## Einstein’s Physics

### 1. Course Title

#### 2. Credit Structure
  - Lecture hours per week: 3
  - Tutorial hours per week: 0
  - Practical hours per week: 0
  - Total Credits: 3

#### 3. Course Code

SC403

#### 4. Program/Semester

Winter Semester

#### 5. Category

Science Elective

#### 6. Prerequisite courses

Mechanics, Electricity & Magnetism, Waves & Optics, Kinetic Theory, Vectors, Modern Physics, Geometry – all of these subjects at the CBSE (10+2) level.

#### 7. Foundation for

#### 8. Abstract Content

The twentieth century was in certain ways the darkest in all of human history. Yet this century shall stand redeemed in the eyes of future humanity due to one figure - Albert Einstein. In this course we study Einstein's physics and its paradigm-shifting impact, that, going beyond Newton and Maxwell, radically revised conventional notions of space, time, mass and energy. The course shall initially revolve around the discoveries published by Einstein in his 1905 “Annus Mirabilis” papers – the special theory of relativity, mass-energy equivalence, the photoelectric effect (Einstein's Nobel Prize winning discovery) and Brownian motion. Beyond these seminal discoveries, we take up radiation through phenomena like Bose-Einstein statistics and lasers. We also look into Bose-Einstein condensates. And finally, we qualitatively consider Einstein’s most startling contribution to human knowledge – the general theory of relativity – a theory that lends a physical character to the geometrical properties of space-time, and is now the foundation of modern cosmology, as well as mysterious astrophysical phenomena like black holes and gravitational waves.

#### Suggested Text book(s)

- Modern Physics – Beiser; Relativity – Resnick; Berkeley Course in Physics; General Properties of Matter – Newman & Searle; Gravity – Hartle.
<table>
<thead>
<tr>
<th>Topic Name</th>
<th>Content (2 -3 lines per 4 – 6 lectures)</th>
<th>No. of lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relativity</td>
<td>Invariance of the laws of physics and the speed of light, transformations of space and time, mass-energy equivalence.</td>
<td>15</td>
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<tr>
<td>Radiation</td>
<td>Photoelectric effect, photons, lasers, Bose-Einstein statistics.</td>
<td>10</td>
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<tr>
<td>Matter</td>
<td>Brownian motion, kinetic theory, Bose-Einstein condensates.</td>
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<tr>
<td>Gravity</td>
<td>Space-time curvature, gravity as geometry, bending of light, black holes, cosmological implications, gravitational waves.</td>
<td>10</td>
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Outcomes and Objectives

On completion, the overarching relevance of Einstein’s work, in as much as it touches Nature deeply at Her foundations, should be understood. Various practical applications of Einstein’s physics, present as well as futuristic, ranging across the likes of nuclear technology, the global positioning system and the possibility of space travel, to name a few, should also be appreciated.

Comments

All the written examinations of the semester will be taken, covering 100 marks.