

1.

- (a) What is Doppler Effect? Obtain an expression for the apparent frequency of sound heard when the observer is in motion with respect to a source at rest.[4]
- (b) Explain the formation of stationary waves in a closed pipe. Derive the equations for the frequencies of the harmonics produced. [4]
- (c) A rocket is moving at a speed of 200 m/s towards a stationary target. While moving, it emits a wave of frequency 2000 Hz. Some of the sound reaching the target gets reflected back to the rocket as an echo. Calculate (i) the frequency of the wave as detected by target.
and (ii) the frequency of echo as detected by the rocket. [4]

2.

- (a) Define critical angle. Explain total internal reflection using a neat diagram. Write any two applications of total internal reflection.[4]
- (b) Draw a neat labeled diagram of a compound microscope and explain its working and derive an expression for its magnification.[4]
- (c) A compound microscope consists of an object lens of focal length 2cm and eyepiece of focal length 5cm. When an object is placed at 2.2 cm from the object lens, the final image is at 25cm the eye lens. What is the distance between the lenses? What is the total linear magnification.[4]

3.

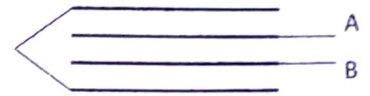
- (a) Explain the optical phenomenon of refraction using Huygen's principle. Hence prove the Snell's law of refraction.[4]
- (b) Using a neat schematic diagram derive an expression for the fringe width ' β ' of interference fringes [4]
- (c) What is Fresnel's distance? Estimate the distance for which ray optics is in good approximation for an aperture of 4mm and wavelength 400nm [4]

4.

- (a) State Gauss's law in electrostatics. Apply Gauss's law to calculate the electric field due to uniformly charged conducting spherical shell at points (i) Outside the shell (ii) On the surface of the shell (iii) Inside the shell.[4]
- (b) What is an electric dipole? Derive an expression for the torque acting on the dipole placed in a uniform electric field.[4]
- (c) There are four charges, each with magnitude Q. Two are positive and two are negative. The charges are fixed to the corners of a square of side L, one to each corner, in such a way that the force on any charge is directed toward the center of the square. Find the magnitude of the net electric force experienced by any charge.[4]

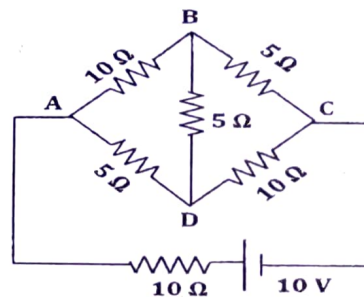
5.

- (a) Define electric potential. Derive an expression for the electric potential due to an electric dipole and hence the electric potential at a point (a) on the axial line (b) on the equatorial line of electric dipole. [4]
- (b) What is a capacitor. Derive an expression for the energy stored in a capacitor. [4]
- (c) Derive an expression for the capacitance of a parallel plate capacitor. In the given figure four identical metal plates each of area 'A' separated by a distance d. Find the effective capacitance between the terminals 'A' and 'B'. [4]



6.

- (a) State ohm's law and derive a relation between electric current and drift velocity. [4]
- (b) State Kirchhoff's laws for an electric network. Using these laws deduce the condition for balance in Wheatstone bridge. [4]
- (c) Apply Kirchhoff's laws to determine the current in branches AB, BC, CD and DA of the following network. [4]



7.

- (a) What are beats? Obtain an expression for the beat frequency? Write any two applications. [4]
- (b) Define Snell's law. Using a neat labeled diagram derive an expression for the refractive index of the material of an equilateral prism. [4]
- (c) An object is placed at (i) 10 cm (ii) 25 cm in front of a concave mirror of radius of curvature 15 cm. Find the position, nature and magnification of the image in each case. [4]