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**M.Tech. (Second Semester)  
EXAMINATION, MAY-JUNE, 2022  
Paper Fifth (OE-28B)  
(Nanophotonics)**

**Elective B**

*Time : Three Hours]*

*[Maximum Marks:80]*

*[Minimum Pass Marks: 16]*

**Note- Attempt all sections as directed.**

**SECTION-A**

**(Objective/Multiple Choice Questions)**

**(1 mark each)**

**Note:- Attempt all questions. Choose the correct answers.**

1. The size of quantum dot is \_\_\_\_\_ m.

- (A)  $5 \times 10^{-5}$
- (B)  $5 \times 10^{-9}$
- (C)  $5 \times 10^{-10}$
- (D)  $5 \times 10^{-11}$

**P.T.O.**

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2. The two important properties of nanosubstances are-

- (A) pressure and friction
- (B) sticking and friction
- (C) sticking and temperature
- (D) temperature and friction

3. Non linear optics is dealing with-

- (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

4. Plasmonics is-

- (A) A field of nanophotonics that holds the promise of molecular-size optical device technology
- (B) The science of fluorescent nanoparticles used in modern fireworks
- (C) A hypothetical science used in science fiction weaponry (plasma cannons)
- (D) The technology used to design and build the laser-guided photonic gyroscopes used in aviation

5. Which one of these statements is NOT true?

- (A) Gold at the nanoscale is red
- (B) Copper at the nanoscale is transparent
- (C) Silicon at the nanoscale is an insulator
- (D) Aluminium at the nanoscale is highly combustible

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6. The compressive strength of a nanotube \_\_\_\_\_ its tensile strength
- (A) is less than
  - (B) is greater than
  - (C) is equal to
  - (D) may be greater than
7. The deflection of light by minute particles and molecules in all direction is called-
- (A) Scattering
  - (B) dispersion
  - (C) diffraction
  - (D) interference
8. Which one of these condiments is unique due to the nanoscale interactions between its ingredients?
- (A) Ketchup
  - (B) Mustard
  - (C) Mayonnaise
  - (D) All of the above
9. Photonic crystal fibers are also called as-
- (A) Conventional fibers
  - (B) Dotted Fibers
  - (C) Waveguide fibers
  - (D) Holey Fibers

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10. Conventional optical fibers have more transmission losses than photonic
- (A) It is true
  - (B) Its false as losses are same
  - (C) Its false at low temperature
  - (D) It may be true or false depending on certain conditions
11. Biophotonics is a multidisciplinary field where
- (A) Bio-based technologies are utilized to reveal biological mechanisms, and diagnose several diseases along with finding their treatments
  - (B) light based technologies are utilized to reveal biological mechanisms, and diagnose several diseases along with finding their treatments
  - (C) nano technologies are utilized to reveal light mechanisms, and diagnose several diseases along with finding their treatment
  - (D) None of the above
12. What is quantum dot?
- (A) A semiconductor nanostructure that confines the motion of conduction band electrons, valence band holes, or excitons in all three spatial directions
  - (B) The sharpest possible tip of an Atomic Force Micro-

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scope

(C) A fictional term used in science fiction for the endpoints of wormholes

(D) Unexplained spots that appear in electron microscopy images of nanostructures smaller than 1 nanometer

13. The periodic arrangement of cladding airholes in photonic bandgap fibers provides for the formation of a photonic bandgap in the

(A) H plane of fiber

(B) E plane of fiber

(C) E-H plane of fiber

(D) Transverse plane of fiber

14. Which nanoparticles can be used as diagnostic tool for tissue imaging?

(A) Inorganic NMs containing metals such as gold, silver or platinum and non magnetic NPs

(B) Inorganic NMs containing metals such as gold, silver or platinum and magnetic NPs

(C) Inorganic NMs containing metals such as gold, silver or platinum and organic NPs

(D) Organic NMs containing metals such as PPV and Polyflourine and magnetic NPs

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15. Which of the following statement/s is/are true?

(i) TEM has much higher resolution than SEM

(ii) TEM gives more information obtained from sample than SEM

(iii) The cost of TEM machine is much higher than SEM

(iv) Sample preparation is easy in TEM than SEM

(A) All four

(B) (ii) and (iv)

(C) (i), (ii) and (iii)

(D) (ii), (iii) and (iv)

16. The optical properties in nonlinear optical materials depends on

(A) intensity of light

(B) frequency of light

(C) velocity of light

(D) wavelength of light

17. In index guided photonic crystal fiber structure, the dark areas are holes. What does white areas suggest?

(A) Air

(B) Silica

(C) Water

(D) Plasma

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18. Which of the following statements about Transmission Electron Microscopy is not true-

- (A) The specimen must be stained with osmium or other heavy metal
- (B) The specimen are placed in a high vacuum for viewing
- (C) The specimen must be sliced very thin, 20-100 nm in thickness
- (D) The beam is focused by electromagnetic lenses

19. X-ray diffraction can only be applied to-

- (A) solid, crystalline materials
- (B) gaseous or vapour materials
- (C) liquids
- (D) all of the above

20. Losses in photonic crystal fibers are reduced to a level of-

- (A) 0.1 dB/km
- (B) 0.2 dB/km
- (C) 0.3 dB/km
- (D) 0.4 dB/km

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### Section - B

(Very Short Answer Type Questions)

(2 marks each)

**Note: Attempt any eight questions. Each answer should be in 2-3 lines answers.**

1. Define Near-Field Microscopy.
2. What do you understand by Dielectric Confinement Effect?
3. Define Transmission Electron Microscopy.
4. Explain Dendrimers.
5. What is Nanosphere Lithography?
6. Explain Nanocomposites.
7. Define the use of Bacteria as Bio synthesis.
8. Write applications of Photonic Crystal Fibers.
9. Mention properties of Bioderived Materials.
10. What is opto electro integrated circuit?
11. What do you mean by Nano barcodes?

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**Section - C**

**(Short Answer Type Questions)**

**(3 marks each)**

**Note : Attempt any eight questions. Each answer should be  $\leq$  75 words.**

1. Explain Quantum-Confined Stark Effect.
2. Explain optical fiber based signal processing.
3. Explain use of Photonic Crystal Sensors.
4. Define Quantum Wells, Quantum Wires, Quantum Dots.
5. What are main Growth Methods for nano materials?
6. Define Scanning Electron Microscopy and their application.
7. Explain the concept of Laser Paints.
8. Describe the concept of Nano clinics for Optical Diagnostics.
9. What are the features of Supramolecular Structures?
10. Explain Laser-Assisted Vapor Deposition.
11. How Quantum-Confined structures are uses as Lasing Media?

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**Section - D**

**(Long Answer Type Questions)**

**(4 marks each)**

**Note- Attempt any five questions. Each answer should be  $\leq$  150 words.**

1. Describe the Monolayer and Multilayer Molecular Assemblies.
2. Describe working principle of Scanning Probe Microscopy.
3. Explain working of Self-Cleaning Glass Fluorescent Quantum Dots.
4. Discuss the used in Theoretical Modelling of Photonic Crystals.
5. Explain application of Semiconductor Quantum Dots for Bio imaging.
6. Describe Time-and Space-Resolved Studies of Nanoscale Dynamics.
7. How characterization of Nano materials is carried out?
8. Describe Nanolithography and its applications.
9. Write a note on Nanocomposites for Optoelectronics.