

## Tribhuvan University, 2072

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

Full Marks : 50

Environmental Assessment and Projects Management (Env. 303)

Time : 1½ hrs.

### Section A

Attempt Any Two Question.

[2×10=20]

1. What is environmental governance ? Highlight the roles of inclusion of environmental governance in policies.
2. Explain in brief the processes involved during an Initial Environmental Examination.
3. What is impact prediction ? What are the different biological impacts of hydropower development on environment ?

### Section B

Attempt any Five Questions.

[5×4+2.5×4=30]

(Question number six is Mandatory)

4. What are the different environmental criteria of the quality assurance ?
5. Highlight the requirements of Resettlement Policy.
6. What are the different grievance redress mechanisms ?
7. How do you differentiate mid-term and final monitoring ?
8. What do you mean by project alternative analysis ?
9. Write short notes on the followings :
  - a. Project cycle
  - b. Environmental Screening
  - c. International Certification
  - d. EPA 1996

## Tribhuvan University, 2072

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

Full Marks : 100

Environmental Science (Env. 301)

Time : 3 hrs.

### Section 'A'

1. Long Questions (Attempt all the questions) [4×10=40]
  - 1.1 Explain the sources and nature of ambient air pollutants. Briefly describe the effects of air pollution on human health.
  - 1.2 Describe the integrated approach of solid waste management techniques.

OR

Briefly explain the current solid waste management issues in Nepalese context.



- 1.3 Discuss the existing practices and their relevancy of rain water harvesting in Nepal.
- 1.4 Describe the sources and types of toxic chemicals in environment. Briefly explain the route of toxic agents in biological system.

OR

Explain the dose-response relationship with the help of dose-response curve.

**Section 'B'**

2. Short Questions (Attempt any EIGHT questions) [8×5=40]
  - 2.1 Define environmental pollution. Being a student of Environmental Science, what role would you play at local level for the improvement of river water quality ?
  - 2.2 Briefly discuss the major physico-chemical parameters to be tested while analyzing the drinking water quality.
  - 2.3 Briefly describe the different water purification methods to be use as safe drinking.
  - 2.4 Discuss the status and controlling measures of noise pollution in Nepalese context.
  - 2.5 Highlight the major problems associated with the management of natural resources in Nepal.
  - 2.6 Mention the major safety measures that should be adopted by industrial workers with the case of mineral industrial.
  - 2.7 In the context of recent earthquake of 2072.01.12 B.S. explain the relevancy of emergency food aid program in Nepal.
  - 2.8 Explain the major challenges of biodiversity conservation in Nepal.
  - 2.9 Discuss the major alternative sources of energy used in Nepal.
  - 2.10 Highlight the role of indigenous knowledge systems for the conservation of environment.

**Section C**

3. Differentiate between (Attempt all the questions) [10×2=20]
  - 3.1 Primary and secondary air pollutants
  - 3.2 BOD and COD
  - 3.3 Composting and vermicomposting
  - 3.4 Bioaccumulation and biomagnifications
  - 3.5 Traffic noise and industrial noise
  - 3.6 silicate and carbonate minerals
  - 3.7 Traditional and commercial energy resources.
  - 3.8 LD25 and LD50
  - 3.9 J-shape and S-shape curve



## Tribhuvan University, 2072

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

Full Marks : 50

Geohazard and Climate Change-Elective (Geo. 304)

Time : 1½ hrs.

Attempt ALL Question.

1. What are geohazards ? Describe various types of geohazard and discuss the socio-economic impacts of geohazards. [10]  
OR
2. What is flood hazard ? Describe the methods of flood hazard mapping. [10]  
What is seismic hazard ? Describe the method of seismic risk assessment. [10]  
OR
3. Discuss about the Recent climate changes and its effects.  
(a) Describe the effects of volcanic eruptions in climate change. [5]  
(b) Discuss the earthquake risk in the Himalaya. [5]
4. (a) Describe the effects of climate change in human health. [5]  
(b) Briefly describe the climate change policies of Nepal. [5]
5. Write short notes on any FOUR : [2.5×4=10]  
a. Seismic microzonation  
b. Copenhagen Accord  
c. Subsidence hazard  
d. Greenhouse effect  
e. GLOF

## Tribhuvan University, 2072

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

Full Marks : 50

Geomorphology-Elective (Geo. 303)

Time : 1½ hrs.

Attempt ALL Question.

1. What is a cirque ? Discuss the landforms developed by advance and retreat of glaciers. [10]  
OR
2. Describe various landforms formed by igneous activity. [10]  
What is weathering ? Discuss the significance of weathering in landform development. [10]  
OR
- What is mass movement ? Describe the causes of mass movement and its role in the landform development.

3. (a) Describe the characteristic features of the Kast topography. [5]
- (b) Briefly describe the landforms developed in organic coasts. [5]
4. (a) Explain the landform developed by fault. [5]
- (b) What is a sand dune? Describe its formation mechanism. [5]
5. Write short notes of any FOUR : [2.5×4=10]

  - a. Kast topography
  - b. River delta
  - c. Aggradation
  - d. Questa
  - e. Erosional coasts

## Tribhuvan University, 2072

Bachelor Level (4 Yrs./Science & Tech./III Year

Full Marks : 100

Geology of economic mineral deposits, stratigraphy and Geology of Nepal,  
Geochemistry and Geophysics [Geo. 301]

Time : 3 hrs.

Attempt All questions

### Group A

1. What are economic mineral deposits? Discuss how the economic type of lead and zinc deposits are formed.

OR

Give classification of metallic non-metallic deposits. Give an account of chemical composition, important physical properties, mode of occurrence and utilization of limestone. [10]

2. (a) Describe the formation of mineral deposits by sublimation and evaporation. [5]
- (b) What do you understand by economic mineral deposit? Define grade, tenor and tonnage of ores. [5]
3. Write short notes on (any TWO) [2.5×2=5]

  - (a) Rare Earth Elements
  - (b) Magnesite occurrence in Nepal
  - (c) Ore reserves

### Group 'B'

4. What is Lithostratigraphy? Discuss the principles of Lithostratigraphic classification and correlation.

OR

What is an index fossil? Describe one index fossils of each system of the Paleozoic Era. [10]

5. Describe the stratigraphy of Sub-Himalaya in Nepal.



Describe in brief the metallic mineral resources of Nepal.

6. (a) What is a columnar section? Describe its utility in stratigraphy? [5]
- (b) Describe the principles of magnetostratigraphic classification. [5]
7. (a) Describe the geology of Kathmandu basin. [5]
- (b) Describe the current status of mineral resources development in Nepal. [5]
8. Write short notes on any Four. [2.5×4=10]
  - (a) Homonyms in stratigraphy
  - (b) Middle Siwaliks
  - (c) Informal stratigraphic units.
  - (d) International stratigraphic code
  - (f) Granites of Nepal.

**Group 'C'**

9. What is the objective of geochemical survey? Discuss principles adopted in such investigations.

OR

[10]

Describe the principles, applications and limitations of gravity method.

10. (a) Shortly describe the geochemical classification of elements. [5]
- (b) Describe the applications and limitations of seismic survey method. [5]
11. Write short notes on any two: [2.5×2=5]
  - (a) Geochemical cycle
  - (b) Pathfinder elements
  - (c) Bouguer Anomaly

**Tribhuvan University, 2072**

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

Full Marks : 50

Analytical Biochemistry (CHEM 305)

Time : 1½ hrs.

Comprehensive Questions

[2×9=18]

Attempt and TWO Questions.

1. What is meant by Regression analysis? What is its importance in chemical analysis?
2. Discuss the working principle of Visible Spectrophotometry. Also discuss the instrumentation involved and major application.
3. What is chromatography? Classify the different chromatographic technique based on adsorption and partition process.



Attempt any Eight questions.

- What is meant by proportional error? Explain.
- How is sample of water taken to test for the extent of contamination in the river?
- What is meant by aliquots? Point out its application in volumetric analysis.
- What criteria would you employ to choose an organic reagent to be used for gravimetric analysis.
- Give an example of precipitation titration. Point out the functions of indicator used in such titration.
- State Nernst distribution law. Point out that the distribution coefficient value is an important parameter of successful solvent extraction technique.
- Show your acquaintance with Affinity Chromatography?
- Explain the term diffusion-current? What types of analytical technique is based on diffusion current?
- What is meant by matrix effect?
- How is pH measurements carried out?
- Suggest a method for the determination of Ca content in a sample of cement.
- Suggest a method for determining the mercury content in a sample of fish.

## Tribhuvan University, 2072

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

Full Marks : 50

Basic Biochemistry (CHEM 303)

Time : 1½ hrs.

Comprehensive Questions

[2×9=18]

Attempt any Two Question.

- Describe briefly the metabolism of glucose 6-phosphate. [9]
- How is the rate of an enzyme-catalyzed reaction influenced by substrate concentration, temperature, and pH? [3+3+3]
- Describe protein biosynthesis (transcription and translation) [9]

Short Answer Questions

[8×4=32]

Attempt any Eight questions.

- Write the name of biological buffer systems and their role. Derive Henderson-Hasselbalch equation.
- Discuss the importance of biochemistry.
- Show your acquaintance with cyclooxygenase pathway.
- What are inhibitors? Explain about competitive inhibition with one suitable example.



8. What are the standard amino acids ? Outline the biosynthesis of methoionine.
9. What is gluconeogenesis ? Highlights its importance in brief.
10. Describe in brief the component of electron transport chain.
11. Describe in brief the metabolism of fat with particular reference to  $\beta$ -oxidation.
12. Give an account of essential fatty acids.
13. Explain in brief the DNA sequencing by Sanger method.
14. RNA is readily hydrolyzed by alkali, whereas DNA is not why ?
15. Explain briefly about the different secondary structure of proteins.

## Tribhuvan University, 2072

Bachelor Level (4 Yrs.)/Science & Tech./III Year  
Chemistry (CHEM 301)

Full Marks : 100  
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 silicates ? Draw the structure of any four types of silicates and point out the nature of bonding and one example of each type.

OR [1+8]

- (a) What is meant by group electronegativity ? What are different approaches to estimate it ? [5]
- (b) What is electronegativity equalization ? Explain the method of estimating charge. [4]

2. Short answer questions. [6×4=24]

- 2.1 Do you agree with the statement 'The type of hydride which an element forms depends on the electronegativity of an element ? Give examples of different types of hydrides.
- 2.2 What are four electron three centre bonds ? Illustrate with example of  $\text{XeF}_2$ .
- 2.3 How is Borazine prepared / Why is it called inorganic benzene ?
- 2.4 Orthoboric acid is a weak acid but in presence of glycerol or ethylene glycol, it acts as strong acid. Explain.
- 2.5 What are Pseudohalides ? In what respect CN resembles with Cl ion. Illustrate.
- 2.6 What is nitrogenase ? Discuss its importance in nitrogen fixation.

- 2.7 What are synthetic fertilizers? How phosphate fertilizers are made? In what forms N, P and K are used in plant fertilizers.
- 2.8 What is meant by anthropogenic emissions? Point out the effect of these emission in the quality of air.
- 2.9 What is meant by soil pollution? What are the main sources of soil pollution?

#### Group 'B' (Organic)

3. Comprehensive Question

Discuss in brief the principle of mass spectrometry. Show your familiarity with the chemical shift, equivalent and non-equivalent proton, and spin spin coupling and also write their significance in the structure elucidation. [3+6]

OR

Show your familiarity with the

- (a) Thermodynamic and kinetic requirement of a reaction
- (b) Microscopic reversibility
- (c) Baldwin's rules of ring closure [3.5+2+3.5]

4. Short Answer questions. [6×4=24]

- 4.1 What is the scope of isotope labelling in the determination of reaction mechanism? Explain with suitable example.
- 4.2 Show your acquaintance with free radical substitution and free radical addition reactions.
- 4.3 What are carbenes? Differentiate between singlet and triplet carbenes giving suitable reaction.
- 4.4 How do you distinguish alcohol, amine, ether and carbonyl functional group from IR spectrum?
- 4.5 What do you mean by coupling constant and give its importance in structure elucidation of organic compounds.
- 4.6 How do you prove the existence of benzyne intermediate?
- 4.7 In what position, the electrophilic substitution reaction in pyridine takes place and why?
- 4.8 How do you obtain furan from pentosan? Give appropriate reaction.
- 4.9 Define aromaticity and antiaromaticity. Discuss with giving suitable examples.

#### Group 'C' (Physical)

5. Comprehensive Question

Discuss the interionic attraction theory of conductance on the basis of relaxation and asymmetric effects qualitatively.



Calculate the ionic strength and the mean activity coefficient of aqueous solutions of 1m mole/kg  $\text{CaCl}_2$  and  $\text{KCl}$  at  $25^\circ\text{C}$  using Debye-Huckel limiting law.

Given : Debye-Huckel constant  $A = 0.509$  at  $25^\circ\text{C}$  [5+5]

OR

Define the terms absorption, adsorption and sorption. Discuss the Langmuir adsorption isotherm with its postulate, derivation, interpretation and limitations. [3+7]

6. Short answer questions. [6×4=24]

- 6.1 Define activity and activity coefficient. Calculate the ionic strength of 0.001 mole/kg  $\text{NaCl}$  Solution.
- 6.2 The EMF of a standard cadmium cell is 1.02 V at  $25^\circ\text{C}$  and the temperature coefficient of the cell is  $-5.0 \times 10^{-5} \text{V/K}$ . Calculate  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  for the cell reaction.
- 6.3 What do you mean by chemical and concentration cells? Derive an expression for EMF of a chemical cell without transference.
- 6.4 Discuss the application of EMF measurement for the determination of solubility products of a salt.
- 6.5 state the Gibbs phase rule. Explain the terms phase, component and degree of freedom with an example of each.
- 6.6 Draw well labelled phase diagram of  $\text{Mg-Zn}$  system and explain it briefly.
- 6.7 State and derive the Nernst distribution law. Point out preconditions for its validity.
- 6.8 Write a short note on energy levels of rigid rotor.
- 6.9 State and explain the selection rule for rotation transitions.  
Explain why  $\text{CH}_4$ ,  $\text{SF}_6$ ,  $\text{CO}_2$ ,  $\text{H}_2$  do not have rotational spectra while  $\text{NH}_3$  and  $\text{HCl}$  do have rotational spectra.

## Tribhuvan University, 2072

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

Full Marks : 100.

Math Physics and Classical Mechanics (Phy. 301)

Time : 3 hrs.

Attempt ALL Question.

1. Find the solution of the differential equation

$$(1-x^2) \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + \ell(\ell+1)y = 0 \text{ by series solution method.}$$

Discuss its orthogonality.

OR

[10]

Explain gradient, divergence, curl and Laplacian of a vector in curvilinear coordinates.

2. Obtain Lagrange equation of motion from D'Alembert principle. Discuss the conservation of energy in the context of Lagrangian formulation.

OR

[8]

What are the basic difference between Galilean and Lorentz transformations. Use Lorentz transformations to find expressions for time dilation and length contraction. Give examples to explain time dilation and length contraction.

3. Consider an infinite heat conducting slab of thickness  $D$  with one surface ( $x=D$ ) is insulated. If initially, the temperature is zero and then heat supplied (e.g. by radiation) at a constant rate,  $Q$  calorie per second per  $\text{cm}^2$  at the surface  $x=0$ . Find the temperature as a function of position and time within the slab. [10]
4. Describe the theory and hence the motion of a symmetrical top. [8]
5. Describe Schmidt orthogonalization process with an example. [10]
6. Describe brachistochrone problem. [8]
7. Answer all questions [2×3=6]

- (a) Explain generalized force and generalized potential.

OR

Give an account of rotating coordinate system.

- (b) For a given  $2\pi$  periodic function, find Fourier series of the function  $f(x) = 3, -\pi < x \leq \pi$ .

OR

Find the angle between the surface  $x^2 + y^2 + z^2 = 9$  and  $z = x^2 + y^2 - 3$  at point  $(2, -1, 2)$

8. Answer all questions [5×3=15]
- a. Show that the vectors  $(1, 0, 1)$ ,  $(0, 1, 1)$  and  $(1, 1, 1)$  are linearly independent.
- b. Find Laplace transform of dirac-delta function  $\delta(x-a)$ .
- c. Find the eigen value of matrix  $\begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$ .
- d. Explain convolution theorem.
- e. What are the differences between Rheonomous and Scleronomous constraint?
9. A pendulum of mass  $m$  and length  $l$  with angular displacement  $\theta$  from the vertical is oscillating. Use Lagrange equation of motion and find the expression for angular acceleration. [5]



10. A space ship is observed to be 45 meters long while at rest on the Earth. As it passes the Earth, it appears to be 8 meters long. How fast is the ship travelling?
11. Find the square of the length of the vector  $u_i$ ? [5]
12. Obtain the relation of  $J_{1/2}(x)$ . What is its physical significance? [5]
13. Use this relation to prove.

$$\int_{-\infty}^{\infty} \varphi^{\circ}(P_x) \varphi(P_x) dP_x = 1 \text{ if } \int_{-\infty}^{\infty} \varphi^{\circ}(x) \varphi(x) dx = 1.$$

## Tribhuvan University, 2072

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

Full Marks : 50

Space Science - Elective (Phy. 305)

Time : 1 1/2 hrs.

Attempt ALL Question.

1. Describe the methods through which stellar atmosphere can be studied. Given an account of Classification of stellar spectra.

OR

[10]

Explain the properties of the electromagnetic radiation that are used to describe the remote sensing technique.

2. Describe primordial nucleosynthesis. [10]
3. Describe the components Geographical Information system (GIS). [6]

OR

Show that  $A = (2.5 \log e) \alpha r$ , where  $A$ ,  $\alpha$  and  $r$  represent interstellar extinction, opacity of the medium and distance to the star.

4. Attempt any two questions. [2×3=6]
  - a. Explain rocket launch technology?
  - b. Write a brief account on Comets.
  - c. What are the fundamental properties of Hydrosphere of the Earth?
5. Describe hydrological cycle in the Earth system. [6]
6. The Andromeda galaxy is approaching the Milky Way at 266 km/s. The galaxies are approximately 1 million parsec apart. How long it will be until they collide? (Hubble constant = 73 km/s/MP<sup>o</sup>) [6]
7. If the apparent magnitude of the components of binary stars are 1 and 2. Find the total magnitude of the binary star. [6]

## Tribhuvan University, 2072

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

Full Marks : 50

Applied Mathematics - Elective (Phy. 304)

Time : 1½ hrs.

Attempt ALL Question.

1. Describe the motion of damped harmonic oscillator. Explain the term critical damping. [10]

OR

Formulate double and multiple Fourier series. Discuss its applications.

2. Describe steady state theory for the impedance in an electric circuit. Derive complex impedance of the filter circuit. [10]
3. How products of inertia can be described? What are its uses? [6]

OR

Describe non-linear problem in electric circuit theory.

4. Attempt any two questions [2×3=6]
- a. What are the uses of Laplace transformation?
- b. What do you mean by electrical networks?
- c. Give an example of differential equations used in particle dynamics and discuss it.
5. Set up the equations for the uniform transmission line. [6]
6. Describe the motion of a particle whose mass varies. [6]
7. A bar of length  $\ell$  with its end  $x = \ell$  fixed is at rest and unstrained. At  $t = 0$  the end  $x = 0$  a small disturbance  $a$ , is given. Use Laplace transform to find its motion. [6]

## Tribhuvan University, 2072

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

Full Marks : 100

Plant Biochemistry and Plant Biotechnology (Bot 301)

Time : 3 hrs.

### Section 'A' (Plant Bio-Chemistry)

Long answers questions (any two)

[2×10=20]

1. What are carbohydrates? Give a generalized classification of carbohydrates with suitable examples? What are the biological roles of different types of carbohydrates?
2. Describe amino acids with their important properties.
3. Give a general account of DNA replication in eukaryotes.

Short answers questions : (any four)

[4×5=20]

4. What are buffers? Explain their role in living cells?



5. What are lipids and how are they classified ? What is their role in living cells ?
6. How do enzymes catalyze different chemical reactions taking place in living cells ?
7. Draw the structure of chlorophyll 'a'. (No description is needed)
8. Which vitamins are water soluble ? Give biological role of any three water soluble vitamins.
9. What is bioinformatics ? Why is it important to biologists ?

Write short answer : (any four)

[4×2.5=10]

10. How is biochemistry related to plant physiology and genetics ?
11. Differentiate between a peptide bond and a glycosidic bond.
12. Describe different types of pyrimidine bases found in nucleic acids.
13. What is the biological role of carotenoids ?
14. Write a short note on pH scale ?
15. Give a concise note of FASTA.

#### Section 'B' (Plant Bio-technology)

Long answer questions (any two)

[2×10=20]

16. What is biotechnology ? Give an account of scope and importance of biotechnology.
17. With illustrative diagrams describe *in vitro* micropropagation techniques from nodal culture.
18. What is biological nitrogen fixation ? Describe nitrogen fixation by symbiotic organisms.

Short answers questions : (any four)

[4×5=20]

19. What do you mean by protoplasts ? How are they isolated and cultured ? What is the significance of protoplast culture ?
20. How are haploid plants generated ? Explain their significance.
21. How are embryos produced from somatic cells ?
22. Describe in brief the different methods for the direct gene transfer in plants.
23. How can we maintain aseptic environment in biotechnology laboratory ?
24. Describe the role of cyanobacteria as biofertilizer.

Write short answer : (any four)

[4×2.5=10]

25. Name any one reporter gene you know and describe in brief how this gene can be used for the selection of transformants in genetic engineering.
26. What are the applications of protoplast fusion ?
27. What are the potential risks of modern biotechnology ?
28. Explain in brief the role of auxins and cytokinins in plant tissue culture.
29. Describe the role of cryoprotectors in cryopreservation.

30. What are the practical applications of embryo culture ?

## Tribhuvan University, 2072

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

Full Marks : 50

Evolution and biogeography (Bot 303)

Time : 1½ hrs.

Give an explanatory answers to the following questions (any two) [2×10=20]

1. What do you mean by speciation ? Discuss the different types of speciation in nature.
2. What do you mean by Tectonic plates ? Discuss the types of plate boundaries with suitable examples.
3. What do you mean by 'Theory of Island Biogeography' ? Discuss its application in biodiversity conservation.

Short answer to the following questions (any four) [4×5=20]

4. Distinguish between convergent and divergent evolution with examples.
5. Point out the genetic factors bringing about variation in a population.
6. Discuss the forces of molecular evolution.
7. What are biodiversity hot spots ? Discuss in brief the concept and distribution of hotspot area around the world.
8. Describe geological time scale with its implications.
9. Write down the major gradient in biodiversity distribution with examples.

Write short answers to the following questions (any four) [4×2.5=10]

10. Give primary sources of genetic variation in a population.
11. What is genetic drift ? What causes genetic drift ?
12. Point out the characteristic features of Cape Kingdom.
13. What is biome ? How does it differ from biogeographic realm ?
14. Distinguish between continental drift and plate tectonics ?
15. Point out the major changes on the rise of flowering plants in Cenozoic era.

## Tribhuvan University, 2072

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

Full Marks : 50

Medicinal and Aromatic Plants (MAPs) (Bot 304)

Time : 1½ hrs.

(Elective)

Give explanatory answers to the following questions (any two) [2×10=20]

1. Describe the cultivation and harvesting technologies, and major trade issues of *Asparagus racemosus*.
2. What is the national status of *Paris Polyphylla* ? What are the major issues and challenges in the sustainability of use of this herb ?



3. Discuss the major in-situ and ex-situ strategies needed for the conservation of medicinal and aromatic plants in the context of Nepal.

Give Short answer to the following questions (any four) [4×5=20]

4. Discuss with examples the importance of traditional knowledge in modern drug development.
5. Discuss the factors affecting the distribution of MAPs in Nepal.
6. Explain the major policies and programs for the promotion of MAPs in Nepal.
7. What are the multidisciplinary scope of pharamcognosy ?
8. What is the conservation status of *Nardostachys grandiflora* ? Also describe its chemical constituents and uses.
9. Describe the distribution pattern, and climatic and soil requirements of *Swertia chirayita*.

Write short answers to the following questions (any four) [4×2.5=10]

10. What is bioprospecting ? Explain its importance.
11. Describe, in brief, the role of *Daphne bholua* in the promotion of peoples' livelihood.
12. What are herbal cosmetics ? Explain with suitable examples.
13. Why is *Ophiocordyceps sinensis* called as 'gold rush medicinal fungus of the Himalaya' ?
14. What is the usable part of *Neopicrorhiza scrophuriiflora* ? How is it processed ?
15. Give two suitable scientific name of medicinal plants with brief discription used for anthelmintic.

## Tribhuvan University, 2072

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

Full Marks : 100

Zoology (Physiology, Genetics and Molecular biology) (Zool. 301) Time : 3 hrs.

Illustrate your answers with suitable diagrams wherever necessary.

### Group 'A'

Attempt any two questions

[2×10=20]

1. What are respiratory pigments ? Describe the mechanism and regulation of respiration in animals.
2. What do you mean by myogenic heart ? Describe the working mechanism of myogenic heart.
3. Which endocrine gland is called master gland ? Describe pituitary gland with its hormones and their functions.



Group 'B'

[2×10=20]

Attempt any two questions.

4. What are giant chromosomes ? Describe the structure and significance of lampbrush chromosome with labelled diagram.
5. What do you mean by multiple allelism ? Describe the inheritance of ABO system and Rhesus Factor of blood groups into the generation.
6. What are nucleic acids ? Describe the structure and composition of Deoxyribonucleic acid.

Group 'C'

[8×5=40]

Attempt any eight questions.

7. Give general properties and mechanism of enzymatic action.
8. Discuss the transport of Carbon dioxide.
9. Write consequences of incompatibel Rhesus factor during pregnancy.
10. Write down the role of kidney in maintaining electrolyte balance.
11. What are emergency hormones ? Give its importance in daily activities.
12. Write short note on Golgi complex.
13. Illustrate the dominant non allelic gene interaction with example.
14. Discuss the unidirectional and bidirectional DNA replication.
15. Write short note on RNA polymerase in prokaryotes.
16. Give brief account of gene expression.

Group 'D'

17. Give very short answers of the following (any eight)

- i. Regulation of Gastric secretion
- ii. Bohr's effect
- iii. Cardiac output
- iv. Function of Thyroxine hormone
- v. Oogenesis
- vi. Nuclear envelop
- vii. Y-linked inheritance
- viii. Cell cycle
- ix. Wobble hypothesis
- x. ELISA test



## Tribhuvan University, 2072

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

Full Marks : 50

Zoology (Natural Resource Management)

Time : 1½ hrs.

Elective (Zool. 303)

Illustrate your answers with suitable diagrams wherever necessary.

### Group 'A'

[2×10=20]

Attempt any two questions.

1. Discuss in brief concept and evolution of sustainable development.
2. Describe types and characteristics of forests of Nepal.
3. Mention water resource management with reference to Nepal.

### Group 'B'

[4×6=24]

Attempt all questions.

4. Write causes of land degradation.
5. Describe types and significance of biological resource.
6. Discuss impacts of water resource depletion.

OR

What are the consequences of mineral extraction ? Discuss briefly.

7. Discuss non-renewable energy resources.

### Group 'C'

[3×2=6]

8. Give very short answer of any three.
  - a. Impacts of climate change
  - b. Importance of natural resources.
  - c. Ground water
  - d. Land use types
  - e. Natural resources in mountain.

## Tribhuvan University, 2072

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

Full Marks : 50

Zoology (Bioinformatics)

Time : 1½ hrs.

Elective (Zool. 304)

Illustrate your answers with suitable diagrams wherever necessary.

### Group 'A'

[2×10=20]

Attempt any two questions.

1. What is bioinformatics ? Write a note on history, challenges and opportunities of bioinformatics.
2. Describe NCBI, DDBJ and EMBL net in brief and international database collaboration among NCBI, DDBJ, and EMBL net.

3. Explain the process of chemical and enzymatic methods of DNA sequencing.

**Group 'B'**

**[4×6=24]**

Attempt all questions.

4. Explain the primary database of bioinformatics.  
5. Describe FASTA format and its importance in biological databases.  
6. What do you mean by cladistic methods of phylogenetic tree construction ?

OR

What do you mean by the Smith Waterman algorithm ?

7. Discuss pair wise alignment techniques.

**Group 'C'**

**[3×2=6]**

8. Give very short answers of any three.

- a. Proteins, and proteomes  
b. Difference between homology and analogy  
c. Internet  
d. Expressed Sequence Tags (EST)  
e. Intranet and internet packages.

## **Tribhuvan University, 2072**

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

Full Marks : 80

Research Methodology (Compulsory)

Time : 3 hrs.

Attempt any eight questions.

1. What do you mean by research questions ? How it is related to research theme ? Discuss the methods of identifying and formulating meaningful research questions.
2. Define survey method of research. Describe its basic assumptions and purposes. Also explain how it is different than the other research methods.
3. What are the methods of data collection for the purpose of research ? Discuss the ways data collection activity by schedule ? Also, describe different types of schedule.
4. Explain about the ethical issues of a research ? What are major concerns of ethics ? Discuss why a researcher concerned with the ethical norms should.
5. Define and differentiate between simple random sampling and multistage sampling. If a simple random sample from a population of 5000 items is to be drawn to estimate the percent defective within 4% of the true value with 95% confidence interval, what should be the size of sample ?
6. In two factories A and B, the following information about wages were obtained. Discuss with factory pays larger bill for the wage and which one



has more consistent wage rate? Can you regard the difference between the wages are statistically significant at 5% level of significance?

	Factory A	Factory B
No. of workers	120	100
Average wage	Rs. 200	Rs. 220
Standard deviation	25	30

7. Define reliability and validity. Discuss the theory of reliability. The reliability coefficient of a test is found to be 0.75; the mean score as 60 and the standard deviation is as 5. Mr. X obtains a score of 50 on a test, what is the true score. Compute, 95% confidence interval for true mean score.
8. Define the percentile ranks. How can you obtain the percentile scaled scores? The following table shows the raw scores obtained by 120 items; find scaled percentile ranks of the scores?

Raw scores	16	18	22	24	26	28	30
No of items	12	14	20	26	18	16	14

9. Define literature review and discuss its need in research. Describe the components of literature review and the method of selecting relevant literature.
10. Define and discuss about different kinds of research report. How an academic research report is different than the other reports? Describe the qualities of a good research report and explain the precautions that should be taken in report preparation.

## Tribhuvan University, 2072

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

Full Marks : 50

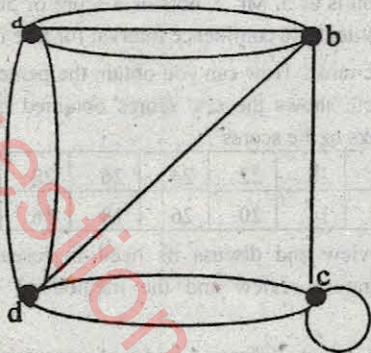
Discrete Mathematics (Math 304) (Elective)

Time : 1½ hrs.

Attempt All the questions.

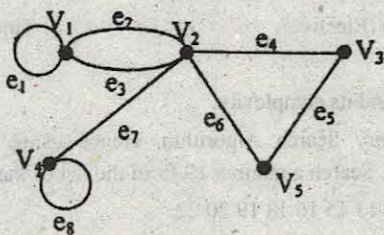
1. (a) Define algorithm and its complexity. [3]  
 (b) Describe the Binary Search Algorithm. Hence using the Binary Search Algorithm. Search a number 19 from the list of the numbers.  
 1 2 3 5 6 7 8 10 12 13 15 16 18 19 20 22. [3+4]
2. Consider the following relations on {1, 2, 3, 4} :
- $R_1 = \{(1, 1), (1, 2), (2, 1), (2, 2), (3, 4), (4, 1), (4, 4)\}$   
 $R_2 = \{(1, 1), (1, 2), (2, 1)\}$ ,  
 $R_3 = \{(1, 1), (1, 2), (1, 4), (2, 1), (2, 2), (3, 3), (4, 1), (4, 4)\}$ ,  
 $R_4 = \{(2, 1), (3, 1), (3, 2), (4, 1), (4, 2), (4, 3)\}$ ,  
 $R_5 = \{(1, 1), (1, 2), (1, 3), (1, 4), (2, 2), (2, 3), (2, 4), (3, 3), (3, 4), (4, 4)\}$ ,  
 $R_6 = \{(3, 4)\}$

- (a) What is a transitive relation? Extract the transitive relation from the given example justifying your extraction. [2+3]
- (b) Prove that the relation  $\mathcal{R}$  on a set  $A$  is transitive if and only if  $\mathcal{R}^n \subseteq \mathcal{R}$  for  $n = 1, 2, 3, \dots$  [5]
3. (a) Define a graph. When is a graph called an undirected graph? Give an example. Show that an undirected graph has an even number of vertices of odd degree.
- (b) Define adjacency matrix. Represent the given graph with the adjacency matrix.



Or

- (a) Show that a simple graph is bipartite if and only if it is possible to assign one of two different colours to each vertex of the graph so that no two adjacent vertices are assigned the same colour.
- (b) Define incidence matrix. Represent the given graph with the incidence matrix. [1+4]



4. Define a tree. Give an example of a tree and an example that is not a tree justifying each of both. Prove that an undirected graph is a tree if and only if there is a unique simple path between any two of its vertices. [1+3+6]
5. Describe the Labelling Algorithm to find the maximum flow in a network and illustrate it with an example. [5+5]



## Tribhuvan University, 2072

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

Full Marks : 35

Numerical Methods (Math 303) (Elective)

Time : 1½ hrs.

Attempt All the questions.

1. Find the accuracy and precision of the numbers 750.5 and 0.00002932. [3]
2. Solve the following system using Gauss elimination with partial pivoting  
 $2x + 2y + z = 6$ ;  $4x + 2y + 3z = 4$ ;  $x + y + z = 0$ .

OR

[7]

Solve the following system using Gauss-Seidel Iterative method.

$$2x - 7y - 10z = -17; 5x + 7 + 3z = 14; x + 10y + 9z = 7$$

3. Find a Lagrange interpolation polynomial  $P(x)$  from the following data  
x: -2 -1 1 2  
y: -6 0 0 6

And hence find  $P(0)$ .

[7]

4. Define a root of an equation  $f(x) = 0$ . Find the real root of the equation  $x^2 - 3x + 1 = 0$  by Newton Raphson method correct up to three decimal places.

[1+5]

5. Derive the formula of Simpson's  $\frac{1}{3}$  rule to evaluate definite integral

$$\int_a^b f(x) dx.$$

Evaluate:  $\int_0^1 \frac{\tan^{-1}x}{x} dx$  using Trapezoidal rule.

[3+3]

6. Given  $y' = x + \sin y$ ,  $y(0) = 1$ . Compute  $y(0.2)$  using modified Euler method.

[6]

## Tribhuvan University, 2072

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

Full Marks : 50

Mountain Meteorology [MET 302] [Elective]

Time : 1½ hrs.

Attempt any two questions from Group I, FOUR from Group II and FOUR from Group III.

Group I

[2×10=20]

1. Describe the three factors that affect terrain-forced flows. What kind of two waves generate at the condition of flow over mountains?
2. Describe atmospheric pressure and wind system over mountainous area.
3. Are mountains affecting the climate in our country? Describe.

**Group II****[4×5=20]**

4. How altitude affects the climate ?
5. How continentality affects the climate ?
6. Illustrate the life cycle of thunderstorm.
7. Describe briefly characteristics of diurnal mountain winds over plateaus.
8. Describe diurnal wind system in a mountainous basin.

**Group III****[4×2.5=10]**

9. What are Sun dogs and haloes ?
10. What is a Buys-Ballot law ?
11. What do you understand by standing waves ?
12. Write briefly about down slope winds.
13. Write a short note on jet streams.

**Tribhuvan University, 2072**

Bachelor Level (4 Yrs.)/Science &amp; Tech./III Year

Full Marks : 100

Synoptic Meteorology and Fluid Dynamics (MET 301)

Time : 3 hrs.

**Section 'A' - Synoptic Meteorology**

Attempt TWO questions from Group I and Four from Group II and Four from Group III

**Group I****[2×10=20]**

1. What do you understand by synoptic meteorology ? Describe any two methods for forecasting tropical storm.
2. What is an air mass ? Describe characteristics of air mass source regions and classify air masses according to their source region.
3. Write an essay on general circulation of the atmosphere.

**Group II****(4×5=20)**

4. Discuss the generation of monsoon associated with the depression in the Bay of Bengal.
5. State the different types of air masses and their source region.
6. Explain cold front and warm front occlusion.
7. What is zonal index ? Compare and contrast the global weather characteristics associated with high and low zonal indices.
8. Explain with diagram the life cycle of extra tropical cyclone.

**Group III****(4×2.5=10)**

9. Write an introduction on synoptic meteorology.
10. What is Intertropical convergence zone (ITCZ) ? Write briefly on the weather associated with it.



11. Write briefly about trade winds.
12. Write briefly about sea surface temperature distribution.
13. Write short notes on any two :
  - a. Sea breeze
  - b. Monsoon rainfall
  - c. Motion of tropical storm.

### Section 'B' - Fluid Dynamics

Attempt TWO questions from Group IV and Four from Group V and Four from Group VI

#### Group IV

(2×10=20)

14. Derive equation of continuity for unsteady compressible three dimensional flows. Also discuss the conditions for steady compressible and incompressible flow.
15. State Bernoulli's theorem and derive a differential equation of motion for steady flow of an ideal fluid along a stream line.
16. Derive the relation for pressure at a point in compressible fluid for adiabatic process.

#### Group V

(4×5=20)

17. Discuss on assumptions underlying Bernoulli's Equation.
18. Enlist various types of fluid flow and discuss any one type in detail.
19. Derive a relation for centre of pressure for vertically inclined immersed surface.
20. A plate 0.05 mm distant from a fixed plate moves at 1.2 m/s and requires a force of 2.2 N/m<sup>2</sup> to maintain this speed. Find the viscosity of the fluid between the plates.
21. Discuss and derive linear momentum equation and impulse momentum theorem.

#### Group VI

(4×2.5=10)

Write short notes on :

22. Types of fluid
23. Eulerian method for describing fluid motion
24. Capillarity of a liquid
25. Circulation and Vorticity
26. Stream function.



## Tribhuvan University, 2072

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

Full Marks : 50

Bioinformatics (MB 303) (Elective)

Time : 1½ hrs.

Attempt any TWO questions from Group I and Four from Group II and Four from Group III

### Group I

[2×10=20]

1. Write in brief on the dawn of sequencing. Write some of the important achievements of Human Genome Project.
2. Write the important features of DNA sequence analysis. What types of issues are generally raised in the interpretation of EST searches ?
3. Compute the best alignment for the following two sequences by dynamic programming. (match score =1, mismatch score = 0 and gap penalty = -1)  
ACACT  
ACT

### Group II

[4×5=20]

4. What do you mean by EMB net ? Explain.
5. What do you mean by composite protein sequence databases ? Explain any two.
6. What is multiple sequence alignment ? Write the significance of multiple sequence alignment.
7. Write different methods of construction of phylogenetic trees.
8. How can you build a sequence search protocol ?
9. Differentiate between Orthologs and Paralogs.

### Group III

[4×2.5=10]

10. Very short answers questions.
  - a. Write short notes on genomics and proteomics.
  - b. What is a PROSITE ?
  - c. Write short notes on web browsers ?
  - d. What is SCOP ?
  - e. Write briefly on Ethics in Bioinformatics.

## Tribhuvan University, 2072

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

Full Marks : 50

Pharmaceutical Microbiology and Quality Management

Time : 1½ hrs.

[MB 302] [Elective]

Attempt any TWO questions from Group I and Four from Group II and Four from Group III

### Group I

[2×10=20]

1. Define antibiotic. Describe the mode of action of cell wall synthesis inhibitors. [8+2]



2. Define spoilage. Describe the types of spoilage of pharmaceutical products. [2+8]
3. Describe the safety and quality auditing process of the food and pharmaceutical products. [10]

**Group II**

[4×5=20]

4. Mention the characteristic features of antibiotic.
5. Describe the mode of action of tetracycline antibiotic.
6. Explain chemical indicators of sterilization.
7. Describe different methods of risk management.
8. Describe quality auditing of food.
9. Describe quality management systems ISO 22000.

**Group III**

[4×2.5=10]

10. Very short answers questions
- a. Mention biological indicators of sterilization.
- b. Enlist antiviral drug.
- c. Define sterility testing.
- d. Name four preservatives used in pharmaceutical products.
- e. Mention the sources of antibiotic
- f. Define GLP.

**Tribhuvan University, 2072**

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

Full Marks : 100

Agricultural and Food Microbiology [MB 301]

Time : 3 hrs.

**Group 'A'**

Long Answer Questions.

Attempt FOUR questions

[4×10=40]

1. Describe the role of microorganisms in a cycle turnover of carbon in the biosphere. [10]
2. Define microbial interaction. Describe mutualism and synergism with examples. [4+6]
3. Describe microbial spoilage of cheese. [10]
4. Define food intoxication. Explain Clostridial food poisoning in brief. [2+8]
5. List various types of food preservatives. Describe the principles of food preservation using heat. [2+8]
6. Define phylospheric microorganisms. Discuss the role of phyloplane microorganisms in plants. [3+7]

### Group 'B'

Short answer questions.

Attempt and Eight questions.

[8×5=40]

7. Write a short note on ammonification.
8. Mention composition of biogas.
9. Give an account on preservation of juices by irradiation.
10. Differentiate between actinomycetes and fungi.
11. Explain briefly on recycling of organic wastes.
12. Describe the mechanisms of microbial degradation of hemi-cellulose.
13. Write the importance of pasteurization of beer.
14. Lay down the quality standard of milk.
15. What is sulphur cycle ?
16. Briefly explain on microbiology of egg spoilage.

### Group 'C'

Attempt any eight questions.

[8×2.5=20]

17. Very short answers questions.
  - a. Define clay particles of soil.
  - b. Define biofertilizer.
  - c. Write short notes on significance of lactic acid bacteria in food.
  - d. Explain the spoilage of fermented products.
  - e. Illustrate well labelled diagram of Winogradsky's column.
  - f. Define intoxication.
  - g. Explain role of microorganisms in mechanism of metal deterioration.
  - h. Write short notes on primary sources of meat and meat product contamination.
  - i. Explain cold temperature as preservation of food.
  - j. Enlist the major minerals present in soil.

## Tribhuvan University, 2072

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

Full Marks : 100

Probability and Inference II [STA 301]

Time : 3 hrs.

### Group A

Attempt any four Questions.

[4×10=40]

1. Describe Negative Binomial Distribution. Derive its moment generating function. Show Poisson distribution as limiting case of Negative binomial distribution.



- Describe negative exponential distribution. State and prove its lack of memory property. Also, show that sum of iid exponential variates is a gamma variate.
- What is Strong Law of Large Numbers? Let  $\{X_n\}$  be a sequence of independent and identically distributed random variables  $X_1, X_2, \dots$ . Then a necessary and sufficient condition for the sequence  $\{X_n\}$  to satisfy strong law of large numbers is  $E(X_i)$  exists and  $E(x_i) = \mu$ .
- State and prove central limit theorem. Show that CLT is generalisation of Law of large numbers.
- Define Kruskal- Wallis H Test. An investigator wants to study the score of 3 matched groups under 5 conditions. each group contains five subjects, one being assigned to each of the five conditions. Let the scores obtained are given in the following table :

Group	Conditions				
	1	2	3	4	5
A	9	8	5	1	7
B	6	7	5	2	8
C	9	7	5	2	6

Carry out the Friedman two way ANOVA test.

- Describe Bayes risk and Bayes decision rule, Suppose  $x$  is a single observation drawn from Poisson distribution  $P(\lambda)$  and the prior distribution of  $\lambda$  is known to be Gamma distribution with parameter  $\alpha$  and  $\beta$  using the quadratic loss function, find the Bayes estimator of  $\lambda$ .

**Group 'B'**

Attempt any Eight Questions.

[8×5=40]

- A lot contains 15 items of which 4 are defectives. If items are drawn at random, one at a time, without replacement from the lot until 4 non defective items are obtained, find the probability of getting 2 defective items and find its mean and variance.
- Describe Cauchy distribution with its properties.
- Describe the Beta distribution and find its mean and variance.
- Explain Chebyshev's inequality.
- What is convergence in probability and convergence almost surely?
- Explain hyper geometric distribution.
- Describe Mann Whitney U test.
- Describe Kolmogorov Smirnov test of goodness of fit in the case of one sample test.
- Describe the Bayes estimates.



16. Suppose a fair coin is tossed 12 times and 7 heads are observed. Test hypotheses  $H_0 : \theta = \frac{1}{2}$  against  $H_1 : \theta = \frac{3}{4}$  where  $\theta$  is the probability of getting a head. Assuming that the prior probabilities of  $H_0$  and  $H_1$  are equal to  $\frac{1}{2}$ .
17. Let  $X \sim N(0, \sigma^2)$  where  $\sigma^2$  is unknown. Obtain the sequential probability ratio test of hypotheses  $H_0 : \sigma^2 = 4$  against  $H_1 : \sigma^2 = 9$  with  $\alpha = 0.05$  and  $\beta = 0.10$ .

**Group 'C'**

18. Attempt any TEN questions. [10×2=20]
- i. Write mean and variances of two alternative forms of negative binomial distribution.
  - ii. What are the difference between hyper geometric distribution and negative hyper geometric distribution ?
  - iii. Differentiate between logistic distribution and normal distribution.
  - iv. State density function of Weibull distribution with its one property.
  - v. State probability function of Binomial distribution truncated at  $X = 0$ . And give its mean and variance.
  - vi. What is convergence in distribution ?
  - vii. When is Wilcoxon Signed rank test used ?
  - viii. What are the most commonly used assumptions used in non-parametric test ?
  - ix. What is Bayes odds ?
  - x. What are the properties of SPRT ?
  - xi. What is operating characteristic Function of SPRT ?

**Tribhuvan University, 2072**

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

Full Marks : 75

Algebra II (Math 301)

Time : 3 hrs.

Attempt ALL the Questions.

**Group A**

[5×7=35]

1. Let  $V$  be a vector space over the field  $K$ . Let  $\{v_1, v_2, \dots, v_m\}$  be basis of  $V$  over  $K$ . Let  $\{w_1, w_2, \dots, w_n\}$  be elements of  $V$ . Assume that  $n > m$  then  $w_1, w_2, \dots, w_n$  are linearly dependent. [7]
2. State and prove Hamilton - Cayley Theorem. [1+6]

OR

Let  $f(t) \in K(t)$  be a polynomial and suppose  $f = f_1 f_2$  where  $f_1, f_2$  and polynomials of degree  $\geq 1$  and greatest common divisor equal to 1. Let  $A: V \rightarrow V$  be an operator. Assume that  $f(A) = 0$ .



Let  $W_1 = \text{kernal of } f_1(A)$  and  $W_2 = \text{kernal of } f_2(A)$ . Then  $V$  is the direct sum of  $W_1$  and  $W_2$ .

3. If  $N$  is a normal subgroup of  $G$  and if  $h$  is any subgroup of  $G$  then  $HUN = HN = NH$ . Furthermore if  $H$  is normal in  $G$  then  $HN$  is normal in  $G$ . [7]

4. Let  $G_1, G_2, \dots, G_n$  be the groups of  $(a_1, a_2, \dots, a_n)$  and  $(b_1, b_2, \dots, b_n)$  in  $\prod_{i=1}^n G_i$ , defines  $(a_1, a_2, \dots, a_n) (b_1, b_2, \dots, b_n)$  to be the element  $(a_1 b_1, a_2 b_2, \dots, a_n b_n)$ . Then  $\prod_{i=1}^n G_i$  is a group the direct product of the group  $G_i$  under this binary operation.

OR

[7]

The group  $Z_m \times Z_n$  is cyclic and is isomorphic to  $Z_{mn}$  if and only if  $m$  and  $n$  are relatively prime that is the gcd of  $m$  and  $n$  is 1.

5. Define algebraic element over the field  $F$  with example. Let  $E$  be the algebraic extension of a field  $F$ . Then there exists a finite number of elements  $\alpha_1, \alpha_2, \dots, \alpha_n$  in  $E$  such that  $E = F(\alpha_1, \alpha_2, \dots, \alpha_n)$  if and only if  $E$  is a finite dimensional vector space over  $F$ , that is if and only if  $E$  is a finite extension of  $F$ . [1+6]

Group 'B'

[10×4=40]

6. Let  $V$  be a finite dimensional vector space over the field  $K$  and is direct sum of subspaces  $U$  and  $W$  then,

$$\dim V = \dim U + \dim W.$$

[4]

7. If  $\beta = \{(3, 2, 1), (0, -2, 5), (1, 1, 2)\}$  and  $\beta = \{(1, 1, 0), (-1, 2, 4), (2, -1, 1)\}$ , then find  $M_{\beta}^{\beta}(i d)$ .

OR

[4]

Let  $A$  be an  $n \times n$  matrix and let  $A^1, A^2, \dots, A^n$  be its column. Then  $A$  is invertible if and only if  $A^1, A^2, \dots, A^n$  are linearly independent.

8. If  $v_1, v_2, \dots, v_n$  are mutually perpendicular unit vectors and  $C_i$  is the Fourier coefficient of  $v$  along  $v_i$ , then,

$$\sum_{i=1}^n c_i^2 \leq \|v\|^2$$

Verify this for  $v_1 = (1, 0)$   $v_2 = (0, 1)$  and  $v = (1, 3)$

[2+2]

9. Let  $V$  be finite dimensional vector space over the field  $K$  with a non-degenerate scalar product  $\langle \cdot, \cdot \rangle$ . Let  $A, B$  be operators of  $V$  then

(i)  $t_{(A+B)} = t_A + t_B$

(ii)  $t_{(AB)} = t_B t_A$

(iii)  $t_{t_A} = A$  [1+2+1]

OR

Let  $V$  be a finite dimensional vector space over the complex number with a positive definite hermitian form  $\langle \cdot, \cdot \rangle$ . If  $A$  is an operator such that  $\langle Av, v \rangle = 0$  for all  $v \in V$  then  $A = 0$ .

Is the matrix  $\begin{pmatrix} 2 & i \\ -i & 5 \end{pmatrix}$  hermitian? [3+1]

10. Let  $V$  be a vector space and let  $A : V \rightarrow V$  be a linear map, let  $v_1, v_2, \dots, v_n$  be eigenvectors of  $A$  with eigenvalues  $\lambda_1, \lambda_2, \dots, \lambda_n$  respectively. Then  $v_1, v_2, \dots, v_n$  are linearly independent assuming eigen values  $\lambda_i$  are distinct that is  $\lambda_i \neq \lambda_j$  for  $i \neq j$ . [4]

11. Let  $G$  be a cyclic group with  $n$  elements and generated by  $a$ . Let  $b \in G$  and  $b = a^s$  then  $b$  generates a cyclic subgroup  $H$  of  $G$  containing  $n/d$  elements where  $d$  is the greatest common divisor of  $n$  and  $s$ . [4]

OR

Let  $G$  be a cyclic group with generator  $a$ . If the order of  $G$  is infinite then  $G$  is isomorphic to  $(\mathbb{Z}, +)$ .

12. Let  $H$  be a subgroup of  $G$ . Let the relation  $\sim$  be defined by  $a \sim b$  if  $ab^{-1} \in H$ . Then  $\sim$  is an equivalence relation. [4]

13. Describe all ring homomorphism of  $\mathbb{Z}$  into  $\mathbb{Z}$ . [4]

14. Define an ideal of a ring  $R$  with example. If  $r$  is a ring with unity and  $N$  is an ideal of  $R$  containing a unit then  $N = R$ . [1+3]

OR

Let  $R$  be a commutative ring with unity and  $N \neq R$  be an ideal of  $R$ . then  $R/N$  is an integral domain if and only if  $N$  is a prime ideal in  $R$ . [4]

15. Define Euclidean ring with example. Prove that  $F[x]$  is P.I.D. [2+2]

## Tribhuvan University, 2072

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

Mathematical Analysis I (Math 302)

Attempt ALL the Questions.

Full Marks : 75

Time : 3 hrs.

### Group A

[5×7=35]

1. State Bolzano Weierstrass theorem and illustrate by an example that boundedness is not necessary in order to have an accumulation point for an infinite set. Use Bolzano Weierstrass theorem to prove Cantor intersection theorem. [2+5]

2. Define Riemann-Stieltjes sum of a bounded function. Let  $f \in \mathcal{R}(\alpha)$  on  $[a, b]$  and  $\alpha$  has a continuous derivation  $\alpha'$  on  $[a, b]$ . Prove that the Riemann integral  $\int_a^b f(x)\alpha'(x)dx$  exists and



$$\int_a^b f(x) d\alpha(x) = \int_a^b f(x) \alpha'(x) dx. [2+4+1]$$

Using this theorem, evaluate  $\int_0^2 x^2 d(x^2)$

OR

State Riemann's condition for integrability of  $f$  w.r.t  $\alpha$  on  $[a, b]$ . Assume that  $\alpha \nearrow$  on  $[a, b]$ . Let  $f \in \mathcal{R}(\alpha)$  on  $[a, b]$  and  $f, g \in \mathcal{R}(\alpha)$  on  $[a, b]$ , then prove that  $f/g \in \mathcal{R}(\alpha)$  on  $[a, b]$  and  $f \cdot g \in \mathcal{R}(\alpha)$  on  $[a, b]$  [2+5]

3. Define primitive of a function with an example. State and prove second fundamental Theorem of integral calculus. [2+5]

4. Define uniform convergence of a sequence of functions on a set and interpret it geometrically. Let  $f_n$  be continuous functions on  $[a, b]$  for all  $n$ . If  $f_n \rightarrow f$  uniformly on  $[a, b]$ , prove that

$$\lim_{n \rightarrow \infty} \int_a^b f_n(x) dx = \int_a^b \lim_{n \rightarrow \infty} f_n(x) dx = \int_a^b f(x) dx.$$

Also formulate analogous theorem for series of functions. [2+5]

5. Define an improper integral of first kind and interpret it geometrically. State and prove Cauchy Criterion for convergence. [2+5]

OR

When does the integral  $\int_a^\infty f(x) dx$  converge? Let  $0 \leq f$  be integrable over  $[a,$

$t]$  for all  $t \geq a$  and for  $p > 1$ ,  $\lim_{x \rightarrow \infty} x^p f(x) = L$  (finitely exists), then prove that the

integral  $\int_a^\infty f(x) dx$  converges. Use this theorem, show that the integral  $\int_a^\infty$

$e^{-x^2} dx$  converges.

[1+4+2]

Group 'B'

[10×4=40]

6. Define derived set of a set in  $\mathcal{R}^n$ . Prove that the derived set  $S'$  of a set  $S$  in  $\mathcal{R}^n$  is a closed set. [1+3]

OR

Define metric space. Let  $M$  be any non empty set. Define a function  $d: M \times M \rightarrow \mathcal{R}$  by  $d(x, y) = 0$ , if  $x = y$  and  $d(x, y) = 1$ , if  $x \neq y \forall x, y \in M$ .

Prove that  $d$  is a metric on  $M$ .

[1+3]

7. What do you mean by the complete metric space? Prove that every Cauchy sequence in a compact subset of a metric space is convergent. [1+3]

OR

Let  $S$  be a closed subset of  $\mathcal{R}^n$ , and let  $x \in \mathcal{R}^n$ . Then there exists a point  $y \in S$  such that  $d(x, y) = d(x, S)$ .

[4]

8. State the sequential criterion of limit of a function from one metric space to another. Let  $A = \mathbb{R} - \{0, -2\}$ , define  $f: A \rightarrow \mathbb{R}$  by

$$f(x) = \frac{x}{2x + x^2}$$

Use Sequential Criterion to show that  $\lim_{x \rightarrow 0} f(x) = \frac{1}{2}$ . [1+3]

9. Define a contraction map. Let  $T$  be a contraction map, let  $x_0$  be an element of the metric space and construct the sequence  
 $x_1 = T(x_0), x_2 = T(x_1), x_3 = T(x_2), \dots$

Prove that if  $T$  has a fixed point  $x$ , then  $x_n \rightarrow x$ . [1+3]

10. Prove that a function which is differentiable at point  $c$  admits first order partial derivative at that point. [1+3]

11. Let  $S$  be an open subset of  $\mathbb{R}^n$  and let  $f: S \rightarrow \mathbb{R}^n$  is differentiable at each point of  $S$ . Let  $x$  and  $y$  be two points of  $S$  such that

$L(x, y) \subseteq S$ . Then prove that for every point  $a$  in  $\mathbb{R}^n$ , there is a point  $z$  in  $L(x, y)$  such that :

$$a \cdot \{f(y) - f(x)\} = a \cdot \{f'(z)(y - x)\}. \quad [4]$$

12. Define a function of bounded variation on  $[a, b]$ ? Is boundedness of  $f'$  necessary for  $f$  to be of bounded variation? Justify your answer by taking suitable example. [1+3]

OR

Define total variation of a bounded function on  $[a, b]$ . Let  $f$  be a function of bounded variation on  $[a, b]$ . Let  $V$  be defined on  $[a, b]$  as follows :

$$V(x) = V_f(a, x) \text{ for } a < x \leq b \text{ and } V(a) = 0.$$

Prove that  $V$  and  $V - f$  are the increasing functions on  $[a, b]$ . [1+3]

13. Assume that  $\alpha \nearrow$  on  $[a, b]$ . Then for any two partitions  $P_1$  and  $P_2$  of  $[a, b]$ , prove that  $L(P_1, f, \alpha) < U(P_2, f, \alpha)$ . [4]

14. If  $f$  is continuous on  $[a, b]$  and if  $\alpha$  is of bounded variation of  $[a, b]$  prove that  $f \in \mathcal{R}(\alpha)$  on  $[a, b]$ . [4]

15. Discuss the absolute convergence of the integral  $\int_1^{\infty} \frac{\sin x}{x^2} dx$ . [4]

OR

Investigate the convergence or divergence of  $\int_a^b \frac{dx}{(x-a)^p}$ . [4]