Objectives for Material to be Learned from Unit 4

By the end of this unit, students should be able to:

4.1 (Continuing objective) Be able to relate concepts of gravitation to "everyday" situations and to discuss various applications of the concepts to practical problems in various fields of science, medicine and engineering.

4.2 Use Kepler's laws to relate distance, velocity, and period of revolution for planetary systems or satellites.

4.3 Calculate the gravitational force acting between point-like or spherical objects using Newton's law of gravitation.

4.4 Apply Newton's second law and Newton's law of gravity to circular orbit problems. Explain in your own words how Kepler's laws follow from Newton's laws.

4.5 Using the expression for gravitational potential energy and conservation of energy, relate speed and distance for objects in free flight. Use conservation of energy to solve problems involving escape velocity.

4.6 Determine radial displacement in the presence of a spherical mass according to general relativity. Know how to determine the coordinate r used to parametrize curved spacetime.

4.7 Determine the rates for stationary clocks in the presence of a spherical mass according to general relativity.

4.8 Describe the principle of maximum proper time. Be able to apply it qualitatively to compare various trajectories, and to apply it quantitatively in situations with no spacetime curvature.

4.9 Describe the Equivalence Principle in your own words. Be able to discuss how this principle explains the phenomenon of gravitational lensing.

4.10 Be able to describe black holes and how they can be detected.

4.11 Be able to discuss various pieces of experimental evidence for general relativity.