

All the questions paper of Exam -2068 B.Sc. Second Year

TRIBHUVAN UNIVERSITY

2068

Bachelor Level / II-Year/ Science & Tech

Full Marks: 100

1. Statistics II Paper (Stat.321)

Time: 3 hrs.

1. (Compulsory) Attempt any SIX questions.

6x5=30

Distinguish between parametric and non-parametric test. State the underlying assumptions in non-parametric test.

What do you understand by hypothesis testing? How null and alternative hypothesis are stated and tested?

A sales man in a departmental store claims that at most 60 percent of the shoppers entering the store leave without making purchase. A random samples of 50 shoppers showed that 35 of them left without making a purchase. Are these sample results consistent with the claim of the salesman? Use 5% level of significance.

Illustrate how Jacobean transformation is used to find the distribution of $\left(\frac{x_1}{x_2}\right)$

If X is a non-negative random variate with mean \bar{X} and λ is a real valued positive number, then prove that $P(X \geq \lambda \bar{X}) \leq \frac{\bar{X}}{\lambda}$.

For the random variables X and Y having pdf is given by $f(x,y)=(2-x-y)$;
 $0 \leq y \leq 1$

=0; elsewhere.

find the marginal p.d.f. of X and Y.

Explain what do you understand by point estimation and interval estimation. Give examples.

Group "A"

Attempt any four questions.

4x7=28

Find the probability generating function of truncated binomial distribution truncated at origin. Hence find its mean and variance.

State Chebyshev's inequality. A symmetrical die thrown 720 times. What is the lower bound of getting 100 to 140 sixes?

For the following bivariate probability distribution, find $E(X)$, $E(Y)$, $V(X)$, $V(Y)$, $Cov(XY)$ and correlation coefficient between X and Y .

x	1	2	3
y			
-1	0	0.1	0.1
0	0.1	0.2	0.2
1	0.2	0.1	0

For two variables X and Y show that

$$\sqrt{e(x+y)^2} \leq \sqrt{e(x)^2} + \sqrt{E(Y)^2}$$

6.. State and prove weak law of Large Numbers.

Group "B"

Attempt any SIX questions.

6x7=42

Define χ^2 - variate. Find the mean and variance of χ^2 distribution.

A comparison of reaction times (in seconds) for two different stimuli in a psychological word association experiment produced the following results when applied to a random sample of 16 people.

stimulus1	1	3	2	1	2	1	3	2
stimulus 2	4	2	3	3	1	2	3	3

Do the data present sufficient evidence to indicate a difference in mean reaction times for the two stimuli? Test using $\alpha = 0.05$.

Discuss the characteristics of good estimator. Show that the sample variance is a consistent estimator of the population variance of a normal distribution.

10 What are the main features of F- distribution? An experimenter is concerned that the variability of responses using two differs experimental procedures may not be same. Before conducting his research he conducts a pre-study with random samples of 10 and 8 responses and gets $s_1^2=7.14$ and $s_2^2=3.21$ re respectively. Do the sample variances present sufficient evidence to indicate, that -the population variances are unequal?

11. Show that $t = r \sqrt{\frac{b-2}{1-r^2}}$ is distributed as students t with $(n-2)$ degree of freedom under $H_0: \rho = 0$ r being correlation coefficient.

12. Explain the median test. A sequence of small glass sculptures was inspected for shipping damage. The sequence of acceptable (A) and damaged. (D) pieces was follows:

D, A, A, A, D, D, D, D, A.; 0, D, A, A, A, A, D, A; A, D, D.

Test for randomness of the damage to the shipment sing the 0.05

significance level.

13. Write short notes on:

- p - value
- Power of test
- Degree of freedom

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Bachelor Level / II Year / Science & Tech.

Full Marks: 100

2. 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. 2x10=20

- 1.1. Explain in detail about the detailed 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. What are the different CASE tools? Why CASE tools are used in system design and development?

2. Short Answer Questions

Attempt ALL the Questions. 10x3=30

- 2.1. Differentiate between positive and negative feedback.
- 2.2. What is standard? Explain its impotence.
- 2.3. Why planning is required in the information system design?
- 2.4. How the data dictionary can be used?
- 2.5. What do you mean by system implementation? Describe cut-over method.
- 2.6. Explain in brief about ER diagram.
- 2.7. Explain the jobs of system analyst.
- 2.8. Explain in brief about DSS.
- 2.9. What do you understand by post operation evaluation?
- 2.10. What are the main components of DFD?

Group "B" (Data Structure and Algorithm)

3. Long Answer Questions

Attempt any TWO Questions. 2x10=20

- 3.1. What do you understand by recursion? Explain it with Tower-of-Hanoi example. When it becomes more effective to use recursive algorithm? Write the merits and demerits of recursion in programming.
- 3.2. What do you mean by searching? Differentiate between sequential and binary search.
- 3.3. Describe Greedy algorithm and explain why it is a popular algorithm in finding the shortest path in directed graph?

4. Problems

Attempt any TWO Questions.

2x5= 10

- 4.1. Write a C programme for selection sort.
- 4.2. Write a C function for push and pop operations in stack.
- 4.3. Write a C function to traverse a binary tree in inorder.

5. Short Answer Questions

Attempt ALL the Questions.

8x2.5=20

- 5.1. Write the steps involved in inserting a node in an AVL tree.
- 5.2. Explain the characteristics of Huffman algorithm and its application.
- 5.3. Discuss quick sort. How you rate this sorting from merge sort.
- 5.4. Explain binary-search tree. Write the searching algorithm in binary search tree.
- 5.5. Differentiate between singly linked list and doubly linked list with suitable examples.
- 5.6. Explain hashing with suitable example.
- 5.7. Explain why linked list is called dynamic list? Write the algorithm and its application.
- 5.8. Differentiate between stack and queue.

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Full Marks: 100

3. Environmental Science (ENV.321) Time: 3 hrs

New Course

SECTION "A"

1. Attempt any THREE questions.

3x10=30

- 1.1. Categorize the organisms in water on the-basis of life form. Discuss why these organisms are regarded as indicators of water quality.
- 1.2. A field study was carried unit to investigate the concentration of biochemical oxygen demand (BOD, mg/L) in water and the density (per sq.m) of mayfly nymph in the streams. The following observations were made:

Stream	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
Density of mayfly nymph	16	22	28	12	18	24	8	4	16	2	20	10	14	30
BOD level in water	18	6	5	16	8	6	30	40	12	45	8	20	15	4

Determine the relationship between the density of mayfly nymph and BOD content in streams. Test the relationship for its Significance.

The critical values of 't' areas follows:

d.f \ α	0.10	0.05	0.02	0.01
12	1.782	2.179	2.681	3.055
13	1.771	2.160	2.650	3.012
14	1.761	2.145	2.624	2.977
15	1.753	2.131	2.602	2.947
16	1.746	2.120	2.583	2.921

- 1.3. What is meant by evapotranspiration? Explain the empirical methods for the determination of evapotranspiration.
- 1.4. What are the metallic and non-metallic minerals? Discuss the major environmental consequences that are faced during extraction and recovery of such minerals.

SECTION "B"

2. Describe briefly any TEN Questions: 10x5=50

- 2.1. Physical impacts of clam on riverine ecosystem
- 2.2. Causes of rock failure
- 2.3. Water as an agent of morphological processes
- 2.4. Physiographic provinces of Nepal
- 2.5. Impacts of climate change
- 2.6. Forms of precipitation
- 2.7. East- west variation of rainfall in Nepal
- 2.8. Nature and origin of the atmosphere
- 2.9. Global positioning system

- 2.10. Secondary air pollutants
- 2.11. Earth co-ordinate systems and map projections
- 2.12 Ecological importance of freshwater ecosystems

SECTION "C"

3. Attempt ALL the Questions. 10x2-20

Diferentiate between:

- 3.1. Rapid and pool zones
- 3.2. Aquitard and aquifuse
- 3.3. Direct runoff and base flow
- 3.4. Lakes and ponds
- 3.5. Perched and general water tables
- 3.6. Lithosphere and hydrosphere
- 3.7. Lesser Himalayan and Higher Himalayan zones
- 3X Summer and winter monsoons
- 3.9. Visual and numerical interpretations of images
- 3.10. Dependent and independent variables

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4. **Ecology, Physiology, Cytology and Genetics,
Embryology and Anatomy (Bot.321) Time: 3 hrs.**

New Course

Attempt ALL questions.

SECTION "A" (ECOLOGY)

Describe the structure and lunctions of a pond ecosystem.

OR

What are the causes of water pollution? Give the details of its effects and central measures.

- 2. Give an account of Nitrogen cycle in mature. [5]
- 3. Describe different vegetational zones of Nepal.
- 4. Explain positive and negative interactions in biotic community. E5]

SECTION "B" (PHYSIOLOGY)

- 5. Explain the mechanism of aerobic respiration that occurs in cytoplasm of a cell.

OR

(10)

Explain the cyclic and non-cyclic photophosphorylation in light reaction of photosynthesis.

6. Differentiate between C_3 and C_4 plants. [5]
7. Write down the mechanism of stomatal transpiration. [5]
8. Explain the physiological role of auxins. [5]

SECTION "C" (CYTOLOGY & GENETICS)

9. Define point mutation. Describe different types of point mutation and their effects.

OR [10]

Explain different stages of Prophase I in Meiosis I and write its significances.

10. Differentiate between DNA and RNA. [5]
11. State and explain law of segregation with a suitable example. [5]
12. Role of plant breeding for livelihood. [5]

SECTION "D" (EMBRYOLOGY)

13. Explain the development of a typical dicot embryo. [5]
14. Discuss sones of palynology. [5]
15. Differentiate between self pollination and cross pollination.

OR [5]

Draw a well labelled diagram of a campylotropous ovule. (Description not required)

16. What is anomalous secondary growth? Describe secondary growth in Aristolochia stem.

OR

What is meristem? Explain two different theories to explain organization of shoot apex in plants.

17. Draw a well labelled diagram of T.S. of stem of a hydrophyte. (No description required.) [5]

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5. Zoology (Zo1-321)

Time: 3 hrs.

New Course

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

GROUP "A" (Chordata)

Attempt any TWO questions.

[2x 10=20]

1. How would you distinguish between the poisonous and non-poisonous snakes? Give examples of both the types.
2. Describe the respiratory system of *Columba* and the functions of the air-sacs.

3. Describe the characteristic features of Prototheria and Metatheria and give examples.

GROUP "B" (Physiology, Cytology, Mol. & Dev. Biology)

Attempt any TWO questions. [2x 10=20]

4. Explain briefly the steps involved in protein synthesis.
5. Give the structure, chemical composition and functions of Mitochondria.
6. Describe the physiological functions and disorders of thyroid hormones.

GROUP "C"

Attempt All the questions. [8x5=40]

7. Give an account of parental care in Amphibia.
8. Discuss the structure of gill in *Labeo* with the help of labelled sketch.

OR

Give an account of the economic values of fishes.

9. Write a note on amphibia & fauna of Nepal.
10. Give the external features of *Petromyzon*.
11. List the differences between enzymes and hormones.
12. Explain the formation of three primary germ layers.

OR

Describe Polytene chromosomes.

13. Describe the replication of DNA as suggested by Watson and Crick.
14. Differentiate between sympatric and allopatric speciation.

GROUP "D"

All are compulsory. [8x2.5=20]

15. Give the very short answers of the following:
- Illustrate the external features of *Calotes*.
 - What is snake's venom and antivenom?
 - Give the ecology of *Lophoporus* sp.
 - Mention different types of animal egg.
 - What is transgenic organism? Which gene was used in producing the abnormal^y lar^ge transgenic mouse?
 - Which cell organelle is called suicidal bag and why?
 - Define gene mutation.
 - Name three post zygotic isolating mechanisms.

Old Course (Chordata, Cell & Tissue Biology)

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

Group "A" 2x 15=30

1. Give a short account of reproductive organs of *Scoliodon*.
2. Describe the structure of brain in pigeon and indicate its differences with that of lizards.

3. Discuss how Amphibia originated from the ancestral stocks and adapted to the amphibious habit.

Group "B" 2x 15=30

4. Explain the physiological process of urine formation in vertebrates giving roles of hormones,
 5. What is gene concept? Describe gene interaction in detail.
 6. Write an account of structure of the master gland. Mention the hormones secreted by it with their roles.

GROUP "C" 8x5=40

7. Enlist the characteristics of Prototheria and give examples.
 8. Give the characteristics of Anapsida and Diapsida of Reptilia.
 9. Describe the structure of buccal funnel of Petromyzon.
 10. What are the types of vitamins? Mention their functions.
 11. How is nerve impulse generated? Explain.
 12. Comment upon the histological structure of mammalian kidney.
 11 Describe the process of crossing over in short.
 14. Give the ecological notes and systematic position of Naia and Pavo.

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

6. Meteorology II Paper (MET 321) Time: 3 hrs.

New Course

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

- 1.(a) What is geostrophic motion? Explain with vector form of its equation. [1+3]
- 1.(b) From the principle of kinematics of rotating motion, prove that $\vec{a}_c = \Omega^2 R \sin \theta \vec{N}$, where \vec{a}_c is the centripetal acceleration, Ω is the angular velocity, $R \sin \theta$ is the radius and \vec{N} is the normal unit vector. [6]
2. Discuss the distribution of surface temperature and water vapour in tropics. Also, explain resultant wind at 200 mb level. [7+3]
3. What do you understand by synoptic data? How can you prepare synoptic charts and use them for weather forecasting. [2+6]
4. What is monsoon? Describe the onset and distribution of monsoon over Nepal. [1+7]
5. With a schematic diagram, describe cold front and warm front, and explain occluded fronts. [3+3+2]

6. What are frontogenesis and frontolysis? What are the conditions favourable for the formation of thunderstorms? [2+6]
7. Write short notes on any TWO of the following:
 - a. Air mass and fronts
 - b. Extra tropical cyclones
 - c. Temperature and radiative inversions [4+4]
8. What do you understand by the earth's energy balance? Describe the distribution of surface temperature on tropical region. [2+6]
9. How do you measure degree of cloudiness? Describe the general degree genera of seasonal cloudiness over Nepal. [2+6]
10. What are gradient level wind and jet stream? Explain the role of jet stream in Asian summer monsoon. [3+5]
11. Write short notes on any TWO of the following:
 - a. Tornadoes and hail storm
 - b. Tropical cloud type
 - c. El Niño and La Niña [4+4]
12. Define dynamical meteorology? Explain three conservation principles that are important in earth's atmosphere. [6+2]
13. What are barotropic and baroclinic atmosphere. Explain the kinematics method of determining the vertical motion of the atmosphere. [2+6]
14. What is geostrophic motion? Explain with vector form of its equation. Also, describe its application in the atmosphere. [1+4+3]
15. What do you understand by apparent forces?
 Prove that $\Omega \times (\Omega \times r) = -\Omega^2 R$ Where, Ω is the angular velocity, r is the radius vector and R is the position vector. [1+7]
16. Write short notes on any TWO of the following:
 - a. Land and sea breezes
 - b. Kelvin's theorem
 - c. Circulation and vorticity [4+4]

Old Course (MET 321/322)

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

1. What are fronts? Explain different types of fronts with schematic diagrams. Derive an expression for frontogenetic factor in terms of deformation and divergence. [2+7+6]
2. Describe briefly the basic process of photosynthesis. What do you understand by saturation light intensity? Write the chemical equation of photosynthesis and discuss the effects of solar radiation and air temperature on photosynthesis. [5+2+3+5]
3. What is turbulence? Describe CAT. [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 thunderstorm? Briefly explain the conditions favourable for its formation. [1+4]
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. The diameter of a pipe at the sections 1 and 2 are 20cm and 13cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 3 m/s. [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. What do you understand by greenhouse effects? Name the major greenhouse gases. [3+2]

Bachelor Level Sc. & Tech. / II Year

Full Marks: 100

7. Microbial, Biochemistry and Biotechnology (MB.321)

Time: 3 hrs.

New Course

GROUP "A"

5x10=50

(Long Answer Questions)

(Attempt All FIVE questions each of ten full (or breakdown) marks)

1. Briefly describe secondary and tertiary structures of proteins. Mention the comes of chemicals used for precipitation of protein. [8+2]
2. Describe hexose monophosphate pathway of glucose breakdown. [10]
3. Enlist microorganisms involved in acetic acid production, and describe microbial method of acetic acid production. [10]
4. Describe microbiology and steps involved in yoghurt production. [10]
5. What is central dogma? Describe process of transcription. [2+8]

OR

Describe general protocol of gene cloning.

(Short Answer Questions)

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

6. Briefly describe β oxidation of fatty acids.
7. Describe general properties of amino acids.
8. Briefly mention principle and applications of electrophoresis.
9. Sketch a labelled diagram of a small laboratory scale fermenter.
10. Describe different macro-organisms that can be used as biofertilizers.
11. Briefly describe microbial production and, application of proteases enzyme.

GROUP "C"

5x3=15

12. Very Short Answer Questions.

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

- a. Define H¹FST pasteurization
- b. Enlist vitamins and hormones added in tissue. culture media
- c. Draw a chemical structure of purine bases.
- d. Draw the structure of RNA.
- e. Point out applications of bioinformatics in biotechnological research.
- f. What is genetic code?

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Bachelor Level / Science & Tech. /II Year/

Full Marks: 100

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

Time: 3 hrs.

NEW COURSE

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

ALL questions carry equal marks.

GROUP "A"

1. Discuss IUGS classification system of plutonic rocks with a neat sketch of triangular diagram and explain the basis of chemical classification.

OR

Define the 'metamorphism'. Explain the different types of metamorphism by representing them in pressure-temperature diagram.

2. (a) Describe briefly the classification of sandstone and sedimentary structures in sandstone.
2. (b) What is solid solution? Describe briefly the crystallization of two component system: Albite ($\text{NaAlSi}_3\text{O}_8$) Anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) at 1 bar pressure.

3. (a) Describe the factors controlling sedimentary particle morphology.
(b) Describe briefly the textures of metamorphic rocks with sketches.
4. (a) What is diagenesis? Describe the diagenesis process in brief.
(b) What are the controls (factors) of metamorphism? Describe them in brief with sketches.
5. (a) Describe the texture and classification of limestone and explain the mineral composition.
(b) Explain the different types of large scale intrusive features of igneous rocks with suitable diagram.
6. Write short notes on any TWO of the following:
 - a. Bowen's reaction series
 - b. Erosional structures in sedimentary rock
 - c. Metamorphic differentiation

GROUP "B"

7. Describe the geologic time scale with major events during each period.
OR
What do you understand by the term 'geochronology'? Describe the different methods used in radiometric dating.
8. (a) What is correlation in stratigraphy? Describe the methods of stratigraphy correlation in brief.
(b) Discuss the break-up of Pangaea during the Mesozoic Era.
9. (a) Define 'paleogeographic reconstruction.' Discuss in brief the paleogeographic changes from Palaeozoic (Permian) to Mesozoic Era.
(b) Describe in brief the origin of solar system.
10. Write short notes on any TWO of the following:
 - a. Index fossil
 - b. Craton
 - c. Precambrian Era

GROUP "C"

11. Describe the stratigraphy and tectonics of the central Nepal Himalaya according to Stocklin and Bhattarai (1977).
OR
Describe the stratigraphy and tectonics of the eastern Nepal Lesser Himalaya (between Dudh Koshi and Mechi Rivers).
12. (a) Describe briefly the geology of the Tibetan-Tethys Himalaya of Manang area.
(b) Prepare the stratigraphic column of Tansen area according to Sakai (1983).
13. (a) Describe briefly the geology of the Siwaliks.
(b) Short notes on:
 - a. Inverse metamorphism of the Nepal Himalaya
 - b. Peninsular India

9. Physics II Paper (Phy.321)**(Optics, Atomic & Nuclear Physics, Electronics)****Time: 3 hrs.****New Course**

Attempt ALL the questions.

1. Explain the difference between spatial and temporal coherences. Describe, with necessary theory, how the difference between two D lines of sodium is measured by Michelson's interferometry. [3+7]

OR

How is Fresnel's diffraction different from Fraunhofer's diffraction? Explain the meaning of resolving power of an optical instrument and discuss the theory of resolving power of a plane transmission grating. [2+2+6]

2. Explain the significance of different quantum numbers associated with vector atom model. Present two important applications of this model. [3+6]

OR

Write down the characteristics similarities and dissimilarities between X - rays and gamma rays. Also obtain an expression for the variation of intensity of gamma rays falling on an absorber. What does the term "half value thickness" signify? [2+5+2]

3. What is a rectifier? Explain the use of a p n junction diode as half wave and full wave rectifier. Also discuss the use of a capacitor filter. [1+4+1]

OR

What do you understand by sustained oscillation? Draw a circuit diagram of a Colpit's oscillator and find its frequency of oscillation. [6]

4. Explain the meaning of circularly and elliptically polarized light. How is circularly polarized light produced? Explain. [3+3]

OR

What do you understand by stimulated emission of radiation? -Explain the working principle of He - Ne gas laser. [2+4]

5. Explain the working principle of a Geiger Muller counter. [6]

OR

Discuss, in brief, the difference between normal and anomalous Zeeman effects and obtain an expression for normal Zeeman shift. [3+3]

6. What is an operational amplifier? Derive its voltage gain for inverting and non-inverting cases. [2+4]

OR

Explain the working of a FET. What is a pinch - off voltage? [3+3]

7. Answer all in brief: [6x3=18]

- a. Explain achromatism in Huygen's eye piece.
 - b. Sketch the intensity distribution on a screen when a monochromatic light falls on a sharp edged obstacle.
 - c. Present a theoretical justification in finding the density of a nucleus X_{A_1} if the density of an another nucleus Y_{A_2} is known.
 - d. What do you understand by fine structure of Z hydrogen lines? Explain.
 - d. Point out the difference between Zener and avalanche effects in semiconductor.
 - e. What do you understand by class A and class B operations in amplifier?
8. The diameters of 6th bright rings with air and liquid films are respectively 2.5mm and 2mm while performing a Newton's ring experiment. What is the refractive index of the liquid? [6]
 9. Find the specific rotation of a given sample of sugar solution if the plane of polarization is turned through 26.4°. The length of the tube containing 25 percent sugar solution is 20cm. [6]
 10. An X - ray is found to have its wavelength 0.124 Angstrom and undergoes Compton effect from a carbon block. Calculate the wavelength when it is scattered through 180°. [6]
 11. Estimate the mass of RW26 if its activity is 50000 Rutherford and half life is 1620 years. [6]
 12. Draw a suitable circuit of your own to explain Norton's theorem. [6]
 13. Add and subtract two binary numbers 11101 and 1011 and write results in decimal equivalent. [6]

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10. 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. What are transition elements? Discuss the followings characteristics of transition elements with reference to 3d-block elements.
 - (a) Variable oxidation state
 - (b) Colour compounds

(c) Catalytic properties [2+7]

OR.

Discuss any two methods for the preparation of hydrogen peroxide. How does it act both as oxidising and reducing agent? Give its structure and main uses. [4+3+2]

2. Short Answer Questions 8x3=24

- 2.1. What are ion exchange resins? How are they used for the separation and purification of metals? Explain.
- 2.2. Explain the meaning of zone refining and oxidative refining with examples.
- 2.3. Give the postulates of Werner's - theory , of coordination compounds.
- 2.4. Give the structure and bonding of hydrazine - and hydroxylamine.
- 2.5. Write notes on hydration energy and mobility of alkali metal ions.
- 2.6. What is diagonal relationship? How does lithium resemble magnesium? Explain.
- 2.7. What is inert pair effect? Explain it with reference to thallium.
- 2.8. What is the difference between carbon, silicon and other remaining elements of group IVA?
- 2.9. How is S_4N_4 prepared? Discuss the structure of S_4N_4
- 2.10. What are clathrate compounds?. Which inert gases do not form clathrate and why? Also mention the uses of clathrates.
- 2.11. Draw and briefly explain the structures of CF_3 , IF_5 , and IF_7 .

GROUP "B" (ORGANIC)

Comprehensive Question

3. Define nucleophilic addition reaction. Give nucleophilic addition reaction of carbonyl compound with ammonia and its derivative with mechanism.

OR

[9]

Show your acquaintance with following reactions giving mechanism

- (a) Wittig reaction
- (b) Reimer - Tieman reaction
- (c) Claisen condensation

4. Short Answer Questions 8x3=24

- 4.1. What is aromaticity? How it is related to Huckel's rule? Show that cyclopentadienyl anion is aromatic.

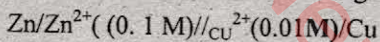
- 4.2. Draw the newman projection formula for diequatorial and diaxial 1, 3-dimethyl cyclohexane and compare the stability of both of the isomer.
- 4.3 Give the preparation and uses of a polyamide.
- 4.4. Discuss the basicity of the primary, secondary and tertiary amine.
- 4.5. Discuss the mechanism of acetoacetic ester synthesis of ketone.
- 4.6. How do you explain the effect of halogen substituted benzene on further electrophilic substitution reaction?
- 4.7. Give the preparation and uses of Bakelite.
- 4.8. Describe the Gatten-nan synthesis.
- 4.9. How do you prepare carboxylic acid by Kolbe reaction? The o-hydroxybenzoic acid is more volatile than p-hydroxybenzoic acid. Why?
- 4.10. Which of the following aldehyde undergo aldol condensation?
 (a) HC140 (b) $(\text{CH}_3)_2\text{CH}-\text{CH}_2-\text{CHO}$
 Also give the mechanism.
- 4.11. Give the reaction and mechanism of acid catalysed halogenations of ketone.

GROUP "C" (PHYSICAL)

Comprehensive Question

5. Write three main statements of second law of thermodynamics. Describe about the Carrot cycle" for obtaining the maximum' convertibility of heat into work.

Calculate the electrode motive force of the following cell:



(Given: the standard electrode potentials of Zn/Zn^{2+} and Cu/Cu^{2+} are -0.763V and 0.345V , respectively) [2+4+4]

OR

Define order and molecularity of a reaction with examples. Derive the rate equation for a pseudo first order reaction.

For a second order reaction between $\text{CH}_3\text{COOC}_2\text{H}_5 (0.05\text{M})$ and $\text{NaOH} (0.10\text{M})$, the rate constant is found to be $6.2 \times 10^{-3} \text{ l/mole} \cdot \text{sec}$ at 25°C . Calculate the time for the hydrolysis of 50% and 95% $\text{CH}_3\text{COOC}_2\text{H}_5$. [2+4+4]

6. Short Answer Questions

8x3=24

- 6.1. Discuss the reaction mechanism of decomposition of ozone.
- 6.2. What do you mean by rate determining step of a reaction? How do you determine the half life of a reaction? Discuss.
- 6.3. Discuss the general criteria of catalyst.
- 6.4. State Lambert and Beer's laws. Derive the Lambert - Beer's equation.
- 6.5. Define quantum yield. Point out the reasons for high and low quantum yields.
- 6.6. Discuss the variation of electrolytic κ conductances with dilution for strong and weak electrolytes.
- 6.7. Point out some important applications of conductance measurement. Discuss about potentiometric titration with example.
- 6.8. What do you mean by primary reference electrode? Point out the superiority of it over secondary electrode.
- 6.9. What do you mean by electrochemical series? How do you estimate the standard electrode potential of an electrochemical cell? Discuss.
- 6.10. Derive an equation showing the relation between enthalpy and entropy.
- 6.11. In the formation of silver chloride from its elements under normal conditions, ΔG is - 26.3 K Cal and ΔH is -30.0 Kcal/mole at 20°C . What is the corresponding entropy change?

Mathematical Analysis I (Math. 322) Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

New Course

Attempt ALL the questions.

Grpyp "A"

5x7=35

1. Define a statement. Prove that if p and q are any statements and c is a contradiction, then

$$(p \Rightarrow q) \Leftrightarrow (p \wedge \text{a contradiction} \Rightarrow c)$$

is a tautology. Use it to prove that if a and b are real numbers and

$$\forall \epsilon > 0 \quad a \leq b + \epsilon \quad \text{then} \quad a \leq b.$$

[1+3+3]

2. Define the supremum of a set. Prove that the supremum of a set, if it exists, is unique. Show that if A is a nonempty bounded set in \mathbb{R} and $k \geq 0$ then $\sup kx = k \sup x$.

[1+2+4]

$$x \in A \quad x \in A$$

OR

Prove that every infinite set is equinumerous to a proper subset of itself. Also, show that for any set A , the cardinality $|A|$ of A is less than the cardinality $|P(A)|$ of the power set of A .

[2+5]

3. Define a convergent sequence. Show that if (x_n) converges to a real number x , then every subsequence of $\{f_n\}$ converges to x . Let A be a set in \mathbb{R} . Prove that a real number x is an adherent point of A iff there is a sequence $f(x_n)$ in A converging to x , then every subsequence of (x_n) converges to x .

[1+21-4]

OR

Show that if $a_n \rightarrow 0$ and for some $K > 0$ there is natural number m such that $\forall n \geq m |x_n - x| \leq K |a_n|$, then $\{x_n\}$ converges to x . Prove

that the $\lim \left(1 + \frac{1}{n}\right)^n$ exists. [2+5]

4. State the sequential criterion for discontinuity. Show that the $f: (0, 1) \rightarrow \mathbb{R}$ defined by

$$f(x) = \begin{cases} \frac{1}{n} & \text{if } x = \frac{m}{n} \text{ is rational in the lowest terms} \\ 0 & \text{if } x \text{ is irrational} \end{cases}$$

is discontinuous at each rational number in $(0, 1)$, but continuous at each irrational in $(0, 1)$. [1+6]

3. 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 $f \cdot g$ is also integrable on $[a, b]$. [2+5]

Group "B"

10 4, 40

6. State order axioms of the real number system. Show that if $a < b$ and $c < 0$, then $ac > bc$. [2+2]
7. Prove that $\text{int}(A \cup B) \supseteq \text{int}(A) \cup \text{int}(B)$. Give an example of two sets A and B such that $\text{int}(A \cup B) \neq \text{int}(A) \cup \text{int}(B)$. [3+1]
8. What is an open set? Show that every open interval is an open ball and every open ball is an open interval. [1+3]

OR

Prove that

a. $\overline{A \cup B} = \overline{A} \cup \overline{B}$,

b. $\overline{A \cap B} \subseteq \overline{A} \cap \overline{B}$

where the bar indicates 'closure'.

[2+2]

9. State and prove Cauchy's root test.

OR

[4]

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

10. State the comparison test. Use it to test the following series for convergence:

$$1 + \frac{2}{1^3+2} + \frac{5}{2^3+2} + \frac{10}{3^3+2} + \frac{17}{4^3+2} + \dots \quad [1+3]$$

11. Prove the quotient rule for derivatives.

OR

[4]

'Prove that if I and J are intervals in \mathbb{R} and let $f: I \rightarrow \mathbb{R}$ be differentiable at $c \in I$ and $g: J$ where $f(I) \supset J$ is differentiable at $f(c)$, then the composition $g \circ f$ is differentiable at c and $(g \circ f)'(c) = g'(f(c))f'(c)$.

[4]

12. Define concave upward and downward functions on intervals. Determine the intervals in which the function $f(x) = 3x^5 - 5x^3 + 3$ is concave upward or downward.

[4]

13. Prove that if a real-valued function f is continuous on $[a, b]$, then it is integrable on $[a, b]$

[4]

14. State and prove the first fundamental theorem of integral calculus,

OR

[4]

State and prove the theorem of integration by parts.

15. Prove that if f and g are integrable on $[a, b]$, then

$$\int_a^b |f(x)g(x)| dx \leq \left(\int_a^b (f(x))^2 dx \right)^{1/2} \left(\int_a^b (g(x))^2 dx \right)^{1/2}$$

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

New Course

Attempt ALL the questions.

Group "A"

5x7=35

1. What do you mean by consistent and inconsistent equations? State the condition for a system of linear equations to have (i) a unique solution (ii) no solution (iii) infinite a number of solutions. Test the consistency and solve the system of equations.

$$\begin{cases} x+y+z=2 \\ 3x-4z=-7 \\ 2x-y+7z=15 \end{cases} \quad [1+2+4]$$

2. Define homomorphism and isomorphism of groups. Let G be a group of all real numbers under addition and \bar{G} is the group of non-zero real numbers under multiplication and a mapping $\phi: G \rightarrow \bar{G}$ is defined by $\phi(x) = 2^x$, $x \in G$, then show that ϕ is a homomorphism. Prove that homomorphism $\phi: G \rightarrow \bar{G}$ with kernel K_ϕ is an isomorphism of a group G into a group \bar{G} if and only if $K_\phi = \{e\}$. [1+2+4]
3. What do you mean by orthogonal basis? Prove that every finite dimensional non-zero vector space has an orthogonal basis. Let $u_1 = (1, 0, 0)$, $u_2 = (1, 1, 0)$, and $u_3 = (1, 1, 1)$ be a basis of \mathbb{R}^3 . Find the set of ortho-normal basis for \mathbb{R}^3 from the vectors u_1, u_2, u_3 . [1+4+2]

OR

Define sum and direct sum of two subspaces U and W of a vector space V . If $U + W = V$ and $U \cap W = (0)$ then prove that V is the direct sum of U and W . Let $U = \{(a, b, c) : a + b + c = 0\}$ and $W = \{(0, 0, c) : c \in \mathbb{R}\}$, then show that \mathbb{R}^3 is a direct sum of U and W . [1+3+3]

4. If R and R' are rings and f is a ring homomorphism from R onto R' , then prove that $\frac{R}{K_f}$ where K_f is the kernel of f , is isomorphic to R' .

Also if R is a ring with unit element 1 and f is a homomorphism of R onto R' , prove that $f(1)$ is the unit element of R' . [5+2]

5. Find the condition that the equation $ax^2 - 3bx^2 + 3cx + d = 0$ may

have two equal roots. Solve the equation $4x^3 + 20x^2 - 23x + 6$
two of its roots being equal. [4+310]

OR

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

Group 'B'

10x4=40

6. If A and B are two non-singular square matrices.
prove that $(A-B)^{-1} = B^{-1}A^{-1}$

Also verify this for the matrices $A = \begin{pmatrix} 1 & 2 \\ 2 & 6 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 1 \\ 5 & 3 \end{pmatrix}$ [2+2].

OR

Prove that

$$\begin{vmatrix} (a+b)^2 & ca & cb \\ ca & (b+c)^2 & ab \\ bc & ab & (c+a)^2 \end{vmatrix} = 2abc(a+b+c)^3 \quad [4]$$

7. Show that the numbers 91 and 171 are relatively prime to each other.
Find m and n such that $171m + 91n = 1$. [4]

8. Let H be a subgroup of a group G and $T = \{x \in G : xH = Hx\}$, then
prove that T is a subgroup of G. [4]

OR

Define subgroup of a group. Prove that the intersection of two
subgroups of a group G is also a subgroup of G. Give an example to
show that the union of two subgroups is not necessarily a subgroup.

[1+2+1]

9. Prove that a non-empty subset S of a ring R is a subring of R if and
only if $a, b \in S$ implies (i) $a - b \in S$ and (ii) $ab \in S$. [4]

OR

Define quotient ring. Let R be a ring and I an ideal of R. Let f be a
mapping from R to $\frac{R}{I}$ defined by $f(a) = a + I$ for all $a \in R$, then

prove that f is a homomorphism of R onto $\frac{R}{I}$ [1+3]

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

transformation.

[4]

11. Define scalar and vector projection in \mathcal{R}^n . Find the scalar and vector projection of the vector $(-1, 2, 5)$ onto the vector $(-4, 3, 7)$. [1+3]
12. What is subspace of a vector space V ? Prove that the intersection of any two subspaces of a vector space V is also a vector subspace.
13. Show that the linear transformation $T: \mathcal{R}^3 \rightarrow \mathcal{R}^3$ defined by $T(x, y, z) = (x - y, y - z, z)$ is invertible. Find a formula for T^{-1} . (2+2)
14. Solve by using Ferrari's method, the equation $x^4 + 12x - 5 = 0$. [4]
15. Prove that an equation in which the coefficient of the first term in unity, and the other coefficient are integers (positive or negative), can not have a fractional root but it may have irrational roots. [4]

OR

Define superior limit of a positive roots of an equation. Find the superior limit of the positive roots of the equation

$$x^4 - 2x^3 - 13x^2 + 38x - 24 = 0. \quad [1+3]$$