

Title of the Course Unit : Special Theory of Relativity

Special Theory of Relativity - Dr. M. M. P. M. Fernando

Code of the Course Unit : PHY 207 1.0 / PHY 257 1.0****

**** Optional Course available for students who are not offering Physics as a subject.**

Lecturer in Charge : Dr. M. M. P. M. Fernando

Number of Lectures : 15 (at least 15 hours)

Number of Tutorials : 04 (at least 04 Tutorial Classes)

Faculty : Applied Science

Department : Physics Department

Degree : B. Sc. General / Special Degree

**Compulsory / Optional : Compulsory for Students that have doing
Physics as a subject combination and Optional
for other students**

Year : Second Year

Semester : Second Semester

Method of assessment : End of semester theory examination - 100%

Introduction :

This course unit offered by the department of physics to both physical science students as well as biological science students. This is also an optional course available for students who are not offering Physics as a subject in the applied science faculty.

This course covers the fundamental aspects of Relativity such that Einstein's Special theory of Relativity and Introduction to Special theory of Relativity in Western and Eastern Philosophies.

Aims and Objectives of the course unit :

The course unit aims to familiarize the students with the fundamental aspects of Special theory of relativity and develop the student's skills (logical and creative thinking) through a series of lectures, solving problems, class room demonstrations as well as discussions and extra open seminars.

It further aims to develop the students comprehension of modern thinking and creative working in their lives of aspects of Special Theory of Relativity in the different areas such as Western and Eastern Philosophical Background, Concept of Time, Length,.... Transformation Equations and other applications.

Details of the Course Unit : PHY 207 1.0/ PHY 257 1.0
(Special Theory of Relativity)

| WEEK | MAIN TOPIC | SUB TOPICS |
|-------------|---|--|
| 1 | Introduction to Philosophical Background of Science | General Knowledge about Philosophical Background of Science from Aristotle, Socrates, Plato, ... to Newton. |
| 2 | Path to Einstein to Special Theory of Relativity - 1 | Discovery of the speed of Sounds and its propagating media (Air) Discovery of the speed of Light The Philosophical and Scientists ideas about the propagating media of Light |
| 3 | Path to Einstein to Special Theory of Relativity - 2 | The Concept of the “Luminiferous Ether” The Philosophical and Scientists ideas about the “Luminiferous Ether” |
| 4 | Michelson – Morley Experiment | Explain the Experimental Setup Experiment Targets Experimental Observations And Experimental Conclusions |
| 5 | The Concept of Special Theory of Relativity and its Results | What is a Postulate? Introduce Einstein's Postulates and Explain that in General Everyday examples The Concept of “Time” and Define the “Time” Measurement of Time and Relativistic Time Equation |

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| | | Introduce “Proper Time” and “Improper Time” in Relativistic Time Equation |
| 6 | Experimental Background for Relativistic Time Equation | Rossi and Hall Experiment in 1938 Modern Particle Accelerators Observations Introduction of Time Dilation And Examples for “Proper Time” and “Improper Time” |
| 7 | Measurement of Length | Define the “Length” Concept of “Proper Length” and “Improper Length” Measurement of Length and Relativistic Length Equation Experimental Background for Relativistic Length Equation Introduction of Length Contraction And Examples |
| 8 | The Doppler’s Effect | What is Doppler’s Effect in Sound Derive an Equation for the Doppler’s Effect for Light Variation of Colour Spectrum in Doppler’s Effect for a moving Light Source (eg: moving Star) Relative Motion in Source and Observer and Derive Two Equations for that cases. |
| 9 | Relativistic Energy and Momentum | Introduction to the concept of Energy and Momentum in everyday world The Energy Equivalence The concept of Relativistic Energy The concept of Relativistic Momentum |

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| | | <p>Derive an equation for the Relativistic Energy (Einstein's Relativistic Energy Equation)</p> <p>The concept of Relativistic Mass and Obtain $E = mc^2$ equation using Einstein's Relativistic Energy Equation</p> |
| 10 | Experimental Background for Relativistic Mass Equation | <p>Modern Particle Accelerators Observations for Protons and Electrons to explain the concept of Relativistic Mass</p> <p>Using Bore's and Sommerfeld's atomic theorem and analyzing "He" split Spectrum.</p> |
| 11 | The Twin Paradox | <p>What is Paradox</p> <p>Former Paradoxes in Relativity</p> <p>Twin Paradox</p> <p>What is Time Traveling Concept</p> |
| 12 | Transformation Equations | <p>What is Transformation</p> <p>Introduction to Galilean Transformation Equations</p> <p>And Examples</p> <p>Lorentz Transformation Equations for Time and Space</p> |
| 13 | Transformation Equations - 2 | <p>Lorentz Inverse Transformation Equations for Time and Space</p> <p>Lorentz Transformation Equations for Velocity</p> <p>Lorentz Inverse Transformation Equations for Velocity</p> <p>Lorentz Transformation Equations for acceleration</p> <p>Lorentz Inverse Transformation Equations</p> |

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| | | for acceleration |
| 14 | Transformation Equations – 3 | Derive equations for Time Dilation and Length Contraction using Lorentz Transformation Lorentz Invariants Relative Velocity Equation 4 particles |
| | Four Vector Spaces | Three Dimension Space Four Dimension Vector Spaces as a special new Dimension of time <i>ict</i> . |
| | Causality | What is Causality? Causality in Western and Eastern Philosophy Strength causality for Relativity |
| 15 | Brief Introduction to General Relativity | What is General Theory of Relativity Newton's Gravitation Force for Light Light Bending due to Heavy Mass Radiation Pressure Big Bang Theory Expansion for the Universe Electric and Magnetic Fields |
| | Summary For Our Lesson | Summary for This Course Unit |

References:

- Fundamentals of Physics – HALLIDAY / RESNICK / WALKER
- Newton to Einstein – Ralph Baierlein.
- On the shoulders of the Giants – Stephen Hawkins.
- The Brief Introduction of Time – Stephen Hawkins.
- Relativity for the Layman – James A. Coleman.
- Understanding special theory of Relativity – Y. R. Waghmare.
- Testing the Theory of Relativity – Brian Jones & Gerald Laban.
- Element of Special Relativity – S. P. Singh & M. R. Badge.
- What the Buddha Thought – Rev. Walpola Rahula.
- Special Relativity – A. P. Fench.
- Special theory of Relativity – B. L. Warsnop.
- Special theory of Relativity – David Bohm.
- An Introduction to the special theory of Relativity – Robert Kats.
- Introduction to the special theory of Relativity – James Smith.
- අභිධර්ම මාර්ගය - මහාවාරිය පූජ්‍ය රේරැකානේ චන්ද්‍රවිමල.
- අභිධර්මයේ මූලික කරුණු - මහාවාරිය පූජ්‍ය රේරැකානේ චන්ද්‍රවිමල.
- අභිධර්ම සමුච්චය - පූජ්‍ය හේන්පිටගෙදර ඥාණසීහ.
- සූත්‍ර පිටකය (දීඝ නිකාය, මජ්ඣිම නිකාය, සංඥකාන නිකාය, අංගුත්තර නිකාය හා බුද්දක නිකාය) - බෞද්ධ සංස්කෘතික මධ්‍යස්ථානය අනුග්‍රහයෙන් මුද්‍රනයයි.