R3633

Sub. Code
533301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

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. Which of the following is an example of an organic nanomaterial used in nanomedicine? (CO1, K2)

   (a) Gold nanoparticles

   (b) Quantum dots

   (c) Carbon-based nanomaterials

   (d) Zinc oxide nanoparticles

2. The primary advantage of nano-fertilizers over conventional fertilizers is: (CO2, K6)

   (a) Increased soil erosion

   (b) Reduced nutrient uptake

   (c) Enhanced photosynthesis and nitrogen fixation

   (d) Higher toxicity levels

3. Which of the following is NOT a type of nanocarrier used in drug delivery? (CO2, K4)

(a) Lipid nanocarriers

(b) Polymeric nanocarriers

(c) Dendrimers

(d) Cellulose nanofibers

4. In bioimaging applications, quantum dots are preferred because of their: (CO4, K6)

(a) High toxicity

(b) Broad absorption and narrow emission spectrum

(c) Low brightness

(d) Large particle size

5. ZnO nanoparticles are commonly used in agriculture due to their: (CO3, K6)

(a) Ability to promote bacterial growth

(b) Strong antimicrobial properties

(c) High solubility in water

(d) High toxicity to plants

6. The main function of a nanobiosensor is: (CO1, K6)

(a) Energy storage

(b) Detection of biomarkers

(c) Data encryption

(d) Water purification

7. What property of nanomaterials enhances their ability to penetrate biological membranes? (CO2, K5)

(a) High surface area-to-volume ratio

(b) Low electrical conductivity

(c) Large particle size

(d) Strong magnetic properties

8. Which of the following is an example of an advanced nanomedicine application? (CO2, K5)

(a) Traditional chemotherapy

(b) Antibiotic treatment

(c) Cancer nanotheranostics

(d) Conventional MRI scanning

9. Controlled drug release in nanocarrier-based systems is regulated by: (CO4, K6)

(a) pH and temperature

(b) Air pressure

(c) Magnetic fields only

(d) None of the above

10. Which of the following is an example of a carbon-based nanomaterial used in biomedical applications? (CO1, K2)

(a) Silver nanoparticles

(b) Carbon nanotubes

(c) Iron oxide nanoparticles

(d) Silica nanoparticles

Part B (5 × 5 = 25)

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

11. (a) Explain the role of nanotechnology in biomedical applications. (CO2, K2)

Or

(b) Describe the different types of nanomaterials used in nanomedicine. (CO3, K2)

12. (a) What are nano-fertilizers? Explain their advantages over conventional fertilizers. (CO5, K6)

Or

(b) Describe the mechanisms by which nano-fertilizers enhance plant growth. (CO3, K6)

13. (a) Explain the working principle of nano-biosensors and their applications. (CO5, K6)

Or

(b) Discuss the role of quantum dots in bioimaging. (CO3, K6)

14. (a) What are the different types of nanocarriers used in drug delivery systems? (CO2, K4)

Or

(b) Discuss the importance of controlled drug release in nanomedicine. (CO3, K4)

15. (a) Explain the applications of nanomaterials in regenerative medicine. (CO2, K5)

Or

(b) Discuss the role of nanotheranostics in cancer treatment. (CO3, K5)

Part C (5 × 8 = 40)

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

16. (a) Describe in detail the different types of nanomaterials used in nanomedicine and their biomedical applications. (CO5, K2)

Or

(b) Explain the fundamental principles behind nanobiotechnology and its tools used in biomedical applications. (CO3, K2)

17. (a) Discuss the role of nanotechnology in sustainable agriculture with a focus on nanofertilizers and nano-biosensors. (CO5, K6)

Or

(b) Explain the impact of nanotechnology in plant protection and nutrient management. (CO3, K6)

18. (a) What are nano-biosensors? Explain their working principle, fabrication and applications in biomedical and environmental monitoring. (CO1, K6)

Or

(b) Discuss the advantages of using quantum dots for biomedical imaging over conventional imaging agents. (CO2, K6)

19. (a) Explain the various drug delivery mechanisms involving nanocarriers and the parameters influencing their release. (CO1, K4)

Or

(b) Discuss the different routes of drug administration using nanotechnology and their biomedical advantages. (CO3, K4)

20. (a) Discuss the recent advancements in nanotechnology for biomedical applications, including regenerative medicine and nanotheranostics. (CO2, K5)

Or

(b) Explain how nanotechnology is revolutionizing cancer treatment through targeted drug delivery and imaging techniques. (CO5, K5)

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R3634

Sub. Code
533302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Nanoscience and Technology

NANOELECTRONICS AND NANO DEVICES

(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 is the primary advantage of FinFETs over traditional MOSFETs? (CO1, K1)

   (a) Higher power consumption

   (b) Better short-channel control

   (c) Lower electron mobility

   (d) Increased leakage current

2. In quantum dots, the energy levels are: (CO1, K1)

   (a) Continuous

   (b) Discrete

   (c) Determined by magnetic fields

   (d) Independent of size

3. Which technique is commonly used to fabricate silicon nanowires? (CO2, K4)

(a) Lithography

(b) Electrochemical etching

(c) Self-assembly

(d) Epitaxial growth

4. The density of states in a 2D electron gas varies: (CO2, K4)

(a) Linearly

(b) Quadratically

(c) Constant with energy

(d) Exponentially

5. What is the role of gate dielectrics in MOSFETs? (CO3, K2)

(a) To increase electron mobility

(b) To insulate the gate from the channel

(c) To enhance leakage current

(d) To reduce the threshold voltage

6. What is the key characteristic of topological insulators? (CO3, K2)

(a) Superconducting behavior

(b) Metallic surface states with insulating bulk

(c) High-temperature stability

(d) Absence of bandgap

7. Spintronics utilizes: (CO4, K5)

(a) Electron charge only

(b) Electron spin and charge

(c) Proton spin

(d) Phonon interactions

8. Carbon nanotubes exhibit which type of electrical behavior? (CO4, K5)

(a) Always metallic

(b) Always semiconducting

(c) Can be either metallic or semiconducting

(d) Insulating

9. The major limitation of Moore's Law in nanoelectronics is: (CO5, K6)

(a) Increasing device size

(b) Quantum effects at small scales

(c) Higher temperature stability

(d) Reduced transistor count

10. Which property makes graphene suitable for high-speed electronics? (CO5, K6)

(a) High electron mobility

(b) Large bandgap

(c) High dielectric constant

(d) Low thermal conductivity

Part B (5 × 5 = 25)

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

11. (a) Explain the working principle of FinFETs and their advantages over MOSFETs. (CO1, K1)

Or

(b) Discuss the concept of Coulomb blockade in quantum dots. (CO1, K1)

12. (a) Explain the fabrication techniques of nanowires. (CO2, K4)

Or

(b) Describe the density of states in 1D, 2D, and 3D systems. (CO2, K4)

13. (a) What are the different types of gate dielectrics used in MOSFETs, and how do they affect performance? (CO3, K2)

Or

(b) Explain the concept of topological insulators with an example. (CO3, K2)

14. (a) Describe the basic working principle of spintronic devices. (CO4, *K5)*

Or

(b) How do carbon nanotubes exhibit different electronic properties? (CO4, *K5)*

15. (a) Discuss the limitations of Moore's Law and potential solutions. (CO5, K6)

Or

(b) What are the electronic properties of graphene, and how do they influence its applications? (CO5, K6)

Part C (5 × 8 = 40)

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

16. (a) Explain the scaling challenges in MOSFETs and how FinFET technology addresses them. (CO1,K1)

Or

(b) Describe the quantum mechanical principles governing quantum dots and their applications. (CO1, K1)

17. (a) Discuss the different methods for nanowire synthesis and their impact on electronic properties. (CO2, K4)

Or

(b) Explain the role of electron density of states in nanoelectronic device performance. (CO2, K4)

18. (a) What are high-k dielectrics? Explain their advantages in MOSFET scaling. (CO3, K2)

Or

(b) Describe the experimental techniques used to study topological insulators. (CO3, K2)

19. (a) Explain the fundamental principles of spintronics and its applications in memory devices. (CO4, K5)

Or

(b) Discuss the synthesis, properties, and applications of carbon nanotubes in nanoelectronics. (CO4, K5)

20. (a) Explain the role of electron mobility and band structure in the future of nanoelectronics. (CO5, K6)

Or

(b) How does graphene-based transistor technology compare to silicon-based transistors? (CO5, K6)

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R3635

Sub. Code
533303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Nanoscience and Technology

NANOENGINEERING

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

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

1. What is the role of Lorentz microscopy in semiconductor nanostructures? (CO1, K2)

   (a) Imaging magnetic domains

   (b) Analyzing spin dynamics

   (c) Visualizing electric fields

   (d) Studying atomic vibrations

2. Define molecular electronics. (CO3, K3)

   (a) Study of chemical bonds

   (b) Electronics at a molecular scale

   (c) Semiconductor physics

   (d) Magnetic material properties

3. Name two unique properties of carbon nanotubes. (CO2, K3)

(a) High reactivity and low conductivity

(b) High strength and excellent conductivity

(c) Weak bonding and low weight

(d) Brittle structure and high weight

4. What is the Datta-Das spin field-effect transistor? (CO4, K2)

(a) A thermal sensor

(b) A device using spin-orbit coupling

(c) A carbon-based sensor

(d) A light-emitting polymer

5. List any two types of magnetic media used in semiconductor nanostructures. (CO5, K2)

(a) Optical disks and floppy disks

(b) Magnetic tapes and hard drives

(c) Graphene and CNTs

(d) Fullerenes and polymers

6. What are molecular crystals? (CO1, K1)

(a) Crystals formed by covalent bonds

(b) Crystals composed of individual molecules

(c) Crystals with metallic properties

(d) Crystals of carbon-based polymers

7. Explain the term “spintronics” in nanoscale materials. (CO2, K2)

(a) Use of light in electronics

(b) Manipulation of spin and charge in materials

(c) Development of nanoscale sensors

(d) Study of magnetic fields in materials

8. State one application of CNTs in field-effect transistors. (CO4, K3)

(a) Temperature sensing

(b) Energy storage

(c) Channel material for high conductivity

(d) Magnetic domain visualization

9. Define “electroluminescence” in the context of molecular materials. (CO5, K1)

(a) Emission of light by electrical stimulation

(b) Generation of heat by current flow

(c) Production of magnetic fields

(d) Absorption of light by molecules

10. What is the Rashba effect in spintronics? (CO4, K2)

(a) A form of molecular hybridization

(b) Coupling of spin and momentum in a material

(c) A phenomenon in light propagation

(d) Charge transfer between layers

Part B (5 × 5 = 25)

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

11. (a) Explain the fabrication techniques for semiconductor nanostructures. (CO1, K2)

Or

(b) Describe the role of optical imaging in characterizing nanostructures. (CO1, K2)

12. (a) Discuss the applications of graphene in molecular electronics. (CO2, K3)

Or

(b) Compare the properties of fullerenes and CNTs in nanoelectronics. (CO2, K3)

13. (a) Illustrate the working principle of nanoelectronic sensors. (CO3, K2)

Or

(b) Summarize the advantages and disadvantages of thermal sensors. (CO3, K2)

14. (a) Explain the concept of interface tunnel barriers in nanoscale devices. (CO4, K2)

Or

(b) Define and describe spin relaxation in nanoscale materials. (CO4, K2)

15. (a) How do excitons contribute to light emission in photonic molecular materials? (CO5, K1)

Or

(b) Discuss the difference between conducting and semi-conducting polymers. (CO5, K1)

Part C (5 × 8 = 40)

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

16. (a) Describe the physical processes in semiconductor nanostructures with suitable examples. (CO1, K2)

Or

(b) Discuss magnetic data storage and the role of write heads and read heads. (CO1, K2)

17. (a) Explain the structure and applications of carbon nanotubes in detail. (CO2, K3)

Or

(b) Illustrate the role of CNTs in shielding and logic gates in nanoelectronics. (CO2, K3)

18. (a) Discuss various approaches to nanoelectronic devices and their industrial relevance. (CO3, K2)

Or

(b) Analyze the extension of micro actuators to the nanoscale, with examples of applications. (CO3, K2)

19. (a) Define spintronics and explain its significance in magnetic multilayers. (CO4, K2)

Or

(b) Elaborate on non-equilibrium spin dynamics in magnetic structures. (CO4, K2)

20. (a) Describe the phenomenon of electroluminescence in molecular materials with examples. (CO5, K1)

Or

(b) Discuss the influence of supramolecular order in photonic molecular materials. (CO5, K1)

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R3636

Sub. Code
533304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Nanoscience and Technology

MICROSYSTEM TECHNOLOGY

(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. Which of the following techniques requires a high vacuum environment for thin film deposition? (CO1, K3)

   (a) Spin coating

   (b) Dip coating

   (c) Thermal evaporation

   (d) Electroless plating

2. In RF magnetron sputtering, what is the role of the magnetic field (CO1, K2)

   (a) To heat the substrate

   (b) To confine plasma near the target

   (c) To accelerate ions directly

   (d) To deposit material uniformly

3. Which of the following is considered a top-down fabrication method? (CO2, K3)

(a) Chemical Vapor Deposition (CVD)

(b) Lithography

(c) Sol-gel synthesis

(d) Self-assembly

4. Which of the following processes is not a part of microfabrication techniques? (CO2, K3)

(a) Etching (b) Doping

(c) Welding (d) Photolithography

5. Which of the following factors does NOT influence the thickness of a sputtered thin film? (CO3, K6)

(a) Sputtering power

(b) Working gas pressure

(c) Target-to-substrate distance

(d) Substrate color

6. The resolution of electron beam lithography is superior because : (CO3, K3)

(a) It uses UV light

(b) It uses low-energy electrons

(c) It uses high-energy electron beams

(d) It operates at room temperature

7. Which of the following is NOT a characteristic of piezoelectric materials? (CO4, K3)

(a) They generate voltage under mechanical stress

(b) They are always metallic in nature

(c) They can be used in sensors and actuators

(d) They exhibit reversible electric polarization

8. Electrochemical biosensors are primarily used for detecting (CO4, K4)

(a) Magnetic fields

(b) Optical signals

(c) Biological analytes

(d) Thermal radiation

9. The function of the passivation layer in integrated circuits (ICs) is to : (CO5, K3)

(a) Conduct electricity

(b) Provide mechanical strength

(c) Protect against environmental damage

(d) Increase capacitance

10. Which type of IC fabrication technology integrates all components on a single semiconductor substrate? (CO5, K3)

(a) Hybrid IC (b) Monolithic IC

(c) Thick-film IC (d) Discrete IC

Part B (5 × 5 = 25)

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

11. (a) Write the differences between Sputtering and thermal evaporation deposition. (CO1, K2)

Or

(b) Write a short note on EDA? (CO1, K6)

12. (a) Discuss dry etching methodologies for semiconductors. (CO2, K2)

Or

(b) Write about MEMS packaging hierarchy. (CO2, K6)

13. (a) Explain about radiation for imaging. (CO3, K4)

Or

(b) Summaries Nano imprint lithography. (CO3, K4)

14. (a) Illustrate the functions of bio nano sensor. (CO4, K4)

Or

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

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

Or

(b) Describe biomedical MEMS. (CO5, K3)

Part C

$(5 \times 8 = 40)$

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

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

(i) MBE

(ii) PLD.

Or

(b) Elaborate pattern transfer rapid prototyping. (CO1, K2)

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

Or

(b) Discuss dry etching technologies. (CO2, K6)

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

Or

(b) Discuss about Lithographically induced self-construction. (CO3, K2)

19. (a) Explain in detail about anodic and fusion bonding. (CO4, K2)

Or

(b) How the performance of MEMS device is evaluated. (CO4, K3)

20. (a) Illustrate the non-silicon MEMS and related fabrication techniques. (CO5, K2)

Or

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

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R3637

Sub. Code
533506

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Nanoscience and Technology

Elective : NANO BIOMATERIALS AND NANO BIOTECHNOLOGY FOR TISSUE ENGINEERING

(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. Which of the following is a limitation of orthopedic implants? (CO2, K3)

   (a) Biodegradation

   (b) Wear debris

   (c) Vascular inflammation

   (d) High conductivity

2. What is a major challenge in dental implants? (CO3, K3)

   (a) Electrochemical reaction

   (b) Stress shielding

   (c) Tissue inflammation

   (d) Protein over-absorption

3. Cartilage implants are primarily used to address (CO5, K3)

(a) Joint defects

(b) Nerve damage

(c) Skin transplants

(d) Vascular blockages

4. Which property is crucial for vascular implant materials? (CO1, K3)

(a) Bioinertness

(b) Biocompatibility

(c) Electrical conductivity

(d) High tensile strength

5. Nanomaterials improve tissue engineering by (CO2, K5)

(a) Mimicking the extracellular matrix

(b) Decreasing cell adhesion

(c) Triggering inflammatory responses

(d) Increasing implant failure

6. What causes most failures in cartilage implants? (CO4, K4)

(a) Fatigue wear

(b) Stress and strain imbalances

(c) Tissue overgrowth

(d) Protein absorption

7. Which of the following is an advantage of nanomaterials in implants? (CO2, K5)

(a) Cost reduction

(b) Promotion of osseointegration

(c) Electrochemical stability

(d) Stress generation

8. Protein adsorption in implants leads to (CO2, K6)

(a) Cellular recognition

(b) Implant fatigue

(c) Material degradation

(d) Vascular blockages

9. Nanomaterials used in dental applications include: (CO1, K3)

(a) Gold nanoparticles

(b) Titanium alloys

(c) Carbon nanotubes

(d) All of the above

10. The inflammatory response to implanted materials is initiated by: (CO4, K4)

(a) Cellular growth factors

(b) Protein adsorption on the implant surface

(c) Stress shielding

(d) Overgrowth of tissues

Part B (5 × 5 = 25)

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

11. (a) Explain the modes of failure in orthopedic implants. (CO3, K3)

Or

(b) Write a short note on the impact of wear debris on tissue implants. (CO2, K3)

12. (a) Discuss the materials used for cartilage grafts. (CO1, K3)

Or

(b) Describe the stress and strain imbalances observed in vascular implants. (CO4, K3)

13. (a) Explain the pharmacodynamics of nano-implants in the body. (CO2, K5)

Or

(b) What are the advantages of using nanomaterials as implants? (CO5, K5)

14. (a) Describe the role of protein adsorption in tissue regeneration. (CO2, K6)

Or

(b) Explain how nanotechnology is applied in stomatology. (CO3, K6)

15. (a) What are the major challenges in creating bio-transplants with nano sized materials? (CO5, K6)

Or

(b) Discuss the undesirable reactions of the body to implanted materials. (CO2, K6)

Part C (5 × 8 = 40)

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

16. (a) Discuss in detail the classification of materials used in orthodontic and dental implants, along with their limitations. (CO2, K3)

Or

(b) Explain the interaction of nanomaterials with biological cells and its role in tissue engineering. (CO5, K6)

17. (a) Elaborate on the challenges and solutions in cartilage transplant materials. (CO1, K3)

Or

(b) Describe the stress and strain imbalances at the tissue-implant interface and their consequences. (CO4, K3)

18. (a) Explain the applications of nanotechnology in advanced medical devices and tissue engineering. (CO2, K6)

Or

(b) Illustrate the biological responses to nano-implants in the body. (CO1, K6)

19. (a) Discuss the advantages and limitations of using nanomaterials in vascular implants. (CO2, K3)

Or

(b) Describe the role of the extracellular matrix in tissue regeneration. (CO5, K3)

20. (a) Explain how nanotechnology-based innovations address the challenges in bio-transplants. (CO2, K6)

Or

(b) Discuss the inflammatory response to implanted nanomaterials and its impact on tissue integration. (CO4, K6)

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