12998-342 (8) Electromagnetism and Relativity (1.5L, 1.5P)

2019

Course summary:

Polarisation and magnetisation of materials, electromagnetic waves and their transitions between different media. Theory of special relativity.

Method of assessment: Flexible assessment.

Prerequisite module:

- *Mathematics 214, 244 or Applied Mathematics 214, 244*
- *Physics 224, 254*

Language policy:

Afrikaans and English in the same class groups:
During each lecture, all information is conveyed at least in English. Summaries and/or explanation of the core concepts will also be given in Afrikaans. Questions in Afrikaans and English will, at the least be answered in the language of the question. Students will be supported in Afrikaans and English during a combination of appropriate facilitated learning opportunities.

Module relevance in programme:

Electromagnetism is the basis for understanding the properties of materials, electronics, light and lasers. Together with Special Relativity it makes GPS devices, space missions and the understanding of the universe possible.

Physics 342 build on the electrostatics of Ph144 and electrodynamics of Ph352, but in Ph342 we also take the electric and magnetic properties of material into account. This enables us to predict how electromagnetic waves (light) will behave in different materials and at interfaces. This theory is essential for understanding of optics and photonics (light-matter interaction), laser, solid state physics, advanced electromagnetism in Honours.

The Special Relativity that has been discussed in Ph144 is revised and developed further. We reach the point where we can predict what it would look like if one would travel at relativistic velocities. We learn the vector notation that is essential for further study (in Honours/postgraduate) of field theory and relativistic theories in quantum mechanics, nuclear physics and cosmology.

Outcomes of course:

This course prepares the student for more advanced applications of electromagnetism, particularly in a medium. The student is also equipped with a working knowledge of special relativity. This course forms the foundations of a number of more advanced courses in electromagnetism, optics, as well as advanced courses founded on relativity.

Lecturer:

Dr CM Steenkamp
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Mentor:

The Department of Physics has appointed a staff member as mentor for each year of its physics programme to be available to students for consultation. Students should feel free to discuss general issues related to the physics programme or specific modules in the programme with the relevant mentor, in addition to usual consultations with their individual lecturers of modules.

The mentor for third year programme and its modules is **Dr** P Neethling pietern@sun.ac.za

Course content:

Formal lectures
We will conduct a theoretical study of the effect of electric and magnetic fields on matter, due to the charges and magnetic dipole moments that exist in atoms. This is relevant to the understanding of magnetism, electricity and the propagation of light. We will use Maxwell's laws to describe light, especially the behaviour of light at the interface between different media (i.e. phenomena such as reflection and refraction). The study of electromagnetic waves on this level leads to the theory of special relativity. We will study the principles and a number interesting applications of Einstein's theory of special relativity.

Laboratory work
A demonstration of some of the optical phenomena discussed in the theory.

Practical (Tutorials):
The tutorials are learning opportunities during which the students enhance their understanding of the theory by applying it to problems and by taking part in group discussions guided by the lecturer.

Study material:
DJ Griffiths ***"Introduction to Electrodynamics".*** The 3rd edition (1999) or 4th edition (2013) can be used.
Notes are provided.

Learning opportunities:
Tutorials, self-study opportunities and demonstrations in optics.

Assessment:
Methods of Assessments
Continuous assessment is used.
Tests, homework and self-study projects all contribute to the final mark.

Venue and time of assessment opportunities
Details will be communicated to students at start of module.

Availability of marks:
1 Week after assessment.

Calculation of final mark for the module:
Self study assignments 10-20%
Homework and tutorial assignments: 30-40%
Test 1: 25%
Test 2: 25%