Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–I & II (NEW) EXAMINATION – SUMMER 2024

Subject Code:2110011 Date:05-07-2024

Subject Name:Physics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Question No. 1 is compulsory. Attempt any four out of remaining Six questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1 Objective Question (MCQ) Marks

(a) 07

1. The SONAR is used

   (a) to remove the tumors from the body (c) to produce the ultrasonic frequency
   (b) to measure the depth of sea (d) none of these

2. The value of standard intensity is

   (a) 0 Wm^{-2} (b) 10^{-12} Wm^{-2} (c) 10^{-2} Wm^{-2} (d) 10^{12} Wm^{-2}

3. Considering incident ray travelling in medium of refractive index η_2 to medium of refractive index η_1. If angle of incidence is Φ and critical angle is Φ_c, then conditions to be satisfied for Total Internal Reflection is

   (a) $\eta_1 < \eta_2$, $\Phi < \Phi_c$ (c) $\eta_1 > \eta_2$, $\Phi < \Phi_c$
   (b) $\eta_1 < \eta_2$, $\Phi > \Phi_c$ (d) $\eta_1 > \eta_2$, $\Phi > \Phi_c$

4. Fuel cell is a device that converts

   (a) Chemical energy into electricity (c) sound energy into electricity
   (b) solar energy into electricity (d) mechanical energy into electricity

5. SQUID is an application of

   (a) Semiconducting materials (c) Superconducting materials
   (b) Nano materials (d) Bio materials

6. Which one is not having permanent dipoles in absence of magnetic field?

   (a) Paramagnetic material (c) Ferrimagnetic material
   (b) Ferromagnetic material (d) diamagnetic material

7. The S.I. Unit of Loudness is

   (a) dB (b) Bel (c) phon (d) OWU

(b) 07

1. The unit of absorption coefficient is _____.

(a) W/m^2 (b) dB (c) Sabine (d) Bel

2. The basic principle behind fibre optic communication is _____.

(a) reflection (c) total internal reflection

(b) refraction (d) diffraction

3. Which of the following is not true for soft magnetic materials? They have

(a) low coercivity (c) low permeability

(b) low retentivity (d) high susceptibility.

4. Weber Fechner law is given as_____.

(a) $L = K / \log_{10} I$ (b) $L = K \log_{10} I$ (c) $I = K / \log_{10} L$ (d) $I = K \log_{10} L$

5. The general chemical formula for a ferrite is _____

(a) $MOFe_2O_4$ or MFe_2O_4 (c) $MOFe_3O_3$ or MFe_3O_4

(b) $MOFe_2O_3$ or MFe_2O_4 (d) $MOFe_2O_2$ or MFe_2O_3.

6. The relation between transition temperature Tc of a superconductor and its isotopic mass M is given as_____.

(a) $T_C \propto \frac{1}{\sqrt{M}}$ (b) $T_C \propto \sqrt{M}$ (c) $T_C \propto \frac{2}{\sqrt{M}}$ (d) $T_C \propto 2\sqrt{M}$

7. Electrical pumping is adopted in _____laser.

(a) Nd:YAG (c) Ruby

(b) CO_2 (d) Semiconductor

Q.2 (a) Define and describe magnetic dipole, magnetic dipole moment and magnetic susceptibility. 03

(b) What are dielectric materials? Distinguish between a dielectric material and an insulator. What are the different types of dielectric materials? Explain them in detail. 04

(c) (1) Describe any two uses of dielectric material in detail. 07
(2) What are Shape Memory Alloys? Give some of its applications.
(3) Calculate the electronic polarizability of an isolated Se atom. The atomic radius of Se atom is 0.12 nm. (Given: $\varepsilon_0 = 8.85 \times 10^{-12}$)

Q.3 (a) The critical temperature of the Nb is 9.15 K. At zero kelvin, the critical field is 0.196 T. Calculate the critical field at 6 K. 03

(b) Define and discuss the factors, reverberation, loudness, echelon effect and noise that affect the acoustics in a hall and the remedies for them. 04

(c) (1) Describe any two characteristics of musical sound. 07

(2) What are biomaterials? Explain the different types of biomaterials and their applications in the medical field.

(3) Explain with neat circuit diagram the generation of ultrasonic waves by magnetostriction oscillator method.

Q.4 (a) An optical fibre, with refractive index 1.6, has cladding with refractive index of 1.50. Determine the acceptance angle for the fibre in water which has refractive index 1.33. 03

(b) Expand LASER. Describe the construction and working of Nd:YAG laser with a suitable energy-level diagram.. 04

(c) (1) Give difference between step index fiber and graded index fiber. 07

(2) Briefly discuss fuel cells.

(3) A step index fiber has a numerical aperture of 0.16, a core refractive index of 1.45 and core diameter of 90 mm, calculate (i) The acceptance angle . (ii) the refractive index of cladding.

Q.5 (a) Justify and give comments on, "At macro scale, the physical and chemical properties are not dependent on the size of the material, but at the nanoscale everything will change including colour, melting point and chemical properties." 03

(b) What do you understand by index profile? List out the difference between step and graded index fibre. 04

(c) (1) Write short note on bio-ceramics. 07

(2) What are metallic glasses? Write applications of metallic glasses.

Q.6 (a) The critical temperature T_C for Hg with isotopic mass 199.5 is 4.185 K. Calculate the critical temperature for its isotopic mass 204.5. Consider $\alpha = 0.5$ 03

(b) Describe temperature and stress induced transformations in shape memory alloys. 04

(c) (1) Define the term nanoparticle. 07

(2) Describe the ball milling and plasma arcing method to produce nanoparticles.

Q.7 (a) A silicon material is subjected to a magnetic field of strength 1000 A/m. If the magnetic susceptibility of silicon is -0.3×10^{-5}, calculate its magnetisation. Also calculate the magnetic flux density of the field inside the material. The permeability of free space is $4\pi \times 10^{-7}$ H/m. 03

(b) Write the applications of Carbon nanotubes. 04

(c) Answer the below given questions using Nd-YAG laser. 07

(1) Draw a schematic diagram of the construction of Nd-YAG laser.

(2) What are the active medium and active centers of the Nd-YAG laser?

(3) Draw the energy level diagram.

(4) Write the working of Nd-YAG laser.

(5) Write applications of Nd-YAG laser.

****