

**Bachelor of Engineering (Metallurgical and Material) Examination 2019**

**(First Year and First Semester)**

**PHYSICS**

Time: 3 hours

Full Marks: 100

Answer any *five* questions

- 1.a) What do you mean by interference of light? Coherent sources are essential for observing sustained interference pattern- explain.
- b) Find the conditions of maxima and minima( in terms of path difference) for an interference pattern.
- c) Describe and explain the formation of Newton's rings in reflected monochromatic light. Show that the diameters of the dark rings are proportional to the square root of natural numbers.
- d) In an Newton's ring experimental setup, the diameter of the  $m^{\text{th}}$  dark ring is 8mm and that of  $(m + 5)^{\text{th}}$  dark ring is 12mm. If the radius of curvature of the lower surface of the lens is 10m, find the wavelength of the light used. 5+3+8+4
- 2.a) Distinguish between Fresnel and Fraunhofer class of diffraction.
- b) Find an expression for the intensity distribution of a Fraunhofer diffraction pattern due to a single slit illuminated by a monochromatic light. Hence find the positions of the maximas and the minimas.
- c) A monochromatic light of wavelength  $5000\text{\AA}$  is diffracted by a grating having 1000 lines per cm. Calculate the maximum order that can be observed. 3+(8+5)+4
- 3.a) What do you mean by polarization of light? Do sound waves show this phenomenon?
- b) What is angle of polarization? Show that when a light ray is incident at the angle of polarization, the reflected ray is perpendicular to the refracted ray.
- c) Explain the terms: Double refraction, O-ray, E-ray and Optic axis.
- d) A thin mica sheet(refractive index=1.6) of 7 microns thickness is introduced in the path of one of the interfering beams in a young's double slit experiment. The central fringe shifts to a position normally occupied by the  $7^{\text{th}}$  bright fringe. Find the wavelength of the light used.

3+6+6+5

[ Turn over

- 4.a) Write down the equation of motion for a particle executing damped simple harmonic motion. Solve it for the case of small damping. Show the solution graphically.
- b) Why is damping usually taken to be proportional to instantaneous velocity?
- c) A mass of 10 kg is acted upon by restoring force of 0.01 N/m and a resisting force of 0.002 N.s/m. Find out whether the motion is oscillatory or non-oscillatory. Also find the value of resisting force for the motion to be critically damped. (3+6+3)+2+6
5. a) What is the time of reverberation?
- b) Derive Sabine's formula. Explain growth and decay of energy density with time and draw necessary diagrams.
- c) Discuss some important parameters which are generally used for judging the acoustics of an auditorium 2+13+5
6. a) Define (i) Young's modulus and (ii) shear modulus.
- b) Establish a relation between Young's modulus and bulk modulus with the help of the necessary diagrams showing the nature of stress and strains.
- c) What is the general equation for the depression ( $y$ ) in case of a cantilever? Explain its maximum value with a diagram. 5+10+5
- 7.a) What is Compton effect? Show that in Compton effect change in wavelength depends only on the angle of scattering. Do you expect Compton effect for visible light?
- b) Compare the de Broglie wavelengths of (i) an electron moving with the velocity  $10^7$  m/s and (ii) a golf ball of mass 45 gm and velocity 50 m/s. (2+10+2)+6
- 8.a) Write down the time independent Schrodinger equation for a particle trapped in a one dimensional box of length  $L$ . Show that the energy values of the particle are quantized. Also find the normalized eigen functions of the particle.
- b) State Heisenberg's uncertainty principle. Using uncertainty relation show that an electron can't exist within the nucleus of an atom. (2+5+7)+6