GSM/D-20
ADVANCED CALCULUS
Paper - BM-231

Time allowed : 3 Hours Maximum Marks : 40

Note: Attempt five questions in all, selecting one question from each unit. Question No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

1. (i) Write the statement of Lagrange’s mean value theorem. 2

(ii) State Schwarz theorem. 2

(iii) Define screw-curvature. What is its magnitude. 2

(iv) Define osculating plane. 2

UNIT-I

2. (i) Every function defined and continuous on a closed interval attains its bounds in that interval. Prove it. 4

(ii) Verify Lagrange’s mean value theorem for

\[ f(x) = \sin x \quad \text{in} \quad \left[ \frac{\pi}{2}, \frac{5\pi}{2} \right]. \] 4
3. (i) Show that:

\[
\lim_{x \to 0} \frac{1}{x} (1 + x)^{\frac{1}{x}} - e + \frac{ex}{2} - \frac{11ex^2}{24} = -\frac{7e}{16}
\]

(ii) Show that the function defined by \( f(x) = x^2 \) is uniformly continuous in \([-2, 2]\).

4. (i) Show that the function \( f \) defined by:

\[
f(x, y) = \begin{cases} 
\frac{x^3 - y^3}{x^2 + y^2} & (x, y) \neq (0, 0) \\
0 & (x, y) = (0, 0)
\end{cases}
\]

is continuous at \((0, 0)\).

(ii) State and prove Euler’s theorem.

5. (i) Let \( f : \mathbb{R}^2 \to \mathbb{R} \) be defined as:

\[
f(x, y) = \begin{cases} 
\frac{xy}{x^2 + y^2} & (x, y) \neq (0, 0) \\
0 & (x, y) = (0, 0)
\end{cases}
\]

Show that \( \lim_{(x, y) \to (0, 0)} f(x, y) \) does not exist.

(ii) If \( z = 2u^2 - v^2 + 3w^2 \), where

\[
u = xe^y, \quad v = ye^{-x}, \quad w = \frac{y}{x}
\]

Find \( \frac{\partial z}{\partial x} \) and \( \frac{\partial z}{\partial y} \).
UNIT-III

6. (i) Show that the function
\[ f(x, y) = \begin{cases} 
\frac{x^3 - y^3}{x^2 + y^2} & (x, y) \neq (0, 0) \\
0 & (x, y) = (0, 0)
\end{cases} \]
is continuous and possesses first order partial derivatives but not differentiable at the origin. 4

(ii) A rectangular box, open at the top, is to have a volume of 27/2 cubic ft. Find the dimensions of the box requiring least material for construction. 4

7. (i) Find the volume of the largest rectangular parallelopiped that can be inscribed in the ellipsoid
\[ \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1 \]

(ii) Give an example of a function \( f(x, y) \) for which \( f_{xy}^{(0, 0)} \neq f_{yx}^{(0, 0)} \). 4

UNIT-IV

8. (i) Find the normal form of the curve
\[ 2 \cos t \hat{i} + 2 \sin t \hat{j} + 6 t \hat{k}, -\infty < t < \infty. \] 4

(ii) Prove that
\[ \frac{d\hat{n}}{ds} = i\hat{b} - k\hat{t}. \] 4
9. (i) Show that the radius of spherical curvature of a circular helix $x = a \cos \theta$, $y = a \sin \theta$, $z = a \theta \cot \alpha$ is equal to the radius of circular curvature.

(ii) Find the involutes and evolutes of circular helix

$$x = a \cos u; \quad y = a \sin u, \quad z = a u \tan \alpha.$$
1. (i) Find the differential equation by eliminating the arbitrary constants $\lambda$ and $A$ from the equation $z = Ae^{\lambda t}\cos \lambda x$. 

(ii) Classify the differential equation

$$ \frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0 $$

(iii) Write the one dimensional and two dimensional Heat Equation.

(iv) Examine the compatibility of system of partial equations:

\[ p = 3x + 6y \]
\[ q = 2x - 4y. \]
(v) Find the complete integral of partial differential equation \( p - 3x^2 = q^2 - y \).  

UNIT-I

2. (i) Find out partial differential equation by eliminating arbitrary function from:

\[ z = \left( \frac{xy}{z} \right) \]

(ii) Solve the partial differential equation:

\[ p + 3q = z + \cot(y - 3x) \]

3. (i) Find the complete solution of partial differential equation \( 2xz - px^2 - 2qxy + pq = 0 \) by using Charpit’s method.

(ii) Find the complete integral by Jacobi’s method for the equation:

\[ 2x^2y \left( \frac{\partial u}{\partial x} \right)^2 \left( \frac{\partial u}{\partial x} \right) - x^2 \left( \frac{\partial u}{\partial y} \right) - 2y \left( \frac{\partial u}{\partial x} \right)^2 = 0 \]

UNIT-II

4. (i) Solve the partial differential equation:

\[ \frac{\partial^3 z}{\partial x^3} - 3 \frac{\partial^3 z}{\partial x^3 \partial y} + 4 \frac{\partial^3 z}{\partial y^3} = e^{x+2y} \]

(ii) Solve:

\[ (D^3 - 4D^2D + 4D^2D)Z = \cos (2x + y) \]
5. (i) Solve:

\[(x^2D^2 - xyDD' - 2y^2D'' + xD - 2yD')Z = \log\left(\frac{y}{x}\right) - \frac{1}{2}.\]

(ii) Solve: \((D^2 - 2DD' + D'')Z = 12xy.\)

UNIT-III

6. (i) Classify and reduce the equation:

\[\frac{\partial^2 z}{\partial x^2} - x^2 \frac{\partial^2 z}{\partial y^2} = 0\] to canonical form.

(ii) Solve \(r + 5s + 6t = 0.\)

7. (i) Solve \(ry^2 + 2xys + x^2t + px + qy = 0.\)

(ii) Solve \(rt - s^2 + 1 = 0\) by Monge’s method.

UNIT-IV

8. (i) Solve the wave equation:

\[\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2} \frac{\partial^2 u}{\partial t^2}\]

by the method of separation of variables.

(ii) Solve the Cauchy problem for the equation

\[\frac{\partial^2 z}{\partial x^2} - \frac{1}{c^2} \frac{\partial^2 z}{\partial t^2} = 0,\] subject to the conditions

\[z(x, 0) = f(x)\] and \(\left[\frac{\partial z}{\partial t}\right]_{t=0} = g(x).\)

9. (i) Find the real characteristics of

\[y \frac{\partial^2 z}{\partial x^2} + (x + y) \frac{\partial^2 z}{\partial x \partial y} + x \frac{\partial^2 z}{\partial y^2} = 0.\]
(ii) Solve:

\[
\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0, \ 0 < x < a \text{ and } 0 < y < a
\]

subject to the boundary conditions

\[
4(x, 0) = 4(x, b) = 0
\]

\[
4(0, y) = 0
\]

\[
4(a, y) = \pi y(b - y).
\]
1. (i) Find the resultant of two unlike parallel forces 40N and 5N acting at A and B respectively where AB = 40 cm.  
(ii) If a force F be resolved into component forces and if one component be at right angles to F and equal to $\sqrt{3}F$ in magnitude. Find the direction and magnitude of the other component.  
(iii) Prove that a given system of forces may be replaced by two forces, one of which acts along a given line OA.  
(iv) State converse of Lame’s theorem.  
(v) Define coefficient of friction.
UNIT-I

2.  (i) Three forces $P$, $Q$, $R$ acting at a point $O$ are in equilibrium and the angle between $P$ and $Q$ is double the angle between $P$ and $R$. show that $R^2 = Q(Q - P)$.

(ii) Forces $P$, $3P$, $2P$, $5P$ act along the sides $AB$, $BC$, $CD$ and $DA$ of the square $ABCD$. Find the magnitude and direction of their resultant and prove that it meets $AD$ produced at a point $E$ such that $AE : DE = 5 : 4$.

3.  (i) A uniform rod of length $2l$ and weight $w$ is laying across two pegs on the same level $d$ metre apart. If neither peg can stand a stress greater than $T$, show that:

$$l - \frac{d (W - T)}{W}$$

(ii) $ABCD$ is a rectangle with $AB = 4m$ and $BC = 3m$. Along $AB$, $BC$, $CD$, $DA$ and $AC$ act forces $2$, $7$, $6$, $10$ and $5$ kg. respectively. Show that the system reduces to a couple and find its moment.
UNIT-II

4. (i) A beam whose centre of gravity divides it into two portions $a$ and $b$ is placed inside a smooth sphere. Show that if $\theta$ be its inclination to the horizon in the position of equilibrium and $2\alpha$ be the angle subtended by the beam at the centre of the sphere then

$$\tan \theta = \frac{b - a}{b + a} \tan \alpha.$$  

(ii) A heavy body is placed on a rough inclined plane of inclination $\alpha$ greater than the angle of friction, being acted upon by a force parallel to the plane and along a line of greatest slope, to find the limits between which the force must lie.  

5. (i) One end of a uniform rod is attached to a hinge and the other end is supported by a string attached to the extremity of the rod; the rod and the string are inclined at the same angle $\theta$ to the horizontal. If $W$ be the weight of the rod, show that the reaction at the hinge is $\frac{1}{4} W \sqrt{8 + \csc^2 \theta}$. Also find the tension in the string.
UNIT-III

6. A heavy uniform rod of length $2\alpha$ rests with its ends in contact with two smooth inclined planes of inclination $\alpha$ and $\beta$ to the horizon. If $\theta$ be the inclination of the rod to the horizon, prove by principle of virtual work that
\[
\tan \theta = \frac{1}{2} [\cot \alpha - \cot \beta].
\]

7. A force $P$ acts along the axis of $x$ and another force $nP$ along a generator of the cylinder $x^2 + y^2 = \alpha^2$. Show that the central axis lies on the cylinder
\[
n^2(nx - z)^2 + (1 + n^2)y^2 = n^4 \alpha^2.
\]

UNIT-IV

8. Wrenches of the same pitch $p$ act along the edges of a regular tetrahedron $ABCD$ of side $a$. If the intensities of the wrenches along $AB$, $DC$ are the same and also those along $BC$, $DA$ and $DB$, $CA$; show that the pitch of the equivalent wrench is
\[
\left( p + \frac{a}{2\sqrt{2}} \right)
\]

9. (i) To find the equation to the null plane of a given point $(a, b, c)$ referred to any axis $Ox$, $Oy$, $Oz$. 

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(ii) A heavy uniform rod rests with one end against a smooth vertical wall and with a point in its length resting on a smooth peg. Find the position of equilibrium and show that it is unstable.
Note: Attempt any five questions, selecting at least one question from each unit. Question No. 1 is compulsory. All questions carry equal marks.

Compulsory Questions

1. (i) Convert $(12.125)_10$ into binary number. 2
   (ii) Define Variables. Name different types of variables available in FORTRAN with suitable examples. 2
   (iii) How cooling is produced by adiabatic demagnetisation, explain? 2
   (iv) Define fusion, vaporisation and sublimation lines on a phase diagram. 2

UNIT-I

2. (i) What is a Computer? Explain the computer organisation with the help of block diagram. 6
(ii) What are builtin functions. Explain with examples. 2

3. (i) Explain various input-output statements available in FORTRAN with examples. 4
(ii) Explain the following statements with example:
   (i) FORMAT statements.
   (ii) DO statement 4

UNIT-II

4. Write an algorithm, flowchart and program to arrange marks in ascending or descending order. 8

5. Write an algorithm, flowchart and program to evaluate finite integral through Simpson's one-third rule. 8

UNIT-III

6. (i) Describe Carnot's cycle and deduce the efficiency of ideal heat engine? 6
(ii) A reversible heat engine converts two-fifth of input heat into work. When the temperature of the sink is reduced by 50°C, its efficiency is doubled. Find the temperature of the source and the Sink. 2
7. (i) Define Entropy. What is its physical significance? Show that the entropy remains constant during a reversible process, but increases in irreversible process. 6

(ii) Calculate the change in entropy, when a body of mass 5 gram is heated from 100K to 1000K. The specific heat of body is 0.1 cal/gram/degree. 2

UNIT-IV

8. Define Helmholtz and Gibb’s functions. Derive them from Maxwell thermodynamic relations. 8

9. (i) Show that \( C_p - C_v = TE\alpha^2 V \), where \( C_p \) and \( C_v \) are the specific heats at constant pressure and volume respectively, \( E \) is the bulk modulus of elasticity, \( \alpha \) the coefficient of volume expansion and \( V \), the specific volume. 5

(ii) Calculate the change in boiling point of water due to change in pressure of 0.01 m of mercury. \( L = 22.68 \times 10^5 \) J Kg\(^{-1}\), volume of 1 kg of water at 100°C is 1000 c.c and volume of 1 kg of saturated steam at 100°C is 1600×10\(^3\) c.c. 3
WAVE AND OPTICS-I

Paper - VI (PH-302)

Time allowed : 3 Hours          Maximum Marks : 40

Note : Attempt any five questions, selecting at least one question from each unit. Question No. 1 is compulsory. Use of Scientific (non-programmable) calculator is allowed.

Compulsory Questions

1. (i) How can we locate central fringe in biprism? 2
   (ii) Why do we use an extended source to produce colours in thin films? 2
   (iii) What is condition of diffraction? Explain the difference between interference and diffraction. 2
   (iv) Distinguish between dispersive power and resolving power of a grating. 2
UNIT-I

2. (i) Describe the method to find the thickness of a thin transparent sheet using biprism. Can you find thickness of a thick sheet also? 6
(ii) Two slits in Young’s apparatus are 0.2mm apart. The interference fringes for light of wavelength 6000Å are formed on screen 80 cm away. How far is the second dark band from the central fringe? 2

3. (i) How will you determine the wavelength of monochromatic light by means of Lloyd mirror? Write the difference between Biprism and Lloyd mirror fringes. 6
(ii) The distance between the slit and the biprism and screen is 60 cm each. The angle of biprism is 179° and its refractive index is 1.5. If the distance between successive fringes is 0.0150 cm. Calculate wavelength of light used. 2

UNIT-II

4. What are non-reflecting films? How they are produced. Derive expression for reflectivity in terms of wavelength and refractive index. 8
5. (i) Explain the formation of Newton's rings by reflected light. How can these be used to find the refractive index of a transparent film.

(ii) A thin film of a material, whose refractive index is 1.45, on being introduced in one of the arms of Michelson's interferometer, causes a shift of 7 fringes. If wavelength of light used is 5893 Å, calculate the thickness of the film.

6. What is zone plate? How is it constructed? Discuss its working as lens. What is phase reversal zone plate?

7. (i) Describe analytically the phenomenon of Fresnel's diffraction at a circular aperture.

(ii) Determine the radius of the first half period zone of a zone plate which behaves as a convex lens of focal length 50 cm for a wavelength of 5000 Å.

8. (i) Discuss Fraunhoffer diffraction at double slit. Find the positions of maxima and minima.
(ii) In a Fraunhoffer diffraction due to a narrow slit is placed 1 m away from the lens to obtain pattern. If slit width is 0.1 mm and first minima lies 4 mm on either side of the central maxima, find wavelength of light used.

9. What is plane diffraction grating? Discuss its theory and derive conditions for secondary maxima and minima.
INORGANIC CHEMISTRY

Paper - VIII - CH-201

Time allowed : 3 Hours            Maximum Marks : 32

Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory.

Compulsory Questions

1. (i) Out of $\text{Cu}_2\text{Cl}_2$ and $\text{CuCl}_2$ which is more stable and why?
   (ii) Give the number of unpaired electrons in $\text{Cr}^{3+}$ and $\text{Co}^{2+}$.
   (iii) Write IUPAC name of $\text{Na}[\text{Co(CN)}_6]$.
   (iv) What is the oxidation state of cobalt in $[\text{Co(NH}_3)_3(\text{H}_2\text{O})_2\text{Cl}]^{2+}$.
   (v) Give the example of amphiprotic solvent.
   (vi) Which out of $\text{NH}_3$ or $\text{H}_2\text{O}$ undergoes more autoionization?
   (vii) What EAN rule?
   (viii) Draw the structure of $[\text{Co(EDTA)}]$.  $1\times8$
UNIT-I

2. (a) Iron is a transition element but sodium is not. Explain.  
   2
   (b) 4s-Subshell is filled prior to 3d but on ionisation, 4s-electrons are removed first. Explain.  
   2
   (c) Cu$^{2+}$ ions are coloured and paramagnetic while Zn$^{2+}$ ions are colourless and diamagnetic. Explain why?  
   2

3. (a) Calculate in Bohr magneton the expected spin magnetic moment for the following ions:  
   (i) Fe$^{3+}$  
   (ii) Ni$^{2+}$  
   2
   (b) Why do transition elements in zero and lower oxidation state form complexes with weak ligands like CO, NO or PR$_3$?  
   2
   (c) Write the stereochemistry of following complexes:  
   (i) [Ag(CN)$_2$]  
   (ii) Ni(CO)$_4$  
   2

4. (a) Consider the Latimer diagram for Tl$^+$.  
   3
   \[
   \begin{array}{cccc}
   \text{Tl}^+ & \text{+1.26} & \rightarrow & \text{Tl}^+ \\
   \text{+0.73} & \rightarrow & \text{Tl} \\
   \end{array}
   \]
   (i) Construct a frost diagram.  
   (ii) Predict the stability or unstability of Tl$^+$.  

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2
(b) Write the names and symbols of members of second and third transition series belonging to Fe, Co and Ni groups. 3

5. (a) Draw polymeric structure of CuCl₂. 2

(b) Which should be a better Oxidising agent: Co²⁺ or Co³⁺ in water. Explain why? 3

(c) Name a transition metal which is liquid at room temperature. Give reason. 3

UNIT-II

6. Write IUPAC names of the following: 3

(i) \([\text{NH}_3]_4\text{Co} \begin{array}{c} \text{NH}_2 \\ \text{NO}_2 \end{array} \text{Co} (\text{NH}_3)_4 (\text{NO}_3)_4\]

(ii) K₂[Fe(CN)₅NO]

(iii) [Cr(NH₃)₆] [Co(CN)₆]

(b) What is oxidation state and coordination number of the metal ion and the geometrical arrangement of ligands in the complex K₄[Ni(CN)₄]. 3

7. (a) What are chelates? Discuss the factors which affect the stability of chelates. 2

(b) Write: 2

(i) Linkage isomer of [Cu(NH₃)₅ONO]Cl₂

(ii) Coordination isomer of [Cu(NH₃)₄] [PtCl₄].

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(c) Calculate EAN of central atom in: 2
Fe(CO)₅ and [Cr(NH₃)₆]³⁺.

8. (a) How do the following solutes behave in liq SO₂ (as an acid or a base)? 2
   (i) SO(SCN)₂  (ii) CaSO₃

(b) Discuss self ionisation of liq. SO₂ as non-aqueous solvent. What are the most effective acids and bases of this solvent system. Give reactions. 3

(c) HgI₂ + KI \( \xrightarrow{\text{liquid SO}_2} \) ? 1

9. (a) Explain why: 2×2
   (i) Acetamide behaves as a weak base in aqueous solution but shows acidic properties in liquid NH₃.
   (ii) Na metal solution in liquid NH₃ is blue in colour, paramagnetic and highly reducing in nature. 2

(b) Complete the following reactions in liquid NH₃ 2
   (i) SO₂ Cl₂ + 4NH₃ →

   (ii) BCl₃ →
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PHYSICAL CHEMISTRY

Paper - CH-202

Time allowed : 3 Hours          Maximum Marks : 32

Note : Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory.

Compulsory Questions

1. (a) Which are intensive properties among following:
   (i) Internal energy
   (ii) Entropy
   (iii) Volume
   (iv) Dipole moment.

   (b) The value of Cp and Cu for a gas are 6.96 and 4.97 find the value of R and Y.

   (c) Define law of chemical equilibrium.

   (d) If \( \frac{C_1}{(1 - \alpha) C_2} \) have constant value, Where concentration of solute is \( C_1 \) and \( C_2 \) in solvent 1 and 2 respectively, and \( \alpha \) is degree of dissociation of solute. What does it signifies.
UNIT-I

2. (a) Explain various types of Thermodynamic systems with examples. 3
(b) Which are state functions among following also give reason:
   (i) Internal energy 3
   (ii) Work

3. (a) Prone enthalpy change is a path function. 3
(b) What symbols, signs are used for work done on the system and work done by the system. 3

4. (a) Explain Joule-Thomson effect for real gases. 3
(b) Derive the relationship of Joule-Thomson coefficient for real gases in terms of Vander Waal’s constants. 3

5. (a) Derive the equations for calculating change in internal energy and work done for adiabatic process of ideal gases. 3
(b) Derive \( P v^r = \text{constant} \) for reversible adiabatic expansion of ideal gas. 3
UNIT-II

6. (a) Derive the equation of equilibrium constant in terms of pressure. 3
(b) Drive the relationship between standard free energy change with equilibrium constant. 3

7. (a) Write the applications of Clavsivs-Clapeyron equation. 3
(b) The normal boiling point of water is 100 °C. Its vapour pressure at 80°C is 0.47 atmosphere. Calculate the enthalpy of vaporization. 3

8. The partition coefficient of Iodine between CS$_2$ and water is 410. A solution of KI containing 8.0gm of salt per litre was shaken with CS$_2$ until equilibrium, the aqueous layer contain 2.15gm of Iodine per litre and the CS$_2$ layer 35.42 gm of Iodine per litre. Calculate the equilibrium constant for the reaction:

$$\text{KI} + \text{I}_2 \rightleftharpoons \text{KI}_3$$

Given that the concentration of Iodine in the aqueous layer is the sum of free and combined iodine. 6
9. (a) Calculate how much compound can be extracted from 100 ml of aqueous solution containing 5.0 gm of compound extracted with 50 ml of ether. The partition coefficient of compound between ether and water is 4.

(b) How to calculate the degree of association of solute in one of the solvents by logarithmic method.
Compulsory Questions

1. (i) Suggest a reagent to convert a carboxylic acid into the corresponding primary alcohol. 1
(ii) Name the reagent which can be used to distinguish between 1,2-propanediol and 1,3-propanediol. 1
(iii) Phenol has smaller dipole moment than methanol. Explain why? 2
(iv) What happens when an organic compound is subjected to UV radiation? 2
(v) Acetic acid in the vapour state has a molecular mass of 120. Explain. 1
(vi) How will you convert an acid chloride into anilide?

UNIT-I

2. (i) Why are alcohols weaker acids than water? Explain.

(ii) Arrange 1-pentanol, 1-butanol, 2-butanol, 2-methyl-12-propanol and 2-methyl-1-propanol in decreasing order of boiling points and explain.

(iii) Compare the acidic character of primary, secondary and tertiary alcohols with suitable examples.

3. (i) Discuss the role of H-bonding on physical properties of alcohols.

(ii) How Lucas test is helpful in distinguishing between primary, secondary and tertiary alcohols.

(iii) What happens when phenol is treated with phosphorus pentachloride.

4. Discuss the mechanism of the following:

(i) Kolbe's reaction

(ii) Claisen rearrangement

(iii) Reimer-Tiemann reaction.

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5. What are epoxides? Discuss the methods of preparation with mechanism:
   (i) Epoxidation of alkenes
   (ii) From halohydrins.

UNIT-II

6. (i) What is a chromophore? Identify the chromophoric group in:
   (a) Cyclopentene
   (b) Toluene
   (c) Butanone.
(ii) Compounds A, B and C have the formula C₅H₈ and on hydrogenation yield n-pentane. The ultraviolet spectra show the absorption values of \( \lambda_{\text{max}} \) for A=176 nm, B=211 nm and C=215 nm. Assign the structures to A, B and C (1-pentene absorbs at \( \lambda_{\text{max}} \) 178 nm).

7. (i) Give reasons for the following:
   (a) Benzene shows an absorption band at \( \lambda_{\text{max}} \) 254nm (\( \varepsilon \) 230) while aniline absorbs at \( \lambda_{\text{max}} \) 280 nm (\( \varepsilon \) 1430).
   (b) Aniline absorbs at \( \lambda_{\text{max}} \) 280 nm (\( \varepsilon \) 1430) in aqueous solution but at \( \lambda_{\text{max}} \) 254 nm (\( \varepsilon \) 230) in aqueous acidic solution.
(ii) How can the rate of reaction be measured using UV-VIS spectroscopy?  

8. Write short notes on the following:  
   (ii) Effect of substituents on the acidic strength of carboxylic acids.  
   (ii) Physical Properties of carboxylic acids.  

9. (i) Discuss the hydrolysis of esters with mechanism taking some suitable example.  
   (ii) Discuss relative stability of acyl derivatives.
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BIOLOGY AND DIVERSITY
OF SEED PLANTS-I

Paper - I

Time allowed : 3 Hours Maximum Marks : 40

Note : Attempt five questions in all, selecting two questions from each unit. Questions No. 1 is compulsory. Draw relevant diagram wherever necessary. All questions carry equal marks.

Compulsory Questions

1. Define the following : 1×8=8
   (a) Pycnoxylic wood
   (b) Zoodiogamy
   (c) Why cycads are called living fossils
   (d) Mycorrhizal root
   (e) Write botanical name of Chir & Kail plants.
   (f) Sympodial growth
   (g) Synangium
   (h) Name characters which made an ovule primitive.
UNIT-I

2. Describe the following fossil plants: 4+4
   (a) Lyginopteris
   (b) Cycadeoidea (= Bennattites)

3. Describe general characters of gymnosperms. 8

4. What are fossils? Describe fossilization process. 8

5. Mention the various eras of geological time scale and their rough duration with the predominant type of vegetation. 8

UNIT-II

6. Draw well labelled diagrams of the following (No description required): 4+4
   (a) T.S. coralloid root of cycas.
   (b) T.S. pinus stem.

7. Describe development of female gametophyte and fertilization in pinus. 8

8. Write notes on: 4+4
   (a) Microsporophyll of Cycas.
   (b) Male cone of pinus.

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9. Describe the following: 4+4
   (a) Primitive characters of Amentiferal and Ranales.
   (b) Male gametophyte of Ephedra.
GSM/D-20

PLANT ANATOMY

Paper - II

Time allowed: 3 Hours

Maximum Marks: 40

Note: Attempt five questions in all, selecting two questions from each unit. Questions No. 1 is compulsory. All questions carry equal marks.

Compulsory Questions

1. Answer briefly: 1×8=8

   (a) Ephemeral plants
   (b) Exarch xylem
   (c) Phellem
   (d) Collenchyma cells.
   (e) Unicostate reticulate venation
   (f) Haplocheilic stomata
   (g) Velamen
   (h) Medullary rays.

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P.T.O.
UNIT-I

2. What are complex permanent tissues in plants? Briefly write about their functions. 8

3. Write notes on: 3+2+3
   (a) Xerophytes
   (b) Sclerenchyma
   (c) Trichomes

4. With suitable diagram, explain anomalous secondary growth in Boerhaavia stem. 8

5. Write difference between: 3+2+3
   (a) Sapwood and Heartwood.
   (b) Xylem and Phloem
   (c) Tracheids and vessels.

UNIT-II

6. Write notes on: 4+4
   (a) Compound leaves.
   (b) Leaf abscission.
7. Write about the following: 4+4
   (a) Stomatal apparatus and its types
   (b) Phyllotaxy and its types.

8. Compare the histological organisation of a monocot and a dicot root. 8

9. Write notes on: 4+4
   (a) Internal structure of root of Rhizophora.
   (b) Internal structure of a monocot leaf.
1. Explain the following: $1\frac{1}{2} \times 10 = 15$

(a) Wheel organ

(b) Endostyle

(c) Retrogressive metamorphosis

(d) Venous heart

(e) Holobranch

(f) Why cyclostomes are called agnatha

(g) Dorsal tubercle
(h) Name two lung fishes

(i) Catadromous fishes

(j) Characteristic features of cartilagenous fishes.

UNIT-I

2. (i) Give an account of digestive system of *Branchiostoma*. 4¼

(ii) Write a note on eye spot of *Branchiostoma*. 2

3. (i) Draw a well labelled diagram of pharynx of *Herdmania*. 4¼

(ii) Discuss gonads in *Herdmania*. 2

4. Explain in detail digestive system in *Amphioxus*. 6¼

5. (i) Give an account of excretory system in *Branchiostoma*. 4¼

(ii) Write a note on reproductive system in *Branchiostoma*. 2

UNIT-II

6. (i) Write general characters of cyclostomata and classify it upto order label. 4¼
(ii) Discuss excretory system in *petromyzon*. 2

7. (i) Explain digestive system in *petromyzon*. 4¼
(ii) Write a note on eye of *petromyzon*.

8. (i) Give an account of circulatory system in *labeo*. 4¼
(ii) Write a note on air bladder of *labeo*. 2

9. Give a detailed account of fish Migration. 6¼
GSM/D-20

MAMMALIAN PHYSIOLOGY

Paper - II

Time allowed: 3 Hours

Maximum Marks: 40

Note: Attempt five questions in all, selecting at least two questions from each Unit I and II. Question No. 1 is compulsory.

Compulsory Question

1. (i) What is a glycosidic bond? 1½×10=15
(ii) Differentiate between myoglobin and haemoglobin.
(iii) What is rancidity?
(iv) What are zymogenes?
(v) Define turgor pressure.
(vi) What is lactose intolerance?
(vii) What are chylomicrons?
(viii) What is tetanus?
(ix) What is osteonecrosis?
(x) What is the disease caused by deficiency of Vitamin C? What are the symptoms?
UNIT-I

2. (i) Write a note on isomerism in mono-saccharides. 3¼
(ii) Describe the structure of glycogen. 3

3. (i) Differentiate between saturated and unsaturated fatty acids. 3
(ii) Discuss the dynamics of biocarbonate buffer system in the body. 3¼

4. (i) Describe secondary structure of proteins with the help of a suitable diagram. 3¼
(ii) Justify the statement that proteins are amphoteric molecules. 3

5. (i) Differentiate between competitive and allosteric inhibition. 3¼
(ii) Write a note on isoenzymes. 3

UNIT-II

6. (i) Describe hormonal control of digestive enzyme secretion.
(ii) What is the function of HCl present in gastric juices? 6¼

7. (i) Differentiate between autotrophic and heterotrophic nutrition. 2
(ii) Explain single muscle twitch. 4¼
8. (i) Describe the sliding filament theory of muscle contraction.  
(ii) Give differences between isotonic and isometric contraction.  

9. (i) Give an account of the structure of mammalian bone.  
(ii) Describe genetic bone disorders.
GSM/D-20

OP-AMP AND LINEAR INTEGRATED CIRCUITS

Paper–I

Time Allowed : 3 Hours] [Maximum Marks : 40

Note : Attempt five questions in all, selecting at least one question from each Unit. Question No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

1. (a) Write the characteristics of an Ideal operational Amplifier. 2
   (b) Define input Bias current. Also define offset voltage. 2
   (c) What is Buried layer in an I.C.? Why is it used? 2
   (d) A Power supply has voltage regulation of 2%. If no load voltage is 30V, what is the full load voltage? 2

UNIT–I

2. (a) Find the expression for the gain of an Operational Amplifier in Non-Inverting configuration. 4
(b) Explain with the help of circuit diagram, how Operational Amplifier can be used as difference Amplifier.

3. (a) Discuss the working of Operational Amplifier as a Summing Amplifier.
(b) Derive relation between input and output in a double ended differential Amplifier.

UNIT–II

4. (a) Explain with the help of circuit diagram, the working of Operational Amplifier as an integrating circuit.
(b) Discuss the working of Op-amp as a multiplier of different signals.

5. (a) Explain the working of a High pass first order active filter using op-amp.
(b) Explain the operation of Op-amp as differentiating circuit.

UNIT–III

6. (a) Discuss the various steps to fabricate NPN transistor in Integrated Circuit.
(b) Discuss the Photolithographic etching process in detail.
(c) What do you mean by SSI, MSI, LSI and VLSI in IC fabrication technology?

7. (a) Discuss the Epitaxial growth in brief.

(b) Explain the importance of SiO\textsubscript{2} layer.

(c) Explain the various methods for making diodes in Integrated Circuit technology.

UNIT-IV

8. (a) Draw the functional block diagram of three Terminal voltage regulators & explain in brief.

(b) Define Line regulation and Load regulation. Elaborate the difference between series and shunt type Voltage regulation.

9. (a) Explain the working of Current regulation using Op-amp.

(b) Explain with the help of circuit diagram, the working of Shunt regulator. What are its advantages over a series voltage regulator?
Opamp and Linear Integrated Circuits-I

Compulsory Question

1. (i) What is buried layer. Why is it used? 2×4=8
   (ii) How virtual ground is different from ordinary ground?
   (iii) State the applications of Schmitt trigger.
   (iv) Differentiate between an active and passive filter. Which is advantageous & why?

UNIT-I

2. (i) What is the difference between dielectric isolation and beam lead isolation? Draw appropriate diagrams. 4
(ii) What is a positive photoresist and how it is different from negative photoresist?  

3. (i) What are the advantages of an IC and what are its limitations.  
(ii) Describe photo-etching process. How many masks are required to complete an IC? List the function performed by each mask.  

UNIT-II  

4. Describe clearly the various steps involved in fabricating the following monolithic circuit:  

5. (i) How JFET and MOSFET are fabricated using monolithic process?  
(ii) Define sheet resistance $R_s$. What in the order of $R_s$ for base region and also for emitter region? Sketch the cross section of an IC resistor.
UNIT-III

6. (i) In an OPAMP, the input and output resistances are 300kΩ and 100Ω respectively, when negative feedback is applied to increase the input resistance to 20 MΩ, the gain of the amplifier reduces to 500. Find:

(i) Open loop voltage gain
(ii) Closed loop output resistance
(iii) Feedback factor.

(ii) Show that the output of an ideal differential amplifier is independent of drift.

7. (i) Explain why the CMRR is infinite if a true current source is used in a symmetrical emitter-coupled differential amplifier?

(ii) For the circuit show below, find the output voltage $V_o$, if open loop gain is $10^3$, $R_i = 50K$.

\[V_1 = 1.0V\]
\[V_2 = 15V\]
\[R_1 = 1.0k\Omega\]
\[R_2 = 5k\Omega\]
\[R_i = 5k\Omega\]
UNIT-IV

8. (i) Discuss Butterworth first order high pass filter. Find the expression for the magnitude of gain and the low cutoff frequency of this filter. Draw its frequency response curve too. 4

(ii) Draw and explain the circuit of integrator. What are its disadvantages? How can these be removed in a practical integrator circuit? 4

9. (i) Discuss the working of OPAMP as Schmitt Trigger with its transfer characteristics. 4

(ii) Discuss how an OPAMP can be used for multiplication and division of signals. 4
GSM/D-20

DIGITAL ELECTRONICS-II

Paper - II

Time allowed : 3 Hours Maximum Marks : 40

Note: Attempt five questions in all, selecting at least one question from each unit. Questions No. 1 is compulsory.

Compulsory Question

1. (i) Differentiate between Asynchronous and synchronors flip-flop.

(ii) List the characteristics that must have a device that are used as a binary memory cell.

(iii) Draw the output waveform of JK flip-flop when the serial inputs applied are $J = 1001$ and $K = 1010$ (Assume $Q = 0$ initially).

(iv) What do you mean by level trigger of flip-flop? $2 \times 4 = 8$

UNIT-I

2. (i) Implement the following boolean function using 8:1 multiplexer:

\[ f(A, B, C) = \Sigma (0, 2, 5, 6, 7) \]
(ii) What is code converter? Design binary to excess-3 code converter. 4

3. (i) Implement the following function using 4 to 16 lines decoder. 4
(a) \( f_1 (A, B, C, D) = \sum (0, 3, 7, 8, 11, 13) \)
(b) \( f_2 (A, B, C, D) = \sum (4, 6, 9, 10, 14, 15) \)

(ii) Design even parity generator cum-essor circuit for 8421 codes. 4

UNIT-II

4. (i) Modify clocked RS flip-flop so that it is in store mode when \( RS = 11 \). 4

(ii) Describe the working of T flip-flop. How a T flip-flop can be used as divide by two device. 4

5. (i) Design and explain the working of a positive edge triggered J-K flip-flop. Also explain the race around problem. 4

(ii) Discuss D-Flip flop Draw the characteristics table of D-flip-flop and explain it. 4

UNIT-III

6. (i) Design a circuit using a counter to generate the following pulse train (101010) and repeats. 4
(ii) What factors determine whether a counter operates a count up or down counter?  

7. (i) What do you understand by skipping state counter? Design a Mod-6 counter using T-FF to count the sequence (1, 2, 3, 5, 6, 7).  
(ii) A synchronous counter is capable of faster operation than a ripple counter. Justify. 

UNIT-IV 

8. (i) What do you understand by cyclic shift register? Explain the operation of ring counter using timing diagram. 
(ii) Discuss the use of shift register in sequence generator. 

9. (i) Describe the working of a PIPO shift register. Explain how a number can be shifted in and out from such a register. 
(ii) Explain the use of shift register for constructing a serial adder of 4-bits.
Compulsory Question

1. (i) Make a full adder using a half adder as a building block.

(ii) What is a parity in digital codes? What is its use?

(iii) What is the difference between a synchronous and asynchronous circuit?

(iv) What is a binary counter? 2×4=8

UNIT-I

2. (i) What is a full subtractor? Explain it with the help of its truth table. 4

(ii) Design a full subtractor using NAND gates only. 4
3. (i) What is a parallel binary adder? Design a parallel binary adder for two 4 bits number. 6
(ii) What is a half adder? What is its limitation. 2

UNIT-II

4. (i) What is a De-multiplexer circuit? Explain a 1:8 De-multiplexer with the help of its truth table. 6
(ii) Implement the following function using 1:8 De-max.
   (a) \( f_1 = \sum (0, 5, 8, 9, 12) \)
   (b) \( f_2 = \sum (3, 5, 10, 13) \). 2

5. (i) What is a parity generator circuit? Design an Even parity generator circuit for a 4-bit message code using Ex-OR / Ex-OR Gates. 6
(b) Implement \( F (A, B, C) = \sum (1, 3, 5, 7) \) using 8:1 multiplexer. 2

UNIT-III

6. What is a flip-flop? Explain JK flip-Flop with the help of its circuit diagram and truth table. What is its limitation and how it is resoled? 8
7. (i) Convert a D-flip flop into SR flipflop using analysis method.  
6
(b) Why preset and clear inputs in a flip-flop are called asynchronous inputs?  
2

UNIT-IV

8. Design a Decade synchronous up-counter using JK flip flops. Make its state diagram and timing waveforms.  
8

6
(b) An asynchronous counter is also known as a Ripple counter, why?  
2
Compulsory Question

1. (i) What is abstract data type? 8
   (ii) What are parallel arrays?
   (iii) Differentiate LIFO and FIFO.
   (iv) How linear data structures are different from non linear data structures?

UNIT-I

2. (i) Define data structure? Explain various data structure operations with example. 8
   (ii) Find time complexity of linear search.

3. (i) What is string? Explain different methods of storing strings in computer memory. 5
(ii) Explain various applications of data structures. 3

4. (i) Write an algorithm to insert an element in one dimensional array.

(ii) What do you mean by sparse Array? How can you store the sparse array in the memory? 8

5. (i) Write an algorithm to delete a node from single linked list.

(ii) Write note on:
(a) Garbage collection 8
(b) Free storage list.

UNIT-III

6. (i) Discuss PUSH and POP operations on stack using arrays. 5

(ii) How does stack play important role in recursion? 3

7. (i) What is circular Queue? Explain advantages of using it by taking suitable example. 3

(ii) Write algorithms to insert and delete element in circular queue. 5
UNIT-IV

8. (i) Discuss linked representation of binary tree in computer memory.

(ii) Explain linked representation of Graph. 8
1. (i) Outline the benefits of Throwaway Prototype Model. 2

(ii) Explain degree of relationship and cardinality of relationship. 2

(iii) What is Rayleigh's curve? Also state its significance. 2

(iv) Explain Test Oracle. 2

UNIT-I

2. Explain Waterfall model? Elaborate its working with help of the diagram. What are its drawbacks? 8
3. Discuss various phases of Software Development Life Cycle.  

UNIT-II

4. (i) Differentiate between Cohesion and Coupling.  
(ii) Explain Process Metrics. Discuss its various attributes.  

5. What is SRS document? What are qualities of a good SRS? Explain.  

UNIT-III

6. (i) Briefly discuss CPM and PERT techniques along with suitable examples.  
(ii) Differentiate between Verification and Validation.  

7. Explain the concept of Data Dictionary, Structured English, Decision Table and Risk Management with suitable examples.  

UNIT-IV

8. Explain various types of testing techniques viz. Unit testing, Integration Testing and System Testing.  

(ii) Discuss the Software Re-engineering Process.
Note: Attempt five questions in all, selecting two questions from each unit and compulsory question no. 1. All questions carry equal marks.

Compulsory Question

1. Write in brief on the following: 1×8=8
   (i) Idiotypes
   (ii) Haptens
   (iii) Lymphocytes
   (iv) Precipitation
   (v) Null cells
   (vi) Convalescent sera
   (vii) Mitogens
   (viii) Cytokines.

UNIT-I

2. Define acquired immunity. Explain its various types with examples. 2+6
3. (i) Describe the complete structure of spleen. 5
(ii) What are T-cells? Describe its receptors. 3

4. Classify antibodies and explain the features of major classes of antibodies. 8

UNIT-II

5. (i) Differentiate between T & B cells. 4
(ii) Write about maturation and activation of B-cells. 4

6. (i) Write the functions of cell mediated immunity. 4
(ii) Explain the various components and properties of complement system. 4

7. (i) Define MHC restriction. What is its importance in immunological control? 4
(ii) Describe autoimmunity with examples. 4
Attempt five questions in all, selecting at least two questions from each unit. Question No. 1 is compulsory.

**Compulsory Question**

1. Explain the following briefly:  \(1 \times 8 = 8\)
   
   (i) Which are the nonsense triplets and why are they so termed?
   
   (ii) What is frameshift mutation?
   
   (iii) Define coding strand and antisense strand.
   
   (iv) What is Shine-Dalgarno sequence?
   
   (v) Differentiate between transformation and transduction.
   
   (vi) Do the two strands of DNA helix carry the same genetic information? Explain.
   
   (vii) What are histone proteins?
   
   (viii) What is the role of RNA in DNA replication?
UNIT-I

2. (i) Discuss the classical blender experiment which demonstrated DNA as genetic material. 4

(ii) Give an account of Watson and Crick’s model of DNA. 4

3. (i) Describe the transposable elements of Maize and P elements of Drosophila. 4

(ii) Describe various steps of DNA replication in eukaryotes. 4

4. (i) What is DNA repair? Discuss the direct reversal and SOS mechanism of DNA repair. 6

(ii) Write short note on Theta configuration. 2

UNIT-II

5. (i) Describe 'Genetic code'. Give a brief account of the experiments which helped in deciphering the genetic code. 4

(ii) Describe the structure of E.coli RNA polymerase and discuss the roles of different components of this enzyme in RNA synthesis on DNA template. 4
6. (i) Discuss the mechanism of protein synthesis in eukaryotes. 5
   (ii) Give an account of conjugation mechanism for recombination in prokaryotes. 3
7. (i) Describe briefly how Lac Operon is a classical example of both negative and positive control systems. 6
   (ii) What do you mean by ‘attenuation’ in reference to transcription? 2
1. (a) Compute $L(f, P)$ and $U(f, P)$ for the function

$$f(x) = \frac{1}{x^2}$$
on $[1, 4]$ and partition $P = \{1, 2, 3, 4\}$. 

$1\frac{1}{2}$

(b) Examine the convergence of

$$\int_{1}^{\infty} \frac{dx}{x}.$$ 

1

(c) Define open sphere and closed sphere and give examples. 

$1\frac{1}{2}$

(d) Show that in a discrete metric space $(X, d)$, every subset of $X$ is open. 

$1\frac{1}{2}$

(e) Show that in a metric space $(X, d)$, the complement of every singleton set is open. 

$1\frac{1}{2}$

(5)
Section I

2. (a) Prove that a bounded function having a finite number of points of discontinuity on \([a, b]\) is integrable on \([a, b]\). \(2\frac{1}{2}\)

(b) Show that \(\lim_{n \to \infty} \left[ \frac{n}{n^2 + 1^2} + \frac{n}{n^2 + 2^2} + \ldots + \frac{1}{2n} \right] = \frac{\pi}{4}\). \(2\frac{1}{2}\)

3. (a) If \(f\) is bounded and integrable on \([a, b]\), then \(|f|\) is also integrable on \([a, b]\). Moreover

\[ \left| \int_{a}^{b} f(x) \, dx \right| \leq \int_{a}^{b} |f(x)| \, dx. \]

(b) Evaluate the integral:

\[ \int_{-1}^{1} ([x] - x) \, dx \]

where \([x]\) stands for greatest integer not greater than \(x\). \(2\frac{1}{2}\)

Section II

4. (a) Show that \(\int_{0}^{\infty} \left( \frac{1}{1+x} - e^{-x} \right) \frac{dx}{x}\) is convergent. \(2\frac{1}{2}\)

(5)L-1030

2
(b) Examine the convergence of the integral
\[ \int_0^\infty \frac{\cos x}{\sqrt{x^2 + x}} \, dx. \]

5. (a) Find the values of \( m \) and \( n \) for which the integral
\[ \int_0^1 x^n e^{-mx} \, dx \]
converges.

(b) Prove that:
\[ \int_0^{\pi/2} \frac{dx}{\left( a^2 \sin^2 x + b^2 \cos^2 x \right)^2} = \frac{\pi(a^2 + b^2)}{4a^3b^3}. \]

Section III

6. (a) Prove that any metric space, \((X, d)\), bounded or not, can be converted into a bounded metric space
\((X, d')\), where \(d'(x, y) = \frac{d(x, y)}{1 + d(x, y)}\).

(b) Prove that every open sphere in a metric space \((X, d)\) is an open set.

7. (a) Let \((Y, d')\) be a subspace of a metric space \((X, d)\). A subset \(B\) of \(Y\) is \(d'\)-open iff there exists a \(d\)-open subset \(G\) of \(X\) such that \(B = G \cap Y\).

(5)L-1030 3
(b) Prove that the usual metric space $(\mathbb{R}, d)$ is complete. \(2\frac{1}{2}\)

Section IV

8. (a) Prove that every contraction mapping $f : (X, d) \to (X, d)$ is uniformly continuous on $X$. \(2\frac{1}{2}\)
(b) Prove that a compact subset of a metric space is closed and bounded. \(2\frac{1}{2}\)

9. (a) Prove that every closed subset of a compact metric space is compact. \(2\frac{1}{2}\)
(b) If $E$ is connected subset of a metric space $(X, d)$ such that $E \cap A \cup B$, where $A$ and $B$ are separated sets in $X$, then either $E \subseteq A$ or $E \subseteq B$. \(2\frac{1}{2}\)
(Compulsory Question)

1. (i) If $a^2 = e$ (identity element) for all $a \in G$, where $G$ is a group. Then prove that $G$ is abelian.
   (ii) Prove that every cyclic group is an abelian group.
   (iii) Define principal ideal.
   (iv) Show that set of all odd integers is not a ring.
   (v) Define primitive polynomial.
   (vi) Define field with examples.

Section I

2. (a) Prove that if $(G, \cdot)$ is an abelian group, then for all $a, b \in G$ and for all integers $n$:
   $$ (a \cdot b)^n = a^n \cdot b^n. $$
(b) If an abelian group of order 6 contains an element of order 3, show that it must by cyclic group.

3. (a) State and prove Lagrange’s theorem for finite groups.
(b) Let \( G \) be a group, with \( o(a) = n \), then prove that \( o(a^k) = \frac{n}{(n,k)} \), where \( a \in G \).

Section II

4. (a) Prove that necessary and sufficient condition for a homomorphism \( f \) to be one-one is that \( \ker f = \{e\} \), where \( \{e\} \) is the identity element of domain.
(b) If \( H \) and \( K \) are subgroups of a group \( G \) and \( H \) is normal in \( G \), then \( \frac{HK}{H} \cong \frac{K}{H \cap K} \).

5. (a) Let \( G \) be a finite group, \( a \in G \), then prove that \( o(cl(a)) = \frac{o(G)}{o((N/a))} \).
(b) Show that centre of a non-abelian group of order 343 always have 7 elements in its centre.

Section III

6. (a) Prove that a division ring has no zero division.
(b) Show that an ideal of a ring of integers is maximal if and only if it is generated by some prime integer.
7. (a) Let $S$ and $T$ be two ideals of a ring $R$ then
\[
\frac{S + T}{S} \equiv \frac{T}{S \cap T}.
\]
(b) Show that if $f : R \to R'$ is a ring homomorphism then Kernel of $f$ is an ideal of $R$.

Section IV

8. (a) Prove that every field is an Euclidean ring.
(b) If $R$ is an Integral domain, then $R[x]$ is also an integral domain.

9. (a) Prove that every Euclidean ring is a unique Factorisation domain.
(b) Show that the polynomial $x^4 + 1$ is irreducible over $\mathbb{Q}$.
GSQ/D-20
NUMERICAL ANALYSIS
BM-353

Time : Three Hours] [Maximum Marks : 20

Note : Attempt Five questions in all, selecting one question from each Section. Q. No. 1 is compulsory.

(Compulsory Question)

1. (a) State Newton-Gregory formula for forward interpolation.
   (b) What is Extrapolation ? Explain with example.
   (c) Write Simpson’s 3/8 quadrature formula.
   (d) Prove that $\nabla = \Delta E^{-1}$. 1,1,1,1

Section I

2. (a) Given that:

\[
\begin{array}{ccccc}
  x & 1 & 2 & 3 & 4 & 5 \\
  y & 2 & 5 & 10 & 17 & 26 \\
\end{array}
\]

Find the value of $\nabla^2 y_5$, using various properties.

(5)L-1
(b) Given:
\[
\begin{array}{cccccccc}
  x  & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
  y  & 1 & 8 & 27 & 64 & 125 & 216 & 343 & 512 \\
\end{array}
\]
Find the value of \( f(7.5) \).

3. (a) By means of Lagrange’s formula, prove that
\[ u_1 = u_3 - 0.3(u_5 - u_3) + 0.2(u_7 - u_5) . \]
(b) Find the polynomial of the lowest possible degree
which assumes the value 3, 12, 15, –21, when \( x \)
has the value 3, 2, 1, –1 respectively.

Section II

4. (a) Use Gauss’ forward formula to find the value of \( y \),
when \( x = 3.75 \) from the following table:
\[
\begin{array}{cccccccc}
  x  & 2.5 & 3.0 & 3.5 & 3.5 & 4.0 & 4.5 & 5.0 \\
\end{array}
\]
(b) Apply Bessel’s formula to obtain \( y_{25} \), given
\[ y_{20} = 2854, y_{24} = 3162, y_{28} = 3544, y_{32} = 3902. \]

5. (a) Find the probability distribution of the number of
heads in three tosses of a coin.
(b) A die is thrown 6 times. Getting an odd number is
a success. What is the probability of getting (i) 5
successes (ii) at least 5 successes.

(5)L-1032
Section III

6. Find the first and second derivatives of the function \( y = f(x) \) tabulated below at the point \( x = 1.1 \):

\[
\begin{array}{cccccc}
  x & 1 & 1.2 & 1.4 & 1.6 & 1.8 & 2.00 \\
  f(y) & 0.00 & 0.1280 & 0.5440 & 1.2960 & 2.4320 & 4.00 \\
\end{array}
\]

7. Using power method, find the largest eigen value and the corresponding eigen vector of the matrix

\[
A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 6 \end{bmatrix}.
\]

Section III

8. (a) Evaluate \( \int_{0}^{1} \frac{1}{1+x^2} \, dx \) by Trapezoidal rule.

(b) The velocity \( V \) (km/min) of a bike which starts from rest is given at fixed intervals of time (min.) as follows:

\[
\begin{array}{ccccccccccccccc}
  x & 0 & 2 & 4 & 6 & 8 & 10 & 12 & 14 & 16 & 18 & 20 \\
  y & 0 & 10 & 18 & 25 & 29 & 32 & 20 & 11 & 5 & 2 & 0 \\
\end{array}
\]

Estimate approximately by the distance covered in 20 minutes.

\( (5)L-1032 \)
9. (a) Apply Euler's method to solve \( \frac{dy}{dx} = x + y \),
\( y(0) = 0 \), choosing the step length = 0.2, find \( y(1.4) \).

(b) Given \( \frac{dy}{dx} = 1 + y^2 \); where \( y = 0 \), when \( x = 0 \) find \( y(0.2) \) by R–K method.
Note: Attempt Five questions in all. Select one question from each Section. Q. No. 1 is compulsory.

Compulsory Question

1. (a) If \( f(x) = x, x \in [0, 1] \) and \( P = \{0, \frac{1}{3}, \frac{1}{2}, \frac{2}{3}, 1\} \) be the partition of \([0, 1]\), then compute \( L(f, P) \) and \( U(f, P) \).

   2

(b) Prove the inequality \( 1 \leq \int_0^1 e^{x^2} \, dx \leq e \).

   1\frac{1}{2}

(c) Show that \( \int_1^\infty \frac{\sin x}{x^m} \, dx \) converges absolutely if \( m \geq 1 \).

   1\frac{1}{2}

(d) Show that the space \((0, 1]\) with usual metric space is not complete.

   1\frac{1}{2}

(e) Prove that usual metric space \((\mathbb{R}, d)\) is not compact.

   1\frac{1}{2}
Section I

2. (a) Show that the function $f$ defined by 
$$ f(x) = x, \quad x \in [0, 1] $$
is integrable and 
$$ \int_0^1 f(x) \, dx = \frac{1}{2}. $$

(b) By definition, prove that 
$$ \int_0^a \cos x \, dx = \sin a, $$
where $a$ is a fixed number.

3. (a) If a function $f$ is continuous on $[a, b]$ and 
$$ F(x) = \int_a^x f(t) \, dt, $$
then $F$ is differentiable on $[a, b]$ and $F' = f.$

(b) Evaluate 
$$ \int_0^1 \sqrt{1 + x^4} \, dx $$
by using mean value theorem.

Section II

4. (a) Examine the convergence of the improper integral:
$$ \int_{-a}^{a} \frac{x \, dx}{\sqrt{a^2 - x^2}} $$

(b) Show that the integral 
$$ \int_{0}^{\infty} x^{n-1} e^{-x} \, dx $$
is convergent if $n > 0.$
5. (a) Evaluate \( \int_0^a \frac{\log (1 + \alpha x)}{1 + x^2} \, dx, \alpha > 0. \)

(b) Show that \( \int_0^{\pi/2} \sin x \log (\sin x) \, dx \) is convergent with the value \( \log \left( \frac{2}{e} \right) \).

Section III

6. (a) The interior set of a subset of a metric space is the largest open set contained in A. Prove.

(b) If A and B are subsets of a metric space \((X, d)\), then prove that:
   (i) \((A \cap B)^o = A^o \cap B^o\)
   (ii) \(A^o \cup B^o \subset (A \cup B)^o\)

7. (a) Every Cauchy sequence is bounded in a metric space. Prove.

(b) Let X be a metric space, then prove that:
   (i) any intersection of closed sets in X is closed.
   (ii) finite union of closed sets in X is closed.

Section IV

8. (a) A metric space is sequentially compact iff every infinite subset has a limit point.
(b) Prove that continuous image of a compact metric space is compact.

9. (a) A continuous image of a connected space is connected. Prove.
(b) Every compact (sequentially-compact) metric space is complete. Prove.
(Compulsory Question)

1. (a) Prove that every subgroup of an abelian group is always normal.  
    1½  
(b) Prove that identity mapping is the only inner automorphism for an abelian group.  
    1½  
(c) Let $f : \mathbb{R} \to \mathbb{R}'$ be a homomorphism. Then $f$ is one to one if $\ker f = \{0\}$.  
    1½  
(d) Define Euclidean ring.  
    1½  
(e) Define transposition. What do you mean by even and odd permutations?  
    2

Section I

2. (a) Prove that order of every element of a finite group is finite and is less than or equal to the order of the group.  
    4  

(2)L-1054
(b) Prove that every subgroup of a cyclic group is cyclic.

3. (a) Prove that the order of every element of a finite group is a divisor of the order of the group.
   (b) If a group \( (G, \cdot) \) has four elements, show that it must be abelian.

Section II

4. (a) Prove that the set \( \text{Inn}(G) \) of all inner automorphisms of a group \( G \) is isomorphic to the quotient group \( G/Z(G) \), where \( Z(G) \) is the centre of \( G \).
   (b) Let \( f : G \to G \) be a homomorphism. Let \( f \) commutes with every inner automorphism of \( G \). Show that \( H = \{ x \in G; f^2(x) = f(x) \} \) is a normal subgroup of \( G \).

5. (a) Let \( G' \) be commutator subgroup of a group \( G \). Then \( G \) is abelian iff \( G' = \{ e \} \), where \( e \) is the identity element of \( G \).
   (b) Find the centre of the permutation group \( S_3 \).

Section III

6. (a) Show that every field is an integral domain. Also show by an example that every integral domain need not be a field.
(b) Let \( R \) be a commutative ring. An ideal \( S \) of \( R \) is a prime ideal iff for two ideals \( A, B \) of \( R \), \( AB \subseteq S \) \( \Rightarrow \) either \( A \subseteq S \) or \( B \subseteq S \).

7. (a) Show that an ideal \( S \) of a commutative ring \( R \) with unity is maximal iff \( R/S \) is a field.

(b) Let \( f \) be a ring isomorphism of \( R \) onto \( R' \). show that if \( R' \) is an integral domain, then so is \( R \).

Section IV

8. (a) Show that an element in a principal ideal domain is prime element iff it is irreducible.

(b) Show that \( \sqrt{-5} \) is a prime element of the ring \( \mathbb{Z}[\sqrt{-5}] = \{a + b\sqrt{-5} : a, b \in \mathbb{Z}\} \).

9. (a) Prove that every principal ideal domain is a unique factorization domain.

(b) Show that the polynomial:
\[
1 + x + x^2 + x^3 + x^4
\]
is irreducible over \( \mathbb{Q} \).

(2)L-1054
MATHEMATICS
BM-353
Numerical Analysis

Time : Three Hours] [Maximum Marks : 30

Note : Attempt Five questions in all, selecting one question from each Unit. Q. No. 1 is compulsory.

(Compulsory Question)

1. (a) Show that \( \Delta y \Delta^2 z \) is independent of \( x, y, z \). 1½

(b) State Gauss's Forward Interpolation Formula. 1½

(c) Define Poisson's distribution. 1½

(d) State Simpson's 1/3rd quadrative formula. 1½

Unit I

2. (a) State and prove Newton-Gregory Formula. 3

(b) Find the value of an annuity at \( 5 \frac{3}{8} \% \), given the following table : 3

<table>
<thead>
<tr>
<th>Rate per cent</th>
<th>4</th>
<th>4 1/2</th>
<th>5</th>
<th>5 1/2</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annuity value</td>
<td>17.29203</td>
<td>16.28889</td>
<td>15.37245</td>
<td>14.53375</td>
<td>13.76483</td>
</tr>
</tbody>
</table>

(2)L-1055 1
3. (a) Given the following data, find $f(x)$ in polynomial process of $(x-5)$:

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>4</td>
<td>26</td>
<td>58</td>
<td>112</td>
<td>466</td>
<td>922</td>
</tr>
</tbody>
</table>

(b) The values of function $f(x)$ for values of $x$ are given as $f(1) = 4$, $f(2) = 5$, $f(7) = 5$, $f(8) = 4$. Find values of $f(6)$ and also value for $x$ for which $f(x)$ is maximum or minimum.

Unit II

4. (a) Derive Gauss Backward Interpolation formula.

(b) Apply Bessel's formula for finding the values of $y$ for $x = 3.75$ given that:

- $f(2.5) = 24.145$, $f(3.0) = 22.043$, $f(3.5) = 20.225$, $f(4.0) = 18.644$, $f(4.5) = 17.262$, $f(5.0) = 16.047$.

5. (a) Find the probability distribution of the number of doublets in 4 throws of a pair of dice.

(b) A manufacturer of bulb knows that 5% of his production is defective. If he sells bulbs in boxes of 100 and guarantees that not more than 4 bulbs will be defective, what is the approximate probability that a box will fail to meet the guaranteed quality? (Take $e^{-5} = 0.0067$)
Unit III

6. (a) The distance(s) covered by a car in a given time \((t)\) is given in the following data:

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>12</th>
<th>14</th>
<th>18</th>
<th>20</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (km)</td>
<td>14</td>
<td>18</td>
<td>23</td>
<td>25</td>
<td>34</td>
</tr>
</tbody>
</table>

Find the acceleration of the car at \(t = 17\).

(b) Find the largest eigen values and the corresponding eigen-vector of the matrices:

\[
\begin{pmatrix}
-1 & 1 & 2 \\
0 & 1 & -1 \\
4 & -2 & -9
\end{pmatrix}
\]

7. Transform the matrix

\[
A = \begin{bmatrix}
1 & 2 & 2 \\
2 & 1 & 2 \\
2 & 2 & 1
\end{bmatrix}
\]

to tri-diagonal form by Given's method. Find the eigen vector corresponding to the largest eigen value from the eigen vectors of the tri-diagonal matrix.

Unit IV

8. (a) Evaluate \(\int_0^4 e^x dx\), by Simpson's one-third rule using the data:

\[e = 2.72, \quad e^2 = 7.39, \quad e^3 = 20.09, \quad e^4 = 54.60\]
(b) Apply Runge-Kutta method to solve \( \frac{dy}{dx} = x + y \); 
\( y(0) = 1 \) for \( x = 0.1 \).

9. (a) Solve the following by Euler's modified method
\[
\frac{dy}{dx} = \log_{10}(x + y), \text{ at } x = 1.2 \text{ and } 1.4 \text{ with } h = 0.2,
\]
given \( y(0) = 2 \).

(b) Use Picard's method to find the third approximation of the following differential equation:
\[
\frac{dy}{dx} = y - 1, \ y(0) = 2
\]
GSQ/D-20 1060
QUANTUM AND LASER PHYSICS
PH-501

Time : Three Hours] [Maximum Marks : 40

Note : Attempt Five questions in all, selecting one question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks. Non-programmable calculator is allowed.

Compulsory Question

1. (a) Write down expression for Compton wavelength. 2

(b) What are the conditions satisfied by a wave function ? 2

(c) What is temporal coherence in laser ? 2

(d) Explain the role of population inversions in laser. 2

Unit I

2. (a) Describe Davisson and Germer's experiment to confirm wave nature of matter. 4

(b) What is uncertainty principle ? Use it to describe that electron can not be part of nucleus. 4

(2)L-1060 1
3. (a) Explain the working of Heisenberg $\gamma$-ray microscope.  
4
(b) Write down 1-D Schrödinger wave equation, develop 3-D time Schrödinger wave equation for a non-relativistic particle. Explain characteristics of wave function.  
4

Unit II

4. Solve the Schrödinger wave equation for a particle passing through a step potential, where $E>V_0$. Prove that $T+R=1$.  

5. Describe the quantum theory of harmonic oscillator and solve the Schrödinger equation. Plot the energy levels.  
8

Unit III

6. (a) What are Einstein coefficient? Derive an expression in relating them between them.  
5
(b) Describe the concept of spatial coherence.  
3

7. Derive threshold condition for laser oscillation.  
8

Unit IV

8. Discuss in detail the principle, construction and working of solid state Ruby laser.  
8

9. Discuss the important application of laser in Industries.  
8

(2)L-1060  
2
GSQ/D-20
PHYSICS
Paper X
Nuclear Physics

Time : Three Hours] [Maximum Marks : 40

Note : Attempt Five questions in all, selecting one question from each Unit. Q. No. 1 is compulsory. Use of scientific calculator is allowed.

(Compulsory Question)

1. (a) What do you mean by quadrupole moment of the nucleus ? 2
   (b) Define mass attenuation coefficient. 2
   (c) What are the limitations of cyclotron ? 2
   (d) Name the conservation laws of nuclear reaction. 2

Unit I

2. (a) Describe the structure of nucleus. Explain, why electrons cannot be constituents of nucleus ? 5

(2)L-1061 1
(b) A nucleus with \( A = 235 \) splits into two fragments whose mass numbers are in the ratio of 3:2. Find the radii of the two fragments. Also find the separation between the fragments at the moment of splitting.

3.

(a) Explain the construction and working of Bain Bridge and Jordan double focussing mass spectrograph. What are its main advantages?

6

(b) Calculate the average binding energy per nucleon for \( ^{64}_{28} \text{Ni} \) having mass 63.9280 amu. Given \( m_p = 1.007825 \) amu and \( m_n = 1.008665 \) amu.

2

Unit II

4. (a) Discuss the theory of \( \alpha \)-disintegration with the help of quantum mechanical tunneling.

6

(b) Compare the radiation loss with the ionisation loss for 2 MeV \( \beta \)-particles in lead. Calculate the \( \beta \)-energy for which these losses are equal in lead. Atomic number of lead is 82.

2

5. Discuss in brief the three processes of interaction of \( \gamma \)-photon with matter by which radiation loses energy while passing through matter.

8

(2)L-1061

2
Unit III

6. (a) Describe a tandem accelerator. Give its merits. 6
   (b) A uniform magnetic field of 2 Wb/N² is used in a
cyclotron to accelerate the protons. The radius of
the cyclotron is 0.64 m. Calculate, how rapidly the
electric field between the dees should be reversed? 2
(Mass of proton = $1.67 \times 10^{-27}$ kg; Charge of proton
$= 1.6 \times 10^{-19}$ C)

7. (a) What is a scintillation counter? Give its
construction and working. 6
   (b) A GM counter wire collects $10^8$ electrons
per discharge. When the counting rate is
500 counts/min, what will be the average current in
the circuit? 2

Unit IV

8. Define Q-value of a reaction. Derive an expression for Q-
value in case of two body system. 8

9. (a) Explain the terms nuclear fission and fusion. Give
example of each. 4
   (b) Discuss the principle, construction and working of
nuclear fission reactor. 4

(2)L-1061 3
1. Fill in the blanks:
   (i) [FeF₆]⁻³ is colourless whereas [CoF₆]⁻³ is ...........
   (ii) CFSE of [TiF₆]⁻³ is ...........
   (iii) In [Ni(NH₃)₆]²⁺, Ni is .......... hybridised.
   (iv) Configuration of low spin Fe(II) is .........
   (v) Higher the value of βₚ, ............. is the complex.
   (vi) Greater the multiplicity .......... is the energy.
   (vii) The term log I₀/I is known as .......... 
   (viii) Pt-halogen bond is ................. labile than Pt-N bond.

1 × 8 = 8

Section A

2. (a) [Cr(NH₃)₆]⁺³ is paramagnetic while [Ni(CN)₄]⁻² is diamagnetic. Explain, why ?

(2) L-1062

1
(b) On the basis of ‘Crystal field theory’, explain why $[\text{Ti(H}_2\text{O)}_6]^3^-$ is coloured?

(c) Calculate CFSE for the following ions in coloured complexes:

(i) $d^4$ strong field

(ii) $d^6$ weak field.

3. (a) Predict the number of unpaired electrons in $[\text{Fe(H}_2\text{O)}_6]^{\text{+2}}$ and $[\text{Fe(CN)}_6]^{\text{-4}}$ and calculate the CFSE for the same.

(b) Which of the following complexes has longer $\Delta$ value and why?

$[\text{Co(CN)}_6]^{\text{-3}}$ or $[\text{Co(NH}_3)_6]^{\text{+3}}$.

4. (a) Arrange the following ligands in the decreasing order of trans effect:

$\text{Br}^-$, $\text{NH}_3$, $\text{Cl}^-$, $\text{H}_2\text{O}$, $\text{OH}^-$.

(b) Which is more stable complex and why?

$[\text{Cu(en)}_2]^{\text{+2}}$ or $[\text{Cu(triien)}]^{\text{-2}}$.

(c) What is the relation between overall stability constant and stepwise stability constant?

5. (a) How will you synthesize three isomers of $[\text{Pt(NH}_3)(\text{Py})(\text{Br})\text{I}]$ starting from $[\text{PtCl}_4]^{\text{-2}}$?

(b) What is the basic difference between the terms thermodynamic stability and kinetic stability?

(c) What are labile complexes?
Section B

6. (a) What is spin magnetic moment? How does it differ from orbital magnetic moment? 2
(b) Calculate in Bohr Magnetron the magnetic moment expected from spin only for the ions: 2
Cr^{3+} and Fe^{3+}
(c) Derive the relationship between magnetic susceptibility and magnetic moment. 2

7. (a) What do you understand by the term ‘diamagnetic correction’? 2
(b) Why does Mn(II) show maximum paramagnetic character amongst the bivalent ions of first transition series? 2
(c) Predict which of the following configurations are expected to have orbital contribution in high spin octahedral field? 2
   (i) $d^1$ (ii) $d^3$
   (iii) $d^5$ (iv) $d^8$

8. (a) Identify the ground state terms for each set of terms:
   (i) $^1S$, $^3P$, $^1D$, $^3F$, $^1G$
   (ii) $^1S$, $^3P$, $^1D$ 2
(b) Why do tetrahedral complexes of an element give much more intense $d$-$d$ spectra than its octahedral complexes? 2

(2)L-1062 3
(c) Draw Orgel diagram for $d^1$ and $d^0$ octahedral complexes.

9. (a) Write a brief note on L-S coupling.
(b) $[\text{Ti(H}_2\text{O)}_6]^{3-}$ ion is purple in colour as shown by absorption spectrum. Explain the transition, position, intensity and nature of bond.
(c) Calculate number of microstates for $p^3$ configuration.
GSQ/D-20 1064
CHEMISTRY
Physical Chemistry
Paper : XVI (CH-302)

Time : Three Hours] [Maximum Marks : 32

Note : Attempt Five questions in all, selecting two questions from each Section. Q. No. 1 is compulsory. Log table and/or non-programmable calculator are allowed.

1. (a) What do you mean by Black body ? 1×8=8
(b) What is the significance of wave function \( \Psi \) ?
(c) Define optical activity of a substance.
(d) What is magnetic permeability ?
(e) Out of the following, which will exhibit pure rotational spectra and why ?
   \( \text{H}_2,\text{HCl},\text{CO}_2,\text{H}_2\text{O} \)
(f) How does force constant ‘\( k \)’ is related to the fundamental frequency ?
(g) What is Hermitian operator ?
(h) Calculate the degrees of freedom of \( \text{H}_2\text{O} \) molecule.

(5)L-1064 1
Section A

2. (a) Derive an expression for Planck’s Radiation law. How does it explain the spectral distribution of black body radiation?
(b) What is photoelectric effect? Explain the effect of frequency and intensity of incident radiation on photoelectric effect. 4.2

3. (a) Derive an expression for energy of a particle in one dimensional box.
(b) Evaluate the following :
   (i) \( (x \frac{d}{dx})^2 \)
   (ii) \( \left( \frac{d}{dx} + x \right)^2 \). 3.3

4. (a) What do you understand by electrical polarisation of molecules? Discuss the effect of temperature on it.
(b) Calculate the specific rotation of a substance, the solution of which contains 5 g of the substance dissolved in 25 ml of water and shows a rotation of 5°, when introduced in 20 cm long polarimeter tube. 4.2

(5)L-1064 2
5. (a) Explain any one method for the measurement of dipole moment.

(b) What is magnetic susceptibility? Discuss its applications.

3,3

Section B

6. (a) Derive an expression for energies of the rotational transitions in a pure rotational spectrum. Discuss the possible rotational transitions on the basis of selection rules for pure rotational spectra.

(b) What is Born-Oppenheimer approximation? 4,2

7. (a) What do you understand by intensity of spectral lines? Explain the factors on which it depends.

(b) Calculate the force constant for the bond in HCl from the fact that the fundamental vibrational frequency is $8.667 \times 10^{13}$ s$^{-1}$. 3,3


(b) What type of molecules exhibit IR spectra? Out of the following, which are IR active:

$$\text{H}_2, \text{HCl, CO}_2, \text{SF}_4, \text{H}_2\text{O}, \text{SF}_6.$$ 4,2

(5)L-1064 3
9. (a) Discuss the effect of isotopic substitution on rotational spectra.

(b) Arrange the following groups in decreasing order of their absorption frequencies:
   (i) CF, CBr, CCl, CH
   (ii) C = C, C - C, C≡C.

(c) What are the advantages of Raman spectroscopy over IR spectroscopy?
1. (a) Define carbohydrates. How are they classified? 2

(b) What are equivalent and non-equivalent protons? Explain with examples. 2

(c) How will you differentiate between cis and Trans 1, 2-Dibromocyclopropane using PMR spectroscopy? 2

(d) What is Grignard’s reagent? Explain method of preparation of Grignard’s reagent. 2
Section A

2. (a) How many PMR signals are expected from the following compounds:
   
   (i) $\text{CH}_3 - \text{CH}_2 - \text{Br}$  
   (ii) $\text{CH}_2\text{-CH}_2\text{Br} - \text{Br}$

   (iii) $\text{CH}_3\text{C} = \text{C} - \text{H}$

   (iv) $[\text{structure}]$

   (b) Explain shielding and deshielding effects in PMR spectroscopy. Explain with examples.

   (c) How can you differentiate between 1, 2-Dibromoethane and 1, 1-dibromoethane using PMR spectroscopy.

3. (a) What is spin-spin coupling in PMR spectroscopy? Explain with examples.

   (b) What is coupling constant? How can be splitting constant used to distinguish between cis and trans isomers?

   (c) Discuss PMR spectra of ordinary ethanol and ultra pure ethanol. Explain the difference between them.

(5)L-1066
4. (a) How can PMR spectroscopy be used in differentiating ethane, ethene and ethyne? 
(b) What do you mean by chemical shift? Discuss the two factors which affect the chemical shift. 
(c) An organic compound having the molecular formula C\textsubscript{10}H\textsubscript{14} gave the following PMR data: 
(i) Singlet 8 0.88, 9H 
(ii) Singlet 8 7.28, 5H 
Assign the structure to the compound on the basis of above data.

5. (a) Write the structural formulae for compounds with the following molecular formula and which give rise to only one PMR signal? 
(i) C\textsubscript{6}H\textsubscript{12} (ii) C\textsubscript{2}H\textsubscript{6}O (iii) C\textsubscript{2}H\textsubscript{4}Br\textsubscript{2} (iv) C\textsubscript{8}H\textsubscript{10}. 
(b) Explain the following: 
(i) Anisotropic effect (ii) Enantiotopic protons. 
(c) Discuss the applications of PMR spectroscopy.

Section B

6. (a) What are Glycosides? Write Haworth Projection formula of methyl α, D (+) Glucopyranoside and β, D (+) Glucopyranoside. 
(b) What do you mean by Invert sugar? Explain. 
(c) What are organolithium compounds? Why organolithium compounds are more reactive than Grignard’s Reagent?
7. (a) Explain the following:
   (i) What degradation
   (ii) Erythro and Threo diastereomers.
(b) What are Polysaccharides? Explain.
(c) Complete the following PQR:
   (i) \[ \text{O} = \text{C} = \text{O} + \text{C}_6\text{H}_5\text{MgBr} \rightarrow \]
   \[ \begin{array}{c}
   \text{O} \\
   \mid
   \end{array} \]
   (ii) \[ \text{CH}_3 - \text{C} - \text{H} + \text{CH}_3 - \text{CH}_2 \]
   \[ - \text{CH}_2 - \text{CH}_2 - \text{hi} \rightarrow \]

(b) Prepare 1°, 2° and 3° alcohol using Grignard's Reagent.
(c) Write the Haworth projection formula of maltose. Assign glycosidic linkage also.

9. (a) Write the modern mechanism for the formation of glucosazone. Why glucose and fructose form the same osazone?
(b) Explain the following:
   (i) Mutarotation
   (ii) Organometallic Compounds.
(c) Give two methods of preparation of organolithium compound.
1. Define/Explain the following : \[1 \times 8 = 8\]
   (a) Plasmolysis and Deplasmolysis
   (b) Hypotonic Solution
   (c) Ascent of Sap
   (d) What are macronutrients and micronutrients ?
   (e) What is the other name of “Hatch- Slack Pathway” ?
   (f) Define Photophosphorylation.
   (g) What is RQ ?
   (h) What do you mean by Senescence ?

(5)L-1070 1
Section A

2. (a) Distinguish between Turgor Pressure and Wall Pressure. 3

(b) Write notes on DPD and Water Potential. How do they differ from each other? 5

3. (a) Define Transpiration. Why is it considered as necessary evil? 4

(b) Write a note on stomatal apparatus and explain the mechanism of opening and closing of stomata. 4

4. What are microelements and beneficial elements for plants? 8

5. Explain Mass Flow Hypothesis. What evidences support this and what are main objections against it? 8

Section B

6. Explain the mechanism of Light Reaction in Plants. 8

7. (a) What is photorespiration? Explain its significance. 4

(b) Draw a flow diagram of C₄ Cycle. 4
8. (a) What is respiration? What are its types? Explain the factors affecting respiration. 5
   (b) What is the significance of Kreb’s Cycle? 3

9. (a) Write notes on Florigen Hypothesis, Photoperiodism and Vernalization. 4
   (b) Explain the significance of Senescence. What are different types of Senescence? 4
Note: Attempt Five questions in all, selecting two questions from each Unit. Q. No. 1 is compulsory (short answer type). All questions carry equal marks.

(Compulsory Question)

1. Define the following: 1x8=8
   (a) Halophytes
   (b) Ecotone
   (c) Vivipary germination
   (d) Plant indicators
   (e) Secondary Succession
   (f) Ecotypes
   (g) Biological Oxygen Demand
   (h) Biomagnification.

Unit I

2. Describe the effect of Temperature as a climatic factor on plants. 8

(5)LM-1071 1
3. Write short notes on the following: 3+5=8
   (a) Soil Profile
   (b) Morphological and Anatomical adaptations in Xerophytes.

4. Describe the various species interactions in Plants with examples. 8

5. What is Population? Describe its different characteristics with suitable examples. 8

Unit II

6. Write short notes on the following: 5+3=8
   (a) Qualitative characteristics of a Community
   (b) Food-Chain and Food-Web.

7. What is Succession? Explain ecological succession on a bare rock (Lithosere). 8

8. Describe the various phytogeographical regions of India. 8

9. What is Pollution? Describe the various sources, types and control of Air Pollution. 8

(5)L-1071 2
1. Define the following: 10
   (a) Differentiate between habitat and niche.
   (b) What do you mean by the eutherma and stenothermal animals?
   (c) Differentiate between the lentic and lotic ecosystem.
   (d) Name the three major biotic components of an ecosystem.
   (e) Define the term ammonification and nitrification.
   (f) What is the carrying capacity of the environment?
(g) What are the biodiversity hot spots?
(h) What is the latitudinal migration?
(i) Define Commensalism.
(j) What is the greenhouse effect?  \[10 \times 1.5 = 15\]

Section A

2. Discuss the effects of light on animals in their environment.  \[6.25\]

3. Write notes on the following:
   (a) Pond Biomass  \[3\]
   (b) Lake Biomass.  \[3.25\]

4. (a) Explain the mechanism of energy through the ecosystem.  \[3\]
    (b) Discuss the various components of the ecosystem.  \[3.25\]

5. What do you mean by sedimentary cycles? Discuss the sulfur cycle.  \[6.25\]

Section B

6. Write a note on natural control on population growth.  \[6.25\]

(5)L-1072  \[2\]
7. Give an account of parental care in Amphibians. 6.25
8. Discuss the phenomenon of proto-cooperation by giving suitable examples. 6.25
9. Describe the methods of control of water pollution 6.25

(5)L-1072 3
Note: Attempt Five questions in all, selecting two questions from each Section A and Section B. Q. No. 1 is compulsory.

(Compulsory Question)

1. Define the following: 10
   (a) Homologous Organs
   (b) Recapitulation Theory
   (c) Species
   (d) Atavism
   (e) Palaeontology
   (f) Vitellogenesis
   (g) Primitive Streak
   (h) Capacitation
   (i) Pfluger’s law
   (j) Amphimixis.
Section A

2. (a) Give a brief account of Miller’s Experiment. What is its importance in the Understanding of origin of life upon earth? 4
(b) Explain the Symbiotic theory of origin of Eukaryotes. 3.5

3. (a) Define Connecting links. What is their Significance? Give at least three examples. 5
(b) Darwin’s Finches. 2.5

4. Explain the four basic steps of Organic Evolution as enlisted in modern concept of evolution. 7.5

5. Describe the following:
   (a) Lamarckism 5
   (b) Mega evolution. 2.5

Section B

6. (a) How is polyspermy prevented in animals? 3.5
(b) Write about various types of eggs on the basis of amount and distribution of yolk. 4

(5)L-1073 2
7. (a) Draw a labelled diagram of fate map of blastula of Chick. 3
(b) Give an account of types of Parthenogenesis. 4.5

8. (a) Explain the induction of Central Nervous System. 5
(b) Write difference between reparative and restorative regeneration. 2.5

9. Describe the process of Gastrulation in Frog. 7.5
GSQ/D-20 1077

MICROPROCESSOR ARCHITECTURE AND PROGRAMMING-I

Paper I

Time : Three Hours] [Maximum Marks : 40

Note : There are nine questions in this paper. All questions carry equal marks. Attempt Five questions in all. Q. No. 1 is compulsory. Attempt remaining four questions by selecting only one question from each Unit.

1. (a) What do you mean by Micro-instruction and Macro-instruction ? 2

(b) What do you mean by one byte, two byte and three byte instructions ? 2

(c) What is difference between CMP reg and SUB reg instructions ? Explain with suitable examples. 2

(d) What is the specialty of HL register pair over the other register pairs ? 2
Unit I

2. Draw the block diagram of SAP-I computer. Discuss the function of each block. 8

3. (a) Explain the instruction set of SAP-I computer. What is the size of MAR of the SAP-I computer? 5
(b) Write an assembly language program for SAP-I computer that will display the result of 8+3–2. 3

Unit II

4. (a) Name and discuss the five different categories in which the instruction set of SAP-II computers are divided. 6
(b) Discuss implied addressing to specify the data of instructions of SAP-II computers. 2

5. (a) Write a program in assembly language using SAP-II instructions to complement a number lying at 2000 H memory location. Store the result at 2100 H. 3
(b) Write a program in assembly language for SAP-II computer to interchange (swap) the contents of two memory locations 2200 H and 2201 H. 3
(c) Explain with an example the register addressing mode in SAP-II computer. 2

(2)L-1077 2
Unit III

6. (a) If carry flag is zero, then show that RAL instruction produces a multiplication of accumulator contents by a factor of 2.  
(b) Explain the following instruction of SAP-III computer. Also discuss which flags get affected with the execution of these instructions: ADD M, CMP B, POP PSW and MOV A, M.  

7. (a) What is the difference between the stack and stack pointer?  
(b) What will be contents of accumulator and flags (CY, S, P and Z), after the execution of SUB D instruction; if A = C3 H and D = 3D H.  
(c) Explain PUSH and POP instructions.  

Unit IV

8. (a) Discuss the role of address buffer and address data buffer in the architecture of 8085 microprocessor.  
(b) Discuss the following instructions of 8085: XCHG, XTHL, SPHL and LHLD address.  

9. (a) Discuss the functions of the following signals of 8085 microprocessor: ALE, WR, RD, S0 and S1.  
(b) Mention various flags provided in 8085 microprocessor and discuss their roles.  

(2)L-1077  

3
(Compulsory Question)

1. (a) Define the terms modulation index and deviation ratio.  

(b) What are the essential requirements of an ideal limiter?  

(c) Why is scanning necessary in T.V. transmission?  

(d) Calculate highest approximate modulating frequency $f_h$ that 625 line television must be able to handle.
Unit I

2. (a) Define DSB-SC, SSB-TC and SSB-SC. What amount of power is carried by each when modulation is 100 per cent ?

(b) Analyze the expression for the sinusoidal carrier voltage which is amplifier modulate by another modulating signal of the same type.

3. (a) A transmitter radiates 10 kW with unmodulated carrier wave and about 12.15 kW when amplitude modulated. Calculate the modulation index. One another sine wave produces 30% of modulation. What will be the total radiated power if both sine waves modulate the carrier simultaneously ?

(b) Derive the relation between the depth of modulation and output power of an AM transmitted wave.

Unit II

4. (a) Prove that sideband terms produced in frequency modulation may be extended theoretically to infinity.

(b) How the information can be recovered using phase shift detector ? Explain in detail with the help of circuit diagram.
5. (a) What do you mean by frequency demodulation? How can we demodulate the frequency signal? 3
(b) Define modulation index in FM and frequency deviation. 3
(c) What do you understand by significant sidebands in frequency modulation? 2

Unit III

6. (a) Define Kell factor. How it affects vertical resolution of a television picture. Show that vertical resolution increases with increase in number of scanning lines. 4
(b) What is progressive and interlaced scanning? Explain. How inter-laced scanning reduces flickers? 4

7. (a) Discuss components of composite video signal in brief. 5
(b) Explain, why the number of lines in TV system are kept odd? 3

Unit IV

8. Draw a neat and clean block diagram of TV Receiver. Explain in detail. 8

(3)L-1079 3
9. (a) Explain the terms:
   (i) complementary colours
   (ii) hue
   (iii) saturation
   (iv) chrominance.

(b) What do you understand by compatibility in TV transmission? Enlist the requirements that composite colour signal must meet to make the system fully compatible.
Note: Attempt Five questions in all, selecting one question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) What is Data and Information and give their differences?
   (b) Define Physical Data independence and logical data independence.
   (c) Define Entity and give its types.
   (d) Define various relationship with example.

2. Define Data base. Differentiate Traditional file system and Data base system.

3. What is DBMS? Explain its components and functions.
Unit II

4. Explain architecture of Database system with emphasis on three views and explain the role of DBA in this. 8

5. Discuss DSL, DDL, DML, DCL with examples. 8

Unit III

6. (a) Define Attributes, Relation and various relationship.
(b) Discuss object based data model and Conceptual Model. 8

7. What is E-R diagram and its symbols and make an ER diagram for Online book Store. 8

Unit IV

8. Explain Client server and Centralised Data model with properties. 8

9. (a) What is a key and explain the role of Primary key, Secondary, Foreign key and Super key in data base access.
(b) Explain constraints and its types. 8

(3)L-1080 2 2
Note: Attempt Five questions in all. Q. No. 1 is compulsory.
In addition to compulsory question, attempt four more
questions selecting one question from each Unit. All
questions carry equal marks.

(Compulsory Question)

1. (a) What are the most commonly used top level domain
    names ?  
   (b) What is IPv6 ?  
   (c) Write the purpose of ALT attribute in <IMG> tag.  
   (d) How can you move a image on web page ?  8

   Unit I

2. (a) What is Internet ? Briefly explain its history.  
     (b) Describe different Internet Services.  8
3. (a) What is Web Casting? Discuss different Web Casting techniques.
(b) Write short notes on the following:
   (i) URL
   (ii) Hypertext Transfer Protocol.

Unit II

4. (a) Discuss the parameters that need attention for planning a Website.
(b) What is a home page? Give some suggestions to develop home page for your personal website.

5. (a) What is Web Hosting? Write down different factors that need attention while choosing a Web Host.
(b) Explain the Web Publishing Process.

Unit III

6. Explain Ordered List, Unordered List and Definition List with examples.

7. What are the tags used for formatting text? Explain with examples.

(3)L-1082
Unit IV

8. (a) How table is created in HTML? Explain <TR>, <TD> and <TH> tags.

(b) Discuss the role of <COLSPAN> and <ROWSPAN> attributes in table. Give example.

9. Write the advantages of using frames in HTML. Using an example divided the browser screen into three horizontal sections and display different web page in each section.
1. Explain the following:
   (a) 70% alcohol for sterilization
   (b) Substrates for adherent cells
   (c) Cell lines vs. primary culture
   (d) Serum vs. plasma.

2. Section I
   (a) Discuss in detail about growth factors required for animal cell culture.
   (b) Differentiate cell culture media with serum and without serum.

3. (a) Discuss about various ways of tissue disaggregation which are required for primary cell culture.
   (b) Write a note on secondary cell culture.
4. (a) What is cell line? Elaborate about commonly used cell lines.
   (b) Write a detailed note on Karyotyping.  

5. (a) Discuss about selectable markers diagrammatically. What are they important to cloning vectors?
   (b) Write a note on vaccine production.  

6. (a) Discuss about embryo transfer technology.
   (b) How do we make transgenic mice? Discuss about its application.  

7. (a) What is the genetically engineering product? Discuss in detail about insulin?
   (b) Write a detailed note on gene therapy.  

(3)L-1089  2
(Compulsory Question)

1. (a) What are the somaclonal variation ? 1
(b) Describe the PDR approach. 1
(c) Write the four examples of auxin and cytokinin each. 2
(d) Describe the main contribution of the scientists ‘Skoog and Miller’ in plant tissue culture. 2
(e) What is the significance of fructans production in transgenic plants ? 2
Unit I

2. Write notes on the following:
   (a) Somatic embryogenesis. 4
   (b) Embryo rescue. 4

3. (a) Write a note on production of cybrids and their significance. 4
   (b) Discuss in brief the significance and limitations of callus and suspension cultures. 4

4. (a) Differentiate between the organogenesis and somatic embryogenesis. 4
   (b) Describe the importance and methods of selection of hybrid fusion products. 4

Unit II

5. (a) Discuss the Binary and Co-integrate vectors with examples. 4
   (b) Write a note on industrial enzymes production in transgenic plants. 4

(3)L-1090 2
6.  (a) Explain briefly various methods of direct gene transfer.  
    (b) Discuss the nutritional enhancement of plants by manipulations in seed storage proteins.

7.  Write notes on the following:
    (a) Development of abiotic stress tolerance in crop plants.
    (b) Fungal disease resistance development.