PHYSICS

1. Write critical notes on any four of the following: (4x7½=30)
        (a) Collisions
        (b) Black body radiation
        (c) Holography
        (d) Magnetism
        (e) Superconductivity
        (f) Logic gates

PART I

2.(a) What is Rutherford scattering? Obtain an expression for the differential scattering cross-section in the case of α-particles striking a thin gold foil and undergoing elastic collisions.   (10)

(b) The path of one particle as observed by an observer from another projectile is a straight line. Establish it.   (10)

(c) Derive the Bernoulli's equation for steady incompressible, irrotational and non-viscous fluid flow. Describe the Pitot tube for the measurement of the velocity of gases.   (10)

3.(a) Distinguish between isothermal and adiabatic processes. Obtain an expression for the work done in compressing a gas in an isothermal process.   (10)

(b) What is Joule-Thomson effect? Obtain an expression for the cooling produced in this process in case of van der Waals' gas.   (10)

(c) Distinguish between average, most probable and r.m.s. speeds of a molecules in a gas.   (10)

4.(a) Find the equation of motion for a damped harmonic oscillator and solve it to obtain the frequency of its oscillation. Give two examples of damped harmonic oscillations.   (10)

(b) Distinguish between the diffraction fringes due to a single slit to width e and interference fringes produced with two narrow slits of separation e.   (10)

(c) A particle of mass 5 gm executes S.H.M. has amplitude of 8 cm. If it makes 16 vibrations per sec. Find its maximum velocity and energy at mean position.   (10)

PART II

5.(a) State and explain Biot-Savart's law. Derive an expression for the magnetic induction at a point due to an infinitely long straight conductor carrying current.   (12)

(b) State and explain Lenz's law in electromagnetic induction. Derive and expression for the self-inductance of a long solenoid.   (12)

(c) The capacity of a parallel plate condenser is 0.2 μF and potential difference between the plates is 2 volts. Calculate the energy stored by the charged condenser. (6)

6.(a) State uncertainty principle. Give justification for it from the theory of measurement. (12)

(b) Distinguish between fission and fusion giving one example of each. (12)

(c) The half life of radon is 3.8 days. After how many days will only one twentieth of radon sample be left over? (6)

7.(a) Give the theory of α-decay exhibited by radioactive nuclides. (10)

(b) Describe the construction, working and characteristics of Zener diode. (10)

(c) If the wavelength of the electromagnetic radiation is 1000 nm, find bandgap energy. (10)