Week 1: Introduction to Physics of the Universe

An overview of the physics of the universe: matter and space; the fundamental constituents of nature; and the role of large-scale experimental facilities.

Week 2. Elementary Particles

An overview of elementary particle physics, the development of the Standard Model, the major large-scale experiments and the big questions for the future.

Week 3: Particle Accelerators

Particle Accelerators from the Cyclotron to the Large Hadron Collider and the technologies and ideas for the Accelerators of the future.

Week 4: The Higgs Boson

The large-scale LHC experiments; the physics and search for the Higgs; the discovery; and future studies of the Higgs Boson and Phenomena.

Week 5. The Future of Particle Physics

Proposed future large facilities for particle physics, and their scientific goals.

Week 6: Neutrinos

The physics of the neutrino, neutrino properties; and the role of neutrinos in particle physics and astroparticle physics.
**Week 7: Neutrino Oscillations**

Large-scale neutrino experiments from long baseline experiments to experiments studying the properties of the neutrino.

**Week 8: Dark Matter**

The evidence for dark matter; the properties of dark matter; proposed supersymmetric particles, axions and the experimental direct and indirect searches.

**Week 8: Gravitational Waves**

Einstein’s theory of General Relativity and the prediction of gravitational waves, the historical development theoretically and early experimental probes.

**Week 9: Gravitational Waves**

The development of suspended mass interferometers, the discovery of gravitational waves and the initial science.

**Week 9: Gravitational Waves**

Gravitational waves: testing General Relativity, Gravitational Wave Astronomy and analyzing gravitational wave data.

**Week 10. Gravitational Waves**

The future of gravitational wave science, next generation instruments and the scientific prospects.

**Week 11. Gravitational Waves**

Gravitational wave astronomy; multimessenger astronomy; and LISA for studying gravitational waves in space.
**Week 12  Topics in Astrophysics and large-scale surveys**

The new astronomy with the large-scale survey instruments like LSST will be discussed.

**Week 13: An Introduction to Cosmology and the Early Universe**

An introduction to the non-static universe and the emergence of observational cosmology; the hot Big Bang Theory and experimentally probes of the Early Universe

**Week 14: Dark Energy**

The evidence for dark energy and the large-scale experimental probes.

**Week 15: The Future**

Ideas, proposals and speculations on large-scale experimental probes for the future of fundamental physics.