[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3211 **II**

Unique Paper Code : 42237904

Name of the Paper : Immunology (DSE)

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

Semester : VI

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. Draw well labelled diagram wherever necessary

1. (a) Define the following: (6)

   (i) Antigenicity

   (ii) Clonal selection theory

   (iii) Phagocytosis

P.T.O.

(iv) Cross reactivity

(v) Autoimmunity

(vi) Avidity

(b) Differentiate between the following: (10)

(i) Primary Immunodeficiency and Secondary Immunodeficiency

(ii) Humoral Immunity and Cell mediated Immunity

(iii) Immediate hypersensitivity and delayed type hypersensitivity

(iv) Primary lymphoid organs and Secondary lymphoid organs

(v) Polyclonal antibodies and Monoclonal antibodies

(c) Mention the contribution of the following scientists: (4)

(i) Louis Pasteur

(ii) Jules Bordet

(iii) Edward Jenner

(iv) Rolf Zinkernagel and Peter Doherty

(d) Explain the function of the following: (4)

(i) Antigen presenting cells

(ii) Immunoproteasome

(iii) CLIP

(iv) Bence Jones proteins

(e) Expand the following: (3)

(i) TAP

(ii) PAMPs

(iii) ISCOM

(iv) IFN

(v) ADCC

(iv) SCID

2. (a) Describe the various barriers of the innate immune system. (6)

(b) Describe the structure and function of Lymph Node. (6)

3. (a) Describe the structure and function of MHC class II molecule. (4)

(b) Describe the technique used for the production of monoclonal antibodies. (8)

4. (a) Describe the initiation and activation of the classical pathway of complement system. (7)

(b) What is Immunogenicity? Discuss the factors which influence immunogenicity. (5)

5. (a) Describe the immune mediator, immune mechanism and typical manifestation of delayed type hypersensitivity. (7)

(b) Describe the various properties and functions of cytokines. (5)

6. (a) Describe the pathway for processing and presentation of endogenous antigen. (6)

(b) Describe the structure of antibody molecule. What are different types of antigenic determinants present on immunoglobulins? (6)

7. Write short note on *any three* of the following: (3x4=12)

(a) Hematopoiesis

(b) DNA vaccine

(c) Sandwich ELISA

(d) AIDS

04/6/24

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3377 II

Unique Paper Code : 42347610

Name of the Paper : Computer Networks (DSE)

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

Semester : VI

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. The paper has **two** sections.
3. **All** questions in **'Section A'** are compulsory.
4. Attempt any **five** questions from **'Section B'**.
5. Parts of a question must be answered together.

P.T.O.

Section A

(Compulsory)

1. (a) Consider the following data fragment in the middle of a data stream in a frame : (2)

A B ESC C ESC FLAG FLAG D

Give the output when byte-stuffing technique is used for framing.

(b) Name the layers on which the following networking devices operate : (2)

(i) Bridge

(ii) Router

(iii) Gateway

(iv) Hub

(c) Indicate whether the following employ connection-less or connection-oriented mechanism : (2)

(i) WhatsApp call

(ii) Facebook chat

(iii) Postal System

(iv) WhatsApp Message

(d) Describe the function of Address Resolution Protocol (ARP). In which layer does it operate? (2)

(e) List at least two differences between the internet and the extranet. (2)

2. (a) Differentiate between the star and bus topologies. List one benefit and one drawback for each. (3)

(b) What is the difference between a single-bit error, a two-bit error, and a burst error? (3)

(c) Differentiate between circuit switching and packet switching. (3)

(d) What is purpose of cladding in an optical fiber cable? Explain with the help of a diagram. (3)

(e) What do understand by simplex, half duplex and full duplex mode of data communication? Give one example of each. (3)

Section B

(*Attempt any* **Five**)

3. (a) We want to transmit the bit-string "10110011" using Cyclic Redundancy Check (CRC). The generator bit-string is "1001". Obtain the transmitted bit-string. (4)

(b) What is the purpose of File Transfer Protocol (FTP)? Briefly explain the different transmission modes of FTP. (6)

4. (a) What do you understand by Domain Name System (DNS)? Which protocol does it use to resolve the name mapping? Discuss how domain name structure is organized. (6)

(b) What are the components of a URL? And what punctuation is used to separate the components? (4)

5. (a) List the differences between ISO-OSI and TCP/IP protocol stacks. (4)

(b) Find the class and subnet mask for each of the following IP addresses. (6)

(i) 208.34.54.12

(ii) 238.34.2.1

(iii) 114.34.2.8

6. (a) List the protocols that are used by modern E-mail Application system. Briefly discuss the role played by these protocols in the E-mail system. (6)

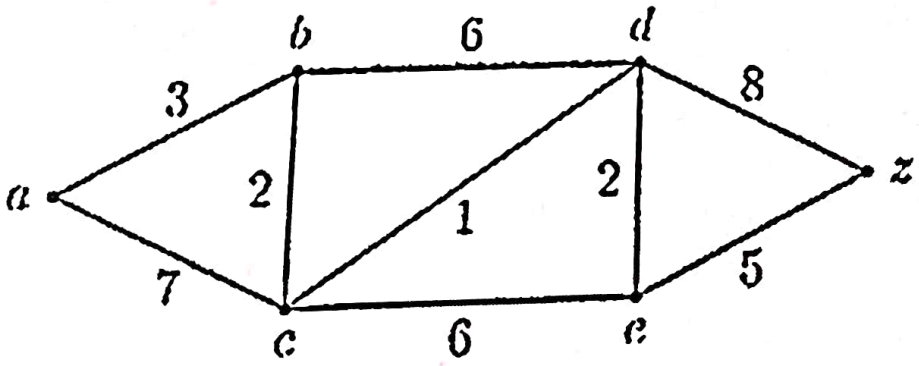
(b) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers? (4)

7. (a) Briefly discuss the functionality of each layer of the ISO-OSI model. (7)

(b) Classify computer networks according to the coverage area. (3)

8. (a) What is the difference between multicast and broadcast in terms of network traffic? Explain with suitable examples. (4)

(b) Find the length and shortest path between "a" and "z" in the following weighted graph. (6)



9. Write short notes on the following **(any two)** :

(a) Stop-and-Wait Protocol

(b) TELNET

(c) Radio Waves (10)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3398

H

Unique Paper Code : 42177926

Name of the Paper : DSE : Organometallics, Bio-Inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR

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

Semester : VI

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. Students should attempt **Section A** and **Section B** separately.

P.T.O.

Section A :

Organometallics, Bio-inorganic Chemistry

(Attempt any **three** *questions)*

1. (a) Write an essential feature for a compound to be termed as organometallic compound. How organometallic compounds are classified on the basis of bonding? Give one example of each.

(b) What is meant by the term hapticity? How it is denoted for a ligand. Give an example where the same ligand can show varying hapticity.

(c) Define the following terms giving one example each :

(i) Essential metal ions

(ii) Trace metals

(iii) Non-essential metal ions. (4,4,4.5)

2. (a) Arrange the following species in increasing order of the property mentioned and give reason :

(i) $Ni(CO)_4$, $[Co(CO)_4]^-$ - C – O bond length

(ii) $Fe(CO)_5$, $[Fe(CO)_4]^{2-}$ - Fe – C bond order

(b) What is synergic effect? How does it account for the formation of carbonyls with transition metals in low oxidation states?

(c) Draw structures of $KMnO_4$ and $K_4[Fe(CN)_6]$.

(d) Define 18 electron rule. (3,3,4,2.5)

3. (a) Give a diagrammatic representation of sodium potassium pump and explain its working. Why is the pump considered to be a case of active transport?

(b) What is the function of haemoglobin? Explain why haem group cannot act as biological oxygen carrier in the absence of globin chain?

(c) Write the toxic effects of Hg(II) poisoning. Give reason for toxicity. (4.5,4,4)

4. (a) What's the geometry, hybridization and oxidation no. of Cr in $K_2Cr_2O_7$? Explain the reason for its color.

(b) Will the C-O bond length in metal carbonyls be longer or shorter than that in free CO? Justify your answer.

(c) Write a short note on :

(i) Zeise's salt

(ii) Role of Magnesium in chlorophyll

(4,2.5,6)

Section B :

Polynuclear Hydrocarbons and UV, IR

(Attempt any **three** *Questions)*

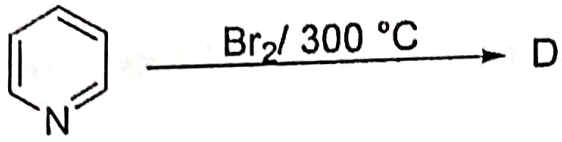
5. (a) Discuss and arrange the reactivity of Benzene, naphthalene and anthracene towards electrophilic aromatic substitution.

(b) Complete the following reactions-

(i)  $\xrightarrow{(CH_3CO)_2O/BF_3}$ A

(ii)  $\xrightarrow{CH_3COO^- \overset{+}{N}O_2}$ B

(iii)  $\xrightarrow{(CH_3CO)_2O/HNO_3}$ C

(iv) 

(c) Give evidence to show that acetoacetic ester exists in keto and enol forms.

(d) How will you distinguish *o*-hydroxybenzaldehyde (salicylaldehyde) and *m*-hydroxybenzaldehyde on the basis of IR spectroscopy? (3,4,2,3.5)

6. (a) Write a short note on any **two** of the following :

(i) Method of preparation of pyridine

(ii) Aromatic character of pyridine

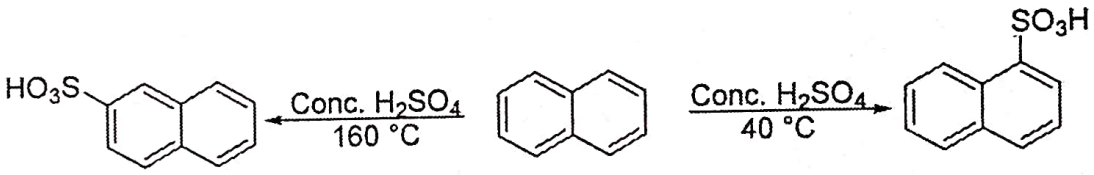
(iii) Establish the structure of anthracene.

(b) Establish the structure and Howarth synthesis of naphthalene.

(c) Explain why pyrrole tend to polymerise in presence of strong acids but pyridine remains unaffected?

(d) Discuss the aromaticity of furan, thiophene and pyrrole. Arrange them in increasing order of aromatic character and reactivity towards electrophilic aromatic substitution. (4,3,2.5,3)

7. (a) When naphthalene is treated with conc. Sulfuric acid the following products were obtained, why?



(b) Discuss the origin of UV-visible spectra and arrange the following electronic excitations in order of their decreasing energy: σ-σ^*, n-σ^*, π-π^*, n-π^*.

(c) Explain with suitable example why pyridine undergoes electrophilic substitution with great difficulty in acidic solution? Write the suitable examples.

(d) Discuss the Elbs reaction. (3,3.5,3,3)

8. (a) Furan is not stable to acids, although it has aromatic character. Why?

(b) How will you synthesize β-ketoesters by Claisen condensation. Write the mechanism.

(c) Write the two methods of preparation of Thiophene.

(d) Write the short note on any **two** –

(i) Bathochromic shift or red shift

(ii) Rocking and Wagging vibrations

(iii) Knorr-Pyrrole synthesis (3,3,2.5,4)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3400 **H**

Unique Paper Code : 42357633

Name of the Paper : DSE-1: Differential Equations

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

Semester : VI Mathematics-I

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** parts from each question.

1. (a) Find an integrating factor of the form $x^{\alpha}y^{\beta}$ of the following differential equation and solve it

$$(8x^2y^3 - 2y^4)dx + (5x^3y^2 - 8xy^3)dy = 0$$

(b) Solve the initial value problem

$$(2x + 3y + 1)dx + (4x + 6y + 1)dy = 0, \quad y(-2) = 2.$$

P.T.O.

(c) Solve the differential equation

$$\frac{dy}{dx}+\frac{x+1}{2x}y=\frac{x+1}{xy}.$$ (6+6)

2. (a) Find a family of oblique trajectories that intersect the family of circles $x^2 + y^2 = c^2$ at angle 45°.

(b) Show that e^{2x} and e^{3x} are linearly independent solutions over R of the differential equation

$$\frac{d^2y}{dx^2}-5\frac{dy}{dx}+6y=0,$$

Write the general solution. Find the solution that satisfies the conditions $y(0) = 2$, $y'(0) = 3$.

(c) Given that $y = x$ is a solution of

$$\left(x^2-x+1\right)\frac{d^2y}{dx^2}-\left(x^2+x\right)\frac{dy}{dx}+(1+x)y=0$$

find a linearly independent solution by reducing the order. Write the general solution. (6+6)

3. (a) Find the general solution of the differential equation

$$\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=\frac{1}{1+e^x}$$

using the method of variation of parameters.

(b) Solve the initial value problem

$$\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 4y = 0\,,\ y(0) = 1,\ y'(0) = -8,\ y''(0) = -4.$$

(c) Find the general solution of

$$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + 4y = 2x \ln x.$$ (6+6)

4. (a) Solve the simultaneous differential equations :

$$\frac{dx}{dt} + 4x + 3y = t,\ \frac{dy}{dt} + 2x + 5y = e^t.$$

(b) Solve the initial value problem

$$4xy\frac{dy}{dx} = y^2 + 1,\ y(2) = 1.$$

(c) Using the method of undetermined coefficients to solve the differential equation

$$\frac{d^2y}{dx^2} - 9y = x + e^{2x} - \sin 2x.$$ (6+6)

5. (a) Find the partial differential equation satisfied by the following surface

$$z = f\left(x^2 + y^2\right)$$

P.T.O.

(b) Find the general solution of the partial differential equation :

$$yu_x + xu_y = u.$$

(c) Find the solution of the following Cauchy Problem $xu_x + yu_y = 2xy$, with $u = 2$ on $y = x^2$.

(6.5+6.5)

6. (a) Apply the method of separation of variables $u(x, y) = f(x) + g(y)$ to solve the following equation

$$x^2u_x^2 + y^2u_y^2 = 1.$$

(b) Find general solution of the following second order partial differential with constant coefficients

$$u_{xx} - 4u_{xy} + 4u_{yy} = e^y$$

(c) Classify the following equation and obtain general solution by reducing it to canonical form

$$y^2u_{xx} - x^2u_{yy} = 0. \qquad (7+7)$$

[This question paper contains 4 printed pages.] 04/6/24

Your Roll No.....

Sr. No. of Question Paper : 3411 **H**

Unique Paper Code : 42237904

Name of the Paper : Immunology

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

Semester : VI

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. Question **1** is compulsory.
3. Draw well labelled diagrams wherever required.

1. (a) Define : (5)

   (i) Opsonization

   (ii) Extravasation

   (iii) Anaphylaxis

   (iv) Paratope

   (v) Adjuvant

P.T.O.

(b) Differentiate between the following : (10)

(i) Innate Immunity & Acquired Immunity

(ii) IPV & OPV

(iii) Primary Immune Response & Secondary Immune Response

(iv) Isotype & Allotype

(v) TH and Tc Cells

(c) Expand the following : (3)

(i) CALT

(ii) PMN

(iii) PRRs

(iv) MAC

(v) HLA

(vi) TNF

(d) Write the contribution/s of the following scientists : (2)

(i) Jules Bordet

(ii) Gerald M Edeman and Rodney Porter

(e) Write the immunological significance of the following : (4)

(i) Macrophages

(ii) NK cells

(iii) Bursa of Fabricus

(iv) Interferons

(f) Give reasons : (3)

(i) Older people are more prone to infections.

(ii) IgM is a good complement activator.

(iii) Mother milk is important for new born babies.

2. (a) Differentiate between Primary and Secondary lymphoid organs. Write a short note on the structure and function of Spleen.

(b) Define Immunogens? Explain the various factors which affect immunogenicity. (6,6)

3. (a) Discuss the general structure of an Immunoglobulin. Give an account of different classes of antibodies.

(b) Differentiate between Class I and Class II MHC diagrammatically. (9,3)

4. (a) Describe the properties of cytokines.

(b) Elaborate different types of vaccines with appropriate examples. (4,8)

5. (a) Explain the formation of MAC through the activation of complement system via alternative pathway.

(b) Distinguish between active and passive immunization. Under which immunological conditions passive immunization is preferred over active immunization. (8,4)

6. (a) Describe different barriers of Innate immunity.

(b) Explain Gell and Coomb's classification of hypersensitivity with suitable examples. (7,5)

7. Write short notes on any **three** : (4,4,4)

(a) Attributes of adaptive Immunity

(b) Immunodeficiency

(c) B and T cell epitopes

(d) Monoclonal antibodies

[This question paper contains 8 printed pages.] 04/6/24

Your Roll No.....

Sr. No. of Question Paper : 3415 **H**

Unique Paper Code : 42357618

Name of the Paper : DSE – NUMERICAL METHODS

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

Semester : VI

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. All questions are compulsory and carry equal marks.
3. Attempt any two parts from each questions.

1. (12)

(a) Using Newton-Raphson Method find solution of the equation compute $x^3 + x^2 - 3x - 3 = 0$ correct to four decimal places in the interval [1,2] upto three iterations.

P.T.O.

(b) Find the relative error of the number 9.6 if both of its digits are correct.

(c) Round off to four significant figures

(i) 19.235121

(ii) 49.85561

(iii) 0.0022218

(d) Perform five iterations of the bisection method to obtain the smallest positive root of the equation $f(x) = x^3 - 4x + 1 = 0$.

2. (12)

(a) Using Secant method find the smallest positive root of the equation $x^3 - 9x = -2$ correct to three decimal digits.

(b) Round off the number 65468 to four significant digits and then calculate the absolute, relative and percentage errors.

(c) Determine the number of significant digits in the following numbers.

(i) 0.004133

(ii) 27

(iii) 1.2×10^{-4}

(d) Using Regula falsi method compute the real root of the equation $x^2 = 2$ correct to four decimal places.

3. (12)

(a) Solve the following system of equations

$$x_1 + x_2 + x_3 = 1$$

$$4x_1 + 3x_2 - x_3 = 6$$

$$3x_1 + 5x_2 + 3x_3 = 4$$

using Gauss elimination method with row pivoting.

(b) Find the inverse of the coefficient matrix of the following system.

$$x_1 + 2x_2 - 3x_3 = -4$$

$$x_1 + 3x_2 + x_3 = 10$$

$$2x_1 - 4x_2 - 2x_3 = -12$$

using Gauss-Jordan method and hence solve the system.

(c) For the following system of equations

$$2x_1 + x_2 + x_3 = 5$$

$$3x_1 + 5x_2 + 2x_3 = 15$$

$$2x_1 + x_2 + 4x_3 = 8$$

obtain the Seidel iteration scheme and starting with $X^{(0)} = (0,0,0)$, iterate three times.

(d) Show that

(i) $\Delta = \frac{1}{2}\delta^2 + \delta\sqrt{\left(1+\frac{1}{4}\delta^2\right)}$

(ii) $\mu = \left(1-\frac{1}{2}\nabla\right)(1-\nabla)^{-1/2}$

4. (12)

(a) Find the polynomial which attains the prescribed values at the given points

x	0	1	4	5
y	8	11	68	123

using Lagrange interpolation. Interpolate the value of y at x = 3.

(b) Find the interpolating polynomial that fits the data

x	0	1	2	3	4	5
f(x)	0	3	8	15	24	35

using Newton forward difference interpolation. Interpolate at x = 2.5.

(c) Find the unique interpolating polynomial of degree 3 or less, such that f(2) = 1.4142, f(3) = 1.7321, f(4) = 2.0, f(6) = 2.4494 using Newton divided difference interpolation.

(d) Obtain the piecewise linear interpolating polynomials for the function f(x) defined by the data

x	–3	–2	–1	1
f(x)	369	222	171	165

Hence find an approximate value of f(–2.5) and f(0.5).

5. (12)

(a) From the following values of x and y,

x	0.4	0.5	0.6	0.7	0.8
f(x)	1.5836	1.7974	2.0442	2.3275	2.6511

Find $\frac{dy}{dx}$ ay 0.6

(b) Use central difference formula to calculate f'(3) for the data sets (1,2), (2,4), (3,8) (4,1,6) and (5,32). Use the Richardson's extrapolation method to further modify the value of f'(3).

(c) Solve by Euler's modified method, the initial value problem $\frac{dy}{dx} = x + y$, $y(0) = 0$. Choose $h = 1$ to evaluate $y(4)$.

(d) Compute the values of $\int_0^1 \frac{dx}{1+x^2}$ using the trapezoidal rule with $h = 0.5, 0.25$.

6. (15)

(a) Compute the trapezoidal rule for finding an approximate area under a given curve. The curve is given by the points given as

x	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
f(x)	23	19	14	11	12.5	16	19	20	30

Estimate the area bounded by the curve, the x-axis and the extreme ordinate.

(b) Using Euler's method, solve the following problem and find $y(3)$ with step size, $h = 1$

(i) $\frac{dy}{dx} = \frac{3}{5}x^3y$, $y(0) = 1$.

(ii) $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

(c) Use mid-point method to solve the initial-value problem $\frac{dy}{dx} = 1 + \frac{2xy}{1+x^2}$, $y(0) = 0$ and find $y(0.2)$ and $y(0.3)$.

(d) Use Heun's method to integrate $y' = 4e^{0.8t} - 0.5y$ from $t = 0$ to 4 with step size 1. The initial condition at $t = 0$ is $y = 2$. Evaluate the value of $y(4)$.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3419

Unique Paper Code : 42227637

Name of the Paper : Solid State Physics

Name of the Course : **B.Sc. Physical Sciences (DSE)**

Semester : VI

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.

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

(a) What is Bragg's law?

(b) What is Debye T^3 law?

P.T.O.

(c) What is superconductivity? Give two applications of superconductors.

(d) Write the significance of Miller indices.

(e) Write the difference between Ferroelectricity and Piezoelectricity.

(f) Show frequency dependence of various types of polarizabilities in a dielectric with a suitable diagram.

(g) Explain the origin of ferromagnetic domains.

2. (a) Calculate the numerical value of the packing fraction for the SC, BCC and FCC crystals.

(b) X-ray of wavelength 1.4 Å is found to be Bragg reflected from the (111) plane of an FCC structure. If the lattice parameter of the crystal is 5 Å, find the angle at which the X-ray is incident on the (111) plane of the crystal.

(c) Using the vector form of Bragg's law derive and draw the First Brillouin Zone for a Square lattice.

(4,4,7)

3. (a) Derive an expression for the frequency of lattice vibrations in the one-dimensional monoatomic lattice, and also discuss its limiting cases at the long and short wavelengths.

(b) Write down the key differences between the Einstein and Debye models of the lattice-specific heat? Discuss Debye's model qualitatively of lattice heat capacity. Discuss the success and failure of this model? (8,7)

4. (a) Derive an expression for the diamagnetic susceptibility (X) under the classical Langevin theory. Explain how the diamagnetic susceptibility (X) varies with temperature.

(b) Explain the hysteresis loop (B-H curve). What does the area of a B-H loop represent? How it can be used to distinguish between soft and hard ferromagnetic materials. (7,8)

5. (a) What is local electric field (E_{loc}) and how it is different from a macroscopic electric field (E_{mac}) in a dielectric material?

(b) Derive Clausius-Mossotti Equation for dielectric and explain its importance. (8,7)

6. (a) What is the Meissner effect and how can it be used to distinguish between type-I and type-II superconductors?

(b) What is Hall Effect? A current of 50A is established in a slab of copper 0.5cm thick and 2cm wide. The slab is placed in a magnetic field B = 1.5 T. The magnetic field is perpendicular to the plane of slab and to the current. The free electron concentration in copper is 8.48×10^{28} electrons/m^3. What is the magnitude of Hall voltage across the width of the slab? (8,7)

7. (a) Discuss the formation of allowed and forbidden energy band gaps on the basis of the Kronig-Penney model.

(b) Discuss the phenomena of Normal and Anomalous dispersion. (10,5)

June 2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3434 **H**

Unique Paper Code : 42347610

Name of the Paper : Computer Networks (DSE)

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

Semester : VI

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. The paper has **two** sections.
3. **All** questions in **'Section A'** are compulsory.
4. Attempt any **five** questions from **'Section B'**.
5. Parts of a question must be answered together.

P.T.O.

Section A

1. (a) List any two advantages of a multipoint connection over a point-to-point connection. (2)

(b) Consider four computers connected by an Ethernet hub at an office. Will it be considered as a LAN, a MAN or a WAN? Give reasons. (2)

(c) Name the layer of the OSI model responsible for the following : (2)

(i) Route determination

(ii) End-to-end process connection

(iii) Interface to transmission media

(iv) Provides access for the end user

(d) What is the significance of twisting in a twisted-pair cable? (2)

(e) Is an oil pipeline an example of - a simplex system, a half-duplex system or a full-duplex system? Justify your answer. (2)

2. (a) What is the purpose of bit stuffing? A bit string, 01111011111101111110, needs to be transmitted using bit-stuffing at the data link layer. Obtain the string that will be transmitted after bit-stuffing. (3)

(b) What is a mesh topology? Assume that there are six devices arranged using a mesh topology. How many cables are needed? And how many hardware ports does each device require? (3)

(c) What is the significance of guard bands in Frequency Division Multiplexing (FDM)? Assume that six channels, each with a 100-kHz bandwidth, are to be multiplexed together. Compute the minimum bandwidth of the link if a 15-kHz guard band is required between each channel. (3)

(d) Differentiate between coaxial cable and Fiber optics cable. (3)

(e) What do you understand by URL? Give an example to explain its parts. (3)

Section B

(Attempt any **Five)**

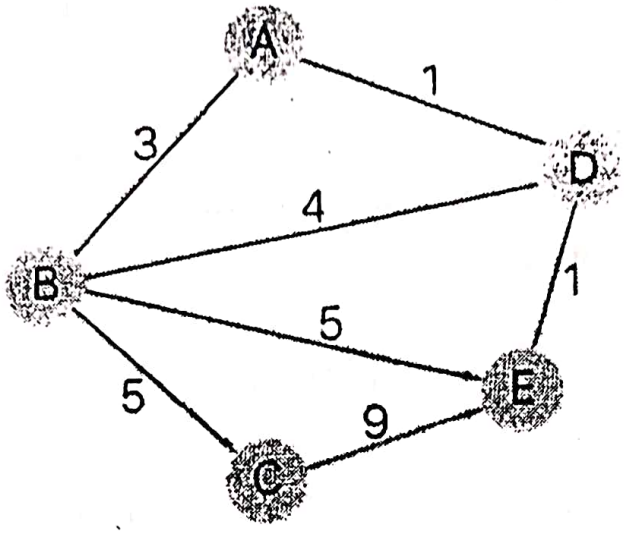
3. (a) Seven-bit messages are transmitted using a Hamming code. How many check bits are needed for the receiver to detect and correct single-bit errors? Show the bit pattern transmitted using Hamming code with even parity for the message "1110001". (6)

   (b) List any four differences between the User Datagram Protocol (UDP) and the Transmission Control Protocol (TCP). (4)

4. (a) What do you understand the term "data communication"? Explain the components of data communication. (6)

   (b) Explain briefly any two responsibilities of the data link layer and the network layers of the ISO-OSI reference model. (4)

5. (a) Using Djikstra's shortest path algorithm, find the shortest route from Router A to all other routers (B, C, D, and E) in the following configuration. Show the working steps. (6)



(b) Write the class and subnet mask of the following IP addresses : (4)

(i) 195.1.1.0

(ii) 1.1.1.1

(iii) 192.168.178.1

(iv) 172.16.52.63

6. (a) What to do you understand by the concept of *pipelining* in the sliding window protocol? A 50-kbps satellite link has a round-trip propagation delay of 500 msec. The transmitter employs the "Stop-&-Wait" scheme with frame size of 1000-bits to be transmitted via the above satellite link. Compute the link utilization using the Stop-&-Wait protocol? (6)

(b) Explain Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM) and Time Division Multiplexing (TDM) techniques. Which multiplexing technique is used for each of the following :

(i) AM and FM radio

(ii) A white light beam passing through an optical fiber (4)

7. (a) What are the differences between a connection-oriented service and a connectionless service? For each of the following write whether it is a connection-oriented service, connectionless service, both or neither.

(i) Telephone call

(ii) Instagram message (4)

(b) A bit stream of 10111011 is to be transmitted using the standard Cyclic Redundancy Check method. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. (6)

8. (a) A learning bridge connects a LAN segment with computers X, Y and Z to another LAN segment with computers A, B and C. Show how the bridge learns the segment to which each computer is connected if the following sequence of frames is transmitted over the network.

(i) X sends to Y

(ii) Y sends to X

(iii) A broadcasts

(iv) B sends to C

(v) Z sends to R (5)

(b) Transport layer is responsible for process to process delivery of data. Justify. (3)

(c) What is the purpose of cladding in an optical fiber? (2)

9. (a) Differentiate the following **(any two)** :

(i) Packet switching and Message switching

(ii) Computer Networks and Distributed systems

(iii) Repeater and Bridge (4)

(b) Write a short note on the following **(any two)** :

(i) Simple Mail Transfer Protocol

(ii) Hyper Text Transfer Protocol

(iii) World Wide Web (6)

June 2024

[This question paper contains 8 printed pages.]

Your Roll No......

Sr. No. of Question Paper : 3455 **H**

Unique Paper Code : 42177926

Name of the Paper : DSE : Organometallics, Bio-Inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR

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

Semester : VI

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. Students should attempt **Section A** and **Section B** separately.

P.T.O.

Section A :

Organometallics, Bio-inorganic Chemistry

(Attempt any **three** *questions)*

1. (a) Which of the following are organometallics compounds: $Ti(OEt)_4$, $B(OMe)_3$, $(\eta^5\text{-}C_5H_5)_2$ fe and $K[PtCl_3(C_2H_4)]$? Give reason.

   (b) Draw MO diagram of CO and explain how CO acts as an electron pair donor and acceptor through carbon and not through oxygen.

   (c) Give one method of synthesis of ferrocene and discuss its structures in solid and gaseous states. (4,5,3.5)

2. (a) The CO stretching frequency in IR spectra are as follows: $[Mn(CO)_6]^+$ - 2090 cm^{-1}, $Cr(CO)_6$ - 2000 cm^{-1}, $[V(CO)_6]'$ - 1860 cm^{-1}, $[Ti(CO)_6]^{2-}$ - 1750 cm^{-1}. The value for CO(g) is 2143 cm^{-1}. Discuss.

   (b) What are the functions of haemoglobin and myoglobin? Explain why haem group cannot act as biological oxygen carrier in the absence of globin chain.

(c) Using the 18 electron rule as a guide. Find :

(i) the number of CO ligands, in

$[W(\eta^6\text{-}C_6H_6)(CO)_n]$

(ii) the number of CO ligands in $[Co(\eta^5\text{-}C_5H_5)(CO)_n]$ (4,4.5,4)

3. (a) Explain the term "active transport" w.r.t action of sodium potassium pump in animal cells. Give systematic diagram for it.

(b) What are the toxic metals for biological system? Explain the toxicity of one such metal.

(c) Write a short note on :

(i) Toxicity of Hg^{2+} ion

(ii) Zeise's salt. (4,4,4.5)

4. (a) What's the geometry, hybridization and oxidation no. of Mn in $KMnO_4$? Explain the reason for its color.

(b) What happens when :

(i) $K_2Cr_2O_7$ is treated with oxalic acid in acidic medium

(ii) $KMnO_4$ is treated with mohr's salt in acidic medium

(c) Why transition elements show different oxidation states? Despite being a 17 electron species, $V(CO)_6$ does not dimerise. Give reason.

(4,4,4.5)

Section B :

Polynuclear Hydrocarbons and UV, IR

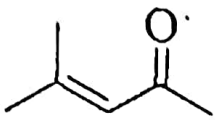
(Attempt any **three** *Questions)*

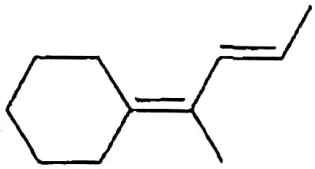
5. (a) Explain the following :

(i) Pyridine is less reactive towards electrophiles than pyrrole.

(ii) Electrophilic substitution in naphthalene is more favoured at α-position than β-positions

(b) Calculate the λ_{max} of the following compounds :

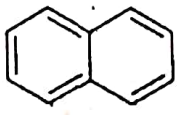
(i)  Base value = 215 nm

(ii)  Base value = 217 nm

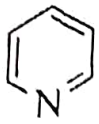
(c) Give the aromaticity order of Pyrrole. Thiophene, Furan, and Benzene. Give reason.

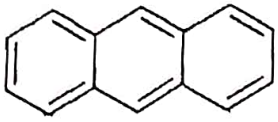
(d) What is keto-enol tautomerism. Explain taking example of ethyl acetoacetate. (4,4,2.5,2)

6. (a) Complete the following reactions :

(i)  $\xrightarrow[AlCl_3]{CH_3CH_2CH_2Br}$?

(ii)  $\xrightarrow{CHCl_3 / KOH}$? + ?

(iii)  $\xrightarrow[250\ ^{o}C]{\text{Fuming } H_2SO_4}$?

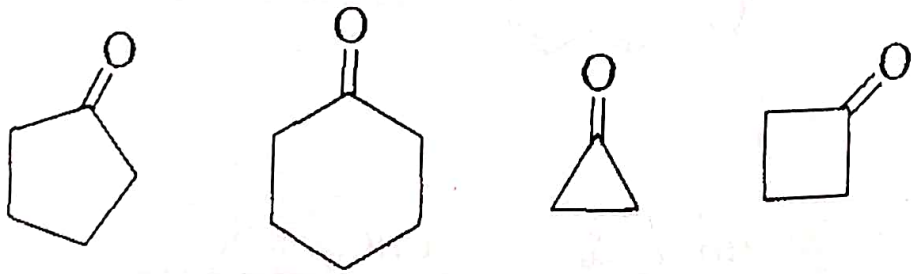
(iv)  $\xrightarrow{Na_2Cr_2O_7 / H^+}$?

(b) (i) Explain the different types of bending vibration in IR spectroscopy.

(ii) How can you distinguish between *cis*-stilbene and *trans*-stilbene using UV spectroscopy?

(c) Discuss the mechanism of Claisen ester condensation.

(d) Arrange the following compounds in increasing $\nu_{C=O}$ stretching absorption. Give reason.



(4,4,2.5,2)

7. (a) Synthesis the following compounds using ethyl acetoacetate **(Any two)**

(i) Succinic acid

(ii) 3-methyl pentan-2-one

(iii) Crotonic acid

(b) Write short notes :

(i) Chichibabin reaction

(ii) Charge transfer complex

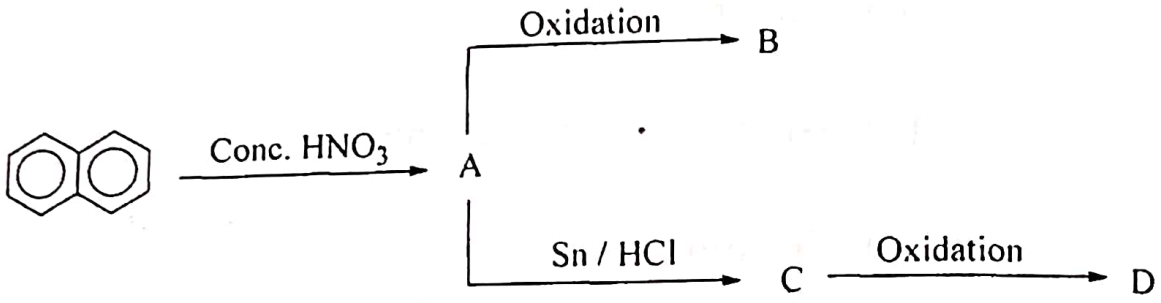
(c) Furan is the only 5-membered heterocyclic aromatic compounds which undergoes Diels-Alder reactions. Explain

(d) Calculate the fundamental vibrational modes in H_2O and CO_2. (4,4,2.5,2)

8. (a) (i) Anthracene on catalytic reduction gives dihydroanthracene, justify.

(ii) Why λ_{max} of aniline shift from 230 nm in neutral medium to 203 nm in acidic medium.

(b) Deduce the structures A, B, C, D



(c) Give the reaction for ketonic hydrolysis of ethylacetoacetate.

(d) What do you understand by bathochromic shift and hypsochromic shift? (4,4,2.5,2)

June 2024

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3457 **H**

Unique Paper Code : 42357633

Name of the Paper : DSE-1: Differential Equations

Name of the Course : **Analytical Chemistry / Industrial Chemistry / B.Sc.**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** parts from each question.

1. (a) Find the value of A such that the following equation is exact and then solve it.

$$(Ax^2y + 2y^2)dx + (x^3 + 4xy)dy = 0.$$

(b) Solve the initial value problem

$$(3x - y - 6)dx + (x + y + 2)dy = 0, \quad y(2) = -2.$$

P.T.O.

(c) Solve the differential equation

$$(1 + y^2)dx = (\tan^{-1} y - x)dy.$$ (6+6)

2. (a) Find the value of K such that the parabolas

$$v = c_1x^2 + K$$

are the orthogonal trajectories of the family of ellipses $x^2 + 2y^2 - y = c_2$.

(b) Show that e^x and e^{4x} are linearly independent solutions of the differential equation

$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 4y = 0 .$$

Find the solution of this differential equation which satisfies the conditions $y(0) = 1$, $y'(0) = 7$.

(c) Given that $y = x^2$ is a solution of

$$\left(x^3 - x^2\right)\frac{d^2y}{dx^2} - \left(x^3 + 2x^2 - 2x\right)\frac{dy}{dx} + \left(2x^2 + 2x - 2\right)y = 0$$

find a linearly independent solution by reducing the order. Write the general solution. (6+6)

3. (a) Find the general solution of the differential equation

$$\frac{d^2y}{dx^2}+y=\frac{1}{1+\sin x}$$

using the method of variation of parameters.

(b) Solve the initial value problem

$$\frac{d^3y}{dx^3}-2\frac{d^2y}{dx^2}+4\frac{dy}{dx}-8y=0,\ y(0)=2,\ y'(0)=0,\ y''(0)=0.$$

(c) Find the general solution of

$$x^2\frac{d^2y}{dx^2}-5x\frac{dy}{dx}+8y=2x^3\ .$$ (6+6)

4. (a) Solve the simultaneous differential equations :

$$2\frac{dx}{dt}+\frac{dy}{dt}-x-y=e^{-t},\ \frac{dx}{dt}+\frac{dy}{dt}+2x+y=e^{t}\ .$$

(b) Solve the initial value problem

$$x\frac{dy}{dx}+\frac{2x+1}{x+1}y=x-1,\ y(1)=2\ .$$

(c) Using the method of undetermined coefficients to solve

$$\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=x+\cos x\ .$$ (6+6)

P.T.O.

5. (a) Find the partial differential equation satisfied by the following surface $2z = (\alpha x - y)^2 + \beta$, where α and β are arbitrary constants.

(b) Find the general solution of the partial differential equation $u(x + y)u_x + u(x - y)u_y = x^2 + y^2$.

(c) Solve the following Cauchy problem

$xu_x + yu_y = xe^{-u}$ with the data $u = 0$ on $y = x^2$.

(6.5+6.5)

6. (a) Apply the method of separation of variables $u(x,y) = f(x)g(y)$ to solve the following equation

$$u_x u_y = u^2.$$

(b) Find the general solution of the following second order partial differential equation with constant coefficient.

$$u_{xx} + 4u_{xy} + 4u_{yy} = 0.$$

(c) Classify the following equation and obtain general solution by reducing it to canonical form.

$$u_{xx} + x^2 u_{yy} = 0.$$

(7+7)

[This question paper contains 8 printed pages]

Your Roll No.....

H

Sr. No. of Question Paper : 3461

Unique Paper Code : 42167904

Name of the Paper : Analytical Techniques in Plant Sciences

Name of the Course : **B.Sc. Life Sciences**

Semester : VI

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. **All** questions carry equal marks.
4. Question No. **1** is compulsory.
5. Illustrate your answers with labeled diagrams.
6. **All** parts of a question must be answered together.

P.T.O.

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

(i) The DNA molecules are immobilized on the _____ in the southern blotting technique.

(ii) _____ is a marker enzyme for peroxisomes.

(iii) While preparing the gel in AGE, the pore size can be regulated by altering the concentration of _____.

(iv) _____ lenses are used in the electron microscopes.

(v) Tracing the fate of a radioactively labelled molecule in a series of metabolic intermediates can be performed by _____ experiments.

(vi) Resolution of a microscope is inversely proportional to _____.

(b) Define (any **five**) : (5×1=5)

(i) Ultramicrotome

(ii) Half-life

(iii) Molecular probe

(iv) Positive staining

(v) Angular aperture

(vi) HPLC

(c) Name the technique used for (any **five**) : (5×1=5)

(i) Locating RNA using specific nucleotide sequence.

(ii) Examining the detailed surface topography of microscopic specimens.

(iii) Determining the 3-D structure of proteins.

(iv) Isolation of Chloroplasts from leaves.

(v) Separating monosaccharide sugars with different carbon numbers from the mixture.

(vi) Obtaining pure fraction of organelles.

2. Differentiate between (any **five**) : (5×3=15)

(a) Freeze fracture and freeze etching

(b) AGE and PAGE

(c) Sucrose density gradient and Caesium Chloride gradient centrifugation

(d) FISH and FACS

(e) Chromosome banding and Chromosome painting

(f) TEM and SEM

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

(a) Autoradiography

(b) X-ray crystallography

(c) Ion-exchange Chromatography

(d) Ultracentrifugation

(e) Embedding in Electron microscopy

(f) Fluorescence Microscope

4. (a) Give reasons for the following statements (any **five**). (5×2=10)

(i) Agarose gel is generally used for DNA analysis while polyacrylamide gel is used for protein analysis.

(ii) Vacuum is required in an electron microscope column but not in light microscope.

(iii) In shadow casting the metal emitting electrode is positioned at an angle to the specimen and not just above the specimen.

(iv) Ultracentrifuges are refrigerated.

(v) Cryofixation is preferred as compared to chemical fixation in electron microscopy.

(vi) Monochromator is used in spectrophotometer.

(b) What are marker enzymes? Give examples and their uses in biological research. (5)

5. (a) Expand the following terms and explain their significance in biological research. (5×2=10)

(i) MALDI

(ii) ELISA

(iii) RCF

(iv) TLC

(v) GFP

(b) Name five radioactive elements used in biological research along with their applications. (5)

6. (a) Write a brief account on autoradiography and its applications. (7)

(b) Explain the process of DNA sequencing. Comment on its applications. (8)

7. Attempt any **three** of the following : (3×5=15)

(a) Discuss the working and applications of flow cytometry.

(b) Give a brief account of DNA fingerprinting.

(c) Explain the principle and applications of spectrophotometry.

(d) Explain the shadow casting technique.

June 2024

[This question paper contains 8 printed pages.]

Your Roll No. .....

Sr. No. of Question Paper : 3472 **H**

Unique Paper Code : 42357618

Name of the Paper : Numerical Methods

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

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** parts from each question.
3. **All** questions carry equal marks.

P.T.O.

1. (a) Define the local truncation error. Round off the number 754682 to four significant digits and then calculate the absolute, relative and percentage errors. (6.25)

(b) Using the Regula Falsi method, compute the real root of the equation $x^3 = 6$ correct to four decimal places. (6.25)

(c) Perform four iterations of the Bisection method to obtain the smallest positive root of the equation $f(x) = x^3 - 4x + 1 = 0$. (6.25)

2. (a) Compute $\sqrt{5}$ correct to four decimal places by using Newton-Raphson Method. (6.25)

(b) Solve the linear system $AX = b$, where

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 10 \\ 3 & 14 & 28 \end{bmatrix}, \quad b = \begin{bmatrix} 1 \\ -2 \\ -8 \end{bmatrix}$$

by Gauss Elimination method using partial pivoting. (6.25)

(c) Using Secant method, find the smallest positive root of the equation $x^4 - x = 10$ correct to three decimal digits. (6.25)

3. (a) Perform three iterations of Gauss-Seidel method to solve the linear system

$$2x - y + 0z = 7$$

$$-x + 2y - z = 1$$

$$0x - y + 2z = 1$$

Take the initial approximation as $(x, y, z) = (0, 0, 0)$. (6.25)

(b) Find the inverse of the matrix A using Gauss-Jordan method, where

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix} \qquad (6.25)$$

(c) Consider the following table :

x	0.1	0.2	0.3	0.4	0.5
$f(x)$	1.40	1.56	1.76	2.00	2.28

Use Newton divided difference formula to calculate the interpolating polynomial and give an estimate for f(0.25). (6.25)

4. (a) Obtain the piecewise quadratic interpolating polynomial for

x	-2	-1	1	2	4
$f(x)$	-29	-8	-2	-5	7

Interpolate at x = 3.0. (6.25)

(b) Construct the interpolating polynomial by using Gregory-Newton backward difference interpolation formula for the given data :

x	1	1.5	2.0	2.5
$f(x)$	2.7183	4.4817	7.3891	12.1825

Estimate the value of f(2.25). (6.25)

(c) Construct the Richardson extrapolation table to find the derivative of $f(x) = 3^x$ at x = 3 using the central difference formula

$$f'(x) = \frac{f(x+h) - f(x-h)}{2h}$$

taking h = 1,2. (6.25)

P.T.O.

5. (a) Consider the following table :

x	1	2	3	4	5
$f(x)$	2	4	8	16	32

Find $f'(3)$ using

(i) Central difference formula

(ii) Three-point forward difference formula.

(6.25)

(b) Compute the value of $\int_{-3}^{3} x^4\,dx$

using the Simpson's 1/3 rule taking six equal subintervals. (6.25)

(c) Apply trapezoidal rule to evaluate the integral

$$\int_0^6 \frac{dx}{1+x^2}$$

Calculate the difference between the exact value and the approximate value. (6.25)

6. (a) Apply Midpoint method to find approximate solution of the initial value problem

$$\frac{dy}{dx} = x + 2y, \quad y(0) = 0, \quad h = 0.1. \qquad (6.25)$$

(b) Apply Euler's method to find approximate solution of the initial value problem

$$\frac{dy}{dx} = \frac{x-y}{z}, \quad y(0) = 1, \quad 0 \le x \le 3, \quad h = 0.5. \qquad (6.25)$$

(c) Find an approximation to y(0.2), for the initial value problem

$$\frac{dy}{dx} = y + x, \quad y(0) = 1, \quad 0 \leq x \leq 0.2.$$

using the Heun's method with h = 0.1. Compare with exact solution. (6.25)

[This question paper contains 4 printed pages.]

Your Roll No.....

H

Sr. No. of Question Paper : 3476

Unique Paper Code : 42227637

Name of the Paper : Solid State physics

Name of the Course : **B.Sc. Prog.-DSE**

Semester : VI

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. **All** questions carry equal marks.
3. Attempt **any Five** questions in total.
4. **Question No. 1** is compulsory.

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

   (a) Define the terms lattice, basis and unit cell.

   (b) Draw the frequency dependence curve for total polarizability of a dieletric material.

P.T.O.

(c) Show that for Bragg reflection to occur the wavelength of X-ray must not exceed twice the inter-planar spacing.

(d) Describe the effect of magnetic field on the superconducting nature of superconductors.

(e) Explain the observation of forbidden energy gap in the lattice dynamics of a linear chain of diatomic crystal?

(f) What is the origin of magnetic moment in an atom?

(g) A two-dimensional square lattice has side 2.5 Å. What will be the momentum of an electron whose wave terminates at the boundary of the first Brillouin zone? Also calculate the energy of the electron.

2. (a) What is a reciprocal lattice? How does it differ from a direct lattice? How is the reciprocal lattice of a direct crystal related with the X-ray diffraction pattern observed on the screen?

(b) A Monochromatic X-ray of wavelength 1.4 Å is incident on a crystal which is having interatomic spacing as 1.5 Å. Calculate the maximum order in which the diffraction takes place.

(c) Determine the Miller indices of a plane which is parallel to x-axis and cuts intercept of 2 and $\frac{1}{2}$ respectively along y- and z-axes. (8,7)

3. (a) Write the assumptions taken in Einstein's theory of crystal heat capacity. What is the success/s and failure/s of this theory?

(b) Why is Debye's model of lattice heat capacity more acceptable than the Einstein's theory?

(c) Debye temperature for aluminium is 428 K. Calculate the frequency of highest possible lattice vibration in aluminium. Also calculate the molar heat capacity of aluminium at 20 (6, 4, 5)

4. (a) Define mobility and conductivity of a semiconductor? Explain the temperature dependence of the mobility in semiconductors. Obtain an expression for the conductivity of an intrinsic semiconductor.

(b) When 90 mA current is passed through a sodium specimen under the transverse magnetic field of 0.20 T, the observed Hall voltage is 0.09 mV. If the width-of the specimen is 0.04 mm, calculate the charge carrier concentration. (10,5)

5. (a) Derive an expression for the electronic polarizability of an atom on the basis of classical theory.

(b) The relative permittivity and square of refractive index of a dielectric material are 4.95 and 2.69 respectively. Determine the ratio between electronic and ionic polarizabilities of the material.

(use $\varepsilon_0 = 8.854 \times 10^{-12}\ Fm^{-1}$) (8,7)

6. (a) Discuss the effect of magnetic field on a superconductor. Suppose that below the transition temperature, a superconductor behaves like a perfect conductor and satisfy the condition dB/dt = 0. Show that the state of magnetisation of the superconductor is not uniquely determined by external conditions (with appropriate diagram).

(b) What is the critical temperature? Explain the origin of superconductivity. (10, 5)

7. (a) Define ferromagnetism and ferromagnetic domains. Discuss the Weiss's theory of ferromagnetism and explain how magnetic susceptibility varies with temperature.

(b) A paramagnetic material has 10^{28} atoms/m^3. Its susceptibility at 350 K is 2.8×10^{-4}. Calculate the susceptibility at 300 K. (10,5)

10/6/2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3496 **H**

Unique Paper Code : 42347610

Name of the Paper : Computer Networks

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

Semester : VI

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. The paper has **two** sections. **All** questions in **'Section A'** are compulsory.
3. Attempt any five questions from 'Section B'.
4. Parts of a question must be answered together.

P.T.O.

Section A

(Compulsory)

1. (a) List two properties of coaxial cable. (2)

(b) Convert the binary IP address 11000011 11101001 11000001 00011010 to its decimal equivalent. (2)

(c) Assume eight devices are arranged in a ring topology. How many cables are needed? How many ports are needed for each device? (2)

(d) Give one advantage and one disadvantage of guided media. (2)

(e) The bit string "01111110111111011111110" needs to be transmitted using bit-stuffing technique at the data link layer. Generate the transmitted string obtained after bit-stuffing. (2)

2. (a) Differentiate between mesh and ring topology. List one advantage and one disadvantage of each. (3)

(b) Discuss the different layers of the TCP/IP model. (3)

(c) Explain how packet switching technique works to deliver packets from source to destination. (3)

(d) Identify the layers of OSI model responsible for performing the following operations : (3)

(i) Logical Addressing

(ii) Synchronization of bits

(iii) Routing

(e) What is the significance of flow control in data communication? Name the layers of the ISO-OSI model where flow control is employed. (3)

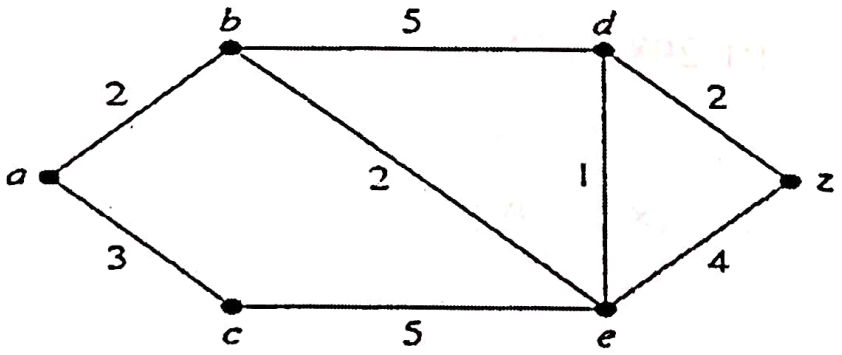
Section B

(*Attempt any* **Five**)

3. (a) Differentiate between simplex, half duplex and full duplex transmission modes with the help of suitable examples. (6)

(b) Obtain the transmitted bit-string using Cyclic Redundancy Check (CRC) when the message polynomial $x^7 + x^5 + 1$ is divided by the generator polynomial $x^3 + 1$. (4)

4. (a) Find the length of the shortest path between the vertices "a" and "z" in the given weighted graph. (6)



(b) Differentiate between virtual-circuit and circuit-switching techniques. (4)

5. (a) Briefly discuss the three multiplexing techniques used in data communication. (6)

(b) What are the differences between connection-less and connection-oriented services? Which type of service is used at the network layer of the TCP/IP protocol suite? (4)

6. (a) Find the class and subnet mask of the following IP addresses. (6)

(i) 208.34.51.12

(ii) 118.34.20.1

(iii) 104.34.2.8

(b) List the factors that determine whether a communication system is a LAN, MAN or a WAN. (4)

7. (a) Explain the functions of the transport and the network layers in the ISO-OSI model. (6)

(b) "Microwaves travel in straight lines". Explain the properties of microwaves in light of the above statement. List two advantages of microwave transmission over guided media. (4)

8. (a) Define TELNET. Illustrate Remote Log-in using TELNET with the help of a diagram. (6)

(b) Explain the Stop-and-wait protocol using a suitable diagram. (4)

9. Writes short notes on the following **(any two)** : (10)

(a) E-mail System

(b) File Transfer Protocol (FTP)

(c) Domain Name System (DNS)

10/6/24

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3508 **H**

Unique Paper Code : 32177908

Name of the Paper : DSE : Green Chemistry

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

Semester : VI

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 **six** questions.
3. Question no. **1** is compulsory.

1. (a) Fill in the blanks :

(i) The first principle of Green Chemistry is _____ .

(ii) _____ is an example of green solvent.

(iii) _____ is an example of non-biodegradable insecticide.

(iv) Addition reactions are _____ % atom economical.

(v) Vessels made of _____ can be used in microwave reactions.

(vi) _____ is a carcinogenic solvent.

(vii) DSIDA is an important intermediate developed by Monsanto by using copper catalyzed dehydrogenation of _____ .

(viii) _____ is the starting material in the green synthesis of adipic acid.

(ix) Disodium iminodiacetate is an alternative of _____ synthesis.

(b) Define any **two** of the following terms with suitable examples :

(i) Inherent Safer Design

(ii) Multifunctional Reagent

(iii) Supercritical CO_2 (9,3,3=15)

2. (a) Discuss any two principles of green chemistry with suitable examples.

(b) What are ionic liquids? Explain advantages of reactions where ionic liquids are used as a solvent.

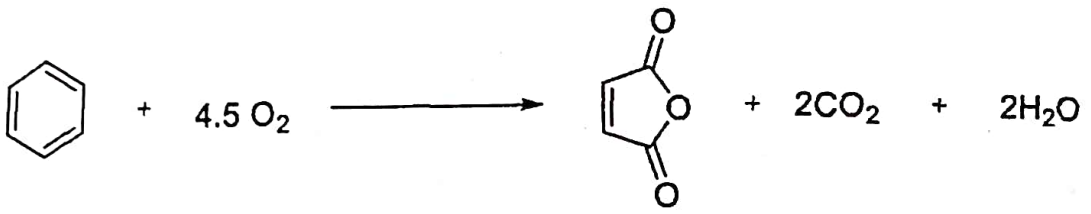
(c) What are VOCs? Explain with example. Suggest any two green alternatives to VOCs.

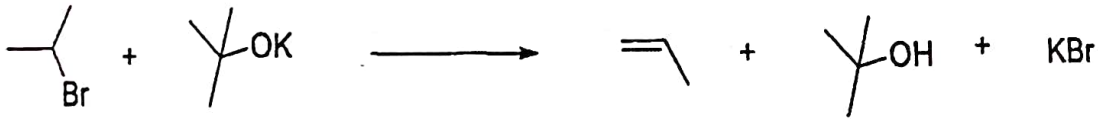
(4,4,4=12)

3. (a) What are the goals of green chemistry?

(b) How % yield is different from atom economy. Discuss any one reaction where % yield is 100% but not the atom economy.

(c) Calculate the atom economy for the following reactions :

(i) 

(ii) 

(Atomic mass: C = 12, H = 1, O = 16, Br = 80, K = 39) (4,4,4=12)

4. (a) Why are conventional methods of heating not considered green? Suggest any two alternative, environmentally friendly methods to carry out chemical reactions.

(b) What are biocatalysts? What are the advantages of bio-catalytic conversions? Explain with an example.

(c) What are the advantages of microwave assisted reactions? Explain why benzene is not a suitable solvent for Microwave assisted reactions.

(4,4,4=12)

5. (a) What are biodegradable polymers? Describe a synthetic process of compostable plastic from corn.

(b) Protecting/deprotecting groups reduces the overall atom economy of the reaction. Explain with an example.

(c) What are fluorous biphasic solvents? Give two examples.

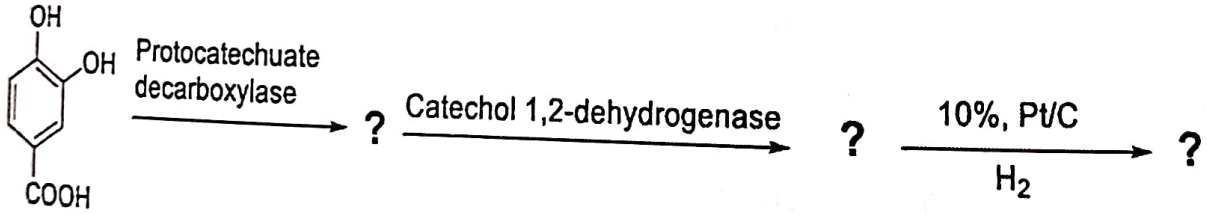
(4,4,4= 12)

3508

6. (a) Match the following :

S.No.	Column A	Column B
1	$[O]/HNO_3$	Carcinogenic
2	Adipic acid	Oxidation
3	Benzene	Pesticides
4	Catechol	Nylon 6, 6 polymer

(b) Complete the following reaction :



(c) Which starting material are used in the green synthesis of catechol? Write the conventional method of the synthesis of catechol, what are the adverse effect of this method on environment?

(4,4,4=12)

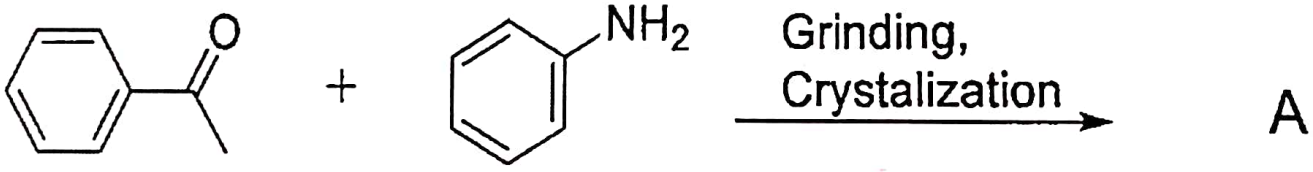
7. (a) Discuss green methodology for the synthesis of following compounds :

(i) Adipic acid

(ii) Azomethine

(b) Differentiate between the chemical and enzymatic interesterification process.

(c) Identify the product A in the following reaction :



(4,4,4=12)

8. (a) Explain : Risk = Function (Flazard x Exposure).

(b) Write short note on **any two** of the following :

(i) Biomimetic reagents

(ii) Oxidation reagents and catalysts

(iii) Green solvents

(c) Explain the microwave assisted solvent free synthesis of copper phthalocyanine and write its advantages over traditional method.

(4,4,4=12)

10/1/24

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3517 **H**

Unique Paper Code : 42177926

Name of the Paper : DSE: Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy

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

Semester : VI

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. Use separate sheets for **Section A** and **Section B**.
3. Attempt **three** questions from each section.
4. Do not intermix the sections and attempt all parts of a question paper together.
5. **All** questions carries equal marks.

P.T.O.

Section A

Attempt any **three** *questions.*

1. (a) How is Potassium dichromate prepared from chromite ore? Write two important uses of $K_2Cr_2O_7$.

(b) Write down the balanced chemical equation for the following reactions :

(i) $KMnO_4$ is added to $FeSO_4$ in acidic medium.

(ii) $K_2Cr_2O_7$ solution is treated KOH.

(iii) $K_4[Fe(CN)_6]$ is added into $CuSO_4$ solution.

(iv) H_2S is passed through $KMnO_4$ solution in acidic medium.

(c) Explain the hybridisation, magnetic behaviour and structure of Potassium ferrocyanide on the basis of VBT. (4,4,4.5)

2. (a) Define 18 electron rule. Using this rule as a guide, find the value of x :

(i) $Fe_3(CO)_x$

(ii) identify 3d metal in $[M(CO)_6]^-$

(iii) $Mn_2(CO)_x$

(b) Ni forms a mononuclear carbonyl but the cobalt carbonyl is dimeric. Explain.

(c) With reference to MO diagram of CO, explain why does CO act as both a Lewis acid and base? Which atom carbon or oxygen is involved in both the cases. (4,4,4.5)

3. (a) Which disease is caused due to toxicity of Hg. What are the symptoms. Give reasons for its toxicity.

(b) Discuss the role of magnesium ion in chlorophyll.

(c) Explain cooperative effect of four heme group in a hemoglobin molecule. Why are shapes of the oxygen saturation curves of hemoglobin and myoglobin different? (4,4,4.5)

4. (a) Give one method for the preparation of $Ni(CO)_4$. Using VBT explain the structure of $Ni(CO)_4$ and predict its magnetic behaviour.

(b) The CO stretching frequency in IR spectra are as follows :

$[Mn(CO)_6]^+$	2090 cm^{-1}
$[Cr(CO)_6]$	2000 cm^{-1}
$[V(CO)_6]^-$	1860cm^{-1}
$[Ti(CO)_6]^{2-}$	1750 cm^{-1}

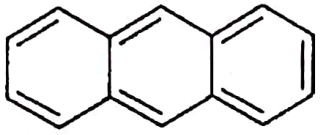
The value for free CO (2143 cm^{-1}). Explain giving reasons.

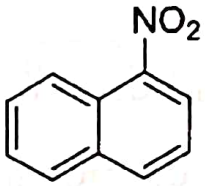
(c) Explain the role of Na-K pump in controlling the concentration of Na^+ ions and K^+ ions inside and outside the cell. (4,4,4.5)

SECTION B

Attempt any **three** *questions.*

5. (a) Write the products formed in the following chemical reactions :

(i)  $\xrightarrow[H^+]{Na_2Cr_2O_7}$?

(ii)  $\xrightarrow{\text{Oxidation}}$?

(iii)  + NH_3 $\xrightarrow{Al_2O_3}$?

(iv)  $\xrightarrow[\text{Heat}]{\text{NBS, } CCl_4}$?

(b) Explain why butadiene has a higher value of λ_{max} than ethylene. 1,3-butadiene absorbs at 217 nm but 1,5-hexadiene absorbs below 200 nm. Explain.

(c) Why does the sulphonation of naphthalene yield different products at low and high temperatures? (4,4,4.5)

6. (a) (i) Why electrophilic attack on anthracene is favored at C-9?

(ii) Calculate the number of fundamental vibrations for carbon dioxide molecules in IR spectroscopy.

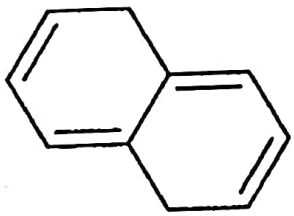
(b) (i) What are active methylene compounds? Explain with any two examples.

(ii) Differentiate between tautomerism and resonance? Give the structures of *keto* and *enol* forms of ethyl acetoacetate.

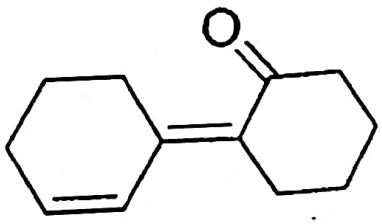
(c) What is a Bathochromic shift? Explain with the help of suitable example, the effect of extended conjugation on the π to π* transition of dienes? (4,4,4.5)

7. (a) Explain the nucleophilic and electrophilic substitution in pyridine and discuss the favorable positions of substitution.

(b) Calculate the λ_{max} by using Woodward-Fieser Rules.



Base value = 253 nm



215 nm

(c) Why some of the fundamental vibrations are infrared active whereas the others are not. Discuss by using the example of cis and trans-1,2-dichloroethylene. (4,4,4.5)

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

(i) Hantzch pyridine synthesis

(ii) Auxochromes and Chromophores

(iii) Lambert's Beer Law

(b) Write down the chemical reactions for the synthesis of the following compounds using ethyl acetoacetate.

(i) Succinic acid

(ii) Butanone

(c) Write down Paal-Knorr synthesis of furan. Give mechanism. (4,4,4.5)

10/6/24

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3519

Unique Paper Code : 42357633

Name of the Paper : DSE-1: Differential Equations

Name of the Course : **Analytical Chemistry / Industrial Chemistry / B.Sc.**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** parts from each question.

1. (a) Solve the differential equation by finding an integrating factor : (6+6)

$$[y^2(x + 1) + y]dx + (2xy + 1)dy = 0.$$

(b) Solve the initial value problem

$$(3x - y - 6)dx + (x + y + 2)dy = 0, \; y(2) = -2.$$

P.T.O.

(c) Solve the differential equation

$$\frac{dy}{dx} + y = xy^3, \; y(0) = 4$$

2. (a) Find a family of oblique trajectories that intersect the family of curves $x + y = cx^2$ at angle α such that $\tan \alpha = 2$.

(b) Show that e^x and xe^x are linearly independent solutions over R of the differential equation

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0,$$

Write the general solution. Find the solution that satisfies the conditions $y(0) = 1$, $y'(0) = 4$.

(c) Given that $y = e^{2x}$ is a solution of

$$(2x + 1)\frac{d^2y}{dx^2} - 4(1+x)\frac{dy}{dx} + 4y = 0 .$$

find a linearly independent solution by reducing the order. Write the general solution. (6+6)

3. (a) Find the general solution of the differential equation

$$\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = \frac{1}{1+e^{2x}} .$$

using the method of variation of parameters.

(b) Solve the initial value problem

$$\frac{d^3y}{dx^3} - 5\frac{d^2y}{dx^2} + 9\frac{dy}{dx} - 5y = 0\,,\ y(0) = 0,\ y'(0) = 1,\ y''(0) = 6.$$

(c) Find the general solution of

$$x^2\frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = 4\ln x\,. \qquad (6+6)$$

4. (a) Solve the simultaneous differential equations :

$$\frac{dx}{dt} + \frac{dy}{dt} - x - 3y = e^t,\ \frac{dx}{dt} + \frac{dy}{dt} + x = e^{3t}\,.$$

(b) Solve the initial value problem

$$x^2\frac{dy}{dx} + xy = \frac{y^3}{x},\ \ y(1) = 1$$

(c) Using the method of undetermined coefficients to solve

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = e^x \sin x \qquad (6+6)$$

5. (a) Find the partial differential equation satisfied by the following surface

$$x + y + z = f(x^2 + y^2 + z^2).$$

(b) Find the general solution of the partial differential equation

$$(1 + x^2)u_x + u_y = 0.$$

(c) Find the solution of the following Cauchy Problem

$3u_x + 2u_y = 0$, with $u(x, 0) = \sin x$ (6.5+6.5)

6. (a) Apply the method of separation of variables $u(x,y) = f(x)g(y)$ to solve the following equation.

$u_x + u = u_y$, $u(x,0) = 4e^{-3x}$.

(b) Find general solution of the following second order partial differential with constant coefficients

$$yu_{xx} + 3yu_{xy} + 3u_x = 0, \; y \neq 0.$$

(c) Classify the following equation and obtain general solution by reducing it to canonical form

$$u_{xx} + xu_{yy} = 0 \quad x > 0. \qquad (7+7)$$

10/6/24

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3523 **H**

Unique Paper Code : 42167904

Name of the Paper : Analytical Techniques in Plant Sciences

Name of the Course : **B. Sc. Life Sciences**

Semester : VI

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. **All** questions carry equal marks.
4. Question No. **1** is compulsory.
5. Illustrate your answers with labeled diagrams.
6. **All** parts of a question must be answered together.

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

   (i) MALDI

   (ii) SDS-PAGE

   (iii) RCF

P.T.O.

(iv) FISH

(v) ELISA

(vi) TLC

(vii) GFP

(b) Define (any **five**) : (5×1=5)

(i) Chromosome painting

(ii) Cryofixation

(iii) Probe

(iv) Gel Electrophoresis

(v) Fluorochromes

(vi) Depurination

(vii) Half-life

(c) Give one word for each (any **five**) : (5×1=5)

(i) A technique used to isolate chloroplast from spinach leaves

(ii) Marker enzyme of mitochondria

(iii) A stain used in electron microscopy sample preparation

(iv) Stationary phase in paper chromatography

(v) Matrix used in Column Chromatography

(vi) A technique used to detect the presence of a specific protein in the cell

2. Differentiate between (any **five**) : (5×3=15)

(a) GLC and HPLC

(b) Freeze fracture and freeze etching

(c) Paper Chromatography and Thin Layer Chromatography

(d) Density gradient centrifugation and Differential centrifugation

(e) SEM and TEM

(f) Colorimetry and Spectrophotometry

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

(a) Pulse Chase Experiment

(b) Ultracentrifugation

(c) Ion-exchange Chromatography

(d) Sample preparation of electron microscopy

4. Describe the following techniques and their applications (any **three**) : (3×5=15)

(a) Shadow Casting

(b) Confocal microscopy

(c) Flow cytometry

(d) Mass spectrometry

5. (a) Briefly discuss the X-ray crystallography technique and write its applications. (6)

(b) Explain the principle, working and applications of Western Blotting. How is it different from Northern blotting? (9)

6. (a) Using a ray diagram, explain the working of a Transmission Electron Microscope Comment briefly on the applications of the technique. (6)

(b) Give a comparative account of native PAGE vs SDS-PAGE. (4)

(c) Discuss the applications of autoradiography technique. (5)

7. (a) Explain the procedure of Polymerase Chain Reaction and list its applications. (5)

(b) Discuss the role of antibodies in the field of research in biology. (5)

(c) Briefly comment on the use of different radioisotopes in biological research. (5)

Unique Paper Code: 42237904 Sr. No.: 3530 10/6/24

Name of the Course: B.Sc. (P) Life Sciences (LOCF)

Name of the Paper: Immunology (DSE)

Semester: VI

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. *Draw well labelled diagram wherever necessary*

1. (a) Define (5)

(i) Opsonization

(ii) Prozone effect

(iii) Haplotype

(iv) Superantigens

(v) Diapedesis

(b) Differentiate between the following: (10)

(i) Primary and Secondary Immune Response

(ii) Apoptosis and Necrosis

(iii) Humoral and Cell mediated Immunity

(iv) Macrophage and Monocytes

(v) Plasma and Memory cells

(c) Expand the following: (3)

(i) TNF

(ii) HLA

(iii) PRR

(iv) CLIP

(v) ADCC

(vi) IEL

(d) Give the immunological significance: (2)

(i) IgM is the first antibody produced in primary immune response.

(ii) Hapten is not able to induce an immune response.

(e) Give the contributions of the following scientists: (4)

(i) M. Chase

(ii) Eva Engvall and Peter Perlmann

(iii) Gerald M, Edelman and Rodney R. Porter

(iv) Edward Jenner

(f) Give the immunological significance: (3)

(i) Adjuvant

(ii) MALT

(iii) Calnexin

(iv) C5a

(v) IL-2

(vi) APCs

2. (a) What are the effector cells of anaphylaxis and their biological responses in immediate type hypersensitivity? (6)

(b) Define epitope. What are the properties of T cell and B cell epitopes? (6)

3. (a) Explain the difference between active and passive immunization. Write a note on DNA vaccine. (6)

(b) Discuss the basic properties and functions of cytokines. (6)

4. (a) Describe the initiation and activation of alternate complement pathway. (6)

(b) Describe how monoclonal antibodies are generated and selected using hybridoma technology. (6)

5. (a) What are lymphoid organs? Elucidate the structure and function of the thymus. (6)

(b) Differentiate between MHC molecules of Classes I and II. Discuss their specific functions. (6)

6. (a) Describe how endogenous antigens are processed and presented through a cytosolic pathway. (6)

(b) Define immunogenicity. Discuss the various factors that influence the degree of immunogenicity. (6)

7. Write short notes on (any *three* of the following): (3x4=12)

(a) Antigenic determinants on immunoglobulin(s)

(b) Hematopoiesis

(c) Inflammation

(d) Autoimmune disorders

10/6/24

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3534 **II**

Unique Paper Code : 42357618

Name of the Paper : DSE – NUMERICAL METHODS

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

Semester : VI

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. **All** questions are compulsory and carry equal marks.
3. Attempt any **two** parts from each questions.

1. (12)

(a) Find the relative error of the number 8.512 up to three significant digits.

P.T.O.

(b) Perform five iterations of the bisection method to obtain the smallest positive root of the equation $f(x) = x^3 + x^2 - 1 = 0$.

(c) Write the order of convergence of Bisection Method, Secant Method and Newton-Raphson Method. Also name these methods in decreasing order w.r.t. rate of convergence.

(d) Determine the number of significant digits in the following numbers.

(i) 5.67800

(ii) 3485000

(iii) 6.5×10^{-8}

2. (12)

(a) Using Regula-Falsi method compute the real root of the equation $x^3 - 5x - 7 = 0$. Correct to four decimal places.

(b) If X = 2.536, find the absolute error and relative error when X is rounded-off to two decimal places.

(c) Using Newton-Raphson Method compute the smallest positive root of $x^3 - 5x + 3 = 0$.

(d) Using Secant method, find the smallest positive root of the equation $\cos x - xe^x = 0$ correct to three decimal digits.

3. (12)

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

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

$$2x + 3y + 2z = 14$$

$$x + 2y + 3z = 14.$$

(b) For the following system of equations

$$5x + y + 2z = 8$$

$$2x - 10y + 3z = -5$$

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

(i) Obtain the Jacobi iteration scheme.

(ii) Show that the Jacobi iteration scheme converges

(iii) Starting with $X^{(0)} = (0,0,0)$, iterate three times.

(c) Consider the system of equations

$$x + ay = b_1$$

$$2ax + y = b_2$$

where 'a' is a real constant. Find a necessary and sufficient condition on 'a' for the convergence of the Jacobi method.

(d) Determine the step size that can be used in the tabulation of $f(x) = \cos x$ in the interval $[0,\pi/2]$ at equally spaced nodal points so that the truncation error of the quadratic interpolation is less than 5×10^{-6}.

4. (12)

(a) Use Lagrange interpolation to estimate f(2.5) from the following table

x	1	1.5	2	3
$f(x)$	2.7183	4.4817	7.3891	20.0859

(b) Given the following data points, obtain the table of divided differences. Use the table to interpolate the value of f(1.5)

x	1	2	3	4	5
$f(x)$	0	7	26	63	124

(c) Estimate the value of sin θ at θ = 25° using Gregory-Newton forward difference interpolation with the help of the following table

θ	10°	20°	30°	40°	50°
$\sin\theta$	0.1736	0.3420	0.5000	0.6428	0.7660

(d) Evaluate the following :

(i) $\Delta^2 (2^x)$

(ii) $\left(\frac{\Delta^2}{E}\right) x^3$

5. (12)

(a) Use Lagrange interpolation polynomial to evaluate three point formula $f'(x_i)$ corresponding to data points $(x_i, f(x_i), i = 1,2, ..., n.$

(b) Use Simpson's $\frac{1}{3}$-rule to compute $I = \int_0^1 \frac{dx}{1+x}$ correct to three-decimal places with step-size, $h = 0.25$.

(c) Evaluate $I = \int_0^1 \sin \pi x \, dx$ using the trapezoidal rule with step-size $h = 0.25$. Calculate the percentage relative error.

(d) The population of a certain town is given below:

Year	1931	1941	1951	1961	1971
Populations (in thousands)	40.62	60.80	71.95	103.56	132.68

Estimate the population in the years 1976 and 2003. Also find the rate of growth of population in 1991.

6. (15)

(a) Apply mid-point method to solve the initial value problem $\frac{dy}{dx} = yx^3 - 1.5y$ from x = 0 to 2 where y(0) = 1 by using the step size, h = 1.

(b) Use the central difference formula to compute $y'(1)$, $y''(1)$, $y'''(1)$ for the data points

x	−1	1	2	3
f(x)	0.5	2	4	4

(c) Solve the initial value problem $u' = -2tu^2$, $u(0) = 1$ using the mid-point method with step-size, $h = 0.5$ over the interval $[0,1]$. Determine the percentage of relative error at $t = 1$.

(d) Use Euler's method to solve numerically the initial value problem $u' = -2tu^2$, $u(0) = 1$ with $h = 0.25$ on the interval and calculate the approximate value of $u(1)$.

10/6/24

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3538 II

Unique Paper Code : 42227637

Name of the Paper : Solid State physics

Name of the Course : **B.Sc. Prog.-DSE**

Semester : VI

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. **All** questions carry equal marks.
3. Attempt **any Five** questions in total.
4. **Question No. 1** is compulsory.

1. Attempt **any five** of the following:- (3x5=15)

   (a) Show that the reciprocal lattice vector $\vec{G}_{hkl}$ is perpendicular to the plane (hkl).

P.T.O.

(b) What are phonons? Mention any one experimental fact which indicates the existence of phonons in solids.

(c) At optical frequencies how does the dielectric constant of a polar dielectric depend on the index of refraction? Explain which polarizibility component contributes to the dielectric constant at optical frequencies.

(d) Distinguish between dia-, para-, ferro- magnetic materials

(e) The critical field and critical temperature of lead (Pb) are $6.5\times10^4\ A/m$ and 7.18 K, respectively. To what temperature it must be cooled to become a superconductor in a magnetic field of $2\times10^4 A/m$.

(f) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.

(g) How does a superconductor differ from a perfect conductor?

2. (a) Show that the reciprocal lattice of a face centered cubic lattice is a body centered cubic lattice

(6)

(b) X-ray of wavelength 1.54 Å are used to calculate the spacing between (200) planes in aluminium. The first order Bragg's angle corresponding to this reflection is 22.4°. Determine the value of lattice parameter of the aluminium crystal. (4)

(c) Construct first, second and third Brillouin Zones for a 2D square lattice. (5)

3. (a) Draw and discuss the dispersion relation for a linear chain of diatomic crystal. How it is different than the linear chain of monoatomic crystal. Discuss the characteristics of the various branches and why they are names acoustic and optical ones. (7)

(b) What is Dulong-Petit's law for heat capacity of solids? How it is different than the observed heat capacity of solids. Draw the necessary plots to explain the difference. Explain what is wrong in the classical theory of crystal heat capacity that it fails miserably at low temperatures. What modifications are required in the model to explain the experimentally observed behavior? (8)

4. (a) What are the main assumptions of the Debye's theory of specific heat of solid? Obtain its high and low temperature limits of the specific heat and show how far it agrees with the experimental results. (12)

(b) Calculate the Debye specific heat of copper at 10 K, given that the Debye characteristic frequency is 6.55×10^{12} *Hz*. (3)

5. (a) What is meant by local field in a dielectric? Obtain an expression for the local field for an atom in a dielectric medium. (8)

(b) Explain Meissner Effect in superconductors with suitable diagram. (7)

6. (a) Obtain an expression for paramagnetic susceptibility on the basis of Classical Langevin's theory. (10)

(b) Discuss difference between Type-I and Type-II superconductors (5)

7. (a) State all the assumptions of the Kronig-Penney model for an electron in a crystal. Draw the E-K relation of an electron for this model and explain the origin of the observation of forbidden gap in solids. (9)

(b) What is Hall Effect? Explain with the help of a suitable diagram the generation of hall voltage in n-type semiconductor. Mention two uses of Hall Effect. (6)