R1997	Sub. Code
	533101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Nanoscience and Technology

INTRODUCTION TO QUANTUM PHYSICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. In terms of bra and ket vectors, the definition of the inner product of the state vectors Ψa and Ψb takes the form $(\Psi a, \Psi b) =$ ————————. (CO1, K2)

   (a) $< a\, b >$ (b) $< b\, a >$

   (c) $< a\, a\, b >$ (d) $< ab\, a\, b >$

2. The Laguerre polynomials $Ln(x)$ arise when solving the Schrodinger equation for which physical system ————————. (CO1, K2)

   (a) Hydrogen atom

   (b) Harmonic oscillator

   (c) Particle in a box

   (d) Free particle

3. Why did Plank's constant introduce in the quantum equation ————————. (CO2, K2)

(a) Chemical equations must have a constant Value

(b) It describes the photon energy from the frequency of light

(c) A constant only can express the energy of light

(d) None of the above

4. Plank's constant applies to ————————. (CO2, K2)

(a) Macroscopic objects

(b) Microscopic objects

(c) Both options (a) and (b)

(d) Neither (a) nor (b)

5. Tunnelling effect results in ————————. (CO3, K3)

(a) The escape of neutrons

(b) The production of gamma rays

(c) The leakage of alpha particles

(d) None of these

6. In quantum mechanics, the tunnelling probability of a particle through a potential barrier increase with ————————. (CO3, K3)

(a) Decreasing barrier width and decreasing barrier height

(b) Increasing barrier width and increasing barrier height

(c) Decreasing barrier width and increasing barrier height

(d) Increasing barrier width and decreasing barrier height

7. Which of the following is wrong about FRET? ————————. (CO4, K5)

(a) The energy transfer is radiative

(b) The transfer occurs through intermolecular dipole-dipole coupling

(c) Low energy fluorophore is quenched

(d) Acceptor fluorophore is at relatively high frequency

8. The Wannier-Mott exciton model describes excitons in which type of Materials ————————. (CO4, K5)

(a) Insulators

(b) Semiconductors

(c) Conductors

(d) Superconductors

9. In an indirect bandgap semiconductor, a transition between conduction band and valance band results in ————————. (CO5, K3)

(a) Heat

(b) Light

(c) Both

(d) None of the above

10. Which of the following factors affects the formation of Ohmic contacts ————————. (CO5, K3)

(a) Work function of the metal

(b) Doping concentration of the semiconductor

(c) Surface roughness at the interface

(d) All of the above

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Define Eigen values and Eigen functions. (CO1, K2)

Or

(b) Derive the relationship between beta and gamma functions. (CO1, K2)

12. (a) Express and explain Planck's quantum hypothesis. (CO2, K2)

Or

(b) State Uncertainty principle. (CO1, K2)

13. (a) Why a particle trapped in a box cannot be at rest? (CO2, K3)

Or

(b) Derive the energy levels of particle in 1D and 2D. (CO2, K3)

14. (a) Write notes general concepts of excitons. (CO3, K5)

Or

(b) Explain size effects in high-dielectric constant materials. (CO3, K5)

15. (a) Explain the construction of a p-n junction in a semiconductor. (CO4, K3)

Or

(b) Prove that the Fermi level is lies exactly in between conduction band and valance band of intrinsic semiconductor. (CO4, K3)

Part C

$(5 \times 8 = 40)$

Answer **all** the questions not more than 1000 words each.

16. (a) Derive Hermite and Laguerre polynomials. (CO1, K2)

Or

(b) What are Eigen Values and Eigen Vectors? Explain the determination of Eigen Values and Eigen Vectors with examples. (CO1, K2)

17. (a) Derive Schrodinger time-independent wave equation. (CO2, K2)

Or

(b) Discuss briefly Einstein's Photoelectric effect. (CO2, K2)

18. (a) Briefly describe momentum eigen functions. (CO2, K3)

Or

(b) Briefly explain tunnel effect. (CO2, K3)

19. (a) Explain size effects in π-conjugated systems. (CO3, K5)

Or

(b) Explain in detail with examples size-dependant optical properties. (CO3, K5)

20. (a) Discuss various energy bands in solids with suitable diagrams. (CO3, K3)

Or

(b) What are different types of semi-conductor optoelectronic materials? Explain them. (CO3, K3)

———————

R1998

Sub. Code
533102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Nanoscience and Technology

BASICS OF MATERIALS SCIENCE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Frenkel defects due to the existence of (CO1, K1)
   (a) Extra electrons in the crystal
   (b) Extra holes in valence bond
   (c) Lattice distortions in crystal
   (d) More than one of The above

2. Which of the following unit cell has constituent particles occupying the corner position only? (CO1, K1)
   (a) Body-centered cell (b) Primitive cell
   (c) Face centered cell (d) End-centered cell

3. Maximum elasticity is in (CO2, K2)
   (a) Rubber (b) Steel
   (c) Silver (d) Glass

4. Which type of solids are formed by three-dimensional arrangement of cations and anions bound by strong electrostatic force? (CO2, K2)

(a) Polar molecular solids

(b) Metallic solids

(c) Covalent solids

(d) Ionic solids

5. The forbidden energy gap for germanium is (CO3, K3)

(a) 0.72 eV (b) 0.12 eV

(c) 1.11 eV (d) 1.52 eV

6. Which of the following most ductile metal? (CO3, K3)

(a) Gold (b) Copper

(c) Silver (d) Iron

7. One of the characteristics of polymer is (CO4, K3)

(a) High temperature stability

(b) High mechanical strength

(c) High elongation

(d) Low hardness

8. Which of the following polymer type is not classified on the basis of its application and properties (CO4, K3)

(a) Rubbers (b) Plastics

(c) Fibres (d) Synthetic

9. The Hall-Petch equation describes the relationship between a material's (CO5, K5)

(a) Stiffness and grain size

(b) Hardness and grain size

(c) Ultimate Tensile Strength and grain size

(d) Yield Strength and Grain size

10. Dislocations present in materials are ———————— defects. (CO5, K4)

(a) Point (b) Line

(c) Surface (d) Planar

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the Growth of a crystal. (CO1, K1)

Or

(b) Write a short note on Schottky and Frenkel defects. (CO1, K1)

12. (a) List out the differences between crystalline and amorphous solids. (CO2, K2)

Or

(b) Explain the structure of silica and silicates. (CO2, K2)

13. (a) Explain in detail about atomic Structure. (CO3, K2)

Or

(b) Explain the energy gap in solids and their band structure. (CO3, K2)

14. (a) What is meant by the Flexural property of the polymer? (CO4, K3)

Or

(b) Explain macroscopic deformation. (CO4, K3)

15. (a) Explain how defects influence the properties of solids. (CO5, K4)

Or

(b) Explain the Deformation in FEE and HCP nanostructures. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain the statistical thermodynamic of crystals. (CO1, K1)

Or

(b) Describe the Scherrer's equation. (CO1, K1)

17. (a) Explain the Properties of solids. (CO2, K2)

Or

(b) Explain Ionic Solids and Molecular Solids. (CO2, K2)

18. (a) Explain electronic properties thermal conductivity and electrical Conductivity. (CO3, K3)

Or

(b) Explain semiconductor devices. (CO3, K3)

19. (a) What is Polymeric Materials explain its classification and properties? (CO4, K4)

Or

(b) Explain Viscoelastic deformation. (CO4, K4)

20. (a) Compare point defects and planar defects. (CO5, K5)

Or

(b) Explain Hall petch Behavior. (CO5, K5)

———————

R1999

Sub. Code
533103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Nanoscience and Technology

BASIC BIOTECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Buffers in biological system helps in maintaining the body ————————. (CO1, K1)

   (a) pH (b) Temperature

   (c) Stress (d) All the above

2. Plasma membrane is ————————. (CO1, K1)

   (a) Permeable (b) Cross linked

   (c) Semi-permeable (d) Densely packed

3. ———————— is having a hairpin loop structure. (CO2, K2)

   (a) mRNA (b) SiRNA

   (c) rRNA (d) tRNA

4. The therapeutic genes are transferred into any cell other than germ cell is called (CO2, K2)

   (a) Germ cell gene therapy

   (b) Somatic cell gene therapy

   (c) Gamate gene therapy

   (d) Gametocyte gene therapy

5. ———————— developed callus culture first. (CO2, K3)

(a) Gobier Haberlandt

(b) Goyel Haberlandt

(c) Goy Haberlandt

(d) Gim Haberlandt

6. Golden rice contains (CO2, K3)

(a) Provitamin B (b) Provitamin A

(c) Provitamin C (d) Provitamin D

7. Trypsinization is the method of separating ————————. (CO1, K3)

(a) Loose cells (b) Adherent cells

(c) Both (d) None

8. Process of introducing transgenic DNA is called ————————. (CO3, K3)

(a) Transformation (b) Transfusion

(c) Transgenesis (d) Transcription

9. CPCB (CO3, K5)

(a) Central Population Control Board

(b) Central Poultry Control Board

(c) Central Pest Control Board

(d) Central Pollution Control Board

10. Bio-energy produced from (CO3, K4)

(a) Non-Renewable biological resources

(b) Renewable biological resources

(c) Both

(d) None

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) Draw a neat sketch of Eukaryotic cell with its significant cell structures. (CO1, K1)

Or

(b) List out and describe the chemical bonds present in biological system. (CO1, K1)

12. (a) Discuss your understanding of gene cloning ethical issues. (CO2, K2)

Or

(b) Evaluate the merits and demerits of cloning. (CO1, K2)

13. (a) Identify and discuss the methods of micropropagation. (CO2, K2)

Or

(b) Elaborate the process of developing transgenic plants. (CO2, K2)

14. (a) Differentiate animal and plant cell culture. (CO3, K3)

Or

(b) Outline the methods for developing transgenic animals. (CO3, K3)

15. (a) Propose the concept of Phytoremediation. (CO4, K4)

Or

(b) Compile the goodness of Single Cell Protein (SCP). (CO4, K4)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Summarize your understanding about the role of carbohydrates in biological system. (CO1, K1)

Or

(b) Relate the role of enzymes in body functions and its reaction kinetics. (CO1, K1)

17. (a) Analyze about the molecular tools involved in genetic engineering. (CO2, K2)

Or

(b) Outline and discuss the biotechnological applications of rDNA technology. (CO2, K2)

18. (a) Evaluate the fundamental requirements and types of plant tissue culture. (CO2, K3)

Or

(b) Discuss and Propose - Plant as a Bioreactor. (CO2, K3)

19. (a) Elaborate the scope of animal biotechnology. (CO3, K4)

Or

(b) Discuss in detail about transgenic animal models and their applications. (CO3, K4)

20. (a) Discuss in detail. Environmental pollution. (CO3, K5)

Or

(b) Construct a summary of Bioactive metabolites. (CO3, K5)

———————

R2000

Sub. Code
533104

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Nanoscience and Technology

INTRODUCTION TO NANOSCIENCE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct answer.

1. In biology, what advantage do nanomaterials provide for drug delivery systems? (CO1, K2)

   (a) Enhanced visibility under microscopes

   (b) Ability to penetrate cell membranes

   (c) Increased magnetic properties

   (d) Reduced toxicity

2. How do nanomaterials contribute to advancements in engineering? (CO1, K2)

   (a) By providing new materials with superior strength and lightweight properties

   (b) By increasing the size of components

   (c) By simplifying manufacturing processes

   (d) By reducing the need for computer modelling

3. Which type of nanomaterial is typically used in high-strength composites? (CO2, K3)

(a) Nanowires (b) Nanotubes

(c) Nanoplates (d) Nanodisks

4. What are 2D films commonly used for in nanotechnology? (CO2, K3)

(a) Energy storage

(b) Structural materials

(c) Coatings and sensors

(d) Magnetic applications

5. Which of the following describes 'quantum confinement' in nanoparticles? (CO3, K6)

(a) The limitation of particle size to below 1 micrometre

(b) The limitation of particle growth due to surface tension

(c) The confinement of nanoparticles in a liquid medium

(d) The restriction of electron movement to discrete energy levels

6. Which of the following is an example of a zero-dimensional nanomaterial? (CO3, K6)

(a) Nanowire (b) Nanotube

(c) Quantum dot (d) Graphene

7. What is a primary characteristic of ceramic nanomaterials compared to their bulk counterparts? (CO4, K4)

(a) Increased density

(b) Enhanced surface reactivity

(c) Reduced mechanical strength

(d) Reduced thermal stability

8. What is the primary force responsible for the interaction between molecules in a liquid? (CO4, K4)

(a) Van der Waals force

(b) Gravitational force

(c) Electromagnetic force

(d) Nuclear force

9. In a semiconductor nanomaterial, how does the reduction in the material's size affect its electronic band structure, particularly with respect to the density of states (DOS) and the bandgap? (CO5, K3)

(a) The density of states increases and the bandgap decreases

(b) The density of states decreases and the bandgap increases

(c) The density of states increases and the bandgap increases

(d) The density of states decreases and the bandgap decreases

10. What is the main purpose of an Ohmic contact in semiconductor devices? (CO5, K3)

(a) To provide rectifying behaviour

(b) To offer low resistance and linear current-voltage characteristics

(c) To separate electron-hole pairs

(d) To create a high resistance barrier

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) Discuss the future prospects of nanoscience and nanotechnology and discuss the challenges. (CO1, K2)

Or

(b) Examine the role of nanomaterials in biological applications, focusing on drug delivery systems, diagnostic tools, and therapeutic treatments. (CO1, K2)

12. (a) Describe the impact of atomic structure on the properties of nanomaterials. How does the arrangement of atoms influence their mechanical, optical, and electrical characteristics? (CO2, K3)

Or

(b) Discuss how dimensionality affects the electronic and optical properties of nanomaterials. (CO2, K3)

13. (a) Discuss the characteristics and applications of zero-dimensional nanomaterials. (CO3, K6)

Or

(b) Describe the synthesis and functionalization of composite nanomaterials. (CO3, K1)

14. (a) Similarities and differences between inter-molecular and interparticle forces. (CO4, K4)

Or

(b) Debate strong intermolecular forces with suitable example. (CO4, K4)

15. (a) Explain the principles and mechanisms behind super-hydrophobicity in nanomaterials. (CO5, K3)

Or

(b) Describe how nanomaterials are used in paints and coatings. What benefits do they provide in terms of performance, and durability? (CO5, K3)

Part C ($5 \times 8 = 40$)

Answer **all** questions not more than 1000 words each.

16. (a) Describe the synthesis methods for nanomaterials. Compare and contrast techniques such as chemical vapor deposition, and ball milling, discussing the Advantages. (CO1, K2)

Or

(b) Explain the quantum confinement effect and its implications for the electronic and optical properties of semiconductor nanomaterials. Provide examples of how this effect is utilized in quantum dots. (CO1, K2)

17. (a) Analyse the role of molecules in the synthesis of nanostructures. What types of molecular interactions are important for controlling the size, shape, and stability of nanomaterials? (CO2, K3)

Or

(b) Discuss the impact of atomic structure on the properties of nanomaterials. How do different atomic arrangements affect mechanical, optical, and electronic properties? (CO2, K3)

18. (a) Describe the methods for synthesizing 2D films and their applications. (CO3, K3)

Or

(b) Discuss how dimensionality impacts the electronic, optical properties, band structure, and application areas of nanomaterials. (CO3, K3)

19. (a) Discuss the biological applications of nanomaterials, focusing on their use in drug delivery systems and medical diagnostics. (CO4, K6)

Or

(b) Explain the unique chemical reactivity of ceramic nanomaterials compared to bulk ceramics. (CO4, K6)

20. (a) Explain the principles and applications of self-cleaning surfaces in nanotechnology. How do photocatalytic nanomaterials and superhydrophobic surfaces work together to achieve self-cleaning properties? (CO5, K6)

Or

(b) (i) Discuss the significance of carbon nanotubes (CNTs) and fullerenes in catalysis. How do these nanomaterials enhance catalytic processes.

(ii) Explain the benefits and challenges of incorporating nanomaterials into textile products. (CO5, K6)

———————

R2001	Sub. Code
	533501

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Nanoscience and Technology

Elective — THIN FILM TECHNOLOGIES AND CHARACTERISTICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The mean free path of the gas molecules inside a thin film deposition chamber is (CO1, K1)

   (a) Directly proportional to the pressure

   (b) Inversely proportional to the pressure

   (c) Equal to the square of the pressure

   (d) Equal to the square of the volume

2. Hertz-Knudsen equation denoted by (CO1, K1)

   (a) $\frac{d\,N}{A\,dt} = \frac{\alpha\,P\,N_A}{\sqrt{2\,\pi\,MRT}}$

   (b) $\frac{d\,N}{A\,dt} = \frac{\alpha PN_AR}{\sqrt{2\,\pi\,MT}}$

   (c) $\frac{d\,N}{A\,dt} = \frac{\alpha PN_AT}{\sqrt{2\,\pi\,MR}}$

   (d) $\frac{d\,N}{A\,dt} = \frac{PN_A}{\sqrt{2\pi\,\alpha\,MRT}}$

3. The radius of the critical nuclei is (CO2, K2)

(a) $r^* = -\frac{2\sigma_{cv}}{\Delta G_v}$ (b) $r^* = -\frac{\Delta G_v}{2\sigma_{cv}}$

(c) $r^* = -\frac{2\gamma\sigma_{cv}}{\Delta G_v}$ (d) $r^* = \frac{2\sigma_{cv}}{\Delta G_v}$

4. Nucleation rate I is proportional to the product of (CO2, K2)

(a) Critical nuclei concentration and rate of diffused molecules

(b) Critical nuclei concentration and growth temperature

(c) Surface energy and growth temperature

(d) Surface energy and adsorption energy

5. The lattice constants of substrate and epilayer are A_{sub} and A_{film}. Lattice misfit (L_{MF}) can be evaluated as (CO3, K3)

(a) $L_{MF} = \frac{A_{sub} - A_{film}}{A_{sub}} \times 100$

(b) $L_{MF} = \frac{A_{film}}{A_{sub}} \times 100$

(c) $L_{MF} = \frac{A_{sub}}{A_{film}} \times 100$

(d) $L_{MF} = \frac{A_{film} - A_{sub}}{A_{film}} \times 100$

6. ———————— is the example of surface defects. (CO3, K2)

(a) Twin boundaries (b) Edge dislocations

(c) Voids (d) Vacancies

7. At thin film spreads well and covers the substrate, when (CO4, K2)

(a) $\gamma_{film} + \gamma_{interface} < \gamma_{substrate}$

(b) $\gamma_{film} + \gamma_{interface} = \gamma_{substrate}$

(c) $\gamma_{film} + \gamma_{substrate} < \gamma_{interface}$

(d) $\gamma_{substrate} + \gamma_{interface} < \gamma_{film}$

8. The degree of texturing is the degree to which the crystallites in (CO4, K2)

(a) The film is randomly oriented

(b) The film is similarly oriented

(c) The film is amorphous

(d) The film is larger in size

9. Youngs modulus of a material is given by (CO5, K5)

(a) Stress/Force (b) Stress/Energy

(c) Stress/Strain (d) Strain/Stress

10. The optical absorption coefficient k of a thin film is given by (CO5, K5)

(a) $k = \frac{4\pi\lambda}{k}$ (b) $k = \frac{4\pi}{k\lambda}$

(c) $k = \frac{4\pi k}{\lambda}$ (d) $k = \frac{k}{4\pi\lambda}$

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) How thin films are deposited in a DC sputtering system? (CO1, K1)

Or

(b) What is RF sputtering? Why you use RF sputtering over DC sputtering? (CO1, K1)

12. (a) Compare 2D and 3D nucleation. (CO2, K2)

Or

(b) Classify the different thin film growth modes. (CO2, K2)

13. (a) Outline the influence of growth parameters on the nucleation process. (CO3, K2)

Or

(b) Summarize on the insitu thin film growth monitoring techniques. (CO3, K2)

14. (a) Relate homo, hetero and strained layer epitaxy. (CO4, K2)

Or

(b) Show the construction of 2 Dimensional superlattice structures for optoelectronic applications. (CO4, K2)

15. (a) Select and explain the appropriate method for analyzing the tensile strength of thin films. (CO5, K5)

Or

(b) Evaluate the temperature coefficient of resistance of a metallic thin film. (CO5, K5)

Part C ($5 \times 8 = 40$)

Answer **all** the questions not more than 1000 words each.

16. (a) Label the structure of DC glow discharge plasma and describe its characteristics. (CO1, K1)

Or

(b) Describe the operation and mechanism of thin deposition using RF sputtering. (CO1, K1)

17. (a) Illustrate the steps of thin film nucleation and growth. (CO2, K2)

Or

(b) Explain the influence of growth parameters on the morphology, microstructure evolution of thin films. (CO2, K2)

18. (a) Summarise the factors determine the surface diffusion rate with suitable expression. (CO3, K2)

Or

(b) Outline the factors governing the development of bulk film structure. (CO3, K2)

19. (a) Explain the fabrication of tunable bandgap structures for a potential application. (CO4, K2)

Or

(b) Classify the crystal imperfections by dimension wise. (CO4, K2)

20. (a) Determine the magnetic properties of thin films. (CO5, K5)

Or

(b) Evaluate the optical reflection and transmission parameters of a thin film interface. (CO5, K5)

———————

R2002	Sub. Code
	533301

M.SC. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Nanoscience And Technology

NANOBIOTECHNOLOGY AND NANOMEDICINE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option

1. What are the different types nanomaterials used in biomedical application (CO1, K1)
   (a) Dendrimer (b) Polymeric nanoparticle
   (c) Both (a) and (b) (d) None of the above
2. Which is the commonly used metal oxide nanomaterial in biomedical application (CO1, K1)
   (a) Tungsten oxide
   (b) Sulphur nanoparticle
   (c) Polymeric nanoparticle
   (d) Zinc oxide
3. Nano-fungicide works with mechanism of (CO2, K2)
   (a) Disruption of Fungal Cell Membranes
   (b) Inhibition of Fungal Enzymes and Proteins
   (c) Formation of sulphites
   (d) Both (a) and (b)
4. Deficiency of iron in plants results in (CO2, K2)
   (a) Chlorosis
   (b) Causes blossom rot early
   (c) Leaf tips looks burnt
   (d) Witches broom forms

5. Size of quantum dot should be (CO2, K3)

(a) Under 100 nm (b) Above 100 nm

(c) 1-10 nm (d) More than 200 nm

6. Principle behind bioimaging by nano particle is (CO2, K3)

(a) Fluorescence

(b) Surface plasmon resonance

(c) Magnetic resonance imaging

(d) All of the above

7. What are the kinetic parameters involved in targeted drug release (CO1, K3)

(a) pH

(b) Temperature

(c) Electrostatic Interaction

(d) All the above

8. Route not involved in administration of nanocarriers (CO3, K3)

(a) Oral route (b) Intravenous routes

(c) Rectal routes (d) Intramuscular routes

9. Nanomaterials in targeted drug delivery are (CO3, K5)

(a) Liposomes (b) Dendrimers

(c) Polymeric nanoparticles

(d) All the above

10. Metals used in dental implants are (CO3, K4)

(a) Titanium (b) Tungsten

(c) Zinc (d) None of the above

Part B (5 × 5 = 25)

Answer **All** questions not more than 500 words each

11. (a) List different types of nanomaterials used in nanobiotechnology? (CO1, K1)

Or

(b) Explain classification of nanomaterials based on dimension? (CO1, K1)

12. (a) Discuss the methods for application of nano-fertilizer? (CO2, K2)

Or

(b) Elaborate the advantages of nano-fertilizers? (CO1, K2)

13. (a) Elaborate the principle of fluorescence and phosphorescence? (CO2, K2)

Or

(b) Discuss the principle and parts involved in biosensing? (CO2, K2)

14. (a) Briefly discuss about lipid nanocarrier? (CO3, K3)

Or

(b) Explain objectives of drug delivery system?(CO3, K3)

15. (a) Write in detail about dental implants in nanotechnology? (CO4, K4)

Or

(b) Discuss about regenerative medicine? (CO4, K4)

Part C $(5 \times 8 = 40)$

Answer **All** questions note more than 1000 words each

16. (a) Explain in detail about nano materials and their classifications. (CO1, K1)

Or

(b) Summarize about hybrid and metal nano particles in pharmaceutical industry? (CO1, K1)

17. (a) Discuss methods for application of nano fertilizers? (CO2, K2)

Or

(b) Elaborate the mechanism behind enhanced nutritional uptake of nano fertilizer? (CO2, K2)

18. (a) Explain about fluorophores and quantum dots? (CO2, K3)

Or

(b) Discuss biosensors and its application? (CO2, K3)

19. (a) Classify the types of nano carriers (CO3, K4)

Or

(b) Shortly explain the route of delivery of nano medicine? (CO3, K4)

20. (a) Explain detail about nano materials in tissue engineering? (CO3, K5)

Or

(b) Elaborate nano medicine for cancer? (CO3, K5)

———————

R2003

Sub. Code
533302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Nanoscience And Technology

NANO ELECTRONICS AND NANO DEVICES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. What is Qubit? (CO1, K1)

   (a) Spin-dependent tunneling of electrons

   (b) Crossbar switch-based electronics

   (c) Non-volatite main memory for PCs

   (d) A basic unit of quantum information

2. Why are super-miniature electronic ICs fully functional at nano scale while mechanical devices are not? (CO1, K1)

   (a) Greater Volume

   (b) Greater Friction

   (c) Greater Surface Area

   (d) Greater Power

3. In ———————— information about an analyte is obtained by measuring the current as the potential is varied. (CO2, K4)

(a) Voltammetry (b) Volumetric

(c) Conductive (d) Transductive

4. ———————— biosensors are a class of electrochemical biosensors that transduce the biological recognition events caused by electroactive species at the sensing surface into a current signal for the quantification of an analyte within a sample matrix. (CO2, K4)

(a) Amperometric (b) Dielectric

(c) Immuno (d) Matrix

5. Which of the following is measured in the unit called Gauss? (CO3, K2)

(a) Radius of the nuclei

(b) Magnetic flux

(c) Magnetic induction

(d) None of the above

6. Devices that utilize the spin properties of electrons of their functionality is known as ———————— device. (CO3, K2)

(a) Electronic (b) Spintronic

(c) Magnetic (d) Molecular

7. Which of the following is correct about power MOSFET?

(CO4, K5)

I. The switching speed is very high and the switching times are of the order of nanoseconds

II. Power MOSFETs find increasing applications in low-power high frequency converters

(a) Both I and II (b) Neither I or II

(c) Only I (d) Only II

8. Who were the developers of the first MOSFET?

(CO4, K5)

(a) Cyrus Tabery and Jakub Kedziersk

(b) Dawon Kahng and Mohamed Atalla

(c) Nick Lindert and Toru Kang

(d) Eiji Takada and Shibly Ahmed

9. Quantum well structures are extensively used in LEDs and laser diodes. Which of the following option does not enhance the performance of these devices? (CO5, K6)

(a) Confine electronic and holes in a limited space

(b) Changes in the composition of the SQ active layer

(c) Guiding the output photons

(d) Un-tunable emission spectrum

10. Why are Quantum dot lasers preferred to traditional semiconductor lasers ? (CO5, K6)

(a) QD lasers have surface defects

(b) QD lasers have reduced electron-phonon interactions

(c) QD lasers have narrow emission line

(d) QD lasers have multiparticle Auger recombination

Part B ($5 \times 5 = 25$)

Answer **all** the questions not more than 500 words each

11. (a) What is information theory? (CO1, K1)

Or

(b) Name some of the basic lithographic techniques used for nanoelectronics. (CO1, K1)

12. (a) Simplify nano ferroelectrics. (CO2, K4)

Or

(b) Examine how ferroelectrics are used as a random-access memory. (CO2, K4)

13. (a) Explain spin dependent tunneling. (CO3, K2)

Or

(b) Give an outline of GMR effect. (CO3, K2)

14. (a) Explain nanorobotics. (CO4, K5)

Or

(b) Assess mechanical molecular nanodevices. (CO4, K5)

15. (a) Elaborate Quantum cascade LASERs. (CO5, K6)

Or

(b) Discuss about the various electroluminescent organic materials. (CO5, K6)

Part C ($5 \times 8 = 40$)

Answer **all** questions not more than 1000 words each

16. (a) How Lithography technique useful for nanoelectronics? (CO1, K1)

Or

(b) Describe the various tools for micro and nanofabrication. (CO1, K1)

17. (a) Interpret FeRAM circuit design. (CO2, K4)

Or

(b) Examine calorimetric sensors. (CO2, K4)

18. (a) Explain ballistic spin transport. (CO3, K2)

Or

(b) Express Landau-Lifshitz Gilbert equation. (CO3, K2)

19. (a) Explain Single electron transistors. (CO4, K5)

Or

(b) Evaluate Augmented and Virtual Reality. (CO4, K5)

20. (a) Discuss white LEDs based on different nanostructures. (CO5, K6)

Or

(b) Propose some high efficiency materials for OLEDS. (CO5, K6)

———————

R2004	Sub. Code
	533303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Nanoscience and Technology

NANOENGINEERING

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** questions by choosing the best answer.

1. The energy gap between the conduction band and the valence band in a semiconductor is known as (CO1, K2)

   (a) Ionization energy (b) Threshold energy

   (c) Bandgap (d) Work function

2. Which of the following materials is commonly used for the magnetic read/write heads in HDDs? (CO1, K2)

   (a) Silicon (b) Permalloy

   (c) Gold (d) Iron oxide

3. The key advantage of using graphene in nano-electronic device is its _____. (CO2, K3)

   (a) High electrical conductivity

   (b) High thermal expansion coefficient

   (c) Low mechanical strength

   (d) Poor chemical stability

4. The property of graphene primarily responsible for its exceptional electrical conductivity is _____. (CO2, K3)

(a) Zero bandgap

(b) Large surface area

(c) High density

(d) High thermal expansion coefficient

5. What is the primary function of the detector's shielding in radiation sensors? (CO3, K2)

(a) To increase the energy resolution of sensor

(b) To amplify detected signal

(c) To protect sensor from environmental radiation

(d) To filter out specific types of radiation

6. The bottom-up approach in nanoelectronics often involves _____. (CO3, K2)

(a) Reducing the size of existing components

(b) Applying high energy external fields

(c) Using large scale etching

(d) Assembling devices from molecular to atomic components

7. The experimental technique commonly used to observe non-equilibrium spin dynamics in magnetic nanostructures is _____. (CO4, K2)

(a) Atomic force microscopy

(b) Scanning tunneling microscopy

(c) Magnetic force microscopy

(d) X-ray diffraction

8. Which of the following materials is commonly used as a tunneling barrier in magnetic tunnel junctions? (CO4, K2)

(a) Silicon (b) Magnesium oxide

(c) Copper (d) Gold

9. Which of the following is a characteristic property of molecular crystals? (CO5, K1)

(a) Low melting and boiling points

(b) High thermal conductivity

(c) High electrical conductivity

(d) High boiling and melting point

10. An exciton is _____. (CO5, K1)

(a) A free electron in a semi-conductor

(b) A type of magnetic domain in ferromagnetic material

(c) A type of phonon in lattice crystal

(d) The bound state of an electron and a hole in semiconductors

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Outline the key components of a Lorentz microscope and how they contribute to the imaging of magnetic domains. (CO1, K2)

Or

(b) Illustrate the key materials used in magnetic media and their properties that make them suitable for data storage. (CO1, K2)

12. (a) Explain the structure and properties of fullerenes. (CO2, K3)

Or

(b) Discuss the properties and types of CNTs. (CO2, K3)

13. (a) Compare and contrast the fabrication techniques used for MEMS and NEMS. (CO3, K2)

Or

(b) Classify the different types of magnetic sensors and their operating principles. (CO3, K2)

14. (a) Explain the concept of Rashba effect and its role in gate-induced spin rotation. (CO4, K2)

Or

(b) Describe the giant magnetoresistance effect and its significance in magnetic multilayers. (CO4, K2)

15. (a) How does the process of doping effect the electrical properties of conducting and semiconducting polymers? (CO5, K1)

Or

(b) Describe the process of electron-hole pair generation and their subsequent binding. (CO5, K1)

Part C $(5 \times 8 = 40)$

Answer **all** questions not more than 1000 words each.

16. (a) Explain how MFM can be used to study magnetic domain structures and magnetic defects in materials. (CO1, K2)

Or

(b) Summarize the physical processes involved in the growth of semiconductor nanowires. (CO1, K2)

17. (a) Identify the challenges associated with integrating carbon nanotubes into electronic devices. (CO2, K3)

Or

(b) Construct a detailed explanation of the principles behind field emission from carbon nanotubes. How do the unique properties of CNTs enhance their field emission capabilities? (CO2, K3)

18. (a) Outline the various approaches to nanoelectronics and their fundamental principles. (CO3, K2)

Or

(b) Explain the various types of radiation sensors and their working mechanisms. (CO3, K2)

19. (a) Express the concept of non-equilibrium spin dynamics in laterally defined magnetic structures. (CO4, K2)

Or

(b) Discuss the physical mechanisms that influence spin-polarized tunneling in magnetic tunnel junctions. (CO4, K2)

20. (a) Explain the formation and characteristics of H-aggregates and J-aggregates. (CO5, K1)

Or

(b) Discuss the key factors that influence the efficiency of electroluminescence in an electrochemical cell. (CO5, K1)

———————

R2005	Sub. Code
	533304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Nano science and Technology

MICROSYSTEM TECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. Which of the following process take place in the presence of required temperature? (CO1, K3)

   (a) Anodic oxidation

   (b) Cathodic oxidation

   (c) Electroless deposition

   (d) Thermal deposition

2. How the process of thin film deposition carried out in cathode sputtering? (CO1, K2)

   (a) Slower than evaporation method

   (b) Faster than evaporation method

   (c) Similar to same as evaporation method

   (d) All of the mentioned

3. Which type of process is also known as fabrication process? (CO2, K3)

(a) Casting (b) Forming

(c) Joining (d) None of the mentioned

4. Which of the following process is not included in fabrication process? (CO2, K3)

(a) Welding (b) Riveting

(c) Pressing (d) Surface finish

5. Choose the correct order of increasing minimum size of feature obtained in photolithography by different light (CO3, K6)

(a) UV light > X-rays > Blue light > Red light

(b) UV light < Red light < Blue light < X-rays

(c) X-rays > UV light > Blue light > Red light

(d) X-rays < UV light < Blue light < Red light

6. The finer resolution in lithography can be obtained using (CO3, K3)

(a) Blue light (b) UV light

(c) Red light (d) X-rays

7. Which of the following is not a piezo electric sensor? (CO4, K3)

(a) PZT (b) Roscelle salt

(c) Mercury (d) Quartz

8. Magnetic bio sensor is widely used for (CO4, K4)

(a) Blood detection (b) DNA detection

(c) ECG detection (d) EMG detection

9. The SiO2 layer in an IC acts as (CO5, K3)

(a) A resistor (b) An insulating layer

(c) Mechanical output (d) None of the above

10. The most popular types of IC's are (CO5, K3)

(a) Thin film (b) Hybrid

(c) Thick-film (d) Monolithic

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) What are the difference between micro-ECM and EDM? (CO1, K2)

Or

(b) Write a short note on MBE method. (CO1, K6)

12. (a) Differentiate between wet and dry etching. (CO2, K2)

Or

(b) What are all the development of MEMS and packaging hierarchy. (CO2, K6)

13. (a) Write a short note on UV and X-rays radiation imaging. (CO3, K4)

Or

(b) Explain Nano imprint lithography (CO3, K4)

14. (a) How does communicable disease are diagnosed using bio nanosensor? (CO4, K4)

Or

(b) Write a note on pressure sensors and packaging. (CO4, K6)

15. (a) How to develop Si Carbide MEMS? (CO5, K3)

Or

(b) Describe the non-silicon MEMS and related fabrication techniques (CO6, K3)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Explain in detail about (CO1, K2)

(i) Sputtering process

(ii) Evaporation process

Or

(b) What are the classification of processing of substrate materials? (CO1, K2)

17. (a) Elaborate the details about silicon fabrication process. (CO2, K6)

Or

(b) Discuss the process of microsystems fabrication techniques. (CO2, K6)

18. (a) What are the classification of advanced lithography? (CO3, K2)

Or

(b) What are the differences between micro and nano lithography technique? (CO3, K2)

19. (a) Explain in detail about bionanosensor devices. (CO4, K2)

Or

(b) What are the performance and evaluations of MEMS techniques? (CO4, K3)

20. (a) Illustrate the integration of microsystems with electronics including RF MEMS. (CO5, K2)

Or

(b) What are the difference between SOC and SOP? (CO5, K2)

———————

R2006	Sub. Code
	533506

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Nanoscience and Technology

Elective : NANO BIOMATERIALS AND NANOBIOTECHNOLOGY FOR TISSUE ENGINEERING

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct options.

1. Which of the following materials is commonly used in orthopaedic implants for its biocompatibility and mechanical strength? (CO1, K2)

   (a) Titanium alloys (b) Polyethylene

   (c) Aluminium (d) Silicone

2. Wear debris generated from orthopaedic implants primarily affects which of the following? (CO1, K1)

   (a) Increases blood flow

   (b) Induces an inflammatory response

   (c) Enhances bone integration

   (d) Improves implant longevity

3. What is a significant cause of stress and strain imbalance at the tissue-implant interface in cartilage implants? (CO2, K2)

(a) Overloading during physical activity

(b) Materials degradation

(c) Poor surgical techniques

(d) All of the above

4. Which type of failure is primarily associated with vascular implants due to an adverse response to wear debris? (CO2, K1)

(a) Structural failure

(b) Infection

(c) Intimal hyperplasia

(d) Mechanical loosening

5. Which of the following materials is commonly used for bladder implants due to its biocompatibility? (CO3, K2)

(a) Polyurethane

(b) Nylon

(c) Stainless steel

(d) Polyvinyl chloride

6. How does wear debris impact the performance of bladder implants? (CO3, K1)

(a) Enhance cellular response

(b) Induces inflammatory reactions

(c) Promotes healing

(d) Improves mechanical stability

7. Which of the following describes a desirable biological response to implanted materials? (CO4, K1)

(a) Inflammation

(b) Fibrosis

(c) Osseointegration

(d) All of the above

8. Nanomaterials can improve the performance of implants by: (CO4, K2)

(a) Increaing the risk of infection

(b) Facilitating drug delivery

(c) Reducing mechanical strength

(d) Causing necrosis

9. Which cellular process is directly influenced by protein interactions with implanted materials? (CO5, K1)

(a) Mitosis

(b) Cellular migration

(c) Apoptosis

(d) Photosynthesis

10. What is the primary role of proteins absorbed on the surface of implanted materials? (CO5, K2)

(a) To create mechanical barrier

(b) To facilitate cellular recognition and adhesion

(c) To induce necrosis

(d) To increase implant weight

Part B (5 × 5 = 25)

Answer **all** the questions not more than 500 words each.

11. (a) List out the commonly used materials in orthopaedic implants with their properties. (CO1, K3)

Or

(b) What are the common modes of dental implant failure and write down the causes for each mode. (CO1, K3)

12. (a) Discuss briefly about how wear debris, stress and strain imbalance affect the performance of vascular graft. (CO3, K4)

Or

(b) What are the materials used for vascular implants and write their properties and applications? (CO3, K4)

13. (a) Elaborate the importance of material selection to avoid cartilage implant failure. (CO3, K4)

Or

(b) Discuss the common failure mechanisms in cartilage implants. (CO3, K3)

14. (a) List out the advantages of using nanomaterials in implants. (CO4, K4)

Or

(b) Discuss the biological response to implanted materials and its significance in implant success. (CO4, K4)

15. (a) Elaborate the process of cell adhesion and migration on implanted materials and how it contributes to tissue regeneration. (CO5, K4)

Or

(b) Briefly discuss the role of cellular differentiation and extracellular matrix deposition in tissue regeneration on implanted materials. (CO5, K4)

Part C ($5 \times 8 = 40$)

Answer **all** the questions not more than 1000 words each.

16. (a) Explain in detail about the modes of failure in orthopaedic implants. (CO1, K4)

Or

(b) List out the materials used in dental implants and discuss the factors lead to their failure. (CO1, K4)

17. (a) Elaborate how wear debris and stress and strain imbalance leads to failure of cartilage implants. (CO2, K5)

Or

(b) Discuss in details about the modes of failure in vascular implants. (CO2, K4)

18. (a) List out the materials used in bladder implants and write their properties, advantages and limitations. (CO3, K4)

Or

(b) Discuss the mechanism of cartilage implant failure, discuss the mode of failure associate with wear debris. (CO3, K5)

19. (a) Elaborate properties and advantages, of using nanomaterials in the field of implantation.(CO4, K6)

Or

(b) Discuss in detail about the biological response of body to implant materials and how it influences the success or failure of implantation. (CO4, K6)

20. (a) Elaborate the role of protein interactions in the cellular recognition of implanted materials and how it influences implantation process. (CO5, K5)

Or

(b) Discuss the role of extracellular matrix in context of implanted materials and how ECM deposition lead to successful tissue regeneration. (CO5, K6)

———————