T.U Exam. 2072

Attempt ALL the questions.

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

OR

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

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

OR

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

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

OR

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

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

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

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

7. Answer any TWO of the following : [2×3=6]
   a) What do you mean by population inversion? Explain.
   b) What is Cauchy's equation? Explain.
   c) Explain the mean life of a radioactive substance.
   d) Explain the phenomenon of pair production.

8. Answer ALL the questions: [4×2.5=10]
   a) State and explain Malus law
   b) What is Zeeman effect?
   c) Explain the fine structure of X- rays.
   d) Write down the uses of FET

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

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

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

12. How long does it take for 80% of a sample of Radon to decay? (Half life of Radon = 3.8 days). [5]

13. A car battery has an internal resistance of 0.04Ω. For what values of load resistance does the car battery appear stiff? [5]

14. Convert the binary numbers 11.01 and 101.11 into their decimal equivalent. Also add these binary numbers to find the decimal equivalent of the result.

[5]

T.U Exam. 2072

Bachelor Level (4 Yrs.)/Science & Tech./II Year Full Marks : 100
Chemistry (CHEM 201) Time : 3 hrs.
Use separate answer book for each group
The comprehensive question of each group is compulsory.
Attempt Six questions of Short answer questions of each group.

Group A (Inorganic)

1. Comprehensive Question

What are transition elements? Explain the salient features of transition elements in terms of (i) variable oxidation state (ii) magnetic behaviour (iii) colour of complexes and (iv) catalytic properties. $[1+2+2+2+2]$

OR

How is hydrogen peroxide prepared in the laboratory? Give any two oxidizing properties of hydrogen peroxide. Calculate the strength of 40 volume' of hydrogen peroxide in terms of g/litre, molarity and normality. $(H = 1, 0 = 16)$ $[3+2+4]$

2. Short Answer Questions $6 \times 4 = 24$

2.1 Which metal is extracted by Mond's process? Write the chemical reactions involved in Mond's process.

2.2 NF_3 is a weaker ligand than NH_3. Explain.

2.3 What are phosphouitrilic compounds? Also give one method of preparation of these compounds and their uses.

2.4 How is hydroxyl amine prepared? Give main uses of hydroxyl amine.

2.5 What do you mean by diagonal relationship? Explain the relationship with reference to second and third period elements.

2.6 What are chelating ligands and chelates? Explain with the help of two examples.

2.7 Why is acid strength increases in the following order $HOCl < HCl O_2 < HCl O_3 < HCl O_4$ Explain.

2.8 'CCl_4 resists hydrolysis while $SiCl_4$ gets readily hydrolyzed.' Why ?

2.9 What is Ziegler- Natta catalyst? How is it used in polymerization? Give the mechanism of the reaction.

Group "B" (ORGANIC)

3. Comprehensive Question

State and illustrate the Huckel's rule taking appropriate example. Predict whether the following compounds are aromatic or not.

(a) Anthracene, (b) Cyclooctatetraene (c) Furan (d) Cyclopentadienyl cation
(e) Cyclopropenyl cation: [4+5]

OR

Give reaction with mechanism for the preparation of carboxylic acid from Grignard reagent and carbondioxide. Give the reaction and mechanism of halogenations of carboxylic acid. How do you account for the fact that boiling point of propanoic acid is higher than propanol?

4. Short Answer Questions 6×4=24

4.1. Write the structure of axial and equatorial methyl cyclohexanes and compare their stability.

4.2. Write notes on Friedel Craft's acylation with mechanism.

4.3. Write the reaction and mechanism of Wittig reaction.

4.4. How do you convert carboxylic acid into an amide? Using IR, how carboxylic acid is differentiated from amide? Describe.

4.5. Acetoacetic ester synthesis is an important synthetic reaction. Illustrate this giving pertinent examples.

4.6. How do you show that $-NH_2$ group in aniline is ring activator and ortho-para director?

4.7. Write notes on Sandmeyer reaction giving mechanism.

4.8. Explain the basic strength of $1°$, $2°$ and $3°$ – amine.

4.9. What is Fries rearrangement? Give its mechanism.

GROUP "C" (PHYSICAL)

5. Comprehensive Question

What do you mean by Pseudo-order reaction? Derive an expression for rate constant of first-order reaction. Give an example of a first order reaction.

A reaction is 50% complete in 20 minutes. It is allowed to proceed another 10 minutes. How much of the reaction would be complete at the end of 30 minutes, if the reaction follows zero order kinetics. [1+4+1+4]

OR

Discuss the construction and working of glass electro e. How do you measure pH of the unknown solution by using glass electrode?

For a cell:

$Ag(s)/Ag\ Br(s)$, $Br^-(c = 0.32m)//\ Cu^{2+}(c = 0.42)$, $Cu\ (c = 0.36m)/pf$ the emf of this cell is 0.0565 V. Write cell reaction and calculate the standard emf of this cell. [4+2+4]

6. Short Answer Questions 6×4=24

6.1. What is activation energy? For a certain reaction, the value of rate constant at 550°C and 625°C are 1.1 L mol^{-1} S^{-1} and 6.4 L mol^{-1} S^{-1} respectively. Calculate activation energy for reaction.

6.2. State Kohlrausch's law of independent migration of ions. How is it used to determine the equivalent conductance of weak electrolytes?

6.3. Sketch and explain the nature of conductometric titration curves for the titration (a) CH_3COOH vs. NaOH (b) $AgNO_3$ vs. NaCl.

6.4. What is quantum yield? Give the condition for high quantum yield.

6.5. Give a brief account for intermediate compound formation theory of catalysis.

6.6. What is an adiabatic process? Calculate the work done for reversible adiabatic contraction of 2 moles of -an ideal gas on cooling from 270°C to 0°C.
(Given: r = 5/3, R = 0.0821 L atm mo^{-1} k^{-1})

6.7. What is Joule - Thomson effect? Why do H_2 and He warm up on adiabatic expansion?

6.8. Discuss the criteria of spontaneity and equilibrium in terms of free energy and entropy.

6.9. Derive the expression for the net work obtained in Carnot's cycle.

T.U Exam. 2072

Group "A"   [4×10=40]

Attempt ALL questions.

1. What are essential elements? Discuss their role in Plant nutrition.

OR

What is oxidative phosphorylation? Describe its mechanism.

2. What are protected areas? How they help in conservation of biodiversity?

OR

Describe the structural and functional aspects of pond ecosystem.

3. Describe the different types of mutation and its role in evolution.

4. Give an account of anomalous secondary growth in Achyranthus stem.

Group "B"   [5×8=40]

Write short answers to the following :

Attempt any **Eight** questions.

5. What is biogeochemical cycles? Explain phosphorus cycle in nature.

6. What is the major causes and consequences of global warming?

7. Write the effects of temperature on plants.

8. What are the major vegetation types of Nepal?

9. Give the physiological role of Gibberellins.

10. Give an account of photophosphorylation.

11. Describe in brief the mechanism of Vernalization.

12. Give an account of microsporogenesis in dicot plants.

13. Illustrate with suitable diagrams the difference in mitotic and meiotic metaphase.

14. What happens when a homozygous tall pea plant is crossed with a homozygous dwarf plant in F_1 and F_2 generations? Explain.

Group "C"   [2×10=20]

Write short notes to the following: (any TEN')

15. Water potential and osmotic potential

16. Photoperiodsm

17. Polygonum type of Embryo sac.

18. Noise pollution

19. Succession

20. Ecological adaptation
21. Electron transport system
22. Transpiration
23. Hydroponics
24. Apical meristem
25. DNA
26. Codominance

T.U Exam. 2072

Bachelor Level 4 Yrs.Prog./Science & Tech./II Year   Full Marks: 100

Zoology (Chordata, Comparative Anatomy and Evolution) (Zool. 201) Time: 3 hrs.

Illustrate your answers with suitable diagram wherever necessary.

Group "A"   [2×10=20]

Attempt ALL questions.

1. Discuss causes, advantages and types of fish migration.
2. Describe different types of stomach in mammals.
3. Explain courtship and mating systems in vertebrates.

Group "B"   [2×10=20]

Attempt any TWO questions.

4. Describe the integuments of reptiles and birds and discuss how they are adapted to their respective modes of life.
5. Give a comparative account of alimentary canal of a reptile and a bird.
6. What is variation? Discuss its types and causes.

Group "C"   [8×5=40]

Attempt any EIGHT questions.

7. Mention the important differences between Petromyzon and Myxine.
8. Describe different types of fins found in fishes.
9. Discuss axolotl and neoteny.
10. Briefly mention the first aid treatment of snake bite.
11. Differentiate between dromaeognathous and schizognathous types of palate.
12. Discuss radiation in limb structure of mammals.
13. Explain physiological process of animal behaviour.
14. Discuss hearts in vertebrates.
15. Give a brief account of basic causes and principles of organic evolution.
16. Discuss briefly zoogeographic affinities of fauna of Nepal.

Group "D"   [8×2.5=20]

17. Give very short answers of any EIGHT:
    a. Ctenoid scales
    b. Paedogenesis
    c. Poison apparatus of snakes
    d. Birds as glorified reptiles
    e. Dental formula of rabbit
    f. Latent learning
    g. Craniostylic suspension
    h. Air sacs

i. Types of isolation
j. Equilibrium theory of Island biogeography

T.U Exam. 2072

Bachelor Level 4 Yrs.Prog./Science & Tech./II Year
Biochemistry and Microbial, Biotechnology MB 201

Full Marks: 100
Time: 3 hrs.

GROUP "A"
Long Answer Questions

Attempt FOUR questions. [4× 10=40]

1. Describe the steps of Pentose Phosphate Pathway.
2. Describe the process of gene translation in bacteria.
3. What are the different structures of protein? Describe them.
4. Describe the industrial production of acetic acid.
5. Describe the process of gene cloning using vector.
6. Describe the process of production of protease enzyme using microorganism.

GROUP "B"
Short Answer Questions.

Attempt any Eight questions. [8×5=40]

7. Briefly explain the fluid mosaic model of biological membrane.
8. What are the biological functions of lipids?
9. Briefly explain the role of ATP as the primary source of energy in the cell.
10. What is genetic code? Enlist its properties.
11. What is deamination? Explain with an example.
12. What is the use of vector in recombinant DNA technology?
13. Draw a well labelled diagram of a fermenter.
14. Briefly describe different types of cheese.
15. Briefly describe the risks associated with biotechnology.
16. Describe briefly on use of Rhizobium as biofertilizer.

GROUP " C"

Attempt any Eight questions. [8×2.5=20]

17. Very short answers questions:
    a. What is isozyme?
    b. Enlist any five polysaccharides.
    c. Define biomolecules.
    d. How is the double stranded DNA denatured?
    e. What are different cleavage pattern of restriction enzymes?
    f. What is totipotency?
    g. 'Enlist the bacteria involved in manufacture of yoghurt.
    h. Define electroporation.
    i. Write down the advantages of bioethanol?
    j. Enlist the microorganisms used in beer manufacture.

Bachelor Level 4 Yrs.Prog. / Science & Tech./II Year   Full Marks: 100

Petrology, Structural Geology and Sedimentology-201 (Geo)   Time: 3 hrs.

GROUP "A"
Long Answer Questions.

Attempt any FOUR questions.   (4×10=40)

1. What is an igneous rock? How are the igneous rocks classified? Briefly describe the IUGS classification of igneous rock.

2. What is metamorphism? Describe the various agents of metamorphism.

3. Discuss the various processes of diagenesis.

4. What is an unconformity? Describe the criteria of recognition of unconformity.

5. Define and classify folds. Write down the criteria of recognition of folds in the field.

6. Briefly describe the physical processes of sedimentation.

GROUP "B"
Short Answer Questions

Attempt any Eight questions.   (8×5=40)

7. Describe the structure and forms of extrusive rocks.

8. Write short note on contact metamorphism.

9. What is a mineralogical phase rule?

10. Describe syn-sedimentary deformational structures and their significance.

11. What do you understand by descriptive analysis in structural geology?

12. Describe main features of diapirs and salt domes.

13. Describe the criteria of recognition of faults in the field.

14. Briefly describe about the microbial processes in generation of sediments.

15. Write short note on carbonate platform.

16. Describe the sediment transport process in eolian environment.

GROUP "C"

Attempt any Eight questions.   (8×2.5=20)

17. Differentiate between igneous and metamorphic rocks.

18. What is eclogite?

19. Define metamorphic facies.

20. What is cementation?

21. Define dip and strike.

22. What is a Mohr circle?

23. What is the difference between an anticline and antiform?

24. What is a depth-velocity diagram?

25. Note down the features of lacustrine deposit.

26. Define Eh and pH.

T.U Exam. 2072

Bachelor Level (4 Yrs.Prog.) Science & Tech./II Year   Full Marks: 100
Applied Meteorology (MET 201)   Time: 3 hrs.
Use Separate answer sheet for each group

Group "A'
Urban Meteorology, Air Pollution and Atmospheric Chemistry

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

Group-i   (2×10=20)

1. Define plume rise. Derive an equation to estimate the effective stack height.
2. Discuss physical, optical and chemical properties of atmospheric aerosol.
3. Define an ozone hole. How can you distinguish the good and bad ozone?

Group-ii   (4×5=20)

4. Describe briefly about a typical variation of ozone flux from the stratosphere to the troposphere.
5. Why dispersion of pollutants at the boundary layer depends on local wind structure.
6. Describe briefly about possible sources of atmospheric particulate matter.
7. Write briefly about a typical altitudinal variation of solar radiation with reasons.
8. How urban infrastructures including vehicles can modify urban climate.

Group-iii   (4×2.5=10)

9. Describe briefly about the heat storage in urban structures.
10. Write in short about logarithmic profile.
11. What are the major sulphur containing compounds?
12. Write in short about the Gaussian plume model.
13. Write a short note on atmospheric ozone.

Group "B"
Satellite Meteorology, Hydro-Meteorology & Agriculture Meteorology

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

Group-iv   (2×10=20)

14. What is remote sensing? Write about different types of satellites.
15. Discuss the hydrological cycle and its components.
16. Explain about artificial modifications of meteorological and hydrological regimes.

Group-v   (4×5=20)

17. Explain briefly two most reliable methods to estimate missing rainfall data.
18. How do you determine water loss from soil surfaces?
19. Explain briefly mechanism of heat transfer into the soil?
20. Distinguish clearly between visible and infrared images.
21. Discuss depth frequency analysis of rainfall.

Group-vi   (4×2.5=10)

22. Write a note on snow albedo.
23. Distinguish between a flood and a drought.
24. What are bright bands?

25. Write in short basic terms used in satellite meteorology and remote sensing.

26. Write a short note on artificial ground water recharge.

T.U Exam. 2072

Bachelor Level (4 Yrs.Prog.)/ Science & Tech.III Year   Full Marks: 100
Fundamentals of Environmental science (Env.201)   Time: 3 hrs.

Section "A"

1. Attempt All the questions.   4×10=40

  1.1. What is lentic community? Describe the nature of biotic communities in lentic water bodies.

      OR

   Describe briefly on physico-chemical and biological water quality indices.

  1.2. What are the major categories of Koppen's climatic classification? Discuss them with uses of various symbols and subdivisions.

  1.3. Elaborate the process and principles of conductometric titration with suitable examples.

  1.4. Describe the physiographic division of Nepal Himalaya with the major hazards associated with these zones.

      OR

   What are the different types of agricultural practices in Nepal? Describe briefly the environmental consequences of modern agriculture systems.

Section "B"

2. Describe briefly any EIGHT questions.   8×5=40

  2.1. Threats to wetland ecosystems
  2.2. Darcy's law and it's condition of validity
  2.3. Floods, their causes and consequences
  2.4. Microbial technology for waste treatment
  2.5 Basic features of geological maps
  2.6 Classification of landslide on the basis of movement
  2.7 Sustainable agricultural practices
  2.8 Degradation of petroleum and hydrocarbons
  2.9 Map and their types
  2.10 Role of Global positioning system in environmental studies.

Section "C"

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

  Differentiate between :

  3.1. Littoral zone and profundal zone
  3.2. Periphyton and benthos
  3.3. Confined aquifer and unconfined aquifer
  3.4. Convective precipitation and orographic precipitation
  3.5. Ultraviolet ray and infrared ray
  3.6. Tropical forest climate and dry climate
  3.7. Lesser Himalaya and Higher Himalaya

3.8. Fall and topple

3.9. Sustainable agriculture and modern agriculture

3.10. GIS and GPS

T.U Exam. 2072 (II)

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

Full Marks: 50
Times : 2 hrs

Group "A"

Attempt any SIX questions.

[6×5=30]

1. What are the desirable properties of a good average? For the dataset representing the number of children in a random sample of 10 families in neighbourhood: 1, 2, 2, 3, 2, 3, 5, 1, 2 and 4, find mean, median and mode.

2. Define conditional probability. The events A and, Bare such that $P(A) = 0.45$, $P(B) = 0.35$ and $P(A \cup B) = 0.7$.

   (i) Find the value of $P(A \cap B)$

   (ii) Explain why A and B are not independent.

   (iii) Find the value of $P(A/B)$

3. Under what condition Binomial distribution turns into Poisson distribution? The probability that a bolt being defective is 0.2%. Bolts are packed in boxes of 500. Find the probability that in a randomly chosen box there are 2 defective bolts.

4. When are two attributes said to be positively associated and negatively associated? In an experiment on immunization of cattle from tuberculosis the following results were obtained:

	Affected	Not affected
Inoculated	12	26
Not inoculated	16	6

By calculating Yule's coefficient of association, examine the effect of vaccine in controlling the disease.

5. The heights of boys at a particular age follow a normal distribution with mean 150.3 cm. and variance 25 cm². Find the probability that a boy picked up at random from this age group has height less than 153 cm.

6. Let P equal to the proportion of drivers who use a seat belt in a state that does not have a mandatory seat belt law. It was claimed that P = 0.14. An advertising campaign was conducted to increase this proportion. Two months after campaign, X = 104 out of random sample of n = 590 drivers who were wearing their seat belt. Was the campaign successful?

   (i) State the null and alternative hypothesis.

   (ii) What is your conclusion at $\alpha = 0.05$.

7. Test the hypothesis of no difference between the ages of male and female employees of certain company, using the Mann - Whitney U test for the sample data below. Use $\alpha = 0.10$

Male	35	43	26	44	40	42	33	38	25	26
Female	30	41	34	31	36	32	25	47	28	24

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

8. The following gives the scores of a cricketer in 40 consecutive innings.

6	18	27	19	57	12	28	38	45	66
72	85	25	84	43	31	63	0	26	17
14	75	86	37	20	42	8	42	0	37
21	11	36	11	29	44	55	62	16	82

By taking suitable class interval calculate Karl Pearson coefficient of skewness and interpret the result. Also draw histogram and frequency polygon.

9. In trying to evaluate the effectiveness of antibiotis in killing bacteria, a research institution complied the following information.

Antibiotics in mg (X)	13	15	14	16	17	10
Bacteria (Y)	5	7	5.6	7.2	8.6	6.2

(i)   Calculate Karl Pearson's coefficient of correlation and interpret its value.
(ii) Fit a regression line Y on X.
(iii) Find the standard error of estimate.
(iv) Test the significance of regression coefficient.

10. Five readings of the resistance X, in ohms, of a piece of wire gave the following results: 1.51, 1.49, 1.54, 1.52, 1.54.
If wire is pure, the resistance is 1.5 ohms. If the wire is impure, 'the resistance is higher than 1.5 ohms. Assuming that the resistance can be modelled by a normal variable with mean 1.1 and standard deviation σ, calculate

(i)   The sample mean $\bar{X}$
(ii) The unbiased estimate of population standard deviation, σ
(iii) Is there evidence, at 5% level of significance, that the wire is impure?
(iv) Calculate the 95% confidence interval for population mean μ.

T.U Exam. 2072

Bachelor Level (4 Yrs.Prog.)/ Science & Tech./II Year   Full Marks: 100
Statistics (Probability and Inference I)   Time: 3 hrs.

Group "A"

Attempt any FOUR questions.   [4×10=40]

1. State and prove Baye's Theorem. Suppose that three types of antimissile defense system has an equally likely chance of detecting and destroying an incoming missile within the range of 250 miles 'with a speed running up to nine times the speed of sound. However, in actual practice it has been observed that the precisions of these antimissile-system are not same, that is, the first system will usually detect and destroy the target 10 of 12 times, the second will detect and destroy it 9 of 12 times, and the third will detect and destroy it 8 of 12 times. We have been observed that the target has been detected and destroyed. What is the probability that the antimissile defense system was of the third type?

[2+4+4]

2. Define random variable. For two variates X and Y show that
$$\sqrt{E(X+Y)^2} \le \sqrt{E(X)^2} + \sqrt{E(Y)^2}$$
[2+8]

3. Define Normal distribution. Obtain moment generating function of Normal distribution.
[3+7]

4. Define two dimensional random variable with an example.
A random variable (X, Y) have the joint density:
$$f(x, y) = 8xy, \qquad 0 < x < y < 1$$
$$= 0. \qquad\qquad otherwise.$$
Find marginal and conditional distribution of X and Y.
[2+8]

5. Define Chi-square distribution. Show that the sum of independent chi-square variates is also a chi-square 'variate.
[3+7]

6. Define null and alternative hypothesis. If $0.5 \le x$ is the critical region for testing $H_0 : \theta = 1$ against $H_1 : \theta = 2$ on the basis of single observation from a population with density function:
$$f(x, \theta) = \frac{1}{\theta}, \ 0 \le x \le \theta$$
$$= 0. \ elsewhere$$
Obtain the probabilities of type I and type II errors.
[3.5+3.5]

Group "B"

Attempt any EIGHT questions.
[8×5=40]

7. What do you understand by union, intersection and complementation of events? If A and B are independent events, prove that,
$$P(A \cup B) = 1 - P(A') \ P(B')$$
[2+3]

8. State under what conditions Binomial distribution tends to Poisson distribution. There are 5000 students in a university. Calculate the probability that exactly 15 of them have their birthdays on 1 January.
[2+3]

9. Define mathematical expectation. If X is the number of the points obtained in a throw with a balanced die, find the mathematical expectation of X.
[2+3]

10. If X_1 and X_2 are two independent random variables. then show that the moment generating function of the product of the above variables is equal to the moment generating function of their sum.
[5]

11. State the condition under which a function is said to be a probability density function. Examine whether the function defined by
$$f(x) = \frac{3}{8} \ (4x - 2x^2). \ 0 < x < 2$$
$$= 0. \ otherwise$$
Is a probability density function?
[2+3]

12. Given the following bivariate probability distribution:

X \ Y	−1	0	1
0	1/15	2/15	1/15
1	3/15	2/15	1/15
2	2/15	1/15	2/15

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Obtain (1) marginal distribution of X (2) conditional distribution of X given Y = 2 (3) E(X).   [1+2+2]

13. If a statistic t follows student's t- distribution with n degrees of freedom then show that t^2 follows F- distribution with (1, n) degrees of freedom.   [5]

14. If X and Y are two independent rectangular variables on [0, 1], find the distribution of $U = \dfrac{X}{Y}$ [5]

15. Show that sample mean is an unbiased estimate of the population mean.   [5]

16. What are the main features and properties of F- curve.   [5]

17. For the continuous distribution,
$$dF = y_0(x - x^2)\, dx,\ 0 \le x \le 1$$
Y_0 being constant, find arithmetic mean and harmonic mean.   [2.5+2.5]

Group "C"

18. Attempt any TEN questions.   [10×2=20]

(a) A problem is given to three students, A, B and C whose chances of solving the problem are in ratio 2 : 3 : 5. Find the probability that the problem will be solved.

(b) The probability function of a discrete random variable X is given by $P(X = x) = cx^2$ for x = –1, 0, 1, 2, 3.
Find the value of c.

(c) The mean and variance of binomial distribution are 4 and 4/3.
Find P(x = 2).

(d) Define sensitivity of a diagnostic test.

(e) Give the statement of Cramer-Rao's Inequality.

(f) A sample poll of 100 voters chosen at random from all voters in a given district indicated that 55% of them were in favour of a particular candidate. Find 95% confidence limits for the proportion of all the voters in favour this candidate.

(g) Suppose X has a Poisson distribution. If $P(X = 2) = \dfrac{2}{3}$ (X = 1), find mean and variance of the distribution.

(h) Write down two properties of likelihood function.

(i) Two perfect coins are tossed together. What is the probability of getting at least one head?

(j) Find the probability that a random variable having standard normal distribution will take on the value less than 1. 2.

(k) What is meant by unbiasedness of estimator?

(l) Give the expression of moment generating function for the following distribution:
(i) X~Binomial (n, p)   (ii) X~ Poisson (λ)

Group "A" $5 \times 7 = 35$

1. Define group with an example. Prove that a set $G = Q - \{1\}$, Q a rational number defined under the binary operation * such that
   $a * b = a + b - ab$ for all $a, b \in G$, is an abelian group.   [2+5]

2. Define an integral domain with an example. Prove that a finite integral domain is a field. What happens if it is not finite ?   [2+4+1]

   ### OR

   Define subring with an example. Prove that a non-empty subset S of a ring R is subring of R if and only if $a - b \in S$ and $a . b \in S$ for all $a, b \in S$.   [2+5]

3. Define Fourier coefficient. Prove that every finite dimensional non zero vector space has an orthogonal basis.   [1+6]

   ### Or

   Define component of a vector along a non-zero vector. If $u_1 = (2, 3)$ and $u_2 = (-1. 2)$ be the vectors of $\Re^2$ with usual scalar product. Does $\{u_1, u_2\}$ form orthogonal basis ? Find the orthonormal basis for $\Re^2$.   [1+1+5]

4. Define kernel and image of a linear transformation. Let V and W be vector space over a field K at $T : V \to W$ be a linear transformation. If V is finite dimensions, then prove that $\dim V = \dim (\ker T) + \dim (\operatorname{Im} T)$.   [2+5]

5. Discuss the relation between roots and coefficients of an equation $f(x) = a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \ldots a_{n-1} X + a_n = 0$.
   Solve the equation $x^3 - 13 x^2 + 15x + 189 = 0$, if one root exceeds another by 2.

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

6. Define hermitian and skew hermitian matrices with examples. Prove that if A and B are two matrices conformable for addition then $(A + B) * = A* + B*$.

   ### OR   [2+2]

   Define inverse of a matrix. Are the matrices

   $A = \begin{pmatrix} 1 & -\frac{3}{2} \\ -1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 4 & 3 \\ 2 & 2 \end{pmatrix}$ inverse each other ? Justify your answer.

                                                                 [1+3]

7. Find the row rank and column rank of matrix $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 5 & 8 \\ 4 & 10 & 8 \end{pmatrix}$ by applying linear independence.   [4]

8. Show that the numbers 29 and 47 are relatively prime to each other. Find x and y such that $29x + 47y = 1$.   [1+3]

9. Prove that every cyclic group is an abelian group. Use this prove that $G = (1, w. w^2)$, where w is the cube root of unity is abelian group.   [2+2]

10. Define normal subgroup of a group. Prove that a subgroup N of a group G is normal subgroup of G is and only if $g N g^{-1} = N$ for all $g \in G$.   [1+3]

    ### Or

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

11. If $\vec{a}$ and $\vec{b}$ are two vectors in $\Re^n$. Prove that $\|\vec{a} + \vec{b}\| = \|\vec{a} - \vec{b}\|$ if an only if $\vec{a}$ is orthogonal to $\vec{b}$.   [4]

Or

Define scalar and vector projection of a vector onto another vector. Determine the scalar projection and vector projection of $\vec{b}$ on $\vec{a}$ if $\vec{a} = (1, -2, 3)$ and $\vec{b} = (-1, 3, 2)$.   [2+2]

12. Define linear hull. Prove that the linear hull of a given set of vectors v_1, v_2, ..., v_n is a subspace of V.   [4]

13. State Descarte's rules of sings. Find the nature of the roots of the equation $x^4 + 15x^2 + 7x - 11 = 0$.   [1+3]

14. Solve, by Cardan's method of $x^3 - 30x + 133 = 0$.   [4]

OR

Solve, by Descart's method of $x^4 - 10x^2 - 20x - 16 = 0$

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

T.U Exam. 2072

Bachelor Level (4 Yrs.Prog.) / Science & Tech./ II Year   Full Marks: 75
Mathematical Analysis I (Math. 202)   Times : 3 hrs
Attempt ALL the questions

Group "A"   5×7 = 35

1. Define the term tautology, conjunction, disjunction and bi-conditional statements with examples. Prove that if p, q and r are stands for statements then $p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$ is a tautology.   [2+5]

Or

A function $f : R \to R$ be defined by $f(x) = x^3 - 1$. Prove that the function is one to one and onto. Let $f : x \to y$ and $g : y \to z$ are one to one and onto functions then the composite function $g \circ f : x \to z$ is one – to one correspondence and $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$.   [3+4]

2. Define adherent point of a set.
Write all adherent points of the set $(1, 4) \cup \{5, 6, 7\}$. Proved that a set 'S' in R is closed if and only if it contains all it's adherent points.   [1+1+5]

3. Let $\{y_n\}$ and $\{z_n\}$ be two real sequences converges to same limit 'L'. If $\{x_n\}$ be a sequence such that $y_n \le x_n \le z_n$ for all $n \in z^+$. Then the sequence $\{x_n\}$ converges and $\lim\limits_{n \to \infty} x_n = L$. Determine the sequence $\left\{ \dfrac{\cos^2 n}{3^n} \right\}$ converges or diverges.   [4+3]

4. Let $f : 1 \to R$ be function $1 \subseteq R$. At what condition that the function f is said to satisfy the Lipschitz condition on I ? Prove that if $f : 1 \to R$, $1 \subseteq P$, satisfies Lipschitz condition on I, then f is uniformly continuous on I. Show that the function $f(x) = x^3$ satisfies the Lipschitz condition on $[0, 2]$.   [1+3+3]

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

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

Or

state when a bounded function $f : [a, b] \to r$ is Riemann integrable ? State and prove the Riemann's condition for integrability on $[a, b]$.

Group "B"

$10 \times 4 = 40$

6. Prove that if S is a non empty set of real numbers with $b = \sup S$, then for every $c < b$ there is some $x \in$. such that $c < x \le b$. $\qquad [2+2]$

7. Show that the set $(0, 1)$ is uncountable.

OR $\qquad [4]$

Define a countable set. Prove that every infinite set has a countable subset.

8. If 'C' is a limit point of a set in R, then every open interval $B(C; r)$ contains infinittely many points of s distinct from C. $\qquad [4]$

9. If Σu_n and Σv_n are two infinie series of positive real numbers such that $u_n \le v_n$ are for all n. If Σv_n converges then Σu_n is also converges.

OR $\qquad [4]$

State direct comparison test and test the convergence of the series $\Sigma \dfrac{1}{n^3 + n - 1}$.

10. Let R_n be a remainder of a series $\sum_{n=1}^{\infty} x_n$ then $\sum_{n=1}^{\infty} x_n$ converges if $\{R_n\}$ converges to O. $\qquad [4]$

11. Show that $\lim_{n \to 1} \dfrac{5 - 8x + 3x^2}{1 - x} = 2$ by finding δ in terms of ε. $\qquad [4]$

12. Prove that if f is differentiable on $(a.b)$ and continuous on $[a, b]$. Then $f'(x) \ge 0$ for all x in (a, b) if and only if f is increasing on $[a, b]$. $\qquad [4]$

13. State Rolle's theorem. Verify it for the function $f(x) = \dfrac{\sin x}{e^x}$ on $[0, \pi]$. $[1+3]$

Or

Find the interval where the graph of the function $f(x) = \sin x$ is concave upward and where it is concave downward in $[0, 2\pi]$. $\qquad [4]$

14. Prove that if f is continuous on a closed interval $[a, b]$ then it is integrable on $[a, b]$.

Or $\qquad [4]$

Let f be a function of Dirichlet's type given by

$$f(x) = \begin{cases} 1 & \text{if } x \text{ rational} \\ -1, & \text{if } x \text{ is irrational} \end{cases}$$

Is the function integrable on the interval $[0.1]$?

15. Let f be a continuous function $[a, b]$. If a function F on $[a, b]$ is a primitive of f, then $\int_a^b f(x)\,dx = F(b) - F(a)$. $\qquad [4]$