भारतीय प्रौद्योगिकी संस्थान
काशी हिन्दू विश्वविद्यालय

IIT INDIAN INSTITUTE OF TECHNOLOGY
BANARAS HINDU UNIVERSITY

DEPARTMENT OF PHYSICS

PHY 101: Classical Quantum and Relativistic Mechanics

Assignment 4 [Special Relativity]

Assigned: 05 March 2020 **Submission:** 19 March 2020

Write the answers to the following questions in loose A4 size sheets and staple them together. Write in the top sheet your **Name**, **Roll no**, **Serial no with batch ID**. You need to submit the assignment to the tutors of the respective sections during the tutorials on or before **19 March 2020**

Problem 1

A rod of rest length L_0 moves with speed $c/2$ with respect to an observer such that the velocity of the rod makes 45° angle with its length. Find the apparent length of the rod measured by the observer.

Problem 2

In the reference frame **S** a particle of mass m is at rest. The particle is found to have an energy of $1\frac{2}{3}$ of its the energy in the frame **S**, from a reference frame **K**. What is the magnitude of momentum of the particle in the reference frame **K**?

Problem 3

The muon is an unstable particle that spontaneously decays into an electron and two neutrinos. If the number of muons at $t = 0$ is N_0, the number N at time t is $N = N_0\ e^{-t/\tau}$, where $\tau = 2{,}20$, μsec is the mean lifetime of the muon. Suppose the muons move at speed 0,95 c.

(a) What is the observed lifetime of the muons?

(b) How many muons remain after traveling a distance of 3,0 km?

Problem 4

As seem from the earth, two rockets A and B are moving away with speeds of $c/2$ and $c/4$ respectively. Their motion are in mutually perpendicular directions as seen from the earth. What is the relative velocity of the rocket B as seen from the rocket A?