All the Question Papers of the Exam, 2070
Tribhuvan University, 2070

Bachelor Level / Science & Tech. /II Year

Full Marks: 100

CHEMISTRY (CHEM.321)

Time: 3 hrs.

Use separate answer-book for each group.

New Course

The <u>Comprehensive Question</u> of each group is compulsory. Attempt EIGHT questions of <u>Short Answer Questions</u> of each Group.

GROUP "A" (INORGANIC)

<u>Comprehensive Question</u>

1. What are d block elements? Explain giving reasons why

   a. Compounds of transition metal are generally coloured.

   b. All transition metal exhibit variable valency.

   c. Paramagnetic character increases from Sc to Mn and then decreases from Mn to Zn.   [1+3+3+2]

OR

Describe how Fluorine is isolated. What are the difficulties in its preparation? What are the main uses of Fluorine?   [3×3=9]

2. <u>Short Answer Questions</u>   8×3=24

   2.1 What are ion exchange resins? Describe cation exchange resin and anion exchange resin with example.

   2.2 What do you mean by crown and crypts? Give their examples.

   2.3 How phosphate fertilizer are made? Write the role of phosphate ester in biological process.

   2.4 Write the role of copper in biological system.

   2.5 Why is that $N(CH_3)_3$ is pyramidal but $N(SiH_3)_3$ is planar.

   2.6 Aluminium forms an ion $[AlF_6]^{3-}$ but B does not form $[BF_6]^3$ ion why?

   2.7 What are phosphonitrilic compounds? Give any one method of their preparation. Cite at least one example of the use of phosphonitrilic compounds.

   2.8 How hydrazine is prepared? Mention its difficulties involved during preparation. Give uses of hydrazine.

   2.9 Give the conditions to form clatharates. What are the reasons for the stability of clatharates?

   2.10 Calculate the effective atomic number of the central metal ions in the following complexes.

       (a) $[Cu(NH_3)_4]^{++}$, $(Z = 29)$

       (b) $[Fe(CN)_6]^{4-}$, $(Z = 26)$

       (c) $[Cr(NH_3)_6]^{+3}$ $(Z = 24)$

   2.11 What do you mean by Chelates? Give at least two examples.

GROUP "B" (ORGANIC)

<u>Comprehensive Question</u>
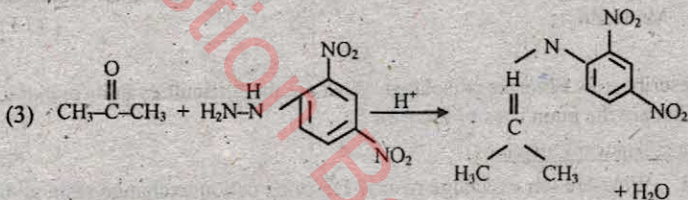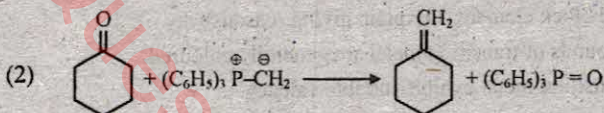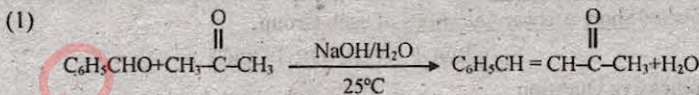
3. Why is benzene reluctant to Undergo addition reactions? Explain. Is nitro ($-NO_2$) group ortho/para or meta directing group? Write your answer giving pertinent resonating structures.

Write mechanism of Friedel - Craft alkylatton reaction.   [2+4+3]
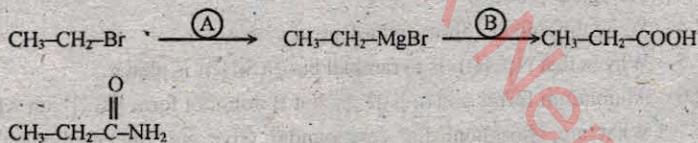
<center>OR</center>

Write mechanism of the following reactions

(1)
$$C_6H_5CHO + CH_3-\overset{\displaystyle O}{\overset{\displaystyle \|}{C}}-CH_3 \xrightarrow[25°C]{NaOH/H_2O} C_6H_5CH=CH-\overset{\displaystyle O}{\overset{\displaystyle \|}{C}}-CH_3 + H_2O$$

(2)

(3)

4. <u>Short Answer Questions</u>   8×3=24

4.1 What is 1, 3 - diaxial interaction? Illustrate giving example.

4.2 What are A, B and C?

$$CH_3-CH_2-Br \xrightarrow{\;\;A\;\;} CH_3-CH_2-MgBr \xrightarrow{\;\;B\;\;} CH_3-CH_2-COOH$$

$$CH_3-CH_2-\overset{\displaystyle O}{\overset{\displaystyle \|}{C}}-NH_2$$

4.3 How would you prepare pentan - 2 - one by an acetoacetic ester synthesis?

4.4 If you have mixture of benzoic acid and phenol, how would you separate them?

4.5 What is Hoffmann rearrangement? Write its mechanism.

4.6 How is bakelite prepared? Mention its uses.

4.7 Write the mechanism of base catalyzed halogenation of acetone.
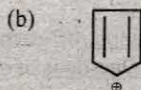
4.8 Among
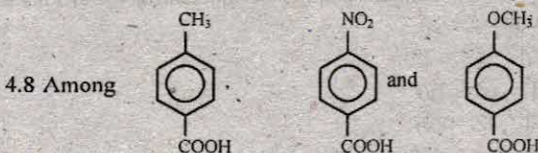
which is the most acidic and why?

4.9 How would you bring about the following reaction?
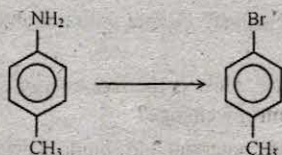
4.10 What is Baeyer's strain theory? What is wrong with this theory ?

4.11 Are the following compounds aromatic? Write your answer giving reason.

(a)

(b)

GROUP "C" (PHYSICAL)

Comprehensive Question   [10]

5.   Define first-order reaction. Derive an expression for rate constant of first-order reaction.

Show that the decomposition of hydrogen peroxide in aqueous solution is a first order reaction from the following data?   [5+5]

Time in minutes	0	5	10	20
$KMnO_4$(ml)	46.1	37.1	29.8	19.6

OR

Derive Nemst equation relating the emf of cell with concentration of the reactant and product.

Calculate the emf of the following concentration cell at 25°C $Cu|CuSO_4(M = 0.02, r = 0.32)|| CuSO_4 (M = 0.2, r = 0.11) | Cu$

6.   Short Answer Questions   8×3=24

6.1   What do you understand by Cp and Cv? Why Cp is always greater than Cv?

6.2   What are the change in entropy when 4 kg of water at 100°C is converted into steam at the same temperature (molar heat of evaporation of water = 9720 cal/mole).

6.3   Point out the difference between thermal and photochemical reaction.

6.4   State 'Beer's law. What are absorbance and molar absorbance co-efficient?

6.5   Sketch and explain the conductometric titration curve that will be obtained when HC I is titrated with NH_4OH.

6.6   At 18°C equivalent conductivities of 0.01N solution of hydrochloric acid NaCl, CH_3COONa and CH_3COOH are 369.3, 101.7, 71.7 and 14.3 ohm^{-1} cm^{-2} respectively.

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Calculate the hydrogen ion concentration of 0.01 N acetic acid at 18°C.

6.7 Can a solution of 1 M copper sulphate be stored in a vessel made of Nickel metal? Given that $E^0_{Ni/Ni^{2+}} = +0.25$ volt and $E^0_{Cu/Cu^{2+}} = -0.34$ volt.

6.8 What is heterogeneous catalyst? Define with suitable example catalytic promoter and position?

6.9 Define the term 'frequency'. How is the free energy change of a reaction related to enthalpy and entropy change?

6.10 What is meant by electrode potential and standard electrode potential?

6.11 Define Joule Thomson effect and Joule Thomson coefficient. What is inversion temperature?

OLD COURSE

The Comprehensive Question of each group is compulsory. Attempt EIGHT questions of Short Answer Questions of each Group.

GROUP "A" (INORGANIC)

Comprehensive Question

1. Why is complex compound? How does it differ from double salt? Explain how Werner's coordination theory is used to explain the bonding in coordination compound. What is EAN rule? [1+1+5+2]

OR

How hydroxyl amine is prepared? Explain its properties as reducing agent, oxidising agent, and mono acidic base character. Give its uses. [4+4+1]

2. Short Answer Questions   8x3=24

2.1 What is the principle behind Mond's process in the purification of impure Nickel?

2.2 What is "inert pair effect"? Discuss it on the basis of gr IV A element.

2.3 What are Freons? What role do they play in ozone hole formation?

2.4 Explain the nature of bonding in metal carbonyls.

2.5 Explain
   (1) $[Sc(H_2O)_6]^{+3}$ is colourless but $[Ti(H_2O_6]^{+3}$ is coloured.
   (2) Cu (I) is diamagnetic but Cu (II) is paramagnetic.

2.6 What is the principle behind solvent extraction? Give an example of the application of solvent extraction in the refining or separation of the metal.

2.7 Draw and explain the structure of XeF_2, XeO_4, $XeOF_4$.

2.8 Solutions of alkali metals in liquid ammonia are blue coloured and reducing in nature. Explain.

2.9 Suggest reason why SF_6 is known but OF_6 is not?

2.10 What are essential elements? Give brief review of role of iron in biological system.

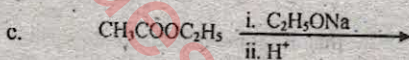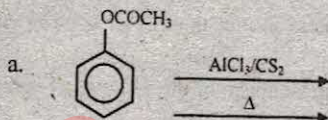2.11 How ozone is prepared in lab? Give its uses and structure.

GROUP "B" (ORGANIC)

3. Account for the angle strain in the cyclohexane in the light of Baeyer's strain theory. Write the conformations of cyclohexane that are free of angle-strain. Which of these would be more stable and why?   [5+3+1]

OR

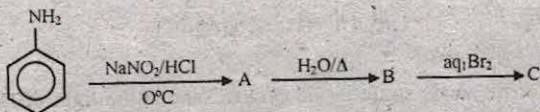Suggest a mechanism and products of the following reactions.

a. $\xrightarrow[\Delta]{AlCl_3/CS_2}$

b. $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + \overset{\oplus}{Ph_3}P-\overset{\ominus}{CH_2} \longrightarrow$

c. $CH_3COOC_2H_5 \xrightarrow[\text{ii. } H^+]{\text{i. } C_2H_5ONa}$

4. Short Answer Questions   8×3=24

    4.1 How does the resonance theory account for the extraordinary stability of benzene?

    4.2 Bromination of $CH_3CH_2COCH_3$ forms $CH_3CHBrCOCH_3$ in acid catalysed mechanism whereas it forms $CH_3CH_2COCH_2Br$ in base catalysed mechanism. How do you account for this observation?

    4.3 Arrange the order of decreasing basicities of the following. Give reason for your answers.
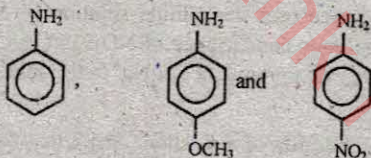
    4.4 Give reasons for the following:

        a. Melting point and boiling point of orthosalicylic acid is much lower than that of its meta and para isomers.

        b. Decarboxylation of β - Keto acid occurs easily.

    4.5 Explain why phenols can be converted into their salts by aqueous hydroxide, but not by aqueous sodium bicarbonate, Give chemical reactions.

    4.6 Outline all steps in the synthesis of 2-hexanone from acetoacetic ester.

    4.7 Identify A, B and C in the following sequence of reactions.

$$\underset{\text{NH}_2}{\bigcirc} \xrightarrow[\text{O°C}]{\text{NaNO}_2/\text{HCl}} A \xrightarrow{\text{H}_2\text{O}/\Delta} B \xrightarrow{\text{aq}_1\text{Br}_2} C$$

4.8 Outline the synthesis of aspirin and methyl salicylate from phenol.

4.9 Account for the following facts.

    a. The O–H bond in carboxylic acid is more polar than O–H bond in alcohol.

    b. The C–Cl bond in chlorobenzene is shorter than C–Cl bond in ethyl chloride.

4.10 Suggest the possible products with mechanism of the following reaction.

$$CH_3CONH_2 + Br_2 + KOH \xrightarrow{\Delta}$$
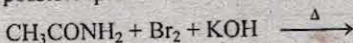
4.11 Explain why chloroacetic acid is stronger than acetic acid.

GROUP "C" (PHYSICAL)

<u>Comprehensive Question</u>   [10]

5. What is Joule-Thomson effect? Show that in Joule-Thomson expansion the enthalpy remain constant. What is temperature of inversion? Why hydrogen and helium show the heating effect at ordinary temperature while other gases do not?

Calculate the pressure – volume work performed by the system during reversible isothermal expansion of two moles of an ideal gas from 2 litre to 10 litres at 20°C.   [2+2+2+4]

OR

What does transport number of an ion mean? How is it determined experimentally by moving boundary method?

The equivalent conductance of a very dilute solution of $NaNO_3$ at 18°C is 105.2 ohm^{-1} cm^2. If the ionic conductance of NO_3^- ion in the solution is 61.7 ohm^{-1} cm^2, calculate the transport number of Na^+ in the solution?   [2+4+4]

6. <u>Shot Answer Questions</u> $8\times3=24$

6.1 What is meant by half life of a reaction? Show that half life of a second order reaction is inversely proportional to the initial concentration of the reactant?

6.2 Differentiate between average rate, instantaneous rate and initial rate of a chemical reaction.

6.3 A first order reaction is 20% completed in 20 minutes. How long will it take for 80% completion?

6.4 Derive Lambert - Beer's law. What is absorbance?

6.5 What is enzyme catalyst? State its specific nature and sensitivities?

6.6 Show your acquaintance with the term

    (a) Promoter (b) Auto catalysis (c) Poison.

6.7 The change in entropy of substance involved in a transformation is

positive. Is the change spontaneous? Explain.

6.8   What do you mean by Molar and equivalent conductance?

6.9 .Sketch conductometeric titration curve for the following reaction:

    (a) CH_3COOH with NaOH and (ii) $(COOH)_2$ with NaOH

6.10 What is a Leclanche cell? Write the cell reaction involved in it.

6.11 Point out the difference between thermal and photochemical reaction.

6.12. Will Ag metal reduce Sn^{++}?

    Given $E^0_{Ag^+/Ag} = 0.80V$ and $E^0_{Sn^+/Sn} = -0.14\ V$

Tribhuvan University, 2070

NEW COURSE

Attempt any THREE questions from Group A, any FIVE from Group B and any TWO from Group C.

ALL questions carry equal marks.

Group 'A'

1.   Discuss the theory of origin of life.

2.   What do you understand by correlation? Describe various methods of stratigraphic correlation.

3.   (a) What is geochronology? Describe the methods of absolute age determination in geology.

    (b) How do geological sections help in understanding paleotectonics?

4.   Write short notes on any TWO:

    a. Epiorogenic movement

    b. Origin of solar system

    c. Precambrian glaciation

GROUP "B"

5.   How does magma evolve? Discuss.

6.   (a) What are the bases for classification of igneous rocks in IUGS System? Give IUGS classification of basic and ultra basic rocks.

    (b) Describe the crystalliiation of magma in Ab-An system.

7.   What is metamorphism? Describe the role of pressure, temperature and chemical composition during metamorphism.

8.   (a) Discuss the metamorphism in continental subduction zone.

    (b) What is diagenesis? Describe diagenesis process.

9.   (a) Give classification of clastic sedimentary rocks.

    (b) What is meant by provenance? Describe different tools for provenance analysis.

10. Write short notes on any TWO:
   a. Kimberlite pipe
   b. Eclogite facies
   c. Textural maturity

GROUP "C"

11. Describe the stratigraphic classification, sedimentary features and depositional environment of the Siwaliks of Nepal.

12. (a) Give the stratigraphic classification of the central Nepal Lesser Himalaya according to Stocklin and Bhattarai (1977).

   (b) Describe the occurrence and composition of basic igneous rocks in the Nepal Himalaya.

13. Write short notes on any TWO:
   a. Inverted metamorphism of the MCT zone
   b. Geology of Deccan Trap
   c. Thrust tectonics of Nepal Himalaya

Old Course

Attempt any THREE questions from Group A, any FIVE from Group 8 and any TWO from Group C.

ALL questions carry equal marks.

GROUP "A"

1. What is a fold? Discuss classification of folds with suitable diagrams.

2. What is Mohr circle? Describe the method of construction and application of Mohr Circle.

3. (a) Define cleavage, foliation and schistosity. Discuss their relation with major geological structures.

   (b) Compare and contrast between ductile and brittle deformations.

4. Write short notes on any TWO:
   a. Principle of failure
   b. Stereographic projection
   c. Dynamic analysis

GROUP "B"

5. Discuss IUGS classification system of igneous rocks with neat sketch of triangular diagram and explain the basis of classification.

6. (a) What is a primary magma? Discuss the physico-chemical composition of magma.

   (b) Discuss the classification and origin of basalt

7. How are metamorphic rocks classified? Discuss the facies classification of metamorphic rocks.

8. (a) Discuss the metamorphism in divergent boundaries.

   (b) Describe the texture and classification of clastic sedimentary rocks.

9. Discuss the texture of sedimentary rocks as indicators of transport and depositional history.

10. Write short notes on any TWO:
   a. Evolution of magma
   b. Mineralogical phase rule
   c. Characteristics of lacustrine sediments

<div align="center">GROUP "C"</div>

11. Discuss the evolution of the Himalaya with special reference to the Nepal Himalaya.

12. (a) Give an account of the geology of the Kathmandu Valley.
   (b) Describe the stratigraphy of the Kali Gandaki Supergroup of Sakai (1985) and its correlation with the Nawakot Complex of Stocklin and Bhattarai (1997).

13. Write short notes on any TWO:
   a. Granites of Nepal
   b. Geology of Deccan Trap
   c. Metamorphism in the Higher Himalaya

Tribhuvan University, 2070

Bachelor Level / II Year / Hum.+ Sc. & Tech.　　　　　Full Marks: 75
Mathematical Analysis I (Math. 322)　　　　　　　　　Time: 3 hrs.

New Course

Attempt ALL the questions.

<div align="center">Group "A"　　　　　　　5×7=35</div>

1. Define one-to-one and onto function. Prove that if $f: X \rightarrow Y$ and $g : Y \rightarrow Z$ are bijectve, then $gof : X \rightarrow Z$ is also bijective and $(gof)^{-1} = f^{-1}og^{-1}$. [2+5]

2. Define open and closed set with examples. Show that every 1 - ball is an open set in $\Re$. Further show that a finite set is closed [2+3+2]

3. State and prove Nested interval theorem. [7]

<div align="center">OR</div>

Define Cauchy sequence. Show that every Cauchy sequence in $\Re$ converges. Examine whether $X_n = 1 + \frac{(-1)^n}{n}$ is bounded below or above or both. [1 +4+2]

4. Let $f: \Re \rightarrow \Re$. Then f is continuous on $\Re$ iff for every open set $A \subseteq \Re$, the inverse image $f^{-1}(A)$ is open. [7]

<div align="center">OR</div>

State and prove L' Hospitals rule and use it to evaluate: $\lim\limits_{x \rightarrow x/2} (\sin x)^{\tan x}$. [5+2]

<div align="center">Group "B"　　　　　　10×4=40</div>

5. State and prove the first fundamental theorem of calculus. Define a primitive function. State the second fundamental theorem of calculus. [5+1+1]

<div align="center">253</div>

6. When are two sets A & B called equivalent? Prove that the set of all even positive integers is equivalent to the set of all positive integers.   [1+3]

7. State the order axioms of the real numbers system.:
   Prove that if $x \in \Re$ and $\delta > 0$ then $|x| \delta \Leftrightarrow -\delta \leq x \leq \delta$.   [2+2]

8. Show that $(p \leftrightarrow q) \leftrightarrow [(p \rightarrow q) \wedge (q \rightarrow p)]$.   [4]

9. For any set S in $\Re$ prove that $\bar{S} = S \cup S'$ where $\bar{S}$ denotes the closure of S and S' denotes the derived set of S.   [4]

10. Define a subsequence of a sequence. Prove that every bounded sequence has a convergent subsequence.   [1+3]

                                    OR

   State the "Direct comparison test" and use it to investigate convergence of divergence of $\Sigma \dfrac{n+1}{n^3 + 2}$ [1+3]

11. What do you mean by absolutely convergent series? Prove that every absolutely convergent series is convergent.   [1+3]

12. Le a function f defined on $\Re \backslash \{0\}$ by $f(x) = \dfrac{x^2 + x}{|x|}$ Prove that f is discontinuous at 0 using $\in - \delta$ definition.   [4]

                                    OR

   Show that a continuous image of a compact set is compact.

13. State the Mean value theorem and verify it for the function
   $f(x) = x^2 - 3x + 2$ in $[-2, 3]$.   [4]

                                    OR

   State and prove L'Hospital rule.

14. Define upper and lower Darboux sum of a function. Let f be a bounded function on [a, b]. Then if P, P* are two partitions of [a, b] such that $P \subseteq P^*$, then

   $$U(P, f) \geq U(P, f^*).$$
                                    OR   [4]

   Let $f(x) = c$ on [a, b]. Show that f is integrable on [a, b] and
   $$\int_a^b f(x)\, dx = c\,(b - a)$$

15. Define step function on [a, b].
   Let S and t be two step functions such that
   $\forall x \in [a, b]$, $S(x) \leq 1(x)$ then
   $$\int_a^b S(x)\, dx \leq \int_a^b t(x)\, dx.$$ [4]

Attempt ALL the questions.

<div align="center">Group "A"</div>   5×7=35

1. Define a closed set. Prove that a set is closed if and only if it contains all its limit points.   [1+6]

2. Define monotonic sequence in $\Re$?.

    If the sequence is monotonically increasing and bounded above then prove that it is convergent and attains its least upper bound. Test whether the sequence $\left\{\dfrac{n+1}{n^2+2}\right\}$ is monotonic or not.   [1+4+2]

<div align="center">OR</div>

Define Cauchy sequence. Show that every Cauchy sequence in $\Re$ converges. Examine whether $x_n = 1 + \dfrac{(-1)^n}{n}$ is bounded below or above or both.   [1+4+2]

3. Define one-to-one and onto functions. Prove that if $f: X \to Y$ and $g: Y \to Z$ are bijective, then $gof: X \to Z$ is also bijective and $(gof)^{-1} = f^{-1} og^{-1}$.   [2+5]

4. State and prove Lagrange's mean value theorem. Interpret it geometrically.
                                                                            [5+2]

5. State and prove the first fundamental theorem of calculus. Define primitive function. State the second fundamental theorem of calculus.   [5+1+1]

<div align="center">OR</div>

State and prove the first mean value theorem of integral calculus. Interpret it geometrically. State the generalized first mean value theorem of integral calculus.   [4+2+1]

<div align="center">Group "B"</div>   10×4=40

6. Define the terms tautology and contradiction. Using truth tables, verify that contradiction is necessarily false.   [1+3]

7. What does the composition of two functions mean? Prove that the composition of any function and the identity function is the function itself.   [1+3]

8. Prove that the set of all infinite sequences of natural numbers is uncountable.

<div align="center">OR</div>   [4]

Prove that the Archimedian property is equivalent to each of the following statements:

a. N is unbounded, i.e. $\forall b \in \Re \exists n \in N: n > b$

b. $\forall c \exists n \in N: 0 < \dfrac{1}{n} < c$.   [2+2]

9. Define a limit point Give its examples. Prove that 0 is the only limit point of the sets $S = \left\{\dfrac{1}{n}: n \in N\right\}$.   [1+3]

10. Prove that every convergent sequence is a Cauchy sequence. Is the converse true? Justify by the example.   [3+1]

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11. What does a uniformly continuous function on a set mean ?
Show that the function f defined by $f(x) = x^3$ is uniformly continuous on
$[-1,1]$. [1+3]

OR

When is a function said to be continuous at a point? Show that the natural
logarithmic function in x is continuous on $(0, \infty)$. [1+3]

12. State L' Hospital rule and use it to evaluate $\lim\limits_{x\to 0} \dfrac{x - \sin x}{x^3}$ [3+1]

13. If $f, g \in R\ [a, b]$ then $fg \in R\ [a, b]$. [4]

OR

State and prove first mean value theorem for Riemann Integral.

14. State and prove second fundamental theorem of Integral Calculus. [4]

15. State and prove squezing Lemma ? [4]

OR

Define one-sided limits of a function. Let $f: \Re \setminus \{0\} \to \Re$ be defined by $f(x) =$
$\dfrac{x^2 + x}{|x|}$. Verify that $\lim\limits_{x\to 0} f(x)$ does not exist. [1+3]

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New Course

Attempt ALL the questions.

Group "A"   5×7=35

1. If H is a subgroup of a finite group G, then prove that order of H divides the
order of G. is converse true? Also, prove that every group of prime order is
cyclic. [4+1+2]

OR

Define a group. Let G = Q - {1}, where Q is a rational number. Then show that
G forms a group with operation * defined by $a*b = a + b - ab$ for all a, b $\in$ G.
[1+6]

2. What is the condition that the system of equations are consistent? Show that
the equations

$$3x - y + 2z = 1$$
$$x + 2y - z = 3$$
$$2x - 2y + 3z = 2$$

are consistent and solve them. [1+6]

3. Define subring o a ring. Give an example. Prove that a nonempty subset S of a
ring R is a subring of R if and only if (i) $a - b \in S$ and (ii) $a.b \in S$ for all a, b $\in$
S. [1+1+5]

4. What are sum and direct sum? Let V be a vector space over the field F and let U, W be subspaces. If V + W = V and U∩W = {0}, then show that V is the direct sum of ∪ and W.

Find two subspaces W_1, and W_2 of the vectorspace $V = \Re^2$ such that V is the direct sum of W_1 and W_2. [1+4+2]

OR

Define orthonormal basis. Find an orthonormal basis of $\Re^2$ of a given basis {(1,1,0), (1,1,1), (1,0,1)} [1+6]

5. Find the condition that the cubic equation $x^3 - px^2 + qx - r = 0$ should have its roots in harmonic progression and solve the equation $x^3 - 11x^2 + 36x - 36 = 0$, whose roots are in harmonic progresses. [7]

Group "B" 10×4=40

6. Define transpose of a matrix. If A and B are two matrices such that they are conformable for multiplication AB, then prove that $(AB)^T = B^T A^T$.

OR

Prove that the determinant $\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix}$ is a perfect square, and find its value. [4]

7. Reduce the matrix $\begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ -1 & 0 & -1 \end{pmatrix}$ to Echelon form and hence find its rank. [3+1]

8. Define equivalence relation. Is the relation "is perpendicular to" over the set of all straight lines in a plane is an equivalence relation? Justify your answer. [1+3]

9. Determine the following even or odd permutation

(a) $p = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 3 & 2 \end{pmatrix}$,

(b) $q = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix}$ [2+2]

OR

Find $(pq)^{-1}$ and $(qp)^{-1}$ if $p = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$ and $q = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$

10. Construct a vector orthogonal to $\vec{a} = (1, 2, 3)$ with respect to $\vec{b} = (-1, -2, -3)$ [4]

11. Define subspace of a vector space.

Show that the subset W = {(x, y, 0) : {(x, y, 0)} is a subspace of V = {(x, y, z) : x, y, z ∈ $\Re$}. [1+3]

12. Let V and W be vector space over a field F and assume that dim V = dim W. If T : V → W is linear transformation, then show that the following are equivalent.

(a) T is invertible

(b) T is one – one and onto, and

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(c) T is non-singular.

<div align="center">OR</div> [4]

Find the eigen vector of the matrix $\begin{pmatrix} 3 & 1 & 0 \\ 1 & 3 & 0 \\ 0 & 0 & 2 \end{pmatrix}$

13. Solve the equation $x^3 + 6x^2 + 12x - 19 = 0$ by removing its second term. [4]

14. Solve the equation $x^4 - 5x^2 - 6x - 5 = 0$ by Descarte's method.

<div align="center">OR</div> [4]

Solve the equation $x^4 - 3x^2 - 6x - 2 = 0$ by Ferrari's method.

<div align="center">OR</div> [4]

15. Solve the equation $3x^4 - 23x^2 + 35x^2 + 31x - 30 = 0$

Old Course

Attempt ALL the questions.

<div align="center">Group "A"</div>   5×7=35

1. What do you mean by consistent for a system of linear equation? Show that a system of linear non-homogeneous equation is consistent if the rank of the coefficient matrix is equal to that of the augmented matrix. [1+6]

<div align="center">OR</div>

Under what circumstances a system of homogeneous linear equation has a non-zero solution? Investigate for what value of p and q the system of simultaneous equations

$x + y + z = 6;$ $x - 2y + 3z = 10;$ $x + 2y + pz = q$

has (1) no solution (2) a unique solution (3) an infinite number of solutions.

         [1+6]

2. Prove that every subgroup of a cyclic group is cyclic.

Let $G = \left\{ I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} A = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix} B = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} C = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \right\}$

Show that G is finite abelian group which is not cyclic. [3+4]

3. Prove that every finite dimensional non-zero vector space has an orthogonal basis.

Find an orthogonal basis of $(0, 1, 1), (0, 2, 1), (1, 5, 3)$ using Gram Schmidt process. [4+3]

4. What do you mean by linear transformation? Let V be a finite dimensional and T: V → W be a linear transformation, prove that dim V = dim (Ker T) + dim (Im T). Also verify this equality from the basis $(1, 0, 0), (0, 1, 0), (0, 0, 1)$ of $\mathfrak{R}^3$. [1+4+2]

<div align="center">OR</div>

Let V and W be vector space over K, T : V → W be a linear mapping. Then

(1) Ker T is subspace of V

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(2) Im T is subspace of W

(3) T is injective iff Ker T = {O_v}

(4) T is surjective iff Im T = W. [7]

5. Find the condition that the cubic equation $ax^3 + 3bx^2 + 3cx + d = 0$ should have its roots in geometrical progression. Solve the equation $27x^3 + 42X^2 - 28x - 8 = 0$, whose roots are in geometrical progression. [3+4]

Group "B" 10×4=40

6. Define relation and equivalence relation on a set. Let Z is a set of all integers and let n ≠ 0 be any fixed integer. For any a, b∈Z define a ≡ b (mod n) if and only if n divides a − b, prove that this defines an equivalence relation on Z.

[1+3]

7. Define the inverse of a square matrix. Prove that the necessary and sufficient condition for a square matrix A to possess an inverse is that the square matrix A is non-singular. [1+3]

OR

Prove that : $\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc\,(a + b + c)^3$.

8. State Cayley-Hamilton theorem and verity it for the matrix [4]

$\begin{pmatrix} 2 & 3 \\ 1 & 5 \end{pmatrix}$

9. If H is any subgroup of G and he H then show that h∈H then show that Hh = H = hH. [4]

10. Define a group homomorphism. Let $\phi : G \to G'$ be a group homomorphism and if e & e' are the identity elements of G and G' respectively, then (1) ϕ (e) = e' (2) ϕ (x^{-1}) = $[\phi(x)]^{-1}$ for all x∈G. [1+3]

OR

Let ϕ be a homomorphism of a group G into group G' with kernel K_ϕ, then K_ϕ is a normal subgroup of G. [4]

11. What is the norm of a vector on $\Re^n$? For any two vectors P and Q in $\Re^n$, prove that [1+3]

$$\|P, Q\| \le \|P\|\,\|Q\|$$

OR

Find the scalar and vector projection of the vector (1, 2, 3) onto the vector (4, −1, 3). Give the geometrical interpretation of these projections. [3+1]

12. Define a basis of a vector space. Prove that the representation of any vector in a vector space in terms of its basis vectors is unique. [1+3]

13. Let T : $\Re^2 \to \Re$ be the linear transformation for which T(1, 2) = 3 and T(0, 3) = 2. Find T(5, 3). [4]

14. Solve: $6x^4 - 13x^3 - 35x^2 - x + 3 = 0$, one root being $2 - \sqrt{3}$. [4]

15. Solve by Cardon's method the equation $x^3 + 6x^2 + 3x + 2 = 0$ [4]

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OR

Use Ferrari's method to solve the equation $x^4 + 6x^2 + 8x + 21 = 0$.

Tribhuvan University, 2070

Bachelor Level / II Year / Se: & Tech.
Environmental Science (ENV.321)

Full Marks: 100
Time: 3 hrs.

New Course

SECTION "A"

1. Attempt any THREE questions. $3 \times 10 = 30$

   1.1 What is lentic ecosystem? Describe the nature of communities in the littoral zone of lentic ecosystem.

   1.2 A surbei sampler of 50×50 sq. cm was used to collect stonefly nymph from downstream region of two streams. The numbers of stonefly nymph from each sampling site of two streams were counted and following observation were made.

Sites	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
Steam A	15	10	6	8	7	12	15	10	12	8	16	13	12	14
Stream B	12	6	8	6	8	4	10	7	5	6	10	7	11	10

Determine whether there is significant difference in the mean number of individuals of stonefly nymph from two different streams or not. The critical value of 't' are as follows:

d.f \ α	0.10	0.05	0.02	0.01
25	1.708	2.060	2.485	2.787
26	1.706	2.056	2.479	2.779
27	1.703	2.052	2.473	2.771
28	1.701	2.048	2.4671	2.763
29	1.699	2.045	2.462	2.756

   1.3 What is hydrological cycle? Justify that hydrological cycle is a dynamic cycle of water.

   1.4 What are photochemical reactions? Describe the process of formation of peroxyacetyl nitrate (PAN) in the atmosphere.

SECTION "B"

2. Describe briefly any TEN Questions: $10 \times 5 = 50$

   2.1 Morphometry of water bodies

   2.2 Engineering properties of rock

   2.3 Factors controlling landform development

   2.4 Air as an agent of morphological processes

   2.5 Factors affecting infiltration

2.6 Properties of aquifer

2.7 Vertical thermal structure of atmosphere

2.8 Importance of Asian Monsoon

2.9 Chemical composition of the earth

2.10 Types of map

2.11 Estimation of extreme flood events

2.12 Aerial photographs and their interpretations

SECTION "C"

3. Attempt ALL the Questions.   10×2=20

Differentiate between:

3.1 Submerged and emergent macrophytes

3.2 Aquifer and aquitard

3.3 Rheotaxis and thigmotaxis

3.4 Weather and climate

3.5 Liquid limit and plastic limit

3.6 Non metallic and metallic minerals

3.8 Actual and potentiali evapotranspiration

3.9 Terai and Lesser Himalaya of Nepal

3.10 Littoral and profundal zones

3.10 Mean and median

Old Course

SECTION "A"

1. Attempt any THREE questions.   3×10=30

1.1. Discuss the adaptational features of the lotic communities for maintaining their position in swift water.

1.2 Nine lakes in mid-hills of Nepal were studied to determine the relationship between Nitrate-Nitrogen in water of lake and density of algae (Scenedesmus).

The following information were obtained:

Lake	Concentration of Nitrate – Nitrogen mg/L	Density of Scenedesmus (Individual/mL
1	18	1
2	32	3
3	45	5
4	57	10
5	69	12
6	100	25
7	120	28
8	150	34
9	155	35

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Determine the relationship between concentration of Nitrate-Nitrogen and density of Scenedesmus. Test whether the relationship is significant or not.

The tabulated value of t is as :

d.f.	Level of significance	
	0.05	0.01
6	2.447	3.707
7	2.365	3.499
8	2.306	3.355
9	2.262	3.250

1.3 Describe the impacts of humans on landscape forms and land

1.4 What is rating curve? Explain the process of determination, adjustment and extension of rating curves.

SECTION "B"

2. Describe briefly any TEN Questions: 10×5=50

2.1 Biotic community of lentic environment

2.2 Land water interchange

2.3 Applications of GIS in environment monitoring

2.4 Bulk properties of soil

2.5 Reactions of oxygen in atmosphere

2.6 Chemical composition of the earth

2.7 Cation and anion exchange phenomenon

2.8 Darey's law and its validity

2.9 Urban climatology

2.10 Jet streams

2.11 Various forms of precipitation

2.12 Climatic pattern in Nepal

SECTION "C"

3. Attempt ALL the Questions.   10×2=20
Differentiate between:

3.1 Oligotrophic and eutrophic lake

3.2 Topographic map and aerial photograph

3.3 Granite and gneiss

3.4 Formation and depletion of ozone in stratosphere

3.5 Non-metallic minerals and fossil fuels

3.6 Indoor and outdoor air pollution

3.7 Potential and actual evapo-transpiration

3.8 Percolation and infiltration

3.9 Laminar flow and turbulent flow

Tribhuvan University, 2070

Bachelor Level / Sc. & Tech. / II Year   Full Marks: 100

Microbial, Biochemistry, and Biotechnology (MB.321)   Time: 3 hrs.

New Course

GROUP "A"   5×10=50
(Long Answer Questions)

Attempt All FIVE questions.

1. Describe the metabolic steps of EMPLOYMENT Pathway.   [10]
2. Classify the aminoacids with examples.   [10]
3. Define Bioreactor. Describe the process of production of Beer.   [2+8]
4. Describe in brief the DNA replication process in bacterial cell.   [10]
5. Describe the sources and application of microbial enzymes.   [5+5]

OR

What is β - oxidation? Describe the β - oxidation steps in palmitic acid.   [2+8]

GROUP "B"   5×7=35
(Short Answer Questions)

(Attempt any FIVE questions each of seven full marks.)

6. Describe the biological functions of carbohydrates.
7. Briefly describe the water is solvent for life.
8. Describe the role of ATP in intermediatary metabolism.
9. Mention the properties of genetic code.
10. What are the risk and hazards of biotechnology?
11. Describe the Drum-Drying method for production of powder milk.

GROUP "C"   5×3=15

12. Very Short Answer Questions.

    (Attempt any FIVE questions each of three full marks.)

    a. Mention the functions of proteins.

    b. Enlist various phospholipids.

    c. Mention different elements required for life.

    d. Enlist advantages of biofertilizers.

    e. Mention the composition of ice cream.

    f. Define plant tissue culture.

Old Course

Attempt ALL the questions.

GROUP "A"   2×15=30

1. Describe the process of DNA replication.   [15]

2. Define biotechnology. Mention the achievements of genetic engineering.

OR   . [15]

Describe the steps involved in β - oxidation of unsaturated fatty acid. Calculate the number of ATP generated in this process.

GROUP "B"   2×10=20

3. Briefly mention the microbial technology of cheese production.   [10]

4. Define enzymes. Describe major properties and application of enzymes used in industry.

OR   [10]

Describe the various steps of micropropagation. Explain the process of production of disease free plants.

GROUP "C"   10×5=50

5. Explain that pyruvic acid is the key compound of microbial metabolism.

6. Differentiate between fermentation and respiration.

7. Explain the role of operons in regulating gene expression in bacteria.

8. Outline the steps in beer production process.

9. Explain the acetic acid production process.

10. Explain the role of RNA in protein synthesis.

11. Differentiate between exergonic and endorgonic reactions.

12. Explain the role of water in living cell.

13. Describe the nutritional importance of mushroom.

14. Mention the Composition of composts.

Tribhuvan University, 2070

Bachelor Level /Science & Tech. /II Year   Full Marks: 100

Physics 11 Paper (Phy.321)

(Optics, Atomic Be Nuclear Physics, Electronics)   Time: 3 hrs.

New Course

Attempt ALL the questions.

1. Explain with outline sketches and examples, the concepts of double refraction, ordinary and extraordinary rays. Also describe the working principle of a Nicol prism.   [5+5].

OR

Present analytical treatment of the theory of diffraction at a single slit and its intensity distribution on a screen.

How would you find the relative intensity of secondary maxima? Explain.

           [6+4]

2. Discuss vector atom model with reference to the significance of different quantum numbers associated with the model.   [9]

OR

Explain the conceptual difference between X - rays and y - rays. Also discuss the processes of interaction of γ - rays with matter. [3+6]

3. Draw a circuit diagram of common emitter amplifier with its DC and AC equivalent circuits. Also obtain an expression for the voltage gain in such an amplifier.

<div align="center">OR [9]</div>

Draw the circuit diagrams of Hartley and Colpit oscillators and explain the physical difference between their workings. Hence write expressions for the frequencies of oscillations in both the cases.

4. What are spherical and chromatic aberrations? Explain, with appropriate diagrams, how these defects are minimized.

<div align="center">OR [6]</div>

Discuss the theoretical details of superposition principle to derive the condition of interference maxima and minima.

5. Explain normal and anomalous Zeeman effect with their physical significance.

<div align="center">OR [6]</div>

Why is the study of accelerators important in nuclear physics? Discuss the working principle of linear accelerator.

6. Write down Boolean expressions to explain OR and and gates and discuss their workings.

<div align="center">OR [6]</div>

Explain the significance of flip-flop circuit with reference to its fundamentals.

7. Answer all questions: [6×3=18]

   a. Draw an outline sketch of a Ramsden eye piece and write down its important features.

   b. Explain "population inversion" in LASER. How is this condition achieved?

   c. How would you conclude by estimation that a - particle is more stable than He3 nucleus?

   d. Write down the conclusions of Sterm - Gerlach experiment.

   e. Two binary numbers 110011 and 1111 are given. Add these numbers and express its equivalent in decimal number.

   f. What is "doping" in semiconductor? Explain.

8. Calculate the distance between two successive positions of a movable mirror of a Michelson's interferometer giving the best fringes in the case of sodium light having lines of wavelengths 5890 A and 5896 A. [6]

9. A zone plate is designed to bring a parallel beam of light of wavelength 600 nm to the first focus of a distance of 2 meters. Estimate the radii of the first three clear elements of the zone plate. [6]

10. A source of light of wavelength 4226 A exhibits normal Zeeman effect when placed in a uniform magnetic field of 4T. Calculate the wavelength of three components of normal Zeeman pattern and the separation between them. [6]

11. The linear absorption coefficient for 1 MeV gamma rays in lead is 78 m^{-1}. Find

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the thickness of lead required to reduce by half the intensity of a beam of such gamma rays. [6]

12. Calculate the maximum current through the diode in the following circuit [6]
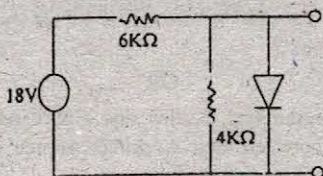
13. Define α_{dc} and β_{dc} of a transistor and find the relation between them. [6]

Old Course

Attempt ALL the questions.

1. How are two coherent sources created in Fresnel's bi-prism experiment? Describe, with necessary theory, how the wavelength of light is determined by such bi-prism experiment

OR [10]

What do you understand by grating elements? How are such elements realized? Describe the theory of plane transmission grating. Also mention its importance in optical studies.

2. Describe with a sketch and necessary theory the working of a cyclotron.

OR [9]

Explain the significance of different quantum numbers associated with a vector atom model.

3. What is brakhansen criterion? Draw a circuit diagram of Hartley oscillator and explain how the frequency of oscillation can be deduced theoretically. [2+2+5]

OR

Explain the significance of Norton's and Theremin's theorems in circuit analysis.

4. Discuss the theoretical details of superposition principle to derive the condition of interference maxima and minima.

OR [6]

Explain how plane, circular and elliptical polarized lights are obtained.

5. Explain normal and anomalous Zeeman effect with their physical significance.

OR [6]

Explain the working of a G - M counter. What are its limitations?

6. Write down the Boolean relations to explain AND and NAND gates and discuss their workings.

OR [6]

What is a Q - point in the load line of a transistor? Explain.

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7. Answer all questions : [6×3=18]
   a. Write down the features of Ramsden eyepiece with its outline sketch.
   b. Make a clear distinction between spontaneous and stimulated emissions of radiation.
   c. What do you mean by mirror nuclei? Give an example.
   d. Explain the hyperfine structure of hydrogen atom.
   e. Add two binary, numbers 111101 and 1111. Express the sum in decimal number.
   f. What is the difference between a negative and positive feed back?

8. In a Michelson interferometer 200 fringes cross the field of view when the movable mirror is moved through 0.0589 mm. Calculate the wavelength of light used. [6]

9. A plane transmitting grating has 15000 lines per inch. Find the angle of separation of the 5048 A and 5016 A lines in second order separation.

10. Calculate the distance of closest approach of an α - particle of velocity 1.6×10^7 mS^{-1} to copper nucleus. Given atomic number of copper to be 29 and mass of proton to be 1.6×10^{-27} kg. [6]

11. An old piece of wood was found to leave C^{14} activity of 6 disintegrations per minute per gm of its carbon content. The C^{14} activity of living wood in 16 disintegration per minute pw gram. Estimate the age of the wood. Half life of C^{14} = 5760 years. [6]

12. Calculate the input impedance and the ac output voltage in the following circuit.
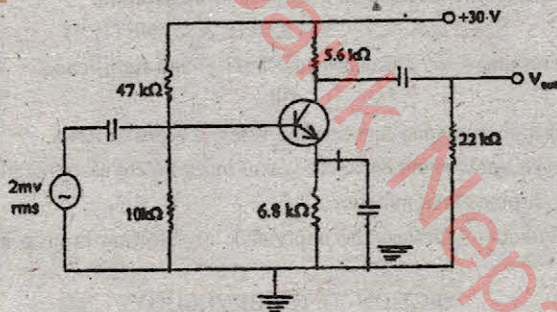
13. Explain the meaning of transistor biasiry and discuss common collector and common base characteristics with proper theory and circuit. [6]

Tribhuvan University, 2070

Bachelor Level /Science / II Year

Full Marks: 100

Ecology, Physiology, Cytology and Genetics, Embryology and Anatomy (Bot.321)

Time: 3 hrs.

New Course

Attempt ALL questions.

SECTION "A" (ECOLOGY)

1. What is succession? Discuss the process of ecological succession with suitable examples.

   OR [10]

   What is biogeochemical cycle? Describe carbon cycle, in nature.

2. Distinguish between national park and conservation area. [5]
3. What are the different measures to control water pollution? [5]
4. Describe important components of vegetation intemperate zone of Nepal. [5]

SECTION "B" (PHYSIOLOGY)

5. What is phosphorylation? Discuss the mechanism of photophosphorylation in plant

   OR [10]

   What is glycolysis? Describe its mechanism.

6. What are the major physiological effects of auxin in plant? [5]
7. Describe the major role of macro-nutrients in plant [5]
8. Discuss in brief the mechanism of stomatal transpiration. [5]

SECTION "C" (CYTOLOGY & GENETICS)

9. What is crossing over? Discuss its mechanism and significance.

   OR [10]

   Discuss the structure and functions of different types of RNA.

10. What do you know about Mendel's law of independent assortment ? [5]
11. Describe chromosomal mutations. [5]
12. What is selection? Discuss the importance of selection in crop improvement. [5]

SECTION "D" (EMBRYOLOGY)

13. Discuss in brief the structure and development of microsporangium.

    OR [5]

    Discuss the process of embryogenesis in dicotyledons.

14. Briefly explain the phenomena of double fertilization in angiosperm. [5]
15. Describe the nature of tetrasporic embryo sacs (female gametophytes). [5]

SECTION "E" (ANATOMY)

16. Illustrate and describe any one most convincing theory of organization of apical meristem in shoot.

<div align="center">OR</div> [5]

Discuss the secondary growth due to abnormal behaviour of normal cambium.

17. What are the special features of interest in the stem anatomy of xerophytes? [5]

Old Course

Attempt ALL the questions.

SECTION "A" (ECOLOGY)

1. Define biotic community. Discuss the characteristics of a plant community.

<div align="center">OR</div> [10]

What is environmental pollution? Discuss major causes of water pollution and its control measures.

2. Describe the biotic factors of a forest ecosystem. [5]
3. Discuss the role of nature reserves in biodiversity conservation. [5]
4. Describe the anatomical features of a Xerophyte and point out the adaptational features. [5]

SECTION "B" (PHYSIOLOGY)

5. What are plant growth regulators? Discuss the physiological role of Auxins in plant growth and development.

<div align="center">OR</div> [10]

What is glycolysis? Explain the fate of pyruvic acid in TCA cycle.

6. Define transpiration. Discuss its significance. [5]
7. Draw a well labelled ultrastructure of chloroplast (no description). [5]
8. Discuss the role of Hydroponics in ensuring food security. [5]
9. Outline the physiological significance of seed dormancy. [5]

SECTION "C" (CYTOLOGY & GENETICS)

10. Define inheritance. Discuss Mendel's law of independent assortment.

<div align="center">OR</div> [10]

Discuss different types of chromosomal observations and their significance.

11. Describe ultrastructure of Mitochondria. [5]
12. Give the structure of circular DNA. [5]
13. Explain incomplete dominance with suitable example. [5]

SECTION "D" (EMBRYOLOGY)

14. Give a brief account of development of a female gametophyte. [5]
15. What is palynology? Discuss its scope. [5]

SECTION "E" (ANATOMY)

16. What is meristem? Discuss the differentiation of shoot apex in the light of suitable theory. [5]

17. Describe the anomalous secondary growth in a dicot stem with one example.
[5]

Tribhuvan University, 2070

Bachelor Level / Science & Tech. / II Year   Full Marks: 100
Meteorology II Paper (MET 321)   Time: 3 hrs.

New Course (MET 321)

Attempt TWELVE questions including Q.No. 1 and 2 which are compulsory.

1. What is thermal wind? Prove that $\vec{V_r} = \frac{1}{f}\vec{K} \times \nabla(\phi_1 - \phi_0)$

   Also, explain cold and warm air advection associated with vertical shear of geostrophic wind. [1+5+4]

2. Define weather and climate. Discuss the life cycle of a tropical cyclone and its various characteristics. [2+8]

3. What do you understand by synoptic meteorology? Why synoptic charts are prepared? Discuss briefly on the various aspect of weather forecasting.[1+3+4]

4. What is the purpose of weather forecasting? How can you prepare synoptic charts and use them for weather forecasting. [2+6]

5. What are monsoon and onset of monsoon? Write about active and break in monsoon. [2+6]

6. What are the conditions favourable for the formation of thunderstorms? Discuss briefly the seasonal frequency of thunderstorms over Nepal? [5+3]

7. Write short notes on any TWO of the following:
   a. Radiative inversions and temperature inversions
   b. Thunderstorm and Tornadoes
   c. Air mass and fronts [4+4]

8. What do you understand by mean sea level pressure? Explain all the resultant winds at 200 mb in the tropical region. [2+6]

9. Explain seasonal and altitudinal precipitation variability over Nepal. [4+4]

10. What is jet stream? Explain rainfall associated with tropical cyclones. [3+5]

11. Write short notes on any TWO of the following:
   a. Cloudiness and tropical cloud types
   b. Precipitation amount and type distribution with altitude
   c. Elnino and southern oscillation [4+4]

12. Explain with necessary diagram, the coordinate systems that are used in dynamical meteorology. Why dynamical meteorology is important to understand atmospheric phenomena? [6+2]

13. What do you understand by geostrophic equations in vector form? Explain their application in the atmosphere. [4+4]

14. Write short notes on circulations and vorticity? Prove that the acceleration of the circulation is equal to the circulation of the acceleration. [3+5]

15. What do you understand by apparent forces?

Prove that $\Omega \times (\Omega \times r) = -\Omega^2 R$. Where Ω is the angular velocity, r is the radius vector and R is the position vector. [1+7]

16. Write short notes on any TWO of the following:

a. Cyclostrophic and inertial flows

b. Bjerkness theorem

c. Barotropic and baroclinic atmosphere [4+4]

Old Course (MET 321/322)

Attempt SIXTEEN questions including Q.No. 1 and Q. No. 2 which are compulsory.

1. What do you mean by tropical disturbances? Describe the formation, movement and forecasting of tropical cyclone. [3+12]

2. What are fronts? Explain different types of fronts with schematic diagrams. Derive an expression for frontogenetic factor in terms of deformation and divergence. [2+7+6]

3. Explain different factors affecting horizontal visibility? Write its components in aviation. [3+2]

4. Write different factors related to tornadoes. What are the causes of its destruction? [3+2]

5. Explain in brief the various approaches of weather forecasting in Nepal. [5]

6. What is the difference between fog and cloud? What are the causes of fog formation? [1+4]

7. What is thunderstorm? Briefly explain the conditions favourable for its formation. [1+4]

8. Explain the rainfall distribution in Nepal. [5]

9. Explain briefly the nature of ideal, real and Newtonian fluids. [5]

10. Explain briefly about the momentum equation. [5]

11. Write short notes on uniform, non-uniform, compressible and incompressible types of flow. [1+1+1+2]

12. Define with schematic diagrams path lines and stream lines. [2+3]

13. Define agricultural meteorology. Why agricultural meteorology is important for Nepal. [1+4]

14. Why air temperature is an important parameter for plan growth? [5]

15. Discuss the prevailing climatological conditions to grow rice in Nepal. [5]

16. Why soil moisture is a necessary condition for plantation? [5]

17. Write briefly the role of climate in crop tests and diseases in the tropical region. [5]

18. How does Solar radiation affects agricultural practices? [5]

19. How does frost affects in agriculture? How can we protect plants from frost? [3+2]

20. Write short notes on:

a. High pressure and low pressure areas

b. Ridge and Trough

[3+2]

Tribhuvan University, 2070

Bachelor Level / Science / II Year

Zoology (Zol.321)

Full Marks: 100

Time: 3 hrs.

New Course

(Chordata, Physiology, Cytology, Mol. & Dev. Biology)

GROUP "A"

Attempt any TWO questions.

[2×12.5=25]

1. Classify Amphibia upto orders giving important characters and examples of each.

2. What do you mean by double circulation? Describe the arterial system of Calotes with necessary diagram.

3. Give an account of air sacs in Columba and comment up on its special adaptive features.

GROUP "B"

Attempt any TWO questions.

[2×12.5=25]

4. Discuss types of crossing over and mention factors influencing it. Also mention its significance.

5. Define tidal volume. Explain the physiology of oxygen and carbondioxide transport.

6. What is adaptive radiation? Describe micro- and macro- evolution in nature with examples.

GROUP "C"

Attempt All the questions.

[8×5=40]

7. What is PCR? Mention its significance.

8. Describe briefly about tissue culture.

OR

Write about flight muscles of Columba.

9. Give an account of the types of cleavage.

10. Sketch and label the pituitary gland of man and list its hormones.

11. What are the salient features of Petrpmyzon?

12. Give the structure of brain of Labeo.

OR

Discuss the affinities of metatheria.

13. Discuss the economic importance of fishes.

14. Write short notes on any TWO:

[2×5=10]

   i. Mechanism of enzyme activity

ii. Bohr's effect

iii. Pancreatic juice

Old Course (Chordata, Cell & Tissue Biology)

Attempt any TWO questions from each Group A & B. Group C is compulsory.

<div align="center">Group "A"</div>   2×15=30

1. Describe the external and internal structure of heart of Scoliodon with suitable diagrams.

2. Describe the structure of male and female reproductive organs of Uromastix with suitable diagrams.

3. Write an account of air sacs in Columba livia. Give the importance of air sacs in birds.

<div align="center">Group "B"</div>   2×15=30

4. What is sex - linked inheritance? Discuss different types of sex - linked inheritance found in different types of living organisms.

5. Describe the structure and function of Plasma Membrane.

6. Discuss the structure of Mammalian Pituitary Gland. List different hormones produced by it and give their functions.

<div align="center">GROUP "C"</div>   8×5=40

7. Give the basic difference between metatheria and eutheria.

8. Discuss in brief differentiating features of poisonous and non-poisonous snakes.

9. What is sex determination? Discuss it in man with suitable diagrammatic example.

10. Give the structure of buccal funnel of Petromyzon with suitable diagram.

11. Write ecological notes on:
    a. Rhacophorus
    b. Gharial

12. Discuss the histological structure of testis of mammalia.

13. What is placenta? Write its function.

14. Define giant chromosome. Give the difference between Lampbrush and Polytene chromosomes.

Tribhuvan University, 2070

Bachelor Level /II Year/ Humanities + Sc. & Tech.   Full Marks: i 00

Statistics II Paper (Stat-321)   Time: 3 hrs.

1. (Compulsory) Attempt any SIX questions.   6×5=30

   (a) A binomial variate X has parameters n and p. Find the probability that $X = x$ given $X > 0$.

   (b) If X and Y are two independent random variables such that $E(X) = \lambda_1$, $V(X) = \sigma_1^2$ and $E(Y) = \lambda_2$, $V(Y) = \sigma_2^2$ then prove that $V(XY) = \sigma_1^2 \sigma_2^2 +$

<div align="center">273</div>

$$\lambda_1^2\,\sigma_2^2 + \lambda\,\sigma_2^2\,\sigma_1^2.$$

(c) Define and discuss the level of significance.

(d) Describe student t - distribution.

(e) The joint distribution of X and Y is given below:

X \ Y	0	1
0	0	K
1	K	2K
2	2K	K
3	K	O

Find (i) K (ii) V(Y) (iii) E(2X + 1)

(f) A supermarket chain is considering two sources A and B for the purchase of 50 - pound bags of onions. The following table gives the result of the study.

	Source A	Source B
No. of bags weighted	80	100
Mean weight	105.9	100.5
Sample variance	0.21	0.19

Test at $\alpha = 0.05$ whether there is a difference in the mean weights.

(g) What properties of estimators are being usually held by-maximum likelihood estimators?

Group "A"

Attempt any FOUR questions. $4\times7=28$

2. Find the mean and variance of truncated Poisson distribution.

3. If the joint pdf of (X, Y) is given by
$$f(x, y) = \begin{cases} x + y & 0 \leq x\,y \leq 1 \\ 0 & \text{otherwise} \end{cases}$$
find the pdf of $U = XY$

4. Two dice are thrown once. If X is sum of the numbers showing up, prove that $P\{|X - 7| \geq 3\} \leq \dfrac{35}{54}$ and compare this value with the exact probability.

5. The joint pdf of the r.V. (X, Y) is given by
$$f(x, y) = \begin{cases} K\,xy\,e^{-(x^2+y^2)} & x > 0,\ y > 0 \\ 0 & \text{otherwise} \end{cases}$$
Find the value of K and prove that X and Y are independent.

6. Define central limit theorem. A soft drink vending machine is set so that amount of drink dispensed is a random variable with a mean of 8 ounces and a standard deviation of 0.4 ounces. What is the approximate probability that the average of 36 randomly chosen fills exceeds 8.1 ounces?

Group "B"

Attempt any SIX questions.   6×7=42

7. If T is unbiased estimator of θ, then show that T^2 is biased estimator of $θ^2$. Also $\sqrt{T}$ is not unbiased estimator of $\sqrt{θ}$.

8. Show that the standard error of mean of a random sample of size n from a large population with variance $σ^2$ is $\frac{σ}{\sqrt{n}}$.

9. Define chi-square distribution. Give its application and its main properties.

10. What is meant by the test of a statistical hypothesis? Define null and alternative hypothesis. Elaborate two types of errors in testing the hypothesis.

11. The records of a hospital show that 52 men in a sample of 1000 men versus 23 women in a sample of 1000 women were admitted because of heart disease. Do these data present sufficient evidence to indicate higher rate of heart disease among men admitted to the hospitals? Use α = 0.05.

12. The following data represent the marks obtained by 10 students in 2 tests one held before coaching and the other after coaching?

Students :	1	2	3	4	5	6	7	8	9	10
Test 1 :	55	60	65	75	49	25	18	30	72	61
Test 2 :	63	70	70	81	54	29	30	30	80	58

Does the data indicate that the coaching was effective in improving the performance of students?

13. Two groups of rats, one group consisting of trained ones, another group not trained one (i.e. controlled) have following number of trials to achieve certain criterion:

Trained rats	78	64	75	45	82
Untrained rats	110	70	53	51	

Use Mann-Whitney u test to test if there is a difference between two average numbers of trials of trained and untrained rats.

Tribhuvan University, 2071

Bachelor Level (4 Yrs.)/Science & Tech./ II Year

Full Marks: 100

CHEMISTRY (CHEM 201)

Time: 3 hrs

Use separate answer-book for each group.

The Comprehensive Question of each group is compulsory. Attempt SIX questions of Short Answer Questions of each Group.

GROUP "A" (INORGANIC)

1. **Comprehensive Question**

   Why and in what ways does Li resemble group IIA metals? On the basis of ionic size it is expected that the ionic conductance of alkali metal ions should decrease in the order $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$. But actually the trend is just the reverse. Explain this anomaly.   [5+4]

   ### OR

   What is meant by coordination compounds? How does coordination compound differ from a double salt? Explain Werner's coordination theory and EAN rule.
                                                                    [1+2+4+2]

2. **Short Answer Questions**   6×4=24

   2.1 How is sodium thiosulphate prepared? Explain its uses in photography and volumetric analysis.

   2.2 What are d-block elements? What are the uses of transition metals in catalytic reactions?

   2.3 Write the chemical reactions of ozone with ethylene, propylene, autylene and lead sulphide.

   2.4 What is meant by refining of metals? Explain parting process.

   2.5 What is inert pair effect? Explain with reference to Thallium (Tl).

   2.6. Calculate the oxidation state of Fe in $K_3[Fe(CN)_6]$. Explain the use of this compound in qualitative analysis with the help of chemical reactions.

   2.7 Calculate the normality of "10 volume" of hydrogen peroxide solution. (Given strength 30g/litre)

   2.8 What are the Marshal's and Caro's acid? Write any one method for the preparation of each of the acid. Also give their uses.

   2.9 $N(CH_3)_3$ is pyramidal but $N(Si H_s)_3$ is planar. Explain.

GROUP "B" (ORGANIC)

3. **Comprehensive Question**

   Why benzene undergoes electrophilic substitution reaction than addition? Give electrophilic substitution reactions of benzene with mechanism taking reference to nitration and acylation reactions.   [3+6]

   ### OR

   Discuss the importance of Baeyer strain theory. How it fails to explain the stability of cyclohexane and higher cycloalkanes? What are axial and equatorial bonds?   [3+3+3]

4. **Short Answer Questions**   6×4=24

   4.1 Explain the stability of axial and equatorial methyl cyclohexane by