R0297	Sub. Code
	542101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Material Science

MATERIALS PHYSICS

(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. Resistance of a material against any external force is termed as ———— (CO1, K1)

   (a) Stiffness (b) Malleability

   (c) Strength (d) Hardness

2. In which of the following test specimen is in the form of cantilever beam? (CO1, K2)

   (a) Izod test (b) Rockwell hardness test

   (c) Charpy test (d) Brinell test

3. Which of the following phenomenon can only be seen in transverse waves? (CO2, K1)

   (a) Diffraction (b) Dispersion

   (c) Polarization (d) Interference

4. Piezoelectric effect is when materials produce electric charges when ———— (CO2, K2)

(a) Voltage is applied

(b) Electric field is applied

(c) Mechanical stress is applied

(d) Magnetic field is applied

5. Soft magnetic materials like iron and its alloys are used in the manufacture of (CO3, K2)

(a) Permanent magnets

(b) Magnets used in measuring meters of current and voltage

(c) Magnets for the toys

(d) Cores of transformers employed in power generation

6. As per Curie-Weiss Jaw, the magnetic susceptibility of a material varies as (CO3, K1)

(a) T^{-2} (b) T^{-1}

(c) T (d) T^2

7. What is the unit of illumination? (CO4, K1)

(a) Lux (b) Henry

(c) Coulomb (d) Candela

8. In optical fiber communication, the only weakly absorbing material over wavelength band required is? (CO4, K1)

(a) GaAs (b) GaSb

(c) Silicon (d) Germanium

9. Which of the following is a metallic glass? (CO5, K1)

(a) Argon (b) Nickel

(c) Crypton (d) Gold

10. When does a shape memory alloy return to its original shape? (CO5, K1)

(a) At transition temperature

(b) At Curie temperature

(c) At memory transfer temperature

(d) At normal temperature

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

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

11. (a) What is plastic deformation? Distinguish plastic deformation by slip? (CO1, K3)

Or

(b) What is dislocation and its movement. (CO1, K3)

12. (a) What is polariability in terms of materials physics. (CO2, K2)

Or

(b) Explain the effects of internal dielectric field in materials. (CO2, K2)

13. (a) Derive the Langevein theory of paramagnetism. (CO3, K3)

Or

(b) Briefly explain molecular theory of magnetism. (CO3, K3)

14. (a) What do you mean by band-to-band absorption? (CO4, K3)

Or

(b) What is the principle of injection luminescence? (CO4, K3)

15. (a) How do shape memory alloys work and explain it with proper example. (CO5, K3)

Or

(b) What is charge-coupled devices and its application? (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) What is creep in materials science and how does creep work in various applications. (CO1, K4)

Or

(b) Write a detailed demonstration of fracture and its types. (CO1, K4)

17. (a) Explain and compare piezo and pyroelectric materials. (CO2, K4)

Or

(b) Derive Claussius-Mossoti equation and explain the dielectric loss. (CO2, K4)

18. (a) What is hysteresis loss and explain soft, hard and ferrite materials in terms of magnetism. (CO3, K5)

Or

(b) What is meant by magnetic anisotropy and describe the magnetic domains. (CO3, K5)

19. (a) Explain the working principle of LED, types and its applications. (CO4, K5)

Or

(b) Describe in detail about liquid crystal display with suitable diagram. (CO4, K5)

20. (a) What are metallic glasses and how manufactured? (CO5, K4)

Or

(b) Demonstrate in detail about smart materials with proper examples and its application. (CO5, K4)

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R0298	Sub. Code 542102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Materials Science

THERMODYNAMICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

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

1. When a bomb explodes, chemical energy is converted to which form _____. (CO1, K1)

   (a) Kinetic energy (b) Potential energy

   (c) Current (d) Sound energy

2. What is the unit of energy? (CO3, K2)

   (a) Radians (b) Volt

   (c) Joule (d) Newton

3. Classical mechanics describe the motion of _____ (CO4, K3)

   (a) Microscopic object (b) Macroscopic object

   (c) Electron (d) Proton

4. Newton's first law of motion is applicable for (CO3, K4)

   (a) Free particles (b) Moving particles

   (c) Rest particles (d) Enzymes

5. The Refrigerator works on which of the following rind les? (CO3, K2)

(a) Osmosis (b) Centrifugation

(c) Dispersion (d) Evaporation

6. Find the correct match in the list I and II;

List I		List II
(A) Isothermal	(i)	Pressure constant
(B) Isochoric	(ii)	Temperature constant
(C) Adiabatic	(iii)	Volume constant
(D) Isobaric	(iv)	Heat content constant

(A) (B) (C) (D) (CO4, K3)

(a) (i), (iii) , (ii), (iv)

(b) (ii), (iii) , (iv), (i)

(c) (ii), (iv) , (iii), (i)

(d) None of the above

7. Particles obeying Maxwell-Boltzmann statistics are _____. (CO2, K5)

(a) Identical and Indistinguishable

(b) Identical and distinguishable

(c) Photons

(d) Metal fluorides

8. Bosons have spin value (CO5, K5)

(a) l/2 (b) 1

(c) 0 (d) 0 (or) 1

9. Planck's law describes the spectrum of _____ radiation (CO5, K6)

(a) White body (b) Black body

(c) Grey body (d) None of these

10. The unit with Stefan-Boltzmann constant is (CO5, K6)

(a) W/m^2 (b) $W/m^2 K$

(c) $W/m^2 K^4$ (d) W/mK

Part B

$(5 \times 5 = 25)$

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

11. (a) Conservation of law's define and explain all laws. (CO1, K1)

Or

(b) D' Alembert's principle and Lagranges equation of motion and explain? (CO1, K1)

12. (a) Define Poisson brackets and Lagrange brackets? (CO2, K2)

Or

(b) Explain Euler's angles, Angular velocity. (CO2, K2)

13. (a) (i) Describe state and path function

(ii) Define exact and inexact differential system. (CO3, K3)

Or

(b) Clausius-Clayperon equation and Helmholtz Gibbs free energies. (CO3, K3)

14. (a) Difference between Maxwell-Boltzmann and Bose-Einstein statistics (CO4, K5)

Or

(b) Define Ensembles and micro and macro states (CO4, K5)

15. (a) Describe and explain Planck's radiation law. (CO5, K6)

Or

(b) Explain Stefan-Boltzmann law. (CO5, K6)

Part C (5 × 8 = 40)

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

16. (a) Discuss on Lagranges equation of motion and cyclic co-ordinates. (CO1, K1)

Or

(b) Explain Hamilton's equations of motion and Euler Lagrange equation. (CO1, K1)

17. (a) (i) Derive the Relationship between Lagrange and Poisson bracket.

(ii) Derive Jacobi Idendity. (CO2, K2)

Or

(b) Explain rigid body dynamics Euler's angles and angular velocity. (CO2, K2)

18. (a) Explain Maxwell's relations. (CO3, K3)

Or

(b) Explain Gibbs Duhem derivation and Gibbs phase rule. (CO3, K3)

19. (a) Discuss the types of Ensembles. (CO4, K5)

Or

(b) Compare MB, BE, FD statistics (CO4, K5)

20. (a) Explain Planck's radiation law and Stefan-Boltsmann law. (CO5, K6)

Or

(b) Write classical partition function, classical ideal gas and equipartition theorem. (CO5, K6)

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R0299	Sub. Code
	542103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Materials Science

ELECTRONICS AND INSTRUMENTATION

(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 method is used for the measurement of medium? (CO1, K2)
   (a) Direction - deflection method
   (b) Anderson method
   (c) Kelvin's double bridge method
   (d) Carey - Faster bridge method

2. Which of the following is a balance equation for computing resistance? (CO1, K3)
   (a) $R_1 = R_2 / R_4$ (b) $R_1 = R_3 / R_4$
   (c) $R_1 = R_2 R_4$ (d) $R_1 = R_2 R_3 / R_4$

3. Inductance control is obtained by (CO2, K1)
   (a) Using R_5 (b) Using R_3
   (c) Using R_2 (d) Using L_x

4. A Schering bridge can be used for the (CO2, K1)
   (a) protecting the circuit from temperature rises
   (b) testing capacitors
   (c) measuring voltages
   (d) measuring currents

5. What is the dependence of the frequency on the balance equation? (CO3, K3)

(a) Varies by a factor of 2

(b) Independent on the detector used

(c) Dependent on the detector used

(d) Depends on the supply magnitude

6. Which of the following can be measured using Maxwell's inductance capacitance bridge? (CO3, K2)

(a) Capacitance

(b) Frequency

(c) Mutual inductance

(d) Inductance

7. The winding of a T.C. are (CO4, K1)

(a) Wound over one another

(b) Shorted

(c) Tied together

(d) Grounded

8. How is the voltage ratio dependent on the frequency? (CO4, K4)

(a) They aid each other

(b) They oppose each other

(c) Depends on the setup of the circuit

(d) They are independent of each other

9. Increasing secondary burden (CO5, K3)

(a) Decrease I_s (b) Keeps I_s constant

(c) Increases I_s (d) Decreases I_s

10. When the moving coil in a Dynameters type wattmeter defects (CO5, K4)

(a) Pointer moves (b) Pointer doesnot moves

(c) Current flows (d) Current flows

Part B (5 × 5 = 25)

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

11. (a) The series ohmmeter in given figure is made up of a 1.5 V battery, a 100 microamperes meter and a resistance R1 which makes (R1 + R_m) = 15 KΩ. Determine the instrument indication when R_x = 0. (CO1, K5)

Or

(b) Discuss the internal circuit of DC voltmeter. (CO1, K1)

12. (a) Draw the circuit diagram of a basic two transistor flip flop. Explain the conditions that keep one transistor ON and the other one OFF. (CO2, K2)

Or

(b) Draw the logic diagram for a general ADC. (CO2, K2)

13. (a) Discuss the electronic meters for measurement of very high and very low resistances. (CO3, K3)

Or

(b) Sketch RL series and parallel equivalent circuits for an inductor. (CO3, K3)

14. (a) Draw the block diagram for a digital spectrum analyzer. Explain its operation. (CO4, K4)

Or

(b) Explain the basic operation of a digital storage oscilloscope, and discuss the relationship between sampling rate and bandwidth. (CO4, K3)

15. (a) Explain Anderson bridge with vector diagram and also derives balance Equation. (CO5, K3)

Or

(b) Describe the working of a digital frequency meter with schematic block Diagram. (CO5, K4)

Part C (5 × 8 = 40)

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

16. (a) Draw the circuit of Kelvin's double bridge used for measurement of low resistance. Derive the condition for balance. (CO1, K1)

Or

(b) Explain salient features of Maxwell's Inductance capacitance bridge. Draw phasor diagram and derive balance equation. (CO1, K3)

17. (a) Explain True RMS Reading Voltmeter. (CO2, K4)

Or

(b) Draw the block diagram of an oscilloscope and explain briefly its major system. (CO2, K2)

18. (a) Explain True RMS Reading Voltmeter. (CO3, K3)

Or

(b) Draw the block diagram of an oscilloscope and explain briefly its major system. (CO3, K4)

19. (a) Describe digital storage oscilloscope with schematic block diagram and state its Applications. (CO4, K3)

Or

(b) Explain Vector Impedance Meter. (CO4, K4)

20. (a) Explain harmonic distortion analyzer. (CO5, K1)

Or

(b) Describe the working of a frequency synthesizer with schematic block diagram. (CO5, K3)

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R0300	Sub. Code
	542104

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Materials Science

ELECTROMAGNETIC THEORY AND OPTICS

(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. The electric flux density is the ratio of (CO1, K1)

   (a) charge to area of dielectric at right angles to direction of electric flux

   (b) charge to distance between the plates

   (c) electric flux to distance between the plates

   (d) electric flux to area of the plates.

2. The relation, $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$ holds good (CO1, K2)

   (a) only in vacuum

   (b) only inside dielectric

   (c) only outside dielectric

   (d) everywhere

3. The electromagnetic wave going through the vacuum is described by $\mathbf{E} = E_0 \sin(kx - \omega t)$ and $\mathbf{B} = B_0 \sin(kx - \omega t)$. Which of the following question is true? (CO2, K4)

(a) $E_0 k = B_0 \omega$ (b) $E_0 \omega = B_0 k$

(c) $E_0 / k = B_0 / \omega$ (d) $E_0 k = 0$

4. The electric and magnetic fields of an electromagnetic wave are (CO2, K3)

(a) in phase and parallel to each other

(b) in opposite phase and perpendicular to each other

(c) in phase and perpendicular to each other

(d) in opposite phase and parallel to each other

5. The refractive index of the glass is 1 .5. then the speed of light in glass is (CO3, K5)

(a) 3×10^8 m/s (b) 1.5×10^8 m/s

(c) 4.5×10^8 m/s (d) 2×10^8 m/s

6. The negative refractive index of metals give rise to (CO3, K4)

(a) refraction (b) reflection

(c) absorption (d) scattering

7. Raman and Brillouin scattering are usually observed at (CO4, K1)

(a) High optical power densities

(b) medium optical power densities

(c) low optical power densities

(d) Threshold power densities

8. In linear medium, the polarization P is relative to the electric field E is (CO4, K4)

(a) $\mathbf{P} = \varepsilon_0 \mathbf{E}$ (b) $\mathbf{P} = \chi \mathbf{E}$

(c) $\mathbf{P} = \varepsilon_0 \chi \mathbf{E}$ (d) None of these

9. Nonlinear optics is dealing with (CO5, K3)

(a) the variation of focal length of lenses

(b) the variation of optical absorption

(c) the variation of refractive index with intensity of light

(d) the variation of electric and magnetic fields

10. Kerr effect is a (CO5, K2)

(a) linear electro optic effect

(b) nonlinear electro optic effect

(c) linear magneto optic effect

(d) nonlinear magneto optic effect

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

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

11. (a) State Laplace law and its applications. (CO1, K1)

Or

(b) Derive the expression for induced e.m.f from Faraday's law of electromagnetic induction. (CO1, K2)

12. (a) State poynting theorem and give the applications of pointing vector and pointing theorem. (CO2, K1)

Or

(b) The electric charges of $1\mu C, -1\mu C$ and $2\mu C$ are placed in air at the corners A, B and C respectively of an equilateral triangle ABC having the length of each side is 10 cm. Find the resultant force on the charge at C. (CO2, K5)

13. (a) Write short note on index ellipsoid and wave plates. (CO3, K3)

Or

(b) Describe the positive and negative crystals with an example. (CO3, K2)

14. (a) State and explain magneto optical Kerr effect. (CO4, K4)

Or

(b) Write short notes on Stimulated Brillouin Scattering (SBS). (CO4, K4)

15. (a) Why optical switches are advanced than electrical switches? (CO5, K5)

Or

(b) What is optical phase conjugation (OPC)? Give the uses of OPC. (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) Derive Maxwell's equations for time varying fields. (CO1, K2)

Or

(b) State Biot-Savart's law and give the applications of this B-S law. (CO1, K1)

17. (a) Give an account of propagation of electromagnetic waves in anisotropic dielectric medium. (CO2, K2)

Or

(b) State Maxwell's equation for the electromagnetic field and obtain the wave equations for free space. (CO2, K3)

18. (a) Explain different types of symmetry crystals. (CO3, K1)

Or

(b) Derive an expression for Fresnel equation for parallel and perpendicular polarization. (CO3, K5)

19. (a) List out the electro optic effects and explain them. (CO4, K4)

Or

(b) Discuss in detail the Stimulated Raman Scattering (SRS) and their applications. (CO4, K4)

20. (a) Give an account on the nonlinear optical materials and their applications. (CO5, K3)

Or

(b) Write short notes on : (CO5, K1, K4)

(i) Solitons

(ii) Optical mixing.

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R0301	Sub. Code
	542505

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Materials Science

Elective — LASER AND APPLICATIONS

(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 layer of a CD is responsible for reflecting the laser beam back to the CD player? (CO1, K1)

   (a) Substrate layer (b) Reflective layer

   (c) Data layer (d) Label layer

2. The following is not a candidate material for laser source in fibre optics (CO1, K2)

   (a) Nd-YAG (b) He-Ne

   (c) Argon (d) Phosphorous

3. What is a disadvantage of LED lights over laser lights? (CO2, K4)

   (a) non-coherent light source

   (b) hardly available

   (c) consuming more power

   (d) costlier than laser

4. A ruby maser prefers to ammonic maser for microwaves application because it has (CO2, K3)
   (a) Much greater band width
   (b) Lower noise frequency
   (c) Better frequency stability
   (d) No need for a circulator

5. Population inversion semiconductor laser diode is achieved by (CO3, K5)
   (a) Lightly doping p and n sides
   (b) Introducing trap centres on p and n sides
   (c) Heavily doping p and n sides
   (d) Reverse biasing the junction

6. Which of the following is a unique property of laser? (CO3, K4)
   (a) Directional (b) Speed
   (c) Coherence (d) Wavelength

7. Which of the following is a example of optical pumping? (CO4, K1)
   (a) Ruby laser
   (b) He-Ne laser
   (c) Semiconductor laser
   (d) Dye laser

8. Calculate the wave length of radiation emitted by an LED made up of semiconducting with band gap energy 2.8 eV. (CO4, K4)
   (a) 2.8 Å (b) 4.3308 Å
   (c) 5548.4 Å (d) 4430.8 Å

9. Which of following is used in b atomic clocks? (CO5, K3)
   (a) Laser (b) Quartz
   (c) Cesium (d) Helium

10. Which of the following can be used in the vibrational analysis of structure? (CO5, K2)
   (a) Maser (b) Quartz
   (c) Electrical waves (d) Laser

Part B (5 × 5 = 25)

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

11. (a) What is the meaning of smart material? Explain different types of smart material. (CO1, K2)

Or

(b) Describe the fracture mechanism of fibre composite material. (CO1, K3)

12. (a) Explain induce absorption, spontaneous emission and stimulated emission when radiation interacts with matter. (CO2, K2)

Or

(b) Explain the characteristic properties of LASER. (CO2, K1)

13. (a) Derive the expression for energy density of radiation in terms of Einstein coefficients and compare it with Planck's law of radiation. (CO3, K4)

Or

(b) What is Boltzmimn factor? On which parameters depend? (CO3, K2)

14. (a) Mention the condition for Laser system. (CO4, K1)

Or

(b) Discuss the requisites for Laser system. (CO4, K2)

15. (a) Discuss 3-level and 4-level lasing schemes in detail. Mention the advantages of 4-level scheme. (CO5, K5)

Or

(b) Explain the working of an optical resonator / laser cavity in a neat sketch. (CO5, K4)

Part C (5 × 8 = 40)

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

16. (a) Explain construction a working of He-Ne laser with the help of energy level diagram. (CO1, K2)

Or

(b) Why is the partial pressure of He more than that of Ne in He-Ne laser? (CO1, K3)

17. (a) With neat sketches, explain the construction and working of semiconductor laser. (CO2, K1)

Or

(b) What are the advantages of semiconductor laser? (CO2, K2)

18. (a) What is LIDAR? Explain the principle of working and uses of LIDAR. (CO3, K3)

Or

(b) Explain how laser are used for precise measurements of deflection of bridges. (CO3, K5)

19. (a) Explain the mechanism of light propagation in an optical fiber with suitable diagram. (CO4, K3)

Or

(b) Define Acceptance angle and Numerical Aperture (NA) of optical fiber. Derive an expression for NA in term of refractive indices of core and cladding. (CO4, K5)

20. (a) Defines fractional index change. Derive the relation between fraction index changes and numerical aperture. (CO5, K3)

Or

(b) With neat sketches, discuss differ types of optical fibers. (CO5, K4)

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R0302	Sub. Code 542301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Materials Science

NANOMATERIALS

(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 melting point of particles in nano form ———— (CO1, K1)

   (a) Increases (b) Decreases

   (c) Remains same (d) Increases then decreases

2. The colour of the nano gold particles is (CO1, K2)

   (a) Yellow (b) Orange

   (c) Red (d) Variable

3. A simple ———— degree rotation of a graphene sheet transforms the nanotube it creates from armchair to zigzag or vice versa. (CO2, K2)

   (a) 40 (b) 30

   (c) 60 (d) 180

4. The diameter of the nano wire is about (CO2, K2)

   (a) 10^{-6} m (b) 10^{-3} m

   (c) 10^{-8} m (d) 10^{-9} m

5. Chemical vapour decomposition is developed in an year (CO3, K1)

(a) 2001 (b) 2002

(c) 2006 (d) 2007

6. The current used in the arc discharge method is about (CO3, K4)

(a) 100 mA (b) 200 mA

(c) 300 mA (d) 400 mA

7. Which among the following helps us in getting a three-dimensional picture of the specimen? (CO4, K1)

(a) Transmission Electron Microscope

(b) Scanning Electron Microscope

(c) Compound Microscope

(d) Simple Microscope

8. Absorption spectrum results when an electron in an atom undergoes a transition from (CO4, K2)

(a) High energy level to a lower one

(b) Lower energy level to a higher one

(c) Intermediate levels

(d) All the of the above

9. A material with one dimension in Nano range and the other two dimensions are large is called (CO5, K2)

(a) Micro-material (b) Quantum wire

(c) Quantum well (d) Quantum dot

10. Which one of the following is an example for semiconducting nanowires? (CO5, K5)

(a) Nickel (b) Platinum

(c) Silicon (d) All of the above

Part B (5 × 5 = 25)

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

11. (a) Write a short note on mechanical properties of nanoparticles. (CO1, K2)

Or

(b) What is quantum confinement? Discuss the role of quantum confinement in properties of nanoparticles. (CO1, K2)

12. (a) Compare SWCNTs and MWCNTs. (CO2, K2)

Or

(b) Write the properties and applications of nanotubes. (CO2, K3)

13. (a) Discuss the solvothermal method synthesis of nanowires. (CO3, K5)

Or

(b) Write a short note on semiconductor nanowires. (CO3, K2)

14. (a) How does FESEM works? How the d-spacing values are calculated from HRTEM? (CO4, K4)

Or

(b) What is the principle of scanning capacitance microscopy? Write about the instrumentation of scanning capacitance microscopy. (CO4, K4)

15. (a) Discuss about the role of nanoparticles in data storage applications. (CO5, K5)

Or

(b) Discuss nanomaterials sensors and its applications. (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) Give reasons for the change in optical and electrical properties of nanoparticles. (CO1, K2)

Or

(b) How does melting point and specific surface area of the nanoparticle changes when size reduces and explain. (CO1, K2)

17. (a) Describe the synthesis of carbon nanotubes by pyrolysis techniques. (CO2, K5)

Or

(b) What are nanowires? Give examples. Explain the VLS mechanism for the synthesis of nanowires. (CO2, K5)

18. (a) Give a detailed note on instrumentation and procedure for PVD method. (CO3, K5)

Or

(b) Define nanofibers and explain the electro spinning technique. (CO3, K5)

19. (a) Discuss about absorption and emission spectra of nanoparticles with suitable examples. (CO4, K2)

Or

(b) Explain the working principle, instrumentation and applications of scanning capacitance microscopy. (CO4, K5)

20. (a) Explain about magnetic data storage and quantum wells. (CO5, K2)

Or

(b) Discuss the fabrication of millipede memory chip and its characteristics. (CO5, K4)

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R0303	Sub. Code
	542302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Materials Science

POLYMER AND COMPOSITE MATERIALS

(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 is a condensation polymer? (CO1, K1)

   (a) Teflon (b) PVC

   (c) Decron (d) PAN

2. Monomers of natural rubber will be (CO1, K1)

   (a) Chloroprene (b) 1, 3 Butadiene

   (c) Styrene (d) Isoprene

3. What is the process by which nylon is obtained? (CO2, K2)

   (a) Distillation (b) Evaporation

   (c) Hydrogenation (d) Polymerization

4. Which of the polymer is used to make Bullet Proof Glass? (CO2, K3)

(a) Gldyptal (b) PMMA

(c) Teflon (d) None of these

5. One of the characteristic of polymer is (CO3, K2)

(a) High temperature Stability

(b) High mechanical strength

(c) High elongation

(d) Low hardness

6. The Non Metal Vulcanization of rubber is (CO3, K3)

(a) Phosphorous (b) Sulphur

(c) Graphite (d) Iodine

7. Which of the following polymer is thermosetting polymer? (CO4, K2)

(a) Terylene (b) Polystyrene

(c) Bakelite (d) Neoprene

8. Which type of rubber is Ebonite? (CO4, K2)

(a) Natural Rubber

(b) Synthetic Rubber

(c) High Vulcanized Rubber

(d) None of these

9. Which of the following is the storage natural fiber? (CO5, K3)

(a) Cotton (b) Jute

(c) Silk (d) Wool

10. The primary substance used for Vulcanizing Sulphur rubber is (CO5, K5)

(a) Ammonium hydroxide

(b) Isoprene

(c) Zinc Oxide

(d) Sulphur

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

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

11. (a) Discuss any four thermosetting plastics in terms of their composition, characteristics, merits, demerits and applications. (CO1, K2)

Or

(b) Explain the working principle and applications of the following processes with neat sketches. (CO1, K1)

(i) Injection moulding

(ii) Compression moulding

(iii) Thermo forming.

12. (a) Explain the fabrication methods, properties and applications of : (CO2, K4)

(i) Glass fibers

(ii) Carbon fibers.

Or

(b) (i) Explain the properties, fabrication methods and applications of any two organic fibers. (CO2, K3)

(ii) Compare the properties of polymers with ceramics and metals.

13. (a) (i) Briefly discuss about the principle, drawbacks and applications of Autoclave molding and pultrusion. (CO3, K3)

(ii) Write short notes about the interface region of PMC.

Or

(b) (i) Explain the equipment, principle, advantages, disadvantages and applications of Vacuum bag molding with neat sketches. (CO3, K2)

(ii) Write short notes on recycling of PMC.

14. (a) Explain the processing of MMCs with Rhea casting, Diffusion bonding and powder metallurgy methods. (CO4, K4)

Or

(b) Explain any four metallic matrices with respect to their physical, thermal, mechanical and electrical properties. (CO4, K5)

15. (a) What is the meaning of smart materials? Explain different types of smart materials. (CO5, K5)

Or

(b) Describe the fracture mechanism of fiber composite materials. (CO5, K3)

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

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

16. (a) Define composites and justify why the composites are better than the conventional materials. (CO1, K3)

Or

(b) Differentiate between thermosetting and thermoplastic polymers. (CO1, K2)

17. (a) With neat sketch explain the hand layup process in composite manufacturing. (CO2, K4)

Or

(b) Suggest the manufacturing process with neat sketch to produce cylindrical components. (CO2, K3)

18. (a) Define volume and mass fractions for fiber and matrix and derive expressions for them. (CO3, K5)

Or

(b) What are the assumptions made in macro mechanics? (CO3, K5)

19. (a) Define composite failure and discuss the modes of failure in composites. (CO4, K1)

Or

(b) Explain maximum stress and maximum strain failure theories used in the composites. (CO4, K5)

20. (a) Explain the basic assumptions in the classical laminate plate theory. (CO5, K3)

Or

(b) Derive the expressions for [A], IB] and [D] matrices for laminate. (CO5, K1)

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R0304	Sub. Code
	542303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Materials Science

SOLID STATE 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. Crystals are anisotropic because (CO1, K1)

   (a) atoms, ions or molecules are closely packed in a small volume

   (b) often they contains ions off different elements

   (c) crystal has different periodic arrangements in different directions

   (d) the interaction space is void

2. The melting points of molecular solids is (CO1, K4)

   (a) fairly low (b) very low

   (c) very high (d) normal

3. The ratio of the density of ideal gas to that of free electron gas is (CO2, K2)

   (a) $=1$ (b) <1

   (c) 0 (d) >1

4. The general expression for the Fermi energy of a metal at 0 K is (CO2, K1)

(a) $3.65\times10^{-19}\times n^{2/3}e\text{V}$

(b) $3.65\times10^{-19}\times n^{2}e\text{V}$

(c) $3.65\times10^{-19}\times n^{1/3}e\text{V}$

(d) $3.65\times10^{-19}\times n^{3/2}e\text{V}$

5. If the v_p and v_g be the phase and group velocity of the lattice wave then in long wavelength side is (CO3, K2)

(a) $v_p < v_g$ (b) $v_p = v_g$

(c) $v_p > v_g$ (d) $v_p = v_g = 0$

6. In inelastic scattering of a photon with lattice a phonon is (CO3, K4)

(a) created

(b) absorbed

(c) created or absorbed

(d) none of these

7. In a crystal having N primitive cells, the maximum number of electrons per band is (CO4, K1)

(a) N (b) $2N$

(c) $N/2$ (d) 0

8. The width of the energy band depends on (CO4, K3)

(a) the extend of overlap of wave functions ψ_1 and ψ_2 corresponding to the two atoms

(b) the interaction between the two atoms

(c) both (a) and (b)

(d) none of these

9. The mean lifetime of the carrier injected into a semiconductor is the time in which the carrier value falls to (CO5, K5)

(a) 10% of its initial value

(b) 17% of its initial value

(c) 27% of its initial value

(d) 37% of its initial value

10. Transition temperature of most superconducting element lies (CO5, K3)

(a) Zero to 10 K (b) 10 to 20 K

(c) 20 to 50 K (d) above 50 K

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

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

11. (a) Find an expression for cohesive energy of ionic crystals. (CO1, K1)

Or

(b) Calculate the density of lattice points in lattice plane (111) in a SC lattice of constant 2.5 $\mathring{A}$. (CO1, K5)

12. (a) What are the merits and demerits of free electron theory of metals after Drude? (CO2, K4)

Or

(b) What are the sources of electrical resistivity in metals? (CO2, K2)

13. (a) Give a comparative study Einstein's and Debye's theory of specific heat of solids. (CO3, K5)

Or

(b) Obtain N-process and U-process is applied to lattice vibration. (CO3, K2)

14. (a) Distinguish metal, semiconductor and insulator in view of band theory of solids. (CO4, K4)

Or

(b) Explain the physical significance of effective mass in electron. (CO4, K3)

15. (a) Sketch the E – k diagram for direct and indirect band gap semiconductor. (CO5, K1)

Or

(b) Explain the high temperature superconductors and its applications. (CO5, K3)

Part C (5 × 8 = 40)

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

16. (a) Find the packing density of BCC and FCC structure of lattice constant a. (CO1, K3)

Or

(b) Determine Madelung constants. Evaluate the Madelung constant for a one dimensional chain of alternative signs. (CO1, K1)

17. (a) State clearly the limitations of classical and quantum free electron model. Briefly discuss the advantages of the quantum free electron model over classical free electron model. (CO2, K4)

Or

(b) Explain Fermi – Dirac distribution function. Plot this function for various temperature including 0 K. (CO2, K3)

18. (a) Discuss the Debye model of lattice heat capacity, Why is Debye theory more acceptable than Einstein's theory? (CO3, K5)

Or

(b) Obtain dispersion relation for one dimensional atomic crystal and discuss the nature of acoustic and optical models. (CO3, K2)

19. (a) Discuss the Kronig – Penny model for the motion of an electron in a periodic potential. (CO4, K4)

Or

(b) State and prove Bloch theorem in periodic potential in a crystal. (CO4, K2)

20. (a) (i) How will you experimentally determine whether a given semiconductor is n-or p-type? (CO5, K5)

(ii) Deduce Einstein relation.

Or

(b) Give an account of the phenomenon of superconductivity. Explain type I and II superconductors. (CO5, K4)

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R0305	Sub. Code
	542304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Materials Science

CERAMIC MATERIALS

(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. Porcelain is a type of ceramic (CO1, K1)

   (a) Whiteware (b) Stone

   (c) Abrasive (d) Cement

2. Which of the following carbides are used for cutting tools? (CO1, K2)

   (a) Silicon carbide (b) Tungsten carbide

   (c) Vanadium carbide (d) Chromium carbide

3. Which of the following is a characteristic of alumina? (CO2, K1)

   (a) Excellent hardness

   (b) Good tensile strength

   (c) Good toughness

   (d) Poor wear resistance

4. Not a major contributor of engineering ceramics (CO2, K2)

(a) SiC (b) SiO_2
(c) Si_3N_4 (d) Al_2O_3

5. The following ceramic product is mostly used as pigment in paints (CO3, K2)

(a) TiO_2 (b) SiO_2
(c) UO_2 (d) ZrO_2

6. Hot isostatic pressing is not a viable option if the chief criterion is (CO3, K1)

(a) Strength without grain growth
(b) Low cost
(c) Zero porosity
(d) Processing refractory ceramics

7. During sintering densification is not due to (CO4, K1)

(a) Atomic diffusion (b) Surface diffusion
(c) Bulk diffusion (d) Grain growth

8. Ceramics consists of (CO4, K1)

(a) Ionic bonding
(b) Ionic and covalent bonding
(c) Hydrogen bonding
(d) None of the above

9. Which of the following properties are true for ceramics? (CO5, K1)

(a) Light weight construction with less inertia of force
(b) Excellent wear
(c) Lower frictional loss
(d) All of the mentioned

10. Which of the following is a thermosetting polymer? (CO5, K1)

(a) PVC (b) PTFE
(c) Bakelite (d) Polyesters

Part B (5 × 5 = 25)

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

11. (a) Write an explanation of doctor blade processing method and how it works? (CO1, K2)

Or

(b) Discuss surface finishing techniques in ceramics. (CO1, K2)

12. (a) What you mean by ceramics oxides and explain preparation methods. (CO2, K3)

Or

(b) Why nitrides are significant is structural designing of ceramics. (CO2, K3)

13. (a) Discuss different types of ferroelectric ceramics and devices. (CO3, K3)

Or

(b) What is the role of PLZT materials in electronic applications? (CO3, K3)

14. (a) Explain the types of refractories with proper diagram. (CO4, K2)

Or

(b) Describe in detail about special refractories of silica. (CO4, K2)

15. (a) Explain the role of glass transition temperature. (CO5, K1)

Or

(b) Give a detailed discussion on glass manufacturing process. (CO5, K1)

Part C (5 × 8 = 40)

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

16. (a) Explore the sintering techniques in ceramics. (CO1, K1)

Or

(b) Why sol-gel method is much important in ceramics processing? (CO1, K1)

17. (a) What are bioceramics and elaborate its medical applications. (CO2, K3)

Or

(b) Explain silicon and tungsten carbides use in structural ceramics. (CO2, K3)

18. (a) Define superconducting ceramics and discuss mechanism in detail. (CO3, K2)

Or

(b) What are oxide and non-oxide varistors and distinguish them. (CO3, K2)

19. (a) What is ceramic fiber and how prepared and discuss its applications. (CO4, K5)

Or

(b) Discuss about the high temperature application of ceramic fibers. (CO4, K5)

20. (a) Explain different types of glass ceramics. (CO5, K4)

Or

(b) Discuss the nucleation process in the glass ceramics industry. (CO5, K4)

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R0306	Sub. Code 542513

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Materials Science

Elective — BIOSENSORS

(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 are transducers? (CO2, K1)
   (a) They convert power from one form to another
   (b) They convert work from one form to another
   (c) They convert work to power
   (d) They convert energy from one form to another

2. Which of the following is not a characteristic of an ideal transducer? (CO2, K3)
   (a) High dynamic range
   (b) Low linearity
   (c) High repeatability
   (d) Low noise

3. Biosensors have been applied in medical field to _____ (CO1, K2)
   (a) measure BOD
   (b) detect toxic compounds
   (c) detect plant neutrients
   (d) diagnose infectious diseases

4. How many major types of transducers are there? (CO2, K3)

(a) 2 (b) 4
(c) 6 (d) 8

5. Electrical transducers generate ———————— (CO3, K6)

(a) biological signals (b) chemical signals
(c) physical signals (d) electrical signals

6. Electrical transducers are ————————

(a) small and non-portable
(b) large and non-portable
(c) small and compact
(d) large and portable

7. What is the standard form of HRP? (CO3, K5)

(a) Horseradish Peroxidase
(b) Horseradish Phosphorescene
(c) Horseradish Phosphorous
(d) None of the above

8. The study and application of molecular building blocks for the fabrication of electronic components is called as ———————— (CO4, K4)

(a) electronics
(b) microelectronics
(c) molecular electronics
(d) macro electronics

9. What is the standard form of FBS? (CO5, K2)

(a) Flexible Blood Sugar
(b) Fasting Blood Sugar
(c) Fasting Body Sugar
(d) None of the above

10. Blood glucose level measurement device uses a biosensor works on the principle of (CO5, K4)

(a) optical (b) electrochemical
(c) peizoelectric (d) acoustic

Part B (5 × 5 = 25)

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

11. (a) Write note on historical events on biosensors development. (CO1, K1)

Or

(b) Discuss applications of biosensors in medical field giving two examples. (CO1, K1)

12. (a) What are different type of transducers? Give examples for each type. (CO2, K3)

Or

(b) Describe in detail acoustic wave sensor. (CO2, K3)

13. (a) How enzyme sensor can be fabricated? Give example. (CO3, K5)

Or

(b) What are the methods used for biomolecular immobilization? (CO3, K5)

14. (a) Discuss on different molecules used for developing molecular wire. (CO4, K6)

Or

(b) Describe molecular memory stores. (CO4, K6)

15. (a) Discuss history of glucose sensors. (CO5, K4)

Or

(b) Discuss different glucose sensors. (CO5, K4)

Part C (5 × 8 = 40)

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

16. (a) Explain different characteristics of biosensors. (CO1, K1)

Or

(b) Explain different types of electrochemical biosensors. (CO2, K3)

17. (a) Explain cell based biosensor fabrication with suitable example. (CO3, K5)

Or

(b) Explain DNA molecule properties and its application in electronics. (CO4, K4)

18. (a) Discuss on invasive and non-invasive glucose monitoring. (CO5, K6)

Or

(b) Explain molecular switches and rectifiers. (CO4, K6)

19. (a) Discuss rectifying molecular behavior with different functional groups. (CO4, K2)

Or

(b) Discuss applications of biosensor botanical field. (CO3, K5)

20. (a) Explain piezoelectric biosensors. (CO2, K2)

Or

(b) Discuss on different receptor molecule based biosensors. (CO1, K3)

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