M.Sc Sem III Relativistic Mechanics

Part-1

Q.1 Prove formula for Lorentz transformation equation.

Q.2 What is relativistic composition of parallel velocities

Q.3 Prove Lorentz-Fitgerald contraction formula

Q.4 State and prove Relativistic transformation formula for velocities

Q.5 What is the transformation for the Lorentz contraction factor (prove it)

Q.6 Prove transformation formula of particle acceleration

Q.7 Prove that the set of all SLT (special Lorentz transformation) satisfie the group property

Q.8 If u and v are two velocities in same direction and V is their resultant velocity given by

$$\tanh^{-1}\frac{V}{c} = \tanh^{-1}\frac{u}{c} + \tanh^{-1}\frac{v}{c}$$

and deduce the law of composition of velocities from this equation.

Q.9 State and Prove Abberation

Q.10 Prove that $m = \dfrac{m_0}{\sqrt{1-u^2/c^2}}$ where u is velocity of particle

when its mass is 'm' and mo is mass of particle at rest

Q.11 State and prove Equivalence of mass and energy

Q.12 Prove transformation formula for mass

Q.13 Prove transformation formula for momentum and energy

Q.14 What is relativistic Lagrangian (prove it)

Q.15 Prove the formula for relativistic Hamiltonian

Q.16 The length of the rocket ship is 100 meters on the ground. During flight, its length observed on ground is 99 meter. Calculate the speed.

Q.17 Calculate the energy equivalent to one atomic mass unit in million electron vaet (MeV). It is given that Avogadro number is

$$N = 6 \times 10^{23}$$

Part-B

Q.1 Define Relative character of space and time.

Q.2 What is two postulates of special theory of Relativity.

Q.3 Write formula for relativistic composition of parallel velocities.

Q.4 Define and prove time dilation

Q.5 Show that $x^2 + y^2 + z^2 - c^2t^2$ is Lorentz invariant.

Q.6 If a body of mass 'm' disintegrates at rest into two parts of rest masses m_1 and m_2. Show that the energies E_1 and E_2 of parts are given by

$$E_1 = c^2 \frac{m^2 + m_1^2 - m_2^2}{2m}, \quad E_2 = c^2 \frac{m^2 - m_1^2 + m_2^2}{2m}$$

Q.7 At what speed should a clock be moved so that it may appear to lose 1 minute in each hour.

Q.8 An electron is moving with a speed of .85 c in a direction opposite to that of a moving photon. Find the relative velocity of electron and photon.

Q.9 The rest mass of an electron is 9×10^{-28} gms. Find its mass if it were moving with velocity $\frac{4}{5}$ times the speed of light.

Q.10 Calculate the rest mass of a particle whose momentum is $\frac{130}{c}$ MeV. when its kinetic energy is 40 MeV

Q.11 Define Minkowski - space

Q.12 Define time like interval

Q.13 Define space like interval

Q.14 What is light like interval

Q.15 Define Null Cone

Q.16 What is world line of a particle.

Q.17 Define proper time

Q.18 What is relativity and Causality

Q.19 If half life of a particle is 10^{-7} second when it is at rest then find its half life when it is travelling with a speed of 0.99 c.

Q.20 A particle moves through the laboratory with a speed of 0.9 c and mean proper life time is 2 μ etc. Calculate its life time as measured by an observer in the laboratory. ($1\mu = 10^{-6}$ second)