TRIBHUVAN UNIVERSITY, 2069

Bachelor Level / 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) Define truncated distribution. Explain why such distribution is needed.

   (b) Show that $E[E(X/Y)]=E(x)$.

   (c) Describe type I and type II errors in hypothesis testing.

   (d) Describe Mann - Whitney U - test.

   (e) Find the value of K such that $f(x, y) = Kxy; 1 < x < y < 2$ will a probability density function.

   (f) Define χ^2 - (Chi-square distribution). State its applications.

   (g) Define maximum likelihood estimator. State the properties of M.L.E.

Group "A"

Attempt any FOUR questions. 4x7=28

2. Write down the probability distribution function of truncated Poisson distribution. Also obtain the mean and variance of the distribution.

3. If X and Y have two random variables having joint density function

   $$f(x, y) = \frac{1}{8}(6-x-y); 0 < x < 2, 2 < y < 4$$

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

   Find (a) $P(X < 1 \text{ and } Y < 3)$ (b) $P(X + Y < 3)$ and (c) $P(X < 1 \mid Y < 3)$

4. State and prove Central limit theorem.

5. Let x and y are two independently and identically distributed rectangular variables on [0,1] with pdf

   $$f(x) = \begin{cases} 1 & \text{if } 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$$

   find pdf of $U = \dfrac{x}{y}$

6. An unbiased die is rolled twice. Let X denote the number shown on the first roll and Y denote the number shown on the second roll. Find $E(X + Y)$, $E(XY)$.

Group "B"

Attempt any SIX questions. 6 × 7 = 42

7. Write the probability density function of chi-square distribution, for a chi-square distribution with n df establish the following recurrence relation between the moments;

   $$\mu_{r+1} = 2r(\mu_r + n\mu_{r-1}), \quad r \ge 1.$$

   Hence, find β_1 and β_2.

8. If $x \ge 1$, is the critical region for testing $H_0 : 0 = 2$ against the

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alternative $\theta = 1$, on the basis of the single observation from the population.

$f(x, \theta) = \theta \exp. (-\theta x), 0 \le x \le \infty$

obtain the values of type I and type II errors.

9. Prove that in simple random sampling with replacement, the sample variance is an unbiased estimate of population variance.

10. What do you mean by testing of hypothesis? Explain the steps involved in testing of hypothesis.

11. A random sample of 18 pairs of observations drawn from a bivariate normal population showed a correlation coefficient of 0.3. Does this show evidence of having sample come from a bivariate population with zero correlation? Also, find the 95% confidence interval for the population correlation.

12. Write the probability density function of t - distribution and state its properties.

13. The following are the yield data of 10 pigs under two treatments' x and y.

x :	46	45	32	42	39	48	49	30	51	34
y :	44	40	59	47	55	50	47	71	43	55

Use median test to test effectiveness of two treatments.

TRIBHUVAN UNIVERSITY, 2069

Bachelor Level / Science / II Year   Full Marks: 100

Zoology (Zol. 321)   Time: 3 hrs.

NEW COURSE

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

Group "A"

Attempt any TWO questions.   [2x12.5=25]

1. Describe the external features of *Petromyzon* and compare them with those of *Myxine*.

2. What is parental care? Give an account of parental care in Amphibia.

3. Discuss the salient features of Prototheria and Metatheria. Also mention the affinities of Metatheria.

Group "B"

Attempt any TWO questions.   [2×12.5=25]

4. Explain the embryonic development of rabbit till the formation of germinal layers.

5. Define sex-linked inheritance. Explain it with reference to *Drosophila* and man with examples.

6. List the endocrine glands of man. Describe the structure and function

of thyroid gland.

Croup "C"

Attempt All the questions.   [8×5=40]

7. What do you mean by MRI? Give its significance.
8. Discuss in brief the major steps of protein synthesis.

OR

Write a short account of linkage with suitable examples.

9. Give the structure of fang of snakes. Discuss the nature of snake's venom.
10. Differentiate between polytene and lampbrush chromosome.
11. Sketch the brain *of Columba* (No description required)
12. Describe respiratory dead space and tidal volume.
13. Give the characters of any two poisonous snakes.

OR

What is placenta? Write its functions.

14. Describe the concept of organism cloning.
15. Write short notes on any TWO: [2×5=10]
    (i)   Types of chromosomes
    (ii) Adaptive radiation
    (iii) Economic importance of Birds

OLD COURSE (Chordata. Cell & Tissue Biology)

Attempt any TWO questions from each Group A & B. Group 6 is compulsory.

Group "A"   2×15=30

1. Describe the structure of male and female reproductive organs of : Columba livia with suitable diagrams.
2. What is parental care? Discuss it in the amphibian giving examples.
3. Describe the digestive system in Scoliodon with suitable diagrams.

Group "B"   2×15=30

4. What is heart beat? Describe the mechanism of conduction of heart bet in vertebrate.
5. Describe the structure of Mammalian Pancreas. Mention different types of its secretions, roles and functions.
6. Write about structure, importance and functions of Nucleus with suitable diagrams.

Group "C"   8×5=40

7. Enumerate the characteristics of Prototheria.
8. Give the differentiating characters of Petromvzon and Mvxine.
9. Give the salient features of poisonous snakes giving examples.

10. What do you understand by incomplete linkage? Discuss it with suitable example.
11. Write ecological notes of:
    (a) Axolotle Larva
    (b) Ostrich
12. Discuss the histological structure of mammalian lung.
13. Write a short note on DNA.
14. What is Oxygen Dissociation Curve? Explain.

TRIBHUVAN UNIVERSITY, 2069

Bachelor Level / Hum. + Science & Tech./II Year   Full Marks: 70
Algebra I (Math. 321)   Time: 3 hrs.

NEW COURSE
Attempt ALL the questions.

Group "A"   5×7=35

1. Define an integral domain with an example. Prove that a finite integral domain is a field. What happens if it is not finite?   [1+5+1]
2. What do you mean by consistent and inconsistent equation? Prove that a set of simultaneous linear equation is consistent if the rank of the coefficient matrix is equal to the rank of the augmented matrix, otherwise it is inconsistent. Using this, show that the equations $2x + y = 1$; $6x - 5y = 11$ are consistent.   [1+4+2]
3. Define subgroup of a group G with an example. If H and K are two subgroups of a group G, then prove that HK is a subgroup of G if and only if HK = KH.   [2+5]

OR

Define cyclic group. Prove that every cyclic group is an abelian group. Also, prove that the order of a cyclic group is equal to the order of its generator.   [1+2+4]

4. Let V and W be vector spaces over the field F and T: V → W be a linear mapping. If V is a finite dimensional, then prove that dim V = dim (Ker T) + dim(Im T). Verify this is a linear map T: $\Re^3 \to \Re^3$ defined by T(x, y, z) = (x + z, 0, x - z).   [5+2]

OR

Define linear transformation with an example. Prove that
(i) the sum of two linear transformation is a linear,
(ii) the product of a scalar and a linear transformation is a linear.   [2+3+2]

5. Explain Cardan's method for solving the cubic equation $ax^3 + 3bx^2 + 3cx + d = 0$. Solve, by Cardan method, $x^3 - 15x - 126 = 0$.   [3+4]

Group "B"   10×4=40

6. Define the inverse of a square matrix. Prove that the necessary and

sufficient condition that a square matrix A to possess an inverse is that A is non-singular.

7. Verify Cayley - Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix}$ and find inverse by using this theorem. [2+2]

8. Let ~ be an equivalence relation on a non-empty set X. then prove that for any a, b∈X
   (i) Cl(a) ≠ Φ   (ii) Either Cl(a) ∩Cl(b) = Φ or Cl(a) = Cl(b). [4]

<center>OR</center>

Define equivalence relation on a set. Show that the congruent modulo 5 for integers is an equivalence relation. [1+3]

9. Define semi-group. Prove that the set of natural numbers under addition is a semi-group. [1+3]

<center>OR</center>

Define generator of a cyclic group. Prove that every subgroup cyclic group is cyclic.

10. For any two vectors $\vec{a}$ and $\vec{b}$ in $\Re^n$, prove that $|\vec{a} \cdot \vec{b}| \leq \|a\| \ \|b\|$. [4]

11. Prove that a set of non-zero orthogonal vector is linearly independent. Is converse true? Justify your answer.

<center>OR</center>

Show that the subset S ={(1, 2, 1), (2, 1, 0), (1, −1, 2)} forms a basis $\Re^3$ [4]

12. Define kernel and image of a linear transformation L. Prove that kernel of L is a subspace of V and the image of L is a subspace of W. [1+3]

13. Find the condition that the equation $x^3 - px^2 + qx - r = 0$ should have its roots in geometrical progression. [4]

14. Solve the equations
   $2x^4 + 6x^3 - 3x^2 + 2 = 0$ by Ferrari method.

15. Find the approximate value of the positive root of the equation
   $x^3 - 2x - 5 = 0$ [4]

<center>OR</center>

Find the integer roots of the equation $x^4 + 2x^3 + 14x + 15 = 0$. [4]

OLD COURSE
Attempt ALL the questions.

<center>Group "A"</center>   5×7=35

1. What are consistent and inconsistent equation? Prove that a set linear simultaneous equation is consistent if the rank of the coefficient matrix is equal to the rank of augmented matrix otherwise they are inconsistent.

   Use this show that the equations x − y = 0, 2x + y = 3 are consistent. [1+4+2]

2. Define subgroup with an example. Prove that a non-empty subset H of a group G is a subgroup of G if and only if a, $b \in H \Rightarrow ab^{-1} \in H$ where b is the inverse of b in G. [2+5]

OR

Define permutation group. Calculate the integral, powers of $P = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$ and show that $\{p, p^2, p^3 = e\}$ forms a cyclic group. [1+6]

3. Define ring homomorphism. If R and R' are rings and f is a ring homomorphism from R onto R', then prove that R/K_f, where K_f is the kernel of f_1 is isomorphic to R'. [1+6]

4. Prove that every finite dimensional non-zero vector space has an orthogonal basis. Find an orthogonal basis if given basis vectors are $u_1 = (2, 3)$, $u_2 = (-1, 2)$ of the vectors of $\mathfrak{R}^2$ with usual scalar product. [5+2]

5. What do you understand by the term "a polynomial of degree n over $\mathfrak{R}$"? When a polynomial is said to be a complete polynomial? Apply Descarte's method to solve the equation $x^4 - 5x^2 - 6x - 5 = 0$. [1+1+5]

OR

Find the equation whose roots are the squares of the difference of the roots of the cubic $x^3 + px + q = 0$.

Solve the equation $x^3 - 6x^2 + 3x + 10 = 0$ whose roots are in arithmetical progression. [4+3]

Group "B" $10 \times 4 = 40$

6. Let I be the set of all integers. Given a, $b \in I$, define a ~ b if a − b is an even integer. Then prove that this defines an equivalence relation on I [4]

7. Let A, B and C be matrices of order m×p, p×q and q×n respectively. Then prove that (AB)C = A(BC).

OR [4]

What do you mean by a determinant? Show that if any two rows (or column) of a determinant are either proportional or identical, the value of the determinant is zero.

Use it to show that $\begin{vmatrix} 10 & 13 & 16 \\ 11 & 14 & 17 \\ 12 & 15 & 18 \end{vmatrix} = 0$ [1+1+2]

8. Define rank of a matrix. When a matrix is said to be in Echelon form ?

Reduce the matrix $\begin{pmatrix} 1 & 2 & -2 \\ 0 & 5 & -2 \\ 0 & -2 & 1 \end{pmatrix}$ To Echelon form. [1+3]

9. What is normal subgroup of a group G? Prove that every subgroup of an abelian group is normal. [1+3]

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10. When a ring is said to be an integral domain?

Let $f : R \rightarrow R'$ be a ring homomorphism then prove that

(i) $f(0) = 0'$ where 0 is the zero element of R and 0' that of R' and

(ii) $f(-a) = -f(a)$ for every $a \in R$. $\qquad [1+11\frac{1}{2}+1\frac{1}{2}]$

OR

Define an ideal of a ring R. Give an example. If U is an ideal of a ring R with unity arid $1 \in U$, prove that $U = R$. $\qquad [1+1+2]$

11. Define points in n-space. If any vectors P and Q are in n-space $\mathfrak{R}^n$ and a real number C, prove that

(i) $P + Q = Q + P$ and (ii) $C(P + Q) = CP + CQ$. $\qquad [4]$

12. Prove that the representation of any vector in a vector space in terms of its basis vectors is unique. $\qquad [4]$

13. Define invertible transformation. Prove that the inverse of a linear transformation is linear. $\qquad [1+3]$

OR

Find the eigen vectors of the matrix $\begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$

14. Remove the fractional coefficients from the equation

$$x^3 - \frac{1}{2}x^2 + \frac{2}{3}x - 1 = 0$$

OR

Solve the equation $4x^3 + 20x^2 - 23x + 6 = 0$, two of its roots being equal.

15. Solve by using Ferrari's method, the equation
$x^4 - 2x^3 - 5x^2 + 10x - 3 = 0$. $\qquad [4]$

TRIBHUVAN UNIVERSITY, 2069

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

Environmental Science (ENV. 321) $\qquad$ Time: 3 hrs.

NEW COURSE

Section "A"

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

1.1. What are the causes of freshwater habitat loss and degradation? Explain briefly how degraded freshwater ecosystems be restored.

1.2. What is GIS? Describe the role of GIS in ecological research.

1.3. Define effective rainfall. What are the methods that can be employed for interpretation of precipitation data?

1.4. A bin sampler of 30 cm radius was used to collect Mayfly Nymphs from two streams (X - non polluted and Y - polluted). The individual numbers of Mayfly Nymphs from each sampling site of two streams were counted and following observations were made.

Sites	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14
Stream X	8	7	10	5	2	7	12	8	6	4	10	8	3	14
Stream Y	3	0	3	2	0	1	3	2	0	2	1	0	4	5

Determine whether there is significant difference in the mean number of individuals of Mayfly Nymphs from streams X and Y. 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	2.467	2.763
29	1.699	2.045	2.462	2.756

Section "B"

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

2.1 Sources of environmental data
2.2 Cultural importance of freshwater bodies
2.3 Rock mass rating and its significance
2.4 Land use pattern of Nepal
2.5 Properties of aquifers
2.6 Interpretation of topographic maps
2.7 Consequences of ozone layer depletion
2.8 Techniques for reconstruction of climatic data
2.9 Factors affecting runoff
2.10 Sampling procedures for air quality assessment
2.11 Formation of PAN
2.12 Hydrological forecasting

Section "C"

3. Attempt ALL the Questions   10×2=20

Differentiate between:

3.1 Periphytons and zooplanktons
3.2 Weathering and erosion
3.3 Phototaxis and thigmotaxis
3.4 Random and stratified sampling
3.5 Infiltration and percolation
3.6 El Nino and ENSO
3.7 Metallic and non-metallic minerals
3.8 Inventory and mapping
3.9 Transpiration and evapotranspiration

OLD COURSE

Section "A"

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

1.1 Describe briefly the major physico-chemical parameters that

determine the water quality of freshwater ecosystems.

1.2 A sampling plot of size 50cm × 50cm was used to collect beetles. The individuals of beetles present in each sampling unit were counted and the following values were obtained.

Site A	25	15	10	5	10	15	17	12	10	40	10	8	2	13
Site B	12	10	10	15	5	2	8	4	10	12	6	8	4	15

The null hypothesis is that both samples came from the same population and therefore must have the same mean. Using t-test, write your opinion about the null hypothesis for beetles of two sites of the grassland ecosystem. The critical values 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	2.467	2.763
29	1.699	2.045	2.462	2.756

1.3 Describe the chemical composition and chemical history of the earth.

1.4 What is hydrological cycle? Describe the various processes involved in the completion of hydrological cycle.

Section "B"

2. Describe briefly any TEN Questions:
   2.1 Morphometry of freshwater bodies
   2.2 Sample size determination   10×5=50
   2.3 Investigation of construction site
   2.4 Human impact on landscape
   2.5 Darcy's law
   2.6 Urban climate
   2.7 Radioactivity in the atmosphere
   2.8 Interpretation of aerial photographs
   2.9 Survey techniques for environmental degradation
   2.10 Secondary air pollutants
   2.11 Factors influencing infiltration
   2.12 Land water interactions

Section "C"

3. Attempt ALL the Questions.   10×2
   Differentiate between:
   3.1 Rapid and pool zones
   3.2 Aquitard and aquifuse
   3.3 Dip and strike
   3.4 Lakes and ponds

3.5   Lithosphere and hydrosphere

3.6   Dependent and independent variables

3.7   Surface and sub-surface flow

3.8   BOD and COD

3.9   Deformation and failure

3.10 Physical and chemical weathering

TRIBHUVAN UNIVERSITY, 2069

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

Computer Science (CS. 321)   Time: 3 hrs.

(Information System Design / Data Structure)

Group "A" (Information System Design)

1.   Long Answer Questions

     Attempt any TWO Questions.   2×10=20

     1.1   Explain in detail about the conceptual system design with an
           example.

     1.2   What do you understand by system development life cycle?
           Draw the necessary diagram and explain prototyping model.

     1.3   Explain Data Flow Diagram and its uses with suitable example.

2.   Short Answer Questions

     Attempt ALL the Questions.   10×3=30

     2.1   What do you understand by process oriented methodology?

     2.2   Explain in brief about the planning process.

     2.3   Define data and information with suitable example.

     2.4   What do you mean by feedback and its types?

     2.5   What is a CASE tool?

     2.6   What is IS standard? Explain its importance.

     2.7   How the data dictionary can be used?

     2.8   What do you mean by system implementation? Describe cut-
           over method.

     2.9   Explain in brief about ER diagram.

     2.10 What do you understand by post operation evaluation?

Group "B" (Data Structure and Algorithm)

3.   Long Answer Questions

     Attempt any TWO Questions.   2×10=20

     3.1   Describe recursion? Explain it with Tower-of-Hanoi example.
           How recursive algorithms make program effective? Write the
           merits and demerits of recursion in programming.

     3.2   Describe searching algorithms in data structure. Compare and
           contrast the efficiency of three searching algorithms (sequential,
           binary and quick).

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3.3   What is a linked-list? How can you implement a linked list? Compare between contiguous list and linked list.

4.   Problems

    Attempt any TWO Questions. $2\times5=10$

   4.1.   Write a C program to insert a new node in a binary tree.

   4.2.   Write a C function for push and pop operations in stack.

   4.3.   Write an algorithm for double rotation in balancing of AVL tree.

5.   Short Answer Questions

    Attempt ALL the Questions. $8\times2.5=20$

   5.1 Differentiate between circular queue with linear queue.

   5.2 Write a short note on big O notation.

   5.3 Discuss Huffman algorithm and its application.

   5.4 Write the steps involved in inserting a node in an AVL tree.

   5.5 Differentiate between singly linked list and doubly linked list with suitable examples.

   5.6 Differentiate between stack and queue.

   5.7 Explain hashing with suitable example.

   5.8 Explain why linked list is called dynamic list? Write the algorithm and its application.

TRIBHUVAN UNIVERSITY, 2069

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

Petrology, Historical Geology & Geology of Nepal   Time: 3 hrs.

and Adjacent Region (GEO. 321)

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 tectonic evolution earth's crust.

2.   Give an account of the paleogeography of the Precambrian Era.

3.   (a)   What is index fossil? Describe the index fossils of the Palaeozoic Era.

      (b)   Describe in brief the geological features that help in interpretation of sedimentary environment.

4.   Write short notes on any TWO:

      (a)   Evolution of atmosphere

      (b)   Magnetostratigraphy

      (c)   Tectonic elements of ocean

Group "B"

5.   Discuss magmatism in different tectonic environments.

6. (a) What are ophiolites? Discuss the composition and origin of ophiolites.

   (b) What are xenoliths? Describe their importance in petrology.

7. Define metamorphic zone, grade and facies. Discuss the facies classification of metamorphic rocks with suitable diagram.

8. (a) What is pressure-temperature-time path? Write down its significance.

   (b) Give classification of non-clastic sedimentary rocks.

9. (a) What do you understand by syn-sedimentary deformational structures? Describe their significance.

   (b) What is geosyncline? Describe plate tectonic setting of geosynclines.

10. Write short notes on any TWO:

    (a) Fractional crystallization

    (b) Prophyroblast and tectonism

    (c) Diagenesis process

Group "C"

11. Discuss granitic magmatism in the Nepal Himalaya.

12. (a) Give the stratigraphy of Kali Gandaki Supergroup according to Sakai (1985) and correlated it with the stratigraphy of Kathmandu area by Stocklin and Bhattarai (1977).

    (b) Discuss the stratigraphy of the Tethys Himalaya of Nepal.

13. Write short notes on any TWO:

    (a) Main Central Thrust and inverted metamorphism

    (b) Stratigraphy of Tansen Group

    (c) Fossils of Siwaliks of Nepal

OLD 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. What is meant by stereographic projection? Discuss its application in structural geology with examples.

2. Define stress and strain. Describe the method of construction of Mohr circle and its application.

3. (a) What is fault? Describe different types of faults with suitable diagram.

   (b) Define lineation. Describe different types of lineation with their importance in structural interpretations.

4. Write short notes on any TWO:

   (a) Cylindrical and non-cylindrical folds

   (b) Classification of joints

(c) Diapir and salt domes

GROUP "B"

5. Discuss the formation of magma at different tectonic environment.
6. (a) Describe the process of differentiation of magma.
   (b) What is solid solution? Describe the crystallization of magma in Ab-An system.
7. What is metamorphic facies? Discuss the facies classification of metamorphic rocks with suitable diagrams.
8. (a) What is porphyroblast? Describe the relation of porphyroblast with tectonism.
   (b) What do you understand by paleocurrent? Describe sedimentary features that help in paleocurrent analysis.
9. Give classification of non-clastic sedimentary rocks. Describe the texture, structure and minerals composition of carbonate rocks.
10. Write short notes on any TWO:
    (a) Contact metamorphism and hornfels
    (b) Gabbroic layered intrusions
    (c) Diagenesis process

Group "C"

11. Discuss granitic magmatism in the Nepal Himalaya.
12. (c) Describe the geology of the Peninsular India with special reference to Achaeans.
    (d) Give an account of the stratigraphy of the Tethys Himalaya of Manang area, Nepal.
13. Write short notes on any TWO:
    (a) Evolution of Himalaya
    (b) Fossil records of Nepal Himalaya
    (c) Inverted metamorphism of the MCT zone

TRIBHUVAN UNIVERSITY, 2069

Bachelor Level / Science & Tech./II Year   Full Marks: 100
Chemistry (CHEM. 321)   Time: 3 hrs.
NEW 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. Discuss briefly the Werner's theory of coordination compound with reference to complex of cobalt. Write short notes on effective atomic number and calculate EAN of the central metal ion in the compound $[CO(NH_3)_6]^{+3}$.   [6+1+2]

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OR

Describe how H_2O_2 is produced by modern method. Write the balanced equation for the reaction of H_2O_2 with

(a) An acidified solution of $KMnO_4$.

(b) An aqueous HI.

(c) An acidified solution of potassium hexacyano ferrate (II).

[6+1+1+1]

2. Short Answer Questions $8 \times 3 = 24$

2.1 What is the role of iron in biological process?

2.2 What is the difference between C, Si and other remaining elements of gr IVA elements.

2.3 What are ion exchange resins? Give an example of the applications of ion exchange resin in the separation of metal.

2.4 Explain

(a) Why V_2O_5 is colourless but VO_2 is blue in colour.

(b) Fe^{+3} is more paramagnetic than Fe^{++} ion.

2.5 How is S_4N_4 (sulphur tetranitride) is prepared? Discuss its structure and prove that S_4N_4 is "thermochromic!".

2.6 Why diborane, is classified as an electron deficient compound? Discuss the bonding in diborane.

2.7 Give the general structural characteristics of Fullerenes and write its applications.

2.8 Why is it that NF_3 has no donor properties but PF_3 forms many complex with metals? Give example of such complexes.

2.9 What are the Marshal's acid and Caro's acid? Write any one method for the preparation of each of the acid.

Group "B" (Organic)

Comprehensive Question

3. Give three methods of preparation of carboxylic acids with suitable examples.   [5+4]

Rank the following compounds in order of increasing acidity. Give reason for your ranking.

(a) Benzoic acid, para-methyl benzoic acid and para-chlorobenzoic acid.

(b) Acetic acid, benzoic acid and para-nitrobenzoic acid.

OR   [9]

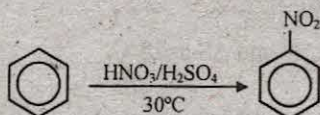Write the mechanisms of base and acid catalyzed halogenation of acetone.   [5+4]

Para-nitrobenzaldehyde is more reactive towards nucleophilic additions than para-methoxybenzaldehyde. Explain.
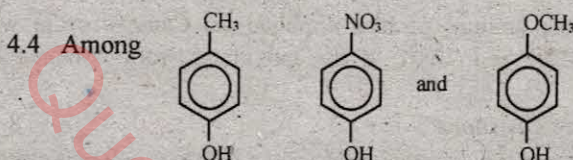
4. **Short Answer Questions**   8×3=24

    4.1 Explain the factors that affect the stability of conformations.
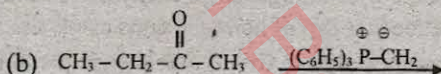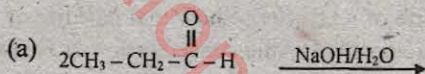
    4.2 Write the mechanism of the following reaction.

$$\underset{}{\text{Benzene}} \xrightarrow[30°C]{HNO_3/H_2SO_4} \underset{}{\text{Nitrobenzene } (NO_2)}$$

    4.3 What is Sandmeyer reaction ? Write its mechanism.

    4.4 Among p-cresol (CH_3, OH), p-nitrophenol (NO_3, OH) and p-methoxyphenol (OCH_3, OH)

        which is the most acidic and why?

    4.5 How is bakelite prepared? Mention its uses.

    4.6 Predict the product in the following reactions

        (a) $2CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{NaOH/H_2O}$

        (b) $CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 \xrightarrow{(C_6H_5)_3 \overset{\oplus}{P}-\overset{\ominus}{CH_2}}$

    4.7 What are A, B and C?

$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-OEt \xrightarrow{NaOEt} \text{(A)} \xrightarrow{CH_3-CH_2-CH_2-Br} \text{(B)} \xrightarrow[\Delta]{H_3O^+} \text{(C)}$$
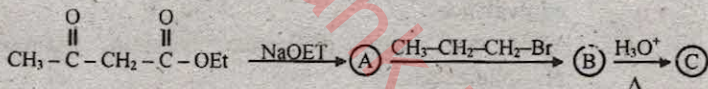
    4.8 Provide reason why the following compounds are aromatic.

        (a)   (b)   (c)
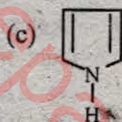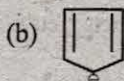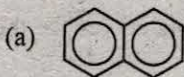
    4.9 Show your acquaintance with Hoffmann rearrangement reaction.

    4.10 What is Riemer - Tiemann reaction? Write its mechanism.

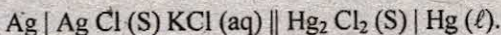   4.11 Explain 1, 3 -diaxial interaction giving example.

Group "C" (Physical)

Comprehensive Question   [10]

5.   Define standard electrode potential. How will you measure it? How does the electrode potential vary with the concentration of ions in a cell?

    For the electrochemical cell

$Ag \mid Ag\,Cl\,(S)\,KCl\,(aq) \parallel Hg_2\,Cl_2\,(S) \mid Hg\,(\ell)$.

The em f measured at different temperature are

t°C	0°C	25°C
emf(v)	0.03705	0.0455

(a) write the cell reaction

(b) Calculate ΔG, ΔH and ΔS at 25°C. [1+2+3+4]

OR

State the second law of thermodynamics. Derive an expression for the efficiency of work done by a hypothetical engine using Garnet cycle?

Calculate the amount of heat supplied to. Camot's cycle working between 368K and 238K, if the maximum work obtained is 895 joules? [2+4+4]

6. *Short Answer Questions* 8×3=24

6.1 What are the difference between a galvanic cell and electrolytic cell?

6.2 Derive an expression for the rate constant for first order reaction? What is its unit?

6.3 Define half life of a reaction. Show that half life of a first order reaction is independent of the concentration of the reactant.

6.4 What is meant by homogeneous catalysis? Explain with one example the mechanism of homogeneous catalysis.

6.5 What is contact catalysis? Give suitable example to illustrate it?

6.6 State and explain the Einstein law of photochemical equivalence.

6.7 What are basic difference between fluorescence arid phosphorescence?

6.8 Define the terms "transport number" and "ionic mobility". How are they inter related?

6.9 Sketch the conductometeric titrations curves for the following reaction

(a) CH_3COOH vs NaOH

(b) CH_3COOH vs NH_4OH

6.10 Calculate the emf of cell

$Zn \mid Zn^{++}\,(0.01M) \parallel Ag^+(0.1M) \mid Ag$.

The standard electrode potential of Ag^+/Ag half cell is + 0.80V and Zn^{++}/Zn half cell is –0.76V.

6.11 What are fuel cells? Explain in brief the hydrogen – oxygen fuel cell?

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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 that even though $A\ell$ is the most abundant metal in the earth's Crust it was discovered at a relatively later period? Name the important ore of $A\ell$ and discuss in brief the principle involved in the extraction of $A\ell$. Also mention important applications of $A\ell$. [2+1+4+2]

OR

How is hydrogen peroxide prepared industrially? What is meant by 100 volume hydrogen peroxide? Discuss the oxidising and reducing properties of hydrogen peroxide. Discuss its structure and important applications. [2+1+2+2+1+1]

2. *Short Answer Questions* $8 \times 3 = 24$

   2.1 What are ion exchange resins? Give an example of the use of ion exchange resin in the separation of metals.

   2.2 Why is the solubility of salts of Gr I metals decreases on descending the group?

   2.3 Point out the anomalous behaviour of Be.

   2.4 Explain the reason for inert pair effect.

   2.5 Point out the difference in structure between anhydrous and hydrated aluminium chloride.

   2.6 What are freons? How do they damage the environment?

   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 Discuss in brief the principle involved in the extraction of fluorine.

   2.9 What are Clathrates? Are they typical chemical compound? Give an example.

   2.10 What is hypo? Discuss its analytical application.

   2.11 What are co-ordination compounds? What is meant by co-ordination number? What is the driving force for the formation of co-ordination compounds?

Group "B" (Organic)

Comprehensive Question

3. Define aromaticity and antiaromaticity. Is-NO^2 group ortho/para directing or meta directing? Give your answer with pertinent resonating structures? Write the mechanism of Friedel-Craft alkylation reaction. [3+3+3]
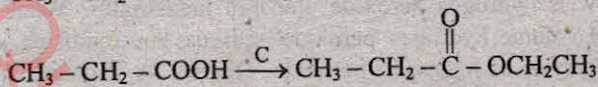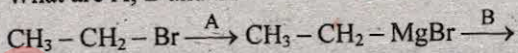
OR

Write the mechanism, scope and applications of the following reactions:

(a) Sandmeyer reaction   (b) Fries rearrangement

(c) Kolbe's reaction

4. **Short Answer Questions** $8 \times 3 = 24$

  4.1   What is meant by 1, 3-diaxi'al interaction? Write giving example.
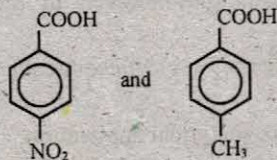
  4.2   What are A, B and C?

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

$$CH_3 - CH_2 - COOH \xrightarrow{C} CH_3 - CH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - OCH_2CH_3$$

  4.3   In between aldehydes and ketones, which is more reactive in terms of addition reactions? Write your answer giving pertinent reasons.

  4.4   What is witting reaction? Write its mechanism.

  4.5   Write the product of the following reaction

$$\overset{\overset{\displaystyle CH_3}{|}}{CH_3 - CH} - CHO + CH_2O \xrightarrow{NaOH, H_2O}$$
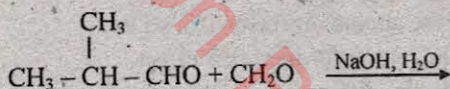
  4.6   Write the mechanism of base catalyzed halogenation of ketones.

  4.7   What are A, B and C?

$$CH_2(COOEt)_2 \xrightarrow{A} \xrightarrow{B} n - C_4Hg \, (CH \, (COOEt)_2$$
$$\xrightarrow{C} n - C_4Hg \, CH_2COOH$$
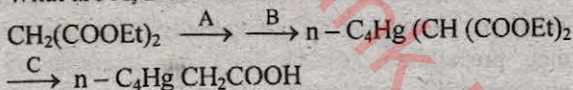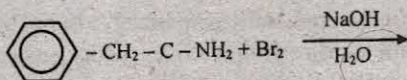
  4.8   Consider the following acids

Which is more acidic and why?

  4.9   Why is meant by reductive animation? Illustrate by giving example.

  4.10 Name and write the product of the following reaction

$$\bigcirc - CH_2 - C - NH_2 + Br_2 \xrightarrow[H_2O]{NaOH}$$

  4.11 How does benzene diazonium salt couple with phenol? Show with reaction.

Group "C" (Physical)

Comprehensive Question [10]

5. What is electrochemical series? What are the applications of electrochemical series?

    The standard reduction potential $E°$ of Cu^{++}/Cu and Ag^+/Ag electrode are +0.34V and +0.80V, respectively. Construct a galvanic cell. Using these electrodes, so that the standard emf is +ve. For what concentration of Ag^+ will the emf of the cell at 25°C be zero if the concentration of Cu^{++} is 0.01M. [2+4+4]

OR

Define order of reaction, molecularity of a reaction and half life period. Show that for first order reaction the half life period is independent of the initial concentration.

The rate constant of a reaction is 1.2×10^{-3} sec^{-1} at 300K. Calculate the rate, constant at 313K, if the activation energy for the reaction is 44.12 KJ-mol^{-1}. [2+4+4]

6. **Short Answer Questions** 8×3=24

    6.1 A first order reaction is 40% complete in 50 minutes. Calculate the value of the rate constant. In what time will the reaction be 80% complete?

    6.2 What are the advantages of potentiometric titration?

    6.3 Sketch the conductometric titration of weak acid with weak base. Write down the advantages of conductometric titration.

    6.4 Write short notes on any TWO:

    (a) Fuel cell

    (b) Botton cell

    (c) Nickel-cadmium cell

    6.5 What are the difference between photochemical and thermoehemical reaction

    6.6 What do you mean by primary and secondary processes?

    6.7 Define catalysis. What are the characteristics of catalysis?

    6.8 Discuss on intermediate compound formation theory of catalysis.

    6.9 Define molar heat capacity. What are the relations between C_p & C_v?

    6.10 What is thermodynamic efficiency? Find the efficiency of Carnots engine working between the steam point and ice point.

    6.11 Calculate the entropy change when 1 mole of ethanol is evaporated at 351 K. The molar heat of vaporisation of ethanol is 39.48 KJ mol^{-1}.

TRIBHUVAN UNIVERSITY, 2069

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. Briefly describe the electron transport chain and its significance. [8+2]
2. What is lipid? Give classification of lipids, and its properties. [2+8]
3. Describe various types of cheese and microbial technology of cheese production. [3+7]
4. Define fermentation. Describe submerged state fermentation with example. [2+8]
5. Explain outline of gene cloning. [10]

OR

Describe production and purification of proteases.

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

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

6. Draw a well labelled diagram of a fermenter.
7. Explain on use of mycorrhiza.
8. Point out risk and hazards of biotechnology.
9. Briefly explain on concept of database in bioinformatics.
10. Briefly mention principle and applications of spectrophotometry.
11. Briefly explain transcription.

Group "C" 5×3=15

12. Very Short Answer Questions.
    (Attempt any FIVE questions each of three full marks.)
    (a) Define buffer with examples.
    (b) Mention essential amino acid in human diets.
    (c) Classify the polysaccharide.
    (d) Define TCA cycle.
    (e) Explain coenzymes.
    (f) Mention denaturation of proteins.

OLD COURSE

Attempt ALL the questions.

Group "A" 2×15=30

1. Describe various metabolic steps of TCA cycle and calculate the total

number of ATP generated in TCA cycle. [10+5]

2. Define transcription. Describe the transcription process in detail.

[2+13]

<center>OR</center>

Define Genetic Engineering. Describe the gene cloning procedure in detail. [2+13]

<center>Group "B" 2×10=20</center>

3. Classify the lipids with examples. [10]

4. Define bioreactor. Draw a labelled diagram to show various component parts of fermenter. [2+8]

<center>OR</center>

Describe the sources and application of microbial enzymes. [5+5]

<center>Group "C" 10×5=50</center>

5. Describe the process of production of cheese.

6. What are the risks and hazards of biotechnology?

7. Mention the properties of genetic code.

8. Explain Ninhydrin reaction.

9. Write the difference between solid state fermentation and submerged state fermentation.

10. Mention various chemical elements present in living cells.

11. Point out the biological functions of carbohydrates.

12. Describe briefly the process of production of ethanol.

13. Mention the steps of mushroom culture.

14. Describe briefly on separation of amino acids by paper chromatography.

<center>

TRIBHUVAN UNIVERSITY, 2069

</center>

Bachelor Level / Science / II Year   Full Marks: 100
Ecology, Physiology, Cytoloy and Genetics,   Time: 3 hrs.
Embryology and Anatomy (Bot. 321)

NEW COURSE

Attempt ALL questions.

<center>Section "A" (Ecology)</center>

1. How light and temperature effects living organism in ecosystems? Explain. [10]

<center>OR</center>

Enumerate protected areas in tropical region of Nepal and name the particular species conserved there.

2. Explain the impacts and mitigation of noise pollution. [5]

3. Give diagrammatic account of nitrogen cycle in nature. [5]

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4. Explain the structure and functions of pond ecosystem. [5]

Section "B" (Physiology)

5. Explain the process of Crassulaceae Acid Metabolism pathway in higher plants. [10]

OR

Define transpiration. Explain the mechanism of stomatal transpiration and different factors affecting the process.

6. Differentiate between Macro and Micro nutrients. [5]
7. Write general steps in tissue culture and its role in agriculture. [5]
8. Explain physiological role of Abscissic acid in plants. [5]

Section "C" (Cytology & genetics)

9. Explain different phases of Meiosis I and discuss its significances.

OR [10]

Describe various types of mutation caused by change in number of chromosomes.

10. Explain the structure of Mitochondria. [5]
11. What is linkage? Explain in complete linkage with a suitable example.
 [5]
12. Highlight role of genetic engineering in agriculture. [5]

Section "D" (Embryology)

13. Write briefly about different types of endosperm. [5]
14. Explain the development of a monocot embryo. [5]
15. Describe the structure and development of bisporic embryo sac. [5]

OR

Write short-notes on polyembryony.

Section "E" (Anatomy)

16. Describe anomalous secondary growth in a plant which has anomalous position of cambium. [5]
 What is meristem? Write the differences found in various types of meristem.
17. Draw a well labelled diagram of T.S. of stem of a mesophyte (description not required).

OLD COURSE

Attempt ALL the questions.

Section "A" (Ecology)

1. What do you mean by 'Protected Areas'? Describe the role of protected areas in biodiversity conservation in the context of Nepal. [10]

OR

What is succession? Describe the process of succession that starts from lakes / ponds.

2. How does nitrogen get cycled in nature? Explain in brief. [5]

3. Give a brief account of air pollution in Nepal. What measures should be taken to reduce it? [5]

4. Describe in brief the different types of positive biotic interactions found in communities. [5]

Section "B" (Physiology)

5. What do you mean by Hill reaction? Describe the process of photochemical reactions of photosynthesis. [10]

OR

Describe the process of anaerobic respiration in plants.

6. How do stomata open and close? Explain. [5]

7. What do you mean by oxidative phosphorylation? How does it take place? [5]

8. Define phytohormon. Give the physiological role of ethylene in plants. 15]

9. What is transpiration? Write different factors that affect transpiration. [5]

Section "C" (Cytology & Genetics)

10. Define mutation. Describe different types of chromosomal mutations.

OR

Describe the features that take place during prophase -I of Meiotic cell division with suitable diagrams.

11. Write down the structure and function of mitochondria. [5]

12. Draw the Watson-Crick model of DNA. [5]

13. State and explain the law of dominance with suitable example. [5]

Section "D" (Embryology)

14. Draw a well labelled diagram of female gametophyte of angiosperms. [5]

15. Write short note on embryogenesis in monocots. [5]

Section "E" (Anatomy)

16. Define Meristem. Write different types of meristems based on origin and explain in brief. [5]

17. How does secondary growth take place in Bignonia stem? [5]

TRIBHUVAN UNIVERSITY, 2069

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

NEW COURSE (MET 321)

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

1. Discuss the distribution of surface temperature and water vapour in tropics. Also, explain resultant wind at 200 mb level. [2+8]

2. 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+2+7]

3. Define air mass. Explain general characteristics of air mass. State the possible reasons of the modification of air mass. [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 is monsoon? Explain the features of southwest Indian monsoon and its influence in Nepal. [1+7]

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

   (a) Elnino and southern oscillation
   (b) Adiabatic processes & environmental lapse rate
   (c) Frontogenesis and Frontolysis [4+4]

7. Explain the variations of temperature, pressure and wind in the tropical region. [8]

8. What are the dominant cloud types in the tropical region? Explain the diurnal cloudiness variation in the tropical region. [3+5]

9. Explain rainfall associated with tropical cyclones. Why diurnal and local effects are important in the tropics? [4+4]

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

    (a) Elnino and Lanino
    (b) Southern oscillation
    (c) Thunderstorm characteristics [4+4]

11. Define dynamical meteorology? Explain three conservation principles that are important in earth's atmosphere. [2+6]

12. What do you mean by pressure gradient force? Write down all basic equations in pressure coordinate with the explanation of symbol used. [2+6]

13. What are barotropic and baroclinic atmosphere? Explain the kinematics method of determining the vertical motion of the atmosphere. [2+6]

14. Derive continuity equation as

$$\frac{1}{\rho}\frac{d\rho}{dt} + \vec{V} \cdot \vec{V} = 0$$

   Also, explain what will be the result of this equation if the atmosphere is incompressible. [5+3]

15. What is geostrophic motion? Explain with vector form of its equation. Also, describe its application in the atmosphere. [1+4+3]

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

    (a) Tornadoes and hail storm

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    (b) Land and Sea breezes

    (c) Temperature and radiative inversions   [4+4]

OLD COURSE (MET 321/322)

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

1. (a) Explain briefly the following types of flows of a liquid system: steady, uniform, laminar and rotational.   [5]

   (b) Derive and explain Dernoulli's equation and discuss the assumptions underlying the development of this equation.   [10]

2. Define air mass and fronts. Explain the distinguishing features of cold fronts and warm fronts with schematic diagrams.   [4+11]

3. What are squall and gust, how are they hazardous for aviation?   [2+3]

4. Discuss on the life cycle of the tropical cyclone.   [5]

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

6. Discuss thermal and orographic depressions.   [5]

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

8. What is TAF? Explain its importance for the safety of an air-craft.

                                         [2+3]

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

10. Derive the equation of continuity for flow of liquids.   [5]

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

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

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

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

15. Discuss why mulching practice is done in agriculture.   [5]

16. A fluid is flowing through a pipe of 6 cm diameter under a pressure of 40 N/cm^2 and with mean velocity of 22m/s. Determine the total head or total energy per unit weight of the fluid at the cross section that is 5m above the datum line.   [5]

17. Discuss the prevailing climatological conditions to grow rice in Nepal.

                                         [5]

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

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

20. Write short notes on:

    (a) Extra-tropical cyclone

    (b) Jet stream.

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

Group "A" 5×7=35

1. Define a tautology. Prove that if p and q are any statements and c is a contradiction, then
$$(p \Rightarrow q) \Leftrightarrow (p \wedge \sim p \Rightarrow c)$$
is a tautology. State the principle of mathematical induction. To illustrate the proof by induction, prove that if $n_1, n_2, n_3 \ldots$ are natural numbers such that $n_k < n_{k+1}$ for all natural number k, then $n_k \geq k$ for all natural number k. [1+3+1+2]

OR

Define a function $f : X \to Y$ and its inverse. Prove that the inverse function $f^{-1} : Y \to X$ exists if and only if the function / is one-to-one and onto. [2+5]

2. Define the closure of a set. Prove that if A is any set in $\Re$, then $\bar{A} = A \cup A'$. Also, show that $\overline{A \cap B} \subseteq \bar{A} \cap \bar{B}$. [1+4+2]

3. State Leibnitz test. Define absolute and conditional convergences. Give an example of a series which is convergent, conditionally, but not absolutely. Prove that absolute convergence of a series implies conditional convergence of the series. [1+1+2+3]

4. Prove that if f is twice differentiable on an interval I and $f'' > 0$ for all x in I, then f is concave upward on I. Define a point of inflection. Consider $f(x) = x^{1/3}$ to show that f'' may not be zero at the point of inflection. [5+1+1]

5. Define a Riemann integrable function on [a, b]. Show that Dirchlet's function f defined on [0, 1] by
$$f(x) = \begin{cases} 1 & \text{if x is rational} \\ 0 & \text{if x is irrational} \end{cases}$$
is not Riemann integrable, but the function $f(x) = c$ on [a, b] is Riemann integrable on [a, b]. [1+3+3]

OR

Define an integrable function on [a, b] and state Riemann's condition of integrability. Prove that if f and g are integrable on [a, b], then the product fg is also integrable on [a, b]. [2+5]

Group "B" 10×4=40

6. State the field axioms of the real number system for addition. Let a, b and c be real numbers.
Prove that if $a + c = b + c$, then $a = b$, thereupon indicating the axioms

of the real number system. [2+2]

7. Show that the set $\Re$ of the real numbers is uncountable. [4]

OR

Define a denumerable set. Prove that every infinite set has a denumerable subset. [1+3]

8. Prove or disprove that
   (i) any union of closed sets in $\Re$ is a closed set.
   (ii) any intersection of closed sets in $\Re$ is a closed set. [2+2]

9. Define the limit of a function at a point. Prove that if $\{y_n\}$ and $\{z_n\}$ converge to the same limit L and $\{x_n\}$ is a sequence such that $y_n \leq x_n \leq z_n$ for all natural number n, then $\{x_n\}$ converges and $\lim x_n = L$. [1+3]

OR

A sequence of real numbers can have at most one limit. [4]

10. What is a Cauchy sequence? Show that if $x_n = \dfrac{2n-1}{3n+1}$ then $\{x_n\}$ is a Cauchy sequence. [1+3]

11. Prove that if $\lim_{x \to c} f(x) = L$ and $\lim_{x \to c} g(x) = K$, then $\lim_{x \to c} f(x) / g(x) = L/K$, provided that $K \neq 0$. [4]

12. When is a function said to be uniformly continuous at a point? Show that function, $f(x) = x^2$ is not uniformly continuous on $\Re$. [1+3]

OR

Define the limit of a function at a point. Evaluate $\lim_{x \to c} \dfrac{x^2 - 2x + 1}{x^2 + 1}$ and verify your answer. [1+3]

13. Prove that if f is differentiable on (a, b) and has a local extremum at a point c in (a, b), then $f'(c) = 0$. Is its converse true? Justify your answer. [1+3]

14. State and prove the second fundamental theorem of integral calculus. [4]

15. State and prove the theorem on integration by parts. [4]

OR

State the first fundamental theorem of integral calculus. Prove that if g : [a, b] $\to$ $\Re$ has a continuous derivative on [a, b] and f is continuous on A = g([a, b]), then $\int_a^b f(g(x)) g'(x) dx = \int_{g(a)}^{g(b)} f(u) du$. [4]

OLD COURSE

Attempt ALL the questions.

Group "A" 5×7=35

1. Define boundary point and boundary of a set.
   Let B $\subset$ $\Re$ Find the exterior; the boundary and exterior of the set B =

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$\{x : 1 < x \leq 3\}$.

Prove that A set S in $\Re$ is closed if and only if it contains all its boundary points. [1.5+1.5+4]

OR

When is a set S in $\Re$ said to be bounded? Prove that every bounded infinite set in $\Re$ has a limit point in $\Re$. [1+6]

2. A sequence $\{x_n\}$ converges to x if f given $\in > 0$, there exists an N such that $|x_n - x| < k\in$ for all $n \geq N$, where $k > 0$ is independent of $\in$ and N. Also prove that if $|x| < 1$, then $x^n \to 0$. [4+3]

3. Define continuity of a function at a point.

A real valued function $f : \Re \to \Re$ is continuous at a point $p \in \Re$ if and only if for every sequence $\{f(x_n)\}$ in domain $\Re$ converging to p, the sequence $\{f(x_n)\}$ converges to $/(p)$ as $n \to \infty$. [1+6]

4. State and prove the Cauchy mean value theorem for derivative and hence verify it for the function $f(x) = x^2$ and $g(x) = x^3$ in $[1, 2]$. [4+3]

5. Define a term 'Riemann Integrable'. Show that $f(x) = K$ is Riemann integrable on $[a, b]$. If $f \geq g$ on $[a, b]$ then $\int_a^b f(x) \, dx \geq \int_a^b g(x) \, dx$.

[1+3+3]

OR

State and prove second fundamental theorem of integral calculus and hence using this theorem evaluate $\int_0^3 \sqrt{x + 1} \, dx$. [5+2]

Group "B" $\qquad$ 10×4=40

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

7. State and prove De-Morgan's law of set theory. [4]

8. Define supremum and infimum of a non-empty set S in $\Re$ Prove approximation property for suprimum and infimum. [2+2]

9. If b is a limit point of a set A, then prove that every open ball B (b; r) contains infinitely many points of A. [4]

OR

Prove that a set S in $\Re$ is closed if and only if it contains all its limit points.

10. State the ratio test and hence examine the convergence of the series $\sum_{n=1}^{\infty} \sqrt{n^3 + 1} - \sqrt{n^3}$ [1+3]

11. Let $I \subseteq \Re$, c be a limit point of I. Let $f : I \to \Re$ and $g : I \to \Re$ be two

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real valued functions and assume that $\lim\limits_{x \to c} f(x) = a$ and $\lim\limits_{x \to c} g(x) = b$ then

$$\lim\limits_{x \to c} \left[\frac{f(x)}{g(x)} \right] = \frac{a}{b}, b \neq 0.$$ [4]

OR

State and prove the "Intermediate Value Theorem".

12. State Rolle's theorem and use it to verify for the function $f(x) = (x - a)^n$ $(x - b)^n$ in [a, b], where m and n are positive integers. [1+3]

OR

Using L' Hospital rule evaluate $\lim\limits_{x \to 0} \dfrac{x - \sin x}{x^3}$. [4]

13. Define subsequence of $\{x_n\}$. If a sequence $\{x_n\}$ converges to a real number x then every subsequence of $\{x_n\}$ also converges to x. [1+3]

14. Show by an example that every bounded function need not be R - integrable. [4]

OR

Let $f(x) = x$ for $x \in [0, 1]$ and let P = (0, 1/3, 2/3, 1) be a partition of [0,1]. Compute U(P, f) and L(P, f).

15. State and prove the formula for integration by parts. [4]

TRIBHUVAN UNIVERSITY, 2069

NEW COURSE

Attempt ALL the questions.

1. What do you mean by chromatic aberration of a lens? Explain how it is caused? How would you correct for chromatic aberration in the case of a lens system in contact? [10]

OR

What is an eyepiece? Why is it necessary to use two lenses instead of a single lens? Give the construction of Huygens eyepiece.

2. Discuss Rutherford experiment on scattering of a - particles. Hence explain its conclusions. Also mention its limitations.

OR

Explain the working principle of Scintillation counter.

3. State and explain Therenin's and Norton's theorem. Also give suitable examples for their applications. [9]

OR

Draw a circuit diagram of a CE amplifier and hence obtain an expression for the voltage gain of the CE amplifier. Explain why there is phase inversion between input and output.

4. Give with necessary theory Newton's ring method for the determination of wavelength of monochromatic light. Why is the centre of the rings dark and how can we get a bright centre? [6]

OR

Describe Febry - Perot interferometer and explain its action. Deduce an expression for its resolving power.

5. Explain spectra of α, β and γ - rays. [6]

OR

Discuss the electric and magnetic properties of nucleus.

6. Why is voltage divider bias commonly used in transistor? Discuss its advantages. [6]

OR

Draw the circuit diagram of a Colpitt's oscillator using bipolar transistor. Which element is responsible for positive feedback in the circuit? Explain.

7. Answer all in brief: [6×3=18]

(a) Distinguish between normal and anomalous dispersion.

(b) Explain the meaning of population inversion.

(c) Why are spectral lines of deuterium shifted to shorter wavelengths than those of ordinary hydrogen? Explain.

(d) What happens when y - rays are exposed to photocell?

(e) What happens to the width of the depletion layer when reverse biasing is increased across the junction of p - n junction diode?

(f) Why binary numbers are used in computers?

8. What is the highest order spectrum, which may be seen with monochromatic light of wavelength 6000Å by means of, a diffraction grating with 5000 lines/cm? [6]

9. Calculate the thickness of a quarter wave plate.
Given: μ_E 1.553, μ_0= 1.544, $\lambda = 6×10^{-5}$ cm. The symbols carry their usual meanings. [6]

10. Calculate the wavelength separation of the fine structure resulting from the spin-orbit interaction within the H atom. [6]

11. The wavelength of the L_α line of X - ray in the case of Platinum (Z = 78) is 1.321 Å. An unknown substance emits L_α of wavelength 4.174 Å. Calculate the atomic number of the unknown substance. Given b - 7.4 for Lα lines. [6]

12. [6]
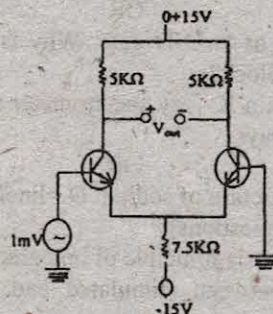
What is the ac output voltage in the differential amplifier shown in the circuit? Also find the input impedance if $\beta = 300$. [6]

13. Find the Boolean expression for the output of figure shown (below) and evaluate it when $A = 1$, $B = 1$, $C = 0$. [6]
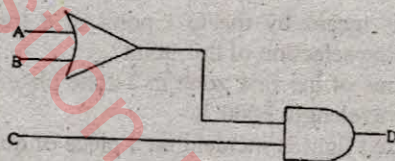
OLD COURSE

Attempt ALL the questions.

1. Give the construction and working of Ramsden eyepiece. How are chromatic and spherical aberrations minimized in this eyepiece? Indicate in a diagram the positions of the cardinal points. Make the necessary calculations. [10]

OR

Explain astigmatism, coma and curvature. How are they minimized?

2. Explain Frank-Hertz experiment. Hence discuss its conclusions. Also discuss the limitations of Bohr model. [9]

OR

How the γ- rays interact with matter? Discuss.

3. What do you mean by a semiconductor? Discuss the energy band with reference to semiconductor and hence explain the meaning of band gap. Also distinguish between n - type and p – type semiconductors.[9]

OR

Explain the need of biasing a transistor. What are the different methods of biasing?

4. Distinguish between Fresnel and Fraunhoffer classes of diffraction. Discuss the diffraction of light by a narrow slit. [6]

OR

What do you mean by double refraction? How is it explained by Huygen's principle?

5. What do you mean by FET? Discuss the basic construction and theory of operation of JFET. [6]

OR

Explain the action of NAND gate. Why is the NAND gate called a universal building block?

6. Describe and explain X - ray spectrometer method of determining the wavelength of X - rays. [6]

OR

Explain the fine structure of sodium D - line.

7. Answer in brief (all questions): [6×3=18]
   (a) Describe the basic principle of holography.
   (b) Distinguish between stimulated and spontaneous emission of radiation.
   (c) What do you mean by Zeeman effect?
   (d) What are mass defect and binding energy of a nucleus?
   (e) Explain how do Zener diodes maintain constant voltage across a load.
   (f) What is meant by the Q - point of a transistor? What factors decide the selection of this point?

8. Find the radius of the first zone in a zone plate of focal length 20 cm for light of wavelength 5000 Å. [6]

9. Plane polarized light is incident on a piece of quartz-cut parallel to the axis. Find the least thickness for which the ordinary and extra ordinary rays combine to from plane polarized light.
   Given: μ_0 1.5442, $\mu_E = 1.5533$, $\lambda = 5 \times 10^{-5}$ cm. The symbols carry their usual meanings. [6]

10. What amount of Ra - 226 of half life 1570 year will Have the activity of one micro curie? [6]

11. A 5 MeV α - particle approaches a gold nucleus (Z = 79) with an impact parameter of 2.6×10^{-13}m. Through what angle will it be scattered. [6]

12. Draw the block diagram of a full adder. Also write its truth table and explain how does it work. [6]

13. Find the input impedance of the base in the given circuit, if $\beta = 300$.

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