University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Environmental Science (ENV.331) Time: 3 hrs.

Section "A"

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

1.1. Describe the effects of primary and secondary air pollutants on human beings. Write down the necessity of air quality standards and legislations to control these pollutants.

1.2. What are water pollutants? Explain the important chemical parameters to be determined for the aquatic ecosystems that are contaminated with sewage.

1.3 Describe IEE approval process in Nepal. List out the importance of conducting IEE for developmental projects.

1.4 Define and classify mass movement. Describe briefly on the major mass movement hazards of Himalayan regions.

Section "B"

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

2.1 Consequences of soil erosion

2.2 Selection of disposal site for solid waste management

2.3 Sources and control of noise

2.4 Cumulative toxicity

2.5 Radioactive fallout

2.6 Bioengineering practices

2.6 Urbanization in developed countries

2.8 Indices of toxicity

2.9 Importance of Scoping in EIA

2.10 Environmental problems from economic point of view

2.11 GLOF

2.12 Pattern of urban growth in Nepal

Section "C"

3. Attempt ALL the Questions. 10×2=20

Differentiate between:

3.1 Primary and secondary air pollutants

3.2 Alkalinity and hardness m water

3.3 Rill and gulley erosion

3.4 Sanitary and secure landfills

3.5 Genetic and somatic effects of radiation

3.6 Acute and chronic toxicity

3.7 Debris flow and rock fall

3.8 Fumigants and external insecticides

3.9 Magnitude and intensity of earthquake

3.10 Persistent and non-persistent pollutants

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Environmental Science (ENV.332) Time: 3 hrs.

Section "A"

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

1.1 Describe briefly about the new trends in food resources production. What are the environmental benefits of organic farming?

1.2 What are the problems related with tourism in mountains? Describe how the natural resources of mountain regions can be managed sustainably.

1.3 Discuss the different types of underground mining practices. Explain about the mine field reclamation techniques.

1.4 What is biodiversity? Elaborate the status and challenges for biodiversity conservation in Nepal.

Section "B"

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

2.1 Elements of sustainable development

2.2 Age structure diagram

2.3 Water resources of Nepal

2.4 Traditional sources of energy resources of Nepal

2.5 Economic valuation of ecosystem services

2.6 Environmental policies of Nepal

2.7 Metallic minerals of Nepal

2.8 Environmental consequences of fossil fuel use

2.9 Efficient use of water resources

2.10 Agricultural policies of Nepal

2.11 Institutional arrangement for environmental conservation in Nepal

2.12 Factors affecting human population size

Section "C"

3. Attempt ALL the Questions. 10×2=20

Differentiate between:

3.1 Biological resource and biodiversity

3.2 Identified and undiscovered resources

3.3 Perpetual and non-renewable resources

3.4 First and second green revolution

3.5 Plateaus and mountains

3.6 Tierra Caliente and Tierra Fria

3.7 Background and mass extinction
3.8 High-throughput and low-throughput economics
3.9 Total and replacement level fertility
3.10 CITES and Ramsar Convention

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100
Applied Meteorology (MET 331) Time: 3 hrs.

Attempt any Three questions from Group A, Two from Group B, Three from group C and Two from Group D.

Group A : Agriculture Meteorology

1. Define agriculture meteorology and discuss why meteorology is important for agricultural development with reference to Nepal. [3+7]
2. Discuss briefly the basic process of photosynthesis. Give the chemical equation of photosynthesis and discuss the effect of temperature and carbon dioxide concentration on photosynthesis. [3+3+4]
3. Describe the role of radiation and soil moisture on plant growth. [10]
4. Explain in details the seed germination process and write down the general conditions for seed germination. [6+4]

Group B : Aviation Meteorology

5. What are factors affecting horizontal visibility? Write its importance in aviation meteorology. [5+5]
6. Explain the types of data used for weather forecasting. Explain briefly the Nowcasting technique and short range forecasting. [4+3+3]
7. Write short notes on any TWO of the following:
   a. Mountain waves
   b. Surface and slant visibility
   c. PANSMET
   d. Microburst

Group C : Air Pollution Meteorology

8. Define pollution monitoring and explain the techniques to monitor pollutants in the air. [3+7]
9. Explain possible sources of air pollution in Kathmandu valley. Suggest some practical ways to mitigate air pollution in the valley. [5+5]
10. Describe effects of air pollutants on human beings, animals, plants and materials. [10]
11. Write short notes on any TWO of the following:
    a. Ekman spiral
    b. Boundary layer scaling
    c. Physical and optical properties of aerosols
    d. Greenhouse gases [5+5]

Group D : Satellite and Radar Meteorology

12. What is electromagnetic radiation? Explain the characteristics of solar radiation with an illustrative diagram. [2+8]

13. What is radar? Describe its physical principal and usefulness in meteorological research. [2+8]

14. What is jet stream? Describe different cloud features associated with jet streams in satellite imageries. [2+8]

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Meteorology (Applied Hydrology) (MET 332) Time: 3 hrs.

Attempt any SIX questions where Q.No.1 and Q. No.6 are compulsory.

1. (a) Distinguish between infiltration and percolation. Discuss the mechanics of infiltration and the factors affecting the infiltration rate. [2+5+5]

   (b) A drainage basin is found the following data:

   area of the basin = 2500 km2;

   length of the main stream =110 km;

   the perimeter of the basin = 367 km.

   Determine the form factor, circulatory ratio, elongation ratio and the compactness coefficient for the basin. [6]

2. (a) Define double mass curve. Explain how you are going to check the consistency of the rainfall data obtained from a station. [2+8]

   (b) Station A failed to report the rainfall during storm, with respect to east west and north west axes set up at station A, the coordinates of 4 surrounding raingauges which are the nearest to A in the respective quadrants are (7.5, 7.5), (–10, 15), (–5, –6.5), (12, –8) km respectively. Determine the missing rainfall at A station, if the storm rainfalls at the four surrounding raingauges are 98, 67, 72 and 53 respectively. [6]

3. (a) Derive Penman's evaporation equation for open water surfaces. Explain how Penman's equation differs from the other empirical equations. [5+5]

3. (b) The mean monthly temperature of Chitwan in May and November are 28.5°C and 20.2°C respectively. Determine the evapotranspiration for sugarcane at this place for these two months.

   (Given: Latitude of Chitwan, 27°N, p for November and May 7.19 and 9.53 respectively). [6]

4. (a) Define overdraft of an aquifer. Explain how the yield of open well can be determined using recuperation and pumping test. [2+4+4]

   (b) A sample has a hydraulic conductivity of 10m/day? What would be its intrinsic permeability? What is its hydraulic conductivity? [6]

5. (a) Define unit hydrograph. What are the assumptions of unit hydrograph theory? How they limits the applicability of unit hydrograph. [2+4+4]

(b) A hydro-electric plant is proposed at a site on a stream which has the following mean monthly discharge.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Discharge (m^3/s)	6.7	6.5	7.3	10.1	12.6	33.8	34.57	55.4	38.8	17.0	10.4	7.9

If the net head is 500m, calculate the theoretical power potential of dependable Q65 discharge of the river. [6]

6. (a) Explain the principle of discharge measurement in the electromagnetic induction ultrasonic methods. Point out the ideal location of hydrometric site. [5+5+2]

(b) Estimate the mean annual discharge of a stream from the Trapezoidal Weir constructed in the stream channel if the height of the water over the Weir crest from the January to December are 0.8, 0.6, 0.5, 0.4, 0.35, 2.3, 2.9, 3.2, 1.8, 1.2, 1.1 and 0.9 respectively. [6]

7. (a) What is stage discharge relation? Discuss different methods which can be applied for interpolation and extrapolation of rating curve. [2+4+4]

(b) Calculate the flood discharge in a stream by the slope-area method from the following data: [6]

	u/s	Middle section	d/s
Area	108.6 m^2	103.1 m^2	99.8 m^2
Wetted perimeter	65.3m	60.7 m	59.4 m
Gauge re ing	-+316.8 m	–	+316.55 m

Determine the flood discharge assuming Mannings n = 0.029 and length between u/s and d/s sections as 250m.

8. Write short notes on any FOUR of the following:
   a. Snow survey
   b. Water equivalent of snow
   c. Physical and optical properties of snow
   d. Glacier mass balance
   e. Energy balance components of snow
   f. GLOF

9. (a) How does a glacial lake form? What are the causes of glacial lake outburst flood? [4+6]

9. (b) Calculate the actual vapour pressure of air at a glacier surface at different conditions of air temperature and relative humidity. [6]

Air temperature (°C)	Relative humidity (%)
5	50
7	60
9	70
11	80
12	90
15	100

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 300

Stratigraphy and Sedimentology, Paiaeontology and Economic Geology

(GEO.331) Time: 3 hrs.

Attempt NINE questions, selecting THREE from each Group.

GROUP "A"

1. (a) What are the criteria of biostratigraphic correlation? Discuss.
   (b) List the methods of dating using radioactive isotopes. Briefly describe the Ar/Ar method of dating.
2. (a) How do you establish lithostratigraphy of a new terrain? Explain,
   (b) Give brief accounts on stratigraphy of sub-himalaya.
3. (a) Give physical processes of formation of a delta deposit.
   (b) What do you mean by sedimentary environment? Describe environmental parameters of Lake Environment.
4. Write notes on (any two):
   (a) Magnetostratigraphy
   (b) Sedimentary cycles
   (c) International stratigraphic code

GROUP-B"

5. (a) Describe evolutionary trend of Anthozoa.
   (b) Describe the scope of Paleontology.
6. (a) Inscribe mode of occurrence, distribution and morphology of class Trilobite.
   (b) What is a fossil? How do you recognize and analyse fossils?
7. (a) Give an account of the Gondwana flora.
   (b) Define index fossil. Discuss the importance of index fossils.
8. (a) Explain the importance of ornamentation in Ammonoidea.
   (b) Describe geological distribution and evolution of Reptiles during the Mesozoic Era.

GROUP "C"

9. (a) How are lenticular ore bodies formed? Describe.
   (b) Give classification of mineral deposits with examples.
10. (a) Describe the processes in the oxidation, and zone of supergene enrichment.
    (b) Describe the process of concentration of minerals during post magmatic stage.
11. (a) Describe metasomatic processes of economic mineral formation,
    (b) What is ore mineral body? How do you distinguish it from rock?
12. (a) What do you understand by a zonal structure of ore body? Explain.
    (b) Write notes on:

(i) Grade of Ore (ii) Formation of coal

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Engineering, Exploration and Environmental Geology and Remote Sensing and GIS (GEO.333) Time: 3 hrs.

Attempt NINE questions, selecting THREE from each Group.

GROUP "A"

1. (a) What are the various ways to collect engineering geological data?
   (b) What are the index properties of soils?
2. (a) Describe the Unified Soil Classification System (USCS). Also add note on dilatancy and dry strength tests of the soil.
   (b) Differentiate the intact rock and rock mass.
3. (a) What are the processes of estimating rock mass strength?
   (b) What is construction material? What are the sources of sand and gravel in the natural environment?
4. (a) What is an engineering geological map? How can it be acquired meaningfully?
   (b) What are the steps to assess natural hazard?

GROUP "B"

5. (a) Describe the geochemical prospecting criteria in exploration geology.
   (b) Discuss blasting techniques.
6. (a) How is open-cast mining performed? What are its disadvantages?
   (b) Why ventilation is necessary for underground mining?
7. (a) Write short notes on:
   (i) Charging and firing in shot-holes
   (ii) Prospecting guides
   (b) In which ways the mineral source and reserve differ?
8. (a) What is sampling? Describe the random and stratified sampling techniques in mineral exploration.
   (b) How can oceans be new areas for exploration of mineral resources?

GROUP "C"

9. (a) What are the geological variables that affect the environment?
   (b) What is slope stability? Describe the environmental friendly slope stabilization measures.
10. (a) Define magnitude and intensity, of earthquake. Discuss the seismicity in the Himalaya.
    (b) Describe the process of evaluating hazard and its adjustment.
11. (a) How does landuse planning help in environmental management?
    (b) What is hydrogeological cycle and how it affects in water budget?

12. (a) Describe the trend of energy consumption. Discuss on environmental impact of coal extraction.

(b) How can air pollution be controlled?

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Solid State Physics, Nuclear Physics, Mechanics (Phy. 331) Time: 3 hrs.

Attempt ALL the Questions

GROUP "A"

1. Find an expression for the effective mass of electron. Give physical interpretation of effective mass. [10]

OR

Give Langevin's theory of paramagnetism. Explain its limitations and discuss Weiss modification.

2. Explain construction and working principle of Betatron. What are difference between cyclotron and Betatron ? [9]

OR

Describe nuclear forces and list its properties. Explain Menson theory on nuclear forces.

3. Give Lorentz transformation equations and show that

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$$

Or

Obtain an equation of motion of a particle moving in a conservative force field on the Lagrange formulation in cylindrical co-ordinate system.

4. Show that the electronic contribution to the specific heat of a metal at low temperature is proportional to the absolute temperature. [6]

Or

Show that the fcc lattice is the reciprocal lattice of the bcc lattice.

5. Describe the latitude effect and east-west asymmetry in the intehsity of cosmic rays. [6]

Or

Define differential cross-section and derive expression for the total collisional cross-section in the case of Rutherford scattering.

6. What are the evidences for the shell model? Explain magic number.

OR [6]

Explain and describe fusion reactors.

7. Answer AH the questions: [6×3=18]

a. Explain primary and secondary cosmic rays.

b. Explain strangeness conservation with examples.

c. What are Eulerian angles?

d. Explain the meaning of Corollis force.

e. Explain Hall effect.

f. What are the important features of superconducting materials?

8. Find the Fermi energy in copper on the assumption that each copper atom contributes one free electron to the electron gas. The density of copper is 8.94×10^3 kg/m^3 and its atomic mass is 63.54u. [6]

9. Calculate the number of atoms per unit cell of a metal having a lattice parameter of 0.29nm and density 7870 kg/m^3. Atomic weight of the metal is 55.85. [6]

10. Determine the wavelength associated with an electron having kinetic energy equal to 1 MeV. [6]

11. At what temperature will the average molecular kinetic energy in a gaseous hydrogen is equal to the binding energy of hydrogen atom? [6]

12. Give the conditions under which Ehrenfest theorem reduces to Newton's second laws of motion. [6]

13. An electron is moving with a speed of 0.80c in a direction opposite to that of the moving photon. Calculate the relative velocity of the photon with respect to the electron.

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Quantum Mechanics, Mathematical Physics (Phy.332) Time: 3 hrs.

Attempt ALL the Questions

1. Solve Lengendre's differential equation by series solution method. Express electrostatic potential between two electric charges, at a distance 'd' apart, as a series of Legendre's polynomials. [10]

Or

Explain symmetric and skew-symmetric tensor. Show that every tensor can be expressed as the sum of two tensors, one of which is symmetric and other skew symmetric in a pair of co-varient or contravarient indices.

2. A particle of mass m and energy $E < V_0$ travelling along X-axis has a potential barrier defined by

$$V(x) = 0 \text{ for } x < 0$$
$$= V_0 \text{ for } 0 < x < a$$
$$= 0 \text{ for } x > a$$

Find the expression of transmission coefficient of the particle. [9]

Or

Use Shrodinger equation in spherical polar co-ordinates and find the solutions of the angular part. What are the quantum numbers associated with angular part ?

3. What is harmonic oscillator ? Find its eigen-functions and eigenvalues. What do you mean by even and odd parity states in harmonic oscillator ? [9]

Or

State and prove the Gauss divergence theorem.

4. Explain orthogonal curvilinear co-ordinates: [6]

Or

If $ds^2 = g_{jk}\, dx^j dx^k$ is an invariant, show that g_{jk} is a symmetric covariant tensor of rank two.

5. Prove that for a rotational motion of a particle the uncertainty principle can be stated in the form of $\Delta L A\theta > \hbar$. [6]

Or

Normalize the wave function $\phi(x) = (1 + ix)$ and hence find the expectation value of momentum in the region $0 \le x \le 1$.

6. Electrons of energy 2eV are incident on a barrier 3 evaluation high and 0.4 nm wide. Find the transmission probability. [6]

Or

Find the Laplace transform of $\sinh^3 t$.

7. Answer ALL questions: [6×3=18]

a. Find the surface area of the sphere $x^2 + y^2 + z^2 = 16$.

b. Find the Fourier transform of $\exp\left\{-\frac{x^2}{2\sigma^2}\right\}$.

c. What are the important properties of Wronskian?

d. Explain parity with few examples.

e. Find $[L_x, L_y]$

f. Explain physical meaning of the equation of continuity in the quantum mechanics.

8. Find the rotational energy eigenvalue of the rigid rotator. [6]

9. Normalize the wave function

$$\psi(x, t) = e^{-ax^{2/2}} e^{-1^{Et/h}}$$

From $-\alpha$ to $+\alpha$ and find the expectation value of x^2 for this function. [6]

10. Calculate the wavelength of thermal neutrons at 27°C, assuming that energy of a particle at absolute temperature T is of the order of $K_B T$, where K_B is Boltmann constant. [6]

11. If $\vec{A} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{B} = i + 4\hat{j} - 2\hat{k}$

find (a) $\vec{A} \times \vec{B}$ (b) $\vec{B} \times \vec{A}$ (c) $(\vec{A} + \vec{B}) \times (\vec{A} - \vec{B})$ [6]

12. If A^{pq}_r and B^{pq}_r are tensors, prove that their sum and difference are also tensors. [6]

13. Find Fourier series to represent f(x) where

$$f(x) = -a \text{ for } -c < x < 0$$
$$= a \text{ for } a < x < c$$

[6]

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Ecology, Wildlife & Fishery (Zol.331) Time:3.hrs.

Group "A"

Attempt any TWO questions 2×12.5=25

A.1. What is Biogeoehemical cycling? Describe oxygen cycle with suitable illustration.

A.2. Explain the boundaries, climate and faunal diversity of oriental region.

A.3. What is wildlife? Explain the methods of wildlife conservation in Nepal.

Group "B"

Attempt any TWO questions 2×12.5=25

B.4. What is induced breeding? Describe the methods of induced breeding used for non-pond breeding fishes.

B.5. What are photophores? Discuss the light producing organs in fishes.

B.6. Discuss briefly the roles of physical and chemical factors in water, in fish production.

Group "C"

Attempt ALL questions 8×5=40

C.7. Discuss the consequences of population growth.

C.8. Write a note on larvivorojus fishes.

Or

Give an account on exotic aquarium fishes.

C.9. How can we produce energy from the cellulose of plants? Discuss.

C.10. Describe different types of caudal fins in fishes.

C.11. Differentiate between learning and innate behaviours.

C.12. What are the sources of air pollution in Nepal? Discuss its effects on human health.

Or

Differentiate food-chain from food-web with examples.

C.13. Give the occurrence, distribution and morphology of Tor putitora.

C.14. Discuss the role of planktons on fish production.

C.15. Write short notes on any TWO: 2×5=10

(a) Competition of wildlife species in nature

(b) Gill-diseases in fishes

(c) Ozone-hole

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Medical Zoology & Applied Entomology (Zol.332) Time: 3 hrs.

Group "A"

Attempt any TWO questions 2×12.5=25

A.1. Give brief account of life-history, mode of infection and pathogenecity of Acanthmoeba sp.

A.2. Write an account of structure and life history of Meloidogyne sp.

A.3. Discuss arthropods as vectors of human diseases.

Group "B"

Attempt any TWO questions 2×12.5=25

B.4. Discuss the habit, habitat, morphology, and short life cycle of wheat pests *Trogdderma granarium*.

B.5. Give an account on damages caused by the insects to stored food grains. Discuss safe storage of food grains in godowns.

B.6. What is Integrated Pest Management (IPM)? Explain chemical and biological control methods.

Group "C"

Attempt ALL questions 8×5=40

C.7. Name the organism causing rabies. Mention the prophylaxis of rabies.

C.8. Discuss entomopathogenic nematodes.

C.9. Mention histo-pathological changes in related organs with disease Nephrosis.

C.10. Discuss damage caused in paddy by the pest Leptocorisa.

C.11. Enumerate the occurrence and control measures of Fasciolopsis.

OR

Give the morphology of Xenopsylla.

C.12. Mention the mode of infection, pathogenecity and prophylaxis of Schistosoma haematobium.

C.13. Describe the mode of action of B-cells to antigens.

Or

Write an account on Macrophages and Dendritic cells of blood.

C.14. Discuss housefly and cockroaches as household pests. 2×5=10

C.15. Write short notes on any TWO:

(a) Avian Influenza

(b) IgG antibody

(c) Sericulture

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Agricultural & Food Microbiology (MB.331) Time: 3 hrs.

Group "A"

(Long Answer Questions) 5×10=50

Attempt ALL FIVE questions.

1. Describe the process of formation of soil. Enlist major soil actinomycetes and point out their characteristics. [7+3]
2. Mention composition of agricultural waste. Describe microbial degradation of hemicellulose. [3+7]
3. Describe the sources of contamination and role of bacteria in milk spoilage. [3+7]
4. Describe sources of transmission and characteristics of causative organism of botulism. [4+6]
5. Describe steps of methane gas production and related microbiology.

   OR [10]

   Describe principle of food preservation and technique of canning method of food preservation. [7+3]

Group "B"

(Short Answer Questions) 5×7=35

Attempt any FIVE questions.

6. Briefly describe applications of bacterial biopesticides.
7. Describe briefly on salient features of Nepal standard for bottled drinking water.
8. Briefly describe applications of Lactobacillus spp. in dairy industry.
9. Briefly describe HACCP system of quality control.
10. Briefly outline the procedure of MBR test and phosphatase test.
11. Briefly describe characteristics of Rhizobium spp. and its role in soil fertility.

Group "C" 5×3=15

Attempt any FIVE questions.

12. Very Short Answer Questions.
    a. Define xenobiotics with examples.
    b. Enlist the name of chitinase and pectinase producing microorganisms.
    c. Define aflatoxin.
    d. Define rhizosphere and rhizoplane.
    e. Enlist any three extrinsic and intrinsic parameters that influence growth of microorganisms in food.
    f. Give biochemical characteristics of genus vibrio.

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Medical and Environmental Microbiology (MB.333) Time: 3 hrs.

Group "A" 5×10=50

(Long Answer Questions)

Attempt ALL FIVE questions.

1. Define opportunistic microorganisms in human body. Describe respiratory tract disease in human. [2+8]
2. Describe the laboratory diagnosis of fungal skin infection. [10]
3. Define sewage. Describe in detail of sewage treatment. [2+8]
4. Define antibody. Describe procedure for Ouchterlony diffusion method and give its application. [2+8]
5. Define air pollution. What are the indicators of air pollution? Give the names of air born diseases with its causal organisms. [3+3+4]

Group "B" 5×7=35

(Short Answer Questions)

Attempt any FIVE questions.

5. Explain in brief auto-immune disease.
7. Explain in brief on medically important fungal growth.
8. Briefly write on viral culture.
9. Explain briefly on decontamination and disposal of infected materials.
10. Explain briefly on chemotherapeutic agents with examples.
11. Explain in brief on microbial ecology.

Group "C" 5×3=15

Attempt ALL FIVE questions.

12. Very Short Answer Questions.
    a. Eclipse phase of bacteriophages.
    b. Anti retro viral agents.
    c. Define niche.
    d. Define microbiology of sewage.
    e. Define immunoglobulin.
    f. Define biohazard and biosafety.

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Plant Bio-chemistry and Plant Bio-technology (Bot.331) Time: 3 hrs.

Attempt All Questions.

Section "A" (Plant Bio-Chemistry)

Long answers questions (any TWO) [2×10=20]

1. Which properties of water make it an ideal solvent for biological systems? Explain.

2. What are enzymes? Give an account of different mechanisms that the enzymes use to catalyze various chemical reactions taking place in living cells.
3. What are proteins? How do they form secondary, tertiary and quaternary structures? Write the biological roles of proteins in living systems.

Short answers questions: (any FOUR) [4×5=20]

4. How is biochemistry related to genetics, molecular biology and plant physiology?
5. What are buffers? Hqw do they resist the change of pH of a system?
6. What are lipids? Write their properties.
7. What are monosaccharides? How are they classified?
8. Give the structure of chlorophyll a.
9. What is RNA? Write their biological role.

Very short answer questions: (any FOUR) [4×2.5=10]

10. Differentiate between a glycosidic bond and phospho-diester bond.
11. Write a short note on biological role of anthocyanins.
12. What do you mean by feedback inhibition? Give one example.
13. How are the enzymes denatured?
14. Name any two fat soluble vitamins and their deficiency syndromes.

Section "B" (Plant Bio-Technology)

Long answers questions (any TWO) [2×10=20]

15. What are the different components of a typical tissue culture media? Write their role in growth of plants in vitro?
16. What do you mean by cryopreservation? How is it carried out? What are its applications?
17. What is biotechnology? Give an account of scope and importance of biotechnology.

Short answers questions: (any FOUR) [4×5=20]

18. Which hormones are routinely used in plant tissue culture? Write their roles.
19. What are plant secondary products? How can we use plant biotechnology for the production of plant secondary products?
20. What do you mean by somaclonal variations? What are its applications?
21. What is micro-propagation? What are its applications?
22. What do you mean by transgenic plants? Write their importance in agriculture.
23. What are mycorrhizae? How do they help plants?

Very short answer questions: (any FOUR) [4x2.5=10]

24. Write notes on blue-green algae.
25. What are the applications of another culture?
26. Why are plants obtained from meristem culture usually free from viruses?

27. Green plants are autotrophic and can synthesize carbohydrates themselves. Why is it necessary to add sucrose or some other carbon source in tissue culture media?

28. Differentiate between symbiotic and non- symbiotic nitrogen fixation?

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Environment & Biodiversity (Bot.333) Time :3hrs.

Section "A"

Give explanatory answer to the following questions: (any TWO) 2×10=20

1. What are the various sources of environmental toxicants and their effects on ecosystems? Suggest various measures to control toxicants responsible for air pollution.
2. What are the various environmental issues associated with development activities? Discuss, any three major issues with example and also suggest ways to minimize negative impacts.
3. How proper management of natural resources can contribute in sustainable development of Nepal?

Write short notes on any FOUR of the following: 4×5=20

4. Ecosystem services of watersheds
5. Organic fertilizers
6. Causes of Green House Effect
7. Carbon sequestration
8. Effects of acid rain
9. Urbanization

Give short answers for the following: (any FOUR) 4×2.5=10

10. EIA as an important method to evaluate impacts.
11. Role of IUCN in conservation.
12. Bio-fuel as future source of energy.
13. Negative effects of excess use of chemical fertilizers in soil fertility.
14. Alpine vegetation.

Section "B"

Give explanatory answer to the following questions: (any TWO) 2×10=20

15. Do you think only protected areas can lead to biodiversity conservation? Justify giving reasons. Discuss the role and various methods of ex-situ conservation.
16. What are the importance's of traditional knowledge in ethnobotany which can lead to improve the livelihood opportunities of rural communities? Discuss it with reference to NTFPs.
17. Discus the role of agrobiodiversity in mountain with the help of suitable examples. What steps are needed to conserve it?

Write short notes on any FOUR of the following: 4×5=20

18. Role of botanical garden in conservation
19. Convention on Biological Diversity
20. Red Data Book
21. CBD and Nepal
22. Intellectual Property Rights
23. Park-people conflict in Nepal

Give short answer for the following: (any FOUR) 4×2.5=10

24. Role of CITES in controlling illegal trade of flora and fauna.
25. Effects of buffer zones on biodiversity conservation.
26. Write down the full forms of GBIF and GEF and their role.
27. Role of Environmental Ethics in conservation activities.
28. Brief note on Gene bank.

Tribhuvan University, 2071

Bachelor Level / III Year/ Sc. & Tech. Full Marks: 100
CHEMISTRY (CHEM.331) Times : 3 hrs

Use separate answer-book for each group.
The Comprehensive Question of each group is compulsory.
Attempt EIGHT questions of Short Answer Questions in each Group.

GROUP "A" (INORGANIC)

Comprehensive Question

1. (a) What are non aqueous solvent? Give examples of the following reactions in liquid ammonia.
   (i) Solvolysis reaction
   (ii) Precipitation reaction
   (iii) Metal ammonia solution reaction
   (b) Write down the advantages of using liquid ammonia as a solvent. [1+6+2]

OR

(a) What are the inter halogen compounds? Discuss the structure of AX_3 and AX_5 type of interhalogen compounds. [1+4]

(b) What are pseudohalides? In what respect N_3^- resembles with Cr^- ion. Illustrate. [1+3]

Short Answer Questions 8×3=24

2.1 What are the main pollutants responsible for air pollution?
2.2 Give an example of three centered four electron bond.
2.3 Starting from atmospheric nitrogen how will you prepare different three types of fertilizer?
2.4 Give evidences for existence of interstitial hydride with example.

2.5 Give examples of three protonic solvent other than water and show how they self ionises.

2.6 Why Borazine is called inorganic benzene? Explain with reason.

2.7 Explain the structure of $N(CH_3)_3$ and $N(SiH_3)_3$.

2.8 Explain basic properties of iodine with example.

2.9 Is CN^- a pseudohalide ion? If so cite its properties to justify it as pseudohalide.

2.10 Explain the structure of XeF_4 and XeF_6.

2.11 Point out the difference between Biochemical Oxygen Demand and Chemical Oxygen Demand.

GROUP "B" (ORGANIC)

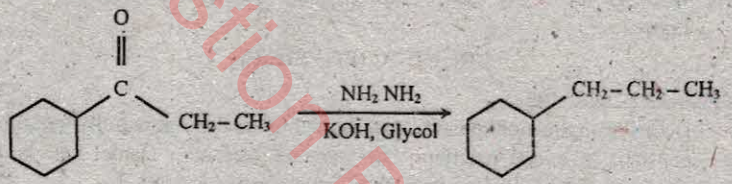
Comprehensive Question

3. Give an account of generation, structure and reactions of carbenes. [9]

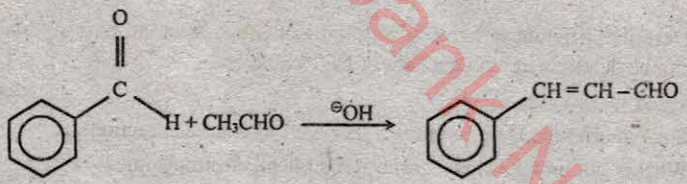
OR

Write mechanism of the following reactions: [3×3]

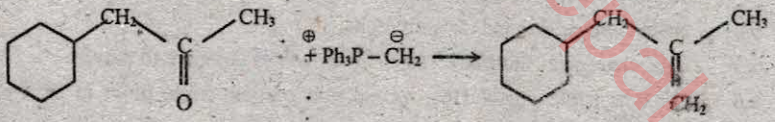
(a)



(b)



(c)



Short Answer Questions 8×3=24

4.1 What is meant by the kinetic and thermodynamic control of reactions? Describe giving examples.

4.2 Define anti-aromaticity. Write structures of two compounds having anti-aromatic character.

4.3 How will infra red spectroscopy be helpful to distinguish the following compounds? Explain.

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3;\quad CH_3-CH_2-OH;\quad CH_3-O-CH_3$$

4.4 Write three applications of NMR spectroscopy.

4.5 What happens when

(a) Pyrrole is treated with chloroform in presence of potassium hydroxide.

(b) Pyridine is treated with $NaNH_2$.

4.6 In which position, electrophilic substitution reaction takes place in pyridine? Offer reason for your answer.

4.7 Give an example of Michael Reaction with mechanism.

4.8 How does stereochemical evidence prove the mechanism of a reaction? Illustrate giving example.

4.9 What factors contribute to the stability of carbocations? Describe in brief

4.10 Why is five membered heterocycles such as pyrrole aromatic? Give reason.

4.11 What is meant by neighbouring group participation? Describe giving examples.

GROUP "C (PHYSICAL)

Comprehensive Question

5. Describe application of emf measurement in the determination of equilibrium constant of a cell reaction. The standard emf of a Daniel cell is 1.1V. Calculate the equilibrium constant for the reaction at 298K. [5+5]

Or

Describe different types of adsorption isotherms. Mention how surface area can be determined with the help of BET equation. [5+5]

Short Answer Questions 8×3=24

6.1 State in brief the Debye - Huckel theory of interionic attraction.

6.2 What is salt bridge? How is it important in an electrochemical cell?

6.3 What are the limitations of distribution law? Deduce the formula for distribution law in case of dissociation.

6.4 State Henry's law and its limitations.

6.5 Why detergents has better cleansing power as compare to soap?

6.6 What is triple point? How would you account triple point in case of one component system?

6.7 What are azeotropes? Describe how a fractional distillation process is useful in separation process.

6.8 How molecular weight of macromolecules by sedimentation method can be determined?

6.9 How would you define critical solution temperature in case of phenol-water system?

6.10 Calculate the ionic strength of 0.1M RCl and 0.1M $CaCl_2$.

6.11 State in brief electrophoresis and electrosmosis.

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

CHEMISTRY (CHEM.333) Time: 3 hrs.

Use separate answer-book for each group.

Tie Comprehensive Question of each group is compulsory,

Attempt EIGHT questions of Short Answer Questions in each Group.

GROUP "A" (INORGANIC)

Comprehensive Question

1. What is Zeise salt? In which class it belongs. Discuss its preparation, structure and bonding. [3+6]

Or

(a) What is main difference in basic assumption of VBT and CFT?

(b) How is the colour of the complex compound explained by the crystal field theory with suitable examples?

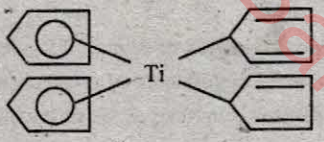
Short Answer Questions 8×3=24

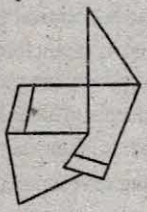
2.1 What do you mean by allylic organo-metallic complexes? Give an example.

2.2 Explain p - hydrogen transfer reaction with suitable example.

2.3 What is oxidative addition reaction? Give an example.

2.4 Give the name of following compound according hapto -nomenclature

(i) 

(ii) 

2.5 Name the following complexes by TUPAC naming

(i) $[(CO)_3\ Fe(CO)_3\ Fe(CO)_3]$

(ii) $K_4\ [Fe\ (CN)_6]$

(iii) $K_3\ [Al\ (C_2O_4)_3]$

2.6 In lanthanides the size of atoms decreases with increase in atomic number. Explain. Why?

2.7 Outline essential feature involved in the binding of O_2 in the haemoglobin molecule.

2.8 What are the three factors on which magnitude of Δ_0 depends on? Explain it.

2.9 Calculate the CFSE of the following complexes:

$[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$ & $[Cu(NH_3)_4]^{2+}$

2.10 How is 18 electron rule applied in explaining the stability of metal carbonyls?

2.11 What is meant by isomerism in co-ordination compound? Discuss the following isomerism:

(i) Hydrate isomerism

(ii) Ionization isomerism.

Group "B" (ORGANIC)

Comprehensive Question

3. Give a method for synthesis of alanyl glycine (Ala-Gly).

Describe the Edman method of N-terminal analysis of protein with mechanism. [4+5]

Or

Write down the steps leading to biosynthesis of fatty acids. [9]

Short Answer Questions 8×3=24

4.1 Define synthon giving examples. What are synthetic equivalents of

(i) $\overset{\oplus}{C}H_2 - OH$ (ii) $\overset{\oplus}{C}H_2 - CH_2 - OH$?

4.2 Give a method of protection / deprotection of carbonyl functional group.

4.3 How can you convert an aldose into ketose and vice versa? White chemical equations.

4.4 Draw the two chair conformations of β – D – glucose:

4.5 What is muta rotation? What is its significance?

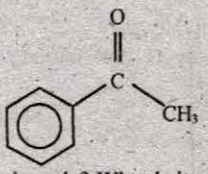
4.6 Write a chemical reaction showing hydrolysis of a fat.

4.7 What is a nucleotide? Write the chemical structure of a DNA nucleotide having guanine nitrogen base.

4.8 Write the mechanism of biological oxidation of ethanol into acetaldehyde.

4.9 What is green chemistry? What is the significance of green chemistry?

4.10 Using retrosynthetic analysis, devise a synthesis of the following compound



4.11 What is the genetic code? What is its significance?

GROUP "C" (PHYSICAL)

Comprehensive Question

5. Describe the thermodynamic criteria of equilibria in terms of entropy, Helmholtz free energy and Gibb's free energy.

Calculate the value of ΔG and ΔA for the process. 2 moles of H2(g) 298 K, 1atm $\rightarrow$ 2 moles of H_2(g) 298 K, 8atm. [5+5]

Or

Describe the dependence of entropy on temperature, volume and pressure. Calculate the AS change when one mole of an ideal gas G = 12.55 JK^{-1} mol^{-1} is transformed from 298K and 2 atm to 273 K and 0.4 atm.

Short Answer Questions 8×3=24

6.1 Explain Gibb's free energy and its significance.

6.2 Calculate the entropy change when one mole of ideal gas is allowed to expand isothermally at 293 K from a pressure of 10 atm to 1 atm.

6.3 Describe in brief the application of third law of thermodynamics.

6.4 Calculate equilibrium constant (Kp) when the reaction between N_2 and H_2 to form ammonia has $K_c = 6.0 \times 10^{-2}$ at 500°C.

6.5 Define activation energy and mention the significance of activation energy with a separate energy profile diagram of exothermic and endothermic reaction.

6.6 What are Frenkel and Schottky defects?

6.7 What are consecutive and parallel reactions?

6.8 Derive Bragg's equation also mention its importance.

6.9 Explain how color center and F - center are formed in a crystal.

6.10 What is the reason for appearance of Reyleigh Stokes and antistokes line in Raman Spectra?

6.11 The fundamental vibrational frequency of CN is 2.07×10^5 M^{-1}. Calculate the reduced mass and force constant.

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100

Elective English Time: 3 hrs.

Attempt ALL the questions.

1. Apply four reading levels (retelling, interpreting, criticizing and assimilating) to "The Lunatic" OR "Mr. Know All." [15]

2. Summarize the main idea of "To Know a Fly." [10]

3. In the following sentences, circle the correct underlined option: [5]
   a. The data clearly show/shows that he is mistaken.
   b. The criteria we applied in this case is/are mistaken.
   c. Nepal is facing a crisis/crises of enormous proportions.
   d. In a beehive, the queen has many offspring/offsprings.
   e. Tribhuvan University has thousands of alumnus/alumni.

4. Sketch briefly the character of Nene Atang. ("Marriage is a Private Affair") [10]

5. Write an essay on "Arrange Marriage versus Love Marriage. [10]

6. In Huxley's views, are some hypotheses better than others? Why or why not? [5]

7. What according to William Golding, are three grades thinking? Illustrate with suitable examples. [10]
8. Write a five-paragraph essay on "Pollution Problem Today." [15]
9. Write a precis of the following extract: [10]

One widely accepted view attributed the ravages of puerperal fever to "epidemic influences', which were vaguely described as "atmospheric cosmic-telluric changes" spreading over whole districts and causing childbed fever in women in confinement. But how, Semmelweis reasons, could such influences have plagued the First Division for years and yet spared the Second? And how could this view be reconciled with the fact that while the fever was raging in the hospital, hardly a case occurred in the city of Vienna or in its surroundings: a genuine epidemic, such as cholera, would not be so selective. Finally, Semmelweis notes that some of the women admitted to the First Division, living far from the hospital, had been overcome by labor on their way and had given birth in the street: yet despite these adverse conditions, the death rate from childbed fever among these cases of "street birth" was lower than the average for the First Division.

10. In one sentence, summarize the main idea of "The Brave Little Parrot." [5]
11. In one long paragraph summarize the plot of "Phaedo." [5]

Tribhuvan University, 2071

Bachelor Level / III Year / Sc. & Tech. Full Marks: 100
Earth Hazard Control - Optional Paper (311 'A') Time: 3 hrs.
Attempt any FIVE Questions from each Group.

Group "A"

1. Describe geological subdivisions of the Nepal Himalayas. Discuss hazards associated with the Higher Himalaya.
2. Define specific and total risks. Describe various approaches of hazard mapping.
3. What are the measures of deformability of rocks? Discuss strength of various rock types.
4. Give briefly structure of soil. Show Unified soil classification system in tabular form.
5. What is hydrograph? Discuss how does change in land use affect a flood hydrograph.
6. Differentiate between epicentre and hypocentre with diagram. Show the intensity scale of earthquake proposed by Mercali.

Group "B"

7. What do you mean by riverbank erosion? Describe the parameters of bank erosion and lateral instability hazard assessment.
8. Give brief account on flooding in Nepal. Discuss management measures of intense rainfall flood.

9. Give mechanisms of breaching of moraine dams. Discuss on GLOF risk mapping and management.

10. What do you mean by structural engineering? Describe major types of retaining structures for slope protection.

11. What is bio-engineering? Give procedures on nursery construction and management

12. Write short notes on any TWO:
    a. Green House Effect
    b. Cyclone
    c. Use of topographical map

Tribhuvan University 2071

Bachelor Level /III Year/ Science & Tech.+ Hum. Full Marks: 100

Sample Surveys and Design of Experiments (Stat.331) Time: 3 hrs.

Group "A"

1. (Compulsory) Attempt any SIX questions. 6×5=30
    a. Describe the technique of analysis of variance. Give the basic assumptions made in analysis of variance for the validity of the F-test.
    b. Define randomization in experimental design. What is the role of randomization in the process of experimentation?
    c. What is meant by confounding in factorial experiment? Explain the terms complete and partial confounding.
    d. Give the layout and analysis of 4 x 4 Latin square design.
    e. What is a sample? In what situations is inevitable?
    f. Discuss sampling and non-sampling errors in a sample survey.
    g. What factors are responsible for determining the size of the sample? How can sample size be determined mathematically?
    h. Explain the difference between ratio and regression method of estimation in sampling theory.

Group "B"

Attempt any FIVE. questions. 5×7=35

2. Describe completely randomized design. Obtain the relative efficiency of randomized block design over this design.

3. Present the analysis of variance table for a randomized block design with 'K' treatments and 'b' blocks with one observation per experimental unit.

4. What do you mean by factorial experiment? Discuss the main effects and interaction effects in 2^3 experiments.

5. What do you mean by analysis of covariance? Illustrate the use of technique of analysis of covariance in reducing error as is applied to the randomized block design.

6. What is treatment contrast? When are two such contrasts are said to be orthogonal?

7. A furniture company wants to know whether there are differences in stain resistance among the four chemicals used to treat three different fabrics. Table given below shows the yields on resistance to stain (a low value indicates good stain resistance).

At the $\alpha = 0.05$, is there evidence to conclude /hat there is a difference in mean resistance among the four chemicals?

Material	Chemical			
	C_1	C_2	C_3	C_4
M_1	3	9	2	7
M_2	7	11	5	9
M_3	6	8	7	8

Group "C"

Attempt any FIVE questions. 5×7=35

8. Explain different steps used in conducting a sample survey.
9. What is meant by sampling distribution of a statistic? Define standard error of statistic.
10. Write down the basic principles of stratification. In a stratification with two strata values of W_h and S_h are as follows:

Stratum	W_h	S_h
1	0.4	4
2	0.6	2

Compute the sample size for each of the stratum to satisfy following conditions:

(i) the standard error of the estimated population mean is 0.1.

(ii) the total sample size to be estimated.

11. What do you understand by systematic sampling? Show that the systematic sampling would be more efficient than simple random sampling without replacement if $\rho < -\frac{1}{nk-1}$

where p is the intracorrelation coefficient between the units of the same systematic sample, n is the sample size and k is the sampling interval.

12. Show that $Var(\bar{y}_{st})$ is minimum for fixed total size of the sample n if $n_i \propto N_i S_i$, where notations have their usual meanings.
13. Describe probability proportional to size sampling. Prove that in probability proportional to size sampling with replacement the sample mean is an unbiased estimate of the population mean.

Tribhuvan University, 2071

Bachelor Level /Sc. & Tech.+ Huma./III Year — Full Marks: 75

Mathematical Analysis (Math.331) — Time: 3 hrs.

Attempt ALL the questions.

Group "A" — 5×7=35

1. Define a convergent double sequence. Let $\lim_{p\to\infty} f(p, q)$ exists, then $\left(\lim_{p\to\infty} f(p, q)\right)$ exists and has the value a. Investigate the existence of iterated limits and double limit of the double sequence given by $f(p, q) = \frac{(-1)^p}{q}$ [1+3+3]

2. Define improper integral of first kind. Interpret it geometrically. State and prove Cauchy criterion for convergence. [2+1+4]

Or

Assume that (i) f is integrable over [a, t] for all $t \geq a$ and there exists a constant $M > o$ such that $\forall\, t \geq a$

$$\left|\int_a^t f(x)\, dx\right| \leq M$$

(ii) g(x) is monotonic decreasing to 0 as $x \to \infty$ i.e.

$g(x) \to 0$ as $x \to \infty$. Then the integral eq $\int_a^\infty f(x)\, g(x)$ is convergent. [7]

3. Prove that if every infinite subset of a set S in R^n has a accumulation point in S then S is closed and bounded. [7]

4. Let f be a bounded variation on [a, b] and $c \in (a, b)$. Prove that f is f bounded variation on [a, c] and on [c, b], and $V[a, b] = V_f[a, c] + V_f[c, b]$. [7]

5. Let $\alpha\nearrow$ on [a, b] and $a < c < b$. Prove that if a and f both are discontinuous from the right or from the left at x = c, then $\int_a^b f d\alpha$ cannot exist. Also, prove that if α is continuous and α' is Riemann integrable on [a, b] then $\int_a^b f(x)\, d\alpha(x) = \int_a^b f(x)\, \alpha'(x)\, d$. [4+3]

OR

State and prove the first Mean value theorem for Riemann Stieltjes integrals. If f is continuous on [a, b] × [c, d] and $g \in R$ on [a, b], show that the function F given by $F(y) = \int_a^b g(x)\, f(x, y)\, dx$ is continuous on [c, d] [4+3]

Group "B" — 10×4=40

6. Define point wise and uniform convergence of a sequenci of function on a set. Prove that $\{x^n\}_{n=1}^\infty$ converges point wise, but not uniformly on [0, 1]. [1+3]

7. Define open set in $\Re^n$. Show that every open Ball B (a ; r) is an open set in $\Re^n$. [1+3]

8. Let X be a closed subset of a compact metric space Then X is compact. [4]

9. If $\{a_n\}$ and $\{b_n\}$ are sequences of points in $\Re$ and $a_n \to 0$ and $b_n \to 0$. Then $\{a_n + b_n\}$ also converges to 0.

If $0 \le c_n \le a_n$ & $a_n \to 0$ then $\{c_n\}$ also converges to 0.

OR

Let $f : S \to \Re$ be a real valued function defined on metric space (S, d_s) to Euclidean space $\Re$. If f is continuous on a compact subset X of S, then $\exists$ points and $q \in X$ S.t

$f(p) = \text{Infimum } f(X)$ and $f(q) = \text{suprimum } f(X)$. [4]

10. If f is monotonic on [a, b], then / is bounded variation on [a, b].

OR

Let f be defined on [a, b]. Then f is of bounded variation on [a, b] if and only if, f can be expressed as the difference of two increasing functions.

11. Let $f(x) = \begin{cases} 1, & \text{when x is rational} \\ 0, & \text{when x irrational} \end{cases}$

then show that $\underline{I}(f, \alpha) \le \overline{I}(f, \alpha)$ [4]

12. State Second Mean Value Theorem. Show by suitable example that the condition / is monotonic on [a, b] can not be dropped out. [1+3]

13. Define limit superior and limit inferior of a sequence. Find limit superior and limit inferior of a sequence $\{a_n\}$ defined by $a_n = (-1)^n (1 + 1/n)$. [2+2]

OR

If Σa_n converges absolutely, then every subseries Σb_n also converges absolutely. Moreover, we have [4]

$$\left| \sum_{n=1}^{\infty} b_n \right| \le \sum_{n=1}^{\infty} |b_n| \le \sum_{n=1}^{\infty} |a_n| \quad [4]$$

14. If f(x) be integrable over [a, t] for all $t \ge a$ and $\lim_{x \to \infty} x\, xf(x) = L \neq 0$ (or $= \pm\infty$). Then the integral $\int_a^{\infty} f(x)dx$ diverges. [4]

15. Let $f : S \to \Re^m$ be differentiable at an interior point c on S, where $S \subseteq \Re^n$. If $v = v_1u_1 + \ldots\ldots + v_nu_n$, where $u_1, \ldots u_n$ are the unit coordinate vectors in $\Re^n$, then prove that $f'(c)(u) = \sum_{k=1}^{n} V_k D_k f(C)$.

Or

Let S be open in $\Re^v$ and $f : S \to \Re^\mu$ is differentiable at each point in S. Prove that if x and y are two points in S such that $L(x, y) \subseteq S$, then for every a in $\Re^m$ there is a point z in L(x, y) such that

$$a \,.\, \{f(y) - f(x)\} = a.\, \{f'(z)(y - x)\}$$

where L(x, y) is a line segment joining x & y. [4]

Tribhuvan University, 2071

Bachelor Level/III Year/Sc. & Tech.+Hum. Full Marks:75

Advanced Calculus VI Paper (332) Time:3hrs.

Attempt ALL the questions.

Group "A" 5×7=35

1. Define curvature, torsion and screw curvature in a curve. Find the equation of the osculating plane at the point t on the curve $\vec{r} = (a\cos t, a\sin t, ct)$.[4+3]

OR

Find the curvature and torsion of the curve $\vec{r} = \vec{r}(t)$ and $\vec{r} = \vec{r}(s)$. [4+3]

2. Define Monge's method of solving second order partial differential equation $R_r + S_s + T_t + U(rt - s^2) = V$ where R, S, T, U, V are functions of p, q, x, y, and z. [7]

OR

Define second order PDE. Solve: $r - 7s + 12t = e^{x-y}$. [1+6]

3. State Divergence theorem. Evaluate

$$\iint_s (y^2z^2\vec{i} + z^2x^2\vec{j} + z^2y^2\vec{k}).\vec{n}\, ds$$

where s|s in the part of the sphere $x^2 + y^2 + z^2 = 1$ above the xy plane and bounded by this plane. [1+6]

4. Define analytic function. Prove that CR equations are satisfied for $f(z) = z^2$ but not for $f(z) = |z|^2$ when $z \neq 0$. [1+6]

5. Define Fourier series. Determine the Fourier coefficients. Hence find the Fourier series for the function f(x) defined as

$f(x) = x\ (-\pi \leq x \leq)$. [1+2+4]

Group "B" 10×4=40

6. Solve: $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = x^2e^x$, by variation of parameter method.[4]

7. Solve : $u = r\frac{d}{dr}\left(r\frac{du}{dr}\right) + ar^3$. [4]

8. Solve : $\frac{dx}{dt} + y = e^t; \frac{dy}{dt} - x = e^{-t}$. [4]

Or

Solve : $\frac{d^2x}{dt^2} + 4x + y = te^{3t}; \frac{d^2y}{dt^2} + y - 2x = \cos^2 t$. [4]

9. Solve by Charpit's method : $q = px + p^2$. [4]

Or

Solve : $9(p^2z + q^2) = 4$. [4]

10. Solve : $r = a^2t$ by Monge's method.

Or

$\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial t}$. [4]

11. Show that the principal normal at consecutive points do not intersect unless $\tau = 0$. [4]

12. Evaluate $\int_C \vec{F} \cdot d\vec{r}$, where $\vec{F} = x^2y^2\vec{i} + y\vec{j}$ and the curve C is $y^2 = 4x$ in the xy plane from (0, 0) to [4, 4] [4]

13. State Green theorem and evaluate

$\oint_C (\cos x \sin y - xy)\, dx + \sin \sin x \cos y\, dx$, by the theorem where C is the circle : $x^2 + y^2 = 1$. [4]

14. What do you understand by a harmonic function ? Show that if $f(z) = u + iv$, is analystic, then u an v are harmonic. [4]

Or

Define Harmonic conjugate. Show that

(a) $V(x, y) = 3x^2y - y^3$ is harmonic

(b) Find the conjugate function u (x, y). [1+1.5+1.5]

15. Expand $f(x) = x^2$ for $-\pi \le x \le \pi$ in a Fourier series. [4]

Tribhuvan University, 2071

2071 Bachelor Level / III Year / Science & Tech: Full Marks: 100

Bio-Statistics (Electives) Time: 3 hrs.

Attempt any TEN questions where Q. No. 12 is compulsory.

1. Define statistics. What are the functions of statistics in biological science? Describe main source of data for the biological studies.

2. The table below gives the number of shoots produced 50 plants in a botanical research laboratory.

Number of shoots	0-4	5-9	10-14	15-19	20-24	25-29	30-34
Number of plants	2	8	12	16	8	3	1

Calculate the mean, variance and coefficient of variation of number of shoots.

3. What is meant by association of attributes? Give brief idea of notations and terminology used in the classification of attributes. Test the consistency for the following data for two attributes A and B.

$N = 400$, $(A) = 80$ $(B) = 120$, $(AB) = 130$ and $(\alpha\beta) = 330$.

4. What do you understand by curve fitting? The atmospheric concentration of trace gas F - 12 was measured in parts per trillion at the South Pole. The results were, with 2010 coded as time 0.

Time	0	1	2	3	4
Concentration	195	216	244	260	284

Obtain the least square straight line trend. Predict the concentration for 2015.

5. Explain why sampling is important in biological studies. Describe in brief probability and non-probability sampling.

6. What do you understand by mutually exclusive events and independent events? In a group of 160 graduates engineering students. 92 are enrolled in advance course in statistics, 63 are enrolled in a course of operation research, and 40 are enrolled in both. What is the probability that a student selected at random is not enrolled either course.

7. Define standard normal distribution. In a photographic process, the developing time of prints may be looked upon as a random variable having normal distribution with a mean of 16.28 seconds and a standard deviation of 0.12 seconds. Find the probability that it will take more than 16.20 seconds to develop one of the prints.

8. Differentiate between point and interval estimation. What are the qualities of good estimator? A limnologist wishes to estimate the mean phosphate content per unit volume of a lake water. It is known from the studies in previous years that the standard deviation has a fairly stable value a = 4. How many water samples must the limnologist analyze to be 90% certain that the error of estimate does not exceed 0.8?

9. Explain the partial and multiple correlation. The simple correlation coefficients between temperature (X_1), Wheat yields (X_2) and rainfall (X_3) are; $r_{12} - 0.59$, $r_{13} = 0.59$ and $r_{23} = 0.77$.

Calculate:

(a) Partial correlation coefficient between wheat yields and rainfall keeping temperature constant.

(b) Multiple correlation coefficient assuming wheat yield as the dependent variable. Also compute coefficient of multiple determination.

Interpret its value.

10. What is meant by the test of a statistical hypothesis? A group of 141 subjects is used in an experiment to compare two treatments. Treatment 1 is given to 79 subjects selected at random and the remaining 62 are given treatment 2. The means and standard deviations of the responses are

	Treatment 1	Treatment 2
Mean	109	128
Standard deviation	46.2	53.4

Suppose the investigation wishes to establish the treatment 2 has a higher mean response than the treatment 1.

a. Formulate the null and alternative hypothesis.

b. State the test statistic and rejection region with a = 0.05.

c. Perform the test at a = 0.05.

11. Many industrial air pollutants adversely affects plants. Sulphur dioxide causes leaf damage in the form of intraveinal bleaching in many sensitive plants. In a study of effects of a given concentration of sulphur dioxide in the air on three types of garden vegetables, 40 plants of each type are exposed to

the pollutant under controlled greenhouse conditions. The frequencies of severe leaf damage are recorded in the following table

	Leaf damage		Total
	Severe	Moderate or none	
Lettuce	32	8	40
Spinach	28	12	40
Tomato	19	21	40
Total	79	41	120

Analyses these data to determine if the incidence of severe leaf particular damage is alike for three types of plants. In particular :

(a) Formulate the null and alternative hypothesis.

(b) Test the null hypothesis at 5% level of significance.

12. Discuss how systematic process such as migration, mutation and selection change gene frequencies.

Tribhuvan University, 2071

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

Research Methodology Time: 3hrs.

Attempt any TEN questions.

1. Define scientific research. What are the purposes of research? Illustrate the process of a research in a diagram.
2. What is the case study and how this method helps in research work?
3. Explain why sampling is important in research work. Discuss in brief probability samplings.
4. Define α-scale and T-scale. Calculate the percentile rank for the score 38 for the following distribution.

Scores	10-20	20-30	30-40	40-50	50-60
Frequency	4	7	12	8	4

5. What is reliability? The reliability coefficient of a test is 0.6; The mean and standard deviation are found to be 55 and 8 respectively. If Mr. A has a score of 46 on the test, what is his estimated true score and standard error of estimation? Compute 99% confidence interval for A's true score.
6. What is hypothesis? What problems are involved in formulating research hypothesis?
7. What is bibliography? Explain the importance of bibliographic representation in review of literature during research process.
8. Distinguish between primary and secondary data. Explain in brief different techniques of collecting primary data.
9. Discuss what you understand by a project work. Define various types of project work.
10. What is research report? Explain the procedures of writing a research report.

11. Distinguish between a questionnaire and a schedule. Discuss in brief different types of schedule.

12. What are the basic features of a thesis? Write down the basic steps to be followed in thesis writing. Also highlight the pitfalls in choosing topics of a thesis work.

Tribhuvan University, 2071

Bachelor Level/III Year/Sc. & Tech.+ Hum. Full Marks: 75

Algebra II. (Math.333) Time: 3 hrs.

Attempt ALL the questions.

Group "A" 5×7=35

1. Define linearly dependent set of vectors. Let V be a vector space over the field K. Let $\{v_1, v_2, \ldots, v_m\}$ be a basis of V, let $w_1, w_2, \ldots, \ldots, w_n$ be elements of V. If $n > m$, prove that $w_1, w_2, \ldots, w_n$ are linearly dependent. Show that if $v_1 = (1, 2)$, $v_2 = (1, -3)$ is a basis of $\Re^2$, then $w_1 = (4, -1)$, $w_2 = (3, 1)$ and $w_3 = (2, 5) \in \Re^2$ are linearly dependent vectors. [1/2+5+11/2]]

OR

Let V and W be two subspaces of a finite dimensional vector space over the field K, prove that $\dim(V + W) = \dim V + \dim W - \dim(U \cap W)$. [7]

2. What do you mean by a herrnitian form? Let V be a vector space of continuous complex valued functions on the interval $[-\pi, \pi]$, if f, $g \in V$ and $(f, g) = \int_{-\pi}^{\pi} f(t)\,\bar{g}(t)\,dt$, show that this is a hermitian form. Also show that f is hermitian form on C^n where f is defined by $f(x, y) = X^t A \bar{Y}$. [1+2+4]

3. Give a non trivial example of a homomorphism and find its kernel. Let $L : G \to \bar{G}$ be a homomorphism and K be the kernel. Prove that —and Im L are isomorphic and also prove that if N is a normal subgroup of a group G then there exists a homomorphism $h : G \to \frac{G}{N}$ with kernel N defined by $h(g) = Ng$ for all $g \in G$. [1+4+2]

OR

Define normalizer of an element a in a group G. Prove that the number of elements conjugate to a in G is the index of the normalizer of a in G i.e. $C_a = \frac{0(G)}{0(N(a))}$. Find the conjugacy class of (12) and normalizer N(12) in S_3 and verify above statement. [1+4+2]

4. Define Euclidean ring. Give an example of a Euclidea ring. Prove that the ideal $A = (a_o)$ is a maximal ideal c the Euclidean ring R if and only if a_o is prime element c R. [1+1+5]

5. How do you define roots of a polynomial? Prove that polynomial of degree n over a field can have at most roots in any extension field. [1+6]

Group "B" 10×4=40

6. Define linear map. Let $F : \Re^2 \to \Re^2$ be a linear mapping such that $F(x, y) = (3x - y, 4x + 2y)$, show that F has a inverse linear map. [1+3]

7. Find the matrix representation of $T : \Re^3 \to \Re^3$ relative to the usual basis where

$T(x, y, z) = (2x - 3y + 4z, 5x - y + 2z, 4x + 7y)$. [4]

8. Find the dual basis of the basis vectors

$B = \{(1, 2), (-1, 3)\}$ for $\Re^2$. [4]

OR

Let $v_1, v_2, \ldots v_n$ be vectors which are mutually perpendicular and such that $\|v_i\| \neq 0$ for all i. Let v be an element of a vector space. V and let C_i, be the Fourier coefficient of v with respect to v_i. Let $a_1, a_2, \ldots, a_n$ be numbers, prove that

$$\left\| v - \sum_{k=1}^{n} a_k v_k \right\| \leq \left\| v - \sum_{k=1}^{n} a_k v_k \right\|$$

If $v_1 = (-1, 2), v_2 = (2, 1) \in \Re^2$ and $v = (1, 0) \in \Re^2$ and $C_1 = \frac{1}{5}, C_2 = \frac{2}{5}$ are the Fourier coefficients of v with v_1 then verify above statement. [3+1]

9. Define quadratic form. What is the associated matrix of the quadratic form f $(x, y) = x^2 - 3xy + 4y^2$? [1+3]

Determine the index of nullity and index of positivity for each form determined by the symmetric matrix $C = \begin{pmatrix} 2 & 1 \\ 2 & -1 \end{pmatrix}$ on $\Re^2$ by using Sylvester's theorem. [2+2]

10. Let V be a finite dimensional vector space over the complex number and assume dim $V \geq 1$. Let $A : V \to V$ be a linear map, prove that there exists a non zero eigen vector of A. What happens if vector space V is over $\Re$? [3+1]

11. What is fan basis? Let $\{v_1, v_2, \ldots, v_n\}$ be a fan basis for a linear map $T : V \to V$. Prove that the matrix associated with T relative to this basis is an upper triangular matrix. [1+3]

12. What do you mean by an inner automorphism of a group G? Prove that the set of all inner automorphisms I (G) is a subgroup of the set of all automorphism A(G) of G. [2+2]

13. Let ϕ be a homomorphism of a group G onto a group $\bar{G}$ with kernel K, prove that $\frac{G}{K} \cong \bar{G}$. [4]

14. Define ring homomorphism with an example. If R is a ring with unit element 1 and ϕ is a homomorphism of R onto 'R', then prove that $\phi(1)$ is a unit element of R'. [1+3]

OR

Prove that a necessary and sufficient condition that the element a in the Euclidean ring be a unit is that d(a) = d(1). [4]

15. If $f(x) \in F[x]$ is irreducible, prove that the following:

(a) If the characteristic of F is 0, f(x) has no multiple roots,

(b) If the characteristic of F is $p \neq 0$, f (x) has a multiple roots only if it is of the form $f(x) = g(x^p)$. [4]

OR

If F is a field of characteristic $p \neq 0$, then prove that the polynomial $x^{p^n} - x \in F[x]$ for $n \geq 1$, has distinct roots. [4]

Tribhuvan University, 2071

Bachelor Level/III Year/Sc. & Tech. + Humanities — Full Marks: 100

Applied Statistics (Stat.332) — Time: 3 hrs.

Group "A"

1. (Compulsory) Attempt any SIX questions. 6×5=30

   a. Define control charts for mean and range.

   b. How do you fit the trend line by the method of least square?

   c. Define an index number and mention its uses.

   d. Define official statistics of Nepal. What are the major limitations of Nepalese official statistics?

   e. Explain why standardized death rate is more accurate than the crude death rate in comparing death rates.

   f. What is general fertility rate, and how can it be determined?

   g. How can one estimate population by compound interest model? Give an example.

Group "B"

Attempt any FIVE questions. 5×7=35

2. Discuss the nature, scope and coverage of demographic studies. Give some examples of important demographic studies in Nepal.

3. Fill in the blanks which are marked with a query in the following skelton life table and explain the meaning of symbols at the heads of the column.

Age x	ℓ_x	d_x	p_x	q_x	L_x	T_x	e_x^0	m_x
30	762227	?	?	?	?	27296632	?	?
31	758580	–	–	–	–	?	–	–

4. Define mean length of generation and net reproduction rate. Derive relation between them.

5. Explain the difference between birth rate and fertility rate. Obtain the total fertility rate for the following table:

Age Group	Number of women	Total births
15 - 19	5687	125
20 - 24	5324	276
25 - 29	4720	262
30 - 34	3933	163

35 - 39	2670	118
40 - 44	3015	27
45 - 49	2601	6

6. What are the different errors usually encountered in age reporting? Discuss main patterns observed in Nepal.

7. What are the different measures of population growth rate? Discuss component method of population projection.

Group "C"

Attempt any FIVE questions. 5×7=35

8. What do you understand by control charts in statistical quality control? Explain the principles on which control chart is based.

9. What is a time series? What purpose is served by time series analysis? Throw light on main drawbacks of the time series analysis.

10. What do you understand by 'seasonal variations' in time series data? Calculate the seasonal indices from the following data by using simple average method.

Year	Q_1	Q_2	Q_3	Q_4
2008	75	60	82	89
2009	78	68	85	92
2010	80	72	89	95
2011	85	80	95	100

11. What is the cost of Jiving index number? Explain the difficulties in its construction. Compute the cost of living index number for the following data:

Items	Food	Clothing	Rent	Transport	Miscellaneous
Weight	50	25	8	4	13
Price relative	167	118	146	128	155

12. What are the tests to be satisfied by a good' index number? Examine how far they are met by Fisher's ideal index number.

13. What do you understand by National Income? Describe different methods used in its computation.

Tribhuvan University, 2071

Bachelor Level /III Year/Hum. + Sc. & Tech. Full Marks:75

Mathematical Statistics (Math. 336) Time: 3 hrs.

Attempt ALL the questions.

Group "A" 3×10=30

1. Define correlation coefficients between two variables and types of correlation. Prove that the correlation coefficient between two variables lies - 1 to 1. What conclusion can be drawn if the correlation coefficient between

the two variables is (a) 0 and (b) 1? Calculate the covariance and the coefficient of correlation between x and y, when

$n = 10$, $\Sigma x = 60$, $\Sigma y = 60$, $\Sigma x^2 = 400$, $\Sigma y^2 = 580$ and $\Sigma xy = 305$. [2+1+3+4]

OR

Describe regression and its types. If the data is

x (age of husband)	25	22	28	35	20	22	40	20	18
y (age of wife)	18	15	20	22	14	16	21	15	14

Find the regression coefficients and hence the equations of the two lines of regressions. Estimate the age of husband, when the age of wife is 19.[2+6+2]

2. Define skewness and its types. Calculate the Karl Pearson's coefficient of skewness of the data

Mid value of the income	150	250	350	450	550	650	750	850
No. of workers	80	105	120	165	100	90	60	40

Interpret the result. [3+6+1]

3. Define Baye's theorem. Illustrate it by an example. Two dice are thrown, what is the probability that the sum is greater than eight? [2+3+5]

Group "B" 9×5=45

4. Define types of data. Give an example of continuous and discrete type of data. [2+3]

5. Define measure of central tendency. Find the geometric mean of the following data:

x :	100	150	200	250	300	350
f :	5	7	100	15	8	5

6. Find the line of regression of x on y for the data : [5]

x	6	2	10	4	8
y	9	11	5	8	7

OR

Calculate the rank correlation coefficient of the data :

x	1	2	3	4	5	6	7	8	9	10
y	3	8	1	7	10	2	9	4	6	5

7. Define law of total probability for two sets.

Describe the case when the two sets are

(i) mutually exclusive

(ii) not mutually exclusive [1+4]

8. If X is a random variable and a, b are constants, prove that

(i) $E(ax) = aE(X)$ (ii) $\text{var}(aX - b) = a^2 \text{var}(X)$ [2+3]

9. Find K for the probability density function

$$f(x) = \begin{cases} kx, & 0 \le x \le 2 \\ 0, & \text{elsewhere} \end{cases}$$

Find $P(1 \le x \le 2)$. [3+2]

10. What is binomial distribution ? Fit a binomial distribution to the following data : [1+4]

x	0	1	2	3	4
f	28	62	46	10	4

Or

If the mean is 6 and the standard deviation is $\sqrt{2}$, write out the all terms of the binomial distribution. [5]

11. What is Poisson distribution ? If a random variable has a Poisson distribution such that P (X = 1) = P (X = 2), find P (X = 4) [1+4]

12. What is t distribution ? What are the importance of the distribution ?

OR [2+3]

A manufacturer intends that his electric light bulbs have a life of 1000 hours. He tests a sample of 20 bulbs, drawn at random from a batch and discovers that the mean life of the sample bulbs is 990 hours with a standard deviation of 22 hours. Does this signify that the batch is not up to the standard ? [5]

Tribhuvan University, 2071

Bachelor Level/III Year/Sc. & Tech.+Hum. Full Marks : 75

Linear Programming (Math,335) Time : 3 hrs

Attempt ALL the questions.

Group "A' 3×10=30

1. A farmer requires 10, 12 and 12 units of chemicals A, B and C respectively for his garden. A liquid product contains 5, 2 and 1 units of A, B, and C respectively, per jar, and a dry product contains 1, 2 and 4 units of A, B, and C respectively per carton. I the cost of the liquid product is Rs.3 per jar and the cost of the dry product is Rs.2^2 per carton, how many of each should be purchased to minimize the cost in linear programming and hence solve it graphically, assuming that the left-over materials cannot be used. [10]

2. Prove that the system

$x_1 + 2x_2 + x_3 = 6;$ $4x_1 + 3x_2 + x_4 = 12;$

$x_1 \geq 0, x_2 \geq 0; x_3 \geq 0, x_4 \geq 0$ has a basic feasible solutions

$x_1 = 0, x_2 = 0; x_3 = 6, x_4 = 12$. If possible find other set of basic feasible solutions. [10]

3. Show that the number of basic variables in a transportation problem of m origin and n destinations is at most m + n – 1. Explain the lowest cost entry method for obtaining an initial basic solution of the following transportation problem.

		Destinations			
		I	II	III	IV
Warehouse	1	21	16	25	13
	2	17	18	14	23
	3	32	27	18	41
Requirement		16	10	12	15

Also the total transportation cost according to the initial solution.

Or [6+3+1]

By Vogel approximation method, solve the following transformation problem:

O \ D	14	8	23
17	13	15	16
12	7	11	2
16	19	20	9

Group "B" 9×5=45

4. Use simplex method, solve the following:

Max $Z = 4x_1 + 10x_2$ subject to the constraints;

$2x_1 + x_2 \leq 50$; $2x_1 + 5x_2 \leq 100$; $2x_1 + 3x_2 \leq 90$; $X_1, x_2 \geq 0$. [5]

5. Show that the dual of the dual of an L.P.P. is the primal [5]

OR

Find the dual minimum of the following:

Max $Z = 2x_1 + 3x_2 + x_3$ subject to the constraints; $4x_1 + 3x_2 + x_3 = 6$; $x_1 + 2x_2 + 5x_3 = 4$; $x_1 \geq 0$, $x_2 \geq 0$, $x_3 \geq 0$. [5]

6. In a 2 × 3 transportation, draw a diagram which shows that the capacities of the sources and destination arid transfer matrix as well as the cost matrix. [5]

7. An office wants to buy two types of pens P_1 and P_2 from two contractors C_1 and C_2. The offers by C_1 are Rs.5 and Rs. 4 for P_1 and P_2 respectively while the offer by C_2 are Rs.5.40 and Rs.3.75 for them. Determine the model of assignments of the pens to the contractors by the office so that the cost of the office will be minimum. [5]

8. A children's game is as follows. Each of players R and C says 'stone' or 'disk' or 'paper', denoted by S, D, P respectively. If one says S and other says D, then the former wins two rupees from the latter. Similarly D beats P, and P beats S. If the two players name the same item, then the game is a tie. Set up the game matrix A. [5]

Or

Find the saddle points, if any and the optimal solution as well as the best strategy for each player of the two person-zero--sum game whose pay off matrix A is

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & -4 & -1 \\ 1 & 3 & -2 \end{bmatrix}$$

9. Determine the optimal sequence of 5 jobs on three machines in the order ABC that minimize the total elapsed time bases on the following information. Processing time on machines is given in hours and passing is not allowed. [5]

Jobs	1	2	3	4	5
Machine A	3	8	7	5	4
Machine B	4	5	1	2	3
Machine C	7	9	5	6	10

10. Determine whether the following non-linear programming problem has maximum or minimum value.

Optimize $Z = 2x^2 + y^2 + 3z^2 + 10x + 8y + 5z - 100$

Subject to the constraints

$x + y + z = 20,\ x, y, z \geq 0$ [5]

Or

Develop Kunn - Tucker condition for the following non-linear programing problem :

Max $Z = 36x - 4x^2 + 16y - 2y^2$

subject to the constrains

$2x + y \leq 10;\ x, y \geq 0.$

11. Find the solution of the difference equation $y_{x+2} + y_x = 3^x$ with initial conditions $y_0 = 0, y_1 = 1$

12. What is line segment joining two given points in $\mathfrak{R}^n$?

Show that the line segment is a convex set? [1+4]

Tribhuvan University, 2071

Bachelor Level/III Year/Hum. + Sc. & Tech. Full Marks: 75

Mechanics (Math.334) Time: 3hrs.

Attempt ALL the questions.

Group "A" 3×10=30

1. Define system of coplanar forces.

If six forces of the relative magnitudes 1, 2, 3, 4, 5 and 6 act along the sides of a regular hexagon, taken in order. Show that the single equivalent force is of the relative magnitude 6 and that its line of action is parallel to the force 5 at a distance from the centre of the hexagon which is 3.5 times the distance of the side from the centre.

OR

A uniform beam of length 2a, rests in equilibrium with one end resting against a smooth vertical wall and with a point of its length resting upon a smooth, horizontal rod which is parallel to the wall, and at a distance b from it. Show that the inclination of the beam to the vertical is $\sin^{-1}\left(\frac{b}{a}\right)^{1/3}$

2. Define angular velocity and angular acceleration. Obtain the expression for tangential and normal velocities.

3. Show that the MI of a semi-circular lamina of mass M and radius a about the tangent parallel to the bounding diameter is $Ma^2\left(\frac{5}{4}-\frac{8}{3\pi}\right)$

Group "B" 9×5=45

4. Forces P, 2P, 3P acts along the sides of a triangle formed by the lines x = 0, y = 0 and 3x + 4y = 5. Find the magnitude of the resultant and equation of the line of action.

5. Two equal uniform rods AB and AC, each of length 2b, are freely joined at A and rest on a smooth vertical circle of radius a show that, if 2θ be the angle between them then $b\sin^3\theta = a\cos\theta$.

OR

Four uniform rods are freely jointed at their extremities and form a parallelogram ABCD which is suspended by the joint A and is kept in shape by a string AC. Prove that the tension of the string is equal to half of the whole weight.

6. Define the term a vertex, axis, directrix, span and a sag of catenary. Further obtain the relation between x and ψ

7. Find the centre of gravity of the area bounded by the parabola $y^2 = 4ax$, the axis of x and the latus rectum.

8. A point describes uniformly a given straight line. Show that its angular velocity about a fixed point varies inversely as the square of its distance from the fixed point.

OR

A point moves in a curve, so that its tangential and normal accelerations are equal and tangent rotates with constant angular velocity. Prove that the equation of the path is of the form $S = Ae^{\psi} + B$

9. A particle moves in a straight line from a distance a towards the centre of the force, the force varying inversely as the cube of the distance. Show that the time of descent to the centre is $\frac{a^2}{\sqrt{\mu}}$.

10. If the orbit is a cardiod $r = a(1 + \cos\theta)$, find the law of force.

OR

A particle acted upon by a central attractive force $\frac{\mu}{r^3}$ is projected with velocity $\frac{\sqrt{\mu}}{a}$ at an angle $\frac{\pi}{4}$ with its initial distance a from the centre of force, prove that the orbit is $r = ae^{-\theta}$.

11. A particle is projected with velocity V from the cusp of a smooth inverted cycloid down the archaeology. Show that the time of $2\sqrt{\frac{a}{g}}\tan^{-1}\left(\frac{\sqrt{4ag}}{v}\right)$

12. Find the M.I of a hollow sphere of mass M about a diameter whose external and internal radii are a & b.