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Code No. : 5611 Sub. Code : PNNM 23/  
ZNNM 23

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2022

Second Semester

Nanoscience and Nanotechnology — Core

PROPERTIES OF NANOMATERIALS

(For those who joined in July 2018 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. What is the attribute of a material which resists the flow of electricity known?

- (a) Conductivity
- (b) Thermoelectricity
- (c) Dielectric strength
- (d) Resistivity

2. What is the nature of the coefficient of resistance of an insulator?

- (a) Positive
- (b) Negative
- (c) Zero
- (d) Infinite

3. Basic source of magnetism —

- (a) Charged particles alone
- (b) Movement of charged particles
- (c) Magnetic dipoles
- (d) Magnetic domains

4. For a diamagnetic material, which of the following statement is correct?

- (a) Magnetic susceptibility  $< 0$
- (b) Magnetic susceptibility  $> 0$
- (c) Magnetic susceptibility  $= 0$
- (d) Magnetic susceptibility  $= 1$

5. Which of the following is used to modify the optical properties of a material system?

- (a) Electricity
- (b) Magnetic field
- (c) Pressure
- (d) Light

6. Time dependent permanent deformation is called

- (a) Plastic deformation
- (b) Elastic deformation
- (c) Creep
- (d) Anelastic deformation

7. Units for thermal conductivity

- (a) J/kg.K
- (b) J/mol.K
- (c) J.ohm/sec.K<sup>2</sup>
- (d) W/m.K

8. Heat capacity of most materials is approximately equal to

- (a) R
- (b) 2R
- (c) 3R
- (d) R/2

9. Fluorescence occurs within

- (a) 10<sup>-5</sup> s
- (b) 10<sup>-5</sup> ms
- (c) 10<sup>-5</sup>  $\mu$ s
- (d) 10<sup>-5</sup> ns

10. Polarization is defined as the dipole moment

- (a) per unit length
- (b) per unit area
- (c) per unit volume
- (d) per unit time

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Explain arrhenius equation.

Or

(b) Write short notes on dielectric loss and dielectric breakdown.

12. (a) What material has the highest magnetic permeability?

Or

(b) What is the significance of curie temperature?

13. (a) Details about tunable band gap.

Or

(b) Describe Moss – Burstein effect.

14. (a) What are difference between plastic and elastic deformation?

Or

(b) Details about Hall – Petch relation.

15. (a) Explain thermal conductivity.

Or

(b) Describe a method to determine the specific heat capacity of a solid.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Write about the types of polarization.

Or

(b) Describe the mechanism of double Schottky potential barrier height model.

17. (a) Differentiate between hard magnets, soft magnets and semi-hard magnets.

Or

(b) Explain the basic concept of giant.

18. (a) How does surface plasmon resonance work?

Or

(b) Explain Curie – Weiss law.

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19. (a) What is compressive strength? How is compressive strength measured?

Or

(b) Details about the High strain rate super plasticity.

20. (a) What are the factors affect on thermal conductivity?

Or

(b) Describe : Melting point depression.

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ZNNM 22

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2022

Second Semester

Nano Science and Nanotechnology — Core

SYNTHESIS OF NANOMATERIALS

(For those who joined in July 2018 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Nano technology deals with \_\_\_\_\_ of nano structures into useful nanoscale devices such as electronic circuits and mechanical devices at the molecular level.
- (a) the design (b) manufacturing  
(c) applications (d) all of these

2. The melting point of particles in nano form
- (a) increases  
(b) decreases  
(c) remains same  
(d) increases then decreases
3. In chemical vapour deposition, the reaction occurs in \_\_\_\_\_ giving a nonvolatile, solid, which can be deposited on a substrate to make it a thin film.
- (a) solid phase (b) liquid phase  
(c) gas phase (d) all three phases
4. In molecular beam epitaxy technique, the distance between the source and the substrate is \_\_\_\_\_ inside the deposition chamber.
- (a) 10 cm (b) 30 cm  
(c) 60 cm (d) 90 cm
5. \_\_\_\_\_ can hold more energy than the separators in batteries.
- (a) Gels (b) Aerosols  
(c) Foams (d) Aerogels
6. The size reduction from micro-composition to nano composites yields can increase in \_\_\_\_\_ which is utilized in sensing applications.
- (a) surface area (b) volume  
(c) thickness (d) molar ratio

7. The diameter of a carbon nanotube will vary from

- (a) 1 to 20 nm      (b) 20 to 50 nm  
(c) 50 to 100 nm      (d) 100 to 200 nm

8. Carbon nanotubes are poor transmitter of electromagnetic radiations due to their

- (a) high conductivity      (b) large surface area  
(c) high porosity      (d) Chemical stability

9. Which of the following is the principal factor which causes the properties of nano materials to differ significantly from other materials?

- (a) size distribution  
(b) specific surface feature  
(c) quantum size effects  
(d) all of the mentioned

10. \_\_\_\_\_ types of nanomaterials has a three - dimensional structure.

- (a) Thin film      (b) Nanowires  
(c) Quantum dots      (d) All the these

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PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Mention the various techniques used to prepare the nano structured materials.

Or

(b) What is meant by nucleation? Explain the role of nucleation in the preparation of nanomaterials.

12. (a) Explain the principle of sputter deposition with a neat sketch.

Or

(b) Write short notes on Langmuir blodgett films.

13. (a) How the nano composites synthesized by sol-gel method? Explain.

Or

(b) Discuss the characteristics and properties of carbon nanotubes.

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14. (a) What are the methods and reactants used to synthesize the carbon nanotubes? Explain.

Or

(b) Explain with suitable example, the aluminosilicate gel used in the sol-gel processing method to synthesize nanomaterials.

15. (a) How the metal polymer structures are formed? Explain. Mention the properties.

Or

(b) Describe the salient properties of nano composites and nanograined materials.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Explain the basic concepts of nanostructured materials and give the properties.

Or

(b) Discuss the significance of thermodynamic role in vapour nanophase system.

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17. (a) Explain the steps of synthesis of nano materials by spray pyrolysis process.

Or

(b) Describe the chemical vapour deposition technique used to produce nanomaterials. What are the advantages and draw backs of this method.

18. (a) How is chemical method different from physical method of synthesis of nano particles? Explain the sol-gel synthesis methods for oxides.

Or

(b) How the sol-gel process can be characterized by a series of distinct steps and explain about the partial - charge model and sol-gel chemistry of metal alkoxides.

19. (a) Describe the laser methods used to produce CNTs. What are the advantages and draw backs of this method.

Or

(b) What are nanotubes? Describe the plasma arcing method used to produce carbon nanotubes with neat diagram.

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20. (a) Discuss the synthesis, properties and applications of random mesoporous structures.

Or

(b) Explain in detail, the following core shell structures with neat sketch

- (i) Metal oxide structures and
  - (ii) Oxide polymer structures.
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Sub. Code : ZNNM 24

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL, 2022

Second Semester

Nanoscience and Nanotechnology — Core

NUMERICAL METHODS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The Gauss Jordan method reduces a original matrix into a \_\_\_\_\_

- (a) Skew Hermitian matrix
- (b) Non-symmetric matrix
- (c) Identity matrix
- (d) Null matrix

2. In Newton Raphson method if the curve  $f(x)$  is constant then \_\_\_\_\_

- (a)  $f'(x) = 0$
- (b)  $f(x) = 0$
- (c)  $f'(x) = c$
- (d)  $f(x) = c$

3. \_\_\_\_\_ formula is used in order to determine the value of the function near the end of the table.

- (a) Newton's forward interpolation
- (b) Newton's backward interpolation
- (c) Gauss Forward interpolation
- (d) None of the above

4. The function  $f(x) = 2x^2 - 3x + 4$  is given. Find the value of the function at  $x = 5$ .

- (a) 34
- (b) 35
- (c) 39
- (d) 69

5. Simpson's three-eighth rule can be applied if the number of subintervals is \_\_\_\_\_

- (a) Odd
- (b) Even
- (c) Multiples of three
- (d) Multiples of eight



6. Simpson's one third rule on numerical integration is called a \_\_\_\_\_ formula.

- (a) Open (b) Closed  
(c) Both (a) and (b) (d) None

7. To use Adams method we need atleast \_\_\_\_\_ values prior to the required value of  $y$

- (a) Three (b) Four  
(c) Two (d) One

8. In II order Runge Kutta method the first increment in  $y$  is given by \_\_\_\_\_

- (a)  $k_1 + k_2$  (b)  $(k_1 + k_2)/6$   
(c)  $(k_1 + k_2)/2$  (d)  $(k_1 + k_2)/3$

9. Classify the differential equation

$$f_{xx} + 2f_{xy} + 4f_{yy} = 0, x > 0, y > 0$$

- (a) Elliptic (b) Parabolic  
(c) Hyperbolic (d) None

10.  $u_{xx} + u_{yy} = 0$  is known as \_\_\_\_\_

- (a) Laplace equation  
(b) Poisson equation  
(c) Hyperbolic equation  
(d) Elliptic equation

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PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Using method of tangents, find the smallest positive root of the equation  $x^3 - 2x + 0.5 = 0$ .

Or

(b) Solve by Iteration method  $2x - \log_{10} x = 7$ .

12. (a) Represent the function  $f(x) = x^4 - 12x^3 + 24x^2 - 30x + 9$  and its successive differences in factorial notation.

Or

(b) The following table gives the value of a function at equal intervals.

X	0	0.5	1.0	1.5	2.0
F(x)	0.3989	0.3521	0.2420	0.1295	0.0540

Find the value of  $f(x)$  at  $x = 1.8$ .

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13. (a) Derive the formula for Simpson's one-third rule.

Or

(b) Evaluate  $\int dx/(1+x^2)$  using Trapezoidal rule between the limits  $x=0$  to  $x=1$  and hence determine the value of  $\pi$ .

14. (a) Given  $dy/dx + y - x^2 = 0$ ,  $y(0) = 1$ ,  $y(0.1) = 0.9052$ ,  $y(0.2) = 0.8213$ , find correct to four decimal places  $y(0.3)$  using Modified Euler's method.

Or

(b) By applying the fourth order Runge - Kutta method find  $y(0.1)$  from  $y' = y - x$ ,  $y(0) = 2$  taking  $h = 0.1$ .

15. (a) Classify the equation  $x^2 f_{xx} + (1 - y^2) f_{yy} = 0$  for  $-1 < y < 1$ ,  $-\infty < x < \infty$ .

Or

(b) Construct partial difference quotient for second order equation in the XY plane for a function of two variables.

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PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Using Gauss Elimination method, solve the system of equations.

$$28x + 4y - z = 32; \quad x + 3y + 10z = 24;$$

$$2x + 17y + 4z = 35.$$

Or

(b) Using Gauss Seidal Iterative method, solve the system of equations

$$8x - y + z - 18 = 0; \quad 2x + 5y - 2z - 3 = 0;$$

$$x + y - 3z - 6 = 0.$$

17. (a) Find the equation of the line of best fit to the following data using the method of Least squares.

$$X \quad 0 \quad 5 \quad 10 \quad 15 \quad 20 \quad 25$$

$$Y \quad 12 \quad 15 \quad 17 \quad 22 \quad 24 \quad 30$$

Or

(b) The following table gives the corresponding values of  $x$  and  $y$ . prepare a forward difference table and express  $y$  as a function of  $x$ . Also obtain  $y$  when  $x = 2.5$ .

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18. (a) Derive the Newton - Cote's formula.

Or

(b) Evaluate  $\int (\sin x - \ln x + e^x) dx$  by Simpson's one third rule between the limits  $x = 0.2$  to  $x = 1.4$ .

19. (a) Using Taylor's series method, solve  $dy/dx = xy + y^2$ ,  $y(0) = 1$  at  $x = 0.1, 0.2$  and  $0.3$  continue the solution at  $x = 0.4$  by Milne's predictor corrector method.

Or

(b) Solve the initial value problem  $dy/dx = x - y^2$ ,  $y(0) = 1$  to find  $y(0.4)$  by Adam's method. Starting solutions required are to be obtained using Runge-Kutta method of fourth order using step value  $h = 0.1$ .

20. (a) Solve  $U_{xx} + U_{yy} = 0$  in  $0 \leq y \leq 4$ ,  $0 \leq x \leq 4$ . Given that  $u(0, y) = 0$ ,  $u(4, y) = 8 + 2y$ ,  $u(x, 0) = x^2/2$ ,  $u(x, 4) = 2$  taking  $h = k = 1$ . Obtain the result correct to one decimal.

Or

(b) Solve the Poisson's equation  $\Delta^2 u = 8x^2 y^2$  for the square mesh of the given figure with  $u(x, y) = 0$  on the boundary and mesh length  $= 1$ .

$u_1$   $u_2$   $u_1$   
 $u_2$   $u_3$   $u_2$   
 $u_1$   $u_2$   $u_1$

$$\int_{0.2}^{1.4}$$

$n = 12$   
 $h = 0.1$

0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9  
 1.0 1.1 1.2 1.3 1.4

$$\frac{1.4 - 0.2}{0.1} = \frac{1.2}{0.1} =$$

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Sub. Code : PNNM 21/  
ZNNM 21

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2022

Second Semester

Nanoscience and Nanotechnology — Core  
FUNDAMENTALS OF NANOSCIENCE

(For those who joined in July 2018 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Radioactive decay is a kind of \_\_\_\_\_ force.

- (a) strong (b) weak  
(c) electromagnetic (d) gravitational

2. The average bond energy between O-H in water molecule is \_\_\_\_\_

- (a) 463 KJ/mol (b) 4630 KJ/mol  
(c) 463 J/mol (d) 46.3 J/mol

3. The diameter of nanoparticle ranges from

- (a) 1-100 nm (b) 1-500 nm  
(c) 1-20  $\mu$ m (d) 1-20 nm

4. If only one dimension of a three-dimensional nanostructure is of nanoscale, the structure is referred to as a

- (a) quantum well (b) quantum wire  
(c) quantum dot (d) nanotube

5. The diameter of quantum wire ranges from

- (a) 10s of nm (b) 100s of nm  
(c) 1000s of nm (d) 10s of  $\mu$ m

6. A strip of conducting material about 10 nm or less in width and thickness that displays quantum mechanical effects are called

- (a) nanotube (b) nanorod  
(c) quantum wire (d) quantum dot

7.  $\beta$  - decay is a form of

- (a) weak force  
(b) strong force  
(c) electromagnetic force  
(d) gravitational force

8. \_\_\_\_\_ is not the form of Vander Waals force.

- (a) Keeson force
- (b) Debye force
- (c) Electrostatic force
- (d) London dispersion force

9. \_\_\_\_\_ is a chemical reaction in which a substance combines with water.

- (a) Salvation
- (b) Hydration
- (c) Polymerization
- (d) Self-assembly

10. A \_\_\_\_\_ is a double layer of closely packed atoms or molecules.

- (a) Self-assembly
- (b) Vesicles
- (c) Micells
- (d) Bilayers

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Write about the time and length scale in structures.

Or

(b) Give the importance of energy landscapes.

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12. (a) What are the advantages of nanomachines?

Or

(b) Enumerate the bottom up approach.

13. (a) Write short notes on quantum dots.

Or

(b) Explain the modification in magnetic property of nanosystem upon size.

14. (a) Explain about weak nuclear force.

Or

(b) Write short notes on strong intermolecular forces.

15. (a) Write about the thermodynamic of self-assembly.

Or

(b) Write short notes on bionanomachines.

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[P.T.O.]

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Elucidate the interdynamic aspects of intermolecular forces.

Or

(b) Describe in detail about the evolution of band structures.

17. (a) Write about the scientific revolutions of nanotechnology.

Or

(b) Explain about the top down approach.

18. (a) Write down the applications of carbon nanotubes.

Or

(b) Explain about the size dependent variation in electronic transport property of nanosystem.

19. (a) Explain about the Vander Waals and electrostatic forces between surfaces.

Or

(b) Explain about the similarities and differences between intermolecular and interparticle forces.

20. (a) Write notes on : micells, bilayers, vesicles.

Or

(b) Explain the advantages of bionanomachines.