

[This question paper contains 8 printed pages.]

(12)

Your Roll No. 2022

Sr. No. of Question Paper : 1509

A

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'. Parts of a question must be answered together.

SECTION A

1. (a) Explain MAN in computer network with example.
(2)
(b) Name the layer of the OSI model responsible for the following :

- (i) Providing interface to transmission media.
 - (ii) Providing interfaces for the end user. (2)
- (c) Define a hyperlink. How can you create a hyperlink in a web page? (2)
- (d) List any two problems with the TCP/IP reference model. (2)
- (e) In which layer/s of the network reference model does the router operate? What is the main function of that layer/s? (2)
- (f) How does the networking metrics **throughput** and **delay** help in calculating the performance? (3)
- (g) List an advantage and disadvantage of star topology. How many links are required to connect k computers in a star topology? (3)
- (h) To provide more reliability than a single parity bit can give, an error-detecting coding scheme uses one parity bit for checking all the odd-numbered bits and a second parity bit for all the even-numbered bits. What is the Hamming distance of this code? Explain your answer. (3)

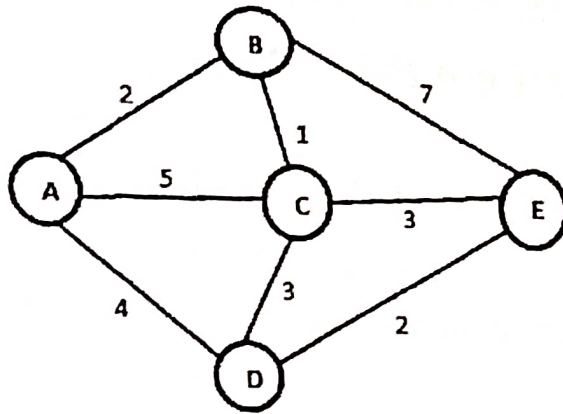
- (i) What is the purpose of cladding in an Optical fiber? How does a Single mode fiber differ from a Multi mode fiber? (3)
- (j) A network has the IPv4 address 134.40.0.0. What class does this IP address belong to? Identify its subnet mask. How many hosts can this network support before subnetting. (3)

SECTION B

(Attempt any five)

2. (a) What do you understand about service primitives? How can these four primitives can be used in a client-server environment for a request-reply Interaction? Explain. (6)
- (b) What is the main difference between TCP and UDP? (4)
3. (a) What is the difference between half-duplex and full duplex transmission modes? Explain using diagrams and give examples of each. (6)

- (b) What do you understand about Point-to-point connection and Multipoint connection? Give an example of each. Which one is better and why? (4)
4. (a) Compare Satellites with optical fibre as the communication medium. (6)
- (b) Explain working of Low Earth Orbit (LEO) satellites in communication. (4)
5. (a) A bit stream 10011101 is to be transmitted using the standard CRC method. The generator polynomial is x^3+1 . What is the actual bit string transmitted? Suppose the third bit from the left is inverted during transmission. How will the receiver detect this error? (6)
- (b) Using Dijkstra's shortest path algorithm, find the route from Router A to Router E given the following configuration. Show the working steps.



(4)

6. (a) A learning bridge connects a LAN segment with computers A, B and C to another LAN segment with computers P, Q and R. Show how the bridge learns the segment to which each computer is connected if the following sequence of frames are transmitted over the network.

- A sends to B
- B sends to A
- P broadcasts
- Q sends to A
- Q sends to P
- C sends to R
- R sends to P

(6)

(b) Four 1 kbps connections are multiplexed together. A unit is 1 bit. Find the following :

- (i) The duration of 1 bit before multiplexing
 - (ii) The transmission rate of the link
 - (iii) The duration of a time slot
 - (iv) The duration of a frame
- (4)

7. (a) What are the four HTTP request types, and what does the server respond with when it receives the specific request type? When does a HTTP server return the status code 404? When does it return status code 400?

(6)

(b) A router has the following (CIDR) entries in its routing table :

Address/mask	Next Hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.0/23	Router 1
default	Router 2

For each of the following IP addresses, what does the router do if a packet with that address arrives?

(i) 135.46.63.10

(ii) 135.46.57.14

(iii) 192.53.40.7

(iv) 192.53.56.7

(4)

8. (a) Define a noiseless channel and noisy channel used for network communication. List two protocols of each type and explain any one of them. (6)

(b) Define framing and the reason for its need. Explain one framing method with the help of an example. (4)

9. (a) Differentiate the following :

(i) Bus topology and Ring topology

(ii) Flow control and Error control

(6)

(b) Specify the characteristics of the SMTP.

(4)

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Your Roll No. 20022

Sr. No. of Question Paper : 1532 A
Unique Paper Code : 42357633
Name of the Paper : DSE - Mathematics - I
(Differential Equations)
Name of the Course : Analytical Chemistry /
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 any two parts from each question.

1. (a) Solve the differential equation

$$(\sqrt{x+y} + \sqrt{x-y})dx + (\sqrt{x-y} - \sqrt{x+y})dy = 0$$

- (b) Solve

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

(c) Solve the differential equation.

$$x \frac{dy}{dx} + y = (xy)^{3/2}, y(1) = 4.$$

(d) Solve the differential equation

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

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

$$y = c_1 x^2 + K$$

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

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

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

Find the solution of this differential equation which satisfies the conditions $y(0) = 1$, $y'(0) = 4$.

(c) Prove that if u is a solutions of

$$a_0(x) \frac{d^2 y}{dx^2} + a_1(x) \frac{dy}{dx} + a_2(x) y = 0$$

and v is a solutions of

$$a_0(x) \frac{d^2y}{dx^2} + a_1(x) \frac{dy}{dx} + a_2(x)y = F(x).$$

then $u + v$ is also a solution of this latter non-homogeneous equation.

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

$$(2x + 1)y'' - 4(x+1)y' + 4y = 0,$$

find a linearly independent solution by reducing the order. Also write the general solution.

(6+6)

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

$$\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + 5y = 6\sin(2x) + 7\cos(2x).$$

(b) Solve the initial value problem

$$\frac{d^2y}{dx^2} - y = 3x^2e^x, \quad y(0) = 1, \quad y'(0) = 2.$$

(c) Use the method of variation of parameters to solve the equation

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

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(d) Find the general solution of

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

given that $y = (x+1)$ and $y = (x+1)^2$ are linearly independent solutions of the corresponding homogeneous equation.

(6+6)

4. (a) Find the general solution of the equation

$$x^2 \frac{d^2 y}{dx^2} + 4x \frac{dy}{dx} + 2y = 4 \ln(x), \quad x > 0.$$

(b) Find the general solution of the equation

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

(c) Find the general solution of the linear system

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

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

(d) Find the general solution of the linear system

$$\frac{d^2x}{dt^2} - \frac{dy}{dt} = e^t,$$

$$\frac{dx}{dt} + \frac{dy}{dt} - 4x - y = 2e^t. \quad (6.5+6.5)$$

5. (a) Find the partial differential equation satisfied by the family of the spheres having the center in xy plane and radius 2

$$(x - a)^2 + (y - b)^2 + z^2 = 4.$$

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

$$(y - xu)p + (x + yu)q = x^2 + y^2.$$

- (c) Find the general solution of the partial differential equation

$$x(y^2 - z^2)u_x + y(z^2 - x^2)u_y + z(x^2 - y^2)u_z = 0.$$

- (d) Solve the following Cauchy problem

$$xu_x + yu_y = 2xy, \quad u(x,y) = 2 \text{ on } y = x^2. \quad (6+6)$$

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

$$y^2 u_x^2 + x^2 u_y^2 = (xyu)^2.$$

- (b) Apply $v = \ln(u)$ and then $v(x,y) = f(x) + g(y)$ to solve the following equation

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

- (c) Solve the following initial-value system

$$u_t + uu_x = e^{-x}v, \quad v_t - av_x = 0 \quad \text{with } u(x,0) = x, \\ v(x,0) = e^x.$$

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

$$3u_{xx} + 4u_{xy} - (3/4)u_{yy} = 0. \quad (7+7)$$

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Your Roll No. 2022

Sr. No. of Question Paper : 1536 A

Unique Paper Code : 42167904

Name of the Paper : Analytical Techniques in
Plant Science

Name of the Course : B.Sc. Life Sciences

Semester : VI

Duration : 3 hours 30 minutes

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. Question no. 1 is compulsory.
4. Attempt **all** parts of the question together.

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

(i) Separation of molecule on the basis of difference in charge is called _____

(ii) _____ is a technique used for separation of lipids.

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- (iii) The two halves of a biological membrane are referred to as the _____ and E-Half.
- (iv) Mass spectrometer was invented by _____
- (v) Beer's law states that the intensity of light decreases with respect to _____
- (vi) The stationary phase in paper chromatography is _____
- (vii) A microscope has a 4X ocular lens and a 10X objective; the microscope's total magnification is _____ X. (5×1=5)

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

- (i) Svedberg unit
- (ii) Half life
- (iii) Stationary phase
- (iv) Cryofixation
- (v) Spectrophotometry
- (vi) Autoradiography

(c) Match the column (any five) : (5×1=5)

- | | |
|-----------------------------|--------------------------------|
| (i) Affinity chromatography | <i>Taq</i> polymerase |
| (ii) ELISA | rotor |
| (iii) PCR | nitrocellulose membrane |
| (iv) Centrifuge | antigen-antibodies interaction |
| (v) Confocal microscope | biomolecular interaction |
| (vi) Blotting techniques | pin hole aperture |

2. Differentiate between (any five) : (5×1=5)

- (i) Positive and Negative Staining
- (ii) Differential and density gradient centrifugation
- (iii) Northern and Southern Blotting
- (iv) G Banding and Q Banding
- (v) GC and HPLC
- (vi) Mass spectrometry and X-ray crystallography

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3. Write short notes on the following (any three):
(3×5=15)
- (i) DNA Sequencing
 - (ii) Marker enzymes
 - (iii) Ultracentrifugation
 - (iv) Shadow casting
4. (a) Define FISH. Give an account of the technique and its application. (7)
- (b) What is autoradiography? How is it helpful in determining the site of protein synthesis and the subsequent transport of secretory proteins? Explain. (8)
5. (a) What is molecular sieve chromatography? Discuss its principle and applications. (7)
- (b) What is the difference between freeze fracture and freeze etching techniques? How are they useful in understanding membrane structure? (5)
- (c) Give a brief account of the phase contrast microscopy. (3)

6. (a) Explain the principle and working of UV-Visible Spectrophotometry with the help of well labelled diagram. (7)
- (b) Differentiate between scanning electron microscopy and transmission electron microscopy. (8)
7. (a) Justify the following statements (Any five) : (5×2=10)
- (i) Paraffin wax is not used as an embedding material in transmission electron microscopy.
 - (ii) TLC has an advantage over paper chromatography.
 - (iii) All the ultracentrifuges are refrigerated.
 - (iv) Biological materials are coated with heavy metals in scanning electron microscopy.
 - (v) Proteins are separated on the basis of their length of amino acid chain in SDS-PAGE.
 - (vi) Resolving power of a microscope is inversely proportional to the limit of resolution

(vii) Carbohydrates and lipids cannot be separated by electrophoresis.

(b) Explain the use of radioisotopes in biological research. (5)

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(15)

Your Roll No. 2022

A

Sr. No. of Question Paper : 1547

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. Attempt any two parts of each question.
3. All questions carry equal marks.

1. (a) Round-off the number 53.86735 correct to four significant digits and then calculate the absolute, relative and percentage errors. (6.25)

(b) Find the relative error of the number 5.6, if both of its digits are correct. (6.25)

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(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. (6.25)

(d) Determine the number of significant digits in the following numbers. (6.25)

(i) 348500,

(ii) 0.0032,

(iii) 5.67800,

(iv) 6.5×10^8 .

2. (a) Perform five iterations of the bisection method to obtain the smallest positive root of the equation $f(x) = x^3 - 5x + 1 = 0$. (6.25)

(b) Using Regula-Falsi method compute the real root of the equation $x^2 = 6$. Correct to four decimal places. (6.25)

(c) Using Newton-Raphson Method compute $\sqrt{2}$ correct to four decimal places. (6.25)

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

3. (a) Approximate the solution of $AX = b$ where

$$A = \begin{bmatrix} 4 & 1 & 0 \\ 1 & 3 & -1 \\ 1 & 0 & 2 \end{bmatrix}, \quad b = \begin{bmatrix} 3 \\ -4 \\ 5 \end{bmatrix},$$

with $x^{(0)} = [0,0,0]^{(t)}$ using Gauss-Seidel iteration method by performing three iterations. (6.25)

- (b) Solve the following system of equations (6.25)

$$3x - y + 2z = 8,$$

$$x + y + 2z = 4,$$

$$2x - 2y - z = 12,$$

using Gauss Jordan Method.

- (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 (0.25). (6.25)

- (d) Find the unique polynomial $P(x)$ of degree 2 or less such that $P(1) = 1$, $P(3) = 27$, $P(4) = 64$, using Langrange interpolating formula. Estimate $P(1.5)$. (6.25)

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4. (a) Perform three iterations to solve the linear system

$$4x + y + 2z = 4,$$

$$3x + 5y + z = 7,$$

$$x + y + 3z = 3,$$

using Gauss-Jacobi iteration method by taking the initial approximation as $(x, y, z) = (0, 0, 0)$. (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) Show that

$$(i) \mu = \left[1 + \frac{\delta^2}{4} \right]^{1/2},$$

$$(ii) \delta = E^{1/2} - E^{-1/2}.$$

Also, if $f(x) = \frac{1}{x^2}$, find the divided difference $f[x_1, x_2, x_3, x_4]$. (6.25)

(d) Find the interpolating polynomial for

x	0	0.5	1	3.5
y	1	2	1	0

in piecewise linear form.

(6.25)

5. (a) Compute the value of $\int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule with $h=0.25$.

(6.25)

(b) Evaluate $\int_1^2 \frac{dx}{x}$ by Richardson's extrapolation method using central divided difference formula

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

(6.25)

(c) Dividing the range into 10 equal parts, apply Simpson's one third rule to evaluate the integral

$$\int_0^5 \frac{dx}{4x+5}$$

correct to four decimal places.

(6.25)

(d) Find Richardson extrapolation of $f(x) = e^x - \sin x$ when $x = 1$, $h = 0.5$, $h = 0.25$ using central divided

$$\text{difference formula } f'(x) = \frac{f(x+h) - f(x-h)}{2h}.$$

(6.25)

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6. (a) Use Heun's method to solve the initial value problem

$$\frac{dy}{dx} = \frac{x-y}{2}, y(0) = 1 \text{ over } [0, 2], \text{ using step size } 0.5. \quad (6.25)$$

- (b) Compute $\int_{-3}^3 x^4 dx$ by trapezoidal rule with $h=1$. (6.25)

- (c) Compute the value of $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's three eight rule. (6.25)

- (d) Use Euler's method and its modified form to obtain $y(0.2)$, $y(0.4)$ and $y(0.6)$ correct to three decimal places, given that $y' = y - x^2$ with initial condition $y(0) = 1$. (6.25)

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(16)

Your Roll No. 2022

Sr. No. of Question Paper : 1590 A

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. (Prog.)

Semester : VI

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt three questions from Section A and three from Section B.

SECTION A

(Attempt any three questions)

1. (a) Compound A when heated with a soluble chloride and concentrated H_2SO_4 gives orange red vapours of compound B. When an alkali is added to A it gives yellow coloured compound C which on

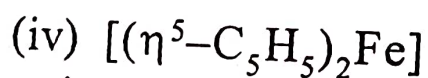
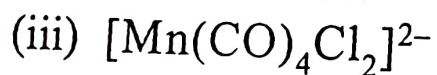
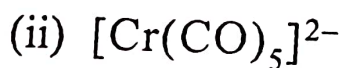
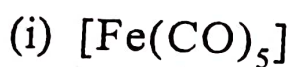
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acidifying converts back to A. Identify compounds A, B and C and write the chemical reactions involved.

(b) Draw and explain the structure of Ferrocene.

(c) What do you mean by cooperativity in haemoglobin? Discuss the role of haemoglobin and myoglobin in biological system. (4,4,4.5)

2. (a) Discuss 18-electron rule for metal carbonyls. Predict which of the following molecule does not obey 18-electron rule



(b) With reference to molecular orbital diagram explain that CO acts as both Lewis acid and Lewis base.

(c) With the help of diagram explain the mechanism of sodium-potassium pump. Why it is considered as an active transport. What is the source of energy for its functioning? (4,4,4.5)

3. (a) Give Reasons for the followings :

(i) Nickel tetracarbonyl is a stable carbonyl but Manganese does not form stable mononuclear carbonyl.

(ii) IR stretching frequency of CO bond is different in terminal and bridging carbonyls.

(b) Discuss the role of Na^+ and Mg^{+2} ions in biological system.

(c) Give method of preparation of potassium ferrocyanide. What is the oxidation state of iron in it? How is it used for the identification of Zn^{+2} ions present in an organic salt? Give chemical reactions. (4,4,4.5)

4. (a) What happens when (give balanced chemical equations)

(i) KMnO_4 reacts with a ferrous salt in acidic medium.

(ii) A solution of potassium dichromate containing dilute H_2SO_4 and ether is treated with H_2O_2 .

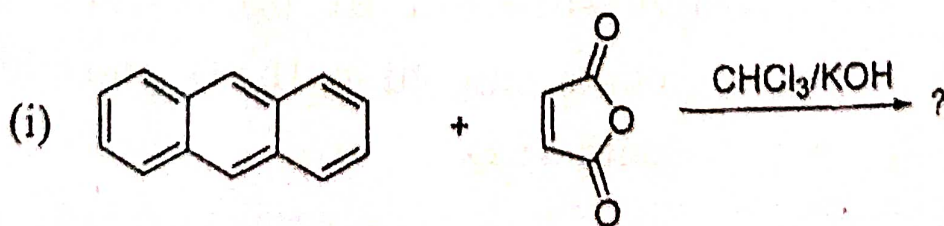
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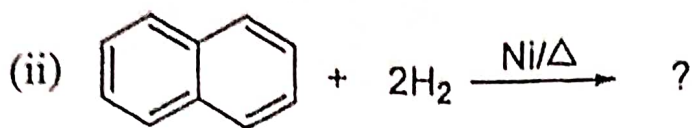
- (iii) Sulphuric acid is added to a saturated solution of K_2CrO_4 .
- (iv) $K_4[Fe(CN)_6]$ is treated with copper sulphate.
- (b) Discuss lead-poisoning and mercury-poisoning in brief.
- (c) What are organometallic compounds? Which of the followings are not organometallic compounds?
- (i) Zeise's Salt
 - (ii) Cisplatin
 - (iii) Ferrocene
 - (iv) Sodium ethoxide
 - (v) Grignard Reagent
- (4,4,4.5)

SECTION B

(Attempt any three questions)

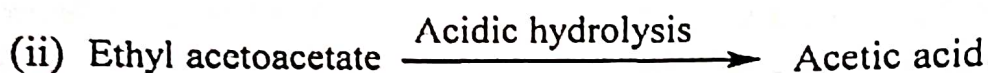
5. (a) What happens when :





(b) Pyridine primarily undergoes nucleophilic substitution at 2- or 6- position. Explain

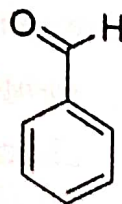
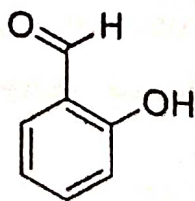
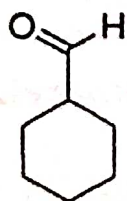
(c) How will you convert :



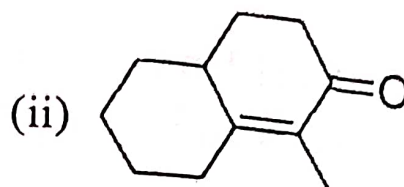
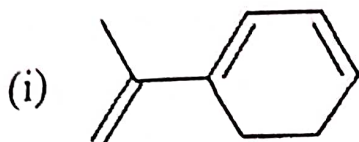
(d) Discuss the theory of electronic spectroscopy with a neat diagram showing electronic transitions in 1,3-butadiene.

(e) Explain: chromophores. (2,2,4,2.5,2)

6. (a) Giving reasons, predict the C=O frequency shift in the given aldehydes, C=O stretching frequencies are 1665 cm^{-1} , 1700 cm^{-1} and 1730 cm^{-1} .



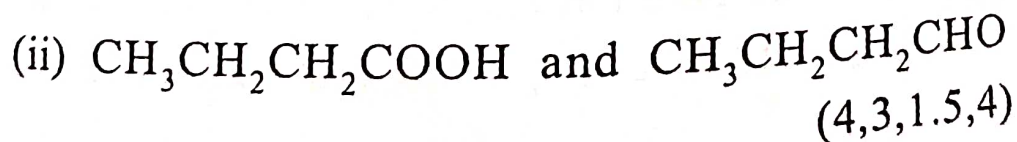
(b) Calculate the absorption maximum (λ_{\max}) for $\pi \rightarrow \pi^*$ transition in the following compounds using Woodward-fieser rules.



Parental/Base values	λ_{\max} (nm)	Increments	(nm)
Acyclic/ Heteroannular dienes	214	Alkyl substitution/ Ring residue	+5
Homoannular dienes	253	Additional conjugation	+30
α, β unsaturated Acyclic ketones	215	Exocyclic double bond	+5
α, β unsaturated Aldehydes	210	α -alkyl substituent	+10
		β -alkyl substituent	+12

(c) Write notes on: Bathochromic shift

(d) How will you distinguish the following pair of compounds using IR spectra?



7. (a) Write the name reaction Claisen ester condensation for the synthesis of ethyl acetoacetate. Explain with mechanism.

- (b) Explain the Keto-enol tautomerism by taking active methylene compound as an example.
- (c) How will you prepare the following from ethyl acetoacetate : (Attempt any six)
- (i) Gluteric acid
 - (ii) Crotonic acid
 - (iii) Cinnamic acid
 - (iv) 4-methyluracil
 - (v) Pentane 2,4-dione
 - (vi) Methylisoxazolone
 - (vii) Cyclohexyl methyl ketone
 - (viii) Ethyl methyl ketone (4,2.5,6)

8. (a) How will you carry out the following conversions?

- (i) Anthracene to 9-bromoanthracene
- (ii) Naphthalene to Decalin
- (iii) Furan to 2-nitrofurane
- (iv) Pyridine to 3-pyridinesulphonic acid
- (v) Pyrrole to 2-formylpyrrole

P.T.O.

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- (b) How do you synthesize anthracene using Haworth synthesis?
- (c) Pyridine is more basic than pyrrole. Explain
- (d) Draw the resonating structure of naphthalene.
(5,3,3,1.5)

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This question paper contains 4 printed pages.]

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Your Roll No. 2022

Sr. No. of Question Paper : 1603

A

Unique Paper Code : 42237904

Name of the Paper : Immunology - (DSE 4)

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.
3. Question No. 1 is compulsory.
 1. (a) Define the following : (5)
 - (i) Hapten
 - (ii) Extravasation
 - (iii) Affinity
 - (iv) Epitope
 - (v) Autoantigen

1603

(b) Expand the following :

- (i) MAC (3)
- (ii) CTL
- (iii) HLA
- (iv) CDR
- (v) CLIP
- (vi) HGPRT

(c) Differentiate between the following : (10)

- (i) Humoral immunity and Cell mediated immunity
- (ii) Memory cells and plasma cells
- (iii) Allotypic variation and Idiotypic variation
- (iv) Opsonization and ADCC
- (v) T_H and T_C cells

(d) Fill in the blank : (3)

(i) Macrophages like cells in Liver are called _____ cells.

(ii) The first evidence of antibody as a serum protein was described by _____.

(iii) _____ class of antibody has a role in Type I Hypersensitivity.

(e) Write contribution of the following scientist : (2)

(i) Louis Pasteur

(ii) K. Prausnitz and H. Kustner

(iii) Kohler and Milstein

(iv) Karl Landsteiner

(f) Explain why : (4)

(i) Serum IgM cannot activate complement by itself.

(ii) T_C cells are said to be MHC class I restricted.

2. (a) Describe the role of various barriers of innate immunity in humans.

(b) What are primary lymphoid organs? Discuss their structure and functions. (6,6)

3. (a) Discuss various cardinal signs of inflammatory response.

- (b) What is Hypersensitivity? Discuss its various types. (4,8)
4. (a) How endogenous antigens are processed and presented. Explain with the help of appropriate diagram(s).
- (b) What are monoclonal antibodies. Write a note on their production by hybridoma technology. (6,6)
5. (a) Give a detailed account of the classical pathway of complement activation.
- (b) Define MHC. Compare the structure of MHC I and MHC II. (6,6)
6. (a) Give a brief account of different types of vaccine.
- (b) Write properties and function of cytokines. (8,4)
7. Write short notes (any three) :
- (i) Antigen presenting cells
- (ii) Autoimmunity
- (iii) Clonal Selection theory
- (iv) AIDS (4,4,4)

[This question paper contains 4 printed pages.]

(18)

Your Roll No. 2022

Sr. No. of Question Paper : 1607

A

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. Attempt any two parts of each question.
3. All questions carry equal marks.

Q 1(a) If $X = 2.536$, find the absolute error and relative error when, X is truncated to two decimal digits. (6.25)

(b) Find the relative error of the number 6.4, if both of its digits are correct. (6.25)

(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. (6.25)

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

(I) 0.6500025, (II) 0.000232317, (III) 50.00045, (IV) 8×10^{-9} .

(6.25)

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

(6.25)

(b) Using Regula-Falsi method compute the real root of the equation $x^2 = 7$. Correct to four decimal places.

(6.25)

(c) Using Newton-Raphson Method compute $\sqrt{17}$ correct to four decimal places.

(6.25)

(d) Using Secant method, find the smallest positive root of the equation $x^3 + 3x^2 = 1$ correct to three decimal digits.

(6.25)

Q. 3(a) Solve the following system of equations $AX = b$ where

(6.25)

$$A = \begin{bmatrix} 2 & 0 & -2 \\ 3 & -4 & -4 \\ -2 & 2 & -1 \end{bmatrix}, \quad b = \begin{bmatrix} -10 \\ -8 \\ 3 \end{bmatrix}$$

using Gauss elimination method by using partial pivoting.

(b) Find the interpolating formula for

(6.25)

x	0	1	2	3
y	1	2	4	8

in Newton form.

(c) Consider the following table:

(6.25)

x	-1	2	4	5
y	-5	13	255	625

Use Lagrange interpolation to estimate (0.25).

(d) Find a cubic polynomial which take the following values using Newton forward difference formula $y(1)=24$, $y(3)=120$, $y(5)=336$, $y(7)=720$. Also, find $y(8)$? (6.25)

Q. 4(a) Perform three iterations to solve the linear system (6.25)

$$\begin{aligned} 8x + y - z &= 8, \\ -x + 7y - 2z &= 4, \\ 2x + y + 9z &= 12, \end{aligned}$$

Using Gauss-Jacobi iteration method by taking the initial approximation as $(x, y, z) = (0, 0, 0)$.

(b) Find the unique polynomial $P(x)$ of degree 2 or less such that $P(1)=1$, $P(3)=27$, $P(4)=64$, using Newton divided difference formula. Estimate $P(1.5)$. (6.25)

(c) Solve the following system of equations (6.25)

$$\begin{aligned} 6x + 2y + 2z &= 8, \\ 6x + 2y + z &= 4, \\ x + 2y - z &= 12, \end{aligned}$$

using Gauss Jordan Method.

(d) Obtain the piecewise linear interpolating polynomial for (6.25)

x	0.5	1.5	2.5
$f(x)$	0.125	3.375	15.625

Interpolate at $x = 2.0$.

Q. 5(a) Apply Richardson extrapolation when $f(x) = e^{-x} + \sin x + x^3$, $x = 1.2$, $h = 0.4$ using central divided difference formula $f'(x) = \frac{f(x+h) - f(x-h)}{2h}$. (6.25)

(b) Compute $\int_1^6 x^3 dx$ by trapezoidal rule with $n = 4$. (6.25)

(c) Find Richardson extrapolation of $f(x) = e^x - \sin x$ when $x = 1$, $h = 0.5$, $h = 0.25$ using central divided difference formula $f'(x) = \frac{f(x+h) - f(x-h)}{2h}$. (6.25)

(d) Compute the value of $\int_1^2 \frac{dx}{x}$ with $h = 0.25$ using Simpson's rule. (6.25)

Q. 6(a) Using Euler modified method, obtain a solution of $\frac{dy}{dx} = x + |\sqrt{y}|$, $y(0) = 1$ for the range $[0, 0.6]$ in steps of 0.2. (6.25)

(b) Use Euler's method and its modified form to obtain $y(0.2)$, $y(0.4)$, and $y(0.6)$ correct to three decimal places, given that $y' = y - x^2$ with initial condition $y(0) = 1$. (6.25)

(c) Compute the value of $\int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule with $h = 0.25$. (6.25)

(d) Compute the value of $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's three eight rule. (6.25)

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(19)

Your Roll No. 2022

Sr. No. of Question Paper : 1622 A
Unique Paper Code : 42224412
Name of the Paper : Waves and Optics
Name of the Course : B.Sc. Prog. – CBCS–Core
Semester : VI
Duration : 3.5 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 parts from the following :

(a) The time period of tuning fork is $\frac{1}{256}$ and it produces 4 beats/second, when sounded with another fork. Calculate the frequency of the second fork.

P.T.O.

(b) If the phase velocity is given by, $v_p = \left(\frac{2\pi S}{\rho\lambda}\right)^{1/2}$

(Here, S and ρ are constant), then derive the relation between group velocity and phase velocity.

(c) Give three differences between travelling waves and stationary waves.

(d) Explain why the reverberation time is larger for an empty hall than for a crowded hall.

(e) What do you understand by wave front? Name one experiment each, which is based on division of wave front.

(f) Why do thin films appear colored in white light?

(g) How many orders will be visible if the wavelength of incident radiation is 4800 \AA and the number of lines on a diffraction grating is 2500 per inch.

(5×3=15)

2. (a) What are Lissajous Figures? For the cases mentioned below, give the graphical as well as analytical representation of the Lissajous Figures

(with direction) for the motion of a particle which is subjected to two perpendicular simple harmonic motions given by,

$$x = 3 \cos (\omega t)$$

$$y = 2 \cos (2\omega t + \alpha), \text{ where } \alpha = 0$$

- (b) Prove that the principle of superposition holds only for linear homogenous differential equation.

(10+5=15)

3. (a) Explain the formation of standing waves on a stretched string.

- (b) For a stationary wave, the displacement (in cm) is given by,

$$y = 4 \sin \left(\frac{\pi x}{15} \right) \cos (96\pi t)$$

What is the distance between a node and the next anti-node?

(10+5=15)

4. (a) What do you mean by Fresnel's half period zones? What are the radii of zones of a zone plate?

- (b) Explain with the help of a diagram, the intensity distribution due to diffraction at a straight edge.

(7+8=15)

P.T.O.

5. (a) State the principle of reversibility of light. Determine the Stokes' relation for reflection of light from an optically denser medium.

(b) Discuss the theory of interference due to two slits and find the expression for fringe width.

(5+10=15)

6. (a) Derive the expression for intensity distribution in case of Fraunhofer diffraction due to single slit.

(b) Show that the relative intensities of the successive maxima are in the ratio of,

$$1 : \left(\frac{2}{3\pi}\right)^2 : \left(\frac{2}{5\pi}\right)^2 \dots \quad (10+5=15)$$

7. (a) Show that electromagnetic waves are transverse in nature.

(b) Explain any two methods of polarizing an unpolarized beam of light. (9+6=15)

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(20)

Your Roll No. 2022

Sr. No. of Question Paper : 1649

A

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. (Prog.)

Semester : VI

Duration : 3.5 Hours

Maximum Marks : 75

Instructions for Candidates

- Write your Roll No. on the top immediately on receipt of this question paper.
- Attempt **three** questions from **Section A** and **three** from **Section B**.

SECTION A

(Attempt any three questions)

- (a) A dark purple coloured compound A is used as a disinfectant. The compound A when warmed with H_2SO_4 oxygen gas is evolved. In alkaline solution,

A is first reduced to a green coloured compound B and finally to colourless compound C. Identify A, B and C and write the chemical reactions involved.

(b) Draw and explain the structure of Methyl Lithium and Zeise salt.

(c) Name the process used to maintain the concentration of sodium ions and potassium ions in extracellular and intracellular fluid. Explain the mechanism of the process with the help of a diagram. What is the source of energy for the functioning of the process? (4,4,4.5)

2. (a) Give any one method of preparation of $\text{Ni}(\text{CO})_4$. With reason arrange the metal carbonyls $[\text{Ni}(\text{CO})_4]$, $[\text{Co}(\text{CO})_4]^{1-}$, $[\text{Fe}(\text{CO})_4]^{2-}$ in increasing order of

(i) M-C bond order.

(ii) C-O bond order

(iii) IR stretching frequency of CO

(b) What are metallo-porphyrin? Draw and discuss the structure and any one function of heme and chlorophyll.

(c) What is the oxidation state of chromium in $K_2Cr_2O_7$? Discuss the oxidising properties of $K_2Cr_2O_7$ in acidic medium. What happens when acidified $K_2Cr_2O_7$ reacts with :

(i) Ferrous sulphate

(ii) Sodium sulphite

(4,4,4.5)

3. (a) Metal carbonyl $Mn(CO)_5$ dimerize to give stable carbonyl $Mn_2(CO)_{10}$ but $V(CO)_6$ does not, although both $Mn(CO)_5$ and $V(CO)_6$ do not follow 18-electron rule. Explain.

(b) What are bulk and trace elements in biological system? Give Examples. Discuss the toxicity of Hg^{+2} ions.

(c) Give laboratory preparation of $K_4[Fe(CN)_6]$. Write the chemical reactions when $K_4[Fe(CN)_6]$ is treated with

(i) Conc. H_2SO_4

(ii) $KMnO_4$ in acidic medium

(iii) Silver nitrate

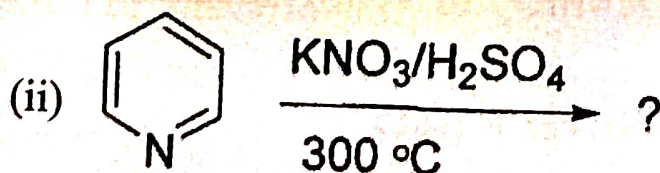
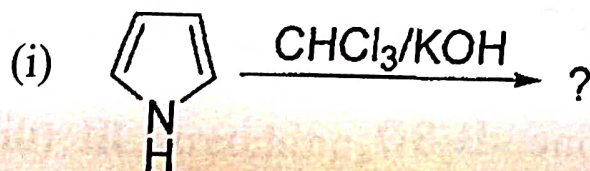
(4,4,4.5)

4. (a) What are the functions of myoglobin? Discuss the changes that occurs in the heme group of myoglobin on going from deoxy to oxy form.
- (b) Discuss with examples the various oxidation states displayed by Cr and Fe.
- (c) Using Molecular orbital diagram of CO explain the bonding in metal carbonyls and give reasons
- (i) CO molecule acts as electron pair donor through C atom and not through oxygen atom
- (ii) CO is a π -acceptor ligand (4,4,4.5)

SECTION B

(Attempt any three questions)

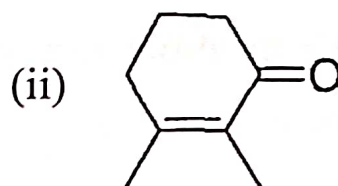
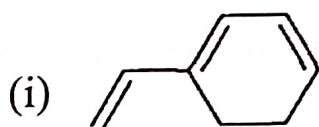
5. (a) What happens when :



- (b) The C_1-C_2 bond length in naphthalene is shorter than C_2-C_3 bond length. Why?
- (c) Explain :
- (i) Ketonic hydrolysis of ethyl acetoacetate.
 - (ii) Acidic hydrolysis of ethyl acetoacetate.
- (d) Write short notes on: Various types of electronic transitions of UV spectroscopy.
- (e) $C=O$ stretching frequency is higher in acids than the corresponding amides. Explain.
- (2,2,4,2.5,2)
6. (a) Give the approximate IR bands for the following characteristic absorptions: (Attempt any **four**)
- (i) $C=O$ stretching in CH_3CHO and CH_3COCH_3 .
 - (ii) $C-H$ stretching in alkanes and alkynes.
 - (iii) $C=C$ stretching in aliphatic compounds and aromatic compounds.
 - (iv) $O-H$ stretching in intramolecular and intermolecular hydrogen bonded $O-H$.

(v) C=O stretching in dimeric and monomeric forms of carboxylic acids.

(b) Calculate the absorption maximum (λ_{\max}) for $\pi \rightarrow \pi^*$ transition in the following compounds using Woodward-fieser rules.



Parental/Base values	λ_{\max} (nm)	Increments	(nm)
Acyclic/ Heteroannular dienes	214	Alkyl substitution/ Ring residue	+5
Homoannular dienes	253	Additional conjugation	+30
α, β unsaturated Acyclic ketones	215	Exocyclic double bond	+5
α, β unsaturated Aldehydes	210	α -alkyl substituent	+10
		β -alkyl substituent	+12

(c) Write notes on: Finger print region

(d) Assign the fundamental vibrational modes of the following molecules: H_2O and CO_2

(4,3,2.5,3)

7. (a) Write reaction and reaction mechanism for the synthesis of ethyl acetoacetate using Claisen condensation.

- (b) Explain: Why the order of the percentage of enol form in following active methylene compounds are found as:

Acetyl acetone > Ethyl acetoacetate > Diethyl malonate

- (c) How will you prepare the following from ethyl acetoacetate: (Attempt any four)

(i) Adipic acid

(ii) 4-oxopentanoic acid

(iii) Hexane 2,5-dione

(iv) 4-methyluracil

(v) Pentane 2,4-dione (4,4.5,4)

8. (a) How will you carry out the following conversions?

(i) Naphthalene to 1-chloronaphthalene

(ii) Anthracene to 9,10-Dihydroanthracene

(iii) Furan to Tetrahydrofuran

(iv) Thiophene to 2-acylthiophene

(v) Pyrrole to 2-Phenylazopyrrol

(b) How do you synthesize naphthalene using Haworth synthesis?

(c) Arrange the followings in decreasing order of basicity. Give suitable explanation.

Pyridine, Pyrrole, aliphatic amine

(d) Draw the resonating structure of furan.

(5,3,3,1.5)

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[This question paper contains 6 printed pages.]

(21)

Your Roll No. 2022

Sr. No. of Question Paper : 1670

A

Unique Paper Code : 42227637

Name of the Paper : DSE: Solid State Physics

Name of the Course : CBCS: 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. Answer five questions in all.
3. Question No. 1 is compulsory.
4. All questions carry equal marks.
5. Non-programmable scientific calculator is allowed.

1. Attempt any five : (3×5)

(a) Mention the lattice type and bases in CsCl structure with diagram.

- (b) Obtain the Miller indices of a plane which makes an intercepts at $a/2$, $b/2$ and $3c$ along the primitive axes of the simple cubic unit cell. Draw a neat diagram of the plane.
- (c) Determine the number of normal modes of vibration in a linear mono-atomic lattice of finite length in first Brillouin zone.
- (d) Describe low temperature behavior of Einstein's theory of specific heat of solids.
- (e) Calculate the Hall Coefficient when number of holes in a semiconductor is 10^{20} m^{-3} . Given that $e = 1.6 \times 10^{-19} \text{ coulomb}$.
- (f) Distinguish between dia, para and ferro-magnetic materials on the basis of magnetic susceptibility.
- (g) Discuss the variation of polarizability with frequency.
- (h) Differentiate a superconductor with a perfect conductor.
2. (a) Mention the names of seven crystal systems in three dimensions with fourteen Bravais lattices included in them. Mention the unit cell characteristics of each system. (10)

(b) For a bcc lattice, determine the diffraction angle for 1st order diffraction maximum from the (220) set of planes with interplanar spacing 1.013 Å with monochromatic X-rays of wavelength 1.790 Å. (5)

3. (a) Discuss the importance of reciprocal lattice space in understanding the structure of a crystal. (5)

(b) Prove that the reciprocal lattice vector \vec{G}_{hkl} is perpendicular to the crystal plane (hkl) of a cubic crystal and that the interplanar spacing d_{hkl} is given as

$$d_{hkl} = \frac{2\pi}{|\vec{G}_{hkl}|} \quad (5)$$

(c) A direct lattice has the following primitive

translation vectors: $\vec{a} = 2(i + j)$, $\vec{b} = 2(j + k)$,

$\vec{c} = 2(k + i)$. Find out the reciprocal lattice vectors and type of lattice. (5)

4. The dispersion relation for the vibrational modes of diatomic linear lattice having masses m and M ($m < M$) is

$$\omega^4 - 2\alpha \left(\frac{1}{M} + \frac{1}{m} \right) \omega^2 + \frac{4\alpha^2}{mM} \sin^2 Ka = 0$$

where the symbols have their usual meanings.

(a) Obtain expressions for acoustical and optical curves. Draw the dispersion curves. (4,2)

(b) Explain its behaviors observed in acoustical and optical branches when

(i) m becomes equal to M .

(ii) m reduces to zero.

(iii) M increases to infinity. (2,2,2)

(c) Determine the smallest possible wavelength allowed by this diatomic lattice in the first Brillouin zone. (3)

5. (a) Describe qualitatively the Einstein's theory of specific heat of solids. Describe its shortcomings. (5,2)

(b) Describe how Debye improved the Einstein's theory? Discuss qualitatively Debye's theory of specific heat. (6)

- (c) The Debye temperature for Aluminum is 418 K. Calculate the frequency of the highest possible lattice vibration in Aluminum. (2)
6. (a) Describe in detail n- type and p- type semiconductors. (6)
- (b) Define conductivity and mobility. Obtain expressions for conductivity and mobility for a highly doped n-type semiconductor. (6)
- (c) What will be the mobility of electrons in Cu if it has 9×10^{28} valence electrons per cubic meter and its conductivity is $6 \times 10^7 \text{ ohm}^{-1}\text{meter}^{-1}$? (3)
7. (a) Describe Langevin theory of paramagnetism and hence, obtain expression of magnetic susceptibility. (10)
- (b) Assuming the existence of Weiss molecular field, obtain modified expression of magnetic susceptibility for a paramagnetic substance. (5)
8. (a) Obtain an expression for the local electric field at an atom in a dielectric medium. (8)

(b) Explain Meissner effect in superconductors.

(5)

(c) For a given specimen of a superconductor, the critical fields are 1.4×10^5 A/m and 4.2×10^7 A/m respectively for 14K and 13 K. What will be the critical field at 4.2 K?

(2)

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