R0264	Sub. Code
	533101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

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 questions by choosing the correct option.

1. Which of the following statement is incorrect? (CO1, K2)

   (a) If two operators have a common set of Eigen vectors then they commute

   (b) Two non-degenerate commuting operators have a common set of Eigen vectors

   (c) Eigen values of a Hermitian operator belonging to different eigen functions are real

   (d) All eigen values of Hermitian operators are real and the eigen vectors belonging to the same eigen values are orthogonal

2. In terms of bra and ket vectors, the definition of the inner product of the state vectors Ψ_a and Ψ_b takes the form $(\Psi_a, \Psi_b) =$ (CO1, K2)

   (a) < a b> (b) <b a>

   (c) <a a b> (d) <ab a b>

3. Pauli's exclusion principle states that (CO2, K2)

(a) two electrons can have all the quantum numbers same

(b) no two electrons can have all the quantum numbers same

(c) particles with integer and half integer spin cannot exist in the same state

(d) none of the above

4. In wave mechanics an incident beam of particles is represented by a ———————— wave in incident channel. (CO2, K2)

(a) circular (b) spherical

(c) plane (d) stationary

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. The scattered particles will (CO3, K3)

(a) Converges (b) Diverges

(c) Split (d) Disperse

7. In how many dimensions, the quantum dot excitons are confined? (CO4, K5)

(a) 0 D (b) 1 D

(c) 2 D (d) 3 D

8. 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

9. Free electrons exist in (CO5, K3)

(a) Free band (b) Conduction band

(c) Valence band (d) Does not exist

10. 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

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

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

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

Or

(b) Covert matrix A to its inverse. (CO1, K2)

$$A = \begin{bmatrix} 2 & 4 & 6 \\ 4 & 2 & 3 \\ 3 & -3 & 1 \end{bmatrix}$$

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

Or

(b) Show the failure of classical mechanics in explaining Einstein's photoelectric effect. (CO2, K2)

13. (a) Identify the non-allowed state for a free particle in a box. (CO3, K3)

Or

(b) Why a particle trapped in a box cannot be at rest? (CO3, K3)

14. (a) Measure the size effect in high dielectric constants materials. (CO4, K5)

Or

(b) What is size effect? Assess the size-dependency of optical properties. (CO4, K5)

15. (a) Explain the construction of a p-n junction in a semiconductor. (CO5, K3)

Or

(b) Prove that the Fermi level is lies exactly in between conduction band and valance band of intrinsic semiconductor. (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) Explain and relate beta and gamma functions. (CO1, K2)

Or

(b) Classify and compare Legendre's polynomial and Hermite's polynomial and give their condition for orthogonality. (CO1, K2)

17. (a) Derive the expression for time independent Schrodinger wave equation. (CO2, K2)

Or

(b) Explain the Uncertainty principle and show that the Uncertainty principle is a natural consequence of wave particle duality. (CO2, K2)

18. (a) Calculate the energy Eigen values and Eigen functions for the motion of a particle in a 2D well. (CO3, K3)

Or

(b) Solve Schrodinger equation for a particle confined to an infinite potential box of width L in order to derive the expression for energy eigen values. (CO3, K3)

19. (a) Explain the size effect in π-conjugated and strongly interacting π-conjugated systems. (CO4, K5)

Or

(b) Interpret the size effect in electromagnetic interactions between molecules and explain FRET. (CO4, K5)

20. (a) Explain the origin of energy bands and solids and illustrate an E-k diagram. (CO5, K3)

Or

(b) Explain the process of band gap modification in a semiconductor optoelectronic material. (CO5, K3)

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R–0265	Sub. Code
	533102

M.Sc. DEGREE EXAMINATION, NOVEMBER 2023.

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 questions by choosing the correct option.

1. The number of lattice points in the rhombohedral unit cell is (CO1, K1)

   (a) 8 (b) 4

   (c) 2 (d) 1

2. The tetragon has (CO1, K1)

   (a) 4 faces (b) 12 edges

   (c) 6 corners (d) 8 edges

3. Primary bonds have energy range in kJ mol^{-1} (CO2, K2)

   (a) 1000 - 5000 (b) 10 - 100

   (c) 100 - 1000 (d) 1 - 10

4. The transition from the ferromagnetic to the paramagnetic state is named after (CO2, K2)

(a) Curie (b) Curie - Weiss
(c) Neel (d) Debye

5. Pure silicon at 0 K is an (CO3, K4)

(a) Intrinsic semiconductor
(b) Extrinsic semiconductor
(c) Metal
(d) Insulator

6. The unit of relative dielectric constant is (CO3, K4)

(a) Dimensionless (b) $F\ m^{-1}$
(c) $C\ V^{-1}$ (d) $F\ C^{-1}$

7. The bulkiest side group in the monomer is in (CO4, K2)

(a) Teflon (b) PVC
(c) PTFE (d) Polystyrene

8. The factors that promote non-crystallinity in polymers are (CO4, K2)

(a) Large random side groups
(b) Branching
(c) Addition of plasticizers
(d) All the above

9. A cation vacancy and an anion vacancy in a crystal of the type AB is called (CO5, K2)

(a) Schottky defect (b) Frenkel defect
(c) Pair of vacancies (d) None of the above

10. The t vector is parallel to the b vector in a dislocation of the type: (CO5, K2)

(a) Edge (b) Mixed
(c) Screw (d) None of these

Part B (5 × 5 = 25)

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

11. (a) Determine the packing fraction efficiency of a face-centered cubic system. (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 optical properties of the solids. (CO2, K2)

13. (a) What is an n-type and p-type semiconductors? (CO3, K4)

Or

(b) Write a short note on p-n junction diodes. (CO3, K4)

14. (a) Explain the crystallinity of long-chain polymers. (CO4, K2)

Or

(b) What is meant by the Flexural property of the polymer? (CO4, K2)

15. (a) Write a short note on twin boundaries. (CO5, K2)

Or

(b) Explain how defects influence the properties of solids. (CO5, K2)

Part C (5 × 8 = 40)

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

16. (a) Explain the principle and working of X-ray diffractometer with a suitable example. (CO1, K1)

Or

(b) Discuss the types of crystal systems. (CO1, K1)

17. (a) Give a detailed description of the structure of silica and silicates. (CO2, K2)

Or

(b) Explain the electrical and magnetic properties of solids with suitable examples. (CO2, K2)

18. (a) Deduce the expression for the carrier concentration in the intrinsic semiconductor. (CO3, K4)

Or

(b) With a neat diagram, explain the working of junction transistors and junction lasers. (CO3, K4)

19. (a) Explain the classification of polymers with examples. (CO4, K2)

Or

(b) Elaborate how macroscopic deformation occurs in semi-crystalline polymers. (CO4, K2)

20. (a) Briefly explain the surface and volume defects. (CO5, K2)

Or

(b) Explain Hall-Petch behaviour and the deformation in FEE nanostructures. (CO5, K2)

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R0266	Sub. Code
	533103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Nanoscience and Technology

BASIC BIOTECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

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

1. Molecules in which the atoms are held together by ———— bonds have the strongest chemical linkages. (CO1, K1)

   (a) Covalent Bond (b) Ionic Bond

   (c) Hydrogen Bond (d) Vanderwaal force

2. Polysaccharides often called as animal starch is (CO1, K1)

   (a) Starch (b) Glycogen

   (c) Inulin (d) Dextrin

3. A gene produced for rDNA technology contains a gene from one organism joined to the regulatory sequence of another gene. Such gene is called as (CO2, K2)

   (a) Oncogene (b) Chimeric gene

   (c) Junk gene (d) Mutant gene

4. Which of the following group of enzymes are popularly called as "Molecular stichers"? (CO2, K2)

   (a) Restriction endonucleases

   (b) Ligases

   (c) RNA polymerases

   (d) DNA polymerases

5. The formation of embryoids from the pollen grains in the tissue culture medium is due to ———— (CO3, K3)

(a) Organogenesis (b) Cellular totipotency

(c) Test tube culture (d) Double fertilization

6. The production of secondary metabolites requires the use of (CO3, K3)

(a) Meristem (b) Protoplast

(c) Axillary buds (d) Cell suspension

7. First human protein produced through recombinant DNA technology is (CO4, K3)

(a) Insulin (b) Erythropoietin

(c) Interferon (d) Growth hormone

8. Type of cell culture prepared by directly inoculating from of the tissue of the organism in culture media is (CO4, K4)

(a) Primary cell culture

(b) Secondary cell culture

(c) Cell lines

(d) Transformed cell lines

9. Which one of the following is not a green house gas? (CO5, K6)

(a) Ammonia (b) Carbon monoxide

(c) Nitrous oxide (d) Methane

10. Use of plants or their products to degrade the pollutant to less toxic/non toxic products are termed as (CO5, K6)

(a) Bioleaching

(b) Bioremediation

(c) Phytoremediation

(d) PhycoreMediation

Part B (5 × 5 = 25)

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

11. (a) Explain the structure of eukaryotic cell with suitable illustrations. (CO1, K1)

Or

(b) Enumerate the salient features of Watson-Crick model of DNA. (CO1, K1)

12. (a) Elaborate the method used for secondary screening of recombinants. (CO2, K2)

Or

(b) Briefly explain the merits, ethical and social issues of gene cloning. (CO2, K2)

13. (a) Enlist the various components and parameters to be considered for the construction of green house. (CO3, K3)

Or

(b) Agrobacterium species is termed as nature's genetic engineer – Justify. (CO3, K3)

14. (a) Explain the characteristic features of primary and immortal cell lines. (CO4, K3)

Or

(b) Briefly explain the various physical methods of gene transfer. (CO4, K3)

15. (a) Explain in detail the role of microbial biotechnology in clearing oil spills in marine environment. (CO5, K6)

Or

(b) Outline the steps involved production of biogas. (CO5, K6)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1,000 words each.

16. (a) Explain in detail classification, structure of heteropolysaceharides and its biological significance. (CO1, K1)

Or

(b) Derive the Michaelis-Menten equation for an enzyme catalyzed reaction. How MM equation can be linearized? (CO1, K1)

17. (a) Outline the steps involved in recombinant DNA technology and add a note on its applications. (CO2, K2)

Or

(b) Discuss in detail *in vivo* and *ex vivo* gene therapy with suitable examples. (CO2, K2)

18. (a) Elaborate the various stages of micropropagation and its advantages. Cite suitable examples for horticulture plants. (CO3, K3)

Or

(b) Summarize your idea about "Biopharming" of plants for the production of recombinant proteins.(CO3, K3)

19. (a) Give a detailed account on typos of cell culture media and its composition. (CO4, K3)

Or

(b) Enumerate the steps involved in construction of transgenic animals. Add a note on its biomedical applications. (CO4, K3)

20. (a) Elaborate in detail the sources and steps involved in single cell protein synthesis, its merits and demerits. (CO5, K6)

Or

(b) Discuss in detail about phytoremediation techniques for waste water treatment. (CO5, K6)

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R0267	Sub. Code
	533104

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

NanoScience and Technology

INTRODUCTION TO NANOSCIENCE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

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

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

1. Which one of the following explains the behaviour of matter at the atomic scale? (CO1, K2)

   (a) Classical (b) Quantum

   (c) Both (a) and (b) (d) None of the above

2. Which one of the following nanomaterials comes under two-dimensional? (CO1, K2)

   (a) Nanoparticles (b) Nanorods

   (c) Nanofilms (d) Bundles of nanowires

3. The melting point of particles in nano form (CO2, K3)

   (a) Increases

   (b) Decreases

   (c) Increases then decreases

   (d) Remains same

4. The first talk about nano-technology was given by ———— (CO2, K3)

(a) Richard Feynman (b) Albert Einstein

(c) Newton (d) George D. Moore

5. Which of the following is an example of top-down approach of the synthesis of nanomaterial? (CO3, K6)

(a) Physical vapour deposition

(b) Sputtering

(c) Chemical vapour deposition

(d) Mechanical attrition

6. In a bucky ball, each carbon atom is bound to ———— adjacent carbon atoms. (CO3, K6)

(a) 4 (b) 3

(c) 2 (d) 1

7. The most important property of nanomaterials is (CO4, K4)

(a) Friction (b) Force

(c) Pressure (d) Temperature

8. The hardest material found in nature is ———— (CO4, K4)

(a) Steel (b) Topaz

(c) Diamond (d) Graphite

9. Which property of nanoparticles provides a driving force for diffusion? (CO5, K3)

(a) Optical properties

(b) High surface-to-volume ratio

(c) Sintering

(d) None of the above

10. Silica coated iron oxide nanoparticles are used in _____ (CO5, K3)

(a) Structural and mechanical materials

(b) Electronics

(c) Magnetic applications

(d) Medical diagnosis

Part B (5 × 5 = 25)

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

11. (a) Write a short note on ceramics. (CO1, K2)

Or

(b) Explain the significance of nanoscale materials. (CO1, K2)

12. (a) What is the difference between nucleation and growth? (CO2, K3)

Or

(b) Write a short note on 2D nanostructures. (CO2, K3)

13. (a) Explain the differences between the properties of bulk and microscopic materials. (CO3, K6)

Or

(b) Give a short note on the optical properties of nanomaterials. (CO3, K6)

14. (a) What is meant by grain boundaries? (CO4, K4)

Or

(b) Write a short note on intermolecular forces. (CO4, K4)

15. (a) Explain superhydrophobicity. (CO5, K3)

Or

(b) Write a short note on biochips. (CO5, K3)

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

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

16. (a) Explain the different types of nanomaterials. (CO1, K2)

Or

(b) Discuss the background of Nanotechnology based on its fundamental scientific implications. (CO1, K2)

17. (a) Explain how the properties of nanomaterials are influenced by the size of nanomaterials. (CO2, K3)

Or

(b) With a neat diagram, explain the phenomena of nucleation and growth of nanomaterials. (CO2, K3)

18. (a) Explain the electrical and mechanical properties of nanomaterials. (CO3, K6)

Or

(b) Give a detailed description of biological nanomaterials with examples. (CO3, K6)

19. (a) Explain the different types of nanocrystals. (CO4, K4)

Or

(b) Elaborate the similarities and differences between the intermolecular and interparticle forces. (CO4, K4)

20. (a) Explain the role of nanostructures in forensic applications. (CO5, K3)

Or

(b) How nanomaterials are useful in the food and cosmetic applications. (CO5, K3)

R0268	Sub. Code
	533501

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

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. Give the thickness range of the film used in thin film technology (CO1, K1)

   (a) 0.5-2.5 mm

   (b) 0.02-8 mm

   (c) 10-20 mm

   (d) 0.05-0.07 mm

2. How is the process of film deposition carried out in cathode sputtering? (CO1, K1)

   (a) Slower than evaporation method

   (b) Faster than evaporation method

   (c) Similar to same as evaporation method

   (d) All of the mentioned

3. What is nucleation in crystallization? (CO2, K2)

(a) It is the initial step in crystallization

(b) It is the final step in crystallization

(c) It is the step where nucleus is added

(d) It is the sub category crystallization

4. Which of the following statements about primary nucleation are correct? (CO2, K2)

Statement 1: The appearance of the first crystal is called primary nucleation time.

Statement 2: It describes the transition to a new phase.

(a) True, False (b) True, True

(c) False, True (d) False, False

5. What is the primary purpose of chemical vapor deposition (CVD) in the manufacturing industry? (CO3, K2)

(a) To coat or deposit thin films on a substrate

(b) To create a vacuum within a chamber

(c) To remove material from a substrate

(d) To produce mechanical vibrations

6. In physical vapor deposition (PVD), which of the following processes is used to create a thin film on a substrate? (CO3, K2)

(a) Chemical reactions between liquid precursors

(b) Erosion of the substrate material

(c) Evaporation of solid source material

(d) Electrochemical plating

7. Which of the following epitaxial growth techniques typically involves the precise deposition of individual atoms or molecules in a high-vacuum environment? (CO4, K2)

(a) Chemical Vapor Deposition (CVD)

(b) Molecular Beam Epitaxy (MBE)

(c) Metalorganic Vapor Phase Epitaxy (MOVPE)

(d) Liquid Phase Epitaxy (LPE)

8. Which epitaxial growth technique often involves the use of liquid-phase solutions to deposit a crystalline layer on a substrate? (CO4, K2)

(a) Chemical Vapor Deposition (CVD)

(b) Metalorganic Vapor Phase Epitaxy (MOVPE)

(c) Molecular Beam Epitaxy (MBE)

(d) Liquid Phase Epitaxy (LPE)

9. Which of the following is a characteristic of thin films? (CO5, K5)

(a) Thickness typically ranges from millimeters to centimeters

(b) They are opaque and do not transmit light

(c) Surface roughness is not a concern in thin film applications

(d) They can exhibit unique optical and electronic properties due to their size and structure

10. What is the key application of thin films in the field of electronics? (CO5, K5)

(a) Building large-scale infrastructure projects

(b) Producing bulk materials for construction

(c) Creating integrated circuits and thin-film transistors

(d) Manufacturing heavy machinery

Part B (5 × 5 = 25)

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

11. (a) Explain Hertz Knudsen equation. (CO1, K1)

Or

(b) Explain how plasma properties can be controlled during glow discharge for specific purposes. (CO1, K1)

12. (a) Explain the concept of nucleation in thin film formation. (CO2, K2)

Or

(b) Describe the self-assembly process. (CO2, K2)

13. (a) Describe adsorption and Surface diffusion. (CO3, K2)

Or

(b) Explain Lattice mismatch and surface morphology in thin film deposition technology. (CO3, K2)

14. (a) What is meant by homo and hetero epitaxy? (CO4, K2)

Or

(b) Describe bandgap engineering in epitaxy thin film technology. (CO4, K2)

15. (a) Explain mechanical and electrical properties of thin film. (CO5, K5)

Or

(b) Describe multilayer thin films. (CO5, K5)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1,000 words each.

16. (a) Describe the key process involved in thin film deposition and provide examples of different deposition methods. (CO1, K1)

Or

(b) Explain the concept of Sputtering as a thin film deposition technique. (CO1, K1)

17. (a) Explain the stages involved in nucleation, the mechanisms that govern the growth of thin film, and the factors that impact the thin film structure. (CO2, K2)

Or

(b) Write about the mechanism and controls for nanostructure of 0 and 1 dimension. (CO2, K2)

18. (a) Describe any four factors that influence the process of nucleation and growth in deposition technology. (CO3, K2)

Or

(b) Explain growth monitoring and composition control in thin film deposition technology of semiconductor devices. (CO3, K2)

19. (a) Summarize the epitaxy technology and its classification. (CO4, K2)

Or

(b) Explain Molecular bean epitaxy. (CO4, K2)

20. (a) Explain various thin film properties for industrial application. (CO5, K5)

Or

(b) Explain the monolayer and Multilayer films. How to analyze it? (CO5, K5)

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R0269	Sub. Code
	533301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Nanoscience And Technology

NANOBIOTECHNOLOGY AND NANOMEDICINE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

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

1. Nano sized polymers built from branched units are called _____ (CO1, K2)

   (a) Dendrimers

   (b) Metal based materials

   (c) Carbon based materials

   (d) Composites

2. Spherical gold nanoparticles are _____ dimensional nanomaterials (CO1, K2)

   (a) Zero (b) Two

   (c) One (d) Three

3. ———————— is used as vehicle to deliver desired molecules into the seeds darg germination. (CO2, K6)

(a) CNT (b) CNF

(c) CNR (d) CNP

4. Gutbuster is a nano ———————— (CO2, K6)

(a) herbicide (b) weedicide

(c) nematicide (d) insecticide

5. Quantum dots are ———————— in nature (CO3, K6)

(a) inorganic (b) organic

(c) metallic (d) biologic

6. In glucose electrode, glucose oxidase has been coupled to an electrode by which of the following materials? (CO3, K6)

(a) Polyacrylamide (b) Urease

(c) Ferrocene (d) Biochips

7. A non-ionic surfactant based multilamellar or unilamellar vesicular structure is (CO4, K4)

(a) Liposome (b) Niosome

(c) Microspheres (d) Nanoparticle

8. Alzet is an example of ———————— type of parenteral system. (CO4, K4)

(a) Osmotic pressure activated

(b) Vapour pressure activated

(c) Magnetically activated

(d) Hydration activated

9. Nanomaterials with antioxidant properties are (CO5, K5)

(a) Nanowires (b) Nanotubes

(c) Fullerences (d) Buckyballs

10. Nanoshells are used in the treatment of (CO5, K5)

(a) Cancer

(b) Parkinson's disease

(c) Alzheimer's disease

(d) HIV

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

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

11. (a) Explain the role of carbon nanotubes in combating infectious disease. (CO1, K2)

Or

(b) Outline the biological significance of organic-inorganic hybrid nanomaterials. (CO1, K2)

12. (a) Discuss the role of nanopesticides in the control of pest and insect. (CO2, K6)

Or

(b) Explain the various methods adapted application of nano-fertilizers on agricultural field. (CO2, K6)

13. (a) Give a brief account on biosensors for the detection of microbes in agro products. (CO3, K6)

Or

(b) Elaborate the role of carbon based nanomaterial in bioimaging. (CO3, K6)

14. (a) Explain the various routes of administration of nanocarriers and mode of cellular entry. (CO4, K4)

Or

(b) Enumerate the characteristic features of lipid based nanocarrier for drug delivery. (CO4, K4)

15. (a) Explain the construction and working principle of respirocytes. (CO5, K5)

Or

(b) Explain in detail the application of nanomaterial in orthopedic medicine. (CO5, K5)

Part C (5 × 8 = 40)

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

16. (a) Describe in detail about natural polymer based nanomaterial and its biomedical application. (CO1, K2)

Or

(b) Summarize the rote of various metal and metal oxide based nanoparticles in the field of biomedicine. (CO1, K2)

17. (a) Elaborate in detail the various commercially available nanofertilizer in the market and its merits over conventional fertilizer. (CO2, K6)

Or

(b) Discuss in detail the mechanism behind enhanced nutritional intake, nitrogen fixation and photosynthesis of plants using nano—fertilizers. (CO2, K6)

18. (a) Elaborate in detail the surface chemistry of quantum dots and its functionalization for cell targeting and imaging. (CO3, K6)

Or

(b) Discuss in detail the working principle of protein based sensor and its potential role in disease diagnosis. (CO3, K6)

19. (a) Classify the polymer based nanocarriers and discuss in detail its salient features as drug delivery system. (CO4, K4)

Or

(b) Outline the steps involved in design and generation of nanobodies. Add a note on its pharmaceutical application. (CO4, K4)

20. (a) Elucidate the role of nanomaterial as nanotheranostic agent for targeted cancer therapy. (CO5, K5)

Or

(b) What are nanofibrous scaffold? Discuss the types of nanoscaffold and its application in tissue engineering? (CO5, K5)

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R0270	Sub. Code
	533302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Nanoscience and Technology

NANOELECTRONICS AND NANODEVICES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

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

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

1. FeRAM and DRAM happens between the _____ cycles. (CO1, K4)

   (a) Re-written (b) Read and write

   (c) Read only (d) Write only

2. In Curie -Weiss law ,the temperature is dependent of _____? (CO2, K1)

   (a) Current

   (b) Energy

   (c) Dielectric constant

   (d) Temperature

3. Colorimetry uses the relationship between colour intensity of a solution and the concentration of the coloured species present. Is this statement true or false? (CO1, K3)

   (a) True (b) False

4. The Field Effect Transistor (FET) has (CO3, K2)

(a) Very high input impedance

(b) Small in Size

(c) Low Power Consumption

(d) All of the above

5. Ballistic spin transport applicable in (CO2, K2)

(a) Nanoelectronics (b) Microelectronics

(c) NEMS (d) Only (a) and (c)

6. Spintronics development i.e GMR (CO4, K2)

(a) 1983 (b) 1984

(c) 1999 (d) 1994

7. The base of a transistor is ———— doped. (CO1, K1)

(a) Heavily (b) Moderately

(c) Lightly (d) None of the above

8. Spintronics materials have a high promise towards scalable quantum computing as (CO2, K3)

(a) Spin is almost the perfect qubit that can be long lived as spin interaction is small

(b) Spin can be changed by polarized light

(c) Spin is a nontrivial quantum degree of freedom

(d) All of the above

9. Semiconductors are ———— on the modern-day electronics. (CO2, K3)

(a) Tools (b) Materials

(c) Building block (d) All the above

10. TMR is a component consisting of ———— ferromagnets separated by a thin ————. (CO5, K4)

(a) One, Insulator

(b) Two, Insulator

(c) One, Semiconductor

(d) Two, Semiconductor

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

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

11. (a) Write brief notes on Physical Fundamentals of Nanoelectronics. (CO1, K2)

Or

(b) Write short notes of quantum blockade effect. (CO1, K2)

12. (a) Describe Electrochemical cells. (CO1, K4)

Or

(b) What is Surface and Bulk Acoustic devices? (CO1, K2)

13. (a) How sensors identify of Hazardous Solvents and Gases? (CO1, K2)

Or

(b) Explain Calorimetric Sensors. (CO3, K3)

14. (a) Write about the tools for Micro and Nanoelectronics fabrication. (CO2, K6)

Or

(b) What is difference of FERAM and DDRAM? (CO2, K1)

15. (a) Sketch and discuss the Quantum Well Laser. (CO3, K2)

Or

(b) Write short notes of Augment and Virtual Reality (AR and VR) concept. (CO1, K1)

Part C (5 × 8 = 40)

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

16. (a) Give a brief note on basics of Lithographic techniques for nanoelectronics. (CO3, K4)

Or

(b) Write in detail about Ballistic transport mechanism. (CO2, K1)

17. (a) What is Sensor? Explain its types and working. (CO4, K4)

Or

(b) Describe Gas Sensitive FET. (CO5, K2)

18. (a) Sketch the Fe-RAM Circuit diagram and mechanism. (CO5, K6)

Or

(b) Discuss the mechanism and working of MRAM. (CO4, K4)

19. (a) Sketch and explain single electron transistor (SET). (CO3, K2)

Or

(b) What are Optical Fibers for Nanodevices? (CO1, K5)

20. (a) Derive Landau-Lifshitz Gilbert equation. (CO2, K1)

Or

(b) Explain Nano scale MOSFET. (CO1, K6)

R0271	Sub. Code
	533303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Nanoscience and Technology

NANO 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 option

1. What is responsible for Conduction in Semiconductor? (CO1, K2)

   (a) Electrons only

   (b) Holes only

   (c) Both electrons and holes

   (d) neither electrons nor holes

2. Which of the following principle used in Holography? (CO1, K2)

   (a) Interference (b) Diffraction

   (c) Interferometer (d) Polarization

3. Which kind of structure present in the metallic carbon nanotubes? (CO2, K3)

(a) Armchair (b) Chiral

(c) Boat (d) Achiral

4. What form will form graphite readily in oxygen containing atmospheres? (CO2, K3)

(a) Carbon-monoxide

(b) Carbon dioxide

(c) Carbon monosulphide

(d) Carbon-disulphide

5. What is the significance of scaling down mechanical systems to the micro and nanoscale? (CO3, K2)

(a) Increased structural stability

(b) Improved resistance to wear and tear

(c) Enhanced sensitivity and precision

(d) Greater resistance to environmental factor

6. In the context of thermal sensors, what is the Seebeck effect? (CO3, K2)

(a) Its a measure of thermal conductivity.

(b) Its a phenomenon where materials generate a voltage when subjected to a temperature gradient.

(c) It's the ability of a sensor to emit radiation.

(d) It's a property of Hall effect sensors.

7. What is a 'spin-up' state for an electron in Spintronics? (CO4, K2)

(a) The electron is not moving

(b) The electron's spin is aligned in the same direction as an external magnetic field

(c) The electron's spin is aligned opposite to an external magnetic field.

(d) The electron has gained energy

8. What is the term for the magnetic effect resulting from the interaction between an electron's spin and its orbital motion? (CO4, K2)

(a) Spin alignment

(b) Spin relaxation

(c) Spin-orbit coupling

(d) Spin polarization

9. Which of the following statement is true regarding hybrid orbitals? (CO5, K1)

(a) The amount of orbitals formed after the hybridization is not equal to the number of orbitals before hybridization

(b) The hybrid orbitals don't have equal energy

(c) They can form more stable bonds than the pure orbitals

(d) Hybridization doesn't indicate geometry

10. Which of the following is not an application of conducting polymers? (CO5, K1)

(a) Rechargeable batteries

(b) Analytical sensors

(c) Electronics

(d) Adhesives

Part B (5 × 5 = 25)

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

11. (a) Write working principle of Lorentz microscopy with schematic diagram. (CO1, K2)

Or

(b) Explain working principle and mechanism of Electron Holography. (CO1, K2)

12. (a) Illustrate the properties of the carbon nanotubes. (CO2, K3)

Or

(b) Discuss about CNTs used in Field emission and shielding applications. (CO2, K3)

13. (a) Explain Micro electrochemical system technology. (CO3, K2)

Or

(b) Write the Schematic diagram and working principle of micro actuators. (CO3, K2)

14. (a) Briefly explain Rashba effect in spin field effect transistor. (CO4, K2)

Or

(b) Mention the concept of Datta–Das transistor. (CO4, K2)

15. (a) What is liquid crystallinity? Explain their preparation and properties. (CO3, K1)

Or

(b) Describe H and J aggregates. (CO3, K1)

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

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

16. (a) Give a Brief note on Magnetic Force Microscopy. (CO1, K2)

Or

(b) What is Magnetic Media and explain their properties. (CO1, K2)

17. (a) What is Field Effect Transistor? How to use CNT in FET applications? (CO2, K3)

Or

(b) Discuss in detail about types of CNTs and their merits and demerits. (CO2, K3)

18. (a) Explain the fabrication process of Nano electronics devices. (CO3, K2)

Or

(b) Bring out significance of thermal sensor and mechanical sensor in nano electronic device. (CO3, K2)

19. (a) Why Spintronics is important? Explain their properties. (CO4, K2)

Or

(b) Briefly explain spin relaxation in magnetic multi layers. (CO4, K2)

20. (a) Make a detailed note on electroluminescence from an electrochemical cell. (CO5, K1)

Or

(b) Explain about (CO5, K1)

(i) Hybridisation

(ii) conjugation and

(iii) excitations.

———————

R0272	Sub. Code
	533304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

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** questions.

1. Thickness of thin film in the range of ————————. (CO1, K1)

   (a) Nm

   (b) Micro meter

   (c) Several nm to several mm

   (d) Several nm to several micro meter

2. ———————— parameter effect on Thin film formation in Thermal evaporation. (CO1, K1)

   (a) Temperature (b) Concentration

   (c) PH (d) Density

3. One of the applications of Bulk micromachining is (CO1, K1)

   (a) SAW sensor

   (b) Resonant sensor

   (c) Temperature sensor

   (d) Pressure sensor

4. ———————— is the most used in silicon micromachining. (CO1, K1)

(a) Laser micromachining

(b) Micro Electro-Discharge machining

(c) Bulk machining

(d) Powder Blasting

5. One of the most used kinds of lasers in microfabrication is (CO1, K1)

(a) Excimer

(b) Diamond milling

(c) Bulk micromachining

(d) None of the above

6. Which of these is a material removal method? (CO1, K1)

(a) Laser Micromachining

(b) Laser Microelectronic

(c) Laser Electro-Discharge

(d) None of the above

7. ———————— process is also called spark erosion. (CO1, K1)

(a) Ultrasonic machining

(b) Powder blasting

(c) Soft lithography

(d) Micro electro discharge machining

8. ———————— method removes material through erosive action. (CO1, K1)

(a) Diamond milling

(b) Soft lithography

(c) Micro-electro discharge machining

(d) Powder blasting

9. ———————— is anisotropic milling method. (CO1, K1)

(a) Diamond milling (b) LCD milling

(c) Both (a) and (b) (d) None of the above

10. Particle speed of powder blasting is in the range of (CO1, K1)

(a) 80 – 200 ms (b) 80 – 400 ns

(c) 80 – 200 ns (d) 80 – 200 s

Part B (5 × 5 = 25)

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

11. (a) Brief the scope and development of the Electronic Design Automation EDA. (CO2, K3)

Or

(b) Manipulate the rapid proto typing and micro ECM. (CO3, K3)

12. (a) Explain the difference between MEMS and microsystems. (CO2, K3)

Or

(b) Distinguish between Microelectronics and Microsystem. (CO2, K5)

13. (a) Interpret the UV imaging technology. (CO2, K4)

Or

(b) Illustrate the process of LISC. (CO3, K5)

14. (a) Demonstrate the MEMS performance and evaluation. (CO4, K6)

Or

(b) Discuss about atomic fusion bonding. (CO3, K5)

15. (a) Explain the Non-silicon MEMS fabrication. (CO3, K4)

Or

(b) Describe about System-on-chip (SOC). (CO4, K4)

Part C (5 × 8 = 40)

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

16. (a) Describe physical vapor deposition with relevant diagrams. (CO4, K4)

Or

(b) Categorize the classification of physical vapor deposition. (CO4, K4)

17. (a) Organize the micromachining for metals. (CO5, K4)

Or

(b) Describe various Sealing Techniques MEMS Mechanical Sensor Packaging. (CO4, K5)

18. (a) Explain the process of nanoimprint lithography. (CO5, K4)

Or

(b) Discuss the e-beam lithography technology. (CO4, K5)

19. (a) Examine the operation of biosensors for the detection of biological threats. (CO4, K4)

Or

(b) Explain the operation of the pressure sensor and its packaging. (CO4, K2)

20. (a) Develop the biomedical MEMS. (CO5, K3)

Or

(b) Predict the integration and exploitation of microsystem. (CO4, K3)

———————