Physics II (Phy.321), 2065

(Optics, Atomic & Nuclear Physics, Electronics)

Time: 3 hours | Full Marks: 100

Attempt ALL the questions.

1. Explain the difference between spatial and temporal coherences. Describe, in brief, how the wavelength of a source of monochromatic light can be measured by Fresnel's biprism. Also explain how the distance between two virtual sources is measured. [10]

OR

Describe the working of a plane transmission grating with necessary theory. Also discuss how the number of diffraction maxima can be known from it. Define and write down expression for its resolving power.

2. Explain the meaning of range, straggling and stopping power of alpha particle. Also discuss the significance of Geiger - Nattal law. [9]

OR

What is Vector Atom Model? Explain the significance of different quantum numbers associated with this model.

3. Explain the meaning of transistor biasing and discuss common collector and common base characteristics with proper theory and circuits. [9]

OR

What are FET and UJT? In what respect they are different? Describe the construction and operation of junction FET.

4. How is Huygen's or Ramsden's eye piece designed? How does it help in minimizing aberration? [6]

OR

What is Nicol prism? Does it work both as polarizer and analyzer? Explain.

5. Describe Franck - Hertz experiment and write its conclusions. [6]

OR

Explain the working of GM detector. What do you understand by quenching and dead time of GM counter?

6. Sketch the diagram of Hartley oscillator. Explain the condition for its sustained oscillation. [6]

OR

What do you understand by Network theorem? Discuss it with reference to Norton's network theorem.

7. Answer in brief. [3×6 = 18]
   a. What is holography?
   b. Write down the difference between normal and anomalous dispersion.
   c. Explain what you understand by fine structure of hydrogen lines.
   d. What do you understand by pair production in gamma ray interaction with matter?
   e. Explain the action of NDR gate.
   f. Explain the importance of Q - point in transistor operation.

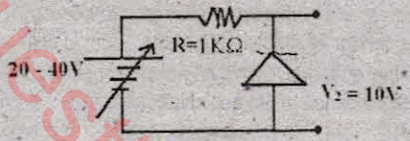
8. A quartz quarter wave plate is to be used with sodium light of wavelength 5893Å. What must be its thickness? (Given: $\mu_e = 1.553$ and $\mu_o = 1.544$). [6]

9. The object glass of a telescope is an achromat of focal length 90 cm. If the magnitude of the dispersive power of the two lenses are 0.024 and 0.036, calculate their focal lengths. [6]

10. A hydrogen atom is in the ground state. What is the quantum number to which it will be excited by absorbing a photon of energy 12.75 eV? [6]

11. Find the mass absorption coefficient of copper of density 8930 kg/m^3 if 1.05 mm of copper reduces the intensity of a beam of X - rays to 0.075 of its original intensity. [6]

12. Using the ideal diode approximation calculate the output voltage in the following circuit and find the minimum zener current.



[6]

13. Write binary equivalent of the decimal number 27.5 and 34. Also add and subtract these binary numbers. [6]

2. Chemistry (Chem.321), 2065

Time: 3 hours **Full Marks: 100**

Use separate answer-book for each group

The Comprehensive question of each group is compulsory.
Attempt EIGHT questions from Short Answer questions of each group.

Group 'A' (INORGANIC)

Comprehensive question **[9]**

1. What is complex compound? What are the main postulates of Werner's theory? Define following term with examples:
❶ Ligand ❷ Co-ordination sphere ❸ Complex ion. [9]

OR

How H_2O_2 is produced by modern method? Show H_2O_2 acts as both oxidising and reducing agent. Give its structure and uses. [3+3+3=9]

2. **Short Answer questions.** **8×3= 24**

2.1 Explain that the lower oxidation states become more stable progressively as we descend down in gr IIIA and IV of a periodic table.

2.2 $[CF_6]^{2}$ ion does not exist while $[SF_6]^{12}$ exist.

2.3 Explain ❶ TiO_2 is white but $TiCl_3$ is violet ❷ Cupric salt are blue in colour while cuprous salt are colourless.

2.4 Give preparation of hydroxylamine and describe one of its major uses.

2.5 How is $Na_2S_2O_3$ made? Explain its uses in photography and volumetric analysis

2.6 Explain with diagram how Co forms back - bonding with transition metal (Ni).

2.7 What are the difficulties in the manufacture Fluorine? Explain.

2.8 Explain the solvent extraction technique for purification of metal with suitable examples.

2.9 Describe the preparation and structure of ❶ Orthophasphoric acid ❷ Pyrophasphoric acid.

2.10 Explain:

❶ $(SiH_3)_3N$ is planar while $(CH_3)_3N$ is tetrahedral

❷ CCl_4 is not hydrolysed by water but $CiCl_4$ is immediately hydrolysed.

2.11 Describe preparation, structure and uses of tetrasulphur tetranitride.

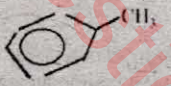
Group 'B' (ORGANIC)

Comprehensive Question [9]

3. Define resonance. Give resonance structures of benzene showing Ti-bonds. Select with justification, the aromatic compounds from the following compounds:

❶ 

❷ $CH_2CH - CH = CH - CH = CH_2$

❸ 

❹ 

[2+2+5]

OR

What are the important factors on which malonic and acetoacetic ester synthesis depend?

Give the synthesis of $(CH_3)_2-CH-CH_2-CH_2-COOH$ from malonic ester and $CH_3-CH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CO-CH_3$ from acetoacetic ester. [3+3+3=9]

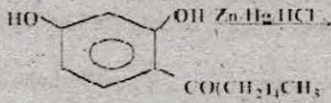
4. **Short Answer Questions** [8×3=24]

4.1 Give reasons why the chair conformation is the most stable conformation of cyclohexane:

4.2 Why Benzene has tendency to undergo electrophilic aromatic substitution? What majorproducts will be formed when ethylbenzene is treated with conc. sulphuric and conc. nitric acid?

4.3 Give the possible products of the following reactions:

(i) $Ph\,CH = CH.\,CHO \xrightarrow[H-O-CH_2-CH_2-NH_2]{9BBN}$

(ii) 

4.4 What test would you use to distir guish primary, amine from tertiary amine? Give reaction involved in the test.

4.5 Give the reaction to prepare chlorobenzene from aniline by Sandmeyer' reaction.

4.6 How would you convert benzyl to benzilic acid? Give reactions.

4.7 Give th reaction and products that will form when 2 - hexanone is treated with willing reagent.

4.8 What product will be formed when propionic acid is treated first with bromine and one equivalent of PBr_3 followed by large excess of ammonia?

4.9 Why P - chloroaniline is less basic than aniline? What products will be formed when P - chloroaniline reacts with acetic anhydride?

4.10 Give the products of the following reactions:

❶ Phenylacetaldehyde + NaOH ⟶

❷ Propionaldehyde + NaOH ⟶

4.11 Why P - nitrophenol is more acidic than m - nitrophenol?

Group 'C' (PHYSICAL)

Comprehensive question [10]

5. What is meant by rate of reaction? Enumerate the reasons responsible for the change in the rate of a reaction with change in ❶ concentration ❷ temperature and ❸ use of catalyst.

The rate of a reaction doubles when the temperature raised from 22°C to 32°C. Calculate the activation energy of the reaction. [1+2+2+2+3]

OR

Describe Carnot cycle for establishing the maximum convertibility of heat into work. How does it lead to the definition of second law of thermodynamics?

A Carnot engine whose low temperature reservoir is at 70°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of high temperature reservoir be increased? [6+1+3]

6. Short Answer questions **8×3 = 24**

6.1 Define entropy. Drive an expression for entropy change of an ideal gas due to the variation of T and V.

6.2. Define half life. How does the half life of zero and first order reaction depend upon initial concentration of the reactant?

6.3 Describe the underlying principle of conductometric titration of strong acid with strong base.

6.4 Define equivalent conductance at infinite dilution. How will you experimentally determine the equivalent conductance of a strong electrolyte at infinite dilution.

6.5 In a particular cell 0.01 M solution of KCl gave a resistance of 160 ohms at 298 K while 0.1 M solution of HCl gave a resistance of 54 ohms. If specific conductance of 0.01 M KCl is 1.40×10^{-3} ohm^{-1} cm^{-1}. Calculate the equivalence conductivity of HCl solution.

6.6 What is a reference electrode? Describe the working of any one reference electrode.

6.7 How pH of a solution is determined using quinhydrone electrode?

6.8 What are primary and secondary cells. Describe the working of a dry cell.

6.9 Defir standard electrode potential. What will be th reduction potential of Zn^{++} / Zn electrode when zinc metal is in contact with 0.1 M $ZnSO_4$ at 25°C solution. Standard oxidation potential of Zn-electrode is + 0.7681 volt.

6.10 Describe the intermediate compound formation theory of catalysis with a suitable example.

6.11 State Lambert's law and Beer's law. Give the equation for Beer-Lambert law and explain the differen symbols present in the equation.

3. Zoology- II (Zo.321), 2065

(Chordata, Cell & Tissue Biology)

Time: 3 hrs. Full Marks: 100

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

Group 'A'

1. Describe the respiratory organs and mechanism of respiration in Scoliodon. [15]
2. Discuss the internal structure of mammalian heart and its working mechanism. [15]
3. Give an account of pheasants of Nepal. [15]

Group 'B'

4. Describe the detail structure of thyroid gland and the roles of its secretion. [15]
5. Discuss in brief transmission of nerve impulse through the nerve fibre and synapse. [15]
6. Describe the structure and functions of RNA. [15]

Group 'C' 8×5 = 40

7. Elaborate ultrastructure of a Golgi complex.
8. Assign the following animals to their respective systematic position with ecological notes.
   (a) Panthera
   (b) Pavo
9. Give historical structure of mammalian ovary.
10. Give an account of Polytene Chromosome.
11. Write a short description of haemoglobin.
12. Describe the affinities of Prototheria.
13. Write a comment on ribosomes.
14. Give the distinguishing characters of Dipnoi.

4. Botany - II, 2065

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

Time: 3 hrs. Full Marks: 100

Attempt ALL the questions.

Section 'A' (Ecology)

1. What is ecosystem? Describe function and structure of grassland ecosystem. [10]

OR

Give an account of carbon cycle found in nature.

2. Discuss in brief water pollution. [5]
3. Draw a well labelled diagram of T.S. stem of a xerophyte. [5]
4. Describe in brief Alpine vegetation of Nepal. [5]

Section 'B' (Plant Physiology)

5. Describe the mechanism of photosynthesis. [10]

OR

Explain the factors regulating transmission.

6. Describe the significance of hydrophonics. [5]
7. Write short note on Auxins. [5]
8. Describe in brief role of micropropagation in conservation. [5]
9. Distinguish between C_3 and C_4 plants. [5]

Section 'C' (Cytology & Genetics)

10. What is meiosis? Describe the stages of prophase I in meiosis. [10]

OR

Write an essay on mutation.

11. Write down the structure of mitochondria. [5]
12. Mention the significance of crossing over. [5]
13. Write note on bacterial DNA. [5]

Section 'D' (Embryology)

14. With the help of illustrated diagrams show the development of embryo in dicotyledon. (Description is not required) [5]
15. Mention the importance of palynology in taxonomy. [5]

Section 'E' (Anatomy)

16. Describe with the help of well-labelled diagram of meristems found I plants. [5]
17. Draw a well-labelled diagram of Isobilateral leaf. (Description is not required) [5]

5. Microbiology- II, 2065

(Microbial, Biochemistry and Biotechnology (MB.321)

Time: 3 hrs. Full Marks:100

Attempt ALL the questions.

Group 'A'

1. Describe the primary, secondary and tertiary structure of DNA. [15]
2. Describe different areas of biotechnology and mention risks and biohazards of modern biotechnology. [12+3]

OR

Describe the various pathways (fates) of pyruvic acid. Explain, which pathway does it follow in presence of oxygen. [5+10]

Group 'B'

3. Describe the properties of genetic code. [10]
4. Differentiate between heterotrophic and autotrophic modes of metabolism. List heterotrophic metabolic pathways of carbohydrates that generate ATP. [10]

OR

Describe the procedure of plant tissue culture with reference to production of disease free plant. [10]

Group 'C' 5×10 = 50

5. Give an account on structure and functions of cell membranes.
6. Discuss on properties of lipids.
7. Explain, why ED-pathway produces less ATP as compared to glycolysis.
8. Differentiate between sold state and submerged state fermentation.
9. Give outlines of gene cloning.
10. Give an account on biofertilizer and its production.
11. Describe briefly the procedure for production of milk powder.
12. Give an account on various microbial enzymes used in food industries.
13. Write short note on Biovet reaction and its use.
14. Describe briefly the processes, induction and repression of Lac-operon.

6. Geology- II, 2065

(Petrology, Historical Geology & Geology of Nepal and Adjacent Region (Geo.321)

Time: 3 hrs. Full Marks: 100

Attempt ALL the questions.

Group 'A'

1. (a) Name various bases of classification of igneous rocks. Discuss in detail the IUGS classification system.
   (b) Describe the solid solution. Describe the crystallisation process of a two component system with solution under 1 bar atmosphere.
2. (a) What is meant by intrusive and extrusive igneous bodies? Describe various structures of extrusive igneous bodies.
   (b) Write short notes on any THREE of the following:
   (i) Bowen's reaction principle (ii) Carbonatite
   (iii) Xenolith (iv) Flow structures
3. (a) Describe the stability limits of various rocks and minerals as a function of P and T in the metamorphism.
   (b) Describe the textures of metamorphic rocks.
4. Write short notes on any THREE of the following:
   (a) Isograde (b) Paired metamorphic belt
   (c) Porphyroblast (d) Preferred orientation
5. (a) What are the reference fundamental factors which can describe the settings of basins? Describe the "Oceanic basins".
   (b) Describe mineralogical composition of limestone. Discuss the classification of limestone.

OR

Write short notes on any THREE the following:

(i) Bedded chert (ii) Evaporite
(iii) Diagensis and lithification (iv) Sandstone

Group 'B'

6. (a) What is solar system? Describe briefly the evolution of the atmosphere.
   (b) Define correlation. Describe different methods of correlation.
7. (a) What is a Precambrian shield? How are they formed? Mention the distribution of the Precambrian rocks in the world.
   (b) Write notes on the following:
      (i) Chronology
      (ii) Catastrophic theory
8. (a) Describe the tectonic history of Devonian Period.
   (b) What is palaeotectonic reconstruction? Describe the tectonic elements of continents.

OR

   (a) What is difference between Homotaxial and Marker Horizon? Describe on its importance in correlation.
   (b) How can life and sediments of Bionomial zone be identified?

Group 'C'

9. Discuss the geology of Tethys Zone of Nepal with special reference to Manang area.

OR

Write short notes on:
   (i) Stratigraphy of the Siwaliks
   (ii) MCT and STDS
   (iii) Stratigraphy of Malekhu area
10. (a) Describe briefly the geology of Tansen area.
   (b) Discuss in brief the geology of Far Western Nepal and show its relation with the geology of eastern Kumaou Himalaya.

7. Meteorology II Paper (Met.321/322), 2065

Time: 3 hrs. Full Marks: 100

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

1. Describe the vertical distribution of atmosphere with a neat diagram. What are the different types of air masses and fronts? Explain with diagrams the formation of frontal depressions. [5+5+5]
2. Explain steady and unsteady flow. Derive Euler's equation of motion and Bernoulli's equation. [5+5+5]
3. Explain why cyclone and anticyclone are respectively associated with bad and good weather. [5]
4. What are the factors affecting horizontal visibility? Write its components in aviation. [3+2]
5. What are the conditions favourable for the formation of thunderstorms? [5]
6. Explain in brief the various approaches for weather forecasting in Nepal. [5]
7. Describe the Jet streams and Clear Air Turbulence (CAT). [3+2]

8. Write briefly about temperature distribution over Nepal. [5]
9. Discuss the generation of monsoon associated with the depression in the Bay of Bengal, [5]
10. Discuss briefly on Tornado and mention two different types of fog. [3+2]
11. Explain briefly the nature of ideal, real and Newtonian fluids. [5]
12. Explain briefly uniform, non-uniform, laminar, compressible and incompressible types of flow. [5]
13. What is flowing through a pipe of 10 cm diameter under a pressure of 34, 43 N/m^2 with mean velocity of 25 m/S. Find the total head or total energy per unit weight of the water at a cross section which is 10m above the datum line. [5]
14. Derive the equation of continuity for flow of a liquid. [5]
15. Discuss the terms translation, rotation, distortion and deformation. [5]
16. Describe the climatological conditions to grow rice in Nepal. [5]
17. Discuss the influence of weather on agriculture I the mountainous region of Nepal. [5]
18. Explain seed germination and pollination in relation to weather elements. [5]
19. Write briefly the role of climate on crop pests and diseases in the tropical regions. [5]
20. Discuss the optimum soil conditions necessary for the plant growth. [5]

8. Statistics II Paper (Stat.321), 2065

Time: 3 hrs **Full Marks: 100**

1. **Compulsory Questions.**

Attempt any FIVE. 5×6 = 30

(a) Discuss the procedures of computing marginal and conditional distributions.

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

(c) Define χ^2 - distribution. Explain when the distribution is used for statistical analysis.

(d) State central limit theorem. Show how this theorem is deduced from Chebycher's theorem.

(e) Find the values of K such that $f(x, y) = K xy$; $1 \leq x \leq 2$ will be a probability density function.

(f) Show that a random variable X may not have moments although its MGF exists.

Group "A" 4×7 = 28

Attempt any FOUR.

2. Find the mean and variance of a truncated binomial distribution.
3. State and prove central limit theorem. A symmetrical die is thrown 600 times. What is the lower bound of getting 80 to 120 sixes?

4. If X_1 and X_2 are independent rectangular variates on [0, 1], find the distribution of $\left(\frac{X_1}{X_2}\right)$.

5. Examine whether the law of large number holds for the sequence $\langle X_n \rangle$ of independent random variables defined as $P[X_k = \pm 2^k] = 2^{-(2k+1)}$; $P[X_k = 0] = 1 - 2^{-2k}$.

6. Show that pdf, g(u, v) of the transformed variables u, v is given by

$$g(u, v) = f(u, y)\,|J| \; ; \; J = \frac{\partial(x, b)}{\partial(u, v)}.$$

Group "B" $6 \times 7 = 42$

Attempt any SIX.

7. If T is a consistent estimator of θ, show that T^2 is a biased estimator of θ^2. Also show that $\sqrt{T}$ is not an unbiased estimator of $\sqrt{\theta}$, if T is unbiased estimator of θ.

8. Show that in a simple random sampling, the sampling variance S^2 defined as $\frac{1}{n-1}\Sigma(x - \bar{x})^2$ is unbiased estimator of population variance S^2.

9. The sex ratio of birth is some times given by the ratio of males to females births instead of the proportion of male to total births. If Z is the sex ratio i.e. $Z = \frac{p}{q}$, show that the standard error of Z is approximately equal to $\frac{1}{1+Z}\sqrt{\frac{Z}{n}}$, n being large so that the deviations are small compared to the mean.

10. Show that the square of a t -variate with n.d.f. is distributed as F with 1 and n.d.f.

11. Describe the method of maximum likelihood estimator. Also discuss its properties.

12. Obtain the best critical region for the population $f(x, \theta) = \theta\, e^{-\theta x}$ for $x \geq 0$ of size α for testing $H_0 : \theta = \theta_0$ against : $\theta = \theta_1$.

13. A machine puts 16 imperfect articles in a sample of 500. After the machine is overhauled, it puts out 3 imperfect articles in a batch of 100. Has the machine improved?

14. Describe Friedman's two way analysis of variance. An investigator wants to study the scores of 3 groups under five conditions each group containing five matched subjects, one being assigned to each of the five conditions.

	Conditions				
	I	II	III	IV	V
Group A	8	9	1	4	6
Group B	6	7	5	2	8
Group C	9	8	5	2	6

Set up the null hypothesis and carry out the ANOV.

9. Mathematics III Paper (Math. 321), 2065

(Algebra –I)

Time: 3 hrs. Full Marks: 75

Attempt ALL the questions.

Group 'A' 5×7 = 35

1. If A be an n × n matrix, prove that
A.(Adj. A) = (Adj. A)A = |A|I where I is the n × n unit matrix. Verify this property for the matrix $A = \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix}$ and find the inverse of A if it exists. [4+2+1]

OR

Define symmetric and skew symmetric matrices with examples of each. Prove that every square matrix can be uniquely expressed as the sum of a symmetric and a skew symmetric matrix. [3+4]

2. Define subgroup of a group. Prove that a non-empty finite subset H of a group G is a subgroup of G if and only if
$a * b \in H$ for all $a, b \in H$.
Also show that the subset $H = \{e, (123), (132)\}$ of S_3 forms a subgroup of S_3. [1+4+2]

3. Define ring and give an example of a ring without unit element. Let R be a ring and I be an ideal of R. Let ϕ be a mapping from R to $\frac{R}{I}$ defined by $\phi(a) = a + I$ for all $a \in R$. Prove that ϕ is a homomorphism of R onto $\frac{R}{I}$. [4+3]

4. What do you mean by the linear transformation? Let V and W be vector spaces over the same field F.
Let $\{v_1, v_2, \ldots, v_n\}$ be a basis of V and let $w_1, w_2, \ldots, w_n$ be arbitrary vectors in W. Then show that there exists a unique linear transformation $T : V \rightarrow$ such that $T(v_1) = w_1, T(v_2) = w_2, \ldots, T(v_n) = w_n$. [1+6]

OR

When a linear transformation is said to be non-singular? Let V and W be vector spaces over the same field F and assume that dim V = dim W.
If $T : V \rightarrow W$ is a linear transformation, then prove that the following are equivalent.
(i) T is invertible
(ii) T is one - one and onto
(iii) T is non-singular.

5. If α, β, γ are the roots of the equation $x^3 + ax \quad r = 0$. Find the equation whose roots are $(\beta - \gamma)^2, (\gamma - \alpha)^2, (\alpha - \beta)^2$. Solve the equation $x^3 - 3x^2 + 4 = 0$ two of its roots being equal. [4+3]

Group 'B' 10×4 = 40

6. What do you mean by an equivalence relation on a set? Show that the relation "congruent modulo n" is an equivalence relation in the set of integers. [1+3]

7. Prove that

$$\begin{vmatrix} 1 & a & a & a \\ 1 & b & b & b \\ 1 & a & b & a \\ 1 & a & a & b \end{vmatrix} = (b-a)^3$$ [4]

8. Test for consistency and solve:

$3x - y + 2z = 1$
$x + 2y - z = 3$
$2x - 2y + 3z = 2$ [4]

OR

State Cayley - Hamilton Theorem and hence verify the theorem for the matrix $\begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}$. [1+3]

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

10. What do you understand by an ideal of a ring? If U is an ideal of a ring R with unity and $1 \in U$, prove that U = R. [1+3]

11. Define points in n - space. If any vectors P and Q are in n - space $\Re^n$ and a real number C, prove that
(i) P + Q = Q + P and (ii) C(P + Q) = CP + CQ. [1+1+2]

OR

Define vector projection of a vector Q onto a vector P. Let P and Q be two vectors in $\Re^n$. Prove that the difference of Q and its vector projection onto P is orthogonal to P. [1+3]

12. What do you mean by subspace of a vector space V over a field F? Prove that the linear hull $L(u_1, u_2, \ldots\ldots u_n)$ of a given set of vectors $u_1, u_2, \ldots\ldots u_n$ in a vector space V is a subspace of V. [1+3]

13. Prove that the sum of two linear transformation is a linear transformation. Prove also that the product of a scalar and a linear transformation is a linear transformation. [2+2]

OR

Let $T : \Re^3 \to \Re^3$ be the linear transformation defined by T(x, y, z) = (x, y, x - 2y). Find the basis and dimension of (a) ker T and (b) Im T. [2+2]

14. Solve the equation $x^3 - 9x^2 + 23x - 15 = 0$ the roots being in arithmetical progression. [4]

15. Solve $28x^3 - 9x^2 + \ldots = 0$ by Cardan's method. [4]

OR

Solve, by using Ferrari's method, the equation
$x^4 - 4x^3 - 4x^2 - 24x + 15 = 0$. [4]

10. Mathematics (Math.322) IV Paper, 2065

(Mathematical Analysis I)

Time: 3 hrs. Full Marks:75

Attempt ALL the questions.

Group 'A' 5×7 = 35

1. Define one-to-one and onto functions.
   Prove that if $f: X \to Y$ and $g: Y \to Z$ are bijective,
   then $g \circ f: X \to Z$ is also bijective and $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$. [2+5]
2. What is a limit point? Show that if sup A exists and does not belong to set A, then it is a limit point of the set A. Prove that 0 is the only limit point of the set {1, ½, 1/3, ... }. [1+1+5]
3. Show that the series $\sum_{n=1}^{\infty} n^{-p}$ converges if $p > 1$ and diverges if $p \leq 1$. Prove that if a series of real numbers is absolutely convergent, then it is convergent. [5+2]

   OR

   Prove that if $\{x_n\}$ is a decreasing sequence of positive numbers and $\lim_{n\to\infty} x_n = 0$, then the series $\sum_{1}^{\infty}(-1)^{n-1}x_n$ converges and the remainder $R_n = \sum_{k=n+1}^{\infty}(-1)^{k-1}x_k$ satisfies the inequality $|R_n| \leq x_{n+1}$. [7]
4. Let f be continuous on [a, b] and differentiable on (a, b). if $f(a) = f(b)$, then there exists a number c in (a, b) such that $f'(c) = 0$. Interpret it geometrically. Is the continuity of f at the end-points necessary? Justify you answer. [4+1+2]
5. State and prove the first fundamental theorem of calculus. Define a primitive function. State the second fundamental theorem of calculus. [5+1+1]

   OR

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

Group 'B' 10×4 = 40

6. Let a, b and c be real numbers. Prove that
   (i) If $a + c = b + c$, then $a = b$
   (ii) If $a c = b$ and $c \neq 0$, then $a = b$.
   thereupon indicating the axioms of the real number system. [2+2]
7. State the order axioms of the real number system. Prove that if $x \in \Re$ and $\delta > 0$, then $|x| \leq \delta \Leftrightarrow -\delta \leq x \leq \delta$. [2+2]

   OR

   State the rational density theorem. Prove that if $a, b \in \Re$ such that $a < b$, then there exists an irrational number w such that $a < w < b$. [1+3]
8. Prove r disprove that
   (i) any union of open sets in $\Re$ is an open set.
   (ii) any intersection of open sets in $\Re$ is an open set. [2+2]
9. A sequence $\{x_n\}$ converges to x iff give: $\varepsilon > 0$, there exists a natural number N such that $|x_n - x| < K\varepsilon$ for all $n \geq N$, where $K > 0$ is independent of ε and N. [4]

OR

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

10. Prove that if $\lim x_n = x$ and $\lim y_n = y$, then $\lim \frac{x_n}{y_n} = \frac{x}{y}$, provided that $y_n \neq 0$ for all n and $y \neq 0$. [4]

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

OR

Define the limit of a function at a point.

Evaluate $\lim_{x \to c} \frac{x^2 - 2x + 1}{x^2 + 1}$ and verify your answer. [1+3]

12. Let f and g be real - valued functions on a set A in $\mathfrak{R}$ and c be a limit point of A. prove that if $\lim_{x \to c} f(x) = L$ and $\lim_{x \to c} g(x) = K$, then $\lim_{x \to c} f(x)\, g(x) = LK$. [4]

13. Let f, g be differentiable and $g'(x) \neq 0$ for all x in an interval I except possibly x=c in I. If $\lim_{x \to c} f(x) = \lim_{x \to c} g(x) = 0$ and $\lim_{x \to c} \frac{f(x)}{g(x)}$ exists and $\lim_{x \to c} \frac{f(x)}{g(x)} = \lim_{x \to c} \frac{f'(x)}{g'(x)}$. [4]

14. State and prove Riemann's condition for intergrability on [a, b]. [4]

OR

Define upper and lower integrals of a function on [a, b]. Illustrate with an example that

$$\int_a^b f\, dx < \int_a^b f\, dx.$$ [1+3]

15. Define a step function. Prove that the value of the integral of a simple function defined on [a, b] remains unchanged even if a finite number of points are added to the partition associated with the simple function. [1+3]

11. Environmental Science (ENV.321), 2065

Time: 3 hrs. Full Marks:100
Pass Marks :35

Section 'A'

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

1.1 What are the major differences in physio-chemical properties of water in lentic and lotic environment? Discuss.

1.2 A quadrate sampler of the size 25 cm by 25 cm was used to collect grubs from the two sites of a cultivated land. The number of grubs in each sampling unit was counted and abundance was calculated as number per square metre.

Site 1:	59, 70, 21, 15, 52, 10, 15, 13, 12, 35, 12, 9, 13
Site 2:	60, 62, 19, 21, 13, 15, 17, 28, 19, 75, 81, 16, 14, 38, 61, 90, 89, 18

The null hypothesis (H_o) is that both samples come from the same population and therefore must have the same mean. Using t - test write your opinion about the null hypothesis for grubs of two sites of cultivated land.

The critical values of t

	Probability				
DF	0.10	0.05	0.02	0.01	0.001
25	1.71	2.06	2.49	2.79	3.73
26	1.71	2.06	2.48	2.78	3.71
27	1.70	2.05	2.47	2.77	3.69
28	1.70	2.05	2.47	2.76	3.67
29	1.70	2.05	2.46	2.76	3.66

1.3 What are actual evapotranspiration (AET) and potential evapotranspiration (PET)? Describe the method to estimate evaporation from land surface using Penman's equation.

1.4 Discuss chemical composition of the earth. Write concise note on chemical history of the earth.

Section 'B'

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

2.1 Photochemical smog.

2.2 Radioactivity in atmosphere.

2.3 Frequency analysis of hydrological events.

2.4 Darcy's law and its validity.

2.5 Elements of agroclimatology.

2.6 Climate of Nepal.

2.7 Physical and bulk properties of soil.

2.8 Rock mass rating.

2.9 Application of GIS.

2.10 Impact of human on landscape forms.

2.11 Microbiology of fresh water ecosystems.

2.12 Biotic community in lentic environment.

Section 'C'

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

Differentiate between

3.1 Primary and secondary air pollutants.

3.2 Snow and hail.

3.3 Surface flow and sub-surface flow.

3.4 Weather and climate.

3.5 Stratification and overturn of lakes.

3.6 Rapid zone and pool zone.

3.7 Deforestation and failure.

3.8 Topographical map and aerial photograph.

3.9 Non-metallic minerals and fossil fuels.

3.10 ean and mode.

12. Computer Science (CS. 321), 2065

(Information System/Data Structure)

Time: 3 hrs. Full Marks:100
Pass Marks: 35

Group 'A' (Information System)

1. **Long answer questions**
Attempt ALL the questions. 2×10 = 20
   1.1 What do you understand by system development life cycle? Draw the necessary diagram and explain in detail about feasibility study.
   1.2 Explain in detail about conceptual system design.
   1.3 What are different CASE tool? Why is it used in SDIC?

2. **Short answer questions**
Attempt ALL the questions. 10×3 = 30
   2.1 Why planning is required in the information system design.
   2.2 What is the use of positive feedback?
   2.3 How the data dictionary can be used?
   2.4 Explain in brief about data flow diagram.
   2.5 What is IS standard? Explain its importance.
   2.6 Explain in brief about prototyping and its applications.
   2.7 What do you understand by post operation evaluation?
   2.8 What are the main components of context diagram?
   2.9 Explain the jobs of a system analyst.
   2.10 What do you understand by cut-over in system implementation?

Group 'B' (Data Structure and Algorithm)

3. **Long answer questions**
Attempt any TWO questions. 2×10 = 20
   3.1 Describe searching in data structure. Compare and contrast the efficiency of three searching algorithms (sequential, binary and quick).
   3.2 Explain why Greedy algorithm is popular in finding the shortest path in directed graph? Explain with a suitable example.
   3.3 What is recursion? Explain with Tower-Of-Hanoi example. How recursive algorithm makes program effective? Write the merits and demerits of recursion of programming.

4. **Problems**
Attempt any TWO questions. 2×5= 10
   4.1 Write C functions for push and pop operations in stack.
   4.2 Write a C function to traverse a binary tree in post order.
   4.3 Write a program in C for bubble sorting.

5. **Short answer questions**
Attempt ALL the questions. 8×2.5 = 20
   5.1 Differentiate between contiguous list and linked with suitable examples.
   5.2 Explain binary search tree. Write the searching algorithm in binary search tree.
   5.3 Explain hashing with suitable example.
   5.4 Explain why linked list is called dynamic ist? Write the algorithm for deleting a new node before a node.
   5.5 Explain the characteristics of Huffman algorithm and its application.
   5.6 Write merits and demerits of recursive function over non-recursive function.
   5.7 Write the steps involved in deleting a node in an AVL tree.
   5.8 Discuss merge sort How can rate this sorting from selection sort.

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