

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 $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$. 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, acetylene 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 (III).
- 2.6 Calculate the oxidation state of Fe in $\text{K}_3[\text{Fe}(\text{CN})_6]$. 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 Marshall's and Caro's acid? Write any one method for the preparation of each of the acid. Also give their uses.
- 2.9 $\text{N}(\text{CH}_3)_3$ is pyramidal but $\text{N}(\text{SiH}_3)_3$ 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

giving Newmann projection formula.

- 4.2 How do you account for the fact that electron donating groups attached to benzene ring are ring activator and ortho-para director?
- 4.3 Why boiling points of aldehyde are higher than corresponding alkanes and lower than corresponding alcohols? Why lower aldehydes are soluble in water?
- 4.4 Write down the reaction and mechanism of wittig reduction.
- 4.5 Why nitrobenzoic acid is more acidic than benzoic acid?
- 4.6 Why is malonic ester synthesis considered an important synthetic reaction. Illustrate giving pertinent reactions.
- 4.7 How do you prepare tertiary amine from primary amines? Write pertinent reactions.
- 4.8 Show your familiarity with Hoffmann degradation of amides with mechanism.
- 4.9 Why p-nitrophenol has higher boiling point than O-nitrophenol? Give reason.

GROUP "C" (PHYSICAL)

5. Comprehensive Question

Define molar conductance. Give its unit. How does it vary with dilution?

Show your familiarity with 'conductivity water'.

Give the equivalent conductance at infinite dilution of sodium butyrate, sodium chloride and hydrochloric acid as 83, 127 and $426 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$ respectively. Calculate the equivalent conductance of butyric acid at infinite dilution.

$$[1+1+2+3+3=10]$$

OR

Discuss the mechanism of the heterogeneous catalysis taking hydrogenation of ethane as an example. Compare the energy associated with the light of wavelength 200 nm and 600 nm.

The quantum yield is 2 for the photolysis of gaseous HI by the light of 253.7 nm wavelength.

Calculate the number of mole of HI that will be decomposed if 300 J of light of this wavelength is absorbed.

$$[3+3+4=10]$$

$$6 \times 4 = 24$$

6. Short Answer Questions

- 6.1 Explain why the rate of a reaction cannot be measured by dividing the total amount of the reactant consumed by the total time taken. Why do we represent the rate of a reaction by dc/dt ? What is implied by assigning + or - sign to dc/dt ?
- 6.2 Derive an integrated rate equation for a zero order reaction and give the unit of its rate constant. Give an example of a zero order reaction.
- 6.3. What is meant by temperature coefficient of the reaction? The following data were obtained for given reaction at 300 K:

| Reaction | Energy of activation (kJ mol^{-1}) |
|-------------|---|
| Uncatalysed | 76 |
| Catalysed | 57 |

Calculate by what factor the rate of the catalysed reaction is increased.

- 6.4 At a certain temperature, the half life period for the catalytic decomposition of ammonia were as follows:

| | | | |
|---------------------------------|------|------|------|
| Pressure (mm of Hg) | 50 | 100 | 200 |
| Relative half life period (min) | 3.52 | 1.82 | 0.96 |

Find the order of the reaction.

- 6.5 What do you mean by potentiometric titration? Discuss its important applications.
- 6.6 Calculate the emf of the following cell at 25°C:
 $\text{Fe}/\text{Fe}^{++}(0.6\text{M})//\text{Sn}^{++}(0.2\text{M})/\text{Sn}$;
Given $E^\circ_{\text{Fe}^{++}/\text{Fe}} = -0.44\text{V}$ and $E^\circ_{\text{Sn}^{++}/\text{Sn}} = +0.14\text{V}$.
- 6.7 Deduce the relation $PV^\gamma = \text{constant}$ for an ideal gas stating the necessary assumption.
 $(\gamma = C_p/C_v)$
- 6.8 Derive an expression for the work done during adiabatic reversible expansion of an ideal gas.
- 6.9 Assuming that nitrogen is an ideal gas, calculate ΔS for the composition of 200 g of the gas from a pressure of 1 to 5 atm at 25°C.

Tribhuvan University, 2071

Bachelor Level / Science & Tech./II Year

Full Marks: 100

CHEMISTRY (CHEM 321)

Time: 3 hrs.

Use separate answer-book for each group.

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

GROUP "A" (INORGANIC)

Comprehensive Question

1. What is the important ore of Aluminium? Discuss how aluminium is extracted from its ore. Also comment upon the important application of aluminium.

[1+6+2=9]

OR

What is a block element? Explain giving reasons why

- Most of the transition metals are paramagnetic.
- Compounds of transition metals are generally coloured.
- All transition metal exhibit variable valency.

[1+2+3+3=9]

2. Short Answer Questions

8×3=24

- 2.1 What is meant by oxidative refining? Give an example of its use in the refining of a metal.
- 2.2 What is acid rain? What factors contribute to acid rain?
- 2.3 What are principal and secondary valencies of the metal ion in the complex compound? Illustrate them in $[\text{Co}(\text{NH}_3)_5]\text{Cl}_3$.
Calculate the EAN of central metal ion.

- 2.4 Group IIA metals form stable complexes with EDTA, but Be does not form complex with EDTA. Explain.
- 2.5 How is hydrazine prepared? Mention the difficulties involved during preparation. Give uses of hydrazine.
- 2.6 Which elements form cluster compounds? Give an example of three major types.
- 2.7 What is meant by solvated electron? Why is the solution of alkali metal in liquid ammonia acts as good conductor of electricity?
- 2.8 What is meant by 100 volume H_2O_2 ? Explain.
- 2.9 How is $Na_2S_2O_3$ made? Explain its uses in photography and volumetric analysis.
- 2.10 Suggest reasons why PF_5 is known but NF_5 does not exist.
- 2.11 Though the electron affinity of chlorine is highest among the halogens it is not the most powerful oxidising agent. Why?

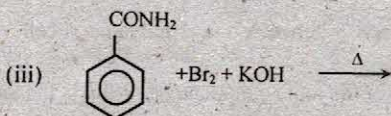
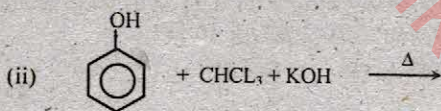
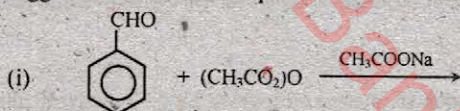
GROUP "B" (ORGANIC)

Comprehensive Question

3. What are the factors affecting stability of conformations? Write down Newman projection formulae for possible conformations of cyclohexane and show them in the energy profile diagram. Which form is more stable and why? [4+2+2+1]

OR

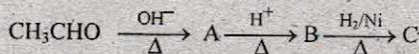
Suggest a mechanism and products for the following reactions



4. Short Answer Questions

8×3=24

- 4.1 Which of the following species will exhibit aromatic character? Write down their structural formulae.
- Cyclopentadienyl anion
 - Tropylium ion
 - Cyclopropenyl cation
- 4.2 Identify A, B and C in the following sequence of reactions



- 4.3 Outline the synthesis of 4-Methylpentanoic acid from malonic ester.

- 4.4 Write down the products obtained from aniline, N-methylaniline and N, N-dimethylaniline on the treatment with NaNO_2 and HCl in cold condition.
- 4.5 Outline the synthesis of diazomethane from N - methyl - N - nitrosoacetamide.
- 4.6 How do you account for the fact that unlike most phenols, 2,4 - dinitrophenol and 2,4, 6 - trinitrophenol are soluble in aqueous sodium bicarbonate?
- 4.7 Cyclopropane is the least stable member of cycloalkane. How do you justify this in term of orbital picture?
- 4.8 Give the reaction and mechanism of acid catalysed halogenation of 2 - butanone.
- 4.9 Account for the fact that C - O bonds in sodium formate have same bond lengths, but not in formic acid.
- 4.10 Show that nitro group in nitrobenzene is a meta directing group, but not the ortho and para directing group towards electrophilic substitution reaction.
- 4.12 Give the synthesis and uses of Bakelite.

GROUP "C" (PHYSICAL)

Comprehensive Question

[10]

5. Define order and molecularity of a chemical reaction? What do you understand by pseudo-order of a chemical reaction? Calculate the activation energy of a reaction whose reaction rate at 27°C get doubled for 10°C rise in temperature.

[4+2+4]

OR

What are spontaneous and non spontaneous process? Explain the term entropy. Prove that all spontaneous process are accompanied by an increase in entropy. Calculate the emf of the cell $\text{Zn}|\text{Zn}^{++}(0.01\text{M})||\text{Ag}^+(0.1\text{M})|\text{Ag}$.

The standard electrode potential of $\text{Ag}^+|\text{Ag}$ half cell is $+0.80\text{V}$ and $\text{Zn}^{++}|\text{Zn}$ half cell is -0.76V .

[4+2+4]

6. Short Answer Questions

8×3=24

- 6.1 What are the difference between a galvanic cell and electrolytic cell?
- 6.2 Explain clearly the meaning of the ionic conductance. What is the unit of ionic conductance?
- 6.3 Define the term "free energy". How is it related to the enthalpy and entropy change?
- 6.4 Define the term thermodynamic efficiency. Calculate the efficiency of following two engines. One engine operating between 100°C and 0°C and other operating between 100°K and 0°K .
- 6.5 How does a poison paralyse the activity of a catalyst?
- 6.7 What is photochemical reaction? How does it differ from thermal reaction?
- 6.7 Define Joule Thomson Effect and Joule- Thomson coefficient. What is

- inversion temperature?
- 6.8 State Lambert - Beer's law and define molar extinction coefficient of an absorbing substance.
 - 6.9 Define the term catalysis. Discuss the criteria of catalysis.
 - 6.10 State and explain Kohlrusch's law.
 - 6.11 Why does the specific conductance decreases and equivalent conductance increases with dilution of a solution of electrolyte?

Tribhuvan University, 2071

Bachelor Level (4 Yrs.)/Science & Tech/II Year
Petrology, Structural Geology and Sedimentology-201

Full Marks: 100

Time: 3 hrs.

GROUP "A"

Long Answer Questions.

Attempt any FOUR questions.

(4×10=40)

1. What is meant by magmatic differentiation? Describe process of fractional crystallization.
2. What is metamorphism? Describe various types of metamorphism.
3. Describe the classification of sedimentary rocks based on texture.
4. What is a fold? Give classification of folds.
5. Describe the basic principle of stereographic projection and its application in structural geology.
6. Describe the characteristics of fluvial environment of deposition.

GROUP "B"

Short Answer Questions.

Attempt any Eight questions.

(8×5=40)

7. Briefly describe IUGS classification of igneous rocks.
8. What is metamorphic facies? Give its classification.
9. Describe syn-sedimentary of deformational structures and their significance.
10. Differentiate between prograde and retrograde metamorphism.
11. Describe the criteria of recognition of folds in the field.
12. What is a joint? Describe how joints are classified.
13. What is lineation? Give classification of lineation.
14. Briefly describe geochemical fence diagram.
15. Give an account of the microbial processes in generation of sediments.
16. Describe bedload transport mechanism in fluids.

GROUP "C"

Attempt any Eight questions.

(8×2.5=20)

17. Differentiate between petrology and petrography.
18. Define crystallinity and granularity.
19. What do you understand by index minerals?
20. What is textural maturity?

21. Define trend and plunge of a line.
22. What is an unconformity?
23. What is a thrust fault?
24. Define Reynolds Number.
25. What is Redox Potential?
26. Note down the scope of sedimentology.

Tribhuvan University, 2071

Bachelor Level (3 Yrs.) Science & Tech. /II Year Full Marks: 100

Petrology, Historical Geology & Geology of Nepal and Adjacent Region

(GEO.321)

Time: 3 hrs.

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

ALL questions carry equal marks.

GROUP "A"

1. Discuss magmatism in different tectonic environments.

OR

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

2. (a) What are ophiolites? Discuss the composition and origin of ophiolites.
(b) What are xenoliths? Describe their importance in petrology.
3. Define metamorphic zone, grade and facies. Discuss the facies classification of metamorphic rocks with suitable diagram.
4. (a) What is pressure-temperature-time path? How is it constructed? Write down its significance.
(b) Give classification of non-clastic sedimentary rocks.
5. (a) What do you understand by syn-sedimentary deformational structures? Describe their significance.
(b) What is geosyncline? Describe plate tectonic setting of geosynclines.
6. Write short notes on any TWO:
 - a. Fractional crystallization
 - b. Prophyroblast and tectonism
 - c. Diagenesis process

GROUP "B"

7. Discuss the tectonic evolution of earth's crust during Palaeozoic Era.

OR

Discuss the theory of origin of life.

8. Give an account of the paleogeography of the Precambrian Era.
9. (a) What is index fossil? Describe any two index fossils of the Cambrian period.
(b) Describe in brief the geological features that help in interpretation of sedimentary environment.

10. Write short notes on any TWO:
- Evolution of atmosphere
 - Magnetostratigraphy
 - Tectonic elements of ocean

GROUP "C"

11. Discuss granitic magmatism in the Nepal Himalaya.

OR

Discuss the geology of Sub-Himalaya of the Butwal area.

12. (a) Give the stratigraphic of Kali Gandaki Supergroup according to Sakai(1985).
 (b) Describe the stratigraphy of the Tethys Himalaya of Nepal.
13. Write short notes on any TWO:
- Main Central Thrust
 - Stratigraphy of Tansen Group
 - Vertebrate fossils of Siwaliks of Nepal

Tribhuvan University, 2071

Bachelor Level (3 Yrs.) / II Year / Hum. + Sc. & Tech.

Full Marks: 75

Mathematical Analysis I (Math. 322)

Time: 3hrs.

Attempt ALL the questions.

Group "A"

5×7=35

1. Define interior point and interior of a set in \mathfrak{R} . Find interior of $A = \{x : 2 \leq x < 5\} \cup \{6\}$.
 Prove that $\text{Int. } A \cup \text{int. } B \subseteq \text{int. } (A \cup B)$. [2+1.5+3.5]
2. Define countable and uncountable sets. The set of all real numbers between 0 & 1 is uncountable. Prove it. [1+6]
3. Prove that $\lim_{x \rightarrow \infty} x_n = 0$ is necessary condition for the convergence of the infinite series $\sum x_n$. Also prove that the sequence $\left\{ \frac{n+1}{n^2+2} \right\}, n = 1, 2, 3, \dots$ is bounded. [1+4+2]

OR

Define Cauchy sequence in \mathfrak{R} . Prove that every Cauchy sequence in \mathfrak{R} is bounded. Is the converse true? Justify your answer by a suitable example.

[1+4+2]

4. Define inverse images and continuity of a function in terms of ball.
 A real valued function f of real number $f : \mathfrak{R} \rightarrow \mathfrak{R}$ is continuous on \mathfrak{R} if f for every open set E in the range \mathfrak{R} , the inverse image $f^{-1}(E)$ is open in the domain \mathfrak{R} . [2+5]

OR

State and prove "intermediate value theorem" for continuous function.

[7]

5. Define Riemann's condition on $[a, b]$. Let f be bounded on $[a, b]$. Then f is integrable on $[a, b]$ if and only if f satisfies Riemann's condition on $[a, b]$.

Group "B"

10×4=40

6. Construct the truth table for the statement

$$[p \wedge (p \Rightarrow q)] \Rightarrow q. \quad [4]$$

7. Show that every infinite set is equinumerous to a proper subset of itself. [4]

8. Let A and B be the sets of real numbers and $C = \{x + y; x \in A, y \in B\}$. Prove that if $\sup A$ and $\sup B$ exists then $\sup C = \sup A + \sup B$. [4]

9. State the rational density theorem. Prove that if $a, b \in \mathbb{R}$ such that $a < b$, then there exists an irrational number w such that $a < w < b$. [1+3]

10. Prove that the union of any number of open sets in \mathbb{R} is open in \mathbb{R} .

Also show that the set $S = \{x : 0 < x < 1, x \in \mathbb{R}\}$ is open but not closed. [3+1]

OR

Define limit points with an example. Prove that a set S in \mathbb{R} is closed if and only if it contains all its limit points. [1+3]

11. Prove that the series

$$\sum_{n=1}^{\infty} \frac{1}{n^p} = \frac{1}{1^p} + \frac{1}{2^p} + \frac{1}{3^p} + \dots \text{ is convergent if } p > 1. \quad [4]$$

OR

What is Cauchy criterion for convergence of series of real numbers? Use it to prove, the series $\sum \frac{1}{n}$ diverges. [4]

12. Verify the means of suitable example that the divergence of $\sum |u_n|$ does not imply the divergence of $\sum u_n$. [4]

13. Show that every polynomial function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $p(x) = a_0 + a_1x + a_2x^2 + \dots + a_nx^n$ (a being real) is continuous. [4]

OR

Show that a continuous image of compact set is compact.

14. Find the stationary points of the function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = x(x-1)(x-2)$.

15. If $f, g \in \mathcal{R}[a, b]$ then prove that $f \cdot g \in \mathcal{R}[a, b]$.

OR

If f and g are integrable over a closed interval $[a, b]$, prove Schwartz inequality.

$$\left(\int_a^b f(x)g(x) dx \right)^2 \leq \left(\int_a^b f^2(x) dx \right) \left(\int_a^b g^2(x) dx \right) \quad [4]$$

Tribhuvan University, 2071

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

Full Marks: 75

Algebra I (Math. 201)

Time: 3 hrs.

Attempt ALL the questions.

Group "A"

5×7=35

1. In terms of rank mention the condition when a given system of equations is consistent.

Show that the equations

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

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

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

are consistent and solve them.

[1+6]

2. Define a homomorphism between two group G and G' with an example. What do you mean by kernel of homomorphism? If $\phi: G \rightarrow G'$ is a homomorphism. prove that the kernel of ϕ is a normal subgroup of the group G . [2+1+4]

OR

What do you understand by normal subgroup of a group? Prove that the subgroup N of a group G is a normal subgroup of G , if and only if $aN = Na$ for all $a \in G$. Also using this result show that subgroup $N = \{1, -1\}$ of the multiplicative group $G = \{-1, 1, -i, i\}$ is a normal subgroup. [1+4+2]

3. Define integral domain with an example.

Is Z_6 , the integer modulo 6, is an integral domain? Justify. Prove that finite integral domain is field. [1+1+5]

4. Define Fourier coefficient of any vector v along a non-zero vector w in a vector space. Prove that every finite dimensional non-zero vector space has an orthogonal basis. Also construct orthogonal basis of \mathfrak{R}^2 from the basis $\{(2, 3), (-1, 2)\}$ [1+4+2]

OR

What do you understand by linearly dependent and linearly independent vectors? Show that $(1, 2, 3), (2, 4, 6), (3, 6, 9)$ are linearly dependent vectors in \mathfrak{R}^3 .

The set of non-zero vector $u_1, u_2, \dots, u_n; n \geq 2$ in a vector space is linearly dependent if and only if at least one of them can be written as a linear combination of the others. [2+1+4]

5. Find the condition that the equation $ax^3 + 3bx^2 + 3cx + d = 0$ may have two equal roots. Solve the equation $x^3 - 7x^2 + 36 = 0$ when one root is double of another. [4+3]

Group "B"

10×4=40

6. Define adjoint of a square matrix. If A is a square matrix of order n , then prove that $A \cdot \text{Adj}(A) = \text{Adj}(A) \cdot A = |A| I_n$, where I_n is the $n \times n$ unit matrix. [1+3]

OR

[4]

Prove that

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}^2 = \begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ca-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix}$$

7. State Cayley Hamilton theorem and verify theorem for the matrix $\begin{bmatrix} 1 & 5 \\ 2 & 3 \end{bmatrix}$ [3+1]
8. Prove that integers a and b are relatively prime if and only if there exist two integers x and y such that $ax + by = 1$. Also show that 91 and 41 are relatively prime to each other. [3+1]
9. Define subgroup. If H is a subgroup of a group G and $K = \{x \in G : xH = Hx\}$, then prove that K is a subgroup G . [1+3]
10. If \vec{a} and \vec{b} are any two vectors in \mathbb{R}^n , then prove that $\|\vec{a} + \vec{b}\| \leq \|\vec{a}\| + \|\vec{b}\|$

Also verify this properly for $\vec{a} = (1, 2)$ and $\vec{b} = (3, 1)$. [3+1]

OR

Define scalar and vector projection of a vector \vec{b} onto another vector \vec{a} in \mathbb{R}^n . Find the scalar and vector projection of vector $(3, 2, 1)$ onto the vector $(3, -1, 4)$. [1+3]

11. Define subspace of a vector space V over the field F . Given a set of vector v_1, v_2, \dots, v_n in V , prove that the set of all linear combination of these vectors is a subspace of V . [1+3]
12. Define kernel and image of a linear transformation. Find $\text{Ker } T$ and $\text{Im } T$ when $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be linear transformation defined by $T(x, y, z) = (0, y, z)$. [2+2]

OR

Define eigen vector. Find the eigen vector of the matrix $\begin{pmatrix} 1 & 2 \\ 2 & -2 \end{pmatrix}$. [1+3]

13. Find $p^{-1}, q^{-1}, (pq)^{-1}$ and $(qp)^{-1}$ if $p = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$, and $q = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$. [2+2]

14. Solve by Cardon's method : $x^3 - 15x - 126 = 0$. [4]

OR

Solve by Ferrari's method : $x^4 + 12x - 5 = 0$ [4]

15. Define superior limit of the positive root of an equation. Find the superior limit of the positive roots of the equation $x^4 - 5x^3 + 40x^2 - 8x + 23 = 0$.

Tribhuvan University, 2071

Bachelor Level (3 Yrs.) / Hum. + Science & Tech. / II Year

Full Marks: 75

Algebra I (Math. 321)

Time: 3 hrs.

Attempt ALL the questions.

Group "A"

5*7=35

1. Define rank of a matrix with example. Prove that the rank of the product of

two matrices A and B, if exists, can not exceed the rank of either of A or B, that is $p(AB) \leq p(A)$ and $p(AB) \leq p(B)$. Verify this by taking

$$A = \begin{pmatrix} 1 & 2 \\ 2 & 4 \end{pmatrix} \text{ and } B = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \quad [1+4+2]$$

2. Define order of a group and order of an element of a group. Find the order of an element -1 of a group $\mathfrak{R} - \{0\}$ with respect to multiplication. Prove that the order of a subgroup H of a finite group G is a divisor of the group. Is converse true? [1+1+4+1]

OR

Define group with examples. Let G be the set of all 2×2 matrices $\begin{pmatrix} a & b \\ 0 & d \end{pmatrix}$

where a, b, d are real numbers such that $ad \neq 0$, prove that G forms a group under matrix multiplication. Is G abelian? [2+4+1]

3. Define division ring. What is zero divisor of a ring R? Give an example of a ring without zero divisor? Prove that a division ring has no zero divisors. [3+4]
4. What do you mean by linearly dependent and independent vectors? Prove that the set of non-zero vectors $u_1, u_2, \dots, u_n, n \geq 2$ of a vector space V over a field F is linearly dependent if and only if at least one of them can be written as a linear combination of the other. Hence show that the four vectors (1, 0, 0), (0, 1, 0), (0, 0, 1) and (1, 1, 1) are linearly dependent. [1+5+1]
5. Find the condition that the 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]

OR

Discuss the method of removal of a second term of an equation $a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \dots + a_{n-1}x + a_n = 0$. Solve the equation $x^3 + 6x^2 + 12x - 19 = 0$ by removing its second terms. [3+4]

Group "B"

10×4=40

6. What is orthogonal matrix? Show that the matrix

$$A = \begin{pmatrix} \cos y & -\sin y \\ \sin y & \cos y \end{pmatrix} \text{ is orthogonal. Is } A = \begin{pmatrix} e^{i\theta} & 0 \\ 0 & e^{-i\theta} \end{pmatrix} \text{ a unitary?} \quad [1+2+1]$$

OR

[4]

Prove that

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = \begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ca-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix}$$

7. Show that the numbers 123 and 325 are relatively prime to each other. Find m and n such that $325m + 123n = 1$. [4]
8. If G is a group and H is a subgroup of index 2 in G, the prove that H is normal subgroup in G. [4]
9. Prove that a non-empty subset S of a ring R is a subring of R if and only if a, b \in S implies (i) $a - b \in S$ and (ii) $ab \in S$. [4]

10. Find the inverse of the matrix $A = \begin{pmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix}$ by elementary transformation. [4]

OR

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

11. Let P and Q be two vectors in \mathbb{R}^n .
 Prove that $|P \cdot Q| \leq \|P\| \|Q\|$. Verify this for $P = (1, 2)$ and $Q = (0, -2)$ [3+1]
 12. Prove that a set of non-zero orthogonal vectors is linearly independent. Is converse true? Give an example. [3+1]
 13. Prove that the sum of two linear transformations and product of a scalar, and a linear transformation are linear transformation. [2+2]

OR

Define eigen vector. Find the eigen vector of the matrix $\begin{pmatrix} -1 & 0 \\ 3 & 4 \end{pmatrix}$. [1+3]

14. Solve by Cardon's method, $x^3 - 6x - 4 = 0$ [4]

OR

Solve by using Ferrari's method, the equation $2x^4 + 6x^3 - 3x^2 + 2 = 0$ [4]

15. Define superior limit of a positive roots of a equation. Find the superior limit of a positive roots of the equation $x^4 - 2x^3 - 3x^2 - 15x - 3 = 0$ [1+3]

Tribhuvan University, 2071

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

Full Marks: 75

Mathematical Analysis I (Math. 202)

Time: 3 hrs.

Attempt ALL the questions.

Group "A"

5×7=35

1. Define conjunction and disjunction of the statement. And write the converse and contrapositive of each of the statements given below:

- (i) The ring of integers is a Euclidean ring.
- (ii) A function is continuous whenever it is differentiable.
- (iii) A set is open provided that each point of the set is an interior point.

[1+2×3=7]

OR

Define equivalence relation. Let A and B be the subsets of a set X and $f: X \rightarrow Y$, then If $A \subset B$, prove that $f[f^{-1}(B)] = B$

And verify with an example showing that inclusion symbol can't be replaced by equality. [3+2+2]

2. Find derived and closure set of the following

- (i) $(-1, 0) \cup (0, 1)$
- (ii) Q'

And prove that every open ball of a limit point of a set contains infinitely many

points of the set. [4+3]

3. Define a convergence of a sequence. A set 'A' is closed iff for every convergent sequence $\{x_n\}$, $\lim x_n$ adheres to A. Determine the sequence $x_n = \frac{n^2-1}{n^2}$ is decreasing or increasing or not monotonic [1+4+2]

4. State and prove intermediate value theorem. Interpret it geometrically.

Find the $\lim_{x \rightarrow 2} (4x + 3)$ using $\epsilon - \delta$ method. [5+2]

5. Prove that if f is bounded on $[a, b]$ and integrable on any closed interval $[a, x]$, $a < x < b$. Then f is integrable on any closed interval $[a, x]$, $a < x \leq b$. Then f is integrable on $[a, b]$. Define upper and lower Darboux sum. Explain what will be the result after the refinement of a partition.

OR

Define Riemann integrable function on $[a, b]$. Let $a < c < b$ then f is integrable on $[a, b]$ if and only if f is integrable on $[a, c]$ and $[c, b]$ and show

$$\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx \quad [1+3+3]$$

Group "B"

10×4=4

6. What is the necessary condition for a series to converge? Also prove it, and define remainder of a series. [1+2+1]

7. Prove that the series $\sum_{n=1}^{\infty} \frac{1}{n^p}$ converges if $p > 1$ and diverges $p < 1$.

8. State and prove the Archimedean property and give its equivalent statement.

OR

Every infinite set is equinumerous to a proper subset of itself.

Find the sup of A, if $A = \left\{ \frac{1}{n} : n \in \mathbb{N} \right\}$ [3+1]

9. Define absolute value of x and for any $x, y \in \mathbb{R}$? prove $|x + y| \leq |x| + |y|$. [2+2]
10. If a function is differentiable at a point, then it is continuous at the point. Give an example showing that the converse may not be true. [3+1]
11. State and prove Roll's theorem. [1+3]

OR

State mean value theorem. Verify it for the function

$$f(x) = x(x-1)(x-2) \text{ on } [1, 3]. \quad [1+3]$$

12. Define primitive of a function. Let f be Riemann integrable on $[a, b]$. If a

function F is defined on $[a, b]$ by $F(x) = \int_a^x f(u) du$. Then prove that F is

continuous on $[a, b]$.

[1 + 3]

13. Define indefinite integral of a function. State and prove First Mean Value Theorem. [1+3]
14. State Bolzano Weirstrass theorem. If A is any set in \mathbb{R} then prove $\overline{A} = A \cup A'$. [1+3]

OR

Define isolated point.

And find the isolated point for the set $A = (0, 1) \cup \{2\}$.

Prove that any union of open sets in \mathbb{R} is open in \mathbb{R} . [1+1+2]

15. Define and explain the different type of discontinuities of a function at a point. [1+3]

OR

If $f: \mathbb{R} \rightarrow \mathbb{R}$ is continuous on \mathbb{R} then prove that inverse image of an open set is open under f .

What will be inverse image of a closed set under f ? [3+1]

Tribhuvan University, 2071

Bachelor Level (4 Yrs.)/Science & Tech./II Year
Environmental Science (Env.201)

Full Marks: 100
Time: 3 hrs.

SECTION "A"

1. Attempt All the questions. 4×10=40
- 1.1. Describe briefly the major limiting factors that affect the distribution of organisms in the fresh water bodies.

OR

Describe briefly the ecological, economic and cultural importance of freshwater environment.

- 1.2. What are the factors affecting solar insolation? Describe the radiation and heat budget equation for the earth and its atmosphere.
- 1.3. Describe the major gaseous chemical reactions in the atmosphere.
- 1.4. Describe the tectonic division of Nepal Himalaya with the major hazards associated with these regions.

OR

Discuss briefly the concept and applications of Remote Sensing (RS) and geographic information system (GIS) in relation to environmental monitoring.

SECTION "B"

2. Describe briefly any EIGHT questions 8×5=40
- 2.1. Classification of fresh water organisms on the basis of life form.
- 2.2. Factors affecting evapotranspiration.
- 2.3. Hydro-geological investigation of ground water.
- 2.4. Relationship between climate parameters and agriculture production.
- 2.5. Categories of Kopeen's classification.
- 2.6. Seasons of Nepal.

- 2.7 Cases of landslides in Nepal.
- 2.8 Sustainable soil management.
- 2.9 Concept and applications of bioremediation.
- 2.10 Land capability mapping.

SECTION "C"

3. Attempt ALL the questions.

10×2=20

Differentiate between:

- 3.1 Rapid zone and pool zone
- 3.2 Emerging macrophytes and submerged macrophytes
- 3.3 Aquifer and aquifuge
- 3.4 Surface flow and subsurface flow
- 3.5 Weather and climate
- 3.6 Hazards of Terai and hazards of Siwalik
- 3.7 Composting and vermicomposting
- 3.8 Water table and piezometric level
- 3.9 Physiographic and tectonic divisions of Nepal Himalaya
- 3.10 First generation and second generation pesticides

Tribhuvan University, 2071

Bachelor Level (4 Yrs./)Science & Tech./II Year
 Biochemistry and Microbial, Biotechnology [MB 201]

Full Marks: 100

Time: 3 hrs.

GROUP "A"

Long Answer Questions.

Attempt FOUR questions.

(4×10=40)

1. Describe various metabolic steps of TCA cycle and calculate the total number of ATP generated in TCA cycle. [8+2]
2. What do you mean by Operon? Describe in detail Lac operon process in *E. coli* with suitable diagram. [2+8]
3. Classify the lipids with examples. [10]
4. Describe the application of biotechnology in food production and enzyme production. [5+5]
5. Describe the production process of Ethanol. [10]
6. Define vectors. Describe any three vectors used in recombinant DNA technology. [2+8]

GROUP "B"

Short Answer Questions

Attempt any Eight questions.

(8×5=40)

7. Write short notes on Ninhydrin reaction.
8. Mention the roles of hormones in plant tissue culture.
9. Water as a solvent for life. Justify the statement.
10. Explain the use of baffle in a fermenter.

11. Describe the role of RNAs in protein synthesis.
12. Outline the production steps of analyse.
13. Classify the enzymes.
14. Outline the process of production of ice-cream.
15. Explain in brief Zwitterionic properties of Amino acids.
16. Describe the applications of mycorrhiza.

GROUP "C"

(8×2.5=20)

Attempt any Eight question

17. Very short answers questions:
 - a. Enlist essential amino acids.
 - b. Classify polysaccharides.
 - c. Enlist various enzymes involved in DNA replication.
 - d. Mention factors affecting regulation of enzymes.
 - e. Define genetic code and mention the nonsense codons.
 - f. Define pasteurization.
 - g. Enlist the micro-organisms found in cheese
 - h. Enlist application of chitinase.
 - i. Define solid state fermentation.
 - j. Define sour milk and skimmed milk.

Tribhuvan University, 2071

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

Full Marks: 100

Microbial, Biochemistry and Biotechnology (MB.321)

Time: 3 hrs.

GROUP "A"

5×10=50

(Long Answer Questions)

Attempt All FIVE questions.

1. Define TCA cycle. Describe the various metabolic steps of TCA cycle. [2+8]
2. Define β - oxidation. Describe in brief the β - oxidation of stearic acid with ATP calculation. [2+8]
3. Define Bioreactor. Draw a well labelled diagram to show various component parts of fermenter. [2+8]
4. Describe the production process of ice-cream. [10]
5. Describe the application and importance of biotechnology in agriculture. [10]

GROUP "B"

5×7=35

(Short Answer Questions)

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

6. Mentions the principles and applications of flourimetry.
7. Describe the application of Bioinformatics.
8. Briefly explain the translation process.
9. Describe the factors affecting the activity of enzymes.

10. Describe the amphoteric properties of amino acids.
11. Classify the polysaccharides.

GROUP "C"

5×7=35

12. Very Short Answer Questions.

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

- a. Enlist the secondary and tertiary structure of protein.
- b. Name the enzymes involved in transcription process.
- c. Enlist functions of phospholipids.
- d. Enlist scope of biotechnology.
- e. Enlist any three restriction endonucleases enzymes.
- f. Mention bioelements of life.

Tribhuvan University, 2071

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

Full Marks: 100

Physics (Phy.201)

Time: 3 hrs.

(Optics, Modern Physics, Electronics)

Attempt ALL the questions.

1. Interference pattern can be obtained by either the division of amplitude or the division of wavefront of the source. Describe it. Also explain spatial and temporal coherence. [4+4+2]

OR

Explain the difference between polarized and unpolarized light. What are the conditions under which light will be plane, circularly and elliptically polarized. State and explain Malus law in this regard. [2+5+3]

2. Derive the laws of successive disintegration. How this law explains the natural radioactive series? Describe it. [5+3+2]

OR

What are the ways through which electromagnetic radiation interact with matter? Explain it. [6+4]

3. Explain the working of inverting and non-inverting mode of Operational Amplifier. What do you, mean by the differential and common mode gain? [6+2+2]

OR

Explain decimal, binary, octal and hexadecimal number of systems and their inter conversion. Give an account of addition and subtraction of binary numbers. [8+2]

4. Explain term astigmatism and coma. How these effects can be removed? [4+4]
5. What is neutrino theory of beta decay? How does it explain the continuous spectrum of beta decay? [4+4]
6. Explain multivibrators and their working principle. [4+4]
7. Answer any TWO of the following: [2×3=6]

(a) Explain why vertically polarized light that is travelling horizontally cannot scatter in the vertical direction.

- (b) Explain the basic principles of holography.
 (c) Explain the Morgan's theorem.
 (d) Explain the working of bubble chamber.
8. Attempt ALL the questions: [4×2.5=10]
 (a) What is dispersive power of a grating?
 (b) Give brief account of Rutherford scattering.
 (c) What do you mean by internal conversion?
 (d) Explain bias stabilization.
9. A light source emits visible light of two wavelengths; $\lambda = 430 \text{ nm}$ and $\lambda = 510 \text{ nm}$. The source is used in a double-slit interference experiment in which $L = 1.5 \text{ m}$ and $d = 0.025 \text{ mm}$. Find the separation distance between the third-order bright fringes. [5]
10. Light of 5000 \AA is incident on a circular hole of radius (i) 1 cm and (ii) 1 mm . How many half period zones are contained in the circle if the screen is placed at a distance of 1 m to observe the diffraction? [5]
11. A 5 MeV alpha particle approaches a gold nucleus ($Z = 79$), with an impact parameter $2.6 \times 10^{-10} \text{ m}$. Through what angle will it be scattered? [5]
12. The half life of Cesium-137 is 30.2 years . If the initial amount of a sample of Cesium-137 is of mass 1 kg , how much 'Cesium-137' will remain after 151 years ? [5]
13. A transistor has $\alpha = 0.95$, $I_B = 100 \mu\text{A}$ and $I_{CO} = 6 \mu\text{A}$. Calculate I_C and I_E . [5]
14. Convert the given binary numbers into their decimal equivalents.
 (i) 11010 (ii) 111.10
 Add these binary numbers and also find the decimal equivalent of the results. [5]

Tribhuvan University, 2071

Bachelor Level (3 yrs.)/Science /II Year/Full Marks: 100

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

Time: 3 hrs.

Attempt ALL questions.

SECTION "A" (ECOLOGY)

1. The protected areas of Nepal play an important role in the conservation of Biodiversity. Explain. [10]
 OR
 What is a biotic community? Describe the important characteristics of a plant community.
2. What is global warming? Explain carbon cycle in nature. [5]
 3. Discuss the role of abiotic factors in an ecosystem. [5]
 4. What is succession? Briefly discuss the main causes of succession.

SECTION "B" (PHYSIOLOGY)

5. Describe the process of respiration in higher plants. How is this process affected by the presence of oxygen?

OR

[10]

Explain dark reactions in the process of photosynthesis in C3 plants.

6. What is osmosis? Explain cell as a osmotic system. [5]
7. Discuss the physiological role of Nitrogen, Phosphorus and Potassium in plants. [5]
8. What are plant growth regulators? Write the physiological role of Gifferellins. [5]

SECTION "C" (CYTOLOGY & GENETICS)

9. Explain Mendel's law of independent assortment with a suitable example.

OR

[10]

Give an account of plant breeding for disease resistance.

10. Write short notes on complete linkage. [5]
11. Define polyploidy. Explain allopolyploids with a suitable example. [5]
12. Write short notes on genetic engineering. [5]

SECTION "D" (EMBRYOLOGY)

13. What is microspore? Write in short the processes of microsporogenesis in angiosperm. [5]
14. Give a brief account of polyembryony. [5]
15. Draw a well labelled diagram of a dicot embryo.

OR

[5]

What is endosperm? What are the different types of endosperm?

SECTION "E" (ANATOMY)

16. What is anomalous secondary growth? How does it occur in Amaranthus stem? Illustrate it with a suitable diagram.

OR

[5]

What are the anatomical adaptational features of xerophytic plants?

17. What is apical meristem? Describe apical cell theory. [5]

Tribhuvan University, 2071

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

Full Marks: 100

Zoology (Chordata, Comparative Anatomy and Evolution) (Zool.201)

Time: 3 hrs.

Illustrate your answers with suitable diagrams wherever necessary.

GROUP "A"

[2×10=20]

Attempt any TWO questions.

1. Discuss various forms of parental care in fishes.
2. Give an account of flight mechanism in birds.
3. Explain social behaviour in animals with examples.

GROUP "B"

[2×10=20]

Attempt any TWO questions.

4. Describe the pelvic girdles in vertebrates.

5. Give a comparative account of the structures of kidney in the vertebrates.
6. Give an account of types and modes of speciation.

GROUP "C"

[6×5=40]

Attempt any EIGHT questions.

7. Mention the salient features of *Petromyzon*.
8. Describe different types of scales found in fishes.
9. Give the diagnostic characters of class Amphibia.
10. Briefly discuss affinities of *Sphenodon*.
11. Explain monophyletic and diphyletic origin of birds.
12. Describe different types of stomach in mammals.
13. Discuss short term and long term memory in learning behaviour.
14. Give an account of hepatic portal system.
15. Explain Hardy-Weinberg Law.
16. Describe bathymetric and geological distribution of animals.

GROUP "D"

[8×2.5=20]

17. Give very short answers of any EIGHT of the followings:

- a. Endemic fishes
- b. Neoteny
- c. Snake's venom
- d. Avian characters of Archaeopteryx
- e. Morphological adaptations of birds
- f. Diphyodont dentition
- g. Imprinting
- h. Nephron
- i. Salivary glands
- j. Genetic drift

Tribhuvan University, 2071

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

Full Marks: 100

Botany – [Bot 201]

Time: 3 hrs.

(Ecology, Physiology, Cytogenetics, Embryology and Anatomy)

Attempt ALL questions.

Write explanatory answers to the following:

1. Discuss the present status of water pollution in Nepal. What steps should be taken in future to solve the problem?

OR

[10]

What is succession? How does primary succession differ from secondary succession? List the processes involved in the succession of plant communities.

2. Photosynthesis is an oxidation reduction process. Explain.

OR

[10]

- Explain the mechanism of aerobic respiration that takes place in mitochondria.
3. State Mendel's law of independent assortment. Explain it with a suitable example. [10]
 4. Describe the process of embryogenesis in a dicot plants. [10]

Write short answer to the following (any EIGHT): (8×5=40)

5. Explain the flow of energy in an ecosystem with suitable diagram.
6. What are the different types of interactions found in a biotic community?
7. Write briefly the vegetation of Nepal along the altitudinal gradient.
8. Write briefly anatomical adaptation of xerophytic plant with a suitable diagram.
9. Discuss the mechanism of stomatal transpiration.
10. What are the essential minerals required to plants? Explain the role of calcium and Phosphorus in plant nutrition.
11. What are plant hormones? Write the importance of Gibberellin hormone in growth and development of plants.
12. Explain the different factors affecting seed germination.
13. Illustrate a suitable diagram to show anomalous secondary growth with abnormal behaviour of cambium.
14. Explain gene mutation and its causes.

GROUP "C"

Write short notes to the following (any TEN): (10×2=20)

15. Water potential and osmotic potential
16. Polarity
17. Role of auxin
18. Loam soil
19. Riverian forest
20. Ecological niche
21. Symbiosis
22. Endosperm haustoria
23. Apical meristem
24. Photoperiodism
25. Crossing over
26. Function of endoplasmic reticulum

Tribhuvan university, 2071

Bachelor Level (3 Yrs.) / II Year / Humanities + Sc. & Tech.

Full Marks: 100

Statistics II Paper (Stat.321)

Time: 3 hrs.

1. (Compulsory) Attempt any SIX questions.

6×5=30

- (a) Distinguish between Parametric test and Non Parametric test.
- (b) Discuss Run test.
- (c) Find Mean and Variance χ^2 (Chi-square) distribution.
- (d) Show that the sample proportion P is an unbiased estimator of the

- population proportion P .
- (e) Show that the moment generating function of χ^2 distribution is given by

$$\frac{1}{(1-2t)^{n/2}}$$

- (f) What are the properties of good estimator?
- (g) State central limit theorem. Show how this theorem is deduced from Chebyshev's theorem.

Group "A"

4×7=28

Attempt any FOUR questions.

2. If the joint distribution of X and Y is given by

$$P_{xy}(x, y) = \begin{cases} k(x^2 + y^2); & x = -1, 0, 1, 3, \text{ and } y = -1, 2, 3 \\ 0; & \text{elsewhere} \end{cases}$$

- find (i) The value of constant K .
- (ii) Marginal probabilities of X and Y
- (iii) $P(X \leq 1, Y > 2)$
- (iv) $P(X + Y > 2)$

3. Find Mean and variance of truncated binomial distribution.

4. If X_1 and X_2 are independent rectangular variates in the interval $[0, 1]$. Find the distribution of $Y_1 = X_1 + X_2$ and $Y_2 = X_1 - X_2$.

5. State Chebyshev's inequality. If a symmetrical die is thrown 750 times what is the lower bound for the probability, of getting 100 to 150 aces.

6. For two variates X and Y show that $\sqrt{E(X+Y)^2} \leq \sqrt{E(X^2)} + \sqrt{E(Y^2)}$

Group "B"

6×7=42

Attempt any SIX questions.

7. Ten soldiers visit a rifle range for two consecutive weeks.

For the first week their scores are: 67, 24, 57, 55, 63, 54, 56, 68, 33, 43 and during the second week the scores in same order 70, 38, 58, 58, 56, 67, 68, 72, 42, 38. Examine if there is any significance difference in their performance.

$$\begin{bmatrix} t_{0.05} = 2.10 \text{ for 18 d.f.} \\ t_{0.05} = 2.26 \text{ for 9 d.f.} \end{bmatrix}$$

8. If P be the probability that a coin will fall head in a single toss. The coin is tossed 5 times and it is desired to test $H_0: P = \frac{1}{2}$ against $H_1: P = \frac{2}{3}$. The H_0 is rejected if more than three heads are obtained. Find the probabilities of type I and type II errors. Also find the power of the test.

9. Sample of sizes 10 and 12 taken from two normal population given $S_1 = 12$ and $S_2 = 18$. Test the normal hypothesis $H_0: \sigma_1 = \sigma_2$.

[Tabulated $F_{0.05} = 3.14$ for 11 and 9 d.f.]

10. Show that the sampling variance of the proportion of males P in a random sample of n people drawn from a population N is given $\frac{N-n}{n-1} \cdot \frac{P(1-P)}{n}$

11. Show that if $\hat{\theta}$ is sufficient estimator of θ then $\frac{\delta \log L}{\delta \theta}$ is a function of $\hat{\theta}$.

12. Show that $t = \frac{r}{\sqrt{1-r^2}} \cdot \sqrt{n-2}$ is distributed as students t distribution with $n-2$ d.f. under $H_0: \rho = 0$, r being the correlation coefficient.
13. A chemist uses three Catalysts for distilling alcohol and the layout in cc were tabulated.

| Catalysts | Alcohol (in cc) | | | | |
|-----------|-----------------|-----|-----|-----|-----|
| C_1 | 380 | 430 | 410 | | |
| C_2 | 290 | 350 | 270 | 250 | 270 |
| C_3 | 400 | 380 | 450 | 380 | |

Use Kruskal -Walliz one way ANOVA test. Are there any significance difference between catalysts? Test 5% level of significance.

Tribhuvan University, 2071

Bachelor Level (3 Yrs.) / Science / II Year
Zoology (Zol.321)

Full Marks: 100
Time: 3 hrs.

GROUP "A"

Attempt any TWO questions.

[2×12.5=25]

1. Classify Mammal upto orders giving important characters and examples of each.
2. What do you mean by sexual reproduction? Describe the male reproductive system of Labeo with necessary diagram.
3. What is parental care? Describe parental care in Amphibia with examples.

GROUP "B"

Attempt any TWO questions.

[2×12.5=25]

4. Describe structure and functions of nucleus. What are the functions of nucleus?
5. What is enzyme? Discuss the characteristics and functions of enzymes.
6. Discuss the embryonic development of fowl in brief.

GROUP "C"

Attempt All the questions.

[8×5=40]

7. What is cloning? Mention its significance.
8. What do you mean by 'Transgenic Animals'?

OR

Write about the structure and functions of placenta.

9. What is gastrulation? Describe about it in Amphibia.
10. Draw a well labelled diagram of 'Thyroid Gland' of man and mention the functions and disorders related to its hormone.
11. Discuss important differences between Petromyzon and Myxine.
12. Give the structure of brain of Amphibia.

OR

What is speciation? Write about the process of speciation.

13. Explain 'Perching Mechanism' in brief and also discuss its significance.
14. Explain 'Oxygen Dissociation Curve.'

15. Write short notes on any TWO:

[2×5=10]

- (i) Suicidal bag
- (ii) Birds of prey
- (iii) Sex linked inheritance

Tribhuvan University, 2071

Bachelor Level (3 Yrs./)Science & Tech. /II Year

Full Marks: 100

Physics II Paper (Phy.321)

(Optics, Atomic & Nuclear Physics, Electronics)

Time: 3 hrs.

Attempt ALL the questions.

1. Describe Michelson Interferometer. Explain the theory to determine the wavelength of a given source.

OR

[10]

Give an account of the phenomenon and the related theory of diffusion due to a straight edge.

2. Explain Compton effect. Derive an expression for the change in wavelength of the scattered wave.

OR

[9]

Describe vector model of the atom and explain the different quantum numbers associated with it.

3. What is Barkhausen criterion for sustained oscillations? Draw a circuit diagram of Hartley oscillator and explain its working. Derive the condition for sustained oscillation.

OR

[9]

Explain current gain in common emitter, common base and common collector configurations. Establish the relation between α and β for dc where α and β have their usual meaning.

4. What is Nicol prism? Explain how it can be used to analyze plane polarized light.

OR

[6]

What is a half wave plate? Explain with appropriate theory how circularly and elliptically polarized wave can be obtained.

5. Explain what do you mean by "plateau curve" and "working voltage" in G.M. detection method.

OR

[6]

Explain how characteristic X - rays are produced. Explain Mösley's law.

6. Explain the Thevenin's theorem and discuss its importance in the circuit analysis.

OR

[6]

Explain AND, NAND, OR gates and write down Boolean equation for the same.

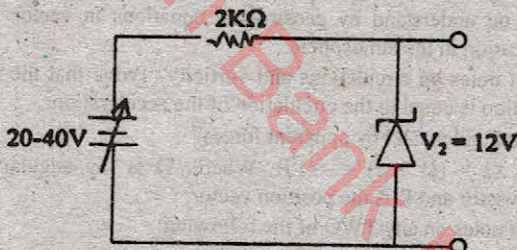
7. Answer all questions in brief:

[6×3=18]

- a. Explain, what happens when white light is used instead of

monochromatic light in producing fringes in fresnels biprism.

- b. Explain quarter wave plate.
 - c. What do you understand by fine structure of hydrogen atom?
 - d. State and explain Pavli exclusion principle.
 - e. What is FET? Explain.
 - f. Discuss the importance of Q point in transistor.
8. Green light of wavelength 5100 Å from a narrow slit is incident on double slit. If the overall separation of 10 fringes on a screen 100 cm away is 8mm, find the slit separation. [6]
9. A plano convex lens of radius of curvature 3m is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of 8th dark ring in the transmitted system is 7.2 mm. Calculate the wave length of light used. [6]
10. The first order Bragg reflection occurs at an angle of 10° when X -ray of 9.8 nm is used in NaCl crystal, what is the spacing between principal planes of the crystal. [6]
11. 0.55 MeV electrons are injected into a 55 MeV linear accelerator powered by a 200 MHz radio frequency supply. Find the approximate length of the last drift tube. [6]
12. Using the ideal zener diode approximation calculate the output voltage in the following circuit. Also find the minimum zener current. [6]



13. Write binary equivalent of 12.5 and 30. Also add and subtract those binary numbers. [6]

Tribhuvan University, 2071

Bachelor Level (3 Yrs.) / Science & Tech. / II Year

Full Marks: 100

Meteorology II Paper (MET 321)

Time: 3 hrs.

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

1. What is thermal wind? Prove that $\vec{V}_t = \frac{1}{f} \vec{k} \times \nabla (\phi_1 - \phi_2)$. 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. El Niño 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]

Tribhuvan University, 2071

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

Applied Meteorology (MET 201)

Use Separate Answer Sheet for each Group.

Full Marks: 100

Time: 3 hrs.

Group "A"

Urban Meteorology, Air Pollution and Atmospheric Chemistry

Attempt TWO questions from Group-i and FOUR from Group-ii and FOUR from Group-iii.

Group-i

(2×10=20)

1. Explain in detail the factors necessary to consider for climate sensitive urban designing and planning.

2. What are the possible sources of air pollution and practical measures to stop or minimize air pollution?
3. Define an ozone hole. Explain present status of tropospheric ozone and reasons of ozone hole formation.

Group-ii

(4×5=20)

4. Write in short about Ekman spiral
5. What is the role of IPCC for developing countries?
6. Discuss convective fluxes and urban energy balance.
7. Discuss direct radiative impacts and indirect radiative impacts.
8. Briefly introduce the global carbon cycle.

Group-iii

(4×2.5=10)

9. Write a short note on cloud condensation nuclei (CCN).
10. Write a short note on atmospheric residence time of particulate matter.
11. Write a short note on optical properties of aerosols.
12. Write a short note on atmospheric turbulence and dispersion of pollutants.
13. Write a short note on urban atmosphere.

Group "B"

Satellite Meteorology, Hydro-Meteorology & Agriculture Meteorology

Attempt TWO questions from Group-iv and FOUR from Group-v and FOUR from Group-vi.

Group-iv

(2×10=20)

1. What is radar? Describe its physical principle and usefulness in meteorological research.
2. Distinguish between infiltration and percolation. Describe a technique of artificial ground water recharge.
3. Explain in details the seed germination process and write down the general conditions for seed germination.

Group-v

(4×5=20)

4. Explain briefly why meteorology is important for agricultural development of Nepal.
5. Describe any two weather related hazards (viz. hail, flood, drought and fire in vegetation).
6. Explain briefly about a typical soil moisture budget of a farm land.
7. Explain briefly about snow metamorphism and densification process of snow.
8. Describe a method of satellite image interpretation.

Group-vi

(4×2.5=10)

9. Write a note on equilibrium line altitude in a glacier.
10. What do you understand by precipitation network design?
11. Differentiate between infiltration and interception by vegetation.
12. Write a short note on snow avalanche.
13. Write short note on seed germination and pollination.

Tribhuvan University 2071

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

Full Marks: 50

Time: 2 hrs.

Group "A"

Attempt any SIX questions.

[6×5=30]

1. Distinguish between mutually exclusive events and independent events. A problem in statistics is given to two students A and B whose chances of solving are $1/2$ and $3/4$ respectively. What is the probability that the problem will be solved if both of them try independently?
2. Under what conditions a binomial distribution turns into a Poisson distribution? If the probability that an individual suffers an adverse reaction from a particular drug is known to be 0.001, determine the probability that out of 2000 individuals exactly 3 will suffer an adverse reaction.
3. What is meant by association of attributes?

Given, $N = 820$, $(A) = 250$, $(\alpha B) = 50$ and $(AB) = 35$.

Test whether the data is consistent.

4. The lengths of sweet-pea flower stems are normally distributed with mean 18.2 cm. and standard deviation 2.3 cm. Find the probability that the length of flower stem is between 16 cm and 20 cm.
5. Define point and interval estimation. A plant produces steel sheets whose weights are normally distributed with a standard deviation of 2.4 kg. A sample of 10 had a mean weight of 31.4 kg. Find 95% confidence limits for the population mean.
6. A fruit grower wants to test a new spray that a manufacturer claims will reduce the loss due to insect damage. To test the claim, the grower sprays 50 trees with the new spray and 50 other trees with the standard spray. The following data were recorded:

| | New spray | Standard spray |
|--------------------------|-----------|----------------|
| Mean yield per tree (kg) | 250 | 227 |
| Variance | 980 | 820 |

Calculate the standard error of difference between two means. Do the data provide sufficient evidence to conclude that the mean yield per tree treated with the new spray exceeds that for trees treated with the standard spray? Use $\alpha = 0.05$.

7. Infections sometimes occur when blood transfusions are given during surgical operations. An experiment was conducted to determine whether the injection of antibodies reduced the probability of infection. An examination of records of 140 patients produced the data shown in the table. Do the data provide the sufficient evidence to indicate that injection of antibodies affect the likelihood of transfusion infection? Test by using $\alpha = 0.05$.

| | Infection | No infection |
|-------------|-----------|--------------|
| Antibody | 6 | 78 |
| No antibody | 11 | 45 |

Group "B"

Attempt any TWO questions.

[2×10=20]

8. The manager of A - Z Super Market, gathered the following information the number of times a customer visits the store during a month. The responses of 50 customers were:

| | | | | | | | | | |
|---|----|---|----|----|---|---|---|---|----|
| 5 | 3 | 2 | 1 | 4 | 4 | 5 | 6 | 4 | 2 |
| 6 | 7 | 1 | 14 | 1 | 2 | 4 | 4 | 4 | 6 |
| 3 | 4 | 5 | 6 | 8 | 4 | 7 | 6 | 0 | 5 |
| 5 | 9 | 3 | 11 | 12 | 4 | 7 | 6 | 5 | 15 |
| 1 | 10 | 8 | 9 | 12 | 4 | 5 | 8 | 9 | 5 |

- (i) Starting with 0 as lower limit of the first a class and interval of 3, organize the data into a frequency distribution.
 - (ii) Draw a histogram and frequency polygon for group data of (i)
 - (iii) Calculate mean, variance and coefficient of variation from grouped frequency distribution.
9. Assume that we conducted an experiment with six fields planted with corn having nitrogen fertilizer. The resulting corn yields are shown in the table as "bag per acre:

| | | | | | | |
|--------------------------|---|---|---|----|----|----|
| Nitrogen in kg | 3 | 5 | 6 | 10 | 12 | 12 |
| Corn yields (bag / acre) | 5 | 8 | 8 | 12 | 15 | 12 |

- (i) Compute correlation coefficient between Nitrogen used and corn yields. Interpret the result.
 - (ii) Compute the regression equation of corn yields on Nitrogen used.
 - (iii) Predict the corn yield for a field treated with 14 kg of Nitrogen
 - (iv) Test the significance of regression coefficient
10. The following table represents immunoglobulin levels of children under 10 years of age of a particular group. The children are grouped as follows: A: ages 1 to less than 3, B: ages 3 to less than 6, C: ages 6 to less than 8.

| | | | | | | | |
|---|----|----|----|----|----|----|----|
| A | 35 | 8 | 12 | 19 | 56 | | |
| B | 31 | 79 | 60 | 45 | 44 | 62 | 20 |
| C | 74 | 56 | 77 | 35 | 95 | 81 | |

Test whether there is a difference between the means for each of the age groups. Use $\alpha = 0.05$.

Tribhuvan University, 2071

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

Statistics (Probability and Inference I)

Full Marks: 100

Time: 3 hrs.

Group "A"

Attempt any FOUR questions.

[4×10=40]

1. State the classical and statistical definition of probability. Suppose the chance that doctor X will diagnose a patient correctly is 90% and wrongly is 10%. The chance that a patient will die by his treatment

- is after correct diagnosis is 5% and the chance of death by wrong diagnosis is 80%. If a patient having disease selected is died, what is the probability that the disease was diagnosed correctly? [4+6]
2. Define random variable. For two random variables prove that $E(XY) = E(X)E(Y)$. [2+8]
3. Define a binomial variate. For a binomial distribution $(q+p)^n$, prove that $\mu_{r+1} = pq \left(n\mu_{r-1} + \frac{d\mu_r}{dp} \right)$ where μ_r is the r^{th} moment about mean. Hence find μ_2 and μ_3 . [2+4+2+2]

4. The joint distribution of X and Y is given by

$$f(x, y) = kxy e^{-(x^2+y^2)}, x \geq 0, y \geq 0.$$

Find the value of k and prove that x and y are independent. [4+6]

5. Define t - distribution. If a statistic t follows student's t - distribution with n degrees of freedom then show that t^2 follows F - distribution with (1, n) degrees of freedom. [3+7]
6. Define null and alternative hypothesis. If $0.5 \leq x$ is the critical region for testing $H_0: \theta = 1$ against $H_1: \theta = 2$ on the basis of single observation from a population with density function:

$$f(x, \theta) = \frac{1}{\theta}, 0 \leq x \leq \theta$$

$$= 0, \text{ elsewhere.}$$

Obtain the probabilities of type I and type III errors. [3+4+3]

Group "B"

Attempt any EIGHT questions. [8×5=40]

7. X and Y are two such events such that $P(X) = 0.2$, $P(Y) = 0.25$ and $P(X/Y) = 0.4$.
Find (i) $P(X \cap Y)$ (ii) $P(X \cup Y)$ (iii) $P(Y/X)$ [2+2+1]
8. If X is a Poisson variate with mean λ , show that $\frac{X-\lambda}{\sqrt{\lambda}}$ is a variate with mean zero and unit variance. [5]
9. Discuss the five chief characteristics of normal distribution. [5]
10. If X and Y are two independent random variables such that $E(X) = \lambda_1$, $E(Y) = \lambda_2$, $\text{Var}(X) = \sigma_1^2$, $\text{Var}(Y) = \sigma_2^2$ then prove that $\text{Var}(X+Y) = \sigma_1^2 + \sigma_2^2$. [5]
11. The time taken to perform a particular task, t hours, has the probability density function

$$f(t) = 10c t^2 \text{ for } 0 \leq t \leq 0.6$$

$$= 9c(1-t) \text{ for } 0.6 \leq t \leq 1.0$$

$$= 0 \text{ otherwise.}$$

Where c is constant.

(i) Find the value of c

(ii) Determine, the probability that the time will be more than 48 minutes. [3+2]

12. Show that the chi-square distribution with n degrees of freedom tends to normal distribution as $n \rightarrow \infty$. [5]

13. 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 | 0 |

- (i) Find the value of k (ii) $\text{Var}(2X + 1)$. [2+3]
14. If X_1 and X_2 are two independent rectangular variates on $[0, 1]$, find the distribution of $X_1 X_2$. [5]
15. If the moment generating function of a random variable is $\left(\frac{1}{3} + \frac{2}{3} e^t\right)^6$, find μ_1 and μ_2 and variance. [3+2]
16. Show that the sample mean is an unbiased estimate of the population mean. [5]
17. Explain the principle of maximum likelihood estimation of population parameter. [5]

Group "C"

18. Attempt any TEN questions. [10×2=20]
- (a) Two perfect coins are tossed together. What is the probability of getting at least one head?
- (b) The standard deviation of a Poisson distribution is 2. Find the probability that $X = 3$.
- (c) The life of power house battery has a normal distribution with mean 210 hours. It is found that 10% of these batteries operate for more than 222 hours. Find the standard deviation of the distribution.
- (d) Give the expression of moment generating function for the following distribution:
- (i) $X \sim \text{normal}(\mu, \sigma^2)$ (ii) $X \sim \text{Poisson}(\lambda)$
- (e) Define sensitivity of a diagnostic test.
- (f) The random variable X has mean 0; it is given that $E(Y) = 50$. Find the value of b if $Y = aX + b$.
- (g) Give four main characteristics F-distribution curve.
- (h) Give an example for the outcome of a random experiment that is two dimensional random variable.
- (i) A plant produces steel sheets whose weights are normally distributed with a standard deviation of 2.4 kg. A sample of 10 had a mean weight of 31.4 kg. Find 95% confidence limits for the population mean.
- (j) What is meant by unbiasedness of estimator?
- (k) Give the statement of Cramer - Rao's inequality.
- (l) Define level of significance and power of test

T.U Exam. 2072

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

Full Marks: 100

Physics (Phy.201)

Time: 3 hrs.

(Optics, Modern Physics, Electronics)

Attempt ALL the questions.

1. Briefly explain the principal defects present in the images formed by spherical lenses. How can these defects be corrected? [3+7]

OR

Describe Michelson interferometer and explain the formation of fringes in it. How was this interferometer used for the standardization of the meter? [4+4+2]

2. Derive a formula for the speed of an electron in the n^{th} orbit of a hydrogen atom according to the Bohr model. Hence compare the speed in $n=1$ and $n=2$ orbits. [7+3]

OR

Mention the properties of α , β and γ - rays. Also discuss the theory of successive disintegration of radioactive substances. [4+6]

3. What do you mean by a semiconductor? Explain the energy bands in semiconductor. Discuss the application of Zener diode in voltage regulation circuit. [2+3+5]

OR

Explain the principle of feedback amplifier. Hence discuss the gain stability, distortion and bandwidth of the feedback amplifier. [4+6]

4. Give an account of the phenomenon and the related theory of diffraction due to a straight edge. [8]

5. Discuss the LHC project and its achievements. [8]

6. What is a multivibrator? Discuss with circuit diagram the working principle of a monostable multivibrator. [2+6]

7. Answer any TWO of the following : [2×3=6]

- What do you mean by population inversion? Explain.
- What is Cauchy's equation? Explain.
- Explain the mean life of a radioactive substance.
- Explain the phenomenon of pair production.

8. Answer ALL the questions: [4×2.5=10]

- State and explain Malus law
- What is Zeeman effect?
- Explain the fine structure of X-rays.
- Write down the uses of FET

9. Calculate the relative orientation of two perfect linear polarizers if under natural illumination the emerging beam is to be reduced to half its maximum transmitted value. [5]

10. How many lines must be ruled on a transmission grating so that it will just resolve the sodium doublet (5896 Å and 5890 Å) in the first order spectrum? [5]

11. X-rays of wavelength 10.0 pm are scattered from a target. Find the wavelength of the X-rays scattered through 45° . ($\lambda_c = 2.426$ pm) [5]