

R3652

Sub. Code

542301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Materials Science

NANOMATERIALS

(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 properties of a particle significantly affects the physical, chemical and biological properties of the drug? (CO1, K1)
 - (a) density
 - (b) sedimentation
 - (c) size
 - (d) surface area
2. Quantum dots can be used in (CO1, K2)
 - (a) Crystallography
 - (b) Optoelectronics
 - (c) Mechanics
 - (d) Quantum physics

3. CNTs are chemically bonded with (CO2, K2)
- (a) sp bonds
 - (b) sp² bonds
 - (c) sp³ bonds
 - (d) No chemical bond
4. Which method of nanowire synthesis makes use of strands of nucleotides as a precursor? (CO2, K2)
- (a) Solution phase synthesis
 - (b) Electrochemical deposition
 - (c) Ion track technology
 - (d) DNA-templated metallic nanowire synthesis
5. Which one of the following is an example of zero-dimensional nanostructure? (CO3, K5)
- (a) Nanoparticles
 - (b) Nanorods
 - (c) Nanotubes
 - (d) All of the above
6. Electrochemical cells follow one of the following rules (CO3, K5)
- (a) The cell potential is a broad characteristic
 - (b) Cell potential is an important independent characteristic
 - (c) An electrochemical cell's Gibbs free energy is an intense attribute
 - (d) Gibbs's free energy for an electrochemical cell is undetermined

7. Which of the following is not a member of the electrochemical cell family? (CO4, K5)
- (a) Voltaic cell
 - (b) Photovoltaic cell
 - (c) Electrolytic cell
 - (d) Fuel Cell
8. The resolving power of TEM is derived from _____ (CO4, K4)
- (a) electrons
 - (b) specimens
 - (c) power
 - (d) ocular system
9. Example for magnetic material used in data storage devices (CO5, K3)
- (a) 45 Permalloy
 - (b) CrO₂
 - (c) Cunife
 - (d) Alnico
10. Maximum magnetic force of magnet is (CO5, K2)
- (a) North pole
 - (b) South pole
 - (c) Between both poles
 - (d) A both pole

Part B

(5 × 5 = 25)

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

11. (a) What are the reason for the change of optical property with particle size? (CO1, K2)

Or

- (b) What is wettability? How do you change the wettability using nanostructure? (CO1, K2)

12. (a) What are the advantages of single wall nanotubes (SWNT) over multiwalled nanotubes (MWNT)? (CO2, K2)

Or

- (b) Write short notes on principles of arc-discharge method for the preparation of CNT? (CO2, K2)

13. (a) How is ballistic flow of electrons in the nanowires? (CO3, K6)

Or

- (b) Explain physical vapour deposition (PVD). (CO3, K4)

14. (a) What are the difference between absorption spectra and emission spectra? (CO4, K5)

Or

- (b) What are the applications of PL spectra? (CO4, K4)

15. (a) Explain GMR (Giant Magneto resistance) effect in magnetic storage? (CO5, K3)

Or

- (b) Explain magnetic tunneling junction (MTJ) in the nanoscale. (CO1, K3)

Part C

(5 × 8 = 40)

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

16. (a) Discuss the electrical and mechanical properties of nanostructured materials. (CO1, K2)

Or

- (b) Discuss the physical properties of the nanomaterials with particle size and shape? (CO1, K2)

17. (a) Explain synthesis of carbon nanotubes by pyrolysis technique. (CO2, K2)

Or

- (b) Discuss the synthesis of CNT using catalyst by chemical vapour technique? (CO2, K2)

18. (a) Discuss the working principles of pulsed laser deposition (PLD) and its advantages? (CO3, K4)

Or

- (b) Explain the synthesis of oxide nanowire using electrochemical deposition? (CO3, K4)

19. (a) Explain working principles of FeSEM with neat diagram? (CO4, K4)

Or

- (b) Discuss the high-resolution transition electron microscope (HRTEM) and its advantages? (CO4, K4)

20. (a) Discuss the MRAM structure and data read and write mechanism? (CO5, K3)

Or

- (b) What is non-volatile memory? Explain Millipeds for storage? (CO5, K3)
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R3653

Sub. Code

542302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Materials Science

POLYMER AND COMPOSITE MATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

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

1. What is the SI unit of molecular weight? (CO1, K2)
(a) Kg/mol (b) Pascal
(c) Kg/m³ (d) Cm/s
2. Which type of compounds cannot exhibit geometrical isomerism? (CO3, K2)
(a) Singly Bonded (b) Doubly Bonded
(c) Triply Bonded (d) Cyclic Compounds
3. Which of the following affects the resin's glass transition temperature? (CO2, K1)
(a) Presence of absorbed moisture
(b) Solvents
(c) Compression strength and modulus
(d) Both (a) and (b)

4. The heat deflection temperature (HDT) is typically _____ the glass transition temperature (CO1, K2)
- (a) Higher than (b) The same as
(c) Lower than (d) Non related to
5. The pseudoplastic flow behaviour can be explained by (CO2, K3)
- (a) apparent viscosity
(b) area of hysteresis loop
(c) hysteresis loop
(d) yield value
6. A capillary rheometer is an apparatus designed to measure (CO1, K2)
- (a) molecular weight (b) Density
(c) Shear stress (d) Shear viscosity
7. Which one of the following is not a precursor in the manufacturing of graphite fibers? (CO4, K2)
- (a) Rayon (b) Polyacrylonitrile
(c) Pitch (d) Silica
8. Which of the following methods are used to manufacture fibres? (CO1, K1)
- (a) Pultrusion (b) Extrusion
(c) Casting (d) All of the above
9. Bi-directional preregs are also known as (CO2, K3)
- (a) Prepreg tape
(b) Prepreg fabric
(c) Non-woven prepreg
(d) None of the above

10. Which of the following is not a trait of epoxy resins?
(CO4, K1)
- (a) High strength
 - (b) Brittle
 - (c) Excellent adhesion
 - (d) Unaffected by moisture

Part B (5 × 5 = 25)

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

11. (a) Write a note on isomerism in polymers. (CO1, K2)
- Or
- (b) Explain molecular weight of a polymer and methods to determine. (CO2, K2)
12. (a) Describe the factors affecting the polymer chain ordering. (CO2, K3)
- Or
- (b) Define Differential Scanning Calorimetry (DSC) technique. (CO3, K2)
13. (a) Write a note on non-Newtonian fluid in polymer processing. (CO2, K2)
- Or
- (b) Explain the working principle of Couette rheometer with diagram. (CO3, K6)
14. (a) Explain ceramic composites and their applications with an example. (CO4, K6)
- Or
- (b) Discuss about the factors affecting the mechanical properties of polymers. (CO2, K2)
15. (a) Define stir-casting method of fabrication of composite. (CO3, K3)
- Or
- (b) Explain the closed moulding techniques of composite fabrication. (CO3, K2)

Part C

(5 × 8 = 40)

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

16. (a) Explain Gel Permeation Chromatography (GPC) with diagram. (CO2, K2)

Or

- (b) Explain different types of condensation polymerization with examples. (CO2, K3)

17. (a) Explain glass transition temperature and crystalline melting temperature. (CO2, K3)

Or

- (b) Explain the Dynamic Mechanical Analysis (DMA) technique. (CO2, K3)

18. (a) Explain conducting polymers and their applications with examples. (CO4, K6)

Or

- (b) Discuss about liquid crystal polymers and their applications. (CO4, K6)

19. (a) Explain matrix based classification of polymer composites with examples. (CO2, K6)

Or

- (b) Explain bonding mechanism of polymer composites. (CO3, K2)

20. (a) Discuss about resin based composites and their applications. (CO3, K6)

Or

- (b) Explain the preparation and application of thermoplastic polymer composites. (CO5, K6)

R3654

Sub. Code

542303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Materials Science

SOLID STATE PHYSICS

(CBCS – 2022 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

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

- Which of the following is not a crystal system? (CO1, K2)
(a) Cubic (b) Trigonal
(c) Triclinic (d) Hexaclinic
- _____ used in determining the electrostatic potential of a single ion in a crystal. (CO1, K1)
(a) Born Haber cycle
(b) Miller constant
(c) Madelung constant
(d) None of the above
- Electrical conductivity is the reciprocal of electrical _____. (CO2, K2)
(a) Conductance (b) Lorentz constant
(c) Resistivity (d) None of the above

4. Fermi energy level for n-type extrinsic semiconductor lies _____ (CO2, K2)
- (a) Close to the valence band
 - (b) Close to the conduction band
 - (c) In the conduction band
 - (d) None of the above
5. SI Unit for thermal expansion is (CO3, K1)
- (a) Nano meter (nm)
 - (b) Milli Gray (mGy)
 - (c) Inverse kelving (K^{-1})
 - (d) None of the above
6. Fill up _____ scattering is limiting the thermal conductivity in crystalline solids. (CO3, K2)
- (a) Light
 - (b) Electrical
 - (c) Umklapp
 - (d) Mechanical
7. When the temperature of either n-type or p-type increases the position of the Fermi energy level moves to _____ (CO4, K2)
- (a) Towards up of energy gap
 - (b) Towards down of energy gap
 - (c) Towards centre of energy gap
 - (d) Towards out of page
8. Rest mass of an electron is (CO4, K1)
- (a) 8.187×10^{-14} joules
 - (b) Zero
 - (c) Unity
 - (d) None of the above
9. The formula for Ohm's law is (CO5, K1)
- (a) $I = V/R$
 - (b) $V = IR$
 - (c) $R = V/I$
 - (d) All are correct

10. Fill up _____ are the charge carriers in semiconductors. (CO5, K2)
- (a) Electrons and holes
 - (b) Electrons
 - (c) Holes
 - (d) Charges

Part B (5 × 5 = 25)

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

11. (a) Illustrate miller indices and list out its importance. (CO1, K4)

Or

- (b) Discuss about packing factors and its significance. (CO1, K4)

12. (a) Write a short note on Wiedemann Franz law and Lorenz number. (CO2, K5)

Or

- (b) Explain about Boltzmann transport theory and its applications. (CO2, K4)

13. (a) Give an account on local phonon model. (CO3, K4)

Or

- (b) Write a short essay on density of states. (CO3, K4)

14. (a) Describe about Bloch's theorem and its significance. (CO4, K4)

Or

- (b) Discuss about tight-binding approximation and list out its limitations. (CO4, K4)

15. (a) Write an essay on direct and indirect gaps in semiconductors. (CO5, K5)

Or

- (b) Explain about III-V semiconductors and list out its advantages and challenges. (CO5, K4)

Part C

(5 × 8 = 40)

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

16. (a) Elaborate the different types bonding. (CO1, K5)

Or

- (b) Explain the concept of Bravais lattices. (CO1, K4)

17. (a) Give an overview on Fermi energy and electronic specific heat. (CO2, K5)

Or

- (b) Discuss about electrical and thermal conductivity of electrons. (CO2, K4)

18. (a) Explain the thermal conductivity phenomenon in solids. (CO3, K4)

Or

- (b) Elaborate the thermal resistance of solids and its importances. (CO3, K5)

19. (a) Write an essay on Fermi surface. (CO3, K5)

Or

- (b) Explain Cyclotron resonance and its any two applications. (CO3, K4)

20. (a) Explain the temperature effect on electrical conductivity in semiconductors. (CO5, K4)

Or

- (b) Discuss the various applications of high temperature superconductors. (CO5, K4)

R3655

Sub. Code

542304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Materials Science

CERAMIC MATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

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

1. Sol-gel method is _____ chemical -process.
(CO1, K2)
(a) Dry (b) Wet
(c) Semi liquid (d) Semi solid
2. Doctor blade process is used to make _____ of ceramics.
(CO1, K1)
(a) Pellets
(b) Powders
(c) Films on substrates
(d) None of the above
3. Silica refractories are also known as _____ refractories.
(CO2, K2)
(a) Acid (b) Basic
(c) Neutral (d) None of the above

4. Which of the following is the hardest compound of boron? (CO2, K2)
- (a) Boron carbide (b) Boron fluoride
(c) Boron nitride (d) None of the above
5. Ferrites are a sub-group of (CO3, K1)
- (a) paramagnetic materials
(b) ferromagnetic materials
(c) non-magnetic materials
(d) ferri-magnetic materials
6. Chemical energy is converted to _____ energy by a fuel cell. (CO3, K2)
- (a) Light (b) electrical
(c) potential (d) mechanical
7. Alumina is (CO4, K2)
- (a) Acidic (b) Basic
(c) Amphoteric (d) None of these
8. What is the chemical formula of zirconia? (CO4, K1)
- (a) SiO_2 (b) Al_2O_3
(c) ZrO_2 (d) TiO_2
9. Glass is _____ solid. (CO5, K1)
- (a) a crystalline (b) nanocrystalline
(c) an amorphous (d) none of the above
10. Chemical formula for Silica is _____. (CO5, K2)
- (a) SiC
(b) Si
(c) SiO_2
(d) None of the above

Part B

(5 × 5 = 25)

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

11. (a) Illustrate the working principles of CVD process with neat block diagram. (CO1, K4)

Or

- (b) Discuss about microwave sintering process. (CO1, K4)

12. (a) Write a short note on silicon nitride and list out its functional properties. (CO2, K5)

Or

- (b) Explain the functional properties of SiAlON. (CO2, K4)

13. (a) Give an account on ceramic insulators. (CO3, K4)

Or

- (b) Explain about Garnets and its importances. (CO3, K4)

14. (a) Discuss about the properties of Ceramic fibers and its applications. (CO4, K4)

Or

- (b) Explain about cordierite and its uniqueness. (CO4, K4)

15. (a) Describe about the glass forming processes. (CO5, K5)

Or

- (b) Discuss about crystal nucleation in glass. (CO5, K4)

Part C

(5 × 8 = 40)

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

16. (a) Elaborate the different types of ball milling techniques with neat diagrams. (CO1, K5)

Or

- (b) Explain the concept of different sintering processes. (CO1, K4)

17. (a) Give an overview on oxide based structural ceramics. (CO2, K5)

Or

- (b) Discuss the unique functional properties of carbides. (CO2, K4)

18. (a) Explain the concept of ferroelectricity and write a short overview about ferroelectric ceramics. (CO3, K4)

Or

- (b) Elaborate the functional properties of spinel ferrites and list out its applications. (CO3, K5)

19. (a) Explain the various special refractories. (CO3, K4)

Or

- (b) Elaborate the Nitride-based refractories and list out its applications. (CO3, K5)

20. (a) Discuss the importance of glass ceramics with suitable examples. (CO5, K4)

Or

- (b) Explain about the non-oxide glasses. (CO5, K4)

R3656

Sub. Code

542513

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Material Sciences

Elective : BIOSENSORS

(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 best defines a biosensor? (CO1, K2)
 - (a) A device that detects any kind of radiation
 - (b) An analytical device that combines a biological element with a physicochemical detector
 - (c) A system that only measures electrical signals
 - (d) A device used only for temperature sensing
2. The sensitivity of a biosensor refers to : (CO1, K1)
 - (a) Its ability to work in extreme temperatures
 - (b) The lowest concentration of analyte that can be detected reliably
 - (c) The maximum analyte concentration measurable before saturation
 - (d) The rate at which the sensor responds to a change in analyte concentration

3. Which of the following best describes a transducer? (CO2, K3)
- (a) A device that amplifies electrical signals
 - (b) A device that converts one form of energy into another
 - (c) A system that stores biological samples
 - (d) A device used only for measuring mass
4. An amperometric electrochemical transducer works by measuring : (CO2, K6)
- (a) Change in temperature of the analyte
 - (b) Change in potential at constant current
 - (c) Current produced by oxidation or reduction reactions
 - (d) Frequency shift caused by mass change
5. In microorganism-based biosensors, the role of the microorganism is to : (CO3, K1)
- (a) Act only as a transducer
 - (b) Provide the biological recognition element by catalyzing specific reactions
 - (c) Store analyte samples for long-term use
 - (d) Increase the electrical sensitivity of the detector
6. Which of the following is an advantage of immobilizing microorganisms in biosensors? (CO3, K5)
- (a) Increased interference from other compounds
 - (b) Reduced operational stability of the sensor
 - (c) Reusability and prolonged activity of the biological element
 - (d) Complete elimination of the need for calibration

7. Which of the following is an application of DNA in molecular electronics? (CO4, K2)
- (a) Molecular wires and switches
 - (b) High-temperature superconductors
 - (c) Classical transistor circuits
 - (d) Magnetic storage devices
8. In DNA-based molecular devices, what is the role of nanofabricated electrodes? (CO4, K4)
- (a) To store large amounts of data permanently
 - (b) To connect molecules and measure electronic properties
 - (c) To increase the molecular weight of DNA
 - (d) To catalyze enzymatic reactions
9. Which of the following correctly describes a non-invasive glucose monitoring method? (CO5, K2)
- (a) Measuring glucose through blood samples
 - (b) Measuring glucose using interstitial fluid or sweat sensors
 - (c) Measuring glucose through liver biopsy
 - (d) Measuring glucose using MRI scans
10. How many generations of glucose sensors are generally recognized in biosensor technology? (CO5, K4)
- (a) One
 - (b) Two
 - (c) Three
 - (d) Four

Part B

(5 × 5 = 25)

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

11. (a) Define a biosensor and explain its basic components.
(CO1, K2)

Or

- (b) Write short notes on calibration and dynamic range of a biosensor.
(CO1, K1)

12. (a) Define a transducer, list the different types used in biosensors.
(CO2, K6)

Or

- (b) Differentiate between amperometric and potentiometric electrochemical transducers with examples.
(CO2, K3)

13. (a) Write a short note on enzyme-based biosensors with an example.
(CO3, K1)

Or

- (b) Explain the principle of microorganism immobilization in biosensors.
(CO3, K5)

14. (a) Write a short note on molecular wires and switches in DNA electronic applications.
(CO4, K2)

Or

- (b) Explain the role of molecular arrays as memory stores.
(CO4, K4)

15. (a) Define a glucose sensor and describe its historical development.
(CO5, K2)

Or

- (b) Explain the difference between invasive and non-invasive glucose monitoring with examples.
(CO5, K4)

Part C

(5 × 8 = 40)

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

16. (a) Discuss in detail the characteristics of a biosensor such as sensitivity, selectivity, signal-to-noise ratio, and interference, with suitable examples. (CO1, K1)

Or

- (b) Explain the applications of biosensors in healthcare and environmental monitoring. What are the major problems faced in their practical use? (CO1, K2)
17. (a) Explain in detail the principle and working of optical and thermal transducers with suitable examples. (CO2, K3)

Or

- (b) Discuss the different types of mass-based transducers (piezoelectric and acoustic wave). Give examples of their applications in biosensors. (CO2, K6)
18. (a) Discuss in detail the different types of biorecognition systems such as botanical biosensors, cultured cells, intact tissues, and receptor elements. (CO3, K1)

Or

- (b) Explain the working of microorganism-based biosensors. Describe the different methods of immobilizing microorganisms with suitable examples. (CO3, K5)

19. (a) Discuss how DNA can be used for molecular devices. Give suitable examples. (CO4, K2)

Or

- (b) Explain in detail the principle and application of biomolecular computers and the concept of molecules between nanofabricated electrodes. (CO4, K6)

20. (a) Discuss the generations of glucose sensors and their working principles. (CO5, K2)

Or

- (b) Describe the glucose sensor market globally and in India. Highlight the current status and challenges. (CO5, K6)
