EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE – 2012/2013

SECOND SEMESTER (PROPER/REPEAT)

(OCTOBER/NOVEMBER 2015)

PH 205 RELATIVITY

Time: 01 hour
Answer ALL Questions

Q1. Write down Lorentz's Transformation equations with clear symbolic definition. Explain, what you mean by length contraction and time dilation in special theory of relativity.

Consider two inertial frames S and S' having standard configuration. If two events occur along the X-axis at a distance d apart in the frame S simultaneously, and having corresponding separation of distance d' apart in the frame S' along the same axis.

(a) show that the relative velocity v, between the frames is given by

$$v = c\sqrt{\frac{d'^2 - d^2}{d'^2}}$$

(b) hence show that, the time interval between the occurrences of the events as measured in frame S' is given by

$$\Delta t' = -\frac{1}{c}\sqrt{d'^2 - d^2}.$$

Q2. Derive an expression for the relativistic kinetic energy of a particle.

(a) Show the Energy-Momentum equation of the particle is given by

$$E^2 - p^2c^2 = m_0^2c^4,$$

where the symbols have their usual meanings.

(b) Hence deduce an expression for the non-relativistic kinetic energy of the particle.

(c) A particle of rest mass m_0 moving at a velocity of $\frac{4c}{5}$ collides with an identical particle at rest. If the two particles join and stick together after the collision, show that

i. the rest mass of the resulting particle is $\frac{4m_0}{\sqrt{3}}$.

ii. the velocity of the resulting particle is $\frac{c}{2}$, and

iii. the momentum of the resulting particle is $\frac{4m_0c}{3}$.