**Outline**

**Foreword** (from Dr. Jawad; These notes were inspired from the Theoretical minimum problem)

1. **Introduction**
   1. Scale, Speed, Units
   2. Galilean relativity, Speed of light, postulates of SR
      1. Galilean relativity is not applicable in higher speeds
   3. Paradoxes, phenomena of SR (time dilation, length contraction, relativity of simultaneity)
2. **Foundations of SR[[1]](#footnote-1)**
   1. Relativity of simultaneity (will be used in future examples)
   2. Time Dilation (Train example, moving mirrors, derivation)
   3. Length Contraction
   4. Paradoxes of simultaneity
   5. Lorentz transformations (properties, addition of velocities)
3. **Spacetime Diagrams[[2]](#footnote-2)**
   1. Introduction (speed of light invariant, rest, constant velocity…)
   2. Cause and effect
   3. Invariants
   4. Examples (addition of velocities – algebraic treatment in D. Tong notes, Illustrated SR, Lorentz transform as an “exotic” rotation)
4. **“Paradoxes” of SR**
   1. Pole in the Barn (two approaches, spacetime diagrams, the issue of locking the doors (simultaneity))
   2. The Twin paradox (3 approaches: Without acceleration, relativistic doppler effect,[[3]](#footnote-3) communication between twins)
   3. Dr. Jawad’s theoretical minimum problem (optional)
5. **Relativistic Kinematics**
   1. Relativistic mass
   2. Momentum
   3. Force and Energy (Relativistic KE and )
   4. Solved example: Compton scattering.

**Afterword:** “Loose Ends”, Maxwell’s equations and , General Relativity (math, physics)

**Appendix A:** 4-vectors (momentum, force, energy; Check D. Tong and Joe’s SR notes)

**Appendix B:** Math of Lorentz Transform (optional)

Note: Look at office hour videos for some important points

1. Title subject to change [↑](#footnote-ref-1)
2. Check out the MinutePhysics video on Spacetime diagrams. [↑](#footnote-ref-2)
3. Define Doppler effect and relativistic Doppler effect. [↑](#footnote-ref-3)