Summary

Topic 11 - Electromagnetic Induction

Subject	Year	Start date	Duration
Physics	IB1, IB2	Week 2, October	5 weeks 16 hours

Course Part

IB2 Additional

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop experimental and investigative scientific skills including the use of current technologies

Develop and apply 21st century communication skills in the study of science

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

Objectives

Demonstrate knowledge and understanding of

- facts, concepts and terminology
- methodologies and techniques
- communicating scientific information

Apply

- facts, concepts and terminology
- methodologies and techniques
- methods of communicating scientific information

Formulate, analyse and evaluate

hypotheses, research questions and predictions

methodologies and techniques

primary and secondary data

scientific explanations

Syllabus Content

Additional higher level

11. Electromagnetic induction

11.1 – Electromagnetic induction

Nature of science:

Experimentation: In 1831 Michael Faraday, using primitive equipment, observed a minute pulse of current in one coil of wire only when the current in a second coil of wire was switched on or off but nothing while a constant current was established. Faraday's observation of these small transient currents led him to perform experiments that led to his law of electromagnetic induction.

Understandings:

Emf

Magnetic flux and magnetic flux linkage

Faraday's law of induction

Lenz's law

Applications and skills:

Describing the production of an induced emf by a changing magnetic flux and within a uniform magnetic field

Solving problems involving magnetic flux, magnetic flux linkage and Faraday's law

Explaining Lenz's law through the conservation of energy

11.2 – Power generation and transmission

Nature of science:

Bias: In the late 19th century Edison was a proponent of direct current electrical energy transmission while Westinghouse and Tesla favoured alternating current transmission. The so called "battle of currents" had a significant impact on today's society.

Understandings:

Alternating current (ac) generators

Average power and root mean square (rms) values of current and voltage

Transformers

Diode bridges

Half-wave and full-wave rectification

Applications and skills:

- Explaining the operation of a basic ac generator, including the effect of changing the generator frequency
- Solving problems involving the average power in an ac circuit
- Solving problems involving step-up and step-down transformers
- Describing the use of transformers in ac electrical power distribution
- Investigating a diode bridge rectification circuit experimentally
- Qualitatively describing the effect of adding a capacitor to a diode bridge rectification circuit

11.3 – Capacitance

Nature of science:

- Relationships: Examples of exponential growth and decay pervade the whole of science. It is a clear example of the way that scientists use mathematics to model reality. This topic can be used to create links between physics topics but also to uses in chemistry, biology, medicine and economics.

Understandings:

- Capacitance
- Dielectric materials
- Capacitors in series and parallel
- Resistor-capacitor (RC) series circuits
- Time constant

Applications and skills:

- Describing the effect of different dielectric materials on capacitance
- Solving problems involving parallel-plate capacitors
- Investigating combinations of capacitors in series or parallel circuits
- Determining the energy stored in a charged capacitor
- Describing the nature of the exponential discharge of a capacitor
- Solving problems involving the discharge of a capacitor through a fixed resistor
- Solving problems involving the time constant of an RC circuit for charge, voltage and current

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will
  - ask students to formulate a reasoned argument to support their opinion or conclusion
  - give students time to think through their answers before asking them for a response
  - reward a new personal understanding, solution or approach to an issue
  - ask open questions
  - set students a task which required higher-order thinking skills (such as analysis or evaluation)
  - build on a specific prior task
  - help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)
  - require students to take an unfamiliar viewpoint into account when formulating arguments
  - ask questions that required the use of knowledge from a different subject from the one you are teaching
  - include a reflection activity
  - make a link to TOK

Social

- In this unit, we will
  - have students work in small groups
  - allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity
  - have students peer assess their group performance or process
  - support students in resolving a conflict in a team
  - give a group assessment task
  - give students feedback on how they worked as a group
  - have students discuss their understanding of a text or idea among themselves and come up with a shared understanding
  - provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance
  - encourage students to consider alternative points of view or to take the perspective of others
  - provide opportunities for students to make decisions

Developing IB Learners

Learner Profile

- Inquirers
- Knowledgeable
- Thinkers
- Communicators
- Principled
- Reflective