UNIVERSITY OF SRI JAYEWARDANEPURA
FACULTY OF APPLIED SCIENCES

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

December, 2019

DEPARTMENT OF PHYSICS

PHY 207 1.0 / PHY 257 1.0 / PHY 302 1.0 / PHY 327 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) = 3×10^8 ms^{-1}

01. Write short notes on,

(i) **Michelson Morley Experiment** and

(ii) **Twin Paradox**

in special theory of relativity (STR). **(25 Marks)**

02. **(i)** Write down **two** main Einstein's Postulates in Special Theory of Relativity (STR).

(ii) Obtain the following relativistic time equation, starting from the above Postulates in STR.

$$t_2 = t_1 \frac{1}{\sqrt{1 - v^2/c^2}}$$ (Symbols have their usual meanings)

(iii) The first human trip to the Moon took about three days (*approximately* 3×10^5 *seconds*) each way. The distance from the Earth to the Moon is roughly 4×10^8 *m*.

P.T.O

(a) **Find** the velocity of the space ship.

(b) When they returned, **how much** younger were the astronauts than their twin brother who remained on the Earth ?

(25 Marks)

03. **(i)** Derive an expression for the length contraction ($l_2 = l_1\sqrt{1-v^2/c^2}$) starting from the relativistic time equation (Symbols have their usual meanings).

(ii) A rod of length **20 cm** is held at an angle of 45^o to the horizontal. It's now projected with a velocity of **0.9c** along the horizontal such that the rod always keeps the same angle of 45^o during the motion. What will be the length of the rod as seen by,

(a) an observer stationary on the ground ?

(b) an observer moving with the rod ?

(25 Marks)

04. **(i)** What is the **Doppler Effect** in Relativity for a moving light source ? **You are given** the following mathematical equation for the Doppler effect,

$f_o = \dfrac{f_s}{\gamma\left(1-\beta\ \cos\theta\right)}$. Where $\gamma = 1/\sqrt{1-\beta^2}$, $\beta = \dfrac{v}{c}$ and other symbols have their usual meanings.

(ii) A **blue** coloured vehicle appears as a **purple** coloured vehicle to a stationary observer on the Earth due to its speed.

(a) Find the velocity of the vehicle. (Wavelengths of **blue** and **purple** light are 450 *nm* and 400 *nm* respectively.)

(b) Is the above incident **practically possible** ? Briefly explain your answer.

(25 Marks)

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