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

Sr. No. of Question Paper : 3354

Unique Paper Code : 42171205

Name of the Paper : Chemical Energetics, Equilibria and Functional Group Organic Chemistry-I

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

Semester : II

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. **Section A** and **B** are **two** parts given in question paper, students should be asked to attempt separately.

3. Attempt any **THREE** questions each from **Section A** and **Section B**.

4. **All** questions carry **12.5** marks each.

5. Attempt all parts of a question together.

P.T.O.

SECTION A

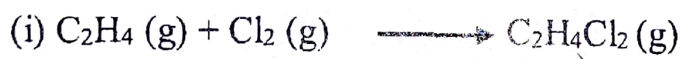1. (a) Calculate the heat of formation of benzene from the following data :

$$C_6H_6 \, (l) + 15/2 \, O_2 \, (g) \longrightarrow 6CO_2 \, (g) + 3H_2O \, (l)$$

$$\Delta H^O = -3303 \, KJ$$

$$\Delta H_f^O \, (CO_2) = -393.5 \, KJ$$

$$\Delta H_f^O \, (H_2O) = -285.8 \, KJ$$

(b) Calculate the enthalpy change for the following reactions

(i) $C_2H_4 \, (g) + Cl_2 \, (g) \longrightarrow C_2H_4Cl_2 \, (g)$

(ii) $C_2H_6 \, (g) + 2Cl_2 \, (g) \longrightarrow C_2H_2Cl_2 \, (g) + 2HCl \, (g)$

Given B.E. (C-C) = 348 $KJmol^{-1}$

Given B.E. (C-H) = 413 $KJmol^{-1}$

Given B.E. (Cl-Cl) = 242 $KJmol^{-1}$

Given B.E. (C-Cl) = 328 $KJmol^{-1}$

Given B.E. (H-Cl) = 432 $KJmol^{-1}$

(c) Derive Kirchhoff s equation thermodynamically. Given the brief account for the importance of Kirchhoff s equation in thermodynamic studies.

(4,4,4.5)

2. (a) What is meant by 'degree of hydrolysis' and 'hydrolysis constant'?

Describe the relationship between hydrolysis constant and the dissociation constant of the base for the hydrolysis of a salt of strong acid and a weak base.

(b) At a certain temperature, degree of dissociation of pure water is 1.81×10^{-9}. Calculate the ionic product of water at this temperature.

(c) Calculate the pH of a solution obtained by mixing 5 gm of acetic acid and 7.5 gm of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid at 25°C is 1.75×10^{-5}.

(4,4.4.5)

3. (a) For a rection

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$
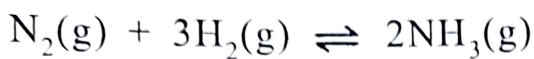
$Kp = 1.64 \times 10^{-4}$ at 673 K.

Calculate :

(i) $\Delta G°$ and

(ii) ΔG when the pressure of N_2 and H_2 are maintained at 10 and 30 atm, respectively and NH_3 is removed at a partial pressure of 3 atm.

(iii) Is this process spontaneous?

(b) For the reaction N_2O (g) $\longrightarrow$ $2NO_2$ (g) at 300K, and 1 atm $Kp = 0.157$. Calculate Kc & Kr for this reaction.

(c) State & explain Le Chatelier's Principle. Apply this principle to study the effect of temperature, pressure and concentration for the reaction

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3 (g) \qquad \Delta H = -92.4 \text{ KJ}$$

(4,4,4.5)
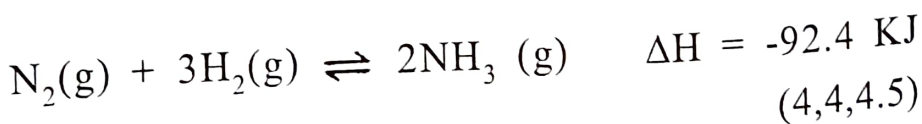
4.   (a) Calculate the enthalpy change for the following reaction at $25°$

$$C_2H_6 (g) + 7/2\ O_2(g) \longrightarrow 2CO_2 (g) + 3H_2O\ (1)$$

$\Delta H_f^{\circ}\ (CO_2) = -393.5\ KJ$

$\Delta H_f^{\circ}\ (H_2O) = -285.8\ KJ$

$\Delta H_f^{\circ}\ (C_2H_6) = -84.5\ KJ$

$\Delta H_f^{\circ}\ (H_2O) = 0$

(b) The equilibrium constant, Kp for the reaction :

$A + B \rightleftharpoons C + D$ is 1×10^{-12} at 600 K and 1×10^{-7} at 800 K. Calculate the heat of reaction.

(c) The solubility product of magnesium hydroxide $Mg(OH)_2$ at $25°C$ is 1.24×10^{-11}. Calculate the solubility of magnesium hydroxide in grams per litre? ($Mg = 24,\ O = 16,\ H = 1$).

(4,4,4.5)

SECTION B

1. (i) Complete the following reactions :

(a) + $CH_3CH_2CH_2Cl$ $\xrightarrow[\text{Heat}]{AlCl_3}$ A

(b) $\xrightarrow{H^+}$ B

(c) $CH_3COCH_2CH_3$ $\xrightarrow{CH_3CH_2MgBr}$ C $\xrightarrow{H_2O/H^+}$ D
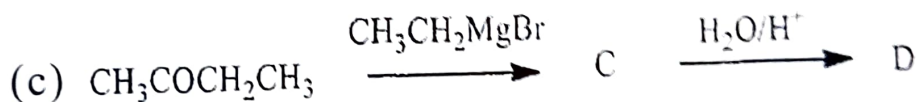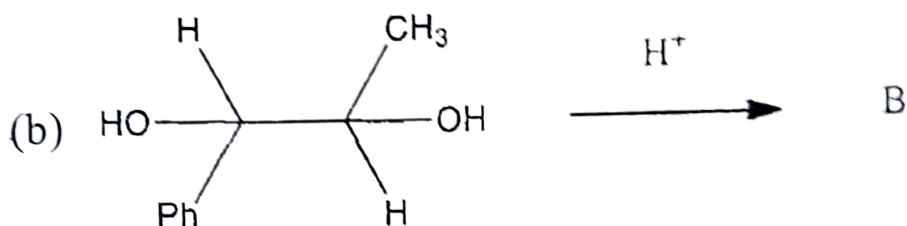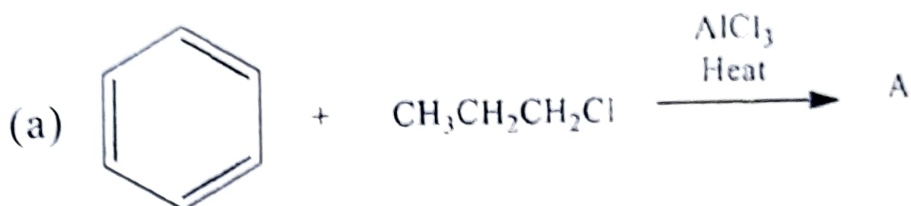
(ii) Carry out following conversion:

(a) Cumene to Phenol

(b) Toluene to Benzaldehyde

(iii) Write a suitable test to distinguish following pair of compounds :

(a) CH_3CHO and C_6H_5CHO

(b) Ethanol and Phenol

(4,4,4.5)

2. (i) Explain Williamson's synthesis of t-Butyl ethyl ether.

    (ii) Explain S$_N$I mechanism with suitable example.

    (iii) Which one is more reactive in nucleophilic addition reaction, Benzaldehyde or Propanol. Explain your answer.   (4,4,4.5)

3. (i) Explain the effect of nitro substituent on reactivity of haloarenes.

    (ii) Why phenols are more acidic than aliphatic alcohols. Compare the acidity of nitrophenol with phenol.

    (iii) Differentiate between Aldol and Cannizzaro reaction by suitable examples and mechanism.   (4,4,4.5)

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

    (i) Benzoin condensation

(ii) Lucas test for alcohol

(iii) Reimer-Tiemann reaction

(iv) Wolff Kishner reduction   (4,4,4.5)

[This question paper contains 8 printed pages.]

30/5/24

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

Sr. No. of Question Paper : 3363

Unique Paper Code   : 42161201

Name of the Paper   : Plant Ecology and Taxonomy

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

Semester   : II

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 **Section-A** and **B** on SEPARATE SHEETS.

3. Question No. **1** of **both** sections is COMPULSORY.

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

5. Attempt all parts of a question together.

P.T.O.

SECTION – A

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

   (i) Homeostasis

   (ii) Standing state

   (iii) Ecotone

   (iv) Ecesis

   (v) Eutrophication

   (vi) Biomagnification

   (b) Fill in the blanks :   (0.5×5=2.5)

   (i) Succession occurring on sand is called

   _____

(ii) *Eichhornia* SP. is an example of a

_____

(iii) Pyramids of energy are always _____

(iv) Hygrometer is used to measure _____

(v) Total water content in soil is known as

_____

2. (a) Discuss the sequence of processes occurring during a primary succession. (5)

(b) Explain the cycling of Nitrogen with the help of a diagram. (5)

(c) Briefly comment on the light as an ecological factor. (5)

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

(a) Soil profile

(b) States of water in soil

(c) Ecological pyramids

(d) Synthetic characters of plant communities

(e) Shelford's law of tolerance

4. Differentiate between **any three** of the following :

(5×3=15)

(a) Grazing food chain and detritus food chain

(b) Neoendemism and paleoendemism

(c) Heterotrophic succession and autotrophic succession

(d) Primary productivity and secondary productivity

(e) Single channel energy flow model and Y shaped energy flow model

SECTION – B

1. (a) Expand **any five** of the following: (5x1=5)

    (i) OTU

    (ii) IAPT

    (iii) *nom. nud.*

    (iv) DC

    (v) R.Br.

    (vi) BSI

(b) Give the alternate name of the following

    families :   (5×0.5=2.5)

      (i) Compositae

      (ii) Palmae

      (iii) Labiatae

      (iv) Cruciferae

      (v) Gramineae

2.   Write short notes **any three** of the following :

                                        (3×5=15)

    (a) Principles of ICN

    (b) Importance of botanical gardens in taxonomy

    (c) Taxonomic hierarchy

(d) Numerical taxonomy

(e) Author citation

3. Differentiate between **any three** of the following :

(3×5=15)

(a) Tautonym and autonym

(b) Phenogram and cladogram

(c) Indented key and parallel key

(d) Holotype and lectotype

(e) Artificial and natural system of classification

4. (a) Give the outline of the system of classification proposed by Bentham and Hooker for seed plants (upto the level of series). Enumerate its merits and demerits. (5+3=8)

(b) Discuss role of cytology in solving taxonomic

problems with suitable examples. (7)

[This question paper contains 8 printed pages.]

01/June.

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

Sr. No. of Question Paper : 3366

Unique Paper Code : 42221201

Name of the Paper : Electricity, Magnetism and EMT

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

Semester : II

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. Attempt **four** questions from the rest of the paper.

4. Use of non-programmable calculator is allowed.

P.T.O.

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

(a) If a vector $\vec{A}$ is irrotational, show that $\vec{A} \times \vec{r}$ is solenoidal where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

(b) A short electric dipole placed in free space has the dipole moment of 3×10^{-9} Cm. Find the electric potential due to the dipole at a far-off point distant 0.3 m from the centre of the dipole situated on

    (i) The axial line

    (ii) The equatorial line

(c) Show that the electric polarization, $\vec{P} = \varepsilon_0 (\varepsilon_r - 1)\vec{E}$, where $\vec{E}$ is the electric field in a linear medium.

(d) An electron circulates around a nucleus in an orbit of radius 5.1×10^{-11} m with constant speed of 0.7×10^{-2} c (where c= 2.998×10^8 m/sec). Calculate magnetic field at the center of the orbit.

(e) Prove that $\vec{B}$ is a solenoidal vector.

(f) A current of 10 A in the primary of a circuit is reduced to zero at a uniform rate in 10^{-3} sec. If the coefficient of mutual inductance is 3 H, evaluate the induced emf in the secondary circuit?

(g) The electric field of a plane electromagnetic wave in free space is given by

$$\vec{E} = \hat{j}50 \; e^{j\left(10^8 t + kx\right)} \; V/m$$

Find

    (i) The direction of wave propagation

    (ii) The value of k

    (iii) Wavelength λ of the wave

2. (a) Show that $\vec{F} = \left(2xy + z^3\right)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$ is a conservative force field and hence find its scalar potential ϕ.   (9)

  (b) Find the unit outward drawn normal to the surface $(x - 1)^2 + y^2 + (z + 2)^2 = 9$ at the point $(3, 1, -4)$.

         (6)

3. (a) State Gauss's theorem of electrostatics. Express it in its integral and differential form.   (5)

(b) Using Gauss's theorem of electrostatics, calculate electric field inside and outside a uniformly charged solid sphere placed in free space. Also write these expressions when the sphere is placed in a medium of dielectric constant K. (5)

(c) Show that the potential difference between any two points in an electric field is given by the line integral of the electric field taken over a path joining these two points. (5)

4.   (a) Show that $K = 1 + \chi_e$; where K is dielectric constant and χ_e is electric susceptibility. (5)

(b) Obtain the expression for the capacitance of a spherical condenser when the outer sphere is earthed. (5)

P.T.O.

(c) A parallel plate capacitor filled with mica having $\varepsilon_r = 5$ is connected to a 10 V battery. The area of the parallel plate is 6 m² and separation distance is 6 mm. After the capacitor is fully charged, the battery is disconnected and the dielectric is removed carefully. Calculate the values of capacitance, stored energy and charge. (5)

5. (a) Differentiate between diamagnetic, paramagnetic and ferromagnetic material on the basis of their properties, response to magnetic field and temperature. Give one example of each. (6)

(b) Derive an expression for magnetic field at a point on its axis of a circular coil carrying current. Use it to prove that magnetic field at the ends of a long solenoid is one-half of that at the center. (9)

6. (a) Derive an expression for the differential form of Faraday's law. (4)

    (b) Define coefficient of mutual inductance and state reciprocity theorem. Derive an expression for coefficient of coupling between the coils having turns N_1 and N_2, coupled in such a way that whole of the magnetic flux from one coil links with the other coil. (4+4=8)

    (c) Calculate the magnetic energy stored in an inductor. (3)

7. (a) What is modified Ampere's circuital law? Discuss its significance in terms of Maxwell theory and obtain an expression for displacement current density. (7)

    (b) Prove that the electromagnetic wave is transverse in nature. (8)

Physical Constants:

$$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C/N-m}^2:$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Wb/A-m};$$

$$c = 3 \times 10^8 \text{ m/s}.$$

$$e = 1.6 \times 10^{-1} \text{ m/s}$$

[This question paper contains 4 printed pages.]

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

Sr. No. of Question Paper : 3367   H

Unique Paper Code   : 42171209

Name of the Paper   : C-9: Industrial Chemistry Fossil
                              Fuels, Cleansing agent and food
                              additives

Name of the Course   : **B.Sc. (Industrial Chemistry)**

Semester   : II

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 **six** questions in all.

3. **All** questions carry equal marks.

4. The questions should be answered in accordance to
    the number in the question paper.

1. (a) What is carbonization of coal? Differentiate
        between low temperature carbonization and high
        temperature carbonization.

P.T.O.

(b) What is fat splitting? Explain in detail.

(c) Define anionic, cationic and amphoteric surfactants with examples. (4,4,4.5)

2. (a) What is cloud point of lubricants ? What does high cloud point mean?

(b) Explain why soap is wasted when washing clothes with hard water? What are the advantages of detergents over soaps?

(c) What is the iodine value? What is its significance? (4,4,4.5)

3. (a) Describe the industrial process of hydrogenation of oil. Why is Hydrogenation of oils carried out ?

(b) State the differences between straight run gasoline and synthetic petrol.

(c) Write the preparation and uses of isoprene and toluene. (4,4,4.5)

4. (a) Give the advantages and disadvantages of flavors and preservatives used in food industries.

(b) Explain the Fischer's Tropsch process for gasoline synthesis.

(c) What are artificial sweeteners? Discuss any two in detail. (4,4,4.5)

5. (a) What are solid and semisolid lubricants? Explain with example.

(b) What is reforming of gasoline? Discuss in detail.

(c) What is coal gasification? Describe the process of hydro gasification and catalytic gasification. (4,4,4.5)

6. (a) How is water gas different from producer gas? Give their respective compositions.

(b) What are the builders and binders of detergents? Explain.

(c) Explain in detail about catalytic and thermal reforming process. (4,4,4.5)

7. (a) Differentiate between any **three** of the following :

(i) High Calorific value and low calorific value.

(ii) Soap and Detergent

(iii) Pour point and cloud point

(iv) Renewable and nonrenewable sources of energy

(b) Give the composition of LPG.   (4,4,4,0.5)

8. (a) Write a note on **any three** of the following :

   (i) Biogas

   (ii) Applications of coal tar

   (iii) Metallurgical coke

   (iv) Rancidity

   (b) CNG is more polluting fuel than petrol (True/ False).   (4,4,4,0.5)

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

Sr. No. of Question Paper : 3369

Unique Paper Code : 42231202

Name of the Paper : Comparative Anatomy and Developmental Biology of Vertebrates

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

Semester : II-LOCF

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

3. All the parts of a question must be attempted together.

4. Draw well labelled diagrams wherever required.

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

    (i) Sebaceous gland

    (ii) Holobranch

P.T.O.

(iii) Carnassial teeth

(iv) Zona pellucida

(v) Preformation

(b) Differentiate between the following: (12)

(i) Euryhaline and Stenohaline organism

(ii) Horns and Antlers

(iii) Larynx and Syrinx

(iv) Pseudobranch and Holobranch

(v) Epiboly and Emboly

(vi) Monospermy and Polyspermy

(c) Give location and function of the following:

                                                     (3)

(i) Ceruminous gland

(ii) Iter

(iii) Macula lutea

(d) Write the contribution of the following: (3)

(i) Hans Spemann

(ii) J. F. Gudernastch

(iii) W. Vogt

(e) State whether the following statements are true or false: (4)

    (i) Glenoid cavity of pectoral girdle articulates with the humerus.

    (ii) The mesonephric duct persists in males forming the vas deferens.

    (iii) Metamorphosis occurs in frog under the influence of growth hormone.

    (iv) Malleus is the modification of quadrate bone.

SECTION-A

2. (a) Explain the structure of avian lung with help of suitable diagrams. Give the mechanism of respiration in birds.   (8)

  (b) Write a short note on the fate of first two visceral arches.   (4)

3. Describe the succession of kidney in vertebrates with suitable diagrams.   (12)

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

$$(4 \times 3 = 12)$$

  (a) Swim bladder

  (b) Dentition in mammals

  (c) Functions of integument

  (d) Evolution of heart in mammals

SECTION B

5. (a) Discuss the pattern of cleavage in different vertebrate organisms.   (6)

  (b) Explain the process of cloning with the help of suitable example.   (6)

6. Describe the formation and functions of different types of placentae in mammals.   (12)

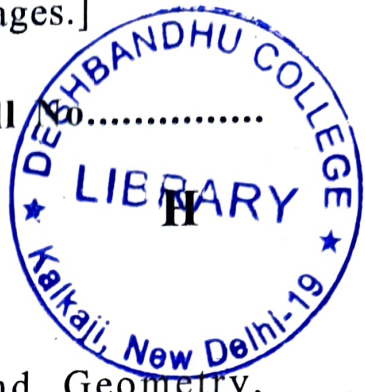7. Write short notes on any three of the following:

$$(4 \times 3 = 12)$$

  (a) Spermiogenesis

  (b) Fate of germ layers

  (c) Metamorphosis in frog

  (d) Embryonic induction

(1000)

June 2024

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

Sr. No. of Question Paper : 3489

Unique Paper Code	: 42351201
Name of the Paper	: Calculus and Geometry, CBCS (LOCF)
Name of the Course	: **B.Sc. (Programme) Mathematical Sciences / Physical Sciences**
Semester	: II

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.   This question paper has **six** questions in all.

3.   Attempt any **two** parts from each question.

4.   **All** questions are compulsory.

5.   Marks are indicated.

1.   (a) Use the second derivative test to determine whether each critical number of the function $f(x) = 3x^5 - 5x^3 + 2$ corresponds to a relative maximum, a relative minimum, or neither.   (6)

P.T.O.

(b) Find all horizontal and vertical asymptotes of the graph of the function $f(x) = \dfrac{1}{x+1} + \dfrac{1}{x-1}$. (6)

(c) (i) Determine whether the graph of the function $f(x) = x^{1/3}(x - 4)$ has a vertical tangent or a cusp. (3)

(ii) Evaluate $\displaystyle\lim_{x \to 1^-} \dfrac{x-1}{\left|x^2 - 1\right|}$. (3)

2. (a) Sketch the graph of the function $y = x^3 - 3x + 2$. (6.5)

(b) Evaluate the following limits using l'Hopital's rule. (6.5)

(i) $\displaystyle\lim_{x \to 0}\left(\dfrac{1}{x} - \dfrac{1}{\sin x}\right)$ (3)

(ii) $\displaystyle\lim_{x \to \infty}\left[\cos\left(\dfrac{2}{x}\right)\right]^{x^2}$ (3.5)

(c) Trace the curve

$x = a(t - \sin t), \; y = a(1 + \cos t), \; 0 \le t \le 2\pi.$ (6.5)

3. (a) If $I_n = \displaystyle\int_0^{\frac{\pi}{4}} \tan^n x \; dx$, show that

$$I_{n-1} + I_{n+1} = \dfrac{1}{n}$$ (6)

(b) Derive the reduction formula for $\int_0^{\pi/2} \sin^m x \cos^n x \, dx$

and use it to find the value of

$$\int_0^{2a} x^2 \sqrt{2ax - x^2} \, dx .$$ (6)

(c) Sketch the graph of $r = a(1 + \cos\theta)$ in polar coordinates, assuming 'a' to be a positive constant.
                                                                (6)

4.   (a) Use cylindrical shells to find the volume of the solid generated when the region enclosed between

$y = \sqrt{x}$, $x = 1$ and $x = 4$ and the x axis is revolved about the y-axis.   (6.5)

(b) Find the arc length of the parametric curve defined by

$$x = \frac{t^3}{3}, \quad y = \frac{t^2}{2}, \quad 0 \le t \le 1.$$ (6.5)

(c) Find the area of the surface that is generated by revolving the portion of the curve $y = x^2$ between $x = 1$ and $x = 2$ about the y axis.   (6.5)

5.   (a) Sketch the parabola and label the focus, vertex and directrix

$$y^2 - 6y - 2x + 1 = 0.$$ (6)

(b) Describe the graph of the equation.

$$16x^2 - y^2 - 32x - 6y = 57.$$ (6)

(c) Rotate the coordinate axes to remove the xy term. Identify the type of conic and sketch its graph

$$x^2 + 4xy - 2y^2 - 6 = 0.$$ (6)

6.   (a) Sketch the graph of the elliptic cone

$$z^2 = x^2 + \frac{y^2}{4}.$$ (6.5)

(b) Define an inverse-square field. Show that the divergence of the inverse-square field

$$F(x,y,z) = \frac{c}{\left(x^2 + y^2 + z^2\right)^{3/2}} (xi + yj + zk) \text{ is zero.}$$

(6.5)

(c) Find parametric equations of the tangent line to the circular helix

$$x = \cos t, \qquad y = \sin t, \qquad z = t$$

at $t = t_0 \in \mathbb{R}$, and use that result to find parametric equations for the tangent line at the point $t = \pi$.

(6.5)

(200)

[This question paper contains 4 printed pages.]

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

Sr. No. of Question Paper : 4017

Unique Paper Code   : 2172551201

Name of the Paper   : DSC : Fossil Fuels and Cleansing Agents

Name of the Course   : **Bachelor of Science in Industrial Chemistry**

Semester   : II

Duration : 2 Hours   Maximum Marks : 60

Instructions for Candidates

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

2. There are **six** questions in all.

3. Attempt any **four** questions.

4. Each question carries **15** marks.

P.T.O.

1.   (a) Differentiate between the following :

   (i) Renewable and non-renewable sources of energy.

   (ii) Solid, liquid, and gaseous fuels

   (iii) Fat and oil

   (b) What is the saponification number of an oil/fat? How is it determined?

   (c) Define Octane number. Why is un-leaded petrol used nowadays?   (9,3,3)

2.   (a) Discuss the carbonization of coal in detail.

   (b) Describe the industrial process of hydrogenation of oil. Why is hydrogenation of oils carried out?

   (c) Write any five requisites of a good metallurgical coke.   (5,5,5)

3.   Write short notes on the following :

   (a) Biogas and its limitations

(b) Producer gas

(c) Water gas (5,5,5)

4. (a) How is the refining of petroleum done? Discuss in detail.

(b) Write a note on the reforming of petroleum.

(c) Discuss thermal and catalytic cracking. Write any **four** applications of it. (5,5,5)

5. (a) Explain why soap is wasted when washing clothes with hard water. What are the advantages of detergents over soaps?

(b) What are clean fuels? Give examples.

(c) Write notes on LNG and CNG and compare them. (5,5,5)

6. (a) What is the calorific value of a fuel? Discuss the high calorific value and low calorific value.

(b) Mention the various uses of coal as a fuel and as a non-fuel in various industries.

(c) What are surfactants? Discuss any two, specifying their role in the manufacture of detergents.

(5,5,5)

Your Roll No. ....

Sr. No. of Question Paper : 4019   H

Unique Paper Code   : 2162521201

Name of the Paper   : Genetics and Molecular Biology

Name of the Course   : **B. Sc. Life Sciences Botany-DSC**

Semester   : II

Duration : 2 Hours   Maximum Marks : 60

Instructions for Candidates

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

2. Attempt **four** questions in all including Question No. **1** which is compulsory.

3. **All** parts of a question must be answered together.

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

1. (a) Fill in the blank (**Any five**) :   (5×1=5)

    (i) 2,4 dioxy-5-methyl pyrimidine is _____.

    (ii) When a second mutation restores the lost original phenotype, the process is known as _____.

    (iii) Tetraploid method for seedless watermelon production was invented by _____.

    (iv) _____ occurs in a genome when a one nucleotide is replaced by other.

P.T.O.

(v) _____ is the enzyme that relieves supercoiling in DNA.

(vi) Class of genetic elements that moves from one location to another within a genome are known as _____.

(vii) Linkage was discovered by _____.

(b) List the contribution of the following (**any five**) :

                                       (5×1=5)

    (i) G. Beadle and E. Tatum

    (ii) Barbara McClintock

    (iii) J. D. Watson

    (iv) T.H. Morgan

    (v) Hugo de Vries, K. Correns, E. Tschermark

    (vi) Karl Landsteiner

(c) Define (**Any five**) :   (5×1=5)

    (i) Okazaki fragments

    (ii) Polygenic inheritance

    (iii) Sex linkage

    (iv) Haploids

    (v) codominance

    (vi) t RNA

    (vii) lethal genes

2. Write short notes on (**Any three**) :   (5×3=15)

    (i) Extrachromosomal inheritance

    (ii) Central dogma

    (iii) Translocation

    (iv) Frameshift mutations

    (v) Multiple allelism

3. Differentiate between (**Any three**) :   (5×3=15)

    (i) Translation in Prokaryotes and Eukaryotes

    (ii) Incomplete dominance and codominance

    (iii) Aneuploids and euploids

    (iv) A-DNA form and B-DNA form

    (v) Transition and transversion

4. Explain with the help of diagrams (**Any three**) :

                                    (5×3=15)

    (i) DNA replication

    (ii) Meselson and Stahl Experiment

    (iii) Para and pericentric inversions

    (iv) Transcription

    (v) Lactose operon

5. (a) Explain the salient features of genetic code. (5)

    (b) What are mutagens? Explain how UV light functions as mutagens.   (5)

(c) In rats black color (B) is dominant to brown (b), while full color (C) is dominant to chinchilla (c^{ch}). The genes controlling these traits are linked. Rats that are heterozygous for both traits and express black, full color were crossed with rats that express brown, chinchilla with the following results.

31 brown, chinchilla

34 black, full color

16 brown, full color

19 black, chinchilla

Determine the arrangement of alleles in the heterozygous parents and the map distance between the two genes. (5)

6. (a) Describe the cis-trans complementation test. (5)

(b) In a dihybrid cross in pea, two randomly selected plants with purple flowers were crossed and in the F_2 population, 105 purple, 40 red and 52 colorless flowers bearing plants were obtained. Use the given information to find out probable segregation ratio. Also, explain the genetic basis of segregation. Write down the genotypes and phenotypes of parents, F_1 and F_2. (10)

[This question paper contains 8 printed pages]

Your Roll No. ....

Sr. No. of Question Paper : 4020

Unique Paper Code   : 2352571201

Name of the Paper   : Elementary Linear Algebra

Name of the Course   : **B.A. / B.Sc. (Prog.) with Mathematics as Non-Major/ Minor – DSC**

Semester   : II

Duration : 3 Hours   Maximum Marks : 90

Instructions for Candidates

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

2. Attempt **all** questions by selecting any **two** parts from each question.

3. **All** questions carry equal marks.

4. Use of simple calculator is allowed.

P.T.O.

1   (a) If x and y are vectors in $\mathbb{R}^n$, then prove that

$\|x + y\| \geq |\|x\| - \|y\||$. Also verify it for the

vectors $x = [2, -1, 3, 2]$ and $y = [4, 3, 2\ 1]$ in

$\mathbb{R}^4$.   (5.5+2)

(b) Solve the following system of linear equations using

Gaussian Elimination method. Also indicate whether

the system is consistent or inconsistent.

$$3x - 2y + 4z = -54$$

$$-x + y - 2z = 20$$

$$5x - 4y + 8z = -83 \qquad (6.5+1)$$

(c) Find the quadratic equation $y = ax^2 + bx + c$

that goes through the points (3,18), (2,9) and

(-2,13).   (7.5)

2.   (a) Solve the following system of equations using the Gauss-Jordan method :

$$5x + 20y - 18z = -11$$

$$3x + 12y - 14z = 3$$

$$-4x - 16y + 13z = 13 \qquad (7.5)$$

(b) Find the rank of the following matrix by converting to row echelon form :

$$\begin{bmatrix} 8 & 0 & 0 & 1 \\ 1 & 0 & 3 & 1 \\ 0 & 0 & 1 & 3 \\ 0 & 8 & 1 & 8 \end{bmatrix} \qquad (7.5)$$

(c) Find the characteristic polynomial, eigenvalues and corresponding eigenvectors for the given matrix :

$$\begin{bmatrix} -1 & 2 \\ 4 & -3 \end{bmatrix} \qquad (2+2+3.5)$$

3. (a) Use the Diagonalization Method to determine whether the following matrix is diagonalizable.

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

(7.5)

(b) Show that the set M_{22} of all 2×2 matrices is a vector space under the usual operations of addition and scalar multiplication. (7.5)

(c) Show that span (S) is a subspace of V, where S a nonempty subset of a vector space V. Let P_3 be the vector space of all real polynomials of degree ≤ 3 and $S = \{x, x^2 + 1, x^3 - 1\}$. Find span (S). Does $(x^2 + x^3) \in$ span (S)? (3+3+1.5)

4.   (a) Check whether the following subset of R is linearly

independent or not.

$$S = \{(0,1,-1), (1,1,0), (1,0,2)\}.$$

Express $(1,1,1)$ as linear combination of vectors in

S.   (4+3.5)

(b) Define a basis of a vector space. Show that the

following set S is a basis for the vector space M_{22}

of all 2×2 matrices :

$$S = \left\{ \begin{pmatrix} 1 & 4 \\ 2 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 2 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} -3 & 1 \\ -1 & 0 \end{pmatrix}, \begin{pmatrix} 5 & -2 \\ 0 & -3 \end{pmatrix} \right\}$$ (2+5.5)

(c) Define a finite dimensional vector space. Let

W be the solution set to the matrix equation $AX = 0$,

where $A = \begin{pmatrix} 1 & -2 & 1 \\ 0 & 1 & 1 \end{pmatrix}$. Show the following :

(i) W is a subspace of R^3.

(ii) Find a basis for W.   (1.5+3+3)

5. (a) Check if the following mappings are linear transformation or not. Prove it or give a counter example to disprove.

   (i) f: $R^3 \to R^3$ defined as $f([a, b, c]) = [-b, c, 0]$

   (ii) g: $M_{22} \to R$ defined as $g\left(\begin{bmatrix} a & b \\ c & d \end{bmatrix}\right) = ad - bc$,

   where M_{22} is the vector space of 2×2 real matrices.   (4+3.5)

(b) Find the matrix T_{AB} of linear transformation T: $R^2 \to R^3$ with respect to basis B = {(1,0), (0,1)} and C = {(1,1,0), (0,1,1), (1,0,1)}, where

$$T([a,b]) = [a - b, a, 2a + b] \qquad (7.5)$$

(c) Define kernel of a linear transformation T. Show that Ker(T) = {0} if and only if T is one-one.

(2+5.5)

6. (a) Consider the linear operator L : $M_{33} \to M_{33}$, defined as L(A) = A $-$ A^T, where M_{33} is vector space of 3 × 3 matrices and A^T denotes the transpose of the matrix A.
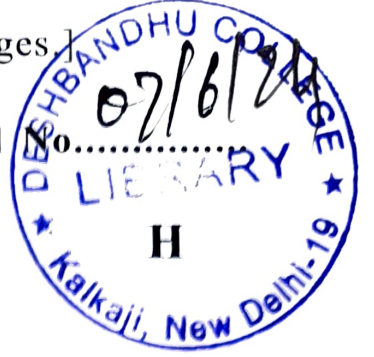
Find dim(Ker(L)) + dim(Range(L)). (7.5)

(b) Define an onto linear transformation. If T be a linear transformation from a finite dimensional vector space V to a finite dimensional vector space W, show that T is onto if and only if dim (Range(L)) = dim (W). (2+5.5)

(c) Show that the mapping $f: M_{nm} \rightarrow M_{mn}$ defined as

$f(A) = A^T$ is an isomorphism. (7.5)

[This question paper contains 4 printed pages.]

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

Sr. No. of Question Paper : 4026   H

Unique Paper Code   : 2222511201

Name of the Paper   : Electricity and Magnetism

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

Semester   : II

Duration : 2 Hours   Maximum Marks : 60

Instructions for Candidates

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

2. Attempt **four** questions in all. **All** questions carry equal marks.

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

4. Non-programmable calculator is allowed.

1. Attempt all of the following :   (5×3)

    (a) Define the electric flux. A square frame of edge 10 cm is placed with a positive normal making an angle of 60° with a uniform electric field of 20 V/m, find the flux of the electric field through the surface bounded by the frame.

P.T.O.

(b) What is Displacement Current?

(c) Define Magnetic permeability and susceptibility. Establish the relation $\mu = \mu_0(1 + \chi)$.

(d) Calculate the coefficient of self-induction of a coil of 1000 turns when a current of 2.5 Ampere produces a magnetic flux of 0.5 micro-Weber.

(e) State Kirchhoff's Current and Voltage law.

2. (a) State and prove Gauss's theorem in electrostatics.

(7)

(b) What is the potential at the center of the square, if the four charges are placed at the corner of the square : $q_1 = +1.0 \times 10^{-8}$ C, $q_2 = -2.0 \times 10^{-8}$ C, $q_3 = +3.0 \times 10^{-8}$ C, $q_4 = +2.0 \times 10^{-8}$ C and side of square is 1.0 meter. (5)

(c) The voltage between parallel plates of a capacitor is V_1. The plates are isolated electrically. A dielectric slab of dielectric constant k is inserted between the plates and completely fills the volume between them. Find the new potential V_2. (3)

3. (a) State and explain Biot-Savart's law. Derive an expression for the magnetic field at a point due to an infinitely long straight current carrying conductor using Biot-Savart's law. (7)

   (b) What are the characteristics of diamagnetic, paramagnetic and ferromagnetic substances. Illustrate by simple experiment. (5)

   (c) A 10 cm long wire carrying a current of 10 ampere is held at an angle 30° with the direction of a uniform magnetic field strength of 1 weber/metre². Calculate the force acting on wire. (3)

4. (a) Explain the phenomenon of self-induction. Derive an expression for the coefficient of self-inductance of a long uniformly wound solenoid. Hence find the self-inductance of a toroidal coil of circular cross-section of radius r. (7)

   (b) Calculate the mutual-inductance of a solenoid of 1 metre length having 500 turns in primary and 100 turns in secondary coil and the area of cross-section of solenoid is 5 cm². (5)

   (c) Write the equation of continuity and explain its physical significance. (3)

5. (a) State the maximum power transfer theorem. Show that power lost in the internal generator is equal to the power delivered to the load and the power efficiency is only 50%. (7)

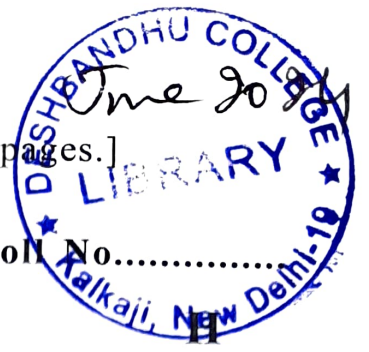(b) Draw the Thevenin's equivalent for the following circuit. Calculate the current through the load resistance. (5)
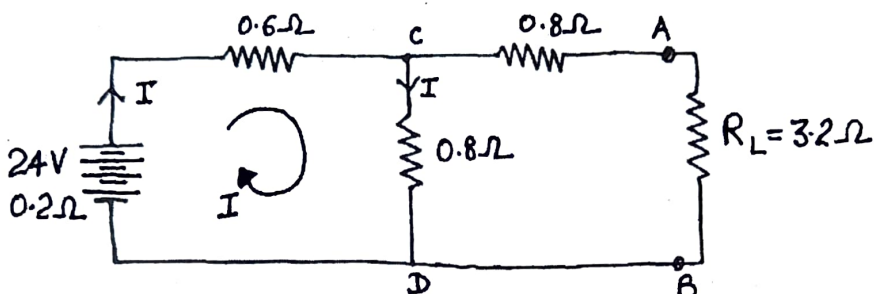
(c) State and explain Norton's Theorem with example. (3)

Constants:

μ_0 = $4\pi \times 10^{-7}$ henry/metre (free space)

ϵ_0 = 8.85×10^{-12} C²/N.m² (free space)

[This question paper contains 4 printed pages.]

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

Sr. No. of Question Paper : 4028

Unique Paper Code : 2232521201

Name of the Paper : Cell and Developmental Biology of Animals

Name of the Course : **B.Sc. (P) Life Sciences, 2023**

Semester : II

Duration : 2 Hours   Maximum Marks : 60

Instructions for Candidates

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

2. Attempt any **FOUR** questions in all including question no. **1** which is compulsory.

3. Draw well labelled diagrams wherever required.

4. **All** parts of a question to be attempted together.

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

     (i) Vitellogenesis

     (ii) Polyspermy

P.T.O.

(iii) Neurulation

(iv) Amphimixis

(v) Morphogenesis

(vi) Grey Crescent

(b) Differentiate between the following (any **four**) :
                                                                    (2×4=8)

   (i) Penetration and copulation path

   (ii) Epiboly and Emboly

   (iii) Epigenesis and Preformation

   (iv) Tight junctions and gap junctions

   (v) Karyokinesis and Cytokinesis

(c) Name the germ layers from which the following
   are derived :   (½×4=2)

   (i) Liver

   (ii) Brain

   (iii) Ovary

   (iv) Lung

2.   (a) Describe the development of frog from fertilized egg to gastrula formation.   (8,7)

    (b) Describe various planes and patterns of cleavage in different animals.

3.   (a) Describe the process of oogensis in mammals.

                                     (8,7)

    (b) Give an account on stem cells.

4.   (a) Describe the process of meiosis and its significance.   (8,7)

    (b) Compare and contrast the prophase of mitosis and meosis.

5.   (a) Describe the cortical reaction. Discuss its role to block polyspermy.   (8,7)

    (b) Discuss the role of various hormones that control Metamorphosis in frog.

6.   Short note any three of the following :   (5,5,5)

    (a) Fate map

   (b) Egg membranes

   (c) Extra-embryonic membrane

   (d) Von Baer Laws

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

Sr. No. of Question Paper : **4030**

Unique Paper Code : 2222551203

Name of the Paper : Mechanics

Name of the Course : **B.Sc. (Prog)_(with Industrial Chemistry)**

Semester : II

Duration : 3 Hours   Maximum Marks : 90

Instructions for Candidates

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

2.   **All** questions carry equal marks.

3.   Attempt any **five** questions in all.

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

5.   Answer any **four** of the remaining **five** questions.

1.   Attempt all parts of this question.

   (a) Prove that $(A \times B) \cdot (C \times D) + (B \times C) \cdot (A \times D) + (C \times A) \cdot (B \times D) = 0$.

P.T.O.

(b) Show that for a constant force, the work done is dependent only on the net displacement, not on the path followed.

(c) A grind stone weighing 40 kg has a radius of 1.2 m. Starting from rest it acquires a speed of 150 r.p.m. in 12 sec. Calculate the torque acting on it.

(d) In a simple harmonic motion, what fraction of the total energy is the kinetic energy and potential energy when the displacement is one-half of the amplitude.

(e) Show that the potential energy per unit volume of a strained wire is ½ (stress × strain)

(f) A rod 1.0 meter long is moving along its length with a velocity of 0.6c. Calculate the length as it appears to a stationary observer?   (3×6=18)

2.   (a) Solve the initial value problem :

$$\left(y+\sqrt{x^2+y^2}\right) dx - x\, dy = 0,\ y(1)=0 .$$

(b) Show that $y = 4e^{2x} + 2e^{-3x}$ is a solution of the

initial value problem $\dfrac{d^2y}{dx^2}+\dfrac{dy}{dx}-6y=0,\ y(0)=6,$

$y'(0) = 2$. Is $y = 2e^{2x} + 4e^{-3x}$ also a solution of this problem?

(c) If $\vec{a}, \vec{b}$ are constant vectors, λ is a constant and $\vec{r}$ is vector function of the scalar variable t given by $\vec{r} = \vec{a} \cos \lambda t + \vec{b} \sin \lambda t$, then show that

$$\vec{r} \times \frac{d\vec{r}}{dt} = \lambda \vec{a} \times \vec{b}.$$

(7,7,4)

3. (a) Consider a rod of length L whose mass density varies along its length and is given by $\lambda = k(1 + ax^2)$, where x is the distance from the light end of the rod and k is a constant. Calculate the centre of mass of the rod.

(b) State the law of conservation of angular momentum. Illustrate with an example. Establish the relation between angular momentum and torque acting on a particle.

(c) A body of mass 0.5 kg starts from rest and slides vertically down a curved tracked which is in the shape of one quadrant of a circle of radius 1 m. At the bottom of the track the speed of the body is 3 m/s. What is the work done by the frictional force? (7,7,4)

4. (a) What is simple harmonic motion, explain it with an example? Prove that the time average of total energy for simple harmonic motion is independent of time.

(b) State Hooke's law. What factors affect the elasticity of the material? Define Young's modulus Y, modulus of rigidity η, and Poisson's ratio σ.

(c) A simple pendulum of length 100 cm has energy equal to 0.3 J when its amplitude is 2 cm. What will be its energy if its length is increased to 150 cm?   (7,7,4)

5.   (a) State Kepler's laws of planetary motion. Show that the areal velocity of a planet round the sun is constant.

(b) Prove that when a particle moves under the action of a central force, the motion takes place in a fixed plane.

(c) What are geostationary orbit and geostationary satellite? Explain.   (7,7,4)

6.   (a) What are the postulates of the special theory of relativity? Derive Lorentz transformation equations for space-time coordinates.

(b) Explain the phenomenon of length compaction in special theory of relativity. Define proper length.

(c) Two electrons, each of velocity 0.9c, move towards each other. Find the relative velocity of one electron with respect to the other.   (7,7,4)

[This question paper contains 8 printed pages.]

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

Sr. No. of Question Paper : 4945　　　　　　H

Unique Paper Code　　　　: 2352571201

Name of the Paper　　　　: Elementary Linear Algebra

Name of the Course　　　　: **B.A./B.Sc. (Prog.) with Mathematics as Non-Major/ Minor – DSC**

Semester　　　　　　　　: II

Duration : 3 Hours　　　　　　Maximum Marks : 90

Instructions for Candidates

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

2. Attempt **all** questions by selecting **any two** parts from each question.

3. **All** questions carry equal marks.

4. Use of simple calculator is allowed.

P.T.O.

1.   (a) If x and y are vectors in $\mathbb{R}^n$, then prove that

$|x.y| \leq ||x|| \, ||y||$. Also verify it for the vectors

$x = [2,2,1]$ and $y = [-4,0,3]$ in $\mathbb{R}^3$.   (5.5+2)

(b) Solve the following system of linear equations using

Gaussian Elimination method. Also indicate whether

the system is consistent or inconsistent.

$$-5x - 2y + 2z = 14$$

$$3x + y - z = -8$$

$$2x + 2y - z = -3 \qquad\qquad (6.5+1)$$

(c) Find the quadratic equation $y = ax^2 + bx + c$

that goes through the points $(-2,20)$, $(1,5)$ and

$(3,25)$.   (7.5)

2.   (a) Find the reduced row echelon form of the following

     matrix :   (7.5)

$$\begin{bmatrix} 1 & -3 & 2 & -4 & 8 \\ 3 & -9 & 6 & -12 & 24 \\ -2 & 6 & -5 & 11 & -18 \end{bmatrix}$$

(b) Determine whether the vector $[7,1,18]$ is in the

   row space of the given matrix:

$$\begin{bmatrix} 3 & 6 & 2 \\ 2 & 10 & -4 \\ 2 & -1 & 4 \end{bmatrix}$$ (7.5)

(c) Find the characteristic polynomial, eigenvalues and

   corresponding eigenvectors for the given matrix:

$$\begin{bmatrix} 2 & -3 \\ 0 & 2 \end{bmatrix}$$ (2+2+3.5)

3.   (a) Use the Diagonalization Method to determine whether the following matrix is diagonalizable.

$$\begin{bmatrix} 7 & 1 & -1 \\ -11 & -3 & 2 \\ 18 & 2 & -4 \end{bmatrix} \qquad (7.5)$$

(b) Show that the set P_3 of all real polynomials of degree ≤ 3 is a vector space under the usual (term-by-term) operations of addition and scalar multiplication.   (7.5)

(c) Define span of S, where S a nonempty subset of a vector space V. Determine span (S) where $S = \{(1,1,0), (2,1,3)\}$ is a subset of R^3. Also examine whether the following vectors of R^3 are in span (S):   (i) (0,0,0);   (ii) (1,2,3).

                             (2+3.5+1+1)

4. (a) Define a linearly independent set of vectors in a vector space. Check whether the following subsets of R^3 are linearly independent or not.

   (i) $\{(1,2,3), (2,3,1), (3,5,4)\}$

   (ii) $\{(1,0,0), (0,0,-5)\}$ (2.5+2.5+2.5)

   (b) Define a finite dimensional vector space. Let W be the solution set to the matrix equation $AX = 0$,

   where $A = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 2 \end{pmatrix}$.

   Show that (i) W is a subspace of R^3.

   (ii) Find a basis for W.   (2+3+2.5)

   (c) Let P_2 be the vector space of all real polynomials of degree ≤ 2. Show that

   $S = \{1, x + 1, 2x + x^2\}$ is a basis of P_2.   (7.5)

5. (a) Check if the following mappings defined on M_{22} the set of 2×2 real matrices, are linear transformation or not. Prove it or give a counter example to disprove.

(i) $f : M_{22} \rightarrow R$ defined as $f(A) = \text{trace}(A)$, where $\text{trace}(A)$ is the sum of diagonal elements of the matrix A.

(ii) $g : M_{22} \rightarrow R$ defined as $g(A) = \det(A)$.

(4+3.5)

(b) Find the matrix of linear transformation $f : P_3(x) \rightarrow R^3$ with respect to standard ordered bases defined as :

$$f(a\,x^3 + b\,x^2 + c\,x + d) = (a + 2b - c,\ 2b + d,\ a - c + d)$$

(7.5)

(c) Define a linear transformation from a vector space

V to W. If $T : V \rightarrow W$ is a linear transformation

and S is a subspace of W, then show that the set

$T^{-1}(S) = \{v \in V \,|\, T(v) \in S\}$ is a subspace of V.

(2+5.5)

6. (a) Consider the linear transformation $L : M_{22} \rightarrow M_{32}$

defined as :

$$L\left(\begin{bmatrix} a & b \\ c & d \end{bmatrix}\right) = \begin{pmatrix} a & 0 \\ 0 & 0 \\ 0 & b \end{pmatrix}, \text{ show that } \dim(\text{Range}(L)) +$$

$\dim(\text{Ker}(L)) = \dim(M_{22})$. (7.5)

(b) Let $L : P(x) \rightarrow P(x)$ be a linear operator defined

as $L(p(x)) = x\,p(x)$, where $P(x)$ denotes the vector

space of real polynomials. Show that L is one-one

but not onto. (4+3.5)

P.T.O.

(c) For the linear transformation $L : R^3 \to R^3$ defined

as, $L(v) = A.v$, where

$$A = \begin{pmatrix} -9 & 2 & 1 \\ -6 & 1 & 1 \\ 5 & 0 & -2 \end{pmatrix}$$

Determine, whether L is an isomorphism or not.

(7.5)