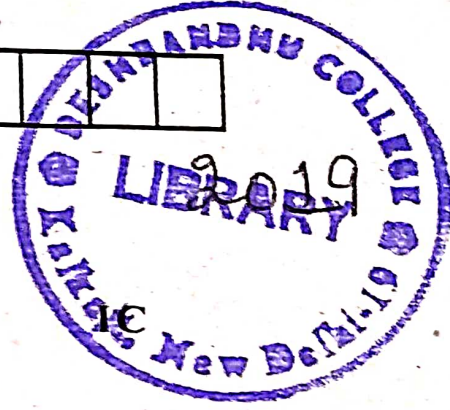This question paper contains 4+2 printed pages]

Roll No. ☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : 2920

Unique Paper Code : 32165201

Name of the Paper : Plant Ecology and Taxonomy

Name of the Course : Botany : G.E. for Honours

Semester : II

Duration : 3 Hours   Maximum Marks : 75

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

Attempt Section A and B on SEPARATE SHEETS

Q. No. 1 of both sections is compulsory.

Attempt *three* questions from Section A and *three* questions from Section B including question number 1 of both sections.

Attempt *All* parts of the question together.

Section A

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

   (i) Pedogenesis

   (ii) Humus

   (iii) Edge effect

(iv) Basal cover

(v) Homeostasis

(vi) Thermocline

(vii) Chresard.

(b) Fill in any *five* of the blanks : 5×½=2.5

(i) Instrument used to measure relative humidity is called ....

(ii) Pyramid of energy is always ....

(iii) ....is an example of hydrophyte.

(iv) .... is the study of relation between organisms and their natural environment.

(v) .... cycle is a sedimentary biogeochemical cycle.

(vi) .... is the successful establishment of a species in a bare area.

(vii) The diameter of clay particle is less than .... mm.

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

 (*i*) Primary and secondary succession.

 (*ii*) Food chain and food web.

 (*iii*) Neo-endemism and palaeo-endemism.

 (*iv*) Soil texture and soil structure.

3. Write short notes on any *three* of the following : 3×5=15

 (*i*) Weathering.

 (*ii*) Soil profile.

 (*iii*) Shelford's law of tolerance.

 (*iv*) Quantitative analytical characters of plant communities.

 (*v*) Soil water.

4. (*a*) List the different botanical provinces of India. Describe any *one* in detail.

7

 (*b*) What are biogeochemical cycles ? Explain Nitrogen cycle with a suitable diagram.

8

Section-B

1. (a) Match the following : 2.5

  (i) Binomial Nomenclature   (a) Takhtajan

  (ii) Bubble Diagram   (b) Engler & Prantl

  (iii) Flora of Delhi   (c) Linnaeus

  (iv) Phylogenetic Classification (d) Botanical Survey of

  India

  (v) Herbaria   (e) J. K. Maheshwari

 (b) Give the alternative names of any *three* of the following families :

  3

  Labiatae, Graminae, Umbelliferae, Cruciferae

 (c) Expand any *two* of the following abbreviations : 2×1=2

  IAPT, ICNCP, nom.cons, Hook. f.

2. Write short notes on any *three* of the following : 3×5=15

 (i) Principle of priority and its limitations.

 (ii) Botanical garden and its functions

(iii) Rejection of names

(iv) Procedure of Numerical taxonomy

(v) Role of cytology in plant systematics with examples

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

    (i)   Diagnosis

    (ii) Herbarium

    (iii) Valid Publication

    (iv) OTU

    (v)   Taxon

    (vi) Flora

    (vii) Holotype.

  (b) Interpret any *five* of the following :   5

    (i)   X Triticosecale

    (ii) *Lupinus* [Tourn.] Linn.

    (iii) *Solanum nigrum* L.

    (iv) *Carex kashmirensis* Clark in Hook.f.

    (v)   *Cynodon dactylon* (Linn.) Pers.

    (vi) *Rosa floribunda* cv. Blessings

(c) Define dichotomous keys ? Discuss two types of dichotomous keys. 5

4. (a) Differentiate between natural and phylogenetic system of classification. Give an outline of Bentham and Hooker's system of classification. Discuss its merits and demerits. 10

(b) Discuss Typification in detail. 5

This question paper contains 8 printed pages]

Roll No.

S. No. of Question Paper : 2921 ②

Unique Paper Code : 32175901

Name of the Paper : Atomic Structure, Bonding, General

Organic Chemistry and Aliphatic

Hydrocarbons

Name of the Course : Generic Elective – Chemistry for

Honours

Semester : II

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, selecting *three* questions
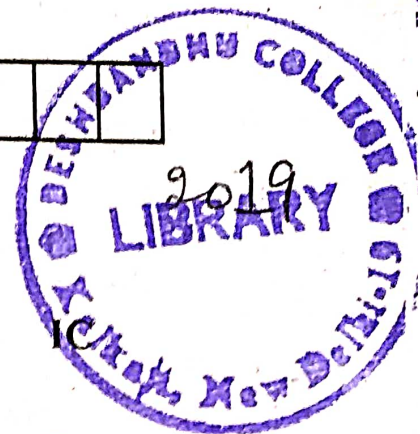
from each Section A and B respectively.

Please indicate the section and do not intermix

the questions from the two sections.

The questions should be numbered in accordance

to the number in the question paper.

P.T.O.

Section A

(Attempt any *three* questions.)

1. (a) Write the Schrödinger equation for wave mechanical model of an atom. Name the *three* quantum numbers of an atom which are yielded by the equation and give the significance of each quantum number.

(b) Give the shapes of *d*-orbitals.

(c) What is the physical significance of ψ and ψ^2 ?

(d) State the Heisenberg's uncertainty principle and give the expression. 5, 2.5, 3, 2

2. (a) Using VSEPR theory, predict the geometry of any *three* of the following :

ClF_3, SF_4, SF_6, PCl_5.
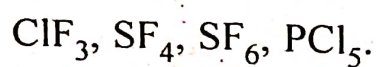
(b) Draw the molecular orbital diagrams of O_2 and N_2 and predict their bond order.

(c) Calculate the lattice energy of RbBr from the given data :

$S(Rb) = 75.3$ kJ/mol, $I(Rb^+) = 399.9$ kJ/mol,

$\frac{1}{2}D(Br_2) = 111.2$ kJ/mol, $E(Br^-) = -337.2$ kJ/mol,

$H_f(RbBr) = -389.5$ kJ/mol.   4.5, 5, 3

3. (a) Give the electronic configuration of Cu and Cr. State the reason for their deviation from Aufbau's principle.

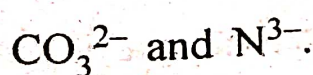(b) Justify $2d$ and $3f$ orbitals are not possible.

(c) Explain the following :

(i) NaCl has a higher melting point than $AlCl_3$.

(ii) AgCl is insoluble and NaCl is soluble in water.

(iii) Ionic crystals are hard but brittle.

(d) Define resonance. Give the resonance structures of

CO_3^{2-} and N^{3-}.   3, 2, 4.5, 3
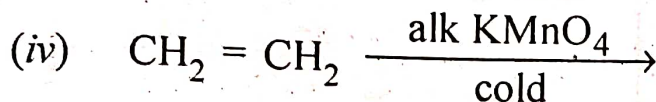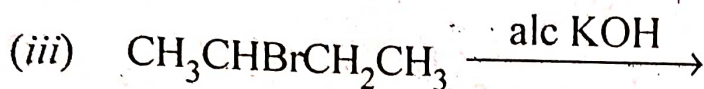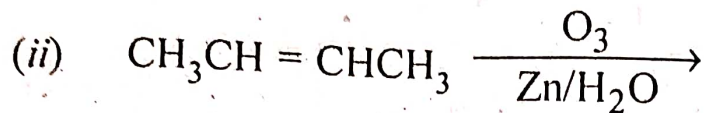
P.T.O.

4.　(a)　Which cation will exert greater polarising power in the following cases and why ?

　　　　(i)　　Na^+ or Mg^{2+}

　　　　(ii)　Cu^{2+} or Ca^{2+}.

　(b)　Find the values of n, l, m and s for an electron in $4f$ and $3d$ orbital.

　(c)　The bond angle in CH_4 is 109.5°, while the bond angle in NH_3 and H_2O is 107° and 104° respectively. Explain.

　(d)　State the de Broglie's hypothesis. Derive the de Broglie's relationship.　　　　　　　　　　　3, 4, 3, 2.5

Section B

(Answer any *three* questions.)

5.　(a)　Explain the following :

　　　　(i)　　Benzyl cation is **more stable than** methyl cation.

　　　　(ii)　Chair conformation of cyclohexane is more stable than boat conformation.

(b). Complete the following reactions :

(i) $CH_3CH_2Cl \xrightarrow{\text{Na/ether}}$

(ii) $CH_3CH = CHCH_3 \xrightarrow[Zn/H_2O]{O_3}$

(iii) $CH_3CHBrCH_2CH_3 \xrightarrow{\text{alc KOH}}$

(iv) $CH_2 = CH_2 \xrightarrow[\text{cold}]{\text{alk KMnO}_4}$
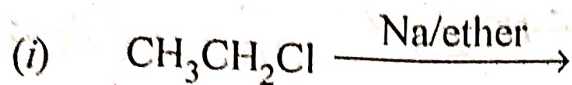
(c) Arrange the following in order of increasing stability and explain :

$^+CH_3, \ ^+CH(CH_3)_2, \ ^+C(CH_3)_3, \ ^+CH_2CH_3$.
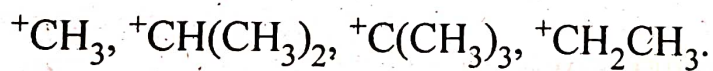
(d) Assign priority order and designate R/S to the following compounds :

(i)

```
        CHO
         |
   H ----+---- CN
         |
        COOH
```

(ii)

$$CH_2CH_3$$

$$H—\overset{\displaystyle CH_2CH_3}{\underset{\displaystyle Cl}{|}}—NO_2$$

(iii)

$$C_6H_5$$

$$D—\overset{\displaystyle C_6H_5}{\underset{\displaystyle H}{|}}—CH_3$$

3, 4, 2.5, 3
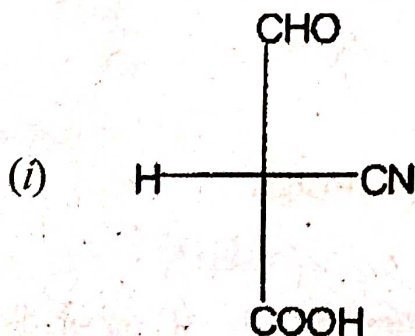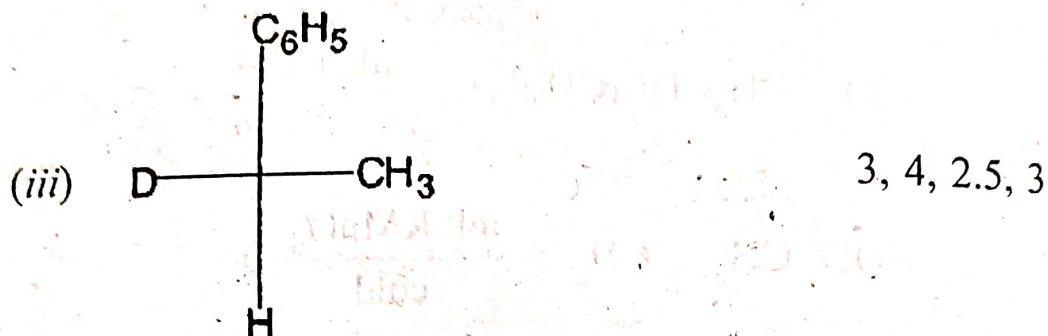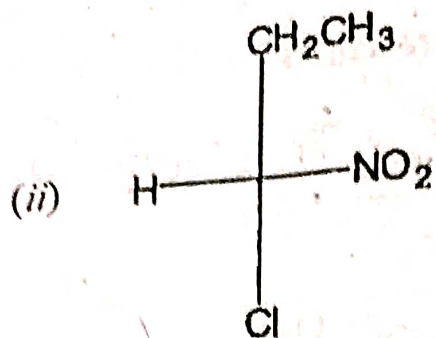
6.　Write short notes on any *five* :

(a)　Inductive effect

(b)　Markovnikov's rule

(c)　Hyperconjugation

(d)　Carbanions

(e)　D and L isomers

(f)　Homolytic and heterolytic cleavage.　　　5×2.5

7.　(a)　Discuss the free radical mechanism of chlorination of methane.

(b) Draw the Newman conformations of *n*-butane. Which conformation is most stable and why ?

(c) Carry out any *two* conversions :

(i) Propyne to 2-pentyne

(ii) Ethyl chloride to butane

(iii) Propene to 1-bromopropane.

(d) Discuss the oxymercuration-demercuration reaction of 1-propene. 3.5, 3, 3, 3

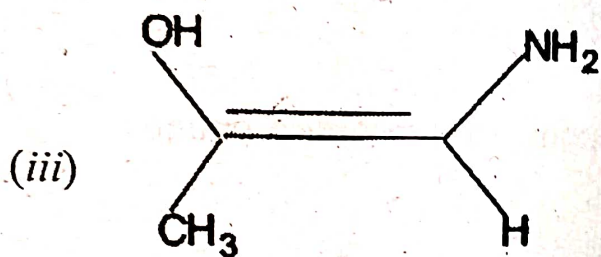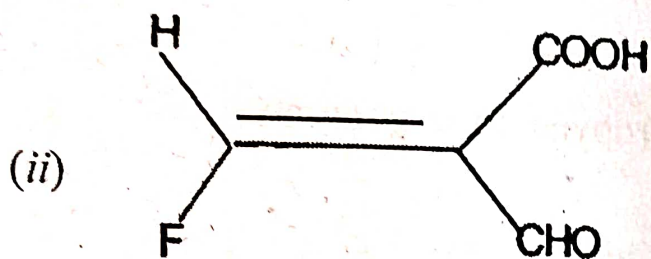8. (a) Draw the resonating structures of aniline.

(b) What is Huckel's rule ? Explain giving *two* examples.

(c) Distinguish between enantiomers, diastereomers and meso compounds using suitable examples.

(d) Assign E, Z configuration to the following compounds :

2, 3, 4·5, 3

(i)

(ii)

(iii)
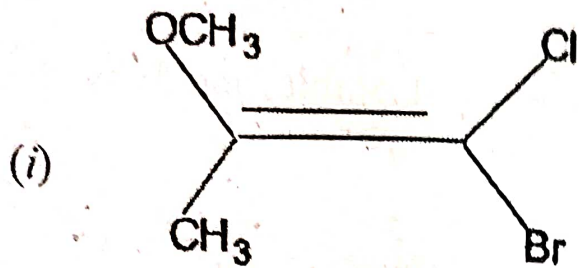
This question paper contains **8** printed pages]

Roll No.

S. No. of Question Paper : 2922

Unique Paper Code : 32175902

Name of the Paper : Chemical Energetics, Equilibria &

Functional Organic Chemistry I

Name of the Course : Chemistry : Generic Elective for

Honours

Semester : II

Duration : 3 Hours   Maximum Marks : 75

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

Attempt *three* questions from Section A

and *three* questions from Section B.

Please indicate the section you are attempting

and do not intermix the sections.

The questions should be numbered in accordance

to the number in question paper.

Calculators and log tables may be used.

P.T.O.

Section A

(Attempt any *three* questions in all.)

1. (a) The standard heat of neutralization ($\Delta H°$) of strong acid like hydrochloric acid (HCl) with strong base like sodium hydroxide (NaOH) is –57.3 kJ mol^{-1} whereas standard heat of neutralization reaction of weak acid like acetic acid (CH_3COOH) with strong base is found to be less. Why ? 3.5

(b) Calculate the equilibrium constant at 25°C for the reaction :

$$2NOCl\ (g) \rightleftharpoons 2NO\ (g) + Cl_2\ (g)$$
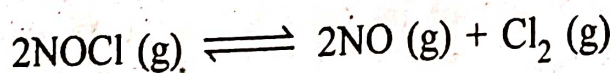
In the experiment 2 moles of NOCl was placed in 1 litre flask and the concentration of NO after attainment of equilibrium was 0.66 mol L^{-1}. 4

(c) Derive Henderson-Hasselbalch equation for an acidic buffer. Calculate pH of the solution made by adding 0.001 moles of NaOH solution to 1 dm³ of solution which contains 0.5 M acetic acid and 0.5 M sodium acetate. Given K_a (acetic acid) = 1.8 × 10^{-5}.   5

2. (a) Using the bond enthalpy data tabulated below calculate the enthalpy change of the reaction :

$$C_2H_4 + H_2 \rightarrow C_2H_6$$
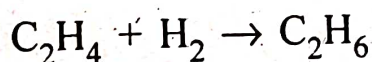
Bond	C-C	C = C	C-H	H-H
Bond enthalpy/kJ mol^{-1}	336.8	606.7	410.9	431.8

4

(b) What do you understand by the term chemical equilibrium ? Give its characteristics. Derive the law of chemical equilibrium thermodynamically. Find the relationship between K_p, K_x and K_c.

4

(c) Derive the expression of hydrolysis constant (K_h), degree of hydrolysis (h) and pH for a solution of a salt of weak base and strong acid of concentration (c).   4.5

3. (a) Derive Kirchhoff's equation of variation of enthalpy with temperature using thermodynamic principles. Calculate standard heat of formation (ΔH_f°) of the hydrochloric acid, (HCl) at 348K from the following data :

$$\tfrac{1}{2}H_2 \text{ (g)} + \tfrac{1}{2}Cl_2 \text{ (g)} \rightarrow HCl \text{ (g)} \quad \Delta H_f^\circ = -92.3 \text{ kJ mol}^{-1}$$
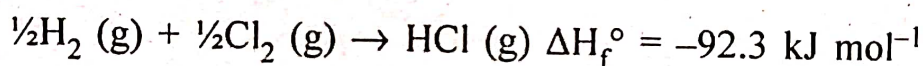
The mean heat capacities at this temperature are H_2 (g) $C_p = 28.53$ J K^{-1} mol^{-1}, Cl_2 (g) $C_p = 32.26$ J K^{-1} mol^{-1}, HCl (g) $C_p = 28.49$ J K^{-1} mol^{-1}.   4

(b) Given the following thermodynamic equation :

$$S \text{ (rhombic)} + O_2 \text{ (g)} \rightarrow SO_2 \text{ (g)} \quad \Delta H = -297.5 \text{ kJ mol}^{-1}$$

$$S \text{ (monoclinic)} + O_2 \text{ (g)} \rightarrow SO_2 \text{ (g)} \quad \Delta H = -300.0 \text{ kJ mol}^{-1}$$
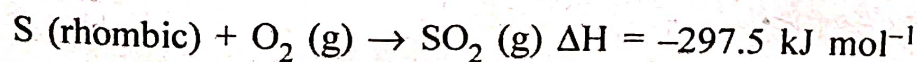
Calculate ΔH for the transformation of 1 gram atom of S (rhombic) to S (monoclinic).   3

(c) The solubility product (K_{sp}) of $Mg(OH)_2$ at 25°C is 1.4×10^{-11}. Calculate solubility of $Mg(OH)_2$ in g dm^{-3}. Given molar mass of $Mg(OH)_2$ is 58.31 g mol^{-1}. 3

(d) Write a brief note on factor affecting degree of ionization. 2.5

4. (a) State third law of thermodynamics. Explain how it can be applied to determine absolute entropy of a substance at given temperature. 3

(b) What are buffer solutions ? Explain the mechanism of buffer action in the solution prepared by mixing equal moles of ammonium hydroxide and ammonium chloride. Why a solution of strong acid or strong base and its corresponding salt with strong base/strong acid do not show buffer action ? 4

(c) Define and explain the following terms :

(1) Integral heat of dilution

(2) Differential enthalpy of solution. 2.5

Or

Define pH of a solution. Calculate pH of aqueous solution formed by mixing 25 mL of 0.2 M Hydrochloric acid (HCl) with 50 mL of 0.25 M Sodium hydroxide (NaOH).   2.5

(d) Discuss the plot of Gibbs free energy, (G) as a function of advancement/extent of reaction.   3

Section B

(Attempt any *three* questions in all.)

5. Explain, why ?

(a) Nitrobenzene when reacted with nitrating reagent gives *m*-dinitrobenzene while toluene gives *o*- and *p*-nitro toluene.

(b) Benzoin condensation catalyzed by cyanide ion not by hydroxide ion.

(c) Compare Friedel Craft alkylation and acylation reaction.

(d) What is the difference between sigma and pi complexes in electrophilic aromatic substitution reaction ?

3, 3, 3, 3.5

6. (a) With the help of a suitable example, write down elimination addition (benzyne) mechanism for nucleophilic aromatic substitution reaction.

    (b) With the help of a suitable example, write down $S_N 1$ mechanism with stereochemistry.

    (c) Explain Cannizzaro reaction by taking *two* examples with its mechanism.   4, 4, 4.5

7. Write short notes on any *three* of the following (with mechanism) :

    (a) Schotten-Baumann reaction

    (b) Gattermann-Koch reaction

    (c) Oppeneauer oxidation

    (d) Pinacol-pinacolone rearrangement.   4, 4, 4.5

8. (a) Give the products of the following reactions (any *five*) :

        (i) Benzoic acid + HNO_3(Conc.)/H_2SO_4(Conc.)

        (ii) Benzene + $RCOCl/AlCl_3/\Delta$

(iii)   Aniline + $Br_2/FeBr_3$

(iv)   Phenol + H_2SO_4/Δ

(v)   Benzaldehyde (C_6H_5CHO) + 10% NaOH + Heat

(vi) $CH_3—CH = CH_2$ + HBr.
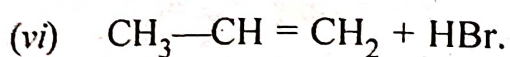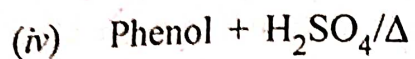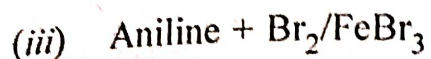
(b)   Write the reaction for the preparation of phenol from cumene.

(c)   Give the reaction of phenol with chloroform in presence of NaOH. Name the reaction and also give its mechanism.   5, 2.5, 5

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

Roll No.

S. No. of Question Paper : **2928** (4)

Unique Paper Code : **32345201**

Name of the Paper : **Introduction to Database Systems**

Name of the Course : **General Elective for Honours :**

Computer Science

Semester : **II**

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

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

Q. No. **1** is compulsory. Attempt any *four* questions out of

Q. Nos. **2** to **7**. Parts of a question must be answered together.

Marks are indicated against each question.

1. (*a*) Suggest appropriate data types for the following

attributes : 3

(*i*) Marks in Examination

(*ii*) Name of an Employee

(*iii*) Date of Birth.

P.T.O.

(b)   What do the following geometrical shapes represent in an ER Diagram ?

3

(i)   [rectangle]

(ii)   [diamond with lines on both sides]

(iii)   [ellipse]
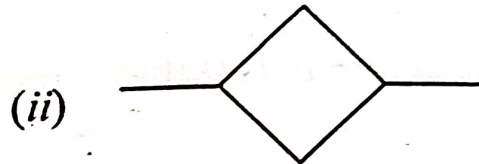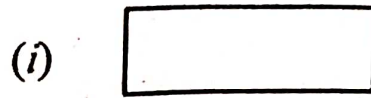
(c)   In each case, draw the geometrical shape to be used in an ER Diagram :

3

(i)   Multivalued attribute

(ii)   Weak entity type

(iii)   Key attribute.

(d)   For each of the following commands, indicate whether it belongs to DDL or DML :

4

(i)   Create table

(ii)   Update table

(iii)   Drop table

(iv)   Delete from table.

(e) For the given binary relationships, suggest the cardinality ratio of the relationship based on the general context of entity types and state the context clearly :   5

	Entity Type	Relationship	Entity Type
(i)	EMPLOYEE	Has	DEPENDENT
(ii)	EMPLOYEE	Works_on	PROJECT
(iii)	TEACHER	Teaches	STUDENT
(iv)	COLLEGE	Offer	COURSE
(v)	BANK	Has	MANAGER

(f) In the following relational database, point out the primary and foreign keys stating any assumptions that you make :   5

EMPLOYEE (ENumber, Ename, Email, Phone)

PROJECT (ProjectName, ProjectDescription, ProjectManager)

WORKS_ON (ENumber, ProjectName, Hours)

(g)   Given the following relations :

EMPLOYEE   DEPARTMENT

Eid	Ename	Salary	Dno
1	Amit	3000	101
2	Sumit	2000	102
3	Jaspal	1000	103
4	Rohit	4000	102
5	Vikas	3000	102

Dno	Dname
101	Administration
102	Research
103	Accounts

What will be the output of the following queries ?   6

(i)   select Dno, Count(*)

        fromEmployee

        group by Dno;

(ii)   select E.Ename,   D.Dname

        fromEmployee E, Department D

        whereE.Dno=D.Dno;

(iii)   select count (Dno)

        fromEmployee;

(h)   Consider the following Relational database schema :

STUDENT

Rollno	Name	Department	Marks
1	Ramesh	CS	94
2	Narayan	CS	75
3	Murthy	MS	62
4	Priya	MS	89
5	Garima	CS	78

Write SQL queries for the following statements :

(i)   Insert a new student <7, 'Priyanka','CS',82> in the above database.

(ii)   Change the Department of ' Ramesh' to 'MS'.

(iii) Delete the records where marks are less than 70. 6

2.   (a)   Consider the relation STUDENT (RollNo, Name, Dept, Marks)

Write the following queries into SQL form :

(i)   Display the total number of students in each department.

(ii)   Display minimum, average and maximum marks of the class.

(iii) Display the details of the students whose name starts with 'J'.   6

(b)   Write two advantages of DBMS over traditional file processing.   4

3. (a) Draw ER diagrams for the following binary relationships. Specify at least *three* attributes for each entity and mention cardinality ratios also : 6

Entity Type	Relationship	Entity Type
(i) EMPLOYEE	Works_For	COMPANY
(ii) STUDENT	Enrols_For	COURSES

(b) Illustrate each of the following with the help of an ER diagram : 4

(i) One to many relationship, and

(ii) One to one relationship.

4. (a) Differentiate between the following :

(i) Primary key and candidate key.

(ii) Physical data independence and logical data independence. 6

(b) Is the relation given below in 1NF ? If yes, justify, otherwise convert it into 1NF : 4

Dno	Dname	Dlocation
101	Administration	{Spring, Houston}
102	Research	Stanford
103	Accounts	Houston

5. (a) Consider the universal relation R = {A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies F = {AB → C, BD → EF, AD → GH, G → I, H → J}. What is the key for R ? Decompose R into 2NF and then 3NF relations. 6

(b) Write SQL query for performing the following tasks on relation schema 4

EMPLOYEE (Eno, Ename, BDate, Address, Dno) :

(i) For displaying employee names having two 'a's in their names.

(ii) For sorting the data of the above table name-wise.

6. (a) EMP_DEPT 6

Ename	Id	Bdate	City	Dno	Dname	DmgrSsn
Kalpna	1	01-05-92	New Delhi	101	Research	3
Daksh	2	02-05-92	Hyderabad	101	Research	3
Nitin	3	11-05-95	Bangalore	102	Admin	4
Anita	4	04-07-92	Mumbai	102	Admin	5
Narayan	5	22-05-82	Hyderabad	105	Headquarter	5

Consider the above relational database schema and give an SQL query for each of the following :

(i) a query that will result in Insertion Anomaly.

(ii) a query that will result in Deletion Anomaly.

(iii) a query that will result in Update Anomaly.

(b) Differentiate between HAVING and WHERE clause with the help of an example. 4

7. Consider a MOVIEdatabase in which data is recorded about the movie industry. The data requirements are summarized as follows :

- Each movie is identified by title and year of release. Each movie has a length in minutes. Each has a production company, and each is classified under one or more genres (such as horror, action, drama, and so forth). Each movie has one or more directors and one or more actors appear in it.

- Actors are identified by name and date of birth and appear in one or more movies. Each actor has a role in the movie.

- Directors are also identified by name and date of birth and direct one or more movies. It is possible for a director to act in a movie (including one that he or she may also direct).

- Production companies are identified by name and each has an address. A production company produces one or more movies.

Identify:

(i) entities of interest.

(ii) attributes for each entity.

Draw an ER diagram for the above database. Also specify clearly all constraints on the relationships in the diagram. State clearly any assumptions that you make.   10

This question paper contains 4+2 printed pages]

Roll No.

S. No. of Question Paper : 2980

Unique Paper Code : 32355202

Name of the Paper : **Linear Algebra**

Name of the Course : **Generic Elective—Mathematics for**

Honours

Semester : **II**

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

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

Attempt *all* questions by selecting any *two* parts

from each question.

1. (*a*) If x and y are vectors in $\mathbf{R}^3$, then prove that :

$$\|x\| - \|y\| \le \|x + y\| \le \|x\| + \|y\|.$$ 6½

    (*b*) Let x and y be nonzero vectors in $\mathbf{R}^3$. If $x \cdot y \le 0$, then

    prove that :

$$\|x - y\| > \|x\|.$$

    Is the converse true ? Justify.   6½

P.T.O.

(c) Solve the following system of linear equations using the Gauss-Jordan method :

$$2x_1 + x_2 + 3x_3 = 16$$

$$2x_1 + 12x_3 - 5x_4 = 5$$

$$3x_1 + 2x_2 + x_4 = 16$$ 6½

2. (a) Define the rank of a matrix and determine the rank

of $\begin{pmatrix} 1 & 2 & -2 & -11 \\ 2 & 4 & -1 & -10 \\ 3 & 6 & -4 & -25 \end{pmatrix}$. 6

(b) Prove that the matrix $\begin{pmatrix} 7 & 1 & -1 \\ 11 & -3 & 2 \\ 18 & 2 & -4 \end{pmatrix}$ cannot be

diagonalized. 6

(c) Let V be a vector space over **R**, then for any vector v in V and every nonzero real number a, prove that

$av = 0$ if and only if $v = 0$. 6

3. (a) Let $S = \left\{ \begin{pmatrix} 1 & 3 \\ -2 & 1 \end{pmatrix}, \begin{pmatrix} -2 & -5 \\ 3 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 4 \\ -3 & 4 \end{pmatrix} \right\}$ be a subset

of 2×2 real matrices. Use the Simplified Span Method to find a simplified form for the vectors in span(S). Is the set S linearly independent ? Justify.   4½+2

(b) Define a basis for a vector space. Show that the set :

$$B = \{[-1, 2, -3], [3, 1, 4], [2, -1, 6]\}$$

is a basis for $\mathbf{R}^3$.   2+4½

(c) Using rank, find whether the non-homogeneous linear system $Ax = b$, where

$$A = \begin{pmatrix} 2 & 1 & 3 \\ 1 & -2 & 2 \\ 0 & 1 & 3 \end{pmatrix}, b = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$$

has a solution or not. If so, find the solution.   4+2½

4. (a) Consider the ordered basis $S = \{[1, 0, 1], [1, 1, 0], [0, 0, 1]\}$ for $\mathbf{R}^3$. Find another ordered basis T for $\mathbf{R}^3$ such that the transition matrix from T to S is :   6

$$P_{S \leftarrow T} = \begin{pmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \\ -1 & -1 & 1 \end{pmatrix}.$$

(b)   Suppose L : $\mathbf{R}^2 \to \mathbf{R}^2$ is a linear operator and L([1, 1]) = [1, −3] and L([−2, 3]) = [−4, 2]. Express L([1, 0]) and L([0, 1]) as linear combinations of the vectors [1, 0] and [0, 1].   6

(c)   Let L : $\mathbf{R}^3 \to \mathbf{R}^2$ be the linear transformation given by :

$$L([x, y, z]) = [−2x + 3z, x + 2y − z]$$

Find the matrix for L with respect to the bases :

B = {[1, −3, 2], [−4, 3, −3], [2, −3, 2]} for $\mathbf{R}^3$ and C = {(−2, −1], [5, 3]} for $\mathbf{R}^2$.   6

5.   (a)   For the graphic figure below, use homogeneous coordinates to find the new vertices after performing a scaling about the point (3, 3) with scale factors of 3 in the x-direction and 2 in the y-direction. Then sketch the final figure that would result from this movement : 4+2½
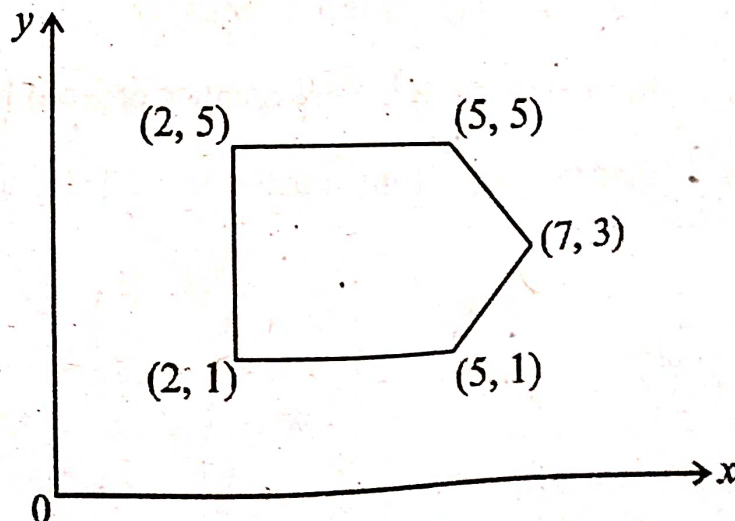
(b) Let $L : \mathbf{R}^3 \to \mathbf{R}^3$ be the linear operator given

by :

$$L\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}\right) = \begin{pmatrix} 3 & 1 & -3 \\ 2 & 1 & -1 \\ 2 & 3 & 5 \end{pmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

Find a basis for ker(L) and a basis for range (L), also

verify the dimension theorem.   4+2½

(c) Show that a mapping $L : P_2 \to P_2$ given by

$L(p(x)) = p(x) + p'(x)$ is an isomorphism, where P_2 is the

vector space of all polynomials of degree ≤ 2.   6½

6. (a) Let W be the subspace of $\mathbf{R}^3$ whose vectors lie in the

plane $3x - y + 4z = 0$. Let $v = [2, 2, -3] \in \mathbf{R}^3$. Find

$proj_{w^\perp}\ v$, and decompose v into $w_1 + w_2$, where

$w_1 \in W$ and $w_2 \in W^\perp$. Is the decomposition

unique ?   6

(b) For the subspace $W = \{[x, y, z] \in \mathbf{R}^3 : 2x - 3y + z = 0\}$ of $\mathbf{R}^3$, find a basis for W and the orthogonal complement $W^\perp$. Also verify that :

$$\dim(W) + \dim(W^\perp) = \dim(\mathbf{R}^3).$$

4+2

(c) If $A = \begin{pmatrix} 1 & -1 \\ 4 & 1 \\ 2 & 3 \end{pmatrix}$, $b = \begin{pmatrix} 0 \\ 4 \\ 5 \end{pmatrix}$, $z = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$. Find vector v

satisfying the inequality :

$$\| Av - b \| \leq \| Az - b \|.$$

6

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

Roll No.

S. No. of Question Paper : 2985 ⑥
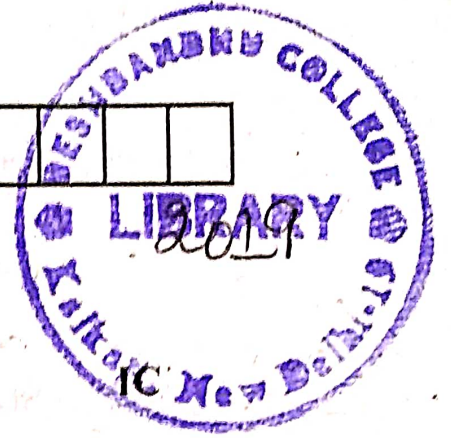
Unique Paper Code : 32225201

Name of the Paper : **Mechanics**

Name of the Course : **Physics : Generic Elective for Honours**

Semester : **II**

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.

Question No. **1** is Compulsory.

Attempt *four* questions from rest of the paper.

1. Attempt any *five* of the following :

   (a) Find the angle between $\vec{A} = 2\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{B} = 6\hat{i} - 3\hat{j} + 2\hat{k}$.

   (b) Solve the differential equation :

   $$\frac{d^2 y}{dx^2} - 5y = 0.$$

   P.T.O.

(c) Does the centre of mass of solid body necessarily lie within the body ? Give examples.

(d) State Kepler's laws of planetary motion.

(e) Define simple harmonic motion. Write differential equation for simple harmonic motion.

(f) What is Poisson's ratio ? Can it be more than 0.5 ?

(g) What are the *two* postulates of special theory of relativity ?   5×3=15

2. (a) If $\vec{A} = 5t^2\,\hat{i} + t\,\hat{j} - t^3\,\hat{k}$ and $\vec{B} = \sin t\,\hat{i} - \cos t\,\hat{j}$, find

$\dfrac{d}{dt}(\vec{A}\,.\,\vec{B})$.   5

(b) Solve :   5

$$\frac{dy}{dx} = \frac{2x^3 + y^3}{3xy^2}.$$

(c) Solve :   5

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = 0.$$

3. (a) State and prove work energy theorem.   1,5

(b) Find the total work done in moving a particle in a force field given by $\vec{F} = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$, from $t = 1$ to $t = 2$.   3

(c) Define centre of mass. Show that in the absence of the external forces, the velocity of centre of mass remains constant.   1,5

4. (a) Explain the principle of a rocket. Establish the following relation for a rocket :

$$V = V_0 + v \log e \frac{M_0}{M},$$

where v is the exhaust velocity of the gases relative to rocket, M_0, V_0 are initial mass and velocity of rocket respectively. M and V are mass and velocity of the rocket at any time 't'.   3,7

(b) A particle of mass m, is moving in x-y plane and the components of its velocity along x and y directions are v_x and v_y. Show that its angular momentum has only a z component.   5

5. (a) What are central forces ? Give *two* examples. Show that in a central force field :

(i) the angular momentum is conserved.

(ii) the particle moves in a fixed plane.   1,1,3,3

P.T.O.

(b)   What is satellite ? Derive expressions for the velocity and time period of a satellite orbiting around earth. 2,2½,2½

6.   (a)   What is simple harmonic motion ? Give *two* examples. Deduce the differential equation of simple harmonic motion and find its solution.   1,1,3,4

(b)   Show that for a harmonic oscillator, mechanical energy remains constant and it is proportional to the square of the amplitude.   6

7.   (a)   Find the work done in stretching the wire.   5

(b)   Define Young's modulus (Y), bulk modulus (K) and modulus of rigidity (η). Prove the relation :

$$Y = \frac{9K\eta}{3K + \eta}.$$ 1,1,1,7

8.   (a)   Write down the Lorentz space-time transformation equations. Discuss the time dilation in special theory of relativity.   2,4

(b)   Obtain the formula for relativistic addition of velocities. 6

(c)   A spacecraft is moving relative to earth. An observer on the earth finds that, according to her clock, 3601 s elapse between 1 p.m. and 2 p.m. on the spacecraft's clock. What is the spacecraft's speed relative to the earth ?   3

This question paper contains **3** printed pages]

Roll No.

S. No. of Question Paper : 3006

Unique Paper Code : 32235907

Name of the Paper : **Human Physiology**

Name of the Course : **Zoology : G.E. for Honours**

Semester : **II**

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

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

Answer *five* questions in all including

question No. **1** which is compulsory.

1.   (*a*)   Define the following :   5

(*i*)   Myxodema

(*ii*)   External respiration

(*iii*)   Tetany

(*iv*)   Porta hepatis

(*v*)   Refractory period.

(*b*)   Differentiate between the following: 6×2

(*i*)   Simple and saltatory conduction.

P.T.O.

(ii) Skeletal and smooth muscle.

(iii) Insulin and Glucagon hormone.

(iv) Renin and Rennin.

(v) Gastric acid and Gastrin.

(vi) Blood and lymph.

(c) Expand the following :   ½×6=3

(i) EEG

(ii) RBC

(iii) EPSP

(iv) ICSH

(v) CCK

(vi) GnRH.

(d) Fill in the blanks :   1×7=7

(i) The liver is primarily located in .... of the abdomino-pelvic quadrants.

(ii) .... processes of astrocytes are involved in the blood-brain barrier.

(iii) The average life span of a red blood cell is approx ....

(iv) Intrinsic factor secreted by the parietal cells of the stomach is important for the absorption of ....

(v) The property that allows the heart to generate and conduct electrical impulses on its own is ....

(vi) The .... carries oxygenated blood from the lungs to the heart.

2. Describe the structure and functions of Pancreas.   12

3. Explain in detail the mechanism of nerve impulse/action potential.   12

4. Discuss the physiology of menstrual cycle.   12

5. Describe the composition and function of bile juice.   12

6. With help of a diagram, describe the structure of the heart.   12

7. Write short notes on any *three* of the following :   12

   (a) Urine formation

   (b) Functions of Liver

   (c) Agranulocytes

   (d) Thyroid hormones.

   (e) Plasma Proteins.