified by the Board of Examiners
2. Inorganic Quantitative Analysis (Volumetric Analysis)

Estimation of ion or salt in Volumetric Analysis.

To all complementary Courses

<table>
<thead>
<tr>
<th>No.</th>
<th>Main Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record Book</td>
<td>3</td>
</tr>
</tbody>
</table>

**Sub-Components for End Sem Evaluation of Quantitative Volumetric Analysis**

<table>
<thead>
<tr>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Principle of the experiment stated &amp; correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td>ii. Aim of the experiment stated &amp; correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td>iii. Procedure stated &amp; correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td>iv. Materials &amp; apparatus specified</td>
<td>Only one : D</td>
</tr>
<tr>
<td>All 4 subcomponents</td>
<td>None : E</td>
</tr>
<tr>
<td>i. Standardization Calculation correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td>ii. Estimation Calculation correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td>iii. Unknown Weight Calculation correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td>iv. Neatness of data and result presentation</td>
<td>Only one : D</td>
</tr>
<tr>
<td>All 4 subcomponents</td>
<td>None : E</td>
</tr>
<tr>
<td>i. (&lt;1%)</td>
<td>A</td>
</tr>
<tr>
<td>ii. (1 - 1.4)</td>
<td>B</td>
</tr>
<tr>
<td>iii. (1.4 - 1.8)</td>
<td>C</td>
</tr>
<tr>
<td>iv. (1.8 - 2.2)</td>
<td>D</td>
</tr>
<tr>
<td>v. (&gt;2.2)</td>
<td>E</td>
</tr>
<tr>
<td>All 4 subcomponents</td>
<td>Only three : B</td>
</tr>
<tr>
<td>Only three</td>
<td>Only two : C</td>
</tr>
<tr>
<td>Only one</td>
<td>None : E</td>
</tr>
<tr>
<td>i. Required No: of Experiments done</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td>ii. Data and experimental details sufficient</td>
<td>Only three : B</td>
</tr>
<tr>
<td>iii. Correctness of results reported</td>
<td>Only two : C</td>
</tr>
<tr>
<td>iv. Neatness of presentation and absence of errors/mistakes in the Record Book</td>
<td>Only one : D</td>
</tr>
<tr>
<td>All 4 subcomponents</td>
<td>None : E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners.
CE for each half practical course (volumetric, cations, organic)

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>≥90% - A</td>
</tr>
<tr>
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<td></td>
<td>&lt;90 - ≥85% - B</td>
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<td></td>
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<td>&lt;85 - ≥80% - C</td>
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<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners.
UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME
UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
Complementary Chemistry offered to Botany Majors

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

**Chemistry Complementary**

**Complementary Courses - 4 Total Credits – 14**

**One Semester – 18 Weeks**

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours/Week</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
<th>Instructional Hours</th>
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<td>2</td>
<td>CH1131.3</td>
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<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1231.3</td>
<td>2×18 = 36</td>
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<td></td>
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<td>2×18 = 36</td>
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<td>2×18 = 36</td>
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<td>4</td>
<td>CH1432.3</td>
<td>2×18 = 36</td>
</tr>
</tbody>
</table>

**GENERAL ASPECTS OF EVALUATION**

**MODE OF EVALUATION - COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSE**

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25% and End Semester evaluation (ESE) with a weightage of 75%. A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
<td>4</td>
<td>3.50-4.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>B</td>
<td>3</td>
<td>2.50-3.49</td>
</tr>
<tr>
<td>Good</td>
<td>C</td>
<td>2</td>
<td>1.50-2.49</td>
</tr>
<tr>
<td>Average</td>
<td>D</td>
<td>1</td>
<td>0.50-1.49</td>
</tr>
<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>
I. 1. **Continuous Evaluation for Lecture Courses**

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lecture Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td>1</td>
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<td>3</td>
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</tbody>
</table>

I. 1.1. **Evaluation of the Assignments and Seminar**

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding
grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td>2</td>
<td>Content &amp; grasp of the topic</td>
<td>Only three : B</td>
</tr>
<tr>
<td>3</td>
<td>Lucidity / Clarity of presentation</td>
<td>Only two : C</td>
</tr>
<tr>
<td>4</td>
<td>References / Interaction/Overall effort</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
</tbody>
</table>

The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

<table>
<thead>
<tr>
<th>N</th>
<th>Main Component</th>
<th>Sub-Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>i. Punctual submission</td>
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<td>iii. Inclusion of Introduction, Discussion &amp; Summary sections</td>
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<td>iv. Absence of errors/mistakes</td>
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<td>Content &amp; grasp of the topic</td>
<td>i. Coverage of topic</td>
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<td>ii. Understanding of topic</td>
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<td>iii. Logical organization</td>
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<td>iv. Originality (No copying from a source or plagiarism)</td>
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<td>Lucidity / Clarity</td>
<td>i. Clarity</td>
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<td>iii. Neatness of presentation</td>
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<td>iv. Inclusion of appropriate diagrams /equations /structures etc</td>
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<td>4</td>
<td>References / Interaction/Overall effort</td>
<td>i. Listing of references</td>
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<td>iii. Correct Response to quiz /questions</td>
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<td>iv. Overall effort in preparing assignment/seminar</td>
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</table>
I. 1. 2. **DETAILS OF THE CLASS TEST**

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1(Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).
7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
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<tbody>
<tr>
<td><strong>Question No</strong></td>
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<tr>
<td>Part A: I. 1-4; II. 4-8</td>
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<td>Part B: 9-12</td>
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<td>Part C: 13,14</td>
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<td>Part D: 15,16</td>
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<td><strong>Total = 10</strong></td>
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I. 2. **CONTINUOUS EVALUATION FOR LABORATORY COURSES**

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each
set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
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<td><strong>No</strong></td>
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The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

1. 2. 1. EVALUATION OF THE EXPERIMENT (LAB) REPORT

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of EXPERIMENT (LAB) Report Evaluation</th>
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<tbody>
<tr>
<td><strong>No</strong></td>
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</table>
I. 2. 2. **Evaluation of the Lab Skill**

<table>
<thead>
<tr>
<th>Mode of Lab Skill Evaluation</th>
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<tr>
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</table>

I. 2. 3. **Evaluation of the Lab Quiz/Test**

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. **End Semester Evaluation for Lecture Courses**

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II. 1. 1. **End Semester Question Paper Pattern**

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices,
match the following, name the following or fill in the blanks or any one word- answer question (Objective type).

4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
SYLLABUS OF COMPLEMENTARY COURSE
Theoretical Chemistry (For Students of Botany Majors)

SEMESTER 1 Complementary Course No. - 1 Course Code-CH1131 .3 Credit-2
L-T-P  2-0-2    36 Hours

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 (mention only, no derivation), concept of
orbitals, the four quantum numbers and their significances. Orbitalwise electron
configuration, energy sequence rule – Pauli’s principle, Hund’s rule, Stability of filled
and half filled orbitals. Electronic configuration of lanthanides and actinides, Lanthanide
contraction

Module II – Chemical Bonding (9 hrs)
Energetics of bond formation – Born-Haber cycle. Hybridisation and structure of
molecules – sp, sp², sp³, dsp², dsp³, sp³d² and sp³d³ 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 –
order, bond distance and stability of O₂, O₂²⁺, O₂²⁻, NO, NO⁺, CO and HF.

Module III – Analytical Principles (9 hrs)
Principles of volumetric analysis – primary standard – standard solutions normality and
molarity, theory of acid-base titrations, permagnometric and dichrometric titrations,
iodometry and complexometric titrations. Theory of acid-base indicator – redox
indicators. Principles of colorimetric titration.

Module IV – 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.

Reference:
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. Co-ordination Chemistry – Bosolo and Johns
MODEL QUESTION PAPER - CHEMISTRY (Complementary) offered to Botany majors Course Code – CH1131 .3 Semester I Course- I
Theoretical Chemistry

Time : Three Hours                                             Total Weightage : 30

Section A, weightage 1 each  (answer in one word \ sentence)
Answer all questions.
I. 1. Give the relation between energy and frequency.
2. Write the valence shell configuration of Cu (atomic number 29).
3. The Bohr wave number equation is …………………..
4. Sketch the shape of p₃ orbital.
II. 5. What is the hybridization of nitrogen in ammonia?
6. Dipole moment = ……………….. x distance
7. Write a molecule possessing intra molecular hydrogen bonding.
8. Give the expression for calculating bond order of a molecule.
III. 9. Normality of 10 % solution of NaOH is ………….
10. Indicator suitable for the titration of H₂C₂O₄ against NaOH is ……………
11. Give an example for a redox indicator.
12. The equivalent weight of KMnO₄ is ……………….
IV. 13. Give an example for sigma bonded organometallic compound.
14. Alkyl magnesium halides are generally known as ……………….
15. Give the formula of Zeise’s salt.
16. Give an example for an organomercury compound used as antiseptic.

1×4 = 4

Section B, weightage 1 each  (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Mention the type of hybridization in the following compounds.
   a. BF₃    b. CH₄    c. PCl₅    d. SF₆
18. Explain the factors influencing polarity of covalent bond.
19. Explain the different series in the atomic spectrum of hydrogen.
20. State and explain Pauli’s exclusion principle.
21. What are redox titrations? Give two examples.
22. How will you prepare 100 ml 0.05 M Mohr’s salt solution?
23. What is Ferrocene? How is it synthesized?
24. What are Grignard Reagents? Mention any two uses.
25. What is Cis Platin? Give its structure.
26. Explain Hund’s rule of maximum multiplicity.
27. Explain Fajan’s rule.
28. What is a primary standard?

1×8 = 8

Section C, weightage 2 each  (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Write a note on the four quantum numbers.
30. What is meant by dipole moment? How it is helpful in explaining the structure of molecule.
31. Explain the theory of acid-base indicators.
32. Explain the bond angles in NH₃ & H₂Ousing VSEPR theory.
Section D, weightage 4 each (long essay) 
Answer any two questions.

33. With examples, differentiate between intermolecular and intramolecular hydrogen bonding.
34. Differentiate between bonding and antibonding molecular orbitals. Calculate the bond order of $\text{O}_2^+$ ion.
35. Write a note on environmental aspects of organometallic compounds.
36. Distinguish between normality and molarity.

$2 \times 5 = 10$

INORGANIC AND BIOINORGANIC CHEMISTRY
Complementary Chemistry for BOTANY Majors
SEMESTER II Course code-CH1231 .3 Credit-2
L-T-P 2-0-2

Module I – 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

Module II - Coordination Chemistry (9 hrs)

Module III – Bio inorganic compounds (9 hrs)

Module IV – Spectroscopy – I (9 hrs)

Reference:
4. Atomic structure and chemical bonding with introduction to molecular spectroscopy – Manas Chanda
5. Concise Inorganic Chemistry – J.D. Lee
Section A, weightage 1 each (answer in one word / sentence)

I. 1. Global warming is a consequence of ……………
   2. Give one example for air pollutants.
   3. ………………….. is responsible for ozone layer depletion.
   4. What is the oxidation state of iron in haemoglobin.

II. 5. Write the IUPAC name of K₄[Fe(CN)₆].
   6. Coordination number of Cu²⁺ in [Cu(NH₄)₂]²⁺.
   7. Give an example for a hexadentate ligand.
   8. Write the oxidation number of gold in Na[Au(CN)₂].

III. 9. ………………….. is an example for a haemoprotein.
   10. Which is the metal present in Chlorophyll?
   11. During assimilation of nitrate, plants and micro organisms reduce nitrate to………..
   12. During fixation of carbon, carbon dioxide is converted to …………………

IV. 13. The essential requirement for a molecule to be microwave active is …………………
   14. Number of waves which pass through a given point in one second is known as ……..
   15. Give the selection rule for IR spectroscopy.
   16. Write the expression to calculate the force constant of a molecule. 1×4 = 4

Section B, weightage 1 each (short answer type)

Answer any eight questions from the following. Each answer must contain 4 points.

17. Explain BOD and COD.
18. How pesticides and fertilizers cause soil pollution?
19. Explain high spin and low spin complexes with an example for each.
20. Explain carbon cycle.
21. Write a note on nitrogen fixation.
22. Explain myoglobin and its importance.
23. Explain electromagnetic spectrum.
24. The force constant of CO is 1840 cm⁻¹. Calculate the vibrational frequency in cm⁻¹. (Atomic mass C¹² = 19.9 x 10⁻²⁷ kg, O¹⁶ = 26.6 x 10⁻²⁷ kg.)
25. What is a chelate? Illustrate with examples.
26. What is acid rain?
27. What is stability constant?
28. HCl is microwave active, H₂ is not. Why? 1×8 = 8
Section C, weightage 2 each (short essay)

Answer any 5 questions from the following. Each answer must contain 8 points.
29. Explain Fajan’s rule.
30. What are the drawbacks of valence bond theory?
31. What is meant by green house effect? Explain its consequences.
32. Write a note on the biochemistry of iron.
33. Compare photosynthesis and respiration.
34. Explain the applications of coordination compounds in qualitative analysis.
35. Write a note on industrial waste management.
36. Write a short note on environmental pollution.  

2 × 5 = 10

Section D, weightage 4 each (long essay)

Answer any two questions.
37. Explain the various types of isomerism in coordination compounds with an example each.
38. Give an account of rotational vibrational spectrum and its applications.
39. What are cytochromes? Discuss their importance in biological systems.

4 × 2 = 8

SYLLABUS OF COMPLEMENTARY COURSE

Physical & Inorganic Chemistry (For Students of Botany Majors)

SEMESTER III Course-3 Credit-3 Course Code – CH1331 .3

L-T-P 3-0-2 Total 54 Hours

Module I. Chemical kinetics 9 Hrs
Chemical kinetics, catalysis, rate of reactions, various factors influencing rate, order, molecularity, zero, first, second, third order reactions (derivation of first order only) 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- Bronstead concept of acids and bases, Kw and pH, pH of strong and weak acids, Ka and Kb, mechanism of buffer action, pH of buffer, Hydrolysis of salt, Degree of hydrolysis and hydrolysis constant.

Module III. Solutions 9 Hrs
Completely miscible liquid pairs, composition curve, boiling point- composition curve- ideal and non ideal solutions, fractional distillations, azeotropes, 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. Chromatography 9 Hrs
Outline study of adsorption and partition chromatography, paper, thin layer, ion exchange,
gas chromatography and HPLC, Rf and Rt value, separation of amino acids and dyes.

**Module V - Radioactivity and Nuclear Chemistry** 9Hrs
Radio active equilibrium, Detection of radioactivity by Wilson's cloud Chamber and Geiger Muller counter, Units of radioactivity - Curie and Rutherford. Applications in agriculture and Medicine. A brief study of the biological effects of radiation such as pathological and genetic damage. Nuclear Chemistry - Stability of nucleus, n/p ratio, artificial transmutation and radioactivity. Mass defect, binding energy, neutron activation analysis.

**Module VI UV spectroscopy** 9 Hrs
Basic characteristics of electromagnetic radiations- absorption of light by molecules-electronic, vibrational and rotational energies- Beer lambert’s law-colorimetry, Colorimetric estimation of glucose and iron, UV spectroscopy-principle-λ_max – auxochrome and chromophore, red shift and blue shift, simple applications of UV spectroscopy, conjugation, functional group and geometrical isomerism.

**Module VI NMR spectroscopy** 9 Hrs
Principle of NMR, nuclear spin, chemical shift, spin-spin coupling, τ and δ, PMR of simple organic molecules, principle of MRI.

**REFERENCES FOR SEMESTER III**
2. Principles of physical chemistry, Puri Shrama Pathania, Vishal
3. Chemistry of natural products, P.S. Kalsi, New Age International Private Ltd
4. Elementary organic spectroscopy, Y.R Sharma, Schand & Company
MODEL QUESTION        THIRD SEMESTER
Complementary course-Botany majors  Course–III course code CH1331 .3
Physical and Inorganic Chemistry

Time : Three Hours                                             Total Weightage : 30

SECTION A,    weightage 1 each  (answer in one word \\ sentence)
Answer all the questions.

I  1. Write an example for first order reaction
   2. Write Arrhenius equation for dependence of rate on temperature.
   3. What is the unit of rate constant for third order reactions?
   4. What is the order of radio active decay?

II  5. How $K_a$ is related to $pK_a$.
    6. Write one examples of Lewis acid.
    7. Write an example of acid buffer.
    8. What is the value $K_w$ of pure water?

III  9. Write an example of ideal solution?
    10. Write any one condition for a solution to be ideal
    11. Write an example of azeotropic solution
    12. Write one example for purification of a substance by steam distillation.

IV  13. Write any one commonly used adsobent in column chromatography
    14. Write any one carrier gas used in gas chromatography
    15. Which spary reagent is commonly used for identification of amino acids?
    16. Write any one detector used in gas chromatography $1\times4 = 4$

SECTION B,       weightage 1  each   (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Explain the buffer action of a mixture of weak acid and its salt
18. What is the principle of steam distillation?
19. Explain fractional distillation?
20. What is retention volume?
21. What is $R_f$ value?
22. What is Beer- Lamberts law
23. What are ion exchange resins?
24. What is chemical shift?
25. What are auxochromes and chromophores
26. What is the difference between adsorption and partition chromatography?
27. Explain binding energy.
28. Write a note on $\delta$ and $\tau$ scales used in nmr. $1\times8 = 8$

SECTION C,   weightage 2  each   (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.

29. Derive the rate equation for first order reaction
30. What is the pH of 0.01M sodium acetate? $K_a$ of acetic acid = $1.7 \times 10^{-5}$
31. What is meant by critical solution temperature?
32. What is HPLC
33. What are red and blue shift? Explain
34. Draw the low resolution and high resolution $^1H$ NMR of ethanol.
35. Explain mass defect.
36. What are the units of radioactivity? $2\times5 = 10$
SECTION D, weightage4 each (long essay)
Answer any two questions
37. Explain collision theory.
38. Derive an equation for pH of an acid buffer.
39. Explain the procedure for estimation of iron colorimetrically. 4x2 = 8

SYLLABUS OF COMPLEMENTARY COURSE

Organic Chemistry (For Students of Botany Majors)

SEMESTER IV Course-4 Credit -3 Course Code CH1431 .3

L-T-P 3-0-2 Total 54 Hours

Module - 1 : Alkaloids 9 Hrs
General methods of isolation, general properties, classification, physiological action of
alkaloids. Structure of conine, morphine and nicotine (no structural elucidation)

Module - II : Terpenes 9 Hrs
Classification, isoprene rule, essential oils, elementary study of Citral and Geraniol, natural
rubber, synthetic rubber, synthesis of Buna - N, Buna - S, neoprene and thiokol. Classification of
polymers with specific examples.

Module III Vitamins, Hormones, Lipids 9 Hrs
Classification of Vitamins, structure and properties of Vitamin A, C and D, Deficiency
diseases, Hormones -cholesterol, bile acids, artificial hormones, Lipids – classification of oils,
fats and iodine value, saponification value, phospholipids (no structural elucidation).

Module IV Insecticides and pesticides 9 Hrs
Pesticides, insecticides, herbicides, fungicides, Classification of Insecticides, Phosphorus,
chlorine and carbamates, detection and identification of insecticides by TLC. Structure and
synthesis of DDT, BHC, malathion, carbamates, Toxicity.

Module V Dyes 9 Hrs
Theory of colour and constitution, classification of dyes, Natural dyes, Synthesis of methyl
orange, congo red, malachite green, phenolphthalein, Schiff's reagent.

Module VI Drugs 9 Hrs
Classification of drugs- analgesic, antipyretic, antibiotic, hypnotics, suphadrugs, antacids,
antimalarials, Synthesis of aspirin, sulphaguanidine, chloramphenicol, Drugs of plant origin-
anticancer compounds from plants.

REFERENCES FOR SEMESTER IV
2. Principles of physical chemistry, Puri Shrama 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
MODEL QUESTION

FOURTH SEMESTER Complementary course-Botany majors
Course—IV course code CH1431 3
Organic Chemistry

Time : Three Hours
Total Weightage : 30

Section A, weightage 1 each (answer in one word/sentence)

Answer all the questions.

I 1. Name two alkaloids from vinca rosa
2. Name of the alkaloid isolated from Hemlock seeds
3. Write any one characteristic of alkaloids
4. Write any one method used for separation of alkaloids from plants.

II 5. Write one example of synthetic rubber.
6. What is the IUPAC name of monomer of natural rubber?
7. Write the name of a Fibre
8. Write the name of a step growth polymer.

III 9. What is the chemical name of Vitamin C.?
10. Which decease is caused by the deficiency of Vitamin A?
11. Which alcohol is present in simple lipids?
12. Write the name of two water soluble vitamins.

IV 13. Write the name of one chloro insecticide
14. Write the name of one phosphorus insecticide
15. What are the raw materials used in the preparation of DDT?
16. Which spray reagent is used for the detection of carbamate? 1×4 = 4

Section B, weightage 1 each (short answer type)

Answer any eight questions from the following. Each answer must contain 4 points.

17. State isoprene rule
18. How vitamins are classified?
19. What is iodine value?
20. How would you prepare methylorange?
21. Draw the structure of DDT and BHC?
22. Name three anticancer compounds?
23. How would you synthesize aspirin from salicylic acid?
24. What is redox titration?
25. What is binding energy?
26. What are bile acids?
27. Write the structure of conine.
28. What is Buna-N? \[ 1 \times 8 = 8 \]

**Section C, weightage 2 each (short essay)**

Answer any 5 questions from the following. Each answer must contain 8 points.

29. Write few examples of plant alkaloids as drugs
30. What are neoprene and thiokol?
31. Draw the structure of vitamin C
32. What are carbamates
33. What is chromophore and auxochome? Explain with examples
34. How chloramphenicol synthesized.
35. Distinguish between natural rubber and synthetic rubber.
36. Explain vitamin deficiency diseases. \[ 2 \times 5 = 10 \]

**Section D, weightage 4 each (long essay)**

Answer any two questions

37. What is step growth and chain growth polymerization? Explain with examples
38. How would you determine saponification value of an oil?.
39. Explain the classification of Lipids? \[ 4 \times 2 = 8 \]

**SYLLABUS FOR LABORATORY COURSES FOR COMPLEMENTARY CHEMISTRY**

**Course V**  
**Course Code CH1432**  
**Credit 2**  
**Semesters 1, 2, 3 & 4**

*For students of Botany, Zoology, Home Science and Biochemistry majors*

Qualitative Analysis

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

Organic preparations

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

A student has to analyse at least twelve organic compounds.

Volumetric Analysis

A. Acidimetry and alkalimetry
a. Preparation and standardization of decinormal HCl using sodium carbonate as primary standard.

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

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

B. Permanganometry

a. Standardization of KMnO4 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. K₂Cr₂O₇ 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 Mg²⁺ or Zn²⁺ ion solution.

b. Estimation of any one metallic ion from Ca²⁺, Mg²⁺, Zn²⁺ or Ni²⁺

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

Gravimetric Analysis

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

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

**COURSE OFFERING AND CREDITS**

Semester IV; credits: Two

**COURSE OBJECTIVES**

To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

**COURSE TRANSACTION FORMAT**

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

**MODE OF EVALUATION**

*Continuous Evaluation:* The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes/tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Component</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Attendance</td>
<td>&gt;90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80% - D</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>A-E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>
Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

### Mode of Experiment (Lab) Report Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctual submission and Neat presentation</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three   : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two     : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one     : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None        : E</td>
</tr>
<tr>
<td>2</td>
<td>Inclusion of aim, materials, procedure etc.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Calculations and absence of errors/mistakes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Accuracy of the result</td>
<td></td>
</tr>
</tbody>
</table>

### Mode of Lab Skill Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three   : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two     : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one     : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None        : E</td>
</tr>
<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td></td>
</tr>
</tbody>
</table>

Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz,
grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

*End Semester Evaluation: 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics\geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3- hr duration.*

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Components in General</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>4</td>
<td>A-E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>8</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>12</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record</td>
<td>6</td>
<td>A-E</td>
</tr>
</tbody>
</table>

*If necessary this table may be modified by the Board of Examiners*

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below.
Semester IV Course Code CH1432 .3

1. Inorganic Quantitative Analysis(Volumetric Analysis)

Estimation of ion or salt in Volumetric Analysis.

To all complementary Courses

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Weight Tag</th>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>2</td>
<td>i. Principle of the experiment stated &amp; correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Aim of the experiment stated &amp; correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Procedure stated &amp; correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Materials &amp; apparatus specified</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All 4 subcomponents : A</td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>4</td>
<td>i. Standardization calculation correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Estimation Calculation correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Unknown weight calculation correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Neatness of data and result presentation</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All 4 subcomponents : A</td>
<td>None : E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>6</td>
<td>i. $\leq 1%$</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. $1.4 &lt; 1.4$</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. $1.4 \leq 1.8$</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. $1.8 &lt; 2.2$</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>v. $2.2$</td>
<td>E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record Book</td>
<td>3</td>
<td>i. Required No: of Experiments done</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Data and experimental details sufficient</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Correctness of results reported</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Neatness of presentation and absence of errors/mistakes in the Record Book</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All 4 subcomponents : A</td>
<td>None : E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
2. Organic Qualitative Analysis
Organic Compound Analysis-Zoology, Botany, Biochemistry & home science majors

<table>
<thead>
<tr>
<th>Sub-Components for End Sem Evaluation of Organic Qualitative Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N o</strong></td>
</tr>
<tr>
<td>---------</td>
</tr>
</tbody>
</table>
| 1       | Principle and Procedure | 2             | i. Principle of the experiment stated  
ii. Aim of the experiment stated  
iii. Neatness  
v. Materials & apparatus specified. | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 2       | Experiment Report & Lab Skill | 4             | i. Preliminary experiments done  
ii. Detection of elements  
iii. Saturated-unsaturated  
v. Aromatic or not aromatic | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 3       | Calculations & Result | 6             | i. 4 correct tests  
ii. 3 tests correct  
iii. 2 correct tests  
v. 1 correct test  
v. 0 correct test | A  
B  
C  
D  
E |
| 4       | Lab Course Record Book | 3             | i. Required No: of Experiments done  
ii. Data and experimental details sufficient  
iii. Correctness of results reported  
v. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |

If necessary this table may be modified by the Board of Examiners

Total weightage for ESE is 30 and for CE is 4.
CE for each half practical course (volumetric, cations, organic)

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>≥90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - ≥85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - ≥80% - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME IN CHEMISTRY
UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
Complementary Chemistry offered to Zoology Majors

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

Chemistry Complementary

Complementary Courses -4 Total Credits – 14

One Semester – 18Weeks

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours\ Week</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
<th>Instructional Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1131 .4</td>
<td>2×18 = 36</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1231 .4</td>
<td>2×18 = 36</td>
</tr>
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<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>CH1331 .4</td>
<td>3×18 = 54</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>CH1431 .4</td>
<td>3×18 = 54</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>4</td>
<td>CH1432 .4</td>
<td>2×18 = 36</td>
</tr>
</tbody>
</table>

GENERAL ASPECTS OF EVALUATION

MODE OF EVALUATION - COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSES

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25 % and End Semester evaluation (ESE) with a weightage of 75 % . A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
<td>4</td>
<td>3.50-4.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>B</td>
<td>3</td>
<td>2.50-3.49</td>
</tr>
<tr>
<td>Good</td>
<td>C</td>
<td>2</td>
<td>1.50-2.49</td>
</tr>
<tr>
<td>Average</td>
<td>D</td>
<td>1</td>
<td>0.50-1.49</td>
</tr>
<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>
I. 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lecture Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

I. 1. 1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.
## Mode of Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td>2</td>
<td>Content &amp; grasp of the topic</td>
<td>Only three : B</td>
</tr>
<tr>
<td>3</td>
<td>Lucidity / Clarity of presentation</td>
<td>Only two : C, Only one : D, None : E</td>
</tr>
<tr>
<td>4</td>
<td>References / Interaction/Overall effort</td>
<td></td>
</tr>
</tbody>
</table>

The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

## Guidelines for Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>N/a</th>
<th>Main Component</th>
<th>Sub-Components</th>
</tr>
</thead>
</table>
| 1   | Adherence to overall structure & submission deadline | i. Punctual submission  
    |                    | ii. Adequate length/duration  
    |                    | iii. Inclusion of Introduction, Discussion & Summary sections  
    |                    | iv. Absence of errors/mistakes  |
| 2   | Content & grasp of the topic | i. Coverage of topic  
    |                    | ii. Understanding of topic  
    |                    | iii. Logical organization  
    |                    | iv. Originality (No copying from a source or plagiarism)  |
| 3   | Lucidity / Clarity | i. Clarity  
    |                    | ii. Effective presentation/delivery  
    |                    | iii. Neatness of presentation  
    |                    | iv. Inclusion of appropriate diagrams /equations /structures etc  |
| 4   | References / Interaction/Overall effort | i. Listing of references  
    |                    | ii. Use of more than one reference source/Use of Web resource  
    |                    | iii. Correct Response to quiz /questions  
    |                    | iv. Overall effort in preparing assignment/seminar  |
I. 1. 2. DETAILS OF THE CLASS TEST

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1(Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).
7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question No</strong></td>
</tr>
<tr>
<td>Part A: I. 1-4; II. 4-8</td>
</tr>
<tr>
<td>Part B: 9-12</td>
</tr>
<tr>
<td>Part C: 13,14</td>
</tr>
<tr>
<td>Part D: 15,16</td>
</tr>
<tr>
<td><strong>Total = 10</strong></td>
</tr>
</tbody>
</table>

I. 2. CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each
set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

I. 2. 1. **Evaluation of the Experiment (Lab) Report**

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of Experiment (Lab) Report Evaluation</th>
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<tbody>
<tr>
<td><strong>N  o</strong></td>
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I. 2. 2. 

**EVALUATION OF THE LAB SKILL**

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
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<tr>
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<td>Punctuality and experiment completion on time</td>
<td>All four sub-components:</td>
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<td></td>
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<td>A</td>
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<td>Only three : B</td>
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<td></td>
<td>Only two : C</td>
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<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
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<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
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<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
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<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td></td>
</tr>
</tbody>
</table>

I. 2. 3. 

**EVALUATION OF THE LAB QUIZ / TEST**

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. 

**END SEMESTER EVALUATION FOR LECTURE COURSES**

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II. 1. 1. **END SEMESTER QUESTION PAPER PATTERN**

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
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 (mention only, no derivation), concept of orbitals, the four quantum numbers and their significances. Orbitalwise electron configuration, energy sequence rule – Pauli’s principle, Hund’s rule, Stability of filled and half filled orbitals. Electronic configuration of lanthanides and actinides, Lanthanide contraction.

Module II – Chemical Bonding (9 hrs)


Module III – Analytical Principles (9 hrs)


Module IV – 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 – organomercy, 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.

Reference:
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. Co-ordination Chemistry – Bosolo and Johns
MODEL QUESTION PAPER - CHEMISTRY (Complementary) offered to Zoology majors Course Code – CH1131 .4 Semester I Course- I
Theoretical Chemistry

Time : Three Hours                                             Total Weightage : 30

Section A, weightage 1 each  (answer in one word \ sentence)
Answer all questions.
I. 1. Give the relation between energy and frequency.
2. Write the valence shell configuration of Cu (atomic number 29).
3. The Bohr wave number equation is .........................
4. Sketch the shape of p\textsubscript{\textit{x}} orbital.
II. 5. What is the hybridization of nitrogen in ammonia?
6. Dipole moment = ...................... \times \text{distance}
7. Write a molecule possessing intra molecular hydrogen bonding.
8. Give the expression for calculating bond order of a molecule.
III. 9. Normality of 10 % solution of NaOH is ............... 
10. Indicator suitable for the titration of H\textsubscript{2}C\textsubscript{2}O\textsubscript{4} against NaOH is ................. 
11. Give an example for a redox indicator.
12. The equivalent weight of KMnO\textsubscript{4} is ................. 
IV. 13. Give an example for sigma bonded organometallic compound.
14. Alkyl magnesium halides are generally known as ................. 
15. Give the formula of Zeise’s salt.
16. Give an example for an organomercury compound used as antiseptic.

1×4 = 4

Section B, weightage 1 each  (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Mention the type of hybridization in the following compounds.
   a. BF\textsubscript{3}  b. CH\textsubscript{4}  c. PCl\textsubscript{5}  d. SF\textsubscript{6}
18. Explain the factors influencing polarity of covalent bond.
19. Explain the different series in the atomic spectrum of hydrogen.
20. State and explain Pauli’s exclusion principle.
21. What are redox titrations? Give two examples.
22. How will you prepare 100 ml 0.05 M Mohr’s salt solution?
23. What is Ferrocene? How is it synthesized?
24. What are Grignard Reagents? Mention any two uses.
25. What is Cis Platin? Give its structure.
26. Explain Hund’s rule of maximum multiplicity.
27. Explain Fajan’s rule.
28. What is a primary standard?

1×8 = 8

Section C, weightage 2 each  (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Write a note on the four quantum numbers.
30. What is meant by dipole moment? How it is helpful in explaining the structure of molecule.
31. Explain the theory of acid-base indicators.
32. Explain the bond angles in NH\textsubscript{3} & H\textsubscript{2}O using VSEPR theory.
33. With examples, differentiate between intermolecular and intramolecular hydrogen bonding.
34. Differentiate between bonding and antibonding molecular orbitals. Calculate the bond order of \( \text{O}_2^+ \) ion.
35. Write a note on environmental aspects of organometallic compounds.
36. Distinguish between normality and molarity. \( 2 \times 5 = 10 \)

Section D, weightage 4 each (long essay)
Answer any two questions.
37. What is lattice energy? Write a note on Born-Haber cycle.
38. Derive Bohr frequency equation. Calculate the wavelength of the first spectral line of Balmer series.
39. Briefly explain different type of acid- base titrations and their indicators with suitable examples \( 4 \times 2 = 8 \)

INORGANIC AND BIOINORGANIC CHEMISTRY

Complementary Chemistry for ZOOLOGY Majors
SEMESTER II Course code-CH1231 .4 Credit-2 36 hrs
L-T-P 2-0-2

Module I – 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

Module II - Coordination Chemistry (9 hrs)

Module III – Bio inorganic compounds (9 hrs)

Module IV – Spectroscopy – I (9 hrs)

Reference:
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
MODEL QUESTION PAPER – Zoology Majors CHEMISTRY
(Complementary) Semester II Course Code- CH1231 .4 Course – II
Inorganic and Bio inorganic Chemistry
Time : Three Hours                                             Total Weightage : 30

Section A,     weightage 1 each (answer in one word \ sentence)
Answer all questions

I. 1. Global warming is a consequence of …………….
2. Give one example for air pollutants.
3. ……………………… is responsible for ozone layer depletion.
4. What is the oxidation state of iron in haemoglobin.

II. 5. Write the IUPAC name of K₄[Fe(CN)₆].
6. Coordination number of Cu²⁺ in [Cu(NH₄)₂]²⁺.
7. Give an example for a hexadentate ligand.
8. Write the oxidation number of gold in Na[Au(CN)₂].

III. 9. ……………………… is an example for a haemoprotein.
10. Which is the metal present in Chlorophyll?
11. During assimilation of nitrate, plants and micro organisms reduce nitrate to………..
12. During fixation of carbon, carbon dioxide is converted to …………………

IV. 13. The essential requirement for a molecule to be microwave active is ……………
14. Number of waves which pass through a given point in one second is known as ………
15. Give the selection rule for IR spectroscopy.
16. Write the expression to calculate the force constant of a molecule. 1×4 = 4

Section B,    weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Explain BOD and COD.
18. How pesticides and fertilizers cause soil pollution?
19. Explain high spin and low spin complexes with an example for each.
20. Explain carbon cycle.
21. Write a note on nitrogen fixation.
22. Explain myoglobin and its importance.
23. Explain electromagnetic spectrum.
24. The force constant of CO is 1840 cm⁻¹. Calculate the vibrational frequency in cm⁻¹. (Atomic mass C¹² = 19.9 x 10⁻²⁷ kg, O¹⁶ = 26.6 x 10⁻²⁷ kg.)
25. What is a chelate? Illustrate with examples.
26. What is acid rain?
27. What is stability constant?
28. HCl is microwave active, H₂ is not. Why ? 1×8 = 8
Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Explain Fajan’s rule.
30. What are the drawbacks of valence bond theory?
31. What is meant by greenhouse effect? Explain its consequences.
32. Write a note on the biochemistry of iron.
33. Compare photosynthesis and respiration.
34. Explain the applications of coordination compounds in qualitative analysis.
35. Write a note on industrial waste management.
36. Write a short note on environmental pollution. \(2 \times 5 = 10\)

Section D, weightage 4 each (long essay)
Answer any two questions.
37. Explain the various types of isomerism in coordination compounds with an example each.
38. Give an account of rotational vibrational spectrum and its applications.
39. What are cytochromes? Discuss their importance in biological systems. \(4 \times 2 = 8\)

ORGANIC AND BIOPHYSICAL CHEMISTRY I
Complementary Chemistry for ZOOLOGY MAJORS
SEMESTER III Course-3 Credit-3 Course Code – CH1331 .4 L-T-P 3-0-2
Total - 54 hrs
Module I – Mechanisms in organic substitution reactions (9 hrs)
Electron displacement in organic compounds – Inductive, electromeric and mesomeric effects, influence of inductive effect on acidic and basic properties of organic compounds, hyperconjugation and steric effect.
Reaction mechanism - Bond fission, rate determining step, nucleophilic substitution of alkyl halides, \(S_N^1\), \(S_N^2\) reactions. Effect of structure on reactivity as illustrated by methyl, ethyl, isopropyl and tertiary butyl groups. Electrophilic addition to ethene and propene – Markownikoff’s rule, free radical addition, peroxide effect.
Module II – Stereochemistry (9 hrs)
Optical isomerism, chirality, recemisation and resolution, relative and absolute configuration, asymmetric synthesis, optical isomerism due to restricted rotation.
Geometrical isomerism, E and Z nomenclature. Aldoximes and ketoximes.
Module III – Carbohydrates
Classification, configuration, glyceraldehyde, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose. 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.
Module IV – Spectroscopy II (9 hrs)

Module V – Heterocyclics and alkaloids (9 hrs)
An outline study of the preparation and properties of furan, pyrrole, thiophene, pyridine. Hoffmann’s exhaustive methylation.
Alkaloids – General methods of isolation, general properties, physiological action of alkaloids, conine, morphine and nicotine (no structural elucidation expected)

Module VI – Vitamins & Hormones(9hrs)
Classification of vitamins, Source, Isolation, Physiological function and deficiency diseases caused by Vitamin A\(_1\) (retinol) A\(_2\) (axerophthol) Vitamin B – B1(thiamine) B\(_2\) (riboflavin and folic acid) B\(_3\) (niacin) B\(_6\) (pyridoxine) B\(_7\) (cyanocobalamine) Vitamin C (ascorbic acid) Vitamin D\(_2\) (ergocalciferol) Vitamin E (Tochopherols) Vitamin H (biotin) and Vitamin K.
Hormones – Steroids – Cholestrol, Bile acids, Artificial hormones (only elementary study)

Reference:

3. Reaction Mechanism in Organic Chemistry – Mukherjee and Singh – Macmillan
4. Physical Chemistry – Rakshit
5. Essentials of Physical Chemistry – Bahl, Tuli & Arun Bahl

MODEL QUESTION PAPER - ZOOLOGY (Majors) – CHEMISTRY (complementary) Course code CH1331 .4 Semester III Course – III Organic and Bio- physical Chemistry I

Time : Three Hours Total Weightage : 30
Section A, weightage 1 each (answer in one word \\ sentence) Answer all questions

I. 1. Which is more strong – acetic acid or formic acid?
2. The permanent displacement of electrons in a pi bond is known as ............
3. Write the rate determining step of nucleophilic substitution in alkyl halides.
4. Anti-Markonikov’s addition to unsymmetrical alkene takes place in presence of ..............

II. 5. The process of separation of racemic modification into D and L forms is known as ............
6. ............ is the cause of optical activity of a molecule.
7. Which is the stable conformation of ethane molecule?
8. Write the structure of L - glyceraldehyde.

III. 9. Give an example for a ketohexose.
10. Aldoses differing only in the configuration of \(\alpha\)-carbon atom from one another are called .................

\[ \text{Glucose} \xrightarrow{\text{HNO}_3} \text{HNO}_3 \xrightarrow{\text{Oxidation}} \text{HNO}_3 \]
IV. 13. Beri beri is caused by the deficiency of ............
14. Which is the most abundant steroid?
15. Write an example for a vitamin which is neither water soluble nor fat soluble.
16. Write an example for a sex hormone. 1×4 = 4

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Explain hyper conjugation with an example.
18. Explain Markownikoff’s rule with example.
20. Explain racemisation.
21. How will you convert glucose to fructose?
22. What is Raman effect? Explain.
23. Explain chemical shift.
24. Write a note on electrophilic substitution in furan with example.
25. Explain the physiological action of conine.
27. Denote the axial and equatorial bonds of cyclohexane.
28. Distinguish between mutarotation and epimerization. 1×8 = 8

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Explain steric effects with suitable examples.
30. Draw and explain different conformations of ethane and cyclohexane.
32. How will you use NMR spectroscopy in the identification of organic molecule? Explain with example.
33. Write the structures of vitamin A₁, B₂ and C.
34. Give a note on vitamin deficiency diseases.
35. Explain the physiological action of alkaloids.
36. Explain vitamin deficiency diseases. 2×5 10

Section D, weightage 4 each (long essay)
Answer any two questions.
37. Explain nucleophilic substitution reactions in alkyl halides with mechanisms.
38. Write a note on the quantum theory of Raman effect.
39. Write a note on optical isomerism in biphenyls with examples. 4×2 = 8
secondary, tertiary and quaternary structure of proteins, test for proteins, Enzymes –
Characteristics, catalytic action, theory of enzyme catalysis – Michaelis – Menton theory –
Co-enzymes.

**Module II** – Nucleic acids and Lipids (9 hrs)
RNA, DNA – their biological role, hydrolysis of nucleoproteins, elementary idea
regarding the structure of nucleic acids.
Lipids – Classification oils, fats and waxes, iodine value and saponification value,
properties of oils and fats – phospholipids

**Module III** – Polymers (9 hrs)
Classification with example – natural and synthetic polymers – condensation and addition
polymerization. Elastic fibres, thermoplastics and thermostetting 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 IV** – Bio physical Analysis (9 hrs)
Osmosis – osmotic pressure, isotonic solutions, determination of molar mass by osmotic
pressure measurement – reverse osmosis. Adsorption – Types of adsorption –
applications. Factors influencing adsorption – Langumuir theory of adsorption

**Module V** – Colloids (9 hrs)
Properties of Colloids – Tyndal effect – Ultramicroscope – Brownian movements –
electrophoresis – electro osmosis sedimentation and streaming potential – stability of
colloids – zeta potential – Hardy Schultz rule. Protective Colloids – gold number –
emulsions, Gels – application of Colloids – delta formation medicines – sewage disposal
– emulsification and cleansing action of detergents and soaps.

**Module VI** – Chromatography 9 hrs
Introduction to Chromatography, Classification, Adsorption, Column chromatography,
Introduction, Principle, Experimental details, Theory of development, factors affecting
column efficiency, Applications, Paper chromatography, Types of paper chromatography,
Experimental details, Applications. TLC – Introduction, Features, Advantages and
limitations, Detecting agents.

Reference:

   & N. Nath
3. Reaction Mechanism in Organic Chemistry – Mukherjee and Singh – Macmillan
4. Physical Chemistry – Rakshit
5. Essentials of Physical Chemistry – Bahl, Tuli & Arun Bahl
I. 1. …………………. is an example for neutral amino acid.
   2. Compounds formed by the condensation of two or more amino acids are known as …………………
   3. …………….. is Millon’s reagent.
   4. Name the enzyme, which catalyses the hydrolysis of urea.

II. 5. Name the RNA, which provides the site for protein synthesis in cytoplasm.
   6. Relationship between the base sequence in DNA and the amino acid sequence in protein is known as …………………
   7. …………….. is the difference between saponification value and acid value.
   8. Nucleoside + ………………… = Nucleotide.

III. 9. Polymer formed by the condensation of hexamethylene diamine and adipic acid is …………………
   10. Give an example for a natural fibre.
   11. Monomer of natural rubber is …………………
   12. Give an example for a thermosetting plastic.

IV. 13. Colloid of liquid in liquid is known as …………………
   14. Write the name of any one carrier gas used in gas chromatography.
   15. By which method, metal colloids are generally prepared?
   16. Scattering of light by colloidal particles is known as …………………. 

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Define the terms, a. acid value  b. saponification value.
18. Explain the isoelectric point of amino acids.
19. Explain osmosis and reverse osmosis.
20. Differentiate between addition polymerization and condensation polymerization with examples.
21. Write a note on adsorption.
22. Explain the different reasons for the coagulation of colloids.
23. Write a note on paper chromatography.
24. Explain the cleansing action of soap.
25. What are the different factors affecting column chromatography.
26. Explain Schulz – Hardy rule.
27. What is vulcanization of rubber?
28. Explain peptide synthesis.

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Explain the theory of enzyme catalysis.
30. Discuss the different functions of DNA and RNA.
31. Write a note on synthetic rubbers.
32. Explain the determination of molar mass by osmotic pressure measurement.
33. Differentiate between lyophilic and lyophobic colloids.
34. What are the advantages and limitations of thin layer chromatography?
35. Explain Michaelis – Menten theory?
36. Explain classification of lipids.  
   \[2 \times 5 = 10\]

Section D, weightage 4 each (long essay)
Answer any two questions.

37. Write on the various properties of colloids.
38. Briefly explain the structure of proteins.
   \[4 \times 2 = 8\]

SYLLABUS FOR LABORATORY COURSES FOR COMPLEMENTARY CHEMISTRY

Course V Course Code CH1432 .4 Credit 2 Semesters 1,2,3 & 4

For students of Botany, Zoology, Home Science and Biochemistry majors

Qualitative Analysis

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

Organic preparations

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

A student has to analyse at least twelve organic compounds.

Volumetric Analysis

1. Acidimetry and alkalimetry
   a. Preparation and standardization of decinormal HCl using sodium carbonate as primary standard.
   b. Estimation of sodium hydroxide using (i) Std oxalic acid and (ii) Std HCl
c. Determination of sodium hydroxide and sodium carbonate in a mixture (indicator method)

II. Permanganometry

d. Standardization of KMnO4 by oxalic acid/sodium oxalate and Mohr’s salt
e. Estimation of oxalic acid/sodium oxalate
f. Estimation of Mohr’s salt
g. Estimation of calcium

III. Dichrometry

h. Preparation of Std. K2Cr2O7 and estimation of ferrous iron by external and internal indicators.
i. Estimation of ferric iron by reduction with stannous chloride (internal indicator).

IV. Iodimetry and Iodometry

j. Standardisation of sodium thiosulphate using std potassium dichromate
k. Estimation of copper in a solution
l. Estimation of iodine.

V. Complexometric titrations

m. Standardisation of EDTA using std Mg2+ or Zn2+ ion solution.
n. Estimation of any one metallic ion from Ca2+, Mg2+, Zn2+ or Ni2+

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

Gravimetric Analysis

1. Estimation of water of hydration in barium chloride crystals

2. Estimation of barium in barium chloride solution.

This laboratory based course reinforces the qualitative and quantitative chemical analysis that the student has learned in the 1st, 2nd, 3rd and 4th semesters.
COURSE OFFERING AND CREDITS

Semester IV; credits: Two

COURSE OBJECTIVES

To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

COURSE TRANSACTION FORMAT

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

MODE OF EVALUATION

Continuous Evaluation: The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes/tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

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<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
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<td>No. 1 Attandance</td>
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<td>Experiment (Lab) Report</td>
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<td>Laboratory Skill</td>
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<td>Quiz / Test</td>
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Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on
sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

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</table>

Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.
**End Semester Evaluation:** 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics/geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3-hr duration.

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Components in General</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>4</td>
<td>A-E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>8</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>12</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record</td>
<td>6</td>
<td>A-E</td>
</tr>
</tbody>
</table>

**Main Components of ESE For Lab Courses**

If necessary this table may be modified by the Board of Examiners

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below

**Semester IV Course Code CH1432 .4**

1. **Inorganic Quantitative Analysis (Volumetric Analysis)**

   Estimation of ion or salt in Volumetric Analysis.

To all complementary Courses.
<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Weight</th>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>2</td>
<td>i. Principle of the experiment stated &amp; correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Aim of the experiment stated &amp; correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Procedure stated &amp; correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Materials &amp; apparatus specified</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>4</td>
<td>i. Standardization calculation correct</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Estimation Calculation correct</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Unknown weight calculation correct</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Neatness of data and result presentation</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>6</td>
<td>i. (&lt;1%)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. (&gt;1 - \leq 1.4)</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. (&gt;1.4 - \leq 1.8)</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. (&gt;1.8 - \leq 2.2)</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>v. (&gt;2.2)</td>
<td>E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record Book</td>
<td>3</td>
<td>i. Required No: of Experiments done</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Data and experimental details sufficient</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Correctness of results reported</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Neatness of presentation and absence of errors/mistakes in the Record Book</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
2. Organic Qualitative Analysis
Organic Compound Analysis-Zoology, Botany,Biochemistry& homescience majors

<table>
<thead>
<tr>
<th>Sub-Components for End Sem Evaluation of Organic Qualitative Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Component</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
</tbody>
</table>
| 1 Principle and Procedure | 2 | i. Principle of the experiment stated  
ii. Aim of the experiment stated  
iii. Neatness  
v. Materials & apparatus specified. | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 2 Experiment Report &Lab Skill | 4 | i. Preliminary experiments done  
ii. Detection of elements  
iii. Saturated-unsaturated  
v. Aromatic or not aromatic | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |
| 3 Calculations & Result | 6 | i. 4 correct tests  
ii. 3 tests correct  
iii.2 correct tests  
v.1 correct test  
v. 0 correct test | A  
B  
C  
D  
E |
| 4 Lab Course Record Book | 3 | i. Required No: of Experiments done  
ii. Data and experimental details sufficient  
iii. Correctness of results reported  
v. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
Only three : B  
Only two : C  
Only one : D  
None : E |

If necessary this table may be modified by the Board of Examiners

Total weightage for ESE is 30 and for CE is 4.
CE for each half practical course (volumetric, cations, organic)

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>≥90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - ≥85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - ≥80% - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
Complementary Chemistry offered to Homescience Majors

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

Chemistry Complementary

Complementary Courses - 4 Total Credits – 14

One Semester – 18 Weeks

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours\Week</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
<th>Instructional Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>CH1131 .5</td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1231 .5</td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>CH1331 .5</td>
<td></td>
<td>3×18 = 54</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>CH1431 .5</td>
<td>CH1432 .5</td>
<td>3×18 = 54</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2×18 = 36</td>
</tr>
</tbody>
</table>

General Aspects of Evaluation

Mode of Evaluation - Common to Core, Elective, Complementary and Foundation Courses

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25 % and End Semester evaluation (ESE) with a weightage of 75 % . A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
<td>4</td>
<td>3.50-4.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>B</td>
<td>3</td>
<td>2.50-3.49</td>
</tr>
<tr>
<td>Good</td>
<td>C</td>
<td>2</td>
<td>1.50-2.49</td>
</tr>
<tr>
<td>Average</td>
<td>D</td>
<td>1</td>
<td>0.50-1.49</td>
</tr>
<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>
I. 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>&gt;90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - ≥85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - ≥80% - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Assignment/ Seminar</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Test paper</td>
<td>2</td>
<td>A-E</td>
</tr>
</tbody>
</table>

I. 1.1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding
grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.

<table>
<thead>
<tr>
<th>Mode of Assignments / Seminar Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

<table>
<thead>
<tr>
<th>Guidelines for Assignments / Seminar Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>№</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>
I. 1. 2. **DETAILS OF THE CLASS TEST**

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1(Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).
7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question No</strong></td>
</tr>
<tr>
<td>Part A: I. 1-4; II. 4-8</td>
</tr>
<tr>
<td>Part B: 9-12</td>
</tr>
<tr>
<td>Part C: 13,14</td>
</tr>
<tr>
<td>Part D: 15,16</td>
</tr>
</tbody>
</table>

Total = 10

I. 2. **CONTINUOUS EVALUATION FOR LABORATORY COURSES**

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each
set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

1.2.1. **Evaluation of the Experiment (Lab) Report**

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of Experiment (Lab) Report Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
I. 2. 2. Evaluation of the Lab Skill

Mode of Lab Skill Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
<td>All four sub-components:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three: B</td>
</tr>
<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
<td>Only two: C</td>
</tr>
<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
<td>Only one: D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None: E</td>
</tr>
<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
<td></td>
</tr>
</tbody>
</table>

I. 2. 3. Evaluation of the Lab Quiz / Test

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. End Semester Evaluation For Lecture Courses

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II. 1. 1. End Semester Question Paper Pattern

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word-answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
Syllabus for complementary courses
(for Home Science Majors)

Semester-1 Complementary Course No. - 1 Course Code-CH1131 .5
Credit-2 L-T-P 2-0-2

SEMESTER 1

Inorganic and Analytical Chemistry 36 hrs

Module I – Atomic structure 9 hrs
Atomic spectra of hydrogen,-different series, Rydberg equation. Bohr theory-postulates -statement of Bohr energy equation –derivation of spectral frequency from Bohr equation-Schroedinger wave equation(mention only), concepts of orbitals, the four quantum numbers and their significance- Orbitalwise electron configuration,energy sequence rule, Pauli’s principle, Hund’s rule, stability of filled and half filled orbitals.

Module II- Analytical Principles 9 hrs
Principles of volumetric analysis, primary standards, Standard solutions, normality and molarity, numerical problems, theory of acid base titrations, permanganometric and dichrometric titrations, theory of acid base and redox indicators.( Numerical problems are to be worked out)

Module III- Radioactivity and Nuclear Chemistry 9 hrs
Radioactive equilibrium, , detection of radio activity, Geiger Muller Counter, Wilson cloud chamber, Units of radioactivity-Curie and Rutherford. Applications of radio activity- in medicine and agriculture, biological effects of radiation, pathological and genetic damage, Nuclear Chemistry-stability of nucleus, n/p ratio, artificial transmutation and radioactivity, mass defect, binding energy, neutron activation analysis

Module IV- Organometallics and biomolecules 9 hrs
Organometallic compounds –Definition and classification, Biological and environmental aspects of organometallics-organometallics in medicine, Organo mercury, boron, silicon and arsenic compounds. Biomolecules –Metallo porphyrins, Haemoglobin and Myoglobin.

References

1. Concise Inorganic Chemistry J. D. Lee
2. Inorganic Chemistry Puri and Sharma
3. Chemistry of Organometallics Rochow
4. Organic Chemistry Vol 2 I.L. Finar
5. Chemistry of natural products Vol. 1 Gurdeep Chatwal
6 The Text Book of Organic Chemistry P.L Soni, H.M. Chowla
Model Question Paper of Chemistry complementary for Homescience Majors
Semester I CH1131 .6 Course- I
Inorganic and Analytical Chemistry
Time : Three Hours                                             Total Weightage : 30

Section A, weightage 1 each (answer in one word \ sentence)
Answer all questions.

I. 1. Angular momentum of an electron is a whole number multiple of _________.
2. Give the relationship between wavelength, frequency and velocity of electromagnetic radiation.
3. The Rydberg equation for calculating wave number of radiation is _________.
4. Give Schrödinger equation which describes the behaviour of the electron in an atom.

II. 5. A substance which is in the pure and stable form is called __________
6. __________ indicator is used for the titration between strong base and weak acid.
7. Name the internal indicator used for the estimation of Fe SO4
8. __________ is the normality of 5% NaOH solution.

III. 9. Complete the equation 238 U 92  →  _________ +  4He2  + _________
10. Who introduced packing fraction?
11. What is meant by transmutation?
12. Name a device used to detect radioactivity.

IV. 13. Give example of one organometallic compound.
14. What are Grignard reagents?
15. Which is the solvent used in the preparation of Grignard reagents?
16. Myoglobin contains __________ in the high spin state. 1×4 = 4

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Draw the shapes of d orbitals
18. Give the names of 2 redox indicators
19. Write a note on stability of nucleus by n\p ratio.
21. Draw the structure of Mg Porphyrin
22. Calculate the weight of Na2CO3 required to prepare 250 ml N\10 solution..
23. Why HCl is not used in permanganometric titrations?
24. Mention any 2 applications of radioactivity.
25. Give the structure of 2 organo arsenic compounds.
26. Explain Hund’s rule with a suitable example.
27. Define electronegativity, explain Pauling’s electronegativity scale.
28. What are the units of radioactivity. Explain. 1×8 = 8

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.

29. Explain the wave nature of material objects. ii. What is uncertainty principle?
30. Explain mass defect and binding energy.
31. Write a short note on applications of organometallic compounds in medicine.
32. What are the functions of Myoglobin and Haemoglobin
33. Explain nuclear fission and nuclear fusion.
34. Explain normality, molarity and molality.
35. What are quantum numbers? Explain its significance.
36. What are the applications of radioactivity in agriculture? \(2 \times 5 = 10\)

**Section D, weightage 4 each (long essay)**
Answer any 2.

37. Derive Bohr frequency equation.
38. Write a note on acid base indicators.
39. What are biological effects of radiation? \(4 \times 2 = 8\)

**Syllabus (Complementary course Chemistry)**
(For Students of Home Science Majors)

**Organic Chemistry I**

**SEMESTER 2 Course No. 2 Course Code CH1231 .5 Credit 2**
36 hrs L-T-P 2-0-2

**Module I: Carbohydrates**
9hrs
Classification, configuration of glyceraldehydes, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose. Reactions of glucose and fructose Pyranoside structures of glucose and fructose Furanoside structure of fructose (structure elucidation not expected), muta rotation, epimerization, conversion of glucose into fructose and vice versa

**Module II: Vitamins**
9hrs
Classification, source, isolation, physiological function and deficiency diseases caused by Vitamin A1 (retinol), A2 (axerophthol), Vitamin B-B1 (thiamine), B2 (riboflavin and folic acid), B3 (niacin), B6 (Pyridoxine), B12 (Cyano cobalamine) Vitamin C (ascorbic acid), Vitamin D2 (ergocalciferol), Vitamin E (Tochopherols), Vitamin H (biotin) and Vitamin K

**Module III: Aminoacids and Proteins**
9hrs
Classification, synthesis of glycine, alanine, phenyl alanine and aspartic acid, zwitter ion, isoelectric point, reactions of aminoacids, peptide linkage, peptide synthesis, polypeptides, primary, secondary, tertiary and quarternary structure of proteins, classification, biological importance and tests for proteins.

**Module IV: Enzymes and Hormones**
9hrs
Enzymes- Characteristics, classification, factors influencing enzyme action, mechanism of enzyme action, Michaelis –Menton theory, enzyme inhibitors.
Hormones- Introduction, isolation, functions and abnormalities due to oxytocin, thyroxin, adrenalin, glutathione, progesterone, estrogens, cortisone, corticosterone, adrenalin

References
1. Concise Inorganic Chemistry J. D. Lee
2. Inorganic Chemistry Puri and Sharma
3. Chemistry of Organometallics Rochow
Model Question paper for S2 Complementary Chemistry-Course - II
Semester 2 CH1231.5 (For Students of Home Science majors)
Organic Chemistry I

Time : Three Hours
Total Weightage : 30

Section A, weightage 1 each (answer in one word / sentence)
Answer all questions.

I 1. Give the structure of D-glyceraldehyde?
   2. Name an aldo pentose.
   3. Give an example of a ketohexose
   4. _______ is dextro rotatory
II 5. Which is the metal present in Vitamin B_{12}
   6. Name a steroid vitamin
   7. Deficiency of _______ causes xerophthalmia
   8. Beriberi can be prevented by supplementing _____
III 9. Give an example of acidic amino acid
   10. _______ is a peptide linkage
   11. Isoelectric point of glycine is ________ .
   12. Which is the reagent used in xanthoproteic test?
IV 13. _____ are biological catalysts.
   14. Which is the optimum P^{H} of enzyme action
   15. Abnormality caused by excess of cortisone in blood is ________ .
   16. Name a protein Hormone

Section B, Weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Draw the ring structure of glucose and fructose
18. What is mutarotation?
19. Give an example each of fat soluble and water soluble vitamin
20. What is a zwitter ion?
21. How can you prepare glycine?
22. What is a prosthetic group?
23. What are the functions of oxytocin?
24. What is the action of bromine water on glucose?
25. What is the physiological function and deficiency disease caused by Vitamin C?
26. What is epimerisation?
27. Explain classification of vitamins.
28. What is bile acid?

1×4 = 4
1×8 = 8
Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Give relevant equations for conversion of fructose to fructosazine
30. Explain the isolation and physiological function of retinol.
31. What are fibrous and globular proteins? Explain.
32. What are the abnormalities shown by the imbalance of thyroxin?
33. What is vitamin E? Mention its importance.
34. How can you convert pyruvic acid to alanine?
35. Write any two tests for protein
36. Deduce the D and L configuration of threose and erythrose. \[2 \times 5 = 10\]

Section D, weightage 4 each (long essay)
Answer any 2.
37. How can you convert glucose to fructose and vice versa?
38. Explain the secondary structure of protein.
\[4 \times 2 = 8\]

Syllabus (Complementary course Chemistry)
(For Students of Home Science majors)
SEMESTER 3 Course-3 Credit-3 Course Code – CH1331 .5
L-T-P 3-0-2
Organic Chemistry II Total - 54 hrs
Module 1: Colloids 9hrs
Introduction, dispersed phase, dispersion medium, classification, multi molecular, macromolecular and associated colloids. Preparation - condensation and dispersion methods, purification - dialysis and ultra filtration, properties of colloidal solution-optical, kinetic and electrical properties, coagulation, Hardy-Schultz rule, protective colloid, applications of colloidal systems, emulsions, emulsifiers and cleansing action of soap.
Module 2: Adsorption and Chromatography 9hrs
Adsorption-Adsorbent, adsorbate, desorption, types of adsorption, physical and chemical adsorption, kinds of adsorption, interactions, adsortion of gases and solutions on solids, importance of adsorption phenomena(applications)- adsorption in catalysis, Chromatography-Column, TLC, paper and gas chromatography.
Module 3: Colour and constitution, Dyes 9hrs
Colours, complimentary colours, chromophore-auxochrome theory, modern theory of colours, classification of dyes, preparation and uses of para red and methyl orange, phenolphthalein and fluorescein, Alizarin, malachite green
Module 4: Terpenes 9hrs
Introduction, isolation, occurrence, isoprene rule, classification, physical and chemical properties and uses of citral, geraniol, menthol and camphor. An elementary idea of the structure of natural rubber, synthetic rubber, Buna-N, Buna-S, Neoprene and Thiokol.
Module 5: Alkaloids 9hrs
Occurrence, general methods of isolation, functional group analysis, functional nature of oxygen containing groups -OH,-COOH,-CHO, >C=O groups, nature of
nitrogen, Hoffmann exhaustive methylation, structure and physiological actions of conine, nicotine, quinine, morphine and codeine (structure elucidation is not expected)

**Module 6: Polymers**

Natural and synthetic polymers, preparation and uses of vinyl polymers-PE, PVC, PVA, PS, PVF, PMMA, PTFE, Synthetic fibres-Nylon, Nylon 66, Terylene, Di methyl teraphthalat, polymers in medicine and surgery

**Semester 3 References**

1. Chemistry of natural products Vol. 1               Gurdeep Chatwal
2. The Text Book of Organic Chemistry                P.L Soni, H.M. Chowla
3. Organic Chemistry Vol 1 & 2                        I.L. Finar
5. Polymer Chemistry                                B.K Sharma
6. Inorganic Polymer Chemistry                       G S Misra

**Nirmalendu Nath**
8. Food Chemistry                                    L. H. Mayer

**Model Question paper for S3 Complementary Chemistry Course - III (For Home Science Programme)**

**Course Code CH1331.5**

**Organic Chemistry II**

**Time: Three Hours**

**Total Weightage: 30**

**Section A, weightage 1 each**

(Answer all questions.)

**I**

1. Give an example of a sol
2. A liquid in liquid system of colloid is called_________
3. Name a purification method of colloidal system
4. Name an optical property shown by colloids

**II**

5. Adsorbent in TLC is_________.
6. Enthalpy of adsorption is negative. True or false.
7. The process of removing the adsorbed substance is known as__________.
8. Paper is_________ phase in paper chromatography?

**III**

9. Colour fixing group of a dye is known as_________.
10. An example of a chromophore is______.
11. Give an example of an azo dye.
12. Name a dye that is used in acid base titration

**IV**

14. Natural rubber is a_________ isomer.
15. How many isoprene units are there in sesquiterpenes?
16. What is the monomer of neoprene $1 \times 4 = 4$
Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. What is meant by coagulation of colloids?
18. Write any two applications of adsorption
19. What is the adsorbent used in chromatography? Differentiate adsorption and partition column chromatography
20. Give the preparation of methyl orange.
22. Define isoprene and special isoprene rule
23. What is the action of Ag₂O on citral?
24. How is the functional nature of OH analysed in alkaloids?
25. Give the structure of Nylon 6,6
26. Explain the principle of ultramicroscope.
27. What is Bakelite?
28. Write the structure of coniine. 1×8 = 8

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. What is gold number? Explain protective colloid
30. Give the preparation of alizarin
31. How is Thiokol prepared?
32. Explain Hoffmann exhaustive methylation.
33. Give the structure and physiological action of coniine.
34. How is polystyrene synthesised?
35. What is Hardy-Schultz rule? Explain with an example.
36. Explain Delta formation. 2×5 = 10

Section D, weightage 4 each (long essay)
(Answer any 2.)
37. Write an essay on the role of polymers in medicine and surgery.
38. What are emulsifiers? Explain the cleansing action of soap.
39. Give preparation and uses (1) PVC (2) PMMA (3) Terylene (4) PTFE
4×2 = 8

Syllabus (Complementary course Chemistry)
(For Students of Home Science majors)
SEMESTER 4 Course-4 Credit-3 Course Code – CH1431 .5
Organic and Medicinal Chemistry
L-T-P 3-0-2  Total- 54 hrs

Module-1: Medicinal Chemistry
Chemotherapy-Drugs- Classification, Elementary study of analgesics, antipyretics, antibiotics, antimalarials, sulphadregs, mode of action of drugs, synthesis of aspirin and paracetamol

Module-2: Food additives
Preservatives –Calcium propionate, sodium benzoate and sodiumbisulphite antioxidants-Structure and functions of Butylated hydroxy anisole(BHA), Butylated
hydroxy toluene (BHT), Vitamine A, E and C. Artificial sweeteners – Structure and applications of saccharin, aspartame and cyclamate. Emulsifiers - chitin

**Module-3: Heterocyclics**

9hrs

Introduction, Classification and nomenclature. Isolation, preparation, physical properties, acidic and basic character, addition, substitution, oxidation and resonance structures of pyrrole, furan, thiophene and pyridine.

**Module-4: Insecticides and pesticides**

9hrs

Insecticides - classification and preparation of compounds like DDT, DDE and BHC. Methoxy chlor, malathion, parathion and carbamates (mention only).

An elementary study of antiseptics, disinfectants, pesticides, rodenticides, herbicides and fungicides.

**Module-5: Environmental Chemistry - I**

9hrs

Air and soil pollution - Introduction, different types of air and soil pollution, air pollutants SO₂, SO₃, NOₓ, NO₂ and smog. Acid rains, CO₂, CO, green house effect, O₃, importance of ozone layer, causes and effects of ozone layer depletion. Aerosol, photochemical oxidants, PAN, hydrocarbons, particulates, dust, smoke, asbestos, lead, mercury, cadmium. Control of air pollution

**Module-6: Environmental Chemistry - II**

9hrs

Water pollution - Factors affecting the 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 and electrodialysis.

**Semester 4 References**

1. Chemistry of natural products Vol. 1               Gurdeep Chatwal
2. The Text Book of Organic Chemistry                P.L Soni, H.M. Chowla
3. Organic Chemistry Vol 1 & 2                                 I.L. Finar
5. Polymer Chemistry B.K Sharma
6. Inorganic Polymer Chemistry G S Misra
Nirmalendu Nath
8. Food Chemistry L. H. Mayer
Model Question paper for S4 Complementary Course - IV  
Course Code – CH1431 .5  
(For Students of Home Science Programme)  
Organic and Medicinal Chemistry  

Time : Three Hours  
Total Weightage : 30  

Section A, weightage 1 each  
(answer in one word \ sentence)  

(Answer all questions.)  

I  
1. Give the structure of aspirin.  
2. Name a sulpha drug.  
3. _____ is an analgesic  
4. What is an antipyretic  

II  
5. _____ is a food preservative  
6. A vitamin that can act as antioxidant.  
7. Draw the structure of Saccharin  
8. Write an example for emulsifier.  

III  
9. What is the product obtained on complete reduction of furan?  
10. Give a reaction showing the acidic character of pyrrole.  
11. A five membered heterocyclic containing sulphur atom is __________ .  
12. Gas responsible for green house effect is _____  

IV  
13. Draw the structure of DDT.  
14. BHC stands for __________ .  
15. Write an example of an antiseptic.  
16. What is the use of methoxychlor ?  

1×4 = 4  

Section B, weightage 1 each (short answer type)  

Answer any eight questions from the following. Each answer must contain 4 points.  

17. Name two antibiotics.  
18. What is BHT? What are its functions?  
19. What is the function of a food preservative?  
20. How is thiophene isolated?  
21. Give the sulphonation reaction of pyrrole.  
22. Write two chemicals used for sterilisation  
23. What is an aerosol ? Give example.  
24. Explain reverse osmosis.  
25. How is water freed from toxic organic matter?  
26. Distinguish between hard and soft water.  
27. What are the different types of pollutants in air?  
28. Explain electrodialysis.  

1×8 = 8  

Section C, weightage 2 each (short essay)  

Answer any 5 questions from the following. Each answer must contain 8 points.  

29. Give the synthesis of aspirin.  
30. What is the mode of action of drugs?  
31. Explain the resonance structure of thiophene.  
32. What are malathion and parathion?  
33. Write a note on green house effect.  
34. Explain the term photochemical oxidant. Give example.  
35. Explain the preparation and properties of furan.
How are the following prepared? (1) DDT (2) DDE (3) methoxychlor (4) BHC

Section D, weightage 4 each (long essay)

Answer any 2.

Give an outline of control of air pollution.

Explain the causes and effects of ozone layer depletion.

Write the structure and applications of saccharine, aspartane and cyclamate. What is chitin? Give its applications.

SYLLABUS FOR LABORATORY COURSES FOR COMPLEMENTARY CHEMISTRY

Course V Course Code CH1432 .5 Credit 2 Semesters 1,2,3 & 4

For students of Botany, Zoology, Home Science and Biochemistry majors

Qualitative Analysis

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

Organic preparations

1. Acetanilide from aniline

2. Metadinitrobenzene from nitro benzene

3. Benzoic acid from benzyl chloride

A student has to analyse at least twelve organic compounds.

Volumetric Analysis

I. Acidimetry and alkaliometry

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

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

c. Determination of sodium hydroxide and sodium carbonate in a mixture (indicator method)
II. Permanganometry
   a. Standardization of KMnO₄ 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

II. Dichrometry
   a. Preparation of Std. K₂Cr₂O₇ and estimation of ferrous iron by external and internal indicators.
   b. Estimation of ferric iron by reduction with stannous chloride (internal indicator).

III. Iodimetry and Iodometry
   a. Standardisation of sodium thiosulphate using std potassium dichromate
   b. Estimation of copper in a solution
   c. Estimation of iodine

IV. Complexometric titrations
   a. Standardisation of EDTA using std Mg²⁺ or Zn²⁺ ion solution.
   b. Estimation of any one metallic ion from Ca²⁺, Mg²⁺, Zn²⁺ or Ni²⁺

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

Gravimetric Analysis

1. Estimation of water of hydration in barium chloride crystals

2. Estimation of barium in barium chloride solution.

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

COURSE OFFERING AND CREDITS
Semester IV; credits: Two

COURSE OBJECTIVES
To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

**COURSE TRANSACTION FORMAT**

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

**MODE OF EVALUATION**

**Continuous Evaluation:** The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes/tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
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<td>1. Attendance</td>
<td>1</td>
<td>≥90% - A</td>
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<td>&lt;90 - ≥85% - B</td>
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<td>&lt;85 - ≥80% - C</td>
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<td>&lt;75% - E</td>
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<td>2. Experiment (Lab) Report</td>
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<td>A-E</td>
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<tr>
<td>3. Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
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<tr>
<td>4. Quiz / Test</td>
<td>1</td>
<td>A-E</td>
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</table>

**Evaluation of the Experiment (Lab) report and Lab Skill:** On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless
experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of Experiment (Lab) Report Evaluation</th>
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<tbody>
<tr>
<td><strong>No</strong></td>
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<th>Mode of Lab Skill Evaluation</th>
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<tr>
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Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.
End Semester Evaluation: 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics\geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3- hr duration.

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Components in General</th>
<th>Weightage</th>
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<td>1</td>
<td>Principle and Procedure</td>
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<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
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<td>3</td>
<td>Calculations &amp; Result</td>
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<td>A-E</td>
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<tr>
<td>4</td>
<td>Lab Course Record</td>
<td>6</td>
<td>A-E</td>
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</tbody>
</table>

If necessary this table may be modified by the Board of Examiners

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below.
Semester IV Course Code CH1432 .5

1. Inorganic Quantitative Analysis(Volumetric Analysis)

Estimation of ion or salt in Volumetric Analysis.

To all complementary Courses

| Sub-Components for End Sem Evaluation of Quantitative Volumetric Analysis |
|-----------------------------|-----------------------------|
| **N o.** | **Main Component** | **Weightage** | **Sub-Components** | **Grades** |
| 1       | Principle and Procedure | 2      | i. Principle of the experiment stated & correct  
        |                        |         | ii. Aim of the experiment stated & correct  
        |                        |         | iii. Procedure stated & correct  
        |                        |         | iv. Materials & apparatus specified | All 4 subcomponents : A  
        |                        |         | Only three : B  
        |                        |         | Only two : C  
        |                        |         | Only one : D  
        |                        |         | None : E |
| 2       | Experiment Report &Lab Skill | 4      | i. Standardization calculation correct  
        |                        |         | ii. Estimation Calculation correct  
        |                        |         | iii. Unknown Weight Calculation Correct  
        |                        |         | iv. Neatness of data and result presentation | All 4 subcomponents : A  
        |                        |         | Only three : B  
        |                        |         | Only two : C  
        |                        |         | Only one : D  
        |                        |         | None : E |
| 3       | Calculations & Result | 6      | i. \(< 1\%\)  
        |                        |         | ii. \(>1 - \leq 1.4\)  
        |                        |         | iii. \(1.4 - \leq 1.8\)  
        |                        |         | iv. \(>1.8 - \leq 2.2\)  
        |                        |         | v. \(>2.2\) | A  
        |                        |         | B  
        |                        |         | C  
        |                        |         | D  
        |                        |         | E |
| 4       | Lab Course Record Book | 3      | i. Required No: of Experiments done  
        |                        |         | ii. Data and experimental details sufficient  
        |                        |         | iii. Correctness of results reported  
        |                        |         | iv. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
        |                        |         | Only three : B  
        |                        |         | Only two : C  
        |                        |         | Only one : D  
        |                        |         | None : E |

If necessary this table may be modified by the Board of Examiners
2. Organic Qualitative Analysis

Organic Compound Analysis-Zoology, Botany, Biochemistry & Homescience majors

<table>
<thead>
<tr>
<th>Sub-Components for End Sem Evaluation of Organic Qualitative Analysis</th>
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If necessary this table may be modified by the Board of Examiners

Total weightage for ESE is 30 and for CE is 4.
CE for each half practical course (volumetric, cations, organic)

<table>
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<th>No</th>
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<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners
UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS
Complementary Chemistry offered to Biochemistry Majors

Each Complementary Course has 4 theory courses and 4 practical courses. The Hour allotments and Credits for all are given in the table.

**Chemistry Complementary**

**Complementary Courses - 4 Total Credits – 14**

**One Semester – 18 Weeks**

<table>
<thead>
<tr>
<th>Sem</th>
<th>Hours/ Week</th>
<th>Theory</th>
<th>Lab</th>
<th>Number Of Credits</th>
<th>Course</th>
<th>Title of Course</th>
<th>Instructional Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1131 .6</td>
<td>2×18 = 36</td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>CH1231 .6</td>
<td>2×18 = 36</td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>CH1331 .6</td>
<td>3×18 = 54</td>
<td>2×18 = 36</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>CH1431 .6</td>
<td>3×18 = 54</td>
<td>2×18 = 36</td>
</tr>
</tbody>
</table>

**GENERAL ASPECTS OF EVALUATION**

**Mode of Evaluation - Common to Core, Elective, Complementary and Foundation Courses**

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 25 % and End Semester evaluation (ESE) with a weightage of 75 %. A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Grade</th>
<th>Grade Point</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>A</td>
<td>4</td>
<td>3.50-4.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>B</td>
<td>3</td>
<td>2.50-3.49</td>
</tr>
<tr>
<td>Good</td>
<td>C</td>
<td>2</td>
<td>1.50-2.49</td>
</tr>
<tr>
<td>Average</td>
<td>D</td>
<td>1</td>
<td>0.50-1.49</td>
</tr>
<tr>
<td>Below Average</td>
<td>E</td>
<td>0</td>
<td>0.00-0.49</td>
</tr>
</tbody>
</table>
I. 1. **Continuous Evaluation for Lecture Courses**

The Continuous evaluation will have 25% percentage weightage 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

Grades A-E will be awarded for each component. There will be two class tests for which, the average of the two grades obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Dept. The topic selection by the student for assignments/seminar will be with the approval of the course teacher. Total weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lecture Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
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<tr>
<td>3</td>
</tr>
</tbody>
</table>

I. 1. 1. **Evaluation of the Assignments and Seminar**

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding grades A-E based for each of the four components below. The seminar is to be conducted within the contact hour allotted for the course.
# Mode of Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to overall structure &amp; submission deadline</td>
<td>All four sub-components : A</td>
</tr>
<tr>
<td>2</td>
<td>Content &amp; grasp of the topic</td>
<td>Only three : B</td>
</tr>
<tr>
<td>3</td>
<td>Lucidity / Clarity of presentation</td>
<td>Only two : C</td>
</tr>
<tr>
<td>4</td>
<td>References / Interaction/Overall effort</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
</tbody>
</table>

The following guidelines are suggested as tentatively for the evaluation of each of the above main components. Thus, if all sub-components are present/satisfactory, then Grade A may be assigned to the main component.

## Guidelines for Assignments / Seminar Evaluation

<table>
<thead>
<tr>
<th>N o</th>
<th>Main Component</th>
<th>Sub-Components</th>
</tr>
</thead>
</table>
| 1   | Adherence to overall structure & submission deadline | i. Punctual submission  
      |                                                    | ii. Adequate length/duration  
      |                                                    | iii. Inclusion of Introduction, Discussion & Summary sections  
      |                                                    | iv. Absence of errors/mistakes |
| 2   | Content & grasp of the topic                        | i. Coverage of topic  
      |                                                    | ii. Understanding of topic  
      |                                                    | iii. Logical organization  
      |                                                    | iv. Originality (No copying from a source or plagiarism) |
| 3   | Lucidity / Clarity                                  | i. Clarity  
      |                                                    | ii. Effective presentation/delivery  
      |                                                    | iii. Neatness of presentation  
      |                                                    | iv. Inclusion of appropriate diagrams /equations /structures etc |
| 4   | References / Interaction/Overall effort              | i. Listing of references  
      |                                                    | ii. Use of more than one reference source/Use of Web resource  
      |                                                    | iii. Correct Response to quiz /questions  
      |                                                    | iv. Overall effort in preparing assignment/seminar |

## 1. 1. 2. DETAILS OF THE CLASS TEST

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D

3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).

4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1(Short Answer).

5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).

6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).

7. Total weightage for the entire questions to be answered is 10.

<table>
<thead>
<tr>
<th>Question Paper Pattern for Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question No</strong></td>
</tr>
<tr>
<td>Part A: I. 1-4; II. 4-8</td>
</tr>
<tr>
<td>Part B: 9-12</td>
</tr>
<tr>
<td>Part C: 13,14</td>
</tr>
<tr>
<td>Part D: 15,16</td>
</tr>
</tbody>
</table>

**I. 2. CONTINUOUS EVALUATION FOR LABORATORY COURSES**

The Continuous evaluation will have 25% percentage weightage. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weightage is 4.
### Components of CE For Lab Courses

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>≥90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - ≥85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - ≥80% - C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;80 - ≥75% - D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;75% - E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

#### 1.2.1. **Evaluation of the Experiment (Lab) Report**

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

### Mode of Experiment (Lab) Report Evaluation

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punctual submission and Neat presentation</td>
<td>All four sub-components: A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Inclusion of aim, materials, procedure etc.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Calculations and absence of errors/mistakes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Accuracy of the result</td>
<td></td>
</tr>
</tbody>
</table>
I.2.2. **Evaluation of the Lab Skill**

<table>
<thead>
<tr>
<th>Mode of Lab Skill Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{No} )</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>&amp;</td>
</tr>
</tbody>
</table>

I.2.3. **Evaluation of the Lab Quiz/Test**

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the better grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II.1. **End Semester Evaluation for Lecture Courses**

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation.

II.1.1. **End Semester Question Paper Pattern**

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains four questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word-answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).

5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).

6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).

7. The total weightage for the entire questions to be answered is 30.
Syllabus for complementary courses
(for Bio Chemistry Majors)

Semester-1 Complementary Course No. - 1 Course Code-CH1131 .6
Credit-2    L-T-P 2-0-2

SEMESTER 1

Inorganic and Analytical Chemistry                               36 hrs

**Module I** – Atomic structure                                     9 hrs
Atomic spectra of hydrogen, different series, Rydberg equation. Bohr theory-postulates –statement of Bohr energy equation –derivation of spectral frequency from Bohr equation-Schrodinger wave equation(mention only), concepts of orbitals, the four quantum numbers and their significance- Orbitalwise electron configuration, energy sequence rule, Pauli’s principle, Hund’s rule, stability of filled and half filled orbitals.

**Module II**- Analytical Principles                                 9 hrs
Principles of volumetric analysis, primary standards, Standard solutions, normality and molarity, numerical problems, theory of acid base titrations, permanganometric and dichrometric titrations, theory of acid base and redox indicators.(Numerical problems are to be worked out)

**Module III**- Radioactivity and Nuclear Chemistry                  9 hrs
Radioactive equilibrium, detection of radio activity, Geiger Muller Counter, Wilson cloud chamber, Units of radioactivity-Curie and Rutherford. Applications of radioactivity- in medicine and agriculture, biological effects of radiation, pathological and genetic damage, Nuclear Chemistry-stability of nucleus, n/p ratio, artificial transmutation and radioactivity, mass defect, binding energy, neutron activation analysis

**Module IV**- Organometallics and biomolecules                      9 hrs
Organometallic compounds –Definition and classification, Biological and environmental aspects of organometallics-organometallics in medicine, Organo mercury, boron, silicon and arsenic compounds. Biomolecules –Metallo porphyrins, Haemoglobin and Myoglobin.

References

1. Concise Inorganic Chemistry                                      J. D. Lee
2. Inorganic Chemistry                                              Puri and Sharma
3. Chemistry of Organometallics                                     Rochow
4. Organic Chemistry Vol 2                                          I.L. Finar
5. Chemistry of natural products Vol. 1                            Gurdeep Chatwal
6. The Text Book of Organic Chemistry                              P.L Soni, H.M. Chowla
7. Modern Inorganic Chemistry                                       R D Madan
Model Question Paper  Chemistry complementary for Biochemistry Majors
Semester I CH1131 .6 Course- I
Inorganic and Analytical Chemistry

Time : Three Hours                                             Total Weightage : 30

Section A, weightage 1 each (answer in one word \ sentence)
Answer all questions.
I. 1. Angular momentum of an electron is a whole number multiple of __________.
2. Give the relationship between wavelength, frequency and velocity of electromagnetic radiation.
3. The Rydberg equation for calculating wave number of radiation is __________.
4. Give Schrödinger equation which describes the behaviour of the electron in an atom.
II. 5. A substance which is in the pure and stable form is called __________
6. __________ indicator is used for the titration between strong base and weak acid.
7. Name the internal indicator used for the estimation of Fe SO4
8. __________ is the normality of 5% NaOH solution.
III. 9. Complete the equation $^{238}$U $\rightarrow$ __________ + $^4$He $+$ __________
10. Who introduced packing fraction?
11. What is meant by transmutation?
12. Name a device used to detect radioactivity.
IV. 13. Give example of one organometallic compound.
14. What are Grignard reagents?
15. Which is the solvent used in the preparation of Grignard reagents?
16. Myoglobin contains __________ in the high spin state. $1\times4 = 4$

Section B, weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Draw the shapes of d orbitals
18. Give the names of 2 redox indicators
19. Write a note on stability of nucleus by n/p ratio.
21. Draw the structure of Mg Porphyrin
22. Calculate the weight of Na$_2$CO$_3$ required to prepare 250 ml N$	imes$10 solution.
23. Why HCl is not used in permanganometric titrations?
24. Mention any 2 applications of radioactivity.
25. Give the structure of 2 organo arsenic compounds.
26. Explain Hund’s rule with a suitable example.
27. Define electronegativity, explain Pauling’s electronegativity scale.
28. What are the units of radioactivity. Explain. $1\times8 = 8$

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Explain the wave nature of material objects. ii. What is uncertainty principle?
30. Explain mass defect and binding energy.
31. Write a short note on applications of organometallic compounds in medicine.
32. What are the functions of Myoglobin and Haemoglobin
33. Explain nuclear fission and nuclear fusion.
34. Explain normality, molarity and molality.
35. What are quantum numbers? Explain its significance.
36. What are the applications of radioactivity in agriculture? \(2 \times 5 = 10\)

**Section D, weightage 4 each (long essay)**
Answer any 2.

37. Derive Bohr frequency equation.
38. Write a note on acid base indicators.
39. What are biological effects of radiation? \(4 \times 2 = 8\)

Syllabus (Complementary course Chemistry)
(For Students of Bio Chemistry Majors)

**SEMMESTER 2 Course No. 2 Course Code : CH1231 .6 Credit 2**

L-T-P 2-0-2

**Organic Chemistry 36 hrs**

**Module I: Carbohydrates 9hrs**
Classification, configuration of glyceraldehydes, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose. Reactions of glucose and fructose. Pyranoside structures of glucose and fructose. Furanoside structure of fructose. (structure elucidation not expected), muta rotation, epimerization, conversion of glucose into fructose and vice versa.

**Module II Vitamins 9hrs**
Classification, source, isolation, physiological function and deficiency diseases caused by Vitamin A1 (retinol), A2 (axerophthol), Vitamin B-B1 (thiamine), B2 (riboflavin and folic acid), B3 (niacin), B6 (Pyridoxine), B12 (Cyano cobalamin). Vitamin C (ascorbic acid), – Vitamin D2 (ergocalciferol), Vitamin E (Tochopherols), Vitamin H (biotin) and Vitamin K

**Module III: Aminoacids and Proteins 9hrs**
Classification, synthesis of glycine, alanine, phenylalanine and aspartic acid, zwitter ion, isoelectric point, reactions of aminoacids, peptide linkage, peptide synthesis, polypeptides, primary, secondary, tertiary and quarternary structure of proteins, classification, biological importance and tests for proteins.

**Module IV: Enzymes and Hormones 9hrs**
Enzymes- Characteristics, classification, factors influencing enzyme action, mechanism of enzyme action, Michaelis – Menton theory, enzyme inhibitors.
Hormones- Introduction, isolation, functions and abnormalities due to oxytocin, thyroxin, adrenalin, glutathione, progesterone, estrogens, cortisone, corticosterone, adrenalin

References

1. Concise Inorganic Chemistry J. D. Lee
2. Inorganic Chemistry Puri and Sharma
3. Chemistry of Organometallics Rochow
Model Question paper for S2 Complementary Chemistry Course - II
Semester 2 CH1231.6 (For Students of Bio Chemistry majors)
Organic Chemistry

Time: Three Hours
Total Weightage: 30

Section A, weightage 1 each (answer in one word/sentence)
Answer all questions.

I 1. Give the structure of D-glyceraldehyde?
2. Name an aldo pentose.
3. Give an example of a ketohexose
4. ________ is dextro rotatory

II 5. Which is the metal present in Vitamin B12
6. Name a steroid vitamin
7. Deficiency of ________ causes xerophthalmia
8. Beriberi can be prevented by supplementing _____

III 9. Give an example of acidic amino acid
10. ________ is a peptide linkage
11. Isoelectric point of glycine is ________.
12. Which is the reagent used in xanthoproteic test?

IV 13. _____ are biological catalysts.
14. Which is the optimum pH of enzyme action
15. Abnormality caused by excess of cortisone in blood is ________.
16. Name a protein Hormone 1×4 = 4

Section B, Weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.

17. Draw the ring structure of glucose and fructose
18. What is mutarotation?
19. Give an example each of fat soluble and water soluble vitamin
20. What is a zwitter ion?
21. How can you prepare glycine?
22. What is a prosthetic group?
23. What are the functions of oxytocin?
24. What is the action of bromine water on glucose?
25. What is the physiological function and deficiency disease caused by Vitamin C?
26. What is epimerisation?
27. Explain classification of vitamins.
28. What is bile acid? 1×8 = 8
**Section C, weightage 2 each (short essay)**

Answer any 5 questions from the following. Each answer must contain 8 points.

29. Give relevant equations for conversion of fructose to fructosazone
30. Explain the isolation and physiological function of retinol.
31. What are fibrous and globular proteins? Explain.
32. What are the abnormalities shown by the imbalance of thyroxin?
33. What is vitamin E? Mention its importance.
34. How can you convert pyruvic acid to alanine?
35. Write any two tests for protein
36. Deduce the D and L configuration of threose and erythrose. \(2 \times 5 = 10\)

**Section D, weightage 4 (long essay)**

Answer any 2.

37. How can you convert glucose to fructose and vice versa?
38. Explain the secondary structure of protein.
39. What is enzyme catalysis? Give Michaelis-Menton theory of enzyme action

\(4 \times 2 = 8\)

**Syllabus for complementary course**

(for Biochemistry Majors)

**Semester-3 Course-3 Credit-3 Course Code – CH1331 .6**

**Inorganic and Organic Chemistry and Spectroscopy** Total - 54hrs

**L-T-P 3-0-2**

**Module I: Chemical Bonding** 9hrs

- Energies of bond formation Born-Haber cycle, hybridization and structure of molecules-sp, sp\(^2\), sp\(^3\), dsp\(^2\), dsp\(^3\), sp\(^3\)d\(^2\) hybridisation with examples, explanation of bond angle in water and ammonia, VSEPR theory with regular and irregular geometry, polarity of covalent bond, its relation with electronegativity, electronegativity scale-Paulings and Mullickens approaches, factors influencing polarity, dipole moment, its relation to geometry, hydrogen bond, intra and intermolecular hydrogen bond, its consequence on BP, volatility and solubility, partial covalent character of ionic bond, Fajans’s rule

**Module II: Coordination Chemistry** 9hrs

- Nomenclature, coordination number, geometry, chelates, isomerism, structural and stereoisomerism, Valence Bond theory of bonding in octahedral and tetrahedral complexes, high spin and low spin complexes, drawbacks of Valence Bond theory, magnetic properties and application in qualitative and quantitative analysis

**Module III: Mechanism in Organic Substitution Reactions** 9hrs

- Electron displacement in organic molecules, inductive, electromeric and mesomeric effects, hyper conjugation and steric effect, bond fission, rate determining step nucleophilic substitution of alkyl halides, SN1, SN2 reactions, effect of structure on reactivity as illustrated by methyl, ethyl, isopropyl and tertiary groups, aromatic electrophilic substitution reactions, directive influence
Module IV: Stereochemistry
Optical isomerism, chirality, racemisation and resolution, relative and absolute configuration, asymmetric synthesis, optical isomerism, E and Z nomenclature, aldoxims and ketoxims, rotational isomerism, rotation about carbon – carbon single bond, conformation of ethane, propane, butane, cyclohexane, axial and equatorial bonds

Module V: Spectroscopy – I
Regions of electromagnetic spectrum interaction radiation with matter, different types of energy levels in molecules, rotation, vibration and electronic levels, various types of molecular spectra, microwave spectroscopy, spectra of diatomic molecules, expression for rotational energy, selection rules, frequency separation, equation for frequency of vibration, expression for vibrational energy, selection rule, calculation of force constant

Module VI: Heterocyclics and Alkaloids
An outline study of the preparation and properties of Furan, Pyrrole, Thiophene, Pyridine, Hoffmans exhaustive methylation, Alkaloids, general method of isolation, general properties, physiological action of alkaloids, conine, morphine and nicotine (no structural elucidation expected)

References:
2. Concise Inorganic Chemistry: J. D. Lee, ELBS
3. Essentials of Nuclear Chemistry: H. S. Arniker
4. Environmental Pollution: B. K. Sharma
5. Inorganic Chemistry: J. E. Huheey
6. Coordination Chemistry: Bosolo and Johnson
8. Organic Chemistry: Peter Sykes
13. Advanced Organic Chemistry: Jerry March

Model Question paper for S2 Complementary Chemistry Course - II
Semester 2 CH1231.6 (For Students of Bio Chemistry majors)

Inorganic and Organic Chemistry and Spectroscopy

Time: Three Hours Total Weightage: 30

Section A, weightage 1 each (answer in one word/sentence)
Answer all questions.

I 1. Give the structure of D-glyceraldehyde?
2. Name an aldo pentose.
3. Give an example of a ketohexose
4. ________ is dextro rotatory

II 5. Which is the metal present in Vitamin B_{12}
6. Name a steroid vitamin
7. Deficiency of _______ causes xerophthalmia
8. Beriberi can be prevented by supplementing _____

III 9. Give an example of acidic amino acid
10. ______ is a peptide linkage
11. Isoelectric point of glycine is __________.
12. Which is the reagent used in xanthoproteic test?

IV 13. _____ are biological catalysts.
14. Which is the optimum PH of enzyme action
15. Abnormality caused by excess of cortisone in blood is ________.
16. Name a protein Hormone

Section B, Weightage 1 each (short answer type)
Answer any eight questions from the following. Each answer must contain 4 points.
17. Draw the ring structure of glucose and fructose
18. What is mutarotation?
19. Give an example each of fat soluble and water soluble vitamin
20. What is a zwitter ion?
21. How can you prepare glycine?
22. What is a prosthetic group?
23. What are the functions of oxytocin?
24. What is the action of bromine water on glucose?
25. What is the physiological function and deficiency disease caused by Vitamin C?
26. What is epimerisation?
27. Explain classification of vitamins.
28. What is bile acid?

Section C, weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Give relevant equations for conversion of fructose to fructosazone
30. Explain the isolation and physiological function of retinol.
31. What are fibrous and globular proteins? Explain.
32. What are the abnormalities shown by the imbalance of thyroxin?
33. What is vitamin E? Mention its importance.
34. How can you convert pyruvic acid to alanine?
35. Write any two tests for protein
36. Deduce the D and L configuration of threose and erythrose.

Section D, weightage 4 each (long essay)
Answer any 2.
37. How can you convert glucose to fructose and vice versa?
38. Explain the secondary structure of protein.
Syllabus for complementary course  
(for Biochemistry students) 

Semester-4 Course-4 Credit-3 Course Code –CH1431 .6

Organic Chemistry and Spectroscopy-II L-T-P 3-0-2  Total 54hrs

Module I: Chromatography 9hrs
    Adsorption and partition chromatography, column, paper and thin layer chromatography, Rf value, applications, gas chromatography, applications, ion-exchange chromatography, applications

Module II: Nucleic acids and Lipids 9hrs
    Nucleic acids: RNA and DNA, their biological role, hydrolysis of nucleoproteins, elementary idea regarding the structure of nucleic acids, Lipids: Classification, oils, fats and waxes, iodine value, saponification value, properties of oils and fats, phospholipids

Module III: Polymers and Terpenes 9hrs
    Polymers- Classification with examples- natural and synthetic condensation and addition polymerization, elastic fibre, thermoplastics and thermosetting plastics, Rubber structure, vulcanisation of rubber, neoprene, butyl rubber, Buna-S, Buna-N, synthetic polymers, Nylon-6, Nylon-66, Bakelite, elementary idea of the structure of natural rubber, Terpenes- classification, isoprene rule, essential oils, elementary study of citral and geraniol(structural elucidation not required)

Module IV: Biophysical Analysis 9hrs
    Osmosis osmotic pressure, isotonic solution, determination of molar mass by osmotic pressure method, reverse osmosis, adsorption - types of adsorption, applications factors influencing adsorption, Langmuir theory of adsorption

Module V: Colloids 9hrs
    Properties of colloids, Tyndal effect, ultra microscope, Brownian movement, elecrophoresis, electroosmosis, sedimentation and streaming potential stability of colloids, Zeta potential, Hardy- Schultze protective colloids, gold number, emulsion, gels, application of colloids, delta formation, medicines, sewage disposal, emulsification and cleansing action of detergents and soaps.

Module VI: Spectroscopy II 9hrs
    Raman spectroscopy, stokes and antistokes lines, quantum theory of Raman spectrum, advantages and disadvantages of Raman spectrum, rotational Raman, vibrational Raman spectrum, complementary with IR spectrum, mutual exclusion principle, NMR spectroscopy, principle of NMR spectroscopy, nuclear spin, interaction with external magnetic field, chemical schift, spin-spin coupling, applications

References:
2. Concise Inorganic Chemistry : J. D. Lee, ELBS
3 .Essentials of Nuclear Chemistry : H. S. Arniker
4. Environmental Pollution : B. K. Sharma
5 .Inorganic Chemistry : J. E. Huheey
6. Coordination Chemistry : Bosolo and Johnson
8. Organic Chemistry : Peter Sykes
Section A, Weightage 1 each (answer in one word/sentence)

1. Rf value is ________-
2. If concentration at the surface is greater than that in the bulk the phenomenon is called ________.
3. The chromatographic method where the components are separated in stacks is called ___________.
4. Sugar present in RNA is ________.

Section B, Weightage 1 each (short answer type)

17. What are Stokes and anti Stokes lines?
18. Write in brief “Ion exchange chromatography.”
19. What is paper chromatography.
20. What is iodine value ?
21. Explain saponification value.
22. What are terpenes ?
23. Explain the stereochemistry of double bond in natural rubber.
24. What are isotonic solutions ?
25. What is Tyndall effect ?
26. What is Hardy-Schultz rule?
27. Explain mutual exclusion rule ?
28. What is chemical shift?  

1×4 = 4  
1×8 = 8
Section C, Weightage 2 each (short essay)
Answer any 5 questions from the following. Each answer must contain 8 points.
29. Write a note on partition chromatography.
30. Explain biological roles of RNA and DNA.
31. Distinguish between addition and condensation polymerization.
32. Distinguish between thermoplastics and thermosetting plastics.
33. What are the different types of adsorption and the factors influencing adsorption.
34. Define electrophoresis and electro osmosis.
35. Explain the terms (1) emulsion (2) gel
36. Explain spin-spin coupling in nmr spectroscopy. \(2 \times 5 = 10\)

Section D, Weightage 4 each (long essay)
37. Briefly explain the theory and principle of Raman spectroscopy.
38. Explain in detail the applications of colloids.
39. (a) How is molar mass determined by osmotic pressure method.
     (b) Write a note on cleansing action of soaps and detergents. \(4 \times 2 = 8\)

SYLLABUS FOR LABORATORY COURSES FOR COMPLEMENTARY CHEMISTRY

Course V Course Code CH1432 .6 Credit 2 Semesters 1,2,3 & 4

For students of Botany, Zoology, Home Science and Biochemistry majors

Qualitative Analysis

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

Organic preparations

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

A student has to analyse at least twelve organic compounds.

Volumetric Analysis

I. Acidimetry and alkalimetry
a. Preparation and standardization of decinormal HCl using sodium carbonate as primary standard.

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

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

II. Permanganometry

a. Standardization of KMnO4 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

III. Dichrometry

a. Preparation of Std. K₂Cr₂O₇ and estimation of ferrous iron by external and internal indicators.

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

IV. Iodimetry and Iodometry

a. Standardisation of sodium thiosulphate using std potassium dichromate

b. Estimation of copper in a solution

c. Estimation of iodine

V. Complexometric titrations

a. Standardisation of EDTA using std Mg²⁺ or Zn²⁺ ion solution.

b. Estimation of any one metallic ion from Ca²⁺, Mg²⁺, Zn²⁺ or Ni²⁺

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

Gravimetric Analysis

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

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

**COURSE OFFERING AND CREDITS**

Semester IV; credits: Two

**COURSE OBJECTIVES**

To equip the students with skill in qualitative and quantitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

**COURSE TRANSACTION FORMAT**

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

**MODE OF EVALUATION**

*Continuous Evaluation:* The Continuous evaluation will have 25% percentage weightage. Grades A-E will be awarded for each component. There will be two quizzes/tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz/Test. These are summarized below. Total Weightage is 4.

<table>
<thead>
<tr>
<th>Components of CE For Lab Courses</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
<td><strong>Component</strong></td>
<td><strong>&gt;90%</strong></td>
</tr>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Quiz/Test</td>
<td>1</td>
</tr>
</tbody>
</table>

Grades A-E will be awarded for each component.
Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an “experiment (lab) report” should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, tables of data collected, equations, calculations, graphs, other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

<table>
<thead>
<tr>
<th>Mode of Experiment (Lab) Report Evaluation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N o</strong></td>
<td><strong>Main Component</strong></td>
</tr>
<tr>
<td>1</td>
<td>Punctual submission and Neat presentation</td>
</tr>
<tr>
<td>2</td>
<td>Inclusion of aim, materials, procedure etc.</td>
</tr>
<tr>
<td>3</td>
<td>Calculations and absence of errors/mistakes</td>
</tr>
<tr>
<td>4</td>
<td>Accuracy of the result</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of Lab Skill Evaluation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N o</strong></td>
<td><strong>Main Component</strong></td>
</tr>
<tr>
<td>1</td>
<td>Punctuality and experiment completion on time</td>
</tr>
<tr>
<td>2</td>
<td>Lab skill &amp; Neat arrangements of table and apparatus in lab</td>
</tr>
<tr>
<td>3</td>
<td>Prompt and neat recording of observations in lab note book.</td>
</tr>
<tr>
<td>4</td>
<td>Experimental Skill and attention to safety</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Details of the Lab Quiz/Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted.
for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

End Semester Evaluation: 75% percentage weightage. Total Weightage is 30. The ESE of the qualitative experiment (analysis of the mixture of two cations for the physics geology majors and organic compound analysis for the zoology, botany, biochemistry and homescience majors) and quantitative volumetric analysis of Course CH1432 will be on the 4th semester. The Examination will be of 3- hr duration.

The main components of the ESE for the Course CH1432 will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

<table>
<thead>
<tr>
<th>No</th>
<th>Main Components in General</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>4</td>
<td>A-E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>8</td>
<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>12</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record</td>
<td>6</td>
<td>A-E</td>
</tr>
</tbody>
</table>

If necessary this table may be modified by the Board of Examiners

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis are given below.
Semester IV Course Code CH1432.6

1. **Inorganic Quantitative Analysis (Volumetric Analysis)**

   Estimation of ion or salt in Volumetric Analysis.
   
   To all complementary Courses.

<table>
<thead>
<tr>
<th><strong>Sub-Components for End Sem Evaluation of Quantitative Volumetric Analysis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N o</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
</tbody>
</table>
| 1 | Principle and Procedure | 2 | i. Principle of the experiment stated & correct  
   ii. Aim of the experiment stated & correct  
   iii. Procedure stated & correct  
   iv. Materials & apparatus specified | All 4 subcomponents : A  
   Only three : B  
   Only two : C  
   Only one : D  
   None : E |
| 2 | Experiment Report & Lab Skill | 4 | i. Standardization calculation correct  
   ii. Estimation Calculation correct  
   iii. Unknown Weight Calculation Correct  
   iv. Neatness of data and result presentation | All 4 subcomponents : A  
   Only three : B  
   Only two : C  
   Only one : D  
   None : E |
| 3 | Calculations & Result | 6 | i. <1%  
   ii. >1 - ≤ 1.4  
   iii. > 1.4 - ≤ 1.8  
   iv. >1.8 - ≤ 2.2  
   v. > 2.2 | A  
   B  
   C  
   D  
   E |
| 4 | Lab Course Record Book | 3 | i. Required No: of Experiments done  
   ii. Data and experimental details sufficient  
   iii. Correctness of results reported  
   iv. Neatness of presentation and absence of errors/mistakes in the Record Book | All 4 subcomponents : A  
   Only three : B  
   Only two : C  
   Only one : D  
   None : E |

If necessary this table may be modified by the Board of Examiners
2. Organic Qualitative Analysis

Organic Compound Analysis-Zoology, Botany, Biochemistry & Home Science majors

<table>
<thead>
<tr>
<th>No</th>
<th>Main Component</th>
<th>Weightage</th>
<th>Sub-Components</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principle and Procedure</td>
<td>2</td>
<td>i. Principle of the experiment stated</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Aim of the experiment stated</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Neatness</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Materials &amp; apparatus specified.</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>2</td>
<td>Experiment Report &amp; Lab Skill</td>
<td>4</td>
<td>i. Preliminary experiments done</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Detection of elements</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Saturated-unsaturated</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Aromatic or not aromatic</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
<tr>
<td>3</td>
<td>Calculations &amp; Result</td>
<td>6</td>
<td>i. 4 correct tests</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. 3 tests correct</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. 2 correct tests</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. 1 correct test</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>v. 0 correct test</td>
<td>E</td>
</tr>
<tr>
<td>4</td>
<td>Lab Course Record Book</td>
<td>3</td>
<td>i. Required No: of Experiments done</td>
<td>All 4 subcomponents : A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Data and experimental details sufficient</td>
<td>Only three : B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iii. Correctness of results reported</td>
<td>Only two : C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>iv. Neatness of presentation and absence of errors/mistakes in the Record Book</td>
<td>Only one : D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None : E</td>
</tr>
</tbody>
</table>

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Total weightage for ESE is 30 and for CE is 4.
CE for each half practical course(volumetric, cations, organic)

### Components of CE For Lab Courses

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Weightage</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>1</td>
<td>≥90% - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;90 - &gt;85% - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;85 - &gt;80% - C</td>
</tr>
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<td></td>
<td></td>
<td>&lt;80 - &gt;75% - D</td>
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<td></td>
<td>&lt;75% - E</td>
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<tr>
<td>2</td>
<td>Experiment (Lab) Report</td>
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<td>A-E</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory Skill</td>
<td>1</td>
<td>A-E</td>
</tr>
<tr>
<td>4</td>
<td>Quiz / Test</td>
<td>1</td>
<td>A-E</td>
</tr>
</tbody>
</table>

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