[This question paper contains 5 printed pages.]

Your Roll No... 2019

Sr. No. of Question Paper : 7273 J

Unique Paper Code : 42351101 – OC

Name of the Paper : Calculus and Matrices

Name of the Course : **B.Sc. (Mathematical Sciences) / B.Sc. (Prog.)**

Semester : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **two** questions from each section.

SECTION – I

1. (a) Verify that the set $S = \left\{ \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \\ 2 \end{bmatrix}, \begin{bmatrix} 0 \\ 2 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} \right\}$ is a

basis of R^4.   (6)

P.T.O.

(b) Is $W = \left\{ \begin{bmatrix} x \\ y \\ 2x \end{bmatrix} : xy > 0 \right\}$ a subspace of R^3? Justify your answer. (6)

2. (a) Let $T : R^3 \to R^3$ be defined by

$$T \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x+y \\ y-z \\ x-z \end{bmatrix}$$

Show that T is a linear transformation. Also find a matrix representation for T. (6)

(b) Find the eigenvalues of the matrix

$$\begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{bmatrix}.$$ (6)

3. (a) Determine the unique solution of the following system of equations

$x + y + z = 6$

$2x + 3y + 4z = 20$

$x + y = z.$ (6)

(b) Find the rank of the matrix

$$\begin{bmatrix} 5 & 3 & 14 & 4 \\ 0 & 1 & 2 & 1 \\ 1 & -1 & 2 & 0 \end{bmatrix}.$$ (6)

SECTION – II

4. (a) (i) Determine whether the sequence $\left\{ 1 + \dfrac{(-1)^n}{n} \right\}$ is bounded and monotonic.

(ii) Compute $\lim\limits_{n \to \infty} \left\{ \dfrac{\cos n}{n} \right\}.$ (6)

(b) Find the nth derivative of $y = e^{3x} \sin(4x+1)$. (6)

(c) If $y = (\sin^{-1}x)^2$, prove that

$(1-x^2) y_{n+2} - (2n+1)xy_{n+1} - n^2 y_n = 0.$ (6)

5. (a) Sketch the graph of $y = e^{-x} + 1$. (6)

P.T.O.

(b) According to Newton's Law of Cooling, the rate at which a substance cools in air is proportional to the difference between the temperature of the substance and that of the surrounding air. If the temperature of the air is 30°C and the substance cools from 100°C to 80°C in 20 minutes, find when the temperature will be 40°C. (6)

(c) Find the Taylor series generated by $f(x) = \dfrac{1}{x}$ at x = 2. (6)

6. (a) Draw the level curves for the surface $z = 9x^2 + 25y^2$ at heights k = 1, 2, 3. (6)

(b) Find all the second order partial derivatives of $f(x, y) = e^{x-3y}$. (6)

(c) Verify that $z = e^x \sin(y) + e^y \cos(x)$ is a solution of the Laplace equation. (6)

SECTION – III

7. (a) Prove that the product of all the nth roots of unity is $(-1)^{n-1}$. (4)

(b) Represent graphically the set $\{z : |z| \leq |z - 1|\}$. (3½)

8. (a) Evaluate $\dfrac{(Cos\,\alpha + i\,Sin\,\alpha)^4}{(Sin\,\beta + i\,Cos\,\beta)^5}$. (4)

(b) State fundamental theorem of algebra. Form an equation in lowest degree with rational coefficients having $\sqrt{3} + 2$ and $\sqrt{5} - 2$ as two of its roots. (3½)

9. (a) Find the equation of the circle described on the join of the points given by $-1 -3i$ and $5+7i$ as extremities of one of its diameters. (4)

(b) Find the equation of the straight line joining the points whose affixes are $2-5i$ and $1-i$. (3½)

(900)

Your Roll No...........
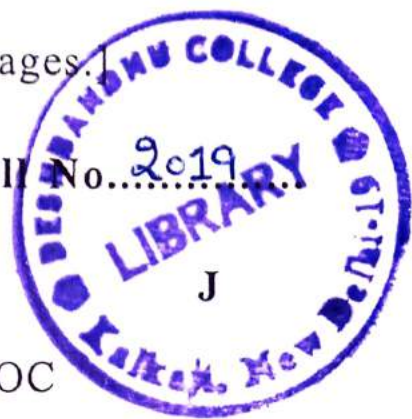
Sr. No. of Question Paper : **7318**　　　　　　J

Unique Paper Code　　　　: 42171103 – OC

Name of the Paper　　　　: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbon

Name of the Course　　　　: **B.Sc. (Prog.)**

Semester　　　　　　　　: I

Duration : 3 Hours　　　　　　Maximum Marks : 75

Instructions for Candidates

1.　Write your Roll No. on the top immediately on receipt of this question paper.

2.　Attempt any **three** questions from each Section.

3.　Use separate Answer booklet for each section.

SECTION – A

1.　(a) Electronic Configuration of Cu is $3d^{10} 4s^1$ and not $3d^9 4s^2$. Explain.

　　(b) What are some special properties which must be fulfilled by the acceptable solution of the wave equation?

P.T.O.

(c) Though the radii of Ag^+ is comparable with the radii of K^-, but the melting point of AgCl is much lower than that of KCl. Explain.

(d) How Born Haber's Cycle can explain the stability of ionic compounds?

(e) Explain why PCl_5 is more reactive than SF_6 Molecule.   (2.5,2.5,2.5,2.5,2.5)

2. (a) Write Schrodinger's wave equation and explain various terms involved in it.

(b) Explain why orbitals 1p, 2d or 3f are not possible?

(c) Explain the stability of half-filled and fully-filled orbitals.

(d) Plot radial probability distribution curves for 4s, 4p, 4d and 4f orbitals.   (2.5,3,3,4)

3. (a) Observed dipole moment of HX molecule is 1.92 D and bond distance is 1.20 Å. Calculate the % ionic character of the molecule, HX.

(b) Write the hybridization of the central atom and shape of the following molecules.

PCl_5, ClF_3, $SnCl_2$

(c) Draw the Molecular Orbital diagram for N_2 molecule.

(d) Calculate the heat of formation ΔHf of MgF_2 from its elements using Born-Haber's cycle with the given data.

Sublimation Energy of Mg, (S)	$= 146.4$ kJmol^{-1}
Dissociation Energy of F_2, (D)	$= 158.9$ kJmol^{-1}
Ionization Energy of Mg^{2+} (I)	$= 2184.0$ kJmol^{-1}
Electron Affinity of F(g) to F^- (E)	$= -334.7$ kJmol^{-1}
Lattice Enthalpy of MgF_2 (Uo)	$= -2922.5$ kJmol^{-1}

(2.5,3,3,4)

4. (a) Compare the covalent character in NaCl and CuCl by giving reason.

(b) How does Molecular Orbital Theory account for the paramagnetic character in O_2 molecule?

(c) Write the expression of Born–Lande equation and explain the terms involved in it.

(d) Write short notes on :

     (i) Heisenberg's Uncertainty Principle

     (ii) Fajan's Rule

     (iii) Solvation Energy   (1.5,2,3,2×3)

SECTION – B

5. (a) Two isometric hydrocarbons (A) and (B) have molecular formula C_4H_6. Both compounds decolorize Br_2 in CCl_4 and react slowly with conc. H_2SO_4. (A) forms precipitate with ammonical silver oxide and on oxidation yields propionic acid and CO_2. Compound (B) does not produce any precipitate with ammonical silver oxide but on oxidation gives oxalic acid and CO_2. Suggest the structural formulae for (A) and (B).

(b) Explain relative stabilities of primary, secondary and tertiary carbanion with suitable examples.

(c) An aqueous solution of tropylium bromide on treatment with silver nitrate yields precipitate of silver bromide. How will you account for this observation?

(d) The boiling point of n-alkanes increases as the molecular mass increases. Explain.   (4.5,3,3,2)

6. (a) What is Huckel's rule of aromaticity? Which of the following are aromatic, non-aromatic or anti-aromatic.

(i) (ii) (iii)
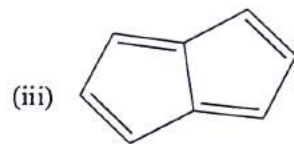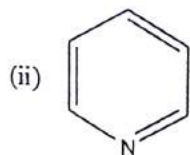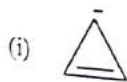
(b) Complete the following reactions and identify A, B, C and D

(i) $\xrightarrow{BH_3}$ A $\xrightarrow[NaOH]{H_2O_2}$ B

(ii) $\xrightarrow{O_3}$ C + D
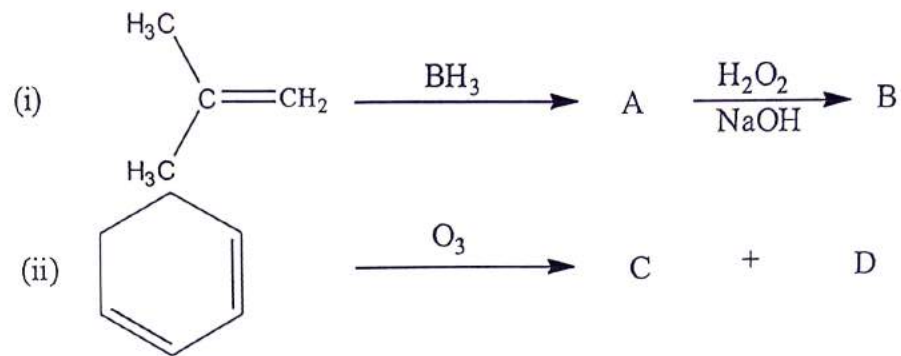
(c) What does conformation mean? Draw Boat and Chair conformations for cyclohexane. Giving reasons state which one is more stable of the two.   (4.5,4,4)
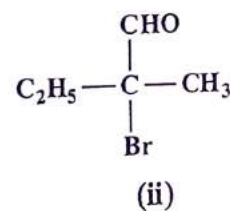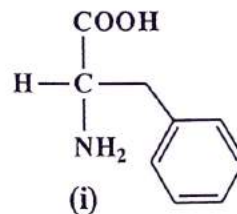
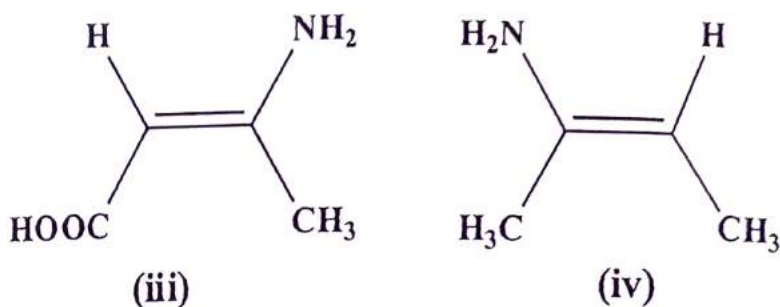7. (a) Differentiate between the following (any two) :

(i) Homolytic and Heterolytic fission

(ii) Resonance and hyperconjugation

(iii) Inductive and Electromeric Effect

(b) Assign E/Z or R/S configuration to the following.

(i) (ii)

(iii)   (iv)

(c) How many stereo-isomers are possible for tartaric acid HOOCCH(OH)CH(OH)COOH? Write down their structure and mention the relationship with respect to each other.   ($2 \times 2, 1 \times 4, 4.5$)

8. (a) Which of the following species behave as a nucleophile, an electrophile, both or neither:

I^-, H_3N, $BeCl_2$, CH_4, Cr^{3+}, $CH_3C \equiv N$, H_2, $SnCl_4$, $H_2C=O$ and NO^{2+}
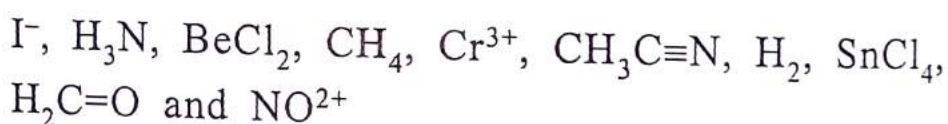
(b) Why is Wurtz synthesis not a good method for preparing propane?

(c) Write short notes on the following (any three) :

    (i) β Elimination reaction

    (ii) Koble's electrolysis method

    (iii) Hoffman elimination method for alkene preparation

    (iv) Kharasch peroxide effect   ($2.5, 2.5, 2.5 \times 3$)

[This question paper contains 6 printed pages.]

Your Roll No............

Sr. No. of Question Paper : 7320

Unique Paper Code : 42161101 – OC

Name of the Paper : Biodiversity (Microbes, Algae, Fungi and Archegoniatae)

Name of the Course : **B.Sc. (Prog.)**

Semester : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** questions in all.

3. Q. No. **1** is compulsory.

4. Attempt all parts of a question together.

5. Draw well labelled diagrams wherever necessary.

1. (a) Fill in the blanks :   (1×5=5)

     (i) .... is the genetic material in T-phage.

P.T.O.

(ii) An alga that gives red colour to the snow is ....

(iii) Dolipore septa are present in .... fungi.

(iv) Ribbon shaped elaters can be seen in ....

(v) .... species of *Pinus* is known as chir pine.

(b) Define **any five** of the following :   (1×5=5)

  (i) Episome

  (ii) Heterocyst

  (iii) Woronin bodies

  (iv) Apophysis

  (v) Leaf trace

  (vi) Sulphur shower

(c) Give an appropriate term for each of the following :   (1×5=5)

  (i) A process by which one bacterium transfers genetic material to another through direct contact.

(ii) Cluster of leaves surrounding the group of antheridia on antheridial branch.

(iii) Phenomenon of frequent appearance of mushroom in circles on ground.

(iv) A colony having definite number of cells arranged in a particular manner, which is determined at the juvenile stage and does not increase during its subsequent growth.

(v) A stele in which the xylem has radiating ribs and the phloem is not continuous but is present in isolated masses, alternating with the projecting angles of xylem.

2. Differentiate between any **three** of the following: (3×5=15)

  (i) Gram positive and gram negative bacterium

  (ii) Crozier and clamp formation

  (iii) Ectomycorrhiza and endomycorrhiza

P.T.O.

(iv) Actinostele and plectostele

(v) Manoxylic and pycnoxylic wood

3. Draw well labelled diagrams of any **three** of the following : (3×5=15)

(i) Bacterial cell

(ii) VS of needle of *Pinus*

(iii) TS of internode of *Equisetum* stem

(iv) LS of capsule of *Funaria*

(v) EM of *Chlamydomonas*

4. Write short notes on any **five** of the following : (5×3=15)

(i) Transformation in bacteria

(ii) Morphology of *Vaucheria*

(iii) Significance of lichens

(iv) Adaptations to land habit

(v) Ecological and economical importance of *Sphagnum*

(vi) Spore dispersal mechanism in *Pteris*

5. (a) What are the differences between the ovule of *Cycas* and *Pinus* at the time of fertilization? Draw diagrammatic sketches to support your answer. (6)

(b) Describe various modes of vegetative reproduction in *Marchantia*. (4)

(c) With the help of suitable diagrams describe the life cycle of nannandrous species of *Oedogonium*. (5)

6. (a) Give a general account of replication in viruses. (3)

(b) Briefly describe the various stages in the life cycle of *Puccinia graminis tritici* found on primary host with the help of suitable diagrams. (5)

(c) What is heterospory? Explain it with special reference to the pteridophytes studied by you and briefly discuss its significance. (7)

Your Roll No...2019...

J

Sr. No. of Question Paper : 7328

Unique Paper Code : 42221101 - OC

Name of the Paper : Mechanics

Name of the Course : **B.Sc. (Prog.)**

Semester : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** questions in all.

3. Question No. **1** is compulsory.

4. **All** questions carry equal marks.

1. Answer any **five** of the following :– $(5×3=15)$

    (a) Suppose a particle moves along a curve whose parametric equations is:

    $x = 40 t^2 + 8t$; $y = 2 \cos 3t$; $z = 2 \sin 3t$.

P.T.O.

Determine its velocity and acceleration at $t = 0$ sec.

(b) The position of a moving particle at any instant is given by :

$r = 3 \cos\theta \, \hat{\imath} + 3 \sin\theta \, \hat{\jmath}$

Show that the force acting on it is a conservative one.

(c) Show that when no external force acts on a body, the acceleration of the centre of mass is zero and its velocity is a constant.

(d) A hollow cylinder and a solid sphere of the same mass and radius are allowed to roll down without slipping along an inclined plane. Determine the ratio of their accelerations.

(e) Show that the theoretical limiting values of Poisson's ratio are −1 and 0.5.

(f) Distinguish between inertial and gravitational mass of a body.

(g) State Einstein's postulates of special theory of relativity.

(h) What is the displacement of a particle executing SHM from its mean position when its kinetic energy is half of its potential energy?

2. (a) Find the area of parallelogram determined by vectors

$\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ and $-3\hat{\imath} - 2\hat{\jmath} + k.$

What is the sine of the angle between the two vectors?

(b) Solve the following differential equation :

$$\frac{dy}{dx} = -\frac{y}{x} + \frac{1}{x^2}$$

(c) Find the general solution of :

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$$ (5,5,5)

3. (a) Find the centre of mass of a thin uniform wire bent in the form of a semi circle of radius R.

(b) State Work-energy theorem.

(c) A rocket ascends from rest in a uniform gravitational field by ejecting exhaust gases with a constant speed u relative to the rocket. Assuming that the rate at which mass is expelled is given by

$$\frac{dM}{dt} = -\gamma M,$$ where M is the instantaneous mass of

the rocket and γ is a constant, find the velocity of the rocket as a function of time. (5,3,7)

4. (a) A solid sphere of mass 0.1 kg and radius 2.5 cm rolls without slipping with uniform velocity of 0.1 ms^{-1} along a straight line on a horizontal table. Calculate its total energy.

(b) State Kepler's laws of planetary motion. Show that for a particle moving in a central force field, the areal velocity is constant.

(c) An earth's satellite makes a circle around earth in 120 minutes. Calculate the height of the satellite above the surface of earth. (5,5,5)

(Given radius of earth is 6400 km and g = 9.8 ms^{-2})

5. (a) Establish the equation of motion of a damped

harmonic oscillator subjected to a resistive force that is proportional to the first power of its velocity. If the damping is less than critical, show that the motion of the system is oscillatory with its amplitude decaying exponentially with time.

(b) A particle is executing simple harmonic oscillation along a straight line. Its velocities at distance x_1 and x_2 are v_1 and v_2 respectively. Find the time period of oscillations. (12,3)

6. (a) Derive a relation connecting the elastic constants Y, K and σ.

(b) Derive an expression for the couple required to twist one end of a cylindrical wire when its other end is fixed. (8,7)

7. (a) Derive an expression for length contraction (assume that observer is in frame S and rod is kept along x-x' axis in frame S').

(b) Two rockets A and B are moving away from the Moon at the respective speeds (w. r. t. Moon) of 0.8 c and 0.9 c. Find the speed of A w. r. t. B.

(c) The proper length of a rod is 5 metres. What would be its length for an observer if it be moving

with velocity 0.8 c relative to him in a direction parallel to its own length? (5,5,5)

8. (a) With what velocity should a rocket move so that every year spent on it corresponds to 4 years on earth?

(b) A brass bar 1 cm square in cross-section is supported on two knife edges 100 cm apart. A load of 1 kg at the centre of the bar depresses that point by 2.51 mm. What is Young's modulus for this bar?

(c) An earth is revolving around the Sun in circular orbit of radius 1.49×10^{13} cm. If mass of Sun is 19.72×10^{34} gm, find the speed of the earth in its orbit.

$(G = 6.67 \times 10^{-8}$ c. g. s. units) (5,5,5)

[This question paper contains 6 printed pages.]

Your Roll No........2019......

Sr. No. of Question Paper : 7329

Unique Paper Code : 42231102 – OC

Name of the Paper : Animal Diversity

Name of the Course : **B.Sc. (Life Science)**

Semester : I

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. There are **two** sections, **Section A** and **Section B** to be answered on separate answer sheets.

3. Answer **three** questions from each section, including Question No. **1** which is compulsory.

4. Draw well labelled diagrams wherever necessary.

SECTION A
(NON CHORDATA)

1. (a) Define the following terms : (4)

    (i) Pseudocoelom

P.T.O.

(ii) Metamorphosis

(iii) Torsion

(iv) Metamerism

(b) Distinguish between the following : (4)

(i) Polyp and Medusa

(ii) Polychaetae and Oligochaetae

(iii) Protostome and Deuterostome

(iv) Holometabolous and Heterometabolous

(c) State the following as True/False (2)

(i) Zoological name of earthworm is *Fasciola hepatica*.

(ii) Leucon is the simplest type of canal system.

(iii) Arthropods have open circulatory system.

(iv) Water canal system is a feature of phylum Echinodermata.

(d) State the location and function of the following :
(4)

(i) Flame cell

(ii) Contractile vacuole

(iii) Typhlosole

(iv) Radula

2. (a) Explain the life cycle of *Taenia solium* with the help of well labeled diagram. (6)

(b) Describe in detail the vision in Arthropoda. (6)

3. (a) Describe Polymorphism in Hydrozoa. (5)

(b) With the help of diagram describe the canal system in *Sycon*. (7)

4. Write short notes on any **three** of the following :
(3×4=12)

(i) Parasitc adaptations in Helminthes

(ii) Water vascular system in Asteroidea

(iii) Locomotory organelles in Protozoa

(iv) Characteristic features of phylum Mollusca

SECTION B
(CHORDATA)

1. (a) Define the following terms :   (4)

    (i) Retrogressive metamorphosis

    (ii) Neoteny

    (iii) Pneumatic bone

    (iv) Ecdysis

(b) Distinguish between the following :   (4)

    (i) Osmoconformers and Osmoregulators

    (ii) Apoda and urodela

    (iii) Protostome and Deuterostome

    (iv) Homodont and Heterodont

(c) State the following as True/False :   (2)

    (i) Common name of *Exocoetus* is Flying frog.

    (ii) All Aves are amniotes.

    (iii) Osteichythes have a cartilagenous endoskeleton.

    (iv) Poison gland of snake is a modified salivary gland.

(d) Write the Zoological name of the following : (3)

    (i) Tongue worm

    (ii) Flying lizard

    (iii) Squirrel

2. (a) Draw a well labeled diagram of the poison apparatus. Discuss briefly the biting mechanism in snakes.   (8)

(b) Enumerate the general features of Agnatha.   (4)

3. (a) What is Osmoregulation? Explain osmoregulation in Teleost.   (8)

(b) Classify Mammals up to orders with examples.   (4)

4. Write short notes on any **three** of the following :

$(3 \times 4 = 12)$

  (i) Parental care in Amphibians

  (ii) Flight adaptation in Aves

  (iii) Protochordata

  (iv) Origin of Mammals

[This question paper contains 4 printed pages.]

Your Roll No...2019....

Sr. No. of Question Paper : 7323

Unique Paper Code   : 42171107 – OC

Name of the Paper   : Industrial Chemicals and Environment

Name of the Course   : **B.Sc. (Prog.)**

Semester   : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Answer **six** questions in all, including Question No. **1** which is compulsory.

1. Attempt any **five** of the following questions :

   (a) Write the principle involved in distillation.

   (b) Give the uses of argon, neon and hydrogen gas.

   (c) Write the consequences of global warming.

   (d) Give the molecular formula of bleaching powder and its uses.

P.T.O.

(e) Explain the froth floatation process.

(f) How does reverse osmosis technique helps in water purification?   (3×5)

2. (a) Describe the method for production of sulphuric acid by Contact process.

(b) Write the application of borax and caustic soda.

(c) Give any one method for production of phosgene gas.   (4,4,4)

3. (a) Explain the manufacture of acetylene by calcium carbide.

(b) Discuss the uses and hazards of chlorine and sulphur dioxide.

(c) Give the molecular formula and uses of chrome alum and potash alum.   (4,4,4)

4. (a) Describe the pollution caused by NOx and SOx gases and suggest the methods to control them.

(b) Describe a method to control emission of particulate in the atmosphere.

(c) What is acid rain? What are the effects of acid rain on human and environment?   (6,3,3)

5. (a) Give the different types of water pollutants with examples.

(b) Describe the secondary treatment for waste water.

(c) What is incineration? Discuss the merits and demerits of this process.   (4,4,4)

6. (a) Differentiate between the following with suitable examples :

     (i) Calcination and Roasting

     (ii) Mineral and Ore

     (iii) Absorption and Adsorption   (3×3)

(b) Explain the ion exchange method in metallurgy.   (3)

7. (a) Explain ozone hole.

(b) How does fly ash causes pollution?

(c) How do we treat the effluents from the following industries (any two) :

(i) Petroleum Industry

(ii) Textile Industry

(iii) Tannery Industry   (4,4,4)

8.   Write short notes on the following **(any three)** :

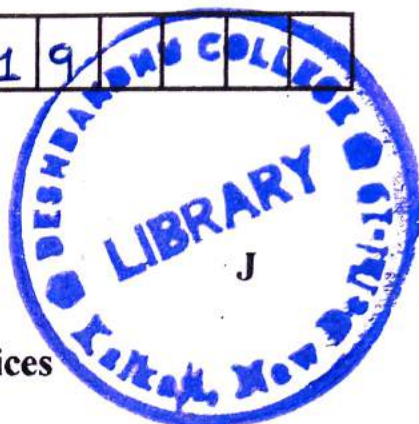(a) Photochemical Smog

(b) Solid Liquid Leaching

(c) Industrial waste management

(d) Green house effect   (4,4,4)

This question paper contains **4+2** printed pages]

Roll No. | | | | 2 | 0 | 1 | 9 | | | |

S. No. of Question Paper : 8562

Unique Paper Code : 42351101

Name of the Paper : **Calculus and Matrices**

Name of the Course : **B.Sc. Mathematical Sciences/B.Sc. (Prog.)**

Semester : **I**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *three* questions from each section.

Section I

1.   (*a*)   Examine the existence of the limit of the function :

$$g(t) = \begin{cases} t-2 & : \quad t < 0 \\ t^2 & : \quad 0 \le t \le 2 \\ 2t & : \quad t > 2 \end{cases}$$

at $t = 0, 2$.

(*b*)   Find a value of the constant k, if possible, that will make the function continuous everywhere.

$$f(x) = \begin{cases} 7x - 2 & x \le 1 \\ kx^2 & x > 1 \end{cases}.$$

P.T.O.

(c) If $y = x^2 \sin x$, then prove that :

$$\frac{d^n y}{dx^n} = (x^2 - n^2 + n)\sin\left(x + \frac{n\pi}{2}\right) - 2nx\cos\left(x + \frac{n\pi}{2}\right).$$ 4+4+4

2. (a) Show that the function $y = |x|$ is differentiable on $(-\infty, 0)$ and $(0, \infty)$ but has no derivative at $x = 0$.

(b) If $y = a\cos(\log x) + b\sin(\log x)$, then show that :

$$x^2 y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0.$$

(c) Find the Maclaurin series for the function $f(x) = \dfrac{1}{x+1}$ assuming the validity of expansion. 4+4+4

3. (a) State and prove Lagrange's mean value theorem. Also discuss its geometrical significance.

(b) Find the value of c for the following function that satisfies the hypotheses of the Lagrange's mean value theorem :

$$f(x) = x^2 + 2x - 1,\ a = 0,\ b = 1.$$

(c) Prove that :

$$\lim_{x \to 0} \frac{1 - \cos x}{x} = 0.$$ 5+4+3

4. (a) Sketch the graphs of the following functions (any *two*) :

(i) $y = 1 + \sqrt{x-1}$

(ii) $y = \sin 2x$ in $[0, 2\pi]$

(iii) $y = e^{-|x|} - 1$.

(b) Given the function $f(x) = |x|$. The graph of the function $f(x)$ is shifted vertically down 3 units and horizontally right 2 units followed by a reflection across x-axis. Sketch the original function $f(x)$ along with the new graph. Also write the equation for the new graph. 6+6

Section II

5. (a) Sketch the contour plot of $f(x) = x^2 + y^2$ using the level curves at heights $k = 0, 3, 5$.

(b) Let $f(x, y) = x^2 + y^2 - 2$. Find an equation of the level curve that passes through the point $(1, -2, 0)$.

(c) Let $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$. Find the eigenvalues and the corresponding eigenvectors of the matrix A. 4+4+5

P.T.O.

6. (a) Verify that $u(x, t) = \sin(x - 4t)$ is a solution of the wave equation.

(b) Row reduce the matrix A to reduced row echelon form. Circle the pivot positions in the final matrix and hence determine its rank :

$$A = \begin{bmatrix} 1 & 1 & 4 & 1 & 2 \\ 0 & 1 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 2 \\ 1 & -1 & 0 & 0 & 2 \\ 2 & 1 & 6 & 0 & 1 \end{bmatrix}.$$

(c) For what value of λ and μ do the following system of linear equations :

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

have :

(i) a unique solution

(ii) no solution

(iii) an infinite number of solutions.   4+4+5

7. (a) Let

$$f(x, y) = x^2 y + 5y^3.$$

Find the slope of the surface $z = f(x, y)$ in x-direction at the point $(1, -2)$.

(b) Check whether the set $\{(1, 1, 1), (1, -1, 1), (1, 1, -1)\}$ is linear independent or not.

(c) Check whether the transformation $T : R^2 \to R^2$ defined as $T(x, y) = (x + 4y, y)$ is linear Sketch the image of the unit square with vertices $(0, 0)$, $(0, 1)$, $(1, 1)$, $(1, 0)$ under the given transformation.   4+4+5

8. (a) Find the standard matrix of the reflection about xz plane.

(b) Find the polar representation of the following numbers :

(i) $z_1 = -1 - i$.

(ii) $z_2 = 1 - i\sqrt{3}$.

(c) If $z_1 = 1 - i$ and $z_2 = \sqrt{3} + i$, then find $Arg(z_1 z_2)$ and $|z_1 z_2|$.   5+4+4

9. (a) Find the equation of the circle whose radius is 3 and whose center has affix $1-i$.

(b) Find the equation of the straight line joining the points whose affixes are $z_1 = 1-i$ and $z_2 = 2-5i$.

(c) Compute $(1+i)^{1000}$.

(d) Solve the equation using De Moivre's theorem $z^7 + z = 0$. 3+3+3+4

[This question paper contains 8 printed pages]

Your Roll No. : ....2035......

Sl. No. of Q. Paper : **8564** J

Unique Paper Code : 42341102 2019

Name of the Course : **B.Sc. (Prog.)/B.Sc. Mathematical Sciences**

Name of the Paper : Problem Solving Using Computers

Semester : I

Time : 3 Hours *Maximum Marks : 75*

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) **Section-A** is compulsory.

(c) Answer any **five** questions from **Section-B**.

(d) Answer **all** parts of a question together.

Section - A

1. (a) What do you understand by Byte. Write number of bytes in each of the following : 3

    (i) Megabyte

    (ii) Gigabyte

P.T.O.

(b) Given a=5, b=6 and c=4, find the value of following expressions   3

    (i) b//c*a

    (ii) b%c and a>c

    (iii) len("hello")>a

(c) Identify the syntax errors in the following code :   3

```
def f1:?
    a=b+5
    return a
f1(5)
```

(d) Rewrite the following for loop using while loop :   3

```
sum=0
for i in range(1,7,2):
    sum+=i
```

(e) Write try and except block to handle exception related to text file "file1.txt" that is to be opened in read mode. Display message "file not found" on the occurrence of the appropriate exception related to files.   3

(f) Evaluate the following functions :   3

    (i) math.ceil(8.6)

    (ii) min("xx","xz","aaa")

    (iii) abs(-5)

2

(g) Find the output of the following code :   2+2

    (i)
```
def fname(n):
    for i in range(n):
        if i==3:
            return 0
        else:
            print("i= ",i)
print("output= ",fname(5))
```

    (ii)
```
names={'DELHI':5,'BOMBAY':6,'GOA':3}
print(list(names.keys())
print(names.get('RANCHI','NONE'))
```

(h) Find the content of S after the execution of the following statements ?   3

```
S1="EXECUTION"
S=S1[0::3]*3
```

Section - B

2. (a) Given two lists L1=["red","green"] and L2=[3,5]. Write Python statement(s) to produce a list named **outlist** having following contents using L1 and L2: outlist=[('red', 3), ('green', 5)]. Also, display length of the outlist and its contents.   2+1

3   P.T.O.

(b) Given two lists NAMES1 and NAMES2 having names of students where the same name may appear in both lists. Write statements to do the following : 4

(i) Generate a list UnqNAMES to store all names without repetition from both NAMES1 and NAMES2.

(ii) Generate a list DupNAMES to have common names from both NAMES1 and NAMES2.

(c) Write PYTHON statements to accept positive integer only from the user. Use appropriate exception/assert statements for the same. 3

3. (a) Find the data type and content of the variable S2 after the execution of each of the following statements where S="Semester Examination" and S1="Finally" 5

(i) S2=S[:-12]+S1[:5]

(ii) S2=S1.find('l')+S1.rfind('l')

(iii) S2=S.split()

4

(b) Write a function that takes **str1** as parameter and replaces alternate character in str1 (starting from 0) with ' * ' and stores resultant string in **str2**. The function shall display the number of character replaced and shall return str2. For example if str1='Examination' then str2='*x*m*n*t*o*' and the number of character replaced is 6. 5

4. (a) Write a function named **fncompute** which takes **number** as parameter where number is a positive integer. The function returns the difference in maximum and minimum digit in the number i.e. if number is 7892, then difference is 9-2=7 5

(b) Write a function named **fnsearch** to search for an element X in a list L using linear search, where X and L are passed as parameters. The function should return all positions at which X is found else -1 if not found. Note that X may appear multiple times in the list. 5

5

5. (a) Consider the following list **X** of numbers : 5

100, 34, 45, 56, 19

Show step by step iterations for arranging the given list in increasing order using insertion sort.

(b) Write a recursive function to compute nth term of the fibonacci series. Fibonacci series has 0 and 1 as first term and second term respectively. The third and subsequent terms are computed as sum of previous two terms. 5

6. (a) Write appropriate file handling statements to do the following : 2+3

(i) Open a text file **'exam.txt'** and append message **'Good Morning'** in it

(ii) Display contents of a CSV file students.csv where fields are seperated by delimiter *

(b) Write a function fnfile() which reads a text file **'sentences.txt'** having sentences of different length and write only those sentences whose length is less than 10 in a new file **'output.txt.'** 5

7. (a) Write a function which accepts a list of names and returns a dictionary where key-value pairs are names and length of name respectively. 5

(b) Identify the local and global variables in the following code and find the output : 5

```
j=5
def fn(a,b=5):
    if a%b==0:
        print("Divisble")
    else:
        print("Non-Divisble")
    j=a+b
    print("in function j= ",j)
fn(15)
fn(16,3)
print("outside function j= ",j)
```

8. (a) Write Python statement(s) to store all common factors of given two numbers no1 and no2 in a variable of type set. 3

(b) Define a class **CIRCLE** having a single data member **radius**. Include following methods in the class definition : 7

(i) Constructor to initialize value to the data member.

(ii) Method **getperimeter** to return the perimiter of the circle which is defined as 2*pi*radius.

(iii) Method **getarea** to return the area of the circle which is defined as pi*radius^2.

After defining the class, create an object of CIRCLE with radius 5.

Your Roll No....2019..

Sr. No. of Question Paper : 8571   J

Unique Paper Code   : 42161101

Name of the Paper   : Biodiversity (Microbes, Algae, Fungi & Archegoniatae)

Name of the Course   : B.Sc. (Prog.)

Semester   : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** questions in all.

3. Question No. **1** is compulsory.

4. All parts of a question must be answered together.

5. Draw well-labelled diagrams wherever necessary.

1. (a) Fill in the blanks (**any five**) :   (5×1=5)

    (i) Plasmids that can integrate into bacterial DNA are called _____ .

    (ii) _____ is the principal pigment of Phaeophyceae that imparts distinctive brown colour to the thallus.

P.T.O.

(iii) Aeciospore of *Puccinia* are found on the ventral surface of _____ leaf.

(iv) *Equisetum* is commonly known as _____ .

(v) Meristematic region is present in the _____ of *Anthoceros*.

(vi) Seed-scale complex is found in _____ .

(b) Define the following **(any five)** : (5×1=5)

   (i) Prion

   (ii) Eye spot

   (iii) Columella

   (iv) Primary protonema

   (v) False indusium

   (vi) Transfusion tissue

(c) Give **one** example for each of the following : (5×1=5)

   (i) A virus having double stranded DNA as a genetic material.

   (ii) In the oogonium of which genus a colourless mass of cytoplasm known as wanderplasm is formed.

   (iii) The sterile diploid cells present in the capsule.

(iv) The air cavities present in the internode of *Equisetum*.

(v) The common name of *Cycas revoluta*.

2. Differentiate between the following **(any three)** : (3×5=15)

(a) Transformation and transduction

(b) Unilocular and plurilocular sporangia

(c) Uredospore and teleutospore

(d) Antheridiophore and archegoniophore

(e) Strobilus of *Selaginella* and *Equisetum*

3. Draw well-labelled diagram of the following **(any three)** : (3×5=15)

(a) Structure of *Chlamydomonas*

(b) L.S. of *Anthoceros* sporophyte

(c) T.S. of *Equisetum* internode

(d) T.S. of *Cycas* coralloid root

4. Write short notes on **(any three)** : (3×5=15)

(a) Economic importance of viruses

(b) Economic importance of gymnosperms

(c) Asexual reproduction in *Marchantia*

(d) Hydrophytic and xerophytic characters of *Equisetum*

5. (a) Explain sexual reproduction in *Vaucheria* with the help of suitable diagrams. (5)

(b) Discuss the role of fungi in industry. (5)

(c) The sporophyte of *Funaria* is partially dependent. Justify the statement. (5)

6. (a) What is suphur shower? What features of pollen in *Pinus* makes it suitable for wind pollination? (3)

(b) Discuss the economic importance of bacteria giving suitable examples. (5)

(c) Describe life cycle of *Puccinia graminis tritici* with the help of suitable diagrams. (7)

This question paper contains **4** printed pages]

Roll No. ☐☐☐☐☐☐☐ 2 0 1 9

S. No. of Question Paper : **8573**

Unique Paper Code : **42221101**

Name of the Paper : **Mechanics**

Name of the Course : **B.Sc. (Prog.)**

Semester : **I**

Duration : **3 Hours**

Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

1. (*a*) For the vectors A = 3*i* – 2*j* + *k* and B = 2*i* – *k*, determine

   A · B and (A × B) · A. 5

   (*b*) Prove (A × B) × C = (A · C) B – (B · C) · A. 5

   (*c*) Solve the differential equation

   $$(x^2 - y^2)\, dy - 2xy\, dx = 0.$$ 5

2. (*a*) State Kepler's laws of planetary motion. 3

P.T.O.

(b) What is a central force ? Give examples of central forces. Prove that under the influence of a central force, the motion of a particle is always confined to a plane.   7

(c) A satellite revolves around a planet of mean density 10^4 kg/m³. If the radius of its orbit is only slightly greater than the radius of the planet, find the time of revolution of the satellite.

[G = 6.67 × 10^{-11} S.I. units]   5

3. (a) What do you understand by the centre of mass of a system of particles ? Show that in the absence of external forces the velocity of the centre of mass remains constant.   5

(b) What is moment of inertia ? State parallel and perpendicular axis theorems.   5

(c) The angular momentum of a rotating body is conserved, while its moment of inertia is decreased. Show that its rotational kinetic energy increases.   5

4. (a) State and prove work-energy theorem.   5

(b) What are conservative and non-conservative forces ? Show that work done by a conservative force along a closed path is zero.   5

(c) Establish the equation of motion of a rocket and obtain the velocity of the rocket at time t taking into account the effect of gravity.   5

5. (a) Define kinetic energy of rotation. Develop an expression for kinetic energy involving both translation and rotation.   10

(b) A torque of 1 Nm is applied to a wheel of mass 10 kg and radius of gyration 50 cm. What is the resulting translational acceleration ?   5

6. (a) What do you understand by simple harmonic motion ? Set up the differential equation of motion for a simple harmonic motion and obtain its solution. Find the expression for time period and angular frequency.   10

(b)   At what displacement the kinetic and potential energies are equal ?   5

7.   (a)   Differentiate between inertial and non-inertial frames.   2

(b)   State Einstein's postulates of special theory of relativity. Derive the Lorentz transformation equations.   8

(c)   A rod 1m long is moving along its length with a velocity 0.6c. Calculate its length as it appears to an observer on the earth.   5

Sl. No. of Question Paper: 8574
Unique Paper Code : 42171108
Name Of Paper   : Mathophysics Mechanics
Name Of Course   :B.Sc.(Prog.)
Semester   : I
Duration   : 3 hours
Maximum Marks   : 75

Attempt *five* question in all.
Question No.**1** is compulsory.
All questions carry equal marks.

1. Attempt any five from the following-

    (a) Three masses weighing 3,4 and 5 kgs are placed at the corners of an equilateral triangle of side 1 meter. Find the centre of mass of the system.   3

    (b) Find the impulse developed by force $\vec{F} = 4t\hat{\imath} + (6t^2 - 2)\hat{\jmath} + 12\hat{k}$ from time t=0 to t=2 seconds.   3

    (c) Define radius of Gyration and Moment of inertia of a rigid body.

    (d)What is the time period of a simple pendulum 200cm long.   3

    (e) Explain the terms stress and strain.   3

    (f)   A particle at a point (2,1,3) is acted upon by a force $\vec{F} = 3\hat{\imath} + 2xy\hat{\jmath} + xz\hat{k}$. Calculate the work done in moving it to a point (4,1,3).   3

    (g) What are the central forces? Give two examples of central and non-central forces each.   3

2. Solve the following differential equations-

    (a) $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = e^{3x}$

    (b) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = x$ 15

3.

    (a) The amplitude of a simple harmonic oscillator is doubled. How does this effect the time period, total energy and maximum velocity of the oscillator?   9

    (b) Give the variation of the kinetic energy, potential energy and total energy of a simple harmonic oscillator. Illustrate your answer with suitable examples. 6

4.

(a) What are the two basics postulates of special theory of relativity. 3

(b) Using Lorentz transformation equations, find the expression for length contraction and time dilation.

5. 12

(a) When a particle moves under a central force, prove that
  (i) The angular momentum is conserved
  (ii) The particle moves in a fixed plane. 4+4=8

(b) A satellite is travelling at a distance of 7000 km from the centre of earth. Calculate the orbital velocity of the satellite.(radius of earth=6400 km and mass of earth=6*10^{24} kg).
  4

(c) What do you mean by Global positioning System (GPS). Explain it. 3

6.

(a) State Kepler's law of planetary motion. 3

(b) Compute the expression for the orbital velocity and period of revolution of a satellite.
  12

7.

(a) State Hooke's law. Derive the relation between young modulus Y, modulus of rigidity η and poission ratio σ.
  12

(b) What is poission's ratio. What are it's limiting values.
  3

[This question paper contains 4 printed pages.]

Your Roll No...2019...

Sr. No. of Question Paper : 8575

Unique Paper Code : 42231102

Name of the Paper : Animal Diversity

Name of the Course : **B.Sc. (Prog.)**

Semester : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** Questions in all.

3. Q. No. **1** is compulsory.

1. (a) Define any **five** of the following terms :   (5)

    (i) Digenetic

    (ii) Torsion

    (iii) Madreporite

    (iv) Operculum

    (v) Metagenesis

P.T.O.

(vi) Ecdysis

(vii) Autogamy

(b) Differentiate between the following terms : (12)

    (i) Polyp and medusae

    (ii) Catadromous and Anadromous

    (iii) Gastrozooids and Dactylozooids

    (iv) Anapsid and Diapsid skull

    (v) Osteichthyes and Chondrichthyes

    (vi) Osmoconformers and osmoregulators

(c) Give the name of the animal in which the following structure is found : (5)

    (i) Tubefeet

    (ii) Nematocysts

    (iii) Mantle

    (iv) Proglottids

    (v) Placoid scales

(d) Give the scientific name and classify the following animals upto class : (5)

    (i) Squirrel

    (ii) Toad

    (iii) Cuttle fish

    (iv) Devil fish

    (v) Centipede

2. Describe the life history of *Toenia solium* with the help of labelled diagrams. (12)

3. (a) Describe general characters and classification of Amphibia upto orders with suitable example.

    (b) With the help of suitable diagram explain biting mechanism in snakes. (7,5)

4. (a) Define polymorphism with suitable examples and its significance.

    (b) Describe canal system in *Sycon*. (6,6)

5. (a) What do you understand by osmoregulation? Give an account of osmoregulatory mechanisms adapted by fishes in varying salinity.

   (b) Describe briefly migration in Birds. (7,5)

6. (a) Discuss briefly torsion in gastropods.

   (b) Briefly explain metamerism in Annelida. (6,6)

7. Write short notes on any **three** of the following :

   (i) Vision in Arthropoda

   (ii) Locomotion in Protozoa

   (iii) Parental care in fishes

   (iv) Water vascular system in Asteroidea

   (4 marks each)

This question paper contains **8** printed pages]

Roll No.

S. No. of Question Paper : **8577**

Unique Paper Code : **42171103**

Name of the Paper : **Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons**

Name of the Course : **B.Sc. (Programme)**

Semester : **I**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *six* questions in all, *three* questions from each Section.

Use separate answer sheets for Section-A and Section-B.

SECTION–A

1. (a) Define Lattice energy ? Write the expression for Born-Landé equation, and explain the terms involved in it. 5

   (b) Write short notes on any *two* :   4

      (i) Heisenberg uncertainty principle

P.T.O.

(ii)   Hund's rule

(iii)   Pauli exclusion principle

(c)   Write the electronic configuration of Cr (Atomic No. 24) and Cu (Atomic No. 29).   2

(d)   Why $BaSO_4$ is insoluble in water ?   1½

2.   (a)   Predict the shape and type of hybridization in each of the following molecules :   4

$$PCl_5, H_2O, ClF_3, SF_4.$$
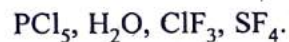
(b)   Draw the MO diagram for N_2 molecule and calculate its bond order.   4

(c)   Which is more covalent in the following pairs ? Explain :

(i) $FeCl_2$, $FeCl_3$

(ii)   LiI, CsI

(iii)   CuCl, NaCl   4½

3.   (a)   Calculate the uncertainty in the position of a particle whose uncertainty in   momentum is 3.3×10^{-2} kg m s^{-1}

($h = 6, 62 \times 10^{-34}$ Js)   4

(b)   Calculate the lattice energy of NaCl crystal   from the following data by the use of Born-Haber Cycle. Sublimation energy for $Na_{(s)}$ =108.7 kJ/mol Dissociation energy for $Cl_{2(g)}$ = 225.9 kJ/mol , Ionization energy for $Na_{(g)}$ = 489.5 kJ/mol, Electron affinity for $Cl_{(g)}$ = -351.4 kJ/mol, Heat of formation of $NaCl_{(s)}$ = -414.2 kJ/mol.   3

(c)   What is the physical significance of Ψ^2 ?   When do we use $\Psi\Psi^*$ instead of Ψ^2 ?   3

(d)   Give the possible value of quantum number for an electron in $4d$ & $3p$ orbital.   2½

4.   (a)   What is dipole moment ? The dipole moment of NH_3 is 1.7 D while that of NF_3 is 0.2 D. Explain briefly.   4

(b)   What are Eigen functions & Eigen values ? Explain why He_2 molecule does not exist ?   4

(c)   Draw the radial distribution curve for $3s$, $3p$ & $3d$ orbitals.   3
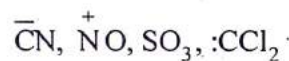
(d)   Calculate the possible value of m for $l = 2$.   1½

SECTION-B

5.   (a)   Giving suitable explanation, classify the following as aromatic or not aromatic in nature :   4½
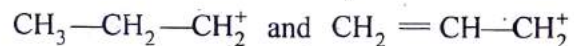
(i)

P.T.O.

(ii)

(iii)
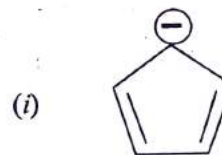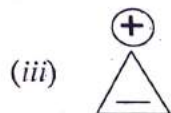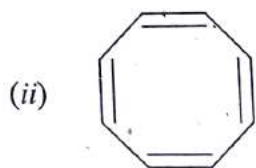
(b)   From the following attempt any *three* :   2×3

(i)   Classify the following as nucleophiles and electrophiles :

$$\overline{C}N,\ \overset{+}{N}O,\ SO_3,\ :CCl_2$$

(ii)   Which of the following cation is more stable and why ?

$$CH_3—CH_2—CH_2^+ \text{ and } CH_2=CH—CH_2^+$$

(iii)   Which of the following free radicals is most stable and why ?

$$CH_3\overset{\cdot}{C}H_2,\ (CH_3)_2\overset{\cdot}{C}H \text{ and } (CH_3)_3\overset{\cdot}{C}$$
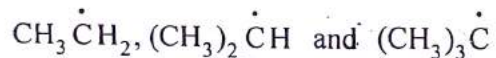
(iv)   Draw the chair and boat conformations of cyclohexane and comment on their stability.

(c)   Giving the steps involved convert the following into Fischer projection (attempt any *one*) :   2

(i)

(ii)
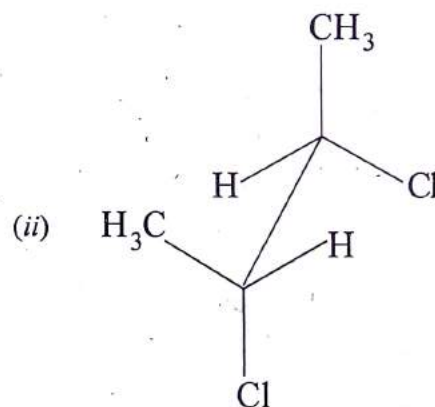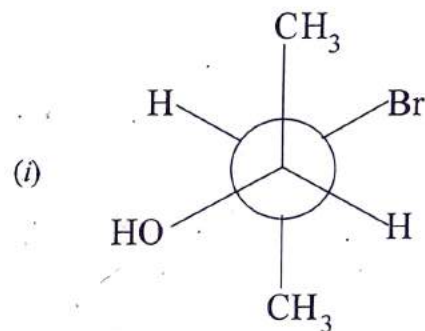
6.   (a)   Draw the different conformations of butane; arrange them in increasing order of stability, with explanation.   5

(b)   Assigning the priority order, explain how will you arrive at R-/S-configuration at each stereocentre in the following :   4½
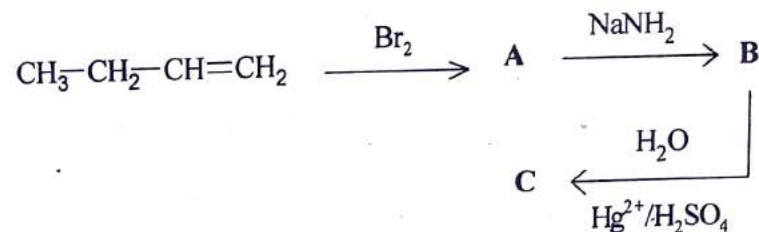
(i)

$$\underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{Cl-\!\!\!\overset{|}{\underset{|}{C}}\!\!\!-OH}}$$

(ii)

$$\begin{array}{c} CHO \\ H-\!\!\!-OH \\ HO-\!\!\!-H \\ CH_3 \end{array}$$
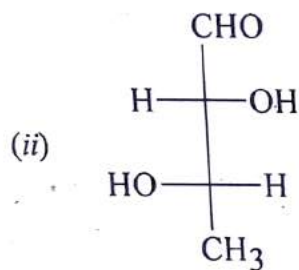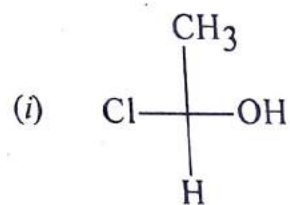
(c) Assigning the priority order, explain how will you

designate E-/Z-to the following :   3

(i)

$$\underset{H_3C}{\overset{HO}{\diagup}}C=C\underset{C_2H_5}{\overset{OCH_3}{\diagdown}}$$

(ii)

$$\underset{Cl}{\overset{H_2N}{\diagup}}C=C\underset{H}{\overset{Br}{\diagdown}}$$
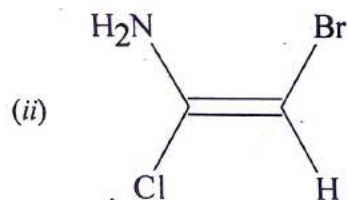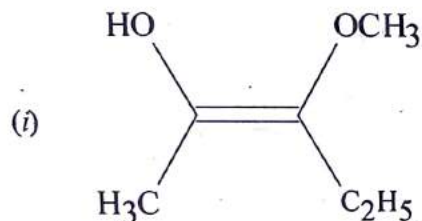
7. (a) What happens when propene reacts with bromine in

presence of light. Give suitable mechanism.   4½

(b) Complete the following sequence of reactions and

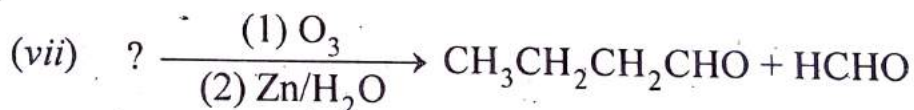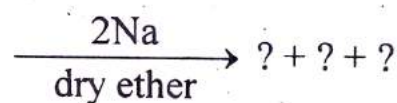identify A-C :   3

$$CH_3\!-\!CH_2\!-\!CH\!=\!CH_2 \xrightarrow{\ Br_2\ } A \xrightarrow{\ NaNH_2\ } B$$
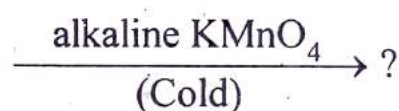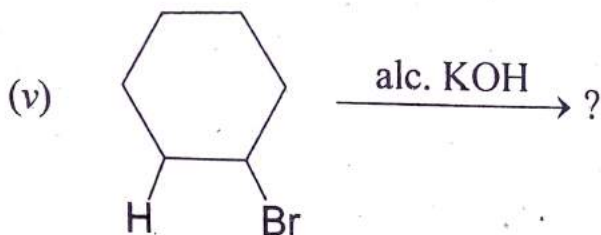
$$C \xleftarrow[\ Hg^{2+}/H_2SO_4\ ]{\ H_2O\ } \Big|$$
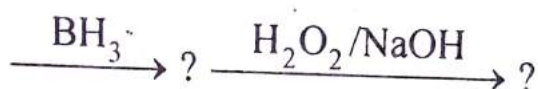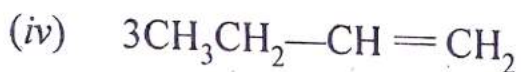
(c) The peroxide effect (Kharasch effect) is observed only

in reaction of alkene with HBr and not with HCl and HI.

Explain why ?   3

(d) How will you distinguish pent-1-yne and pent-2-yne ? 2

8. (a) Complete the following reactions (attempt any five) : 1½×5

(i) $CaC_2 + H_2O \longrightarrow ? \xrightarrow{\ HBr\ } ?$

(ii) $CH_3\!-\!CH_2\!-\!CH\!=\!CH_2 \xrightarrow[\ THF\ ]{\ Hg(OCOCH_3)_2\ ;\ H_2O\ } ?$

$\xrightarrow{\ NaBH_4\ } ?$

(iii) $CH_3C \equiv CH \xrightarrow{\ NaNH_2\ } ? \xrightarrow{\ CH_3CH_2Br\ } ?$

(iv) $3CH_3CH_2\!-\!CH\!=\!CH_2$

$$\xrightarrow{\ BH_3\ } \ ? \ \xrightarrow{\ H_2O_2/NaOH\ } \ ?$$

(v)

$$\xrightarrow{\ alc.\ KOH\ } \ ?$$

H   Br

$$\xrightarrow[\text{(Cold)}]{\text{alkaline } KMnO_4} \ ?$$

(vi) $CH_3CH_2CH_2Br + CH_3CH_2Br$

$$\xrightarrow[\text{dry ether}]{\ 2Na\ } \ ? + ? + ?$$

(vii) $? \xrightarrow[\text{(2) Zn/H}_2\text{O}]{\text{(1) O}_3} CH_3CH_2CH_2CHO + HCHO$
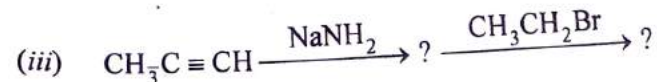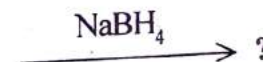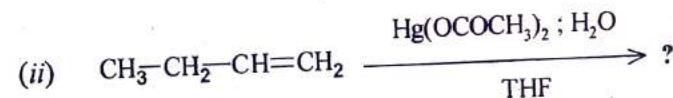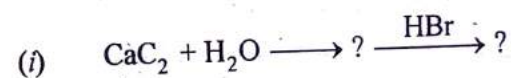
(b) Giving examples, write a short note on the following (any *two*) :   2½×2
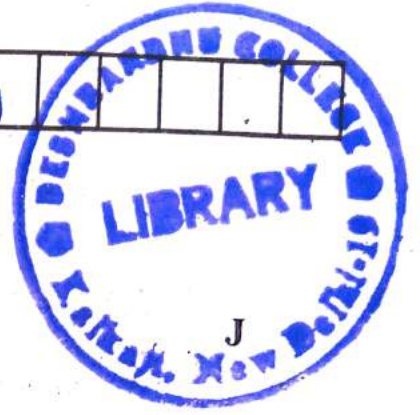
(i)   Hyperconjugation

(ii)   Erythro and threo stereoisomers

(iii)   Preparation of alkanes using Grignard reagent.

This question paper contains **4** printed pages]

Roll No. | | | 2 | 0 | 1 | 9 | | | | |

S. No. of Question Paper : **8580**

Unique Paper Code : **42171107**

Name of the Paper : **Industrial Chemicals and Environment**

Name of the Course : **B.Sc. (Prog.)**

Semester : **I**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer *six* questions in all, including

Question No. **1** which is compulsory.

1.   Attempt any five of the following questions :

    (a) · Write the principle involved in distillation.

    (b) Give the uses of argon, neon and hydrogen gas.

    (c) Write the consequences of global warming.

    (d) Give the molecular formula of bleaching powder and its

    uses.

P.T.O.

(e) Explain the froth floatation process.

(f) How does reverse osmosis technique help in water purification ?   3×5

2. (a) Describe the method for production of sulphuric acid by contact process.

(b) Write the application of borax and caustic soda.

(c) Give any *one* method for production of phosgene gas.

    4,4,4

3. (a) Explain the manufacture of acetylene by calcium carbide.

(b) Discuss the uses and hazards of chlorine and sulphur dioxide.

(c) Give the molecular formula and uses of chrome alum and potash alum.   4,4,4

4. (a) Describe the hazards by SOx gases and also suggest a method to control them.

(b) Describe a method to control emission of particulate in the atmosphere.

(c) What is acid rain ? What are the effects of acid rain on human and environment ?   4,4,4

5. (a) Give the different types of water pollutants with examples.

(b) Describe the secondary treatment for waste water.

(c) What is incineration ? Discuss the merits and demerits of this process.   4,4,4

6. (a) Differentiate between the following with suitable examples

    (i) Calcination and Roasting

    (ii) Mineral and Ore

    (iii) Absorption and Adsorption

(b) Explain the ion exchange method in metallurgy.   9,3

7. (a) Explain ozone hole.

(b) How does fly ash cause pollution ?

(c) How do we treat the effluents from the following industries (any *two*) :

    (i) Petroleum Industry

    (ii) Textile Industry

    (iii) Tannery Industry   4,4,4

8. Write short notes on the following (any *three*) :

   (*a*)   Photochemical Smog

   (*b*)   Solid Liquid Leaching

   (*c*)   Industrial waste management

   (*d*)   Greenhouse effect   4,4,4

Sr. No. of Question Paper : 8763

Unique Paper Code : 217161

Name of the Paper : CHPT-101 Chemistry- I (Atomic Structure, Bonding, General Organic
Chemistry & Aliphatic Hydrocarbons)

Name of the Course : B.Sc. (Programme) (Physical Sciences and Life Sciences)

Semester : I

Duration : 3 hours

Maximum marks : 75

Instructions for the candidates

1. Write your Roll No. on the top immediately on receipt of this question paper
2. Use of scientific calculators and log tables is allowed.
3. Answer six questions in all, three questions from each section.
4. Use separate answer sheets for Section A and B.

(Write your Roll no. on the top immediately on receipt of this question paper)

Section A

Attempt any **three** *questions.*

Question No. **1** *is compulsory.*

1. (a) Write Schrödinger wave equation for one electron system and explain various terms involved.

   (b) Why orbitals of 1p, 2d, 3f are not possible? Explain.

   (c) Define lattice energy. Write Born Lande equation and explain the terms involved in it.

   (d) On the basis of Fajan's rule compare the covalent character in following compounds:

      (i) NaCl and CuCl

      (ii) AgCl and AgI

   (e) Bond angles in NH_3, H_2O, CH_4 are different inspite of same hybridization. Explain.

   (3,2,3,3,2.5=13.5)

2. (a) Which of the following combinations are allowed in LCAO (considering z axis as molecular axis) and sketch the shapes of molecular orbitals formed by their addition and subtraction:

   (i)   s and p_z
   (ii) p_x and p_x
   (iii) p_z and p_y

(b) Why PCl_5 is more reactive than SF_6 molecule? Explain.

(c) Derive a relationship between cartesian and polar coordinates.

(6,3,3=12)

3. (a) Write the M.O configuration of O_2, O_2^+, O_2^- and O_2^{2-} and arrange them in increasing order of their bond length.

(b) Using VSEPR theory justify that ClF_3 is T shaped while XeF_4 is square planar.

(c) The observed dipole moment of HX molecule is 1.92 D and bond distance is 1.20 Å. Calculate the % ionic character of the HX.(electronic charge = 1.602×10^{-19} C)

(4,4,4=12)

4. Write short notes on (any three)

    (i)   Hund's Rule

    (ii) Resonance

    (iii) Radial probability distribution

    (iv) Physical significance of Ψ and Ψ^2

    (v) Pauli's Exclusion Principle

    (vi) Solvation Energy

(4×3=12)

Section B

Attempt any **three** *questions.*

Question No. **5** *is compulsory.*

5. Explain the following:

a) Three isomeric pentanes (C_5H_{12}) have boiling points 9.5 °C, 28 °C and 36 °C. Comment on the structures giving reasons.

b) Primary alkyl carbanion is more stable than secondary alkyl carbanion.

c) Alkenes undergo electrophilic addition reaction whereas benzene undergoes electrophilic substitution reaction.
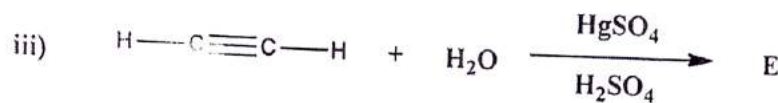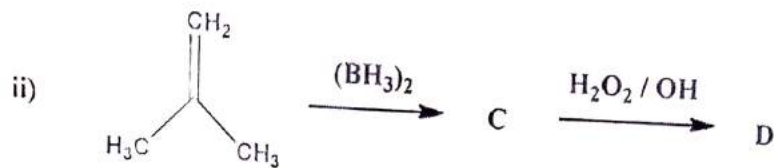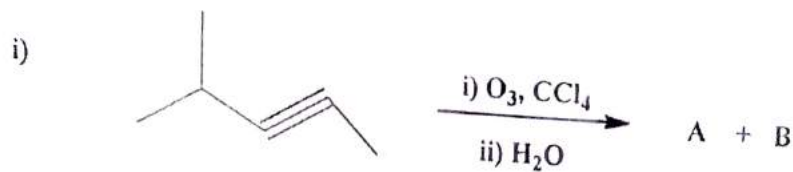
d) Distinguish between Resonance and Hyperconjugation.

e) Different products are formed when propene is treated with HBr in the presence and absence of peroxide.

f) tert-butyl carbocation is more stable than methyl carbocation.

(2.5,2,2,2,2,3=13.5)

6. a) Complete the following reactions:

i)

$$\xrightarrow[\text{ii) } H_2O]{\text{i) } O_3, CCl_4} \quad A + B$$

ii)

$$\xrightarrow{(BH_3)_2} \quad C \quad \xrightarrow{H_2O_2 / OH} \quad D$$

iii)

$$H—C\equiv C—H \quad + \quad H_2O \quad \xrightarrow[H_2SO_4]{HgSO_4} \quad E$$

b) Discuss the free radical mechanism for the chlorination of methane

c) Carry out the following conversions (any two)

i) Propyne to but-2-yne
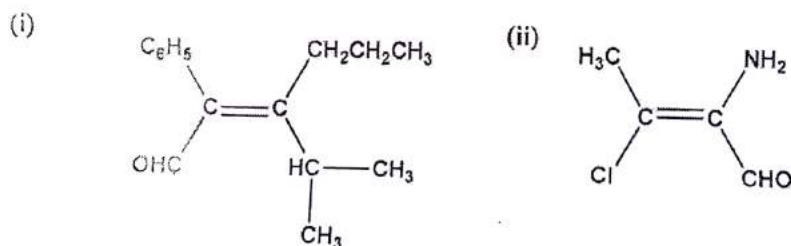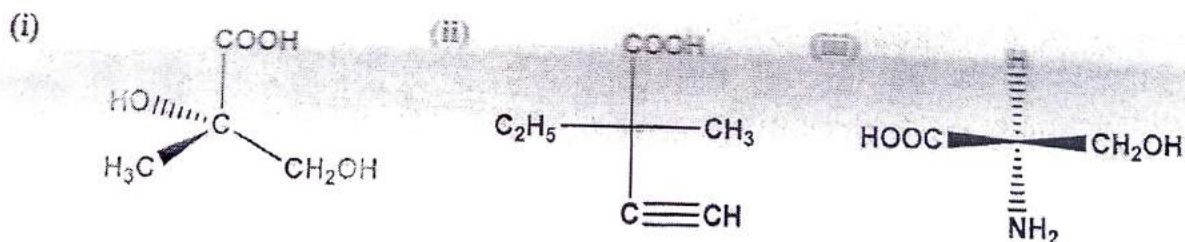
ii) Pent-2-ene to pent-2-yne

iii) Ethylchloride to n-butane

(5,3,4=12)

7. a) Giving priority numbers to the groups attached assign E/Z configuration to the following compounds:
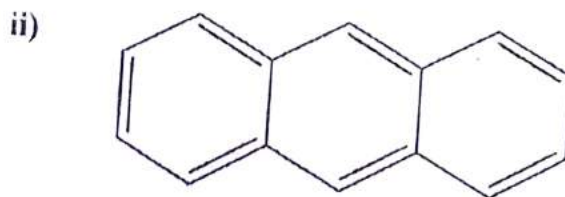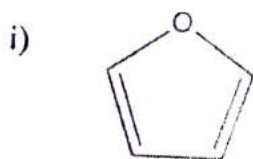
(i)

(ii)

b) Assign R/S configuration to the following compounds:

(i)

(ii)

c) Write down all the possible stereoisomers of 2,3-dibromobutane and give their relation amongst each other.

d) Which of the following compound/s is/are aromatic? Justify your answer.

i)

ii)

(4,3,3,2=12)

8. Write short note on **any four** of the following:

   a) Enantiomers and Diastereomers
   b) Aromaticity
   c) Markonikov's rule
   d) Absolute and relative configuration
   e) Inductive effect
   f) Ozonolysis