

**CHEMISTRY (CHEM321)**

Full Marks: 100

Time: 3 hrs.

**Bachelor level Science & Tech. /II Year 067**

*Use separate answer book for each group.*

**NEW COURSE**

The comprehensive question of each group is compulsory.

Attempt **EIGHT** questions of Short Answer questions of each Group.

**GROUP "A" (Inorganic)**

*Comprehensive Question*

1. What is meant by complex compound? How does it differ from double salt? Give the postulates of Werner's theory of coordination compounds. Explain EAN rule with examples. [1+1+4+3]

OR

How hydrazine and hydroxylamine are prepared? Write properties, structure and uses of hydrazine. (4+5)

*2. Short Answer Questions*

8x3=24

- 2.1: How is nickel extracted by Mond's process? Give chemical reactions involved in this process.
- 2.2. What is meant by solvent extraction? Explain its use for purification of metal with suitable example.
- 2.3. What are d-block elements? How does the ionization potential vary in 3d series of transition elements?
- 2.4. What is meant by solvated electron? Why is the solution of alkali metals in liquid ammonia acts as good conductors of electricity?
- 2.5. What is Grignard's reagent? How is it prepared from magnesium? Give any two uses of Grignard's reagent.
- 2.6. What is meant by electron deficient compound? Explain the bonding in diborane.
- 2.7. What is the Buckminster fullerene? How is it prepared?
- 2.8. What is meant by back bonding? Explain the bonding in metal carbonyl with an example.
- 2.9. Suggest reasons why  $PF_5$  is known but  $NI_5$  not.
- 2.10. Draw and explain the structures of  $XeF_4$ ,  $XeOF_4$  and  $XeO$ .
- 3.2.11. Though the electron affinity of chlorine is highest among the halogens it is not the most powerful oxidising agent. Why?

**Group "B" (ORGANIC)**

*Comprehensive Question*



3. Give an account of the stability of benzene on the basis of Resonance theory. Give the molecular orbital picture of benzene.

OR

[9]

Discuss the reactivity and orientation of monosubstituted benzene for electrophilic substitution reaction with reference to phenol, nitrobenzene and chlorobenzene.

4. short Answer Questions

8x3=24

- 4.1. What are axial and equatorial bonds?  
4.2. What is difference and similarity between Wolf Kishner and Clemenson reduction? Give the mechanism of any one of them.  
4.3. Give the preparation and uses of a polyamide.  
4.4. How would you identify the carbonyl group as a functional group by 2, 4-DNP test? Give reaction and mechanism.  
4.5. Discuss the mechanism of malonic and synthesis of carboxylic acid.  
4.6. Why phenols are more acidic than alcohols?  
4.7. How do you prepare amide derivative of a carboxylic acid? Give reaction with mechanism.  
4.8. Write the reaction mechanism of Fries rearrangement.  
4.9. Write the reaction when aniline reacts with HCl and  $\text{NaNO}_2$  and then alkaline  $\beta$ -naphthol.  
4.10. Discuss the basicity of primary, secondary and tertiary amine.  
4.1.1. Give the reaction and mechanism of base catalysed halogenations of ketone.

Group 'C' (Physical)

Comprehensive Question

[10]

2. What do you mean by rate of a reaction? Discuss the effect of temperature on the reaction rate. How do you calculate the activation energy of a reaction from the rate constant? A first order reaction is 20% complete in 30 minutes. How long it will take to be 50% complete.

[1+2+3+4]

OR

Discuss isothermal and adiabatic processes? Derive the PV relation in the adiabatic expansion of an ideal gas. Calculate the emf and equilibrium constant of the following electrochemical cell.

(Given: standard electrode potentials of  $\text{Zn}|\text{Zn}^{2+}$  and  $\text{Cu}|\text{Cu}^{2+}$  are  $-0.76\text{V}$  and  $0.35\text{V}$ , respectively).

$\text{Zn}|\text{Zn}^{2+}(0.01\text{M})||\text{Cu}^{2+}(0.1\text{M})|\text{Cu}$

[2+4+4]

6. Short Answer Questions

8x3=24

- 6.1. Discuss on the transition state theory of reaction rate qualitatively.



- 6.2. Write a note on the reaction mechanism of the reaction between oxygen and hydrogen bromide.
- 6.3. Write a short note on the adsorption theory of catalysis.
- 6.4. Define photochemistry. Point out some differences between thermal and photochemical reactions.
- 6.5. Discuss on Stark Einstein law of photochemical equivalence.
- 6.6. What do you mean by conductometric titration? Discuss the nature of curves obtained for strong acid versus strong base.
- 6.7. Discuss the Kohlraush law of independent migration.
- 6.8. How do you determine the pH of a solution using glass electrode? Discuss.
- 6.9. How do you determine the emf of an electrochemical cell using Nernst's equation? Discuss.
- 6.10. A Carnot engine working between  $0^{\circ}\text{C}$  and  $100^{\circ}\text{C}$  takes up 8.40 joules from the high temperature reservoir. Calculate the work done, heat rejected and the thermodynamic efficiency.
- 6.11. What is meant by free energy and work function? Point out their significances.

### **Microbial, Biochemistry and Biotechnology (MB.321) 067**

Full Marks: 100

Time: 3 hrs.

**New Course**

GROUP "A"

5x10=50

(Long Answer Questions)

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

1. Mention the general properties of amino acids. Classify the amino acids on the basis of polarity. [6+4]
2. Briefly describe the electron transport system and its significance. [8+2]
3. Describe microbiology and production process of beer fermentation. [10]
4. Describe various types of yoghurt and microbial technology of yoghurt production. [3+7]
5. What is translation? Describe the process of translation. [2+8]

OR

Describe microbial production, purification and activity determination protocol for  $\alpha$ -amylase enzyme.

GROUP "B"

5x7=35

(Short Answer Questions)



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

6. Classify the lipids with suitable examples.
7. Describe double helical structure of DNA.
8. Briefly mention the procedure of thin layer chromatography.
9. What is explant? Briefly mention the general steps of plant tissue culture.
10. Briefly describe risks and hazards associated to Biotechnology.
11. Compare solid state and submerged state fermentation process with example.

GROUP "C"

5x3=15

12. Very Short Answer Questions.

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

- a. Define cofactors and coenzymes.
- b. Draw chemical structure of two acidic amino acids.
- c. Point out the characteristics of top and bottom yeasts.
- d. What are biological buffers?
- e. Mention the significance of azotobacter as biofertilizer.
- f. Point out the role of bioinformatics in molecular biology.

### Old Course

Attempt ALL the questions.

GROUP "A"

1. Classify amino acids and mention their general properties. [15]
  2. Explain Krebs cycle and its significance. [15]
- OR
- Explain production process of cheese.

GROUP "B"

3. Describe general steps of plant tissue culture technique. [10]
4. Explain role of RNAs in protein synthesis. OR [10]  
Briefly explain general procedure of gene cloning.

GROUP "C"

10x5=50

5. Draw flow diagram of industrial production process of alcohol.
6. Point out major issues and hazards associated to Biotechnology.
7. Briefly explain any one of the methods of composting.
8. Briefly mention procedure of  $\alpha$ -amylase activity determination by Dingle's cup plate method.
9. Briefly mention procedure of thin layer chromatography.

10. Briefly, explain secondary structure of protein.
11. Explain genetic code.
12. Point out the biological functions of lipid.
13. Explain functions of water in cell system.
14. Point out differences between polysaccharides and monosaccharides.

### Zoology (Zol.321) 067

Bachelor Level / Science / 11 Year

Full Marks: 100

Time: 3 hrs.

*The figures in the margin indicate full marks.*

#### New Course

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

#### GROUP "A"

(Chordata)

[2x12.5=25]

Attempt any TWO questions.

1. Enumerate the external features of Lamprey and explain how this animal differs from a fish.
2. Describe the female reproductive organs of *Columba* with Well labelled sketch.
3. Give an account of the heart of *Calotes* and explain the mechanism of circulation of blood through it.

#### GROUP "B"

(Physiology, Cytology, Mol. & Dev. Biology) [2x12.5=25]

Attempt any TWO questions.

4. List four important properties of enzymes. How have enzymes been classified recently?
5. Give the structure and functions of nucleus.
6. Describe various kinds of RNA.

#### GROUP "C"

Attempt All the questions

7. Give the ecology of amphibians. [5]
8. Discuss the structure of alimentary canal in *Laheo* with the help of labelled sketch.

OR.

[5]

Give the functions of mitochondria. Why are mitochondria called power houses of the cell?



9. Give an account of the muscles of flight in the pigeon.
10. What is genetic code? Give three characteristics of genetic code.
11. Where are adrenal glands located in the- body? Write about its any one of the hormones. [5]
12. Describe Lampbrush chromosomes.

OR

[5]

Describe the development of Branchiostomia upto the formation of three germ layers

13. What is the role and importance of Electrocardiogram (ECG)? [5]
14. Give the structure of deciduous Placenta in Mammalia.
15. Write short notes on any TWO: [2x5=10]
  - a. Reptilian fauna of Nepal
  - b. Ecology of *Lophopus* sp.
  - c. Parkinson disease

### Old Course(Chordata, Cell & Tissue Biology)

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

Group 'A'

2x 15=30

1. Describe the structures of male and female reproductive organs of Scoliodon.
2. What is parental care? Discuss it in the amphibians giving examples.
3. Write an illustrative account of the structure of avian brain. Mention important advance features over that of the reptilian type.

Group 'B'

2x15=30

4. What is heart-beat? Write the mechanism of vertebrate heart beating.
5. Discuss the microscopic structures of secretions: Thyroid and Adrenal glands. Mention the roles of their secretions.
6. Give detail descriptions of a mitochondrion and explain the reason of calling it power - house of a cell

Group 'C'

8x5=40

7. Explain the affinities of Metatheria.
8. Describe the structure of buccal funnel of *Petromyzon*.
9. Give salient features of poisonous snakes giving examples.
10. Describe the structure of syrinx in pigeon.
11. Write the ecological notes of.
  - a. *Tyto*



b. Pangolin

12. Compare the histological structure of kidney of frog and rabbit.
13. What does the ultra-filtration indicate? Discuss it in detail,
14. Explain the mechanisms of crossing over.

**Meteorology II Paper (MET 321) 067**

Bachelor Level / Science & Tech. / II Year

Full Marks; 100

Time: 3hrs.

New Course

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

1. What are fronts? Explain different types of fronts with schematic diagrams. Derive an expression for frontogenetic factor in terms of deformation and divergence. [2+5+3]
2. Define tropical meteorology. What do you mean by tropical disturbances? Describe the formation, movement and forecasting of tropical cyclone. [1+2+7]
3. Define air mass. Explain general characteristics of air mass. State the possible reasons of the modification of air mass. [1+3+4]
4. What is the purpose of weather forecasting? How can you prepare synoptic charts and use them for weather forecasting. [2+6]
5. What is monsoon? Explain the features of south-west Indian monsoon and its influence in Nepal. [1+7]
6. Write short notes on any TWO of the following:
  - a. Frontogenesis and Frontolysis
  - b. Adiabatic processes and environmental lapse rate
  - c. LCL and CCL
7. Explain the variations of temperature, pressure and wind in the tropical region. [8]
8. What are the dominant cloud types in the tropical region? Explain the diurnal cloudiness variation in the tropical region. [3+5]
9. Explain rainfall associated with tropical cyclones. Why diurnal and local effects are important in the tropics? [4+4]
10. Write short notes on any TWO of the following:
  - a. Mesoscale rainfall distribution
  - b. Southern oscillation
  - c. Thunderstorm characteristics [4+4]
11. Define dynamical meteorology. Explain three conservation principles that are important in earth's atmosphere. [2+6]



12. What do you mean by pressure gradient force? Write down all basic equations in pressure coordinate with the explanation of symbol used.
13. What are barotropic and baroclinic atmosphere? Explain the kinematics method of determining the vertical motion of the atmosphere.
14. Derive continuity equation as

$$\frac{1}{p} \frac{dp}{dt} + \vec{\nabla} \cdot \vec{V} = 0$$

Also, explain what will be the result of this equation if the atmosphere is incompressible. [5+3]

15. What is geostrophic motion? Explain with vector form of its equation. Also, describe its application in the atmosphere. [1+4+3]
16. Write short notes on any TWO of the following:
  - a. Kelvin's theorem
  - b. Land and sea breezes [4+4]
  - c. Circulation and vorticity

#### Old Course (MET 321/322)

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

1. Define air mass and front. Give the distinguishing features of cold fronts and warm fronts. Also explain frontolysis and frontogenesis. [4+5+6]
2. How do the climatological factors affect agriculture? Consider four factors to answer this question. [15]
3. What are squall and gust, how are they hazardous for aviations. [5]
4. Give necessary conditions for the formation of tropical cyclone and explain why they do not form close to the equator. [5]
5. Explain the difference between mist, fog and frost: Which one is most hazardous for winter crop in Nepal? Explain. [5]
6. Derive a relation for continuity of a flow of homogeneous liquid. [5]
7. What is intertropical convergence zone, why thunderstorms are developed over these zones? [5]
8. What is CAT and explain the locations where they are likely to find. [5]
9. What is TAF, explain its importance for the safety of an air-craft. [5]
10. Write short notes on easterly and westerly waves in the tropics. [5]



11. Discuss total and local derivatives of three dimensional distributions of an atmospheric variable. [5]
12. Explain any two methods of weather modifications for agriculture practices. [5]
13. A fluid is flowing through a pipe of 6 cm diameter under a pressure of  $40 \text{ N/cm}^2$  and with mean velocity of  $22 \text{ m/s}$ . Determine the total head or total energy per unit weight of the fluid at the cross section that is 5m above the datum line. [5]
14. What is stream function? Prove that stream function is constant along a stream line. [1+4]
15. What are the conditions favourable for a thunderstorm development? [5]
16. State the Newtons law of viscosity and derive the equation of Newtons law of viscosity. [1+4]
17. Write short notes on:
  - a. Jet stream
  - b. Extra-tropical cyclone [2+3]
18. Discuss the stability criteria of atmosphere on the basis of parcel method. [5]
19. Write about Ridge, Trough, Col, High pressure and low pressure. [1+1+1+1+1]
20. Write down the atmosphere variables that are analysed on the surface and upper air charts. [5]

**Ecology, Physiology, Cytology and Genetics,  
Embryology and Anatomy (Bot.321) 067**

Bachelor Level /Science /II Yea/

Full arks: 100

Time: 3 hrs.

**New Course**

Attempt ALL the questions.

**SECTION 'A' (ECOLOGY)**

1. Describe the role of National Parks in biodiversity conservation of Nepal. [10]  
OR  
Describe the structural and functional features of forest ecosystem.
2. Discuss the sources and impacts of air pollution on plants and human health. [5]
3. Explain effects of temperature on living organisms. [5]



4. What is biogeochemical cycle? Explain phosphorus cycle in nature. [5]

### SECTION 'B' (PHYSIOLOGY)

5. Explain light independent processes in photosynthesis.  
OR [10]  
Explain the mechanism of respiration that occurs in mitochondria of the cell.
6. Differentiate between photo phosphorylation and oxidative phosphorylation. [5]
7. Role of micro nutrients in plant growth. [5]
8. Physiological role of Gibberellins [5]

### SECTION 'C' (CYTOLOGY & GENETICS)

9. What is linkage? Explain different types of linkage with suitable examples.  
OR [10]  
What is mutation? Describe chromosomal aberration and its role in evolution.
10. Explain the functions of DNA. [5]
11. Write the structure of chloroplast. [5]

### SECTION 'D' (EMBRYOLOGY)

12. What are multiple alleles? Explain it with a suitable example. [5]
13. Describe the process of development of a female gametophyte. [5]
14. Define palynology and explain its role in solving taxonomic problem. [5]
15. What is double fertilization? Discuss its significances.  
OR [5]  
Draw a well labelled diagram of dicot embryo. (Description not required.)

### SECTION 'E' (ANATOMY)

16. Describe anomalous secondary growth in a plant which has abnormal behaviour of normal cambium.  
OR [5]  
What is meristem? Classify and explain it on the basis of position.
17. Draw a well labelled diagram of T.S. of stem of a Xerophyte. (Description not required.) [5]

**Environmental Science (ENV 321) 2067**



## New Course

**Section 'A'**

1. Attempt any Three questions.

3x10=30

- 1.1. Discuss the causes of the degradation of freshwater habitats. Suggest the measures that can be employed for the restoration of such habitats.
- 1.2. The nicotine contents (in milligrams per kg) in two samples of tobacco were found as follows:

Observation	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Sample A	24	27	23	21	26	25	20	21	18	22	24	22	25	20
Sample B	27	30	28	31	22	36	30	28	32	34	32	26	34	36

Can it be said that two samples came from the normal populations having the same mean?

The critical values of 't' are as follows:

d.f	$\alpha$	0.10	0.05	0.02	0.01
25		1.708	2.060	2.485	2.787
26		1.706	2.056	2.479	2.779
27		1.703	2.052	2.473	2.771
28		1.701	2.048	2.467	2.763
29		1.699	2.045	2.462	2.756

- 1.3. What are the categories of runoff? Describe briefly on the factors that affect runoff.
- 1.4. What is remote sensing? Describe the role of remote sensing in ecological research.

**SECTION "B"**

2. Describe briefly any TEN Questions

10x5=50

- 2.1. Causes of rock weathering
- 2.2. Urbanization and its impact on landforms
- 2.3. Significance of rock mass rating
- 2.4. Snowfall and its measurement
- 2.5. Process of infiltration
- 2.6. El Nino
- 2.7. Urban climatology
- 2.8. Photochemical smog
- 2.9. Properties of water and its significance
- 2.10. Reconstruction of climatic data in Nepal
- 2.11. Cultural importance of freshwater ecosystems
- 2.12. Chemical history of the earth

**SECTION "C"**

3. Attempt ALL the Questions.

10x2=20

Differentiate between:

- 3.1. Phytoplankton and zooplankton
- 3.2. Rain and snow
- 3.3. Summer and winter monsoon



- 3.4. Troposphere and stratosphere
- 3.5. Rapid and pool zones
- 3.6. Aerial and ground photogrammetry
- 3.7. Confined and unconfined aquifers
- 3.8. Deflation and abrasion
- 3.9. Transpiration and interception
- 3.10. Parameter and statistic

### Old Course

#### SECTION "A"

1. Attempt any THREE questions 3x10=30
- 1.1 Discuss on the limiting factors that are likely to be especially important in fresh water ecosystems.
- 1.2. The relative abundance of parrot (*loriculus vernalis*) in corn field were found to vary from day to day. In a sample study, the following information were obtained:

Days	sun	mon	tue	wed	thu	fri	sat
Relative Abundance	124	133	129	126	125	127	130

Test that the relative abundance of parrots do not depend on the day of week.

d.f.	Level of significance	
	0.05	0.01
4	9.488	13.277
5	11.070	15.086
6	12.592	16.182
7	14.067	18.475

13. Explain the physical and bulls properties of soil.
- 1.4. What are evaporation and evapo transpiration? Explain the method of estimating evaporation from land surface using Penman's equation.

#### SECTION 'B'

2. Describe briefly any TEN questions. 10x5=50
- 2.1 Land water interchange.
- 2.2. Biotic components of the 'entic environment.
- 2.3. Application of GIS in environmental monitoring.
- 2.4. Impact of human on landscape.
- 2.5. Water as agents of geomorphological processes.
- 2.6. Chemical history of the earth.
- 2.7. Reactions of nitrogen in atmosphere.
- 2.8. Structure and properties of water.
- 2.9. Spatial and temporal patterns of climatic parameters in Nepal.
- 2.10. Elements of agroclimatology.
- 2.11. Various forms of precipitation.
- 2.12. Jet streams.

#### SECTION "C"

3. Attempt ALL the Questions. 10x2=20
- Differentiate between:

- 3.1. Rapid zone and pool zone



- 3.2. Dimictic and meromictic lakes
- 3.3. Stress and strain
- 3.4. Deformation and failure
- 3.5. Metallic and non-metallic minerals
- 3.6. Cat ion and an ion exchange
- 3.7. Primary and secondary air pollutants
- 3.8. Percolation and infiltration
- 3.9. Surface and subsurface flow
- 3.10. Median and mode

**Petrology, Historical Geology & Geology of Nepal and  
Adjacent Region (GEO.321) 067**

Bachelor Level / Science & Tech. / 11 Year

Full Marks: 100

Time: 3 hrs.

**NEW COURSE**

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

ALL questions carry equal marks.

**GROUP "A"**

1. Describe the TUGS classification system of plutonic and volcanic rocks with a neat sketch of triangular diagrams.

OR

Describe the tools for provenance *analysis and* factors affecting the composition of siliciclastic sedimentary rocks and their provenance interpretation.

2. (a) What do you mean by "depositional basin"? Describe.
2. (b) What is congruent melting? Describe briefly the inciting of the two component system: Anorthite ( $\text{CaAl}_2\text{Si}_2\text{O}_8$ ) - Diopside ( $\text{CaMgSiO}_3$ )<sub>2</sub> at 1 atmospheric pressure.
3. (a) Define the metamorphism. Explain in brief the different types of metamorphism.
- (b) What is diagenesis? Describe diagenetic stages and regimes.
4. (a) Explain the pressure (P) - temperature (T) time (t) path in metamorphism with suitable diagram.
- (b) Describe briefly the various types of igneous texture with neat sketches.
5. (a) What is metamorphic facies? Describe different types of metamorphic facies.
- (b) What is porphyroblast? Explain briefly the relationship between porphyroblasts and tectonism.
6. Write short notes on any TWO of the following:
  - a. Magma
  - b. Synsedimentary deformational structures
  - c. Metamorphic reaction

**GROUP "B"**



7. What is meant by geochronology? Describe the different methods used in radiometric dating.

OR

Discuss the major paleogeography and crustal movement during the Palaeozoic Era.

8. (a) Discuss the origin of atmosphere in brief.  
(b) Describe briefly the non-paleontological methods for stratigraphic correlation.
9. (a) What is stratigraphy? Describe the principles of stratigraphy.  
(b) Describe in brief the evidences of paleoenvironments of the river and glacier deposits.
10. Write short notes on any TWO of the following:  
a. Regression  
b. Index fossil  
c. folded mountain belts

**GROUP "C"**

11. Describe the stratigraphy and tectonics of the central Nepal Himalaya according to Stocklin and Bhattarai (1977)

OR

Describe the stratigraphy and tectonics of the eastern Nepal Lesser Himalaya (between Dudh Koshi and Mechi Rivers).

12. (a) Describe briefly the geology of the Tibetan-Tethys Himalaya along the Kaligandaki River valley section. (Colchen et. al. 1986)  
(b) Describe briefly the evolution of the Himalaya with sketches.
13. (a) Describe the geology of the Higher Himalaya.  
(b) Short notes on:  
a. Generalized lithostratigraphy of the Siwaliks  
b. Peninsular India

**Old Course**

Attempt ALL the questions.

**GROUP "A"**

1. (a) What do you understand by intrusive igneous rocks? Discuss their relation to geological structures.  
(b) What do you understand by magmatic mixing and assimilation? Discuss briefly.
2. (a) What is meant by phase rules? Describe the crystallization process of a two component system with solution under 1 bar atmosphere. What happens when the pressure increases?  
(b) Write short notes on any THREE of the following:  
(i) Gabbro  
(ii) Pyroclastic material  
(iii) Bowen's reaction principle  
(iv) Geothermal gradient



3. (a) Define metamorphic facies. Describe the characteristics of metamorphic rocks.  
(b) What do you understand by metamorphic differentiation? Describe briefly.
4. Write short notes on any THREE of the following:
- Cataclastic metamorphism
  - Index minerals of metamorphism
  - Eclogite
  - Marble
5. (a) Describe mineralogical composition of limestone. Discuss the classification of limestones.  
(b) What are primary structures of sedimentary rocks? Describe them with neat sketches.
- OR
- Write short notes on the following:
- Non-marine sedimentary facies Geosyncline
  - Bedded iron deposits

GROUP "B"

- 6 (a) What is solar system? Describe briefly the evolution of the earth.  
(b) What is geochronology? Discuss the theoretical basis of radiometric dating.
7. (a) Describe briefly the methodology of paleotectonic reconstruction.  
(b) Distinguish between:
- Biocoenose and thanatocoenose
  - Diastem and angular unconformity
8. (a) Define correlation. Describe its importance in geology.  
(b) Write notes on the following:
- Petrification
  - Uniformitarianism: principle of Hutton

OR

- (a) Describe the tectonic history of Jurassic Period.  
(b) Differentiate between craton and shield. Discuss the main phases of evolution of cratons.

GROUP 'C'

9. Discuss in brief the geology of Far Western Nepal and show its relation with the geology of eastern Kumaou Himalaya.
- OR

Write short notes on:

- Mahabharat Synclinorium
- STDS and MCT
- Stratigraphy of the Siwaliks

- 10 (a) Discuss the geology of Tethys Zone of Nepal with special reference to Thak Khola area.



(b) Describe briefly the geology of Tansen area.

TRIBHUVAN UNIVERSITY

**Computer Science (Information System Design / Data Structure)  
(CS.321) 2067**

Bachelor Level / II Year / Science & Tech.

Full Marks: 100

Time: 3 hrs.

*The figures in the margin indicate full marks.*

**Group "A" (Information System Design)**

**1. Long Answer Questions**

Attempt any TWO Questions.

2x10=20

- 1.1. Describe the system development life cycle model and explain its different phases.
- 1.2. Explain in detail about the detailed system design.
- 1.3. Describe different CASE tools with their use in system design and development.

**2. Short Answer Questions**

Attempt ALL the Questions.

10x3=30

- 2.1. What is negative feedback? What are its uses in system design?
- 2.2. Define data dictionary and its use in system design. 2.3. Explain in brief about ER diagram.
- 2.4. Why planning is required in the information system design. 2.5. Why IS standard are important? Explain.
- 2.6. What do you mean by prototype system design and when it is mostly used?
- 2.7. What do you understand by post-operation evaluation? 2.8. Differentiate between DFD and Context diagram. 2.9. List the functions of system analyst.
- 2.10. What do you mean by system implementation? Describe cut-over method.

**Group "B" (Data Structure and Algorithm)**

**3. Long Answer Questions**

Attempt any TWO Questions.

2x10=20

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



algorithm? Write the merits and demerits of recursion in programming.

#### 4. Problems

Attempt any TWO Questions.

2x5=10

- 4.1. Write a C program for bubble sort.
- 4.2. Write a C function for insertion and deletion operations in ques.
- 4.3. Write a C function to traverse a binary tree in preorder.

#### 5. Short Answer Questions

Attempt ALL the Questions.

8x2.5=20

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

### Physics II Paper (Phy.321) 2067

#### (Optics, Atomic & Nuclear Physics, Electronics)

Bachelor Level / Science & Tech. / II Year

Full Marks: 100

Time: 3hrs.

*The figures in the margin indicate full marks.*

#### New Course

Attempt ALL the questions.

1. Describe the construction and the principle of working of Michelson's interferometer.

OR

Explain Huygen's theory of double refraction in an uniaxial crystal. Also explain how a quarter wave plate is used to detect elliptically polarized light. [4+6]

with a quarter wave plate is used to detect elliptically polarized light.

2. What are the general characteristics of Sommerfeld elliptical orbits? Show that the energy of the electron of hydrogen atom in sommerfeld orbits is the same as that in Bohr's orbit.



OR

Write down the processes by which gamma rays interact with matter with respect to their energies and present the theoretical details of Compton effect. [4+5]

3. Explain the working of bridge rectifier and describe the *action of R-C filter* in smoothing the ac components. Also write down the equivalent circuits for diode approximations you know. [3 3+3]

OR

What is FET? Discuss its characteristics. Also describe the operation of a shunt switch and series switch.

4. What is a plane transmission grating? Discuss the theory of its resolving power. [6]

OR

Describe the working of Ramsden's eye-piece indicating its cardinal points. Write down its merits over Huygen's eye-piece.

5. State Bragg's and Mosley's laws and explain their significances. [2+2+2]

OR

Describe the theory and *working* of a linear accelerator. [6]

6. Present the theory of a phase shift oscillator. [6]

OR

Discuss gain stability and bandwidth in negative feedback amplifier.

7. Answer All questions: 6x3=18

- a. Explain how the coherent sources are produced in Fresnel's bi-prism and Wyot's mirror experiments.
- b. Explain, with figures, the meaning of spherical and chromatic aberrations.
- c. Are the nuclear densities of  ${}^O_{16}$  and  ${}H^2$  same? Present the justification of your answer.
- d. What do you mean by fine structure of hydrogen lines? Explain.
- e. Explain the significance of Q point on a load line.
- f. Point out the difference between zener and avalanche effects in semiconductor.
8. Calculate the radii of the first two clear elements of a zone plate which is designed to bring a parallel beam of light of wavelength 600 nm to the first focus at a distance of 2 meters.
9. Light of wavelength 650 nm falls normally on a thin wedge shaped film of refractive index 1.4 forming fringes that are 2 mm apart. Find the angle of wedge in degree [6]



10. A photon of wavelength 1500 Å is absorbed by cold mercury vapour and two other photons are emitted. If one of them has the wavelength 1800 Å what is the wavelength of the other photon?
11. Find the Q-value of a  $(Be_4^9, C_6^{12})_n$  reaction if the masses of a  $Be_4^9$ ,  $C_6^{12}$  and neutron are respectively 4.003870, amu, 9.01536 amu, 12.003316 amu and 1.008986 amu. [6]
12. Draw a suitable circuit of your own to explain Thevenin's theorem. [6]
13. Add and subtract two binary numbers 111101 and 11011 and write results in decimal equivalent.

### old Course

Attempt ALL the questions.

1. Explain the difference between spatial and temporal coherences and develop the theory of interference due to reflected wavefronts from a rectangular slab. Also explain that the intensity distributions of interference pattern due to reflected and transmitted waves are complimentary to each other. [2+6±2]

OR

Explain the physical significance of a zone plate. How is this constructed? Develop a theory for its working. How is its use compared with these of optical lenses? [2+2+4+2]

2. What are range, straggling and stopping power of alpha particle? Explain the significance of (i) Geiger law and (ii) Geiger-Nuttall law. [3+3+3]

OR

What are continuous and characteristic X-rays? State and explain the significance of Mosley's law. Does this law correspond to Bohr theory? Justify your answer. [2+4+3]

3. How are positive and negative feedbacks different in semiconductor circuits? Draw a circuit diagram of a Hartley oscillator and obtain expressions for its frequency and the condition for sustained oscillation. [2+2+5]

OR

How are JFET and UJT constructed? Discuss the characteristics and important uses of JET. [2+2+5]

4. Describe the construction and working principle of He-Ne gas laser. OR [6]

How are circularly and elliptically polarized lights produced and detected? Explain.



5. Describe Stern-Gerlach experiment with necessary theory and important conclusions. [6]

OR

Discuss, in brief, the interaction processes of gamma rays with matter.

6. What are the basic differences between Norton's and Thevenin's network theorems? Explain one of them with an example of your own. [6]

OR

What are logic gates? Describe the working of AND and NAND gates with corresponding truth tables.

7. Answer all questions: [6x3=18]

- Explain how chromatic aberration can be removed in lenses.
  - Describe with basic technique the working principle of holography.
  - Write down the conclusions of Franck - Hertz experiment.
  - How can one estimate the binding energy per nucleon of the nucleus X? Explain.
  - Explain the concept of forward and reverse biasing in transistor circuits. Write notes on depletion layer.
8. Number of lines per centimeter on a plane transmission grating is 6000. If a light of wavelength 600nm is incident normally on the grating find the difference in angles of deviation between 2nd and 3rd order spectra. [6]
9. A glass wedge of an angle 0.01 radian is illuminated by monochromatic light of wavelength 5500Å falling normally on it. At what distance from the edge of the wedge will the 10<sup>th</sup> fringe be observed by reflected light? [6]
10. In a normal Zeeman experiment the spectral line of wavelength 500 nm splits into three lines separated by 0.28Å in a magnetic field of 3T. Calculate the value of the specific charge of electron from these data. [6]
11. A cyclotron with dees of radius 90 cm has a transverse magnetic field of 0.8T. Calculate the energies to which (i) a proton and (ii) deuteron are accelerated. [6]
12. Estimate gain with feedback, output voltage, feedback factor and feedback voltage in a negative feedback amplifier with  $A = 100$ ,  $\beta = 0.04$  and  $V_1 = 50$  mV where notations carry usual meanings. [6]
13. Write down the decimal number 115 and 7.5 into binary equivalents. Also find their sum and difference in binary systems. [6]

### Algebra I (Math .321) 2067

Bachelor Level / Plum. + Science & Tech./ II Year



## New Course

Attempt ALL the questions.

## Group 'A'

5x7=35

1. What do you mean by consistent and inconsistent equation? Prove that a set of simultaneous linear equation is consistent if the rank of the coefficient matrix is equal to the rank of the augmented matrix, otherwise it is inconsistent. Using this, show that the equation  $x + 2y = 1$ ,  $5x - 6y = -7$  are consistent. [1+4+2]
2. How do you define cyclic group and its generator? Prove that the order of a cyclic group is the same as the order of its generator. Also show that subgroup of a cyclic group is cyclic. [1+4+2]

OR

Prove the following:

- (i) If  $a$  is a fixed element of a group  $G$  then  $H = \{x \in G : ax = xa\}$  is a subgroup of  $G$ .
  - (ii) If  $H$  is a subgroup of  $G$  and if  $xHx^{-1} = \{xhx^{-1} : h \in H\}$  for all  $x \in G$ , then  $xHx^{-1}$  is a subgroup of  $G$ . [3+4]
3. Define Boolean ring. Prove that it is commutative ring. [1+6]

OR

Define integral domain with an example. Prove that a finite integral domain is a field. What happens if it is not finite? [1+5+1]

4. Let  $V$  and  $W$  be vector spaces over the same field  $F$ . Define kernel of  $T$  and image of  $T$  where  $T : V \rightarrow W$  is a linear transformation. Prove that
  - (i) the kernel of  $T$  is a subspace of  $V$  and
  - (ii) the image of  $T$  is a subspace of  $W$ . Let  $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$  be a linear transformation defined by  $T(x, y, z) = (0, y, z)$ , find  $\ker T$  and  $\text{Im} T$ . [1+4+2]
5. Find the relation between roots and coefficients of the equation  $f(x) = x^n + p_1x^{n-1} + p_2x^{n-2} + \dots + p_{n-1}x + p_n = 0$ .  
Solve the equation  $x^3 - 6x^2 + 3x - 10 = 0$ , where roots are in arithmetical progression. [3+4]

## Group "B"

10x4=40

6. Define trace of a matrix. Let  $A$  and  $B$  are the square matrices of order  $n \times n$  then prove that  $\text{tr}(AB) = \text{tr}(BA)$ . [1+3]



Prove that

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

7. Show that the numbers 325 and 131 are relatively prime to each other. Find  $m$  and  $n$  such that  $325m + 131n = 1$ . [4]

8. What do you understand by normal subgroup of a group?

If  $Q : G \rightarrow \bar{G}$  is a group homomorphism where  $G$  and  $\bar{G}$  are groups. Show that kernel  $K_\phi$  is a normal subgroup of  $G$ . [1+3]

9. Define ideal of a ring  $R$ . If  $U$  is an ideal a ring  $R$  with unity and  $1 \in U$ , prove that  $U = R$ . [1+3]

10. Reduce the matrix  $\begin{pmatrix} 0 & 1 & -3 \\ 2 & 1 & 4 \\ 1 & 2 & 1 \end{pmatrix}$  to Echelon form. Hence find its rank. [3+1]

OR

State Layley - Hamilton Theorem. Use it find the inverse of the

matrix  $A = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 2 \end{pmatrix}$ . [1+3]

11. Find the scalar and vector projection of the vector  $(1, 2, 3)$  onto the vector  $(4, -1, 3)$ . Give the geometrical interpretation of these projections. [3+1]

12. Show that the vectors  $\{(1,1,1), (1,-1,1), (2,0,3)\}$  form a basis of  $\mathbb{R}^3$ . Find the coordinates of  $(1, 3, 2)$  with respect to these basis. [3+1]

13. Define linear transformation. Let  $V$  and  $W$  be two vector spaces over the same field  $F$ . Prove that a transformation  $T : V \rightarrow W$  is linear if and only if  $T(av_1 + bv_2) = aT(v_1) + bT(v_2)$  for any  $a, b \in F$  and  $v_1, v_2 \in V$ . [1+3]

OR

Define eigen vector. Find the eigen vector of the matrix  $\begin{pmatrix} 0 & 3 \\ 2 & -1 \end{pmatrix}$ . [1+3]

14. Solve by Cardon's method:  $9x^3 - 6x^2 + 1 = 0$ . [4]

15. Find the integer roots of the equation  $x^4 - 2x^3 - 13x^2 + 38x - 24 = 0$ . [4]

OR

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

$$x^4 - 5x^3 + 40x^2 - 8x + 23 = 0 \quad [1+3]$$



**Mathematical Analysis I (Math. 322) 2067**

Bachelor Level / 11 Year / Hum. + Sc. & Tech.

Full Marks: 75

Time: 3 hrs.

The figures in the margin indicate full marks.

New Course

Attempt ALL the questions.

Group "A"

5×7=35

1. Define a function  $f : X \rightarrow Y$  and its inverse. Prove that the inverse function  $f^{-1} : Y \rightarrow X$  exists if and only if the function  $f$  is one-to-one and onto. [2+5]
2. Define a convergent sequence. Show that if  $\{x_n\}$  converges to a real number  $x$ , then every subsequence of  $\{x_n\}$  converges to  $x$ . Also, prove that if  $0 < x < 1$ , then  $\{x^{1/n}\}$  converges to 1. [1+2+4]

OR

Define a convergent sequence. Show that if  $\{x_n\}$  converges to a real number  $x$ , then every subsequence of  $\{x_n\}$  converges to  $x$ . Let  $A$  be a set in  $\mathbb{R}$ . Prove that a real number  $x$  is an adherent point of  $A$  iff there is a sequence  $\{x_n\}$  in  $A$  converging to  $x$ , then every subsequence of  $\{x_n\}$  converges to  $x$ . [1+2+4]

3. Prove that if  $\{x_n\}$  is a decreasing sequence of positive numbers and  $\lim_{n \rightarrow \infty} x_n = 0$ , then the series  $\sum_1^{\infty} (-1)^{n-1} x_n$  converges. Show that  $\sum (-1)^{n-1} \frac{n}{4n-1}$  converges. [4+3]

OR

State Leibnitz test. Define absolute and conditional convergences. Give an example of a series which is convergent conditionally, but not absolutely. Prove that absolute convergence of a series implies conditional convergence of the series. [1+1+2+3]



4. Define increasing, decreasing, strictly increasing and strictly decreasing functions. Prove that if  $f$  is continuous on  $[a, b]$  and differentiable on  $(a, b)$ , then the function  $f$  is increasing on  $[a, b]$  iff  $f'(x) \geq 0$  for all  $x$  in  $(a, b)$ . [2+5]

5. State and prove the second fundamental theorem of integral calculus. If  $f$  and  $g$  are continuous on  $[a, b]$  and have primitives  $F$  and  $G$  on  $[a, b]$ , then

$$\int_a^b F(x)g(x)dx = [F(x)G(x)]_a^b - \int_a^b f(x)G(x)dx$$

[5+1+1]

Group "B"

10×4=40

6. Show that if  $p, q$  and  $r$  stand for statements, then  $p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$  is a tautology. [4]

7. State the field axioms of the real number system for multiplication. Let  $a, b$  and  $c$  be real numbers. Prove that if  $ac = bc$ , then  $a = b$ , thereupon indicating the axioms of the real number system. [2+2]

8. Prove that the set of all infinite sequences of natural numbers is uncountable. [4]

OR

Prove that the Archimedean property is equivalent to each of the following statements:

a.  $\mathbb{N}$  is unbounded, i.e.  $\forall b \in \mathbb{R} \exists n \in \mathbb{N} : n > b$

b.  $\forall c > 0 \exists n \in \mathbb{N} : 0 < \frac{1}{n} < c$ . [2+2]

9. Prove that a finite union of closed sets in  $\mathbb{R}$  is closed in  $\mathbb{R}$  and an arbitrary union of closed sets in  $\mathbb{R}$  may not be closed in  $\mathbb{R}$ . [2+2]

OR

Define a limit point. Prove that the derived set  $A'$  is closed. [1+3]

10. Define a bounded set. Prove that a set in  $\mathbb{R}$  is bounded iff it is contained in an open 1 - ball. [1+3]



11. Show that the function given by  $f(x) = 1/x$  is continuous on  $\mathbb{R}$ ? [4]  
OR

Prove that if a function  $f$  is continuous on a closed and bounded interval  $[a, b]$  then  $f$  is uniformly continuous on the interval, [4]

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

Define increasing and decreasing functions. Determine the intervals of increase and decrease of the function [1+3]  
 $x$

$$\sqrt{x^2 - 4}$$

14. Define upper Darboux sum, lower Darboux sum and Riemann sum. Prove that if  $f$  is bounded on  $[a, b]$  and  $P$  a partition of  $[a, b]$  then

$$m(b-a) \leq L(f, P) \leq (f, P) \leq M(b-a),$$

where  $M = \sup \{f(x) : x \in [a, b]\}$  and

$$m = \inf \{f(x) : x \in [a, b]\}$$

[2+2]

OR

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

15. Let  $c \in (a, b)$ . Prove that if  $f$  is integrable on  $[a, c]$  and  $[c, b]$ , then  $f$  is integrable on  $[a, b]$  and

$$\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx$$

### Statistics II Paper (Stat.321) 2067

Bachelor Level / II Year/ Humanities + Sc. & Tech.

Full Marks: 100

Time: 3 hrs.

The figures in the margin indicate full marks.

#### New Course

1. (Compulsory) Attempt any SIX questions.

6x5=30

- Distinguish between parametric and non-parametric test. State the underlying assumptions in parametric test.
- Explain the principle of maximum likelihood estimation of population parameter.
- What is truncation of distribution? Give examples of the situations when the truncation distribution arises.
- Define chi-square distribution. State its applications.
- The joint probability density function of a two dimensional variable  $(X, Y)$  is given by

$$f(x, y) = \begin{cases} 2, & 0 < x < 1, \quad 0 < y < x \\ 0; & \text{elsewhere.} \end{cases}$$

Find the marginal density function of  $X$  and  $Y$ .

- Define and elaborate type I and type II errors in testing the hypothesis.
- The average monthly earnings for female social workers is Rs. 12,500. Do men in the same positions have average monthly



earnings are higher than those for women? A random sample of  $n = 40$  male social worker showed  $X = \text{Rs.}13,800$  and  $S = \text{Rs.}3,000$ . Test the appropriate hypothesis at 5% level of significance.

**Group "A"**

Attempt any FOUR questions.

4x7=28

- Find the mean and variance of truncated binomial distribution.
- If  $X_1$  and  $X_2$  are independent rectangular variates on  $[0, 1]$ , find the distribution of  $X_1 X_2$ .
- State central limit theorem. The lifetime of a certain brand of an electric bulb may be considered a random variable with mean 1200 hrs. and standard deviation 250 hrs. Find the probability, central limit theorem, the average life time of 60 bulbs exceeds 1250 hrs.
- The joint distribution of  $X$  and  $Y$  is given below:

$X$	0	1	2	3
$Y$				
	o	o	k	k
	1	k	2k	0

Find ①K ② $v(X)$  ③ $E(2Y + 3)$

④ conditional distribution of  $X$  given  $Y = 0$

- A variate  $X_n$  has the distribution:

$$P[X_k = 0] = 1 - \frac{2}{3^{2k+2}}, P[X_k = 3^k] = P[X_k = -3^k] = \frac{1}{3^{2k+2}}$$

Does the weak law of large number hold for the sequence  $\{X_k\}$ .

**Group "B"**

Attempt any SIX questions.

6x7=42

- Prove that in a random sampling, the sample mean is an unbiased estimate of the population mean.
- From the following table, test the hypothesis that the flower colour is independent of flatness of leaf.

	Flat leaves	Curled leaves
White flower	65	25
Pink flower	42	28
Red flower	15	35

- Obtain the best critical region for the population  $f(x, \theta) = \theta e^{-\theta x}$  for  $x \geq 0$  of size  $\alpha_1$ , for testing  $H_0: \theta = \theta_0$  against  $\theta = \theta_1$ .
- Show that  $t^2$  is a F distribution.
- Samples of two types of electric bulbs were tested for length di life and the following data were obtained.

	Sample 1	Sample 2
Size	8	7
Mean	1230	1025
S.D.	25	36

Is the difference in the means sufficient to warrant that type 1 bulb is superior to type 2 bulb? Use 5% level of significance.



12. Given below are the mileages (in thousand miles) of two samples of automobile tires of two different brands I and II, before they wear out.

Tire I:	34	32	37	35	42	43	47	58	59	62	69	71	78	84
Tire II:	39	48	54	65	70	76	87	90	111	118	126	127		

Use the median test to see the whether the tire II gives more median mileage than tire I. Use  $\alpha = 0.05$ .

13. What are the criteria of good estimators? Explain.

### Algebra I (Math. 321) 2067

Bachelor Level / Hum. + Science & Tech./ II Year

Full Marks: 75

Time: 3 hrs.

New Cotarse Attempt ALL the questions.

#### Group 'A'

5x7=35

- What do you mean by consistent and inconsistent equation? Prove that a set of simultaneous linear equation is consistent if the rank of the coefficient matrix is equal to the rank of the augmented matrix, otherwise it is inconsistent. Using this, show that the equation  $x + 2y = 1$ ,  $5x - 6y = -7$  are consistent. [1+4+2]
- How do you define cyclic group and its generator? Prove that the order of a cyclic group is the same as the order of its generator. Also show that subgroup of a cyclic group is cyclic. [1+4+2]

OR

Prove the following:

- If  $a$  is a fixed element of a group  $G$  then  $H = \{x \in G : ax = xa\}$  is a subgroup of  $G$ .
- If  $H$  is a subgroup of  $G$  and if  $xHx^{-1} = \{xhx^{-1} : h \in H\}$  for all  $x \in G$ , then  $xHx^{-1}$  is a subgroup of  $G$ . [3+4]
- Define Boolean ring. Prove that it is commutative ring. [1+6]

OR

Define integral domain with an example. Prove that a finite integral domain is a field. What happens if it is not finite? [1+5+1]

- Let  $V$  and  $W$  be vector spaces over the same field  $F$ . Define kernel of  $T$  and image of  $T$  where  $T : V \rightarrow W$  is a linear transformation. Prove that
  - the kernel of  $T$  is a subspace of  $V$  and
  - the image of  $T$  is a subspace of  $W$ . Let  $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$  be a linear transformation defined by  $T(x, y, z) = (0, y, z)$ , find  $\ker T$  and  $\text{Im} T$ . [1+4+2]

- Find the relation between roots and coefficients of the equation  $f(x) = x^n + p_1x^{n-1} + p_2x^{n-2} + \dots + p_{n-1}x + p_n = 0$ . Solve the equation  $x^3 - 6x^2 + 3x - 10 = 0$ , where roots are in arithmetical progression. [3+4]

#### Group "B"

10x4=40

- Define trace of a matrix. Let  $A$  and  $B$  are the square matrices of order  $n \times n$  then prove that  $\text{tr}(AB) = \text{tr}(BA)$ . [1+3]



OR

Prove that

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

7. Show that the numbers 325 and 131 are relatively prime to each other. Find  $m$  and  $n$  such that  $325m + 131n = 1$ . [4]

8. What do you understand by normal subgroup of a group?

If  $Q : G \rightarrow \bar{G}$  is a group homomorphism where  $G$  and  $\bar{G}$  are groups. Show that kernel  $K_\phi$  is a normal subgroup of  $G$ . [1+3]

9. Define ideal of a ring  $R$ . If  $U$  is an ideal a ring  $R$  with unity and  $1 \in U$ , prove that  $U = R$ . [1+3]

10. Reduce the matrix  $\begin{pmatrix} 0 & 1 & -3 \\ 2 & 1 & 4 \\ 1 & 2 & 1 \end{pmatrix}$  to Echelon form. Hence find its rank. [3+1]

OR

State Layley - Hamilton Theorem. Use it find the inverse of the

matrix  $A = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 2 \end{pmatrix}$ . [1+3]

11. Find the scalar and vector projection of the vector  $(1, 2, 3)$  onto the vector  $(4, -1, 3)$ . Give the geometrical interpretation of these projections. [3+1]

12. Show that the vectors  $\{(1,1,1), (1,-1,1), (2,0,3)\}$  form a basis of  $\mathbb{R}^3$ . Find the coordinates of  $(1, 3, 2)$  with respect to these basis. [3+1]

13. Define linear transformation. Let  $V$  and  $W$  be two vector spaces over the same field  $F$ . Prove that a transformation  $T : V \rightarrow W$  is linear if and only if  $T(av_1 + bv_2) = aT(v_1) + bT(v_2)$  for any  $a, b \in F$  and  $v_1, v_2 \in V$ . [1+3]

OR

Define eigen vector. Find the eigen vector of the matrix  $\begin{pmatrix} 0 & 3 \\ 2 & -1 \end{pmatrix}$ . [1+3]

14. Solve by Cardon's method:  $9x^3 - 6x^2 + 1 = 0$ . [4]

15. Find the integer roots of the equation

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

OR

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

$$x^4 - 5x^3 + 40x^2 - 8x + 23 = 0 \quad [1+3]$$