

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- 1 SEMESTER – OLD PAPER – W24 & S25 – QUESTION BANK

Subject Name & Code:

Physics- BE01000021

Module 1: Properties of Matter

Winter 2024

- **Q.1 (a) (03 Marks):** Define: (1) Stress (2) Strain and (3) Young's modulus.
- **Q.1 (b) (04 Marks):** The critical temperature for a metal with isotopic mass 199.5 is 4.185 K. Calculate the isotopic mass if the critical temperature falls to 4.133 K.
- **Q.1 (c) (07 Marks):** What is Cantilever? Obtain the expression for depression at free end of thin beam clamped horizontally at one end and loaded at other end.
- **Q.4 (a) OR (03 Marks):** An unknown weight is attached to the lower end of wire of length 4 m, radius 0.7 mm, extends it by 0.8 mm. If $Y = 2 \times 10^{11} \text{ N/m}^2$ Find the unknown weight.

Summer 2025

- **Q.2 (b) (04 Marks):** Find the force required to increase the length of a wire of 10^{-6} m^2 area of cross-section by 50 % whose Young's modulus is $2 \times 10^{11} \text{ N/m}^2$.
- **Q.2 (c) (07 Marks):** Explain torsional pendulum in brief with suitable diagram and derive the equation of twisting couple per unit twist of a wire.
- **Q.2 (c) OR (07 Marks):** Explain: (i) Elastic hysteresis, (ii) Elastic after-effect, and (iii) Elastic fatigue.

Module 2: Waves, Motion and Acoustics

Winter 2024

- **Q.2 (a) (03 Marks):** Define: (1) Reverberation (2) Nano-materials (3) Absorption co-efficient.
- **Q.2 (b) (04 Marks):** The volume of a hall is 475 m^3 . The area of wall is 200 m^2 , area of floor and ceiling each is 100 m^2 . If the absorption co-efficient of wall, ceiling and floor are 0.025, 0.02 and 0.55, respectively. Calculate the reverberation time for the hall.
- **Q.2 (c) OR (07 Marks):** What is simple harmonic motion? Obtain equation for kinetic energy and potential energy of simple harmonic oscillator. Show that at any time the sum of kinetic energy and potential energy remains constant.
- **Q.3 (a) OR (03 Marks):** Define: (1) Meta stable state (2) Population inversion (3) Pumping.
- **Q.3 (a) (03 Marks):** An ultrasonic source of 0.09 MHz sends down a Pulse towards the seabed which returns after 0.55 sec. The velocity of sound in water is 1800 m/s. Calculate the depth of the sea and wavelength of pulse.

Summer 2025

- **Q.3 (a) (03 Marks):** Define: (i) Transverse waves, (ii) Ultrasonic waves, and (iii) Damped oscillations.
- **Q.3 (b) (04 Marks):** The volume of a room is 1500 m^3 . The wall area of the room is 250 m^2 , the floor and the ceiling area is 150 m^2 each. The average sound absorption coefficient for the wall, floor and the ceiling are 0.25, 0.06 and 0.80, respectively. Calculate the average absorption coefficient and the reverberation time.
- **Q.3 (c) (07 Marks):** Derive the differential equation of simple harmonic motion, also write its general solution and obtain the equation of velocity and acceleration of simple harmonic oscillator.
- **Q.3 (a) OR (03 Marks):** Define: (i) Reverberation, (ii) Echo, and (iii) Echelon effect.
- **Q.3 (b) OR (04 Marks):** A particle of mass 0.50 kg executes a simple harmonic motion. If it crosses the centre of oscillation with a speed of 10 m/s, find the amplitude of the motion. (force constant $k = 50 \text{ N/m}$)

Module 3: Ultrasonics & NDT

Winter 2024

- **Q.2 (c) (07 Marks):** Describe production of ultrasonic waves by Piezo-electric method. Give its advantages and limitations.
- **Q.3 (a) (03 Marks):** An ultrasonic source of 0.09 MHz sends down a Pulse towards the seabed which returns after 0.55 sec. The velocity of sound in water is 1800 m/s. Calculate the depth of the sea and wavelength of pulse.

Summer 2025

Q.3 (c) OR (07 Marks): Explain the construction and working of piezoelectric method of ultrasonic wave production with suitable diagram.

Module 4: Optics

Winter 2024

- **Q.4 (a) (03 Marks):** State any three differences between interference and diffraction.
- **Q.4 (b) (04 Marks):** Calculate the minimum number of lines in a grating which will just resolve the lines of wavelength $5890 \text{ \AA}$ and $5896 \text{ \AA}$ in the second order.
- **Q.5 (c) (07 Marks):** Describe the principle, construction and working of Michelson interferometer.
- **Q.5 (a) OR (03 Marks):** State and explain principle of superposition of waves.
- **Q.5 (b) OR (04 Marks):** What is interference? Differentiate Constructive and destructive interference.

Summer 2025

- **Q.1 (b) (04 Marks):** Define: (i) Interference of light, (ii) Diffraction of light, (iii) Fresnel diffraction. Also state Huygens' principle.
- **Q.4 (a) (03 Marks):** In a Young's double slit experiment, the two slits which are 0.5 mm apart are illuminated by the yellow light of wavelength 589.0 nm . Calculate the distance between two consecutive bright bands in the interference pattern observed on a screen 2 m away from the slits.
- **Q.4 (b) (04 Marks):** Define constructive and destructive interference with their condition in terms of path difference.
- **Q.4 (c) (07 Marks):** Explain the formation of Newton's rings with suitable diagram and derive the equation of radius of bright and dark rings produced by the interference of reflected light.

Module 5: Quantum Physics

Winter 2024

- **Q.4 (c) (07 Marks):** Derive the time independent Schrödinger's wave equation.
- **Q.4 (b) OR (04 Marks):** Write a short note on black body radiation.
- **Q.4 (c) OR (07 Marks):** Explain Heisenberg's uncertainty principle and derive it.
- **Q.3 (b) OR (04 Marks):** Write a short note on Scanning Tunneling Microscope (STM).

Summer 2025

- **Q.2 (a) (03 Marks):** What is de-Broglie wave? Write the equation of de-Broglie wavelength and mention the names of each quantity involved in the equation.
- **Q.4 (a) OR (04 Marks):** Calculate de-Broglie wavelength associated with (i) A man of 50 kg mass walking with the speed of 2 m/s, and (ii) An electron moving with the speed of 3×10^5 m/s. Based on your answers obtained in above two cases, explain why the wave nature of the man can't be observed. ($h = 6.63 \times 10^{-34}$ J·s, electron mass = 9.11×10^{-31} kg)
- **Q.4 (b) (04 Marks):** Write Schrodinger's time independent wave equation and explain its each term. Also write Heisenberg's uncertainty principle in terms of position and momentum.
- **Q.4 (c) OR (04 Marks):** Write a short-note on scanning tunneling microscope.

Module 6: Lasers

Winter 2024

- **Q.3 (b) (04 Marks):** Differentiate: Spontaneous and Stimulated emission.
- **Q.3 (c) (07 Marks):** What are Einstein's coefficients? Give relation between them and discuss the result.
- **Q.3 (a) OR (03 Marks):** Define: (1) Meta stable state (2) Population inversion (3) Pumping.
- **Q.3 (c) OR (07 Marks):** What is full form of LASER? Write the characteristics and applications of LASER.

Summer 2025

- **Q.5 (a) (03 Marks):** In He-Ne gas laser, Ne atoms emit laser photons of wavelength 632.8 nm while electrons make transitions from E_3 state to E_2 state. Find the energy difference between these two states. ($h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$ and $c = 3 \times 10^8 \text{ m/s}$)
- **Q.5 (b) (04 Marks):** Write the properties of laser and explain in brief.
- **Q.5 (c) (07 Marks):** Write the full form of laser and explain (i) Absorption, (ii) Spontaneous emission, and (iii) Stimulated emission with suitable diagrams.
- **Q.5 (a) OR (03 Marks):** A ruby laser emits light of wavelength 694.3 nm. Calculate the frequency and the energy of the laser photons emitted. ($h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$ and $c = 3 \times 10^8 \text{ m/s}$)
- **Q.5 (b) OR (04 Marks):** What is population inversion (draw suitable diagram)? Explain why it is necessary for the production of laser?
- **Q.5 (c) OR (04 Marks):** Obtain the relation between Einstein's coefficients.

Module 7: New Engineering Materials

Winter 2024

- **Q.1 (b) (04 Marks):** The critical temperature for a metal with isotopic mass 199.5 is 4.185 K. Calculate the isotopic mass if the critical temperature falls to 4.133 K.
- **Q.2 (a) (03 Marks):** Define: ... (2) Nano-materials ...
- **Q.5 (a) (03 Marks):** Define: (1) Critical Temperature (2) Critical Magnetic field (3) Critical Current density.
- **Q.5 (b) (04 Marks):** Write the applications of nano materials.
- **Q.5 (c) OR (07 Marks):** Explain working of the p-n junction diode and state its applications.

Summer 2025

- **Q.1 (a) (03 Marks):** Transition temperature of mercury of mass number 202 is 4.20 K. Find the transition temperature of isotope of mercury of mass number 204.
- **Q.1 (c)(i) (03 Marks):** Define nanomaterials and explain ball milling technique of synthesis of nanomaterials with suitable diagram.
- **Q.1 (c)(ii) (04 Marks):** Write any four differences between n-type and p-type semiconductors.