

PHYSICS

PAPER-6 (SSE 611)

Special and General theory of relativity, Statistical mechanics, Wave mechanics and Nano physics

Programs	B.Sc
Subject	Physics
Semester	V
University	Kuvempu university
Session	02

Special theory of relativity

Topics Covered:

- Relativistic concept of physical quantities.
- Concept of Ether hypothesis and
- Michelson – Morley experiment.

Recap of Previous Session:

- Newton's laws of motion.
- Galilean transformation equations.
- Relative motion.
- Coordinate system.
- Frames of reference.

Learning objectives

- The laws of motion are the same in all inertial frames
- Concept of ether Hypothesis
- Postulates of theory of relativity
- The speed of light (c) is constant, it is independent of the relative motion of the source and observer.
- Michelson – Morley experiment was an attempt to detect the existence of ether medium.

Session outcomes:

- There is no absolute motion.
- All motions are relative.
- Material medium is necessary for the propagation of waves.
- The invariance of speed of light (c) was postulated by Einstein in 1905 in special theory of relativity.
- ' c ' is a universal physical constant.

Relativistic concept of Physical quantities

Concept of ether hypothesis

Michelson-Morley Experiment:

- Principle
- Construction
- Description



Expression for Path difference,

$$\begin{aligned}\Delta x &= (c/\lambda)(\Delta t \text{ total}) \\ &= (2LV^2/\lambda c^2)\end{aligned}$$

Summary of the session:

- The concept of ether medium.
- Newtonian relativity.
- Result of Michelson-Morley Experiment.

MCQs

- 1) The Michelson-Morley experiment ends with in vain due to-----**
- a) Existence of ether.
 - b) Non Existence of ether.
 - c) Relative motion between earth and ether.
 - d) Absolute motion of the earth with ether.

Answer: b) Non Existence of ether

2) According to special theory of relativity , laws of physics are formulated based on

- a) Inertial frame of reference
- b) Non inertial frame of reference
- c) Both inertial and non inertial frames of reference
- d) All of the above

Answer: a) Inertial frame of reference

3. Which of the following were one of the conclusion of the Michelson Morley experiment

- a) Light propagates with different speeds in different direction
- b) Ether has no observable properties
- c) The velocity of light in free space constant
- d) All laws of physics remain invariant

Answer: b) Ether has no observable properties

4.The device used in the Michelson-Morley experiment is

- a) Telescope
- b) Plane grating
- c) Interferometer
- d) Prism

Answer: c) Interferometer

5)The expression for the path difference in Michelson-Morley experiment is

- a) $2LV^2 / \lambda c^2$
- b) $LV^2 / \lambda c^2$
- c) $\lambda c^2 / LV^2$
- d) $\lambda c^2 / 2LV^2$

Answer: a) $2LV^2 / \lambda c^2$

References:

- Arthur I. Miller “ Albert Einstein’s Special theory of relativity”
- Robert W. Lawson “The special and General theory” -1920
- C L Arora and Dr. P S Hemne “ physics for degree students”
- R Murugesan, Kiruthiga Shivaprasath Modern physics