R7337	Sub. Code
	542301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

Third Semester

Materials Science

FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. Define nano scale.

2. What are the unique properties of nanostructures?

3. What is Chemical vapor deposition?

4. Which technique is commonly used for metal oxide synthesis? Why?

5. What is excitonic Bohr radius?

6. Define quantum dots.

7. When will you employ STM?

8. What is nanoindentation?

9. Write down the applications of nanotubes.

10. Define solar cells.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) List out the properties of zero dimension and 1D structures.

Or

(b) Justify how the size effect of a nano particle contribute to the physical property?

12. (a) Discuss the various types of milling. Describe the strategies involved in self-assembly.

Or

(b) Explain the mechanism of formation for the chemically modified Carbon Nano Tubes.

13. (a) Derive the excitonic Bohr radius for quantum well and quantum dot.

Or

(b) Using optical spectroscopy how the electron confinement in quantum dots can be determined.

14. (a) Calculate the particle size using Scherer constant (k=0.94), Given wavelength (1.54178Å), β (0.00352) and θ (0.29).

Or

(b) Justify when the DLS method can be used to measure the particle size.

15. (a) Describe the coulomb blockade effects in ultra - small metallic junctions.

Or

(b) Explain the principle of dip pen lithography.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Describe the top-down and Bottom-up approach for the synthesis of Nanomaterial with examples.

17. Explain the principle, instrumentation and applications of any two Physical vapour deposition process.

18. Illustrate with neat diagram explain the growth of quantum dots using an epitaxial method.

19. Demonstrate the operation of Nano indentation using AFM and enumerate its application.

20. Write short note on:

    (a) Nano particle based solar cells (3)

    (b) Quantum dot-based LEDs (3)

    (c) CNT based transistors (4)

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R7338	Sub. Code
	542302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

Third Semester

Materials Science

POLYMER AND COMPOSITE MATERIALS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is tacticity and list out its types?

2. List out the methods used for synthesis of polymers.

3. PET bottle become hazy, when it is put into the boiling water. Why?

4. State Boltzmann superposition principle.

5. What is the band gap of conducting polymers and give examples?

6. What is the relationship between rheology and viscosity?

7. How do we classify composite materials?

8. State any two important properties of glass fibres.

9. What are thermoplastics and how it is fabricated?

10. Mention the advantages of carbon/carbon composites.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) List out the classifications of co-polymers and explain them with suitable examples.

Or

(b) Explain the methods of Molecular weight determination of polymers.

12. (a) Discuss the factors influencing the glass transition temperature.

Or

(b) Explain the crystallization behavior of polymers. How the crystalanity of the polymers are determined?

13. (a) Give the effect of polymer blench on rheology.

Or

(b) Describe briefly about polymer processing operations.

14. (a) List out the common ceramic materials and write down their properties advantages, dis-advantages and uses.

Or

(b) Explain the structure, fabrication methods and properties of carbon fibre.

15. (a) Explain the hot press moulding process of fabricating thermoplastics.

Or

(b) Explain the composition, properties, advantages, disadvantages and applications of Thermoplastics.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain the polymerization techniques in detail (a) step growth and (b) chain growth.

17. Discuss the mechanical properties of polymer with suitable examples.

18. Write short note on conducting polymers, liquid crystal polymer, high temperature polymer and bio polymers and their applications.

19. Explain the broad classification of composite material with necessary illustrations.

20. With a neat sketch explain the injection moulding process and compare their advantages and disadvantages.

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R7339	Sub. Code
	542303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

Third Semester

Materials Science

SOLID STATE PHYSICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. What are Miller indices?

2. What is Medelung constant?

3. State Wiedemann - Franz law.

4. What is Fermi energy and Fermi momentum?

5. Find out the possible normal modes of vibration for linear chain of monoatomic lattice.

6. What is an Umklapp process?

7. Define Bloch function?

8. Define de Hass-Van Alphen effect.

9. Distinguish between metals, semiconductors and insulators on the basis of band theory.

10. What are the important predictions of BCS theory?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain the atomic packing factor for FCC and BCC.

Or

(b) Write short notes on types of bonding.

12. (a) Deduce Wiedemann and Franz law. Explain its significance.

Or

(b) Explain why specific heat at constant pressure is greater than the specific heat at constant volume?

13. (a) Discuss anharmonicity and thermal expansion in solid.

Or

(b) Describe the local phonon model of specific heat in solid.

14. (a) What is Brillouin zone? Sketch first and second Brillouin zones. Show that the bcc lattice is the reciprocal lattice of the fcc lattice.

Or

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

15. (a) Explain intrinsic and extrinsic semiconductors with a neat sketch of band diagram.

Or

(b) Explain the high temperature superconductors and its application.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. (a) Derive an expression to calculate the interplanar spacing in orthogonal crystal system?

    (b) How would you calculate the lattice energy using Born Haber cycle.

17. Define Fermi function. Explain the effect of temperature on Fermi-Dirac Distribution.

18. What are the assumptions of Einstein theory of specific heat in solids? Derive the relation for lattice heat Capacity using Einstein Debye's model.

19. Discuss the Kronig-Penney model for the movement of electron in an periodic field of crystal.

20. Write short notes on

    (a) Meissner effect (3)

    (b) Type I and type II superconductors (4)

    (c) BCS theory (3)

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R7340	Sub. Code
	542513

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

Third Semester

Materials Science

Elective : BIO-ELECTRONICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. What are the different dopants used for making p-type silicon?

2. What happens to the fermi level when junctions made?

3. What are the different types of Biosensors?

4. What is cell-based biosensors?

5. Give some examples of Molecular wires and Switches.

6. Write short note on the role of DNA in molecular programming.

7. Give an example for oxidation and reduction reaction.

8. How would you choose electrodes for the body surface recording?

9. How neuron act as the threshold device?

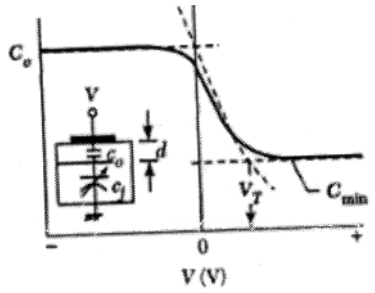
10. What is bioelectricity?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Consider a n-type semiconductor for the fabrication of metal semiconductor junction and describe the current voltage characteristics.

Or



(b) For an ideal metal- SiO_2-Si diode having $N_A = 10^{17}$ cm^{-2} and d=5 nm, calculate the minimum capacitance of the C-V curve in the above Figure. The relative dielectric constant of SiO, is 3.9.

12. (a) List out the criteria for the selection of transducer in biosensor.

Or

(b) Write short note on Enzyme field effect transistor.

13. (a) What are Molecular switches and how it is applicable for information storages?

Or

(b) What are the basic constituents of molecular electronics?

14. (a) Give short note on electrochemical cell and illustrate their mechanism.

Or

(b) Explain the key properties of microelectrodes to use in biological monitoring.

15. (a) Explain the biophysical description of action potential.

Or

(b) Explain the silicon neuron junction in detail.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain the homojunction made from p and n -type Silicon and illustrate their current voltage characteristics.

17. Write the principle, mode of operation, applications of light addressable potentiometric sensors.

18. Explain the properties and applications of DNA in molecular electronics.

19. Define Polarization and explain their types based on their behavior.

20. Discuss Hodgkin and Huxley phenomenon and draw its equivalent circuit.

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