Diploma Programme subject outline—Group 4: sciences			
School name	Gymnázium Šrobárova 1, 040 01 Košice, Slovakia	**School code**	061626
Name of the DP subject *(indicate language)*	Physics		
Level *(indicate with X)*	Higher [x] Standard completed in two years [x] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Zuzana Ješková	**Date of IB training**	6 April 2021 - 4 May 2021
Date when outline was completed	4 June 2021	**Name of workshop** *(indicate name of subject and workshop category)*	Physics (Cat.1)

* All Diploma Programme courses are designed as two-year learning experiences. However, up to two standard level subjects, excluding languages ab initio and pilot subjects, can be completed in one year, according to conditions established in the *Handbook of procedures for the Diploma Programme*.

1. Course outline

– Use the following table to organize the topics to be taught in the course. If you need to include topics that cover other requirements you have to teach (for example, national syllabus), make sure that you do so in an integrated way, but also differentiate them using italics. Add as many rows as you need.

– This document should not be a day-by-day accounting of each unit. It is an outline showing how you will distribute the topics and the time to ensure that students are prepared to comply with the requirements of the subject.

– This outline should show how you will develop the teaching of the subject. It should reflect the individual nature of the course in your classroom and should not just be a “copy and paste” from the subject guide.

– If you will teach both higher and standard level, make sure that this is clearly identified in your outline.

	Topic/unit (as identified in the IB subject guide) *State the topics/units in the order you are planning to teach them.*	Contents	Allocated time One class is 45 minutes. In one week there are 4/SL 6/HL classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	Measurement and uncertainties	1. Measurement in physics 2. Uncertainties and errors 3. Vectors and scalars	Recommended teaching hours: SL: 5 hours (7 classes) HL: 5 hours (7 classes) SL: 6 classes HL: 8 classes	The assessment takes place regularly through: • Discussions • Homeworks • Quizzes • End-of-unit tests • Practical activities Various formative assessment tools will be applied including self-assessment and peer assessment.	David Homer, Michael Bowen-Jones: Physics course companion, Oxford IB Diploma Programme, 2014 Online sources: • https://phet.colorado.edu/ • https://www.walter-fendt.de/html5/phen/ • Other online simulations • Khan Academy • youtube Digital technologies used: COACH 7 universal environment for: • measuring, analyzing, processing data • videoanalysis • modeling • controling
	Mechanics	1. Motion 2. Forces 3. Work, energy and power 4. Momentum	Recommended teaching hours: SL: 22 hours (29 classes) HL: 22 hours (29 classes) SL: 29 classes HL: 33 classes		
	Circular motion and gravity	1. Circular motion 2. Newton´s law of gravitation	Recommended teaching hours: SL: 5 hours (7 classes) HL: 5 hours (7 classes) SL: 6 classes HL: 8 classes		
	Thermal physics	1. Temperature and energy changes 2. Modelling a gas	Recommended teaching hours: SL: 11 hours (15 classes) HL: 11 hours (15 classes) SL: 15 classes HL: 20 classes		

	Engineering physics	1. Rigid bodies and rotational dynamics 2. Thermodynamics 3. Fluids and fluid dynamics (AHL) 4. Forced vibrations and resonance (AHL)	Recommended teaching hours: SL: 15 hours (20 classes) HL: 25 hours (33 classes) SL: 23 classes HL: 33 classes		
	Oscillations and waves	1. Oscillations 2. Travelling waves 3. Wave characteristics 4. Wave behaviour 5. Standing waves	Recommended teaching hours: SL: 15 hours (20 classes) HL: 15 hours (20 classes) SL: 20 classes HL: 23 classes		
	Wave phenomena (AHL)	1. Simple harmonic motion 2. Single-slit diffraction 3. Interference 4. Resoulution 5. The Doppler effect	Recommended teaching hours: HL: 15 hours (20 classes) HL: 23 classes		
	Practical work	Practical activities	SL: 17 classes HL: 31 classes	Practical work report and presentation	
	Practical work	Group 4 project	SL: 13 classes HL: 13 classes		

			Year 1 total: **SL: 128 classes** **HL: 192 classes**		
Year 2	Electricity and magnetism	1. Electric fields 2. Heating effect of an electric current 3. Electric cells 4. Magnetic effects of electric currents	Recommended teaching hours: SL: 15 hours (20 classes) HL: 15 hours (20 classes) SL: 20 classes HL: 20 classes	The assessment takes place regularly through: • Discussions • Homeworks • Quizzes • End-of-unit tests • Practical activities Various formative assessment tools will be applied including self-assessment and peer assessment.	David Homer, Michael Bowen-Jones: Physics course companion, Oxford IB Diploma Programme, 2014 Online sources: • https://phet.colorado.edu/ • https://www.walter-fendt.de/html5/phen/ • Other online simulations • Khan Academy • youtube Digital technologies used: COACH 7 universal environment for: • measuring, analyzing, processing data • videoanalysis • modeling • controling
	Fields (AHL)	Describing fields Fields at work	Recommended teaching hours: HL: 11 hours (15 classes) SL: 5 classes HL: 13 classes		
	Electromagnetic Induction (AHL)	Electromagnetic induction Power generation and transmission Capacitance	Recommended teaching hours: HL: 16 hours (21 classes) SL: 10 classes HL: 20 classes		
	Energy production	Energy sources Thermal energy transfer	Recommended teaching hours: SL: 8 hours (11 classes) HL: 8 hours (11 classes) SL: 11 classes HL: 11 classes		
	Atomic, particle and nuclear physics	Discrete energy and radioactivity Nuclear reactions The stucture of matter	Recommended teaching hours: SL: 14 hours (19 classes) HL: 14 hours (19 classes) SL: 19 classes HL: 19 classes		

	Quantum and nuclear physics (AHL)	The interaction of matter with radiation Nuclear physics	Recommended teaching hours: HL: 16 hours (21 classes) SL: 4 classes HL:20 classes		
	Practical work	Practical activities	SL: 10 classes HL: 22 classes	Practical work report and presentation	
	Practical work	IA	SL: 13 classes HL: 13 classes		
			Year 2 total: **SL: 92 classes** **HL: 138 classes**		

2. The group 4 project

As the IB guides say, "The group 4 project is a collaborative activity where students from different group 4 subjects work together on a scientific or technological topic, allowing for concepts and perceptions from across the disciplines to be shared in line with aim 10—that is, to 'encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.'" Describe how you will organize this activity. Indicate the timeline and subjects involved, if applicable.

The group 4 project is carried out at the end of the school year 1 (May - June). From group 4 subjects, chemistry, biology and physics are taught at the school. The area of knowledge involved in the project is assigned by teachers, however, the exact topic and research question is suggested by students. Students are divided into groups 4-6 students so that every subject is presented in the group. The project work is organized as follows:

1. Brainstorming on possible topics
2. Group discussion leading to formulating the research question
3. Design of the experiment
4. Implementation of the experiment
5. Collecting data
6. Analysis and interpretation of results, individually and then drawing common conclusions.
7. Individual writings and combining the final report.
8. Presentation of project results.

3. IB practical work and the internal assessment requirement to be completed during the course

As you know, students should undergo practical work related to the syllabus.

- Physics, chemistry and biology: 40 hours (at standard level) or 60 hours (at higher level)
- Computer science: 40 hours (at standard level) or 40 hours (at higher level)
- Design technology: 60 hours (at standard level) or 96 hours (at higher level)
- Sport, exercise and health science: 40 hours (at standard level) or 60 hours (at higher level)

Use the table below to indicate the name of the experiment you would propose for the different topics in the syllabus.

An example is given. Add as many rows as necessary.

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Measurement and uncertainities	Determination of the volume of an object	
Mechanics	How do objects move (uniform, uniformly accelerated motion)	Videomeasurement, COACH system to measure and analyse data
	What force is acting on a baseball? (Newtons´ second law of motion)	Videomeasurement, COACH system to measure and analyse data
	What does the friction depends on? (friction, coefficient of friction)	Sensors, COACH system to measure and analyse data
	How does a ball fall? (free fall, law of mechanical energy conservation)	Videomeasurement, COACH system to measure and analyse data
	How much work is done by a weightlifter? (work, power)	Videomeasurement, COACH system to measure and analyse data
Circular motion and gravity	How does a bicycle wheel turn? (circular motion, period, frequency, angular speed)	Videomeasurement, COACH system to measure and analyse data

Thermal physics	How is a metal heated? (specific heat capacity)	Sensors, COACH system to measure and analyse data
	How does a gas behave? (gas laws)	Sensors, COACH system to measure and analyse data
Engineering physics	Investigation of rotational equilibrium by simulation or experimentally (torque)	Phet.colorado.com or experimental kit
	How does parachute jumper fall (air resistance, terminal velocity)	Computer modeling
	Motion of rocket	Computer modeling
Oscillations and waves	How does a weight on a spring oscillate? (simple harmonic motion, period, frequency, energy changes)	Sensors, COACH system to measure and analyse data
	What do sounds look like? (pitch and timber)	Sensors, COACH system to measure and analyse data
	How loud is too loud? (intensity and loundness)	Sensors, COACH system to measure and analyse data
	What is the speed of sound?	Sensors, COACH system to measure and analyse data
Wave phenomena (AHL)	What is the index of refraction?	Experimental kit for optics
Electricity and magnetism	How does resistor (bulb, thermistor, LED) behave in electric circuit? (resistivity, Ohm´ s law)	Sensors, COACH system to measure and analyse data
	What are the properties of an electric cell? (electromotive force, internal resistance)	Sensors, COACH system to measure and analyse data
Electromagnetic Induction (AHL)	What is the voltage induced in a coil? (Faraday´s law of electromagnetic induction)	Sensors, COACH system to measure and analyse data
	How can capacitor be charged or discharged?	Sensors, COACH system to measure and analyse data
Atomic, particle and nuclear physics	Modeling radioactive decay by simulation or experimentally using dice	Computer model simulation

Quantum and nuclear physics (AHL)	How does light emit electrons out from metal (photoelectric effect)	Simulation: phet.colorado.edu

4. Laboratory facilities

Describe the laboratory and indicate whether it is presently equipped to facilitate the practical work that you have indicated in the chart above. If it is not, indicate the timeline to achieve this objective and describe the safety measures that are applicable.

The physics laboratory is equipped with 16 tables for students with 14 computers and one teacher´ s table with computer, smart board and projector. The physics lab equipment involves COACH system for measuring, processing and analysing data, i.e. interfaces, various sensors and software. The quite large equipment enables to conduct demonstrations performed by teacher. There is also multiple equipment available for students´ practical work.

5. Other resources

Indicate what other resources the school has to support the implementation of the subject and what plans there are to improve them, if needed.

The school has a very good cooperation with the Faculty of Science, Pavol Jozef Safarik University in Kosice. The section of physics education, Institute of Physics provides support in relation to the equipment. The equipment (sensors for data collection and other teaching aids for groupwork) can be borrowed from the University to use at school. Students can also use the lab facilities of the Faculty of Science UPJS to conduct experimental activities there, such like Group 4 project work or practical work for internal assessment.

6. Links to TOK

You are expected to explore links between the topics of your subject and TOK. As an example of how you would do this, choose one topic from your course outline that would allow your students to make links with TOK. Describe how you would plan the lesson.

Topic	Link with TOK (including description of lesson plan)

Oscillations and waves	When teaching physics of sound students can answer the following questions : What does a sound look like? How loud is too loud? These questions can be answered by visualization of sound to understand the sound properties and physical quantities desribing sound (frequency, amplitude of intensity). We can point to the the connections between different areas of knowledge (art-music and science-physics). The musicians use pitch, timbre and loundness to describe sound. On the other hand, physicists use specific physical quantities to describe these properties of sounds. Pitch of sound is determined by the sound frequency, timbre is related to the fact that sound consists of harmonic notes of different (basic and higher) frequencies. The basic frequency determines the pitch and higher frequences influence the timbre of sound. Students can record sounds of different pitch, timbre and loundness and determine they properties using physical quantities like frequency, higher frequencies, amplitude of intenstiy and compare sounds of different musical instruments. This can be shown by recording sounds of various musical instruments and with the help of Fourier analysis tools we can even show what frequencies with what intensity are included in the sound of specific musical instrument. When answering the question How loud is too loud? similar analogy can be seen. The loudness corresponds to the amplitude of intensity (pressure changes). However, the human ear works differently, if the sound intensity doubles, the loundness that human ear perceive increases much less. This can be shown measuring sounds with the help of a sound sensor that can be calibrated for measuring pressure changes as well as measuring loundness in decibels.

7. Approaches to learning

Every IB course should contribute to the development of students' approaches to learning skills. As an example of how you would do this, choose one topic from your outline that would allow your students to specifically develop one or more of these skill categories (thinking, communication, social, self-management or research).

Topic	Contribution to the development of students' approaches to learning skills (including one or more skill category)
Electricity and magnetism	Students are provided tools to design an experiment on determination of electric cell properties. They need a spectrum of **research skills** to conduct this activity : to design experiment, implement the experimental design, manipulate tools to collect data, present them in the form of table and graph, analyze data, interpret data and draw conclusions, discuss uncertainities and limitations. Finally, they have to prepare a written report or present the gained results in front of the class. This way they develop their **communication skills**.

8. International mindedness

Every IB course should contribute to the development of international-mindedness in students. As an example of how you would do this, choose one topic from your outline that would allow your students to analyse it from different cultural perspectives. Briefly explain the reason for your choice and what resources you will use to achieve this goal.

Topic	Contribution to the development of international mindedness (including resources you will use)
Circular motion and gravitational	The rocket launch. In establishing effective rocket launch sites and international space stations intensive international collaboration is needed. Students design a computer model in order to learn more about the behavior of a rocket and how satellites are brought into the right earth orbit with the help of rocket. The additional disussion leads to the collaboration of various countries within the European Space Agency and NASA in planning and conducting missions to the space.

9. Development of the IB learner profile

Through the course it is also expected that students will develop the attributes of the IB learner profile. As an example of how you would do this, choose one topic from your course outline and explain how the contents and related skills would pursue the development of any attribute(s) of the IB learner profile that you will identify.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
Thermal physics	Inquirers : investigation of behaviour of gas under different circumstances, investigation of Thinkers : understanding how different objects receiving the same amount of energy behave, understanding theoretical model of gas (kinetic theory of gas) vs. empirical model of gas (equation of state) Communicators : developing a written report on a practical activity (e.g. investigation of gas laws), sharing results of investigation in front of the class Reflective : collaboration within practical activities (investigation of gas laws, ...), respecting others´ opinion