



UNIVERSITY OF SRI JAYEWARDANEPURA - FACULTY OF APPLIED SCIENCES

B. Sc. General Degree Second Year Second Semester Course Unit Examination

March/April, 2025

DEPARTMENT OF PHYSICS

PHY 207 1.0 - Special Theory of Relativity

Time : One hour; No of Questions : 04; No of Pages : 02 & Total marks : 100
Answer all questions

Assume, velocity of light (c) = $3 \times 10^8 \text{ ms}^{-1}$

- 01.** Obtain the following time equation, starting from Einstein's Postulates in Special Theory of Relativity.

$$t = T \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (\text{Symbols have their usual meanings})$$

(10 Marks)

A particle, which is created in a particle accelerator has a velocity of $0.998c$ and travels a distance of 300 km before decaying.

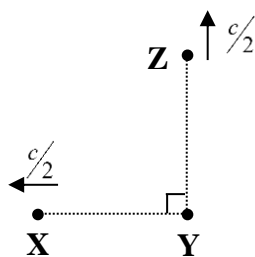
- (a) Find the average life time of the particle in the earth's frame. **(05 Marks)**
- (b) What is the average life time of the particle as measured in its own frame? **(10 Marks)**

- 02.** Describe the “Twin Paradox” in relativity ? **(05 Marks)**

In the twin paradox episode, let **A** be the twin on the Earth and **B** be the twin in the space-ship. Comments on the following statements using your knowledge of special theory of relativity.

- (a) “The twin **B** can travel to the future, but cannot travel to the past ” **(05 Marks)**
- (b) “The twin **A** can travel to the past, but cannot travel to the future ” **(05 Marks)**
- (c) “The twin **B** can always travel to the future ” **(05 Marks)**
- (d) “The twin **B** can always travel to the past ” **(05 Marks)**

- 03.** An observer Y on the Earth observes a particle X moves away from him with a speed of $\frac{c}{2}$ and a proton Z moves with a speed of $\frac{c}{2}$ normal to the direction of X.



Determine the velocity of the proton relative to X.

(25 Marks)

You **may use** the following equations:

Lorentz velocity transformation equations and inverse velocity transformation equations

$u_x^1 = \frac{u_x - v}{1 - \frac{v}{c^2} u_x}$ $u_y^1 = \frac{u_y \sqrt{1 - v^2/c^2}}{1 - \frac{v}{c^2} u_x}$ $u_z^1 = \frac{u_z \sqrt{1 - v^2/c^2}}{1 - \frac{v}{c^2} u_x}$	$u_x = \frac{u_x^1 + v}{1 + \frac{v}{c^2} u_x^1}$ $u_y = \frac{u_y^1 \sqrt{1 - v^2/c^2}}{1 + \frac{v}{c^2} u_x^1}$ $u_z = \frac{u_z^1 \sqrt{1 - v^2/c^2}}{1 + \frac{v}{c^2} u_x^1}$
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- 04.** Write short notes on,

(a) **Radiation Pressure**

(10 Marks)

(b) **Newton's Concept of gravity and Einstein's Concept of gravity**

(15 Marks)

in general theory of relativity.
