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M.Tech. (Second Semester)
EXAMINATION, May-June, 2022
(OPTOELECTRONICS AND LASER TECHNOLOGY)
(Paper First)
(Physics and Advanced Materials)
(OE-21)

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.

Chose the correct answer:-

1. Colour of metalic nanoparticles changes with size due to change in-
   (A) Surface structure
   (B) Crystal structure
   (C) Electronic structure
   (D) Geometric structure

2. In magnetic nanoparticles, the measured magnetic moment is found to be----------the value for a perfect paralled alignment of the moments in the cluster.
   (A) Equal to
   (B) Less than
   (C) More than
   (D) Zero
3. In absorption spectrum of semiconductor nanoparticles, there is-
   (A) Blue shift and increase in intensity
   (B) Red shift and increase in intensity
   (C) Blue shift and decrease in intensity
   (D) Red shift and decrease in intensity
4. Porous silicon exhibits-
   (A) No photoluminescence
   (B) Weak photoluminescence
   (C) Strong photoluminescence
   (D) None of these
5. The thickness of quantum wire is of the order of-
   (A) Picometer
   (B) Nanometer
   (C) Milimeter
   (D) Meter

6. Number of conduction electrons (N) delocalized in two dimensions, as a function of energy (E) is given by

   (A) $K_1 E^{1/2}$

   (B) $K_2 E$

   (C) $K_3 E^{3/2}$

   (D) None of these

7. Tiny machines having nanosized components responding to electrical signal are known as-

   (A) NEMS

   (B) MEMS

   (C) TEM

   (D) None of these

8. In a metallic quantum wire, the electrons are confined in-

   (A) Zero dimension

   (B) One dimension

   (C) Two dimension

   (D) Three dimension

9. The host material of a solid state laser should be------to the light emitted by it.

   (A) Absorbent

   (B) Opaque

   (C) Transparent

   (D) None of these

10. In semiconductor lasers, the energy of photons emitted by it is.

    (A) Equal to the band gap of semiconductor

    (B) Less than the band gap of semiconductor

    (C) Greater than the band gap of semiconductor

    (D) Depends on impurity levels

11. By using heterojunctions in semiconductor diode lasers, the threshold current density is-

    (A) Reduced

    (B) Increased

    (C) Do-not change

    (D) Depends on meterial

12. Generally the EL mechanism in ACTFEL is-

    (A) Hopping

    (B) Acceleration-collision

    (C) Diffusion

    (D) Drift

13. Absorption spectra with transition energy of the order of 0.1 ev are-

    (A) Rotational

    (B) Vibrational

    (C) Electronic

    (D) X-ray

14. Radiation source used in UV-VIS absorption spectroscopy is-

(A) Sodium lamp

(B) Mercury lamp

(C) Hydrogen discharge tube

(D) None of these

15. XRD is used for determining-

(A) Surface structure

(B) Electronic structure

(C) Molecular structure

(D) Crystal structure

16. Epitaxy is a technique to grow-

(A) Nanoparticles

(B) Non-crystalline films

(C) Single crystals

(D) Regular crystalline layers

17. Hall mobility is because of movement of charge carriers due to-

(A) Electric field

(B) Magnetic field

(C) Thermal gradient

(D) Pressure gradient

18. Generally the photoluminescence spectrum of a material depends upon the

(A) Dopants

(B) Host materials

(C) Structural defects

(D) None of these

19. Scanning tunneling microscopy can be used for-

(A) Conductors

(B) Insulators

(C) Semiconductors

(D) Polymers

20. Ellipsometer is used to measure-

(A) Roughness of a film

(B) Area of a film

(C) Thickness of a film

(D) Transparency of a film

SECTION-B

(Very short Answer Type Questions)

(2 marks each)

Note:- Attempt any *eight* questions. Write in two-three sentences:-

1. What are magnetic clusters?
2. Explain porous silicon.
3. What do you mean by semiconductor islands?

4. What are MEMS?
5. What are heterojunction laser materials?
6. Explain QLED.
7. Which radiation source is used for UV-VIS spectroscopy?
8. What do you mean by epitaxial technique?
9. Differentiate between drift mobility and Hall mobility?
10. Give principle of opitical microscope.

SECTION-C

(Short Answer Type Questions)

(3 marks each)

Note:- Attempt any *eight* questions. Answer each question in 75 words.

1. Explain electronic structure of semi conductor nanoparticles.
2. Discuss various carbon nanostructures.
3. Explain how surface of nanoparticles varies with size.
4. Give application of NEMS in optics.
5. Discuss material requirement for solid state lasers.
6. Discuss LED technology for light emission from polymeric materials.
7. Give basis of IR spectroscopy.
8. Explain lithographic technique.
9. Explain double crystal diffraction.
10. Describe gravimetric method for thickness measurement.

SECTION-D

(Long Answer Type Questions)

(4 marks each)

Note:- Attempt any *five* questions. Answer each question in 150 words.

1. Describe a method for synthesis of monodispersed nanoparticles.
2. Discuss properties of bulk nanostructured materials.
3. Describe quantum confinement in quantum wells, wires and dots.
4. Describe photonic nano and micro circuits and give their applications.
5. Describe material design and parameters for semiconductor laser diopdes.
6. Discuss EL excitation mechanism and EL characteristics in AC powder EL.
7. Discuss atomic, molecular, vibrational and X-ray energy levels in materials.
8. Explain principle and working of atomic layer epitaxy technique.
9. Discuss photoluminescence and explain the information obtained from photoluminescence studies.
10. Describe principle and working of scanning electron microscope.