

Code No. : 7273

Sub. Code : PNNM 11

M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2019.

First Semester

Nanoscience and Nanotechnology – Core

MATHEMATICAL PHYSICS

(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. $\text{curl } A \times B$ is

- (a) $(B \cdot \nabla)A - (A \cdot \nabla)B + A \text{ div } B - B \text{ div } A$
 (b) $(A \cdot \nabla)B - (B \cdot \nabla)A + B \text{ div } A - A \text{ div } B$
 (c) $(A \cdot \nabla)B - (B \cdot \nabla)A + A \text{ div } B - B \text{ div } A$
 (d) $(B \cdot \nabla)A - (A \cdot \nabla)B - B \text{ div } A - A \text{ div } B$

2. $\text{curl curl } A$ is

- (a) $\text{div grad } A - \nabla^2 A$ (b) $\text{grad div } A - \nabla^2 A$
 (c) $\text{div div } A - \nabla^2 A$ (d) $\text{grad grad } A - \nabla^2 A$

3. $L^{-1}\{f(as)\}$ is

- (a) $F(ta)$ (b) $F(a)/a$
 (c) $F(t/a)/a$ (d) $f(t/a)$

4. Laplace transform of e^{at} is

- (a) $\frac{1}{s-a}$ (b) $\frac{1}{s+a}$
 (c) $2/s^3$ (d) $1/s^2$

5. Cauchy integral formula is

- (a) $f(z_0) = \frac{1}{2\pi i} \int_C \frac{f(z)}{z-z_0} dz$
 (b) $f(z) = \frac{1}{2\pi i} \int_C \frac{f(z)}{z-z_0} dz$
 (c) $f(z_0) = \frac{1}{2\pi i} \int_C \frac{f(z_0)}{z-z_0} dz$
 (d) $f(z) = 2\pi i \int_C \frac{f(z)}{z-z_0} dz$

6. If f is analytic then $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2$ is

(a) $4|f'(z)|^2$ (b) $4|f'(z)|$

(c) $4|f'(z)|^3$ (d) 4

7. $\frac{d}{dx}(x^n J_n)$ is

(a) $x^n J_n$ (b) $x^n J_{n+1}$

(c) $x^{-n} J_n$ (d) $x^{-n} J_{n+1}$

8. Another name for Bessels functions of third kind is

(a) Hanker functions (b) Ber functions

(c) Ker functions (d) Kei functions

9. Two dimensional laplace equation is

(a) $u_{ax} + u_{yy} = 0$ (b) $u_{xx} + u_{yx} = 0$

(c) $u_{xy} + u_{yy} = 0$ (d) $u_{yx} + u_{xy} = 0$

10. Wave equation is

(a) $\nabla^2 \varphi = \frac{\partial^2 \varphi}{\partial t}$ (b) $\nabla^2 \varphi = 1/c^2$

(c) $\nabla^2 \varphi = 1/c^2 \frac{\partial^2 \varphi}{\partial t^2}$ (d) $\nabla^2 \varphi = 1/c^2 \frac{\partial u}{\partial t}$

PART B — (5 × 5 = 25 marks)

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

11. (a) If \vec{a} is a constant vector, prove that $\text{div}\{\vec{a} \times (\vec{r} \times \vec{a})\} = 2a^2$ where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

Or

(b) Find the eigen values of $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.

12. (a) Find finite Fourier sine and cosine transform of $f(x) = x^2, 0 < x < 4$.

Or

(b) Find the laplace transform of the following (i) $\sin^2 t$ (ii) $\cos^2 t$.

13. (a) Use method of contour integration to prove that $\int_0^{2\pi} \frac{d\theta}{1 - 2p\cos\theta + p^2} = \frac{2\pi}{1 - p^2}$ where p is a fixed real number in the interval $0 < p < 1$.

Or

(b) State and prove Cauchy residue theorem.

14. (a) Prove that $J_2'(x) = (1 - 4/x^2)J_1(x) + (2/x)J_0(x)$ where $J_n(x)$ is the Bessel function of first kind.

Or

(b) Show that $\int x J_0^2(x) = (1/2)x^2 [J_0^2(x) + J_1^2(x)]$.

15. (a) Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to

$$u(0, y) = u(l, y) = u(x, 0) = 0, u(x, l) = \sin \frac{x\pi}{l}$$

Or

(b) Determine the steady state temperature distribution of a thin rectangular plate bounded the lines $x=0, x=l, y=0, y=b$ assuming that the edges $x=0, x=l, y=0$ are maintained at zero temperature and the edge $y=b$ is maintained at steady state temperature $f(x)$.

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

16. (a) Prove that if a rigid body is rotating with constant angular velocity, the curl of linear velocity at any point gives twice is angular velocity.

Or

(b) Evaluate $\iiint_V (\nabla \times \vec{F}) dV$ where V is closed region bounded by $x=0, y=0, z=0$ and $2x + 2y + 2z = 4$ and $\vec{F} = (2x^2 - 3z)\hat{i} - 2y\hat{j} - 4x\hat{k}$.

17. (a) Find the Fourier transform of the slit function $f(x) = \begin{cases} 1/\epsilon, & |x| \leq \epsilon \\ 0, & |x| > \epsilon \end{cases}$. Determine the limit of this transform as $\epsilon \rightarrow 0$ and discuss the result.

Or

(b) Find the laplace transform of $f(t) = t^2 e^t \sin 4t$.

18. (a) Using the method of complex variables show that $\int_0^{2\pi} \frac{\cos 2\theta}{5 + 4 \cos \theta} d\theta = \pi/6$.

Or

(b) Show by contour integration $\int_{-\infty}^{\infty} \frac{dx}{x^4 + a^4} = \frac{\pi}{2\sqrt{2}a^3}$ where $a > 0$.

19. (a) Show that $\int_{-\infty}^{\infty} x e^{-x^2} H_n(x) H_m(x) dx =$

$$\sqrt{\pi} \{ 2^{n-1} n! \delta_{m, n-1} + 2^n (n+1)! \delta_{m, n+1} \}$$

Or

(b) Show that (i) $J_{1/2}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \sin x$

(ii) $J_{-1/2}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \cos x.$

20. (a) A long cylinder is made of two halves thermally insulated from each other, the upper half is at temperature T_1 and the lower half at temperature T_2 . Find the steady state temperature inside the cylinder.

Or

(b) The ends A, B of a rod 20 cm long are at temperature 30°C , 80°C respectively until steady state prevails. The temperatures at the ends are changed to 40°C , 60°C respectively. Find the temperature distribution in the rod at time t .

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

16. (a) Describe about the Dislocation density and micro strain.
Or
(b) Explain the comparison of X-ray powder pattern.
17. (a) Explain the failure stress.
Or
(b) Write in detail about strain toughness.
18. (a) Describe in detail about Transmission electron microscope.
Or
(b) Explain about Scanning probe Microscopy.
19. (a) Explain about the interaction of light with nano system.
Or
(b) Write about the photons imaging.
20. (a) Elaborate in detail about optical techniques.
Or
(b) Explain band gap measurements.

Reg. No. :

Code No. : 8000

Sub. Code : PNNM 31

M.Sc.(CBCS) DEGREE EXAMINATION,
NOVEMBER 2019.

Third Semester

Nano Science and Nano Technology – Core

CHARACTERIZATION OF NANOMATERIALS

(For those who joined in July 2018 onwards)

Time : 3 hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer all questions.

Choose the correct answer :

1. Nano science can be studied with the help of
(a) Quantum mechanics
(b) Newton mechanics
(c) Metal articles
(d) Geo Physics
2. Who coined the word nanotechnology?
(a) Eric Drexler (b) Richard Feynman
(c) Sumio Tijima (d) Richard Smalley

3. High sensitivity environmental sensor can sense the gaseous chemicals like?
- (a) CO_2 (b) NO_3
(c) O_2 (d) NO
4. The synthesised Magnetic nanoparticles from _____ have been found to self-arrange automatically.
- (a) Zinc (b) Copper
(c) Iron (d) Zirconium
5. The diameter of the nano wire is about _____.
- (a) 10^{-6} m (b) 10^{-8} m
(c) 10^{-9} m (d) 10^{-3} m
6. The Properties like melting point, solubility, colour, etc changes on varying the _____.
- (a) Size (b) Composition
(c) Surface properties (d) None of the above
7. Visible light's wavelength range _____.
- (a) 0.39–0.77 mm (b) 0.39–0.72 μm
(c) 0.39–0.77 nm (d) 0.39–0.77 cm
8. Planck's constant _____.
- (a) $6.62 \times 10^{-34} \text{ J}\cdot\text{sec}$ (b) $6.62 \times 10^{-34} \text{ J}\cdot\text{min}$
(c) $6.62 \times 10^{-34} \text{ Cal}\cdot\text{sec}$ (d) $6.62 \times 10^{-34} \text{ Cal}\cdot\text{min}$
9. Sum of these is unity _____.
- (a) Reflectivity + Transitivity
(b) Reflectivity + Refractivity
(c) Reflectivity + Refractivity + Transitivity
(d) Any

10. Metals can _____ the light beams.
- (a) Reflect (b) Refract
(c) Transmit (d) All of these

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) Write about the Neutron and X-Ray diffraction.
Or
(b) Explain about the Theory of Scherer formula.
12. (a) Explain in detail about the micro hardness.
Or
(b) Explain the types of mechanical characterization.
13. (a) Explain in detail about application of microscopes.
Or
(b) Explain about the scanning electron microscope.
14. (a) Explain in detail about optics and photonics.
Or
(b) Describe the properties of light and nanotechnology.
15. (a) Explain about the principle of UV-Vis spectrometer.
Or
(b) Explain the NIR spectrometer.

(6 pages)

Reg. No. :

Code No. : 7995

Sub. Code : PNNM 14

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2019.

First Semester

Nanoscience and Nanotechnology – Core

ELECTRONICS

(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. If an input A is given to an inverter the output will be

(a) $\frac{1}{A}$

(b) 1

(c) \bar{A}

(d) A

2. NAND gate means

- (a) Inversion followed by AND gate
- (b) AND gate followed by an Inverter
- (c) AND gate followed by an OR gate
- (d) None of these

3. A digital word has even parity

- (a) If it has even number of 1's
- (b) If it has even number of 0's
- (c) If the decimal value of digital word is even
- (d) None of these

4. Two input Exclusive NOR gate gives high output

- (a) when one input is high and the other is low
- (b) only when both the inputs are low
- (c) when both the inputs are same
- (d) only when both the inputs are high

5. The Karnaugh map method of minimization of switching function is very convenient and effective, if the number of variable in the switching function are _____.

(a) 8

(b) 4

(c) 5

(d) 6

6. A op-amp can amplify
(a) a.c signals only
(b) d.c signals only
(c) both a.c, d.c signals
(d) neither d.c nor a.c signals
7. The input stage of an op-amp is usually a _____
(a) differential amplifier
(b) class B push-pull amplifier
(c) CE amplifier
(d) Swamped amplifier
8. Determine the time period of a monostable 555 multivibrator
(a) $T = 0.33 RC$ (b) $T = 1.1 RC$
(c) $T = 3RC$ (d) $T = RC$
9. In the locked state of PLL, the phase error between the input and output is _____
(a) Maximum (b) Moderate
(c) Minimum (d) All of the above
10. It is the ability of the sensor to indicate the same output is over a period of time for a constant output.
(a) Stability (b) Resolution
(c) Error (d) Impedance

PART B — (5 × 5 = 25 marks)

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

Each Answer should not exceed 250 words.

11. (a) State and prove De-Morgan's theorem.

Or
(b) Explain how AND, OR gate are constructed using diodes and transistors using truth table, explain their working.
12. (a) Obtain SOP Form of Boolean functions.

Or
(b) Explain the implementations of SOP form using NAND gate, NOR gate.
13. (a) Write down the applications of OP AMP.

Or
(b) Write a note about a Differentor.
14. (a) Write about the application of Timer – 555.

Or
(b) Write the characteristics of PLL IC 566.

15. (a) Write a short note on signal conditioning and recovering.

Or

- (b) What is Sensor? Explain its interface circuits.

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

16. (a) Explain postulates and theorems of Boolean Algebra.

Or

- (b) Explain how EX-OR, EX-NOR gate are constructed using diodes and explain with their symbols and truth table.

17. (a) Minimize $F = \bar{A}BC + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C}$ using the Karnaugh map or reduce $\sum(2,3,4,5)$ using the Karnaugh map.

Or

- (b) Minimize the Boolean function

$$F = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

18. (a) Explain the characteristics and parameters of OP AMP.

Or

- (b) Draw a Analog Multiplexer circuit and explain its working.

19. (a) Explain monostable and astable operation.

Or

- (b) Explain the Internal Architecture and working of Timer – 555.

20. (a) Describe about Impedance Matching Amplification.

Or

- (b) Describe about Electronic measurement and control in Sensors.

(6 pages)

Reg. No. :

Code No. : 7994

Sub. Code : PNNM 13

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2019.

First Semester

Nanoscience and Nanotechnology – Core

SOLID STATE PHYSICS

(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. The material which has got BCC structure is
(a) Silver (b) Tungsten
(c) Zinc (d) Aluminum
2. The crystal structure of Nickel is
(a) FCC (b) HCF
(c) BCC (d) None

3. The coordination number for BCC structure is
(a) 12 (b) 6
(c) 2 (d) 1
4. In intrinsic semiconductor the carrier concentration varies as
(a) $\frac{1}{T}$ (b) $T^{3/2}$
(c) T^2 (d) T
5. In an intrinsic semiconductor at OK, the fermi level lies at the centre of
(a) top of the valance band and bottom of the conduction band
(b) donor level and intrinsic Fermi level
(c) donor level and bottom of the conduction band
(d) acceptor level and top of the valance band
6. Semi conductors have resistivity in the range
(a) 10^{-3} to $10^6 \Omega\text{cm}$ (b) 10^0 to $10^4 \Omega\text{cm}$
(c) 10^4 to $10^{14} \Omega\text{cm}$ (d) None

7. The temperature at which a conductor becomes a super conductor is called
- Super conducting temperature
 - Curi temperature
 - Onne's temperature
 - Transition temperature
8. The width of the energy gap of a super conductor is maximum at
- OK
 - Transition temperature
 - Room temperature
 - None
9. In a super conducting state
- Entropy alone change
 - Electronic specific heat alone change
 - Both electron and entropy specific heat change
 - None
10. The unit of magnetic field intensity is
- Am^{-1}
 - Hm^{-1}
 - $Wb m^{-2}$
 - no units

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 250 words.

11. (a) Write about the periodic array of atoms.
Or
(b) Write a short note on Brillouim Zones
12. (a) Explain with the help of suitable sketches the various types of bonding in crystals. (any one bond)
Or
(b) Describe phonon momentum.
13. (a) Explain motion in magnetic fields.
Or
(b) Discuss energy levels in one dimension.
14. (a) Derive the equations of motion of an electron in an energy.
Or
(b) Write about semimetals. *excitons Impurity conductivity*

15. (a) Explain Meissner effect in super conductors.

Or

(b) Derive London equations and discuss their significance.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

16. (a) Give a report on primitive lattice cell and the three dimensional lattice types.

Or

(b) Describe about diffraction of waves by crystals.

17. (a) Describe about vibration of crystals with monoatomic basis.

Or

(b) Explain the lattice with two atoms per primitive cells.

18. (a) Discuss about free electron gas in three dimension.

Or

(b) Describe about Heat capacity of the electron gas.

19. (a) Explain about super lattices and optical reflectance.

Or

(b) Discuss about the concept of carrier concentration in intrinsic semi conductors.

20. (a) Explain Type II super conductors.

Or

(b) Discuss about BCS theory of super conductivity.

(6 pages)

Reg. No. : 20183152518204

Code No. : 8002

Sub. Code : PNNM33

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2019.

Third Semester

Nanoscience and Nanotechnology – Core

BASICS OF NANO BIOTECHNOLOGY

(For those who joined in July 2018 onwards)

Time : 3 hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL the questions.

Choose the correct answer :

1. The nanoparticles from iron and palladium are used to produce.
(a) Magnets
(b) Magnetic lens
(c) Magneto meters
(d) Magnetic storage device

2. The nano materials are used in the light emitted electro luminescence devices.
(a) True (b) neither (a) nor (b)
(c) False (d) Partially true
3. Coating the nano crystals with the ceramics is carried that leads to.
(a) corrosion
(b) corrosion and resistant
(c) wear and tear
(d) water
4. DNA deflection through—————by using the oligonucleotide functionalised gold nano crystals is developed.
(a) Colorimetric (b) Diathermy
(c) Electrotherapy (d) Treatment table
5. The —————to the ceramics are a superior coating.
(a) Nanoparticles (b) Nano powder
(c) Nanocrystal coating (d) All of these

15. (a) Explain about Quantum dots.

Or

(b) Explain in vivo cancer imaging

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

16. (a) Describe about the various types nanoparticles and applications.

Or

(b) Explain plant production of nano particles.

17. (a) Explain the artificial nanostructure fabrication and application.

Or

(b) Write in detail about nuclei engineered nanomaterial applications.

18. (a) Describe in detail about Protein patterning and Biosensor fabrication.

Or

(b) Explain about the applications of DNA aptamers and biomaterials.

19. (a) Explain about Fertilizers and nutrients in crop.

Or

(b) Write about the efficient delivery of pesticides.

20. (a) Elaborate in detail about quantum dots for live cells.

Or

(b) Explain in VIVO imaging and diagnostics.

(6 pages)

Reg. No. :

Code No. : 7277

Sub. Code : PNNM 21

M.Sc. DEGREE EXAMINATION,
APRIL 2019.

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. Who first used the term nanotechnology?

- (a) Richard Feynman
- (b) Norio Taniguchi
- (c) Eric Drexler
- (d) Sumio Iijima

2. The diameter of human hair is

- (a) $5 \times 10^{-8} \text{ m}$
- (b) $5 \times 10^{-7} \text{ m}$
- (c) $5 \times 10^{-6} \text{ m}$
- (d) $5 \times 10^{-5} \text{ m}$

3. Which of the following method is an example of top-down approach to synthesize nanomaterials?

- (a) gas phase agglomeration
- (b) molecular self assembly
- (c) mechanical grinding
- (d) molecular beam epitaxy

4. The number of molecules of CO_2 present in 44g of CO_2 is

- (a) 6.02×10^{23}
- (b) 3×10^{23}
- (c) 12×10^{23}
- (d) 3×10^{10}

5. Nano wire is a _____ structure

- (a) 3D
- (b) 1D
- (c) 0D
- (d) 2D

6. The size of a quantum dot is _____ nm.

- (a) 15
- (b) 10
- (c) 50
- (d) 100

7. Strength of intermolecular forces from ionic or covalent bond is
- weaker
 - stronger
 - equal
 - none of above
8. Which one of the following pairs atoms is most likely to form an ionic bond?
- Na and F
 - C and F
 - N and F
 - O and F
9. Liposomes consists of bilayer of
- hydropilic molecule
 - hydrophobic molecule
 - both (a) and (b)
 - none
10. The word 'Polymer' meant for material made from _____
- Single entity
 - Two entities
 - Multiple entities
 - Any entity

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) What are the limitations of nanomaterials at nano scales? Explain.
- Or
- (b) Write a note on energy landscapes.
12. (a) Explain the various types of nanostructures based on dimension.
- Or
- (b) Write in detail about bottom-up synthesis of nanomaterials.
13. (a) Write a short note on quantum dots.
- Or
- (b) Explain the size dependent phenomenon of nano systems.
14. (a) Write note on intermolecular forces.
- Or
- (b) Explain the forces between particles and grain boundaries.

15. (a) What are micelles? Explain.

Or

(b) What is the important of adhesion? Explain

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

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

Or

(b) Brief the evolution of band structures and Fermi surface.

17. (a) Explain various types of nanostructures.

Or

(b) Describe how sol-gel method can be employed to prepare nanoparticles.

18. (a) Write note on

(i) Nano wires

(ii) Nano tubes.

Or

(b) Explain the size dependent variation in electronic transport.

19. (a)

Discuss in detail about the forces between atoms and molecules.

Or

(b) Discuss the vander waals and electrostatic forces between surfaces.

20. (a) Explain the process of hydration in nanomaterials.

Or

(b) What are bionanomachines? Explain their applications.