R2036	Sub. Code
	542101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Material Science

MATERIALS 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. Which of the following phenomena can occur during plastic deformation by slip? (CO1, K2)

   (a) The material returns to its original shape after the applied force is removed

   (b) The material does not return to its original shape after the applied force is removed

   (c) The material can return to its original shape if heated

   (d) None of the above

2. The theoretical shear strength of a perfect crystal is approximately equal to (CO1, K2)

   (a) $G/2\pi$ (b) $G/4\pi$

   (c) $2\pi G$ (d) G

3. A high dielectric constant in a material suggests that the material (CO2, K4)

(a) Is a good conductor of electricity

(b) Has a high density

(c) Can be easily polarized

(d) Is a good thermal insulator

4. Polarizability of a material is dependent on (CO2, K4)

(a) Temperature only

(b) Electric field only

(c) Both temperature and electric field

(d) Neither temperature nor electric field

5. Which type of magnetic material shows weak repulsion when placed in an external magnetic field? (CO3, K4)

(a) Diamagnetic (b) Paramagnetic

(c) Ferromagnetic (d) Non-magnetic

6. Which type of magnetic material retains its magnetization even after the removal of an external magnetic field? (CO3, K4)

(a) Soft magnetic material

(b) Hard magnetic material

(c) Paramagnetic material

(d) Diamagnetic material

7. Which of the following statement is true regarding LCD displays? (CO4, K2)

(a) LCDs emit light when an electric current is applied

(b) LCDs use liquid crystals to modulate the intensity of light

(c) LCDs requires a separate backlight for illumination

(d) LCDs are primarily used for lighting purposes

8. Which of the following materials exhibit photoconductivity? (CO4, K2)

(a) Metal (b) Insulator

(c) Semiconductor (d) Polymer

9. What is the primary characteristic of metallic glasses? (CO5, K5)

(a) High ductility

(b) High strength

(c) Low electrical conductivity

(d) Crystalline atomic structure

10. Which of the following material is commonly used in manufacturing of solar cells? (CO5, K5)

(a) Glass (b) Plastic

(c) Aluminium (d) Silicon

Part B (5 × 5 = 25)

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

11. (a) Elaborate on different methods of strengthening against plastic yield. (CO1, K2)

Or

(b) Write a short note on Creep and its various mechanisms. (CO1, K2)

12. (a) Derive Clausius-Mosotti equation. (CO2, K4)

Or

(b) What is meant by Polarization? Explain the different types of polarization. (CO2, K4)

13. (a) Explain in detail about the classification of magnetic materials. (CO3, K4)

Or

(b) Give a short note on Langevin and Weiss theory of magnetism. (CO3, K4)

14. (a) Write a short note on optical absorption in insulators, semiconductors, and metals. (CO4, K2)

Or

(b) Define Luminescence, describe in detail about Injection luminescence. (CO4, K2)

15. (a) Briefly explain the properties and applications of metallic glasses. (CO5, K5)

Or

(b) Write a short note on charge-coupled devices and their applications. (CO5, K5)

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

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

16. (a) Elaborate on Fracture and its various types. (CO1, K2)

Or

(b) Write in detail about various mechanical tests. (CO1, K2)

17. (a) Distinguish between piezoelectric, ferroelectric and pyroelectric materials. (CO2, K4)

Or

(b) Define ferroelectric. elaborate on the types and models of ferroelectric transitions. (CO2, K4)

18. (a) Write a detailed note on Hysteresis. (CO3, K4)

Or

(b) Explain in detail about DMS materials. (CO3, K4)

19. (a) What are liquid crystals? Elaborate on its properties and structure. (CO4, K2)

Or

(b) Give a detailed comparison between LED and LCD displays. (CO4, K2)

20. (a) Define solar cells, write a detailed note on solar cell materials. (CO5, K5)

Or

(b) Elaborate on the various properties of nanomaterials. (CO5, K5)

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R2037	Sub. Code
	542102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Material and Science

THERMODYNAMICS

(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 purpose of generalized coordinates in Lagrangian mechanics? (CO1, K1)

   (a) To describe the state of a system in any number of dimensions

   (b) To calculate the total energy of a system

   (c) To determine the forces acting on a system

   (d) To measure the temperature of a system

2. D'Alembert's principle is a statement of which law of motion? (CO1, K1)

   (a) Newton's First Law

   (b) Newton's Second Law

   (c) Newton's Third Law

   (d) None of the above

3. Which of the following is true about canonical transformations in Hamiltonian mechanics? (CO2, K2)

(a) They change the form of the Hamiltonian

(b) They violate the principle of least action

(c) They are always linear transformations

(d) They always conserve the Hamiltonian

4. What is a rigid body in physics? (CO2, K2)

(a) A body that can change its shape and size under the influence of forces

(b) A body that cannot change its shape and size under the influence of forces

(c) A body that is in equilibrium

(d) A body that is undergoing uniform circular motion

5. The second law of thermodynamics states that (CO3, K3)

(a) Energy cannot be created or destroyed

(b) The entropy of an isolated system can never decrease

(c) The efficiency of a Carnot engine is 1

(d) Heat transfer is always from hot to cold

6. Entropy is a measure of (CO3, K3)

(a) Energy (b) Temperature

(c) Disorder (d) Pressure

7. Which of the following is not a type of statistical ensemble? (CO4, K5)

(a) Canonical ensemble

(b) Grand canonical ensemble

(c) Microcanonical ensemble

(d) Quantum ensemble

8. According to Fermi-Dirac statistics, the maximum number of fermions that can occupy a single quantum state is (CO4, K5)

(a) 0 (b) 1

(c) 2 (d) Infinite

9. The equation of state for an ideal gas is (CO5, K6)

(a) $PV = nRT$ (b) $PV = nR/T$

(c) $P = nRT/V$ (d) $P = nR/V$

10. The classical partition function is used to calculate (CO5, K6)

(a) The total energy of a system

(b) The average energy of a system

(c) The entropy of a system

(d) All of the above

Part B (5 × 5 = 25)

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

11. (a) Explain D'Alembert's principle and its mathematical representation. (CO1, K1)

Or

(b) Give a brief account on principle of least action. (CO1, K1)

12. (a) Discuss the conditions for a transformation to be canonical. (CO2, K2)

Or

(b) Explain the concept of rigid body dynamics. (CO2, K2)

13. (a) Write a short note on the different laws of thermodynamics. (CO3, K3)

Or

(b) Derive Clausious-Clayperon equation. (CO3, K3)

14. (a) Explain the concept of Micro and Macro States in statistical mechanics. (CO4, K5)

Or

(b) Describe Maxwell-Boltzmann statistics. Discuss its limitations and the conditions under which it is most accurate. (CO4, K5)

15. (a) Discuss the Einstein model of a solid. What are its limitations? (CO5, K6)

Or

(b) Explain the phenomenon of Bose-Einstein condensation. (CO5, K6)

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

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

16. (a) Derive Lagrange's equation of motion. (CO1, K1)

Or

(b) State and prove Euler Lagrange equation. (CO1, K1)

17. (a) Discuss in detail on the relation between Lagrange's and Poisson brackets. (CO2, K2)

Or

(b) Discuss the role of generating functions in canonical transformations. (CO2, K2)

18. (a) Derive Maxwells's thermodynamic relations. (CO3, K3)

Or

(b) Explain the concept of a first-order phase transition. How does it differ from a second-order phase transition? (CO3, K3)

19. (a) Define ensemble. Elaborate on the various types of ensembles. (CO4, K5)

Or

(b) Give a detailed comparison between MB, BE, and FD statistics. (CO4, K5)

20. (a) Derive plank's radiation law for black body radiation. (CO5, K6)

Or

(b) Discuss the application of statistics in semiconductor physics. How is statistical equilibrium of electrons in semiconductors achieved? (CO5, K6)

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R2038	Sub. Code
	542103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Materials Science

ELECTRONICS AND INSTRUMENTATION

(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 electrical characteristics is not exhibited by an ideal op-amp? (CO1, K2)

   (a) Infinite voltage gain

   (b) Infinite bandwidth

   (c) Infinite output resistance

   (d) James Gosling Infinite slew rate

2. Find the output voltage of an ideal op-amp. If V1 and V2 are the two input voltages. (CO1, K2)

   (a) $VO = A \times (V1 - V2)$

   (b) $VO = A \times (V1 + V2)$

   (c) $VO = V1 - V2$

   (d) $VO = V1 \times V2$

3. Which of the following options represent the synchronous control inputs in an S – R flip flop? (CO2, K2)

   (a) S (b) Both S and R

   (c) R (d) Clock

4. How many AND gates are required to realize Y = CD + EF + G? (CO2, K2)

(a) 5 (b) 3

(c) 4 (d) 2

5. A light emitting diode is ————————. (CO3, K5)

(a) Lightly doped

(b) Heavily doped

(c) Intrinsic semiconductor

(d) Zener diode

6. Which of the following is a unique property of laser? (CO3, K5)

(a) Coherence (b) Speed

(c) Directional (d) Wavelength

7. Which of the following is not a characteristic of an ideal transducer? (CO4, K4)

(a) High dynamic range

(b) Low noise

(c) High repeatability

(d) Low linearity

8. Which of the following represents an active transducer? (CO4, K4)

(a) LVDT (b) Thermistor

(c) Thermocouple (d) Strain gauge

9. Which of the following terminals does not belong to the MOSFET? (CO5, K1)

(a) Base (b) Drain

(c) Source (d) Gate

10. The nanoparticles from iron and palladium are used to produce ————————. (CO5, K1)

(a) Magneto meters (b) Magnetic storage devices

(c) Magnetic lens (d) Magnets

Part B (5 × 5 = 25)

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

11. (a) Justify Why IC 741 is not used for high-frequency applications? (CO1, K1)

Or

(b) Identify the merits and demerits of op-amp. (CO1, K1)

12. (a) Design and verify the half-adder circuit using logic gates. (CO2, K2)

Or

(b) Sketch the block diagram of the SISO shift register. (CO2, K2)

13. (a) Distinguish solid state laser and semiconductor laser. (CO3, K5)

Or

(b) List out the applications of Photodiode. (CO3, K5)

14. (a) Draw the block diagram of basic instrumentation system. (CO4, K3)

Or

(b) Classify the transducer and its functions. (CO4, K3)

15. (a) Mention the application of the tunneling diode. (CO5, K6)

Or

(b) List out the various steps of electron transport. (CO5, K6)

Part C (5 × 8 = 40)

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

16. (a) Explain the differential mode instrumentation amplifier. (CO1, K1)

Or

(b) Design a circuit to generate square wave using op-amp. (CO1, K1)

17. (a) Sketch the basic gates using the NOR gate. (CO2, K2)

Or

(b) Draw and explain the architecture of the 8085 microprocessor. (CO2, K2)

18. (a) Explain the Electro-Optic Modulator. (CO3, K5)

Or

(b) Discuss in detail the principle and operation of a photonic switch based on self electro optic Device. (CO3, K5)

19. (a) Explain about the Computer-based Data acquisition system. (CO4, K3)

Or

(b) Summarize in detail about the characteristics of LVDT and any two applications of LVDT. (CO4, K3)

20. (a) Explain the constructional features of a MOSFET. (CO5, K6)

Or

(b) Explain nano electromechanical processes in detail. (CO5, K6)

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R2039	Sub. Code
	542104

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Materials Science

ELECTROMAGNETIC THEORY AND OPTICS

(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 statements is true regarding the scalar potential? (CO1, K2)

   (a) It is unique and has a unique value at every point in space

   (b) It depends on the direction of the electric field

   (c) It is only defined in certain regions of space

   (d) It is not related to the electric field

2. Which equation represent the absence of magnetic monopoles in Maxwell's equation? (CO1, K2)

   (a) $\nabla \times B = \mu_0 J$ (b) $\nabla \cdot B = 0$

   (c) $\nabla \cdot B = \frac{\rho}{\varepsilon_0}$ (d) $\nabla \times E = -\frac{\partial B}{\partial t}$

3. The negative value of Poynting vector magnitude indicates (CO2, K2)

(a) Energy is flowing outward from the source

(b) Energy is flowing inward towards the source

(c) No energy flow is present

(d) Energy is flowing in all direction equally

4. The presence of free charges in conductors leads to (CO2, K4)

(a) Reflection of EM waves

(b) Absorption of EM waves

(c) Refraction of EM waves

(d) Diffraction of EM waves

5. In biaxial anisotropic media, how many principal axes of propagation exist? (CO3, K4)

(a) One (b) Two

(c) Three (d) Four

6. Which of the following materials is commonly considered as positive crystal? (CO3, K4)

(a) Quartz (b) Calcite

(c) Silicon (d) Gallium arsenide

7. What type of materials exhibit the Kerr effect? (CO4, K2)

(a) Linear material

(b) Non-linear materials

(c) Ferromagnetic materials

(d) Superconducting materials

8. In the Kerr effect, what type of relationship exists between the induced polarization and the applied electric field? (CO4, K2)

(a) Linear (b) Quadratic

(c) Exponential (d) Inverse square

9. The advantage of optical switching over traditional electronic switching is (CO5, K6)

(a) Lower cost

(b) Higher bandwidth

(c) Greater scalability

(d) Lower power consumption

10. Which factor is important for the efficiency of a non-linear optical crystal? (CO5, K6)

(a) Its transparency to all wavelengths of light

(b) Its ability to generate a large second-harmonic conversion efficiency

(c) Its ability to absorb light without distortion

(d) Its high thermal conductivity

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

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

11. (a) Explain scalar and vector potential. Give examples. (CO1, K2)

Or

(b) Deduce the ampere's circuital law. (CO1, K2)

12. (a) Derive an expression for Poynting vector. (CO2, K2)

Or

(b) Deduce and explain the Fresnel equations for parallel and perpendicular polarization. (CO2, K4)

13. (a) Define the following: (CO3, K4)

(i) optic axis,

(ii) positive crystals and

(iii) negative crystals.

Or

(b) Explain linear – optic effect in detail. (CO3, K4)

14. (a) Define magneto-optical effect. List out its applications. (CO4, K2)

Or

(b) Define the Kerr and Pockels effect. List out its applications. (CO4, K6)

15. (a) Summarize non-linear optical materials in detail. (CO5, K6)

Or

(b) Define optical switching. List out the materials used as optical switches. (CO5, K6)

Part C (5 × 8 = 40)

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

16. (a) Derive and explain the Maxwell's equation in integral and differential form. (CO1, K2)

Or

(b) Deduce the magnetic induction at a point around a wire carrying a current. (CO1, K2)

17. (a) Obtain the electromagnetic wave equation for free space in terms of electric field. (CO2, K2)

Or

(b) Derive the wave equation for an electromagnetic wave propagating in an isotropic medium. (CO2, K4)

18. (a) Explain in detail about the light propagating in anisotropic media. (CO3, K4)

Or

(b) What is index ellipsoid? Explain the characteristics of anisotropic media with the help of index ellipsoid. (CO3, K4)

19. (a) Explain the Stimulated Raman Scattering (SRS) in detail. (CO4, K2)

Or

(b) Explain the application of Stimulated Raman Scattering for material characterization. (CO4, K2)

20. (a) Define non-linear effect. Write down its applications. (CO5, K6)

Or

(b) List out the properties and applications some non-linear optical (NLO) crystals. (CO5, K6)

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R2040

Sub. Code
542501

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

First Semester

Materials Science

Elective : BIOMATERIALS

(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. Which of the following best defines biocompatibility in the context of medical materials? (CO1, K1)

   (a) The ability of a material to resist corrosion

   (b) The ability of a material to avoid causing an adverse reaction in the biological environment

   (c) The ability of a material to dissolve in bodily fluids

   (d) The ability of a material to deform under stress

2. Which of the following processes describes the change in a material's size or mass when exposed to a biological fluid? (CO1, K3)

   (a) Corrosion (b) Swelling

   (c) Friction (d) Deformation

3. Which of the following is a primary component of bone matrix responsible for its strength and rigidity? (CO2, K3)

(a) Collagen (b) Elastin

(c) Keratin (d) Actin

4. Which material is commonly used in joint replacement implants for its wear resistance and biocompatibility? (CO2, K4)

(a) Stainless steel

(b) Polyethylene (UHMWPE)

(c) Cobalt-chromium alloy

(d) Bioglass

5. Which of the following components is primarily responsible for the formation of a blood clot by converting fibrinogen into fibrin? (CO3, K3)

(a) Platelets

(b) Red blood cells

(c) Thrombin

(d) Hemoglobin

6. Which type of vascular implant is used to replace or bypass damaged blood vessels? (CO3, K5)

(a) Cardiac pacemaker

(b) Vascular graft

(c) Cardiac valve prosthesis

(d) Blood substitute

7. Which component of teeth is primarily responsible for their hardness and strength? (CO4, K1)

(a) Dentin (b) Enamel

(c) Cementum (d) Pulp

8. Which type of dental cement is commonly used for its adhesive properties and ability to bond to both tooth structure and restoration materials? (CO4, K5)

(a) Glass ionomer cement

(b) Zinc oxide-eugenol cement

(c) Composite resin cement

(d) Calcium hydroxide cement

9. Which type of material is commonly used in the production of contact lenses due to its high oxygen permeability? (CO5, K2)

(a) Polycarbonate

(b) Polymethylmethacrylate (PMMA)

(c) Silicone hydrogel

(d) Nylon

10. Which type of tissue adhesive is commonly used for its ability to rapidly bond tissues and create a strong seal in surgical procedures? (CO5, K5)

(a) Cyanoacrylate

(b) Collagen-based adhesive

(c) Fibrin glue

(d) Hydrogel

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

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

11. (a) Demonstrate the term biocompatibility with an example. How biocompatibility of implants can be assessed. (CO1, K1)

Or

(b) Elaborate about the host respond against biomaterials? (CO1, K3)

12. (a) Describe the considerations for a biomaterial which is to be used as an orthopedic implant? (CO2, K3)

Or

(b) (i) Differentiate bioglass and bioceramics

(ii) Explain the properties of titanium. (CO2, K4)

13. (a) Differentiate the vascular implants and cardiac pacemakers. (CO3, K5)

Or

(b) Discuss the considerations in selecting the appropriate type of graft. Include factors such as biocompatibility and mechanical properties. (CO3, K5)

14. (a) Explain about the impression materials used for in dentistry and its types. (CO4, K1)

Or

(b) Discuss the types of dental adhesives and their applications. (CO4, K2)

15. (a) Discuss the types of materials used in contact lenses and their properties. (CO4, K2)

Or

(b) Explain the different types of tissue grafts used in medical application. (CO4, K5)

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

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

16. (a) Discuss the mechanisms of material deformation and failure in the biological environment. (CO1, K1)

Or

(b) Explain the concepts of coagulation and hemolysis in relation to biomaterials used in cardiovascular implants? (CO1, K3)

17. (a) Describe the role of ceramics in orthopedic implants. How do these materials differ from polymers in terms of wear resistance and mechanical properties? (CO2, K3)

Or

(b) Discuss the characteristics of UHMWPE and HDPE used in joint replacements. (CO2, K4)

18. (a) Explain about the mechanical properties and functions of the heart valves prostheses. (CO3, K3)

Or

(b) Evaluate the considerations for choosing a vascular graft material for peripheral artery disease. (CO3, K5)

19. (a) Describe the different types of filling and restoration materials. Compare their properties, advantages, and limitations. (CO4, K1)

Or

(b) Explain the dental material properties such as hardness, tensile strength, and wear resistance. (CO4, K5)

20. (a) Describe the different types of suture materials used in soft tissue repair and discuss their properties. (CO5, K2)

Or

(b) Elaborate the drug delivery methods and materials used for implantable sensors. (CO5, K5)

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R2041

Sub. Code
542301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

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. The colour of the nano gold particles is ————— (CO1, K1)

   (a) Yellow (b) Orange

   (c) Red (d) Variable

2. Size of atom (CO1, K1)

   (a) 0.01 nm (b) 0.1 nm

   (c) 1 nm (d) 10 nm

3. Which one of the following is an example for insulating nanowires? (CO2, K2)

   (a) SiO_2 (b) InP

   (c) Si (d) All of the above

4. What is a buckyball? (CO2, K2)

(a) A carbon molecule (C60)

(b) Nickname for Mercedes-Benz's futuristic concept car (C111)

(c) Plastic explosives nanoparticle (C4)

(d) Concrete nanoparticle with a compressive strength of 20 nanonewtons (C20)

5. Addition of little Phosphorus to silicon produces (CO3, K4)

(a) P-type semiconductor

(b) Insulator

(c) N-type semiconductor

(d) Metallic conductor

6. The width of carbon nanotube is (CO3, K4)

(a) 2 nm (b) 1 nm

(c) 1.3 nm (d) 1.55 nm

7. Which one of the following is a characterization technique in carbon nanotuhes? (CO4, K4)

(a) TEM (b) SEM

(c) AFM (d) All of the above

8. What is the type of laser used most widely in industrial materials processing applications? (CO4, K4)

(a) Dye Laser (b) YAG Laser

(c) Ruby Laser (d) Carbon dioxide laser

9. For a permanent magnetic material (CO5, K3)

(a) The residual induction and the coercive field should be large

(b) The residual induction and the coercive field should be small

(c) The area of the hysteresis loop should be small

(d) The initial relative permeability should be large

10. Example for magnetic material used in data storage devices (CO5, K3)

(a) 45 Permalloy (b) CrO_2

(c) Cunife (d) Alnico

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

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

11. (a) Why melting point changes with particle size? (CO1, K2)

Or

(b) Explain the surface tension changes with nanoparticles. (CO1, K2)

12. (a) Explain the properties of carbon nanotube. (CO2, K2)

Or

(b) Explain the preparation of the nanowires. (CO2, K2)

13. (a) Explain the principles of solvothermal technique for the preparation of oxide materials. (CO3, K4)

Or

(b) Explain any two semiconductor nanowires. (CO3, K4)

14. (a) Explain Scanning capacitance microscopy. (CO4, K5)

Or

(b) How photoluminescence spectroscopy works? (CO4, K5)

15. (a) Explain magnetic storage. (CO5, K2)

Or

(b) What are the concept of Millipede for the data storage? (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) Discuss the optical properties and band gap changes with particle size and draw a neat diagram to explain the same. (CO1, K2)

Or

(b) How the size of the nanoparticles plays the role to change the mechanical and electrical properties? (CO1, K2)

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

Or

(b) Explain the synthesis of carbon nanotubes using catalysis with CVD technique. (CO2, K2)

18. (a) Describe the preparation of the semiconductor oxide layer using pulsed laser deposition. (CO3, K4)

Or

(b) Explain the preparation of nanofibers using electro spinning. (CO3, K4)

19. (a) Discus the working principles of FeSEM with neat diagram. (CO4, K4)

Or

(b) Explain the formation of HRTEM images involves complex physical processes. (CO4, K5)

20. (a) (i) What is superparamagnetism? (4)

(ii) Define magnetic dots. (4)
(CO5, K2)

Or

(b) How MRAM works? (CO5, K3)

R2042	Sub. Code
	542302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

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 type questions by choosing the correct option.

1. Which among the following is considered as natural rubber (CO1, K2)

   (a) cis-isoprene

   (b) trans-isoprene

   (c) cis-polyisoprene

   (d) trans-polyisoprene

2. Nylon-6,6 is synthesised by ———— (CO1, K2)

   (a) Chain polymerisation

   (b) Radical polymerisation

   (c) Additional polymerisation

   (d) Step growth polymerisation

3. High Density Polyethylene has ———— branching chains. (CO2, K4)

(a) More (b) Less

(c) Network (d) Cross linking

4. Viscoelastic materials behave both like ———— (CO2, K4)

(a) Liquid and gas

(b) Liquid and solid

(c) Solid and gas

(d) Solid and plasma

5. Apparent viscosity for non-Newtonian fluid is ———— (CO3, K4)

(a) Constant

(b) Depends on the shear rate

(c) Depends on the shear stress

(d) Dynamic

6. Which among the following is not a high temperature polymer? (CO3, K4)

(a) Polyetheretherketone

(b) Polyetherimide

(c) Polyisoprene

(d) Polytetrafluoroethylene

7. The bonding in ceramic is ———————— (CO4, K2)

(a) Metallic

(b) Covalent

(c) Ionic

(d) Partially ionic and partially covalent

8. Which among the following is used for making window panes and beverage bottles? (CO4, K2)

(a) Hard glass (b) Potash glass

(c) Soda glass (d) Crown glass

9. Which of the following is a property of ceramics? (C05, K5)

(a) Resistant to corrosion

(b) Low melting point

(c) Bad insulation

(d) Low strength

10. Composites can be classified based on ———————— (CO5, K5)

(a) Matrix type and reinforcement constituent

(b) Matrix type

(c) Neither on matrix type nor on reinforcement constituent

(d) Type reinforcement constituent

Part B (5 × 5 = 25)

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

11. (a) Classify copolymers based on the arrangement of monomers in the polymer backbone with schematic diagram. (CO1, K2)

Or

(b) Outline the various techniques that are used to determine the molecular weight of polymers. (CO1, K2)

12. (a) Describe about various techniques to determine crystallinity. (CO2, K4)

Or

(b) Compare the mechanical models of viscoelastic behaviour. (CO2, K4)

13. (a) Describe about conducting polymers and its importance. (CO3, K4)

Or

(b) What are the applications of high temperature polymers? (CO3, K4)

14. (a) Classify composite materials based on their applications. (CO4, K2)

Or

(b) Compare polymers, metals and ceramic materials. (CO4, K2)

15. (a) Describe polymer matrix composite and its applications. (CO5, K5)

Or

(b) Give a detail account on metal composites and its uses. (CO5, K5)

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

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

16. (a) Illustrate step growth polymerisation and chain growth polymerisation techniques. (CO1, K2)

Or

(b) Explain tacticity and geometrical isomerism with respect to polymers. (CO1, K2)

17. (a) Explain the principle of Bolzmann superposition. (CO2, K4)

Or

(b) Compare amorphous state and crystalline state of polymers with respect to the ordering of polymer chains. (CO2, K4)

18. (a) Compare Couette rheometer with plate rheometer. (CO3, K4)

Or

(b) Give an elaborate account of basic polymer processing operations. (CO3, K4)

19. (a) Write essay and application of glass, carbon and metallic fibers. (CO4, K2)

Or

(b) Describe in detail about mechanical behaviour of composites. (CO4, K2)

20. (a) Compare injection moulding with hot pressing moulding of thermoplastics. (CO5, K5)

Or

(b) Explain in detail about ceramic composite especially layered ceramic composites. (CO5, K5)

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R2043

Sub. Code
542303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Materials Science

SOLID STATE PHYSICS

(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. How many crystal systems are there in crystallography? (CO1, K1)

   (a) 5 (b) 6

   (c) 7 (d) 8

2. What is the coordination number of an atom in a body-centered cubic (BCC) structure? (CO1, K2)

   (a) 8 (b) 6

   (c) 12 (d) 4

3. What is the unit of electrical resistivity? (CO2, K3)

   (a) Ohm meter (b) Ohm

   (c) Ampere (d) Volt

4. What does the density of states represent in a solid? (CO2, K3)

(a) The number of atoms per unit volume

(b) The number of electrons per unit volume

(c) The number of free electrons per unit volume

(d) The number of available energy states per unit volume

5. In solids, thermal conductivity is primarily due to which of the following? (CO3, K3)

(a) Vibrations of atoms (phonons)

(b) Movement of free electrons

(c) Movement of holes

(d) All of the above

6. What is the main mechanism of phonon-phonon interaction in crystals at high temperatures? (CO3, K3)

(a) Umklapp process

(b) Raman scattering

(c) Compton scattering

(d) Photoelectric effect

7. What is the significance of Bloch's theorem in solid state physics? (CO4, K2)

(a) It explains the photoelectric effect

(b) It explains the existence of energy bands

(c) It explains superconductivity

(d) It explains the Zeeman effect

8. Cyclotron resonance occurs when: (CO4, K4)

(a) The frequency of the applied magnetic field matches the natural frequency of the charged particle

(b) The frequency of the applied electric field matches the natural frequency of the charged particle

(c) The frequency of the applied magnetic field is twice the natural frequency of the charged particle

(d) The frequency of the applied electric field is twice the natural frequency of the charged particle

9. The conductivity of a semiconductor: (CO5, K3)

(a) Decreases with increasing temperature

(b) Increases with increasing temperature

(c) Is not affected by temperature

(d) Becomes zero at high temperatures

10. Superconductors are materials that: (CO5, K5)

(a) Have infinite resistance at absolute zero temperature

(b) Have zero resistance at absolute zero temperature

(c) Have constant resistance at all temperatures

(d) Have resistance that increases with temperature

Part B (5 × 5 = 25)

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

11. (a) Write a short note on the different types of bonding with examples. (CO1, K2)

Or

(b) Briefly explain the structure of diamond and sodium chloride. (CO1, K2)

12. (a) State the reasons for failure of free electron model. (CO2, K3)

Or

(b) Explain thermal conductivity of metals. (CO2, K3)

13. (a) Highlight on Einstein and Debye model of solids. (CO3, K4)

Or

(b) Distinguish between normal and Umklapp processes. (CO3, K4)

14. (a) Briefly explain the structure of Brilliouin Zones with a neat diagram. (CO4, K2)

Or

(b) Write a short note on Cyclotron resonance. (CO4, K2)

15. (a) Explain Meissner effect with the help of a suitable diagram. (CO5, K3)

Or

(b) Write a short note on high temperature superconductors and its applications. (CO5, K5)

Part C (5 × 8 = 40)

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

16. (a) Define unit cell, Write a detailed note on various crystal systems. (CO1, K2)

Or

(b) Elaborate in detail on lattice planes and miller indices. (CO1, K2)

17. (a) Write a detailed note on Fermi-Dirac statistics. (CO2, K3)

Or

(b) Elaborate in detail on electrical conductivity and resistivity of metals. (CO2, K3)

18. (a) Derive the expressions for fermi energy and density of states for a free electron gas at 0K. (CO3, K4)

Or

(b) Discuss in detail on inelastic scattering of photon by long wavelength phonons. (CO3, K3)

19. (a) State and prove Bloch's theorem. (CO4, K2)

Or

(b) Discuss the nearly free electron approximation for a one-dimensional lattice. (CO4, K4)

20. (a) Elaborate in detail on BCS theory of superconductivity. (CO5, K3)

Or

(b) Define superconductors, Give a detailed comparison between type I and type II superconductors. (CO5, K5)

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R2044	Sub. Code
	542304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Material Science

CERAMIC MATERIALS

(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. Sol-gel method is a _____ approach. (CO1, K1)

   (a) Bottom up (b) Top down

   (c) Bottom top (d) None of the above

2. Microwave sintering apparatus operates at a _____ frequency (CO1, K1)

   (a) 2.45 GHz (b) 2.45 MHz

   (c) 2.45 Hz (d) None of the above

3. Fill Up: _____ ceramics are based on the elements silicon (Si), aluminium (Al), oxygen (O) and nitrogen (N). (CO2, K2)

   (a) Metals

   (b) SiAlON

   (c) Carbon nanotubes

   (d) None of the above

4. Fill Up: Mineral consisting of aluminum silicate ($3Al_2O_3 \cdot 2SiO_2$) is called ———— (CO2, K3)

(a) Mullite (b) Ferrite

(c) Halogens (d) None of the above

5. Fill Up: A Varistor is a ———— (CO3, K5)

(a) Current dependent resistor

(b) Voltage dependent resistor

(c) Diode

(d) Photodiode

6. Fuel cell converts chemical energy to electrical energy using a reaction that ————. (CO3, K5)

(a) Eliminates combustion of fuel

(b) Requires combustion of fuel

(c) Requires no ignition of fuel

(d) Fuel is not required

7. Fill Up: Magnesium Iron Aluminium Cyclosiliate is called as (CO4, K3)

(a) Cordierite (b) Metal

(c) Polymer (d) None of the above

8. Silica refractories are also known as ———— refractories. (CO4, K3)

(a) Acid (b) Basic

(c) Neutral (d) Magnesia

9. Glass is ———— (CO5, K1)

(a) An amorphous (non-crystalline) solid

(b) A gaseous material

(c) A crystalline solid

(d) None of the above

10. Glass is a mixture of (CO5, K1)

(a) Non-metallic silicates

(b) Metallic silicates

(c) Metallic acetates

(d) Non-metallic acetates

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

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

11. (a) Write a short essay on spray drying process with near diagram. (CO1, K2)

Or

(b) Write a summary on doctor blade process with neat diagram. (CO1, K2)

12. (a) List out any five unique features of garnets. (CO2, K2)

Or

(b) Write a short summary on bio ceramics. (CO2, K3)

13. (a) Write a summary on types of ceramic insulators. (CO3, K5)

Or

(b) List out any five applications of electronic ceramics. (CO3, K5)

14. (a) Write an overview on types of refractories. (CO4, K3)

Or

(b) List out any five unique characteristics of ceramic fibers. (CO4, K3)

15. (a) Write a summary on glass forming processes. (CO5, K1)

Or

(b) Write a shot essay on optical glasses. (CO5, K1)

Part C (5 × 8 = 40)

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

16. (a) Write an essay on milling techniques with neat diagrams. (CO1, K2)

Or

(b) Explain different sintering processes. (CO1, K2)

17. (a) Discuss the functional properties of oxide ceramics zirconia, alumina, silica and titania. (CO2, K3)

Or

(b) Write an essay on 'silicon, boron and titanium nitrates'. (CO2, K3)

18. (a) Write an essay on ferroelectric ceramics and list out its significances. (CO3, K5)

Or

(b) Explain the technological importance of spinel ferrites with neat diagrams. (CO3, K5)

19. (a) Discuss nitrides-based refractories and its significances. (CO4, K4)

Or

(b) Write an essay on high temperature applications of refractory ceramics. (CO4, K4)

20. (a) Discuss the importances of Fiberglass with neat diagrams. (CO5, K6)

Or

(b) Write an essay on non-oxide glasses. (CO5, K6)

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R2045

Sub. Code
542513

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2024

Third Semester

Material Science

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 one of the following is a bioanalytical device? (CO1, K1)

   (a) Biosensor (b) Biochip

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

2. Sensitivity of a sensor can be depicted by ———————— (CO1, K2)

   (a) Niquist plot (b) Pole-zero plot

   (c) Bode plot (d) None of the above

3. Which of the following biosensors use the movement of electrons produced during redox reactions? (CO2, K3)

   (a) Amperometric biosensor

   (b) Potentiometric biosensors

   (c) Piezo-electric biosensors

   (d) Optical biosensors

4. Which of the following is the physico-chemical component? (CO2, K3)

(a) Enzymes (b) Anti-bodies

(c) Transducer (d) Cells or tissues

5. Which one of the following is a biocomponent-based biosensor? (CO3, K1)

(a) Electrochemical (b) Enzyme

(c) Optical (d) All of the above

6. Which of the following is not a characteristic of the immobilized enzymes? (CO3, K5)

(a) They cannot be re-used

(b) It produces reproducible results

(c) Stability exists

(d) Same catalytic activity is present for number of analysis

7. Microarray analysis involves biological assays based on ————————. (CO4, K2)

(a) Gels

(b) Filters

(c) Purification columns

(d) Small glass chips

8. The genetic monitoring and disease diagnosis are examples for ———————— sensor? (CO4, K4)

(a) Point of care sensors

(b) Cell-based sensors

(c) DNA sensors

(d) All of the above

9. For constructing the glucose sensor, which of the following is used as a gel? (CO5, K2)

(a) Urea

(b) Urease

(c) Acrylamide

(d) Polyacrylamide

10. Biosensors measure glucose concentrations between which of the following ranges? (CO5, K4)

(a) 10^{-1} to 10^{-2} M

(b) 10^{-2} to 10^{-4} M

(c) 10^{-1} to 10^{-4} M

(d) 10^{-1} to 10^{-7} M

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

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

11. (a) State the basic working principle of biosensor. (CO1, K2)

Or

(b) Give a short note on the effect of scaling on the signal to noise ratio and speed of biosensors. (CO1, K1)

12. (a) Define transducer and its types. (CO2, K3)

Or

(b) Give a note on the components of amperometric biosensors. (CO2, K3)

13. (a) Explain the method of immobilization of enzyme by cross-linking method with one example. (CO3, K5)

Or

(b) Briefly explain the nature of profile between product concentration vs substrate concentration at different enzyme loading for an enzyme sensor. (CO3, K1)

14. (a) Write a note on the prospects of DNA data storage. (CO4, K2)

Or

(b) Explain how DNA can be used as a Bio-recognition element in an Optical Biosensor. (CO4, K4)

15. (a) Differentiate the enzymatic and non-enzymatic approaches involved in glucose sensors. (CO5, K2)

Or

(b) Describe the principle and methods of non-invasive glucose monitoring. (CO5, K4)

Part C (5 × 8 = 40)

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

16. (a) Describe in detail about the properties that reflects the performance of the biosensor. (CO1, K1)

Or

(b) Determine the impacts and challenges of biosensing with its applications. (CO1, K2)

17. (a) Illustrate the variations on the biological / biochemical component and transducer component of a bio sensor. (CO2, K3)

Or

(b) Elaborate on optical transducers with the principle of surface plasmon resonance with a neat diagram. (CO2, K3)

18. (a) What is the response time of enzyme biosensor? How is it related with the thickness of enzyme layer? (CO3, K5)

Or

(b) Describe in detail about the detection of pesticides by enzymes. (CO3, K1)

19. (a) Deterrnine the detection of DNA hybridization with the help of Potentiometric biosensor. (CO4, K2)

Or

(b) Elucidate the principle and mechanism of ion selective electrode. (CO4, K4)

20. (a) List the importance of non-enzymatic approach of a glucose sensor with the other generations. (CO5, K2)

Or

(b) Explain in detail on the measurement of glucose with the help of Amperometric Biosensor. (CO5, K4)

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