Diploma Programme subject outline—Group 4: sciences			
School name	**Gymnazium a SOS Rokycany**	**School code**	**061768**
Name of the DP subject *(indicate language)*	**Physics**		
Level *(indicate with X)*	Higher [ ] Standard completed in two years [X] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Helena Cizkova	**Date of IB training**	06/2021
Date when outline was completed	05/2021	**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 3 classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	Topic 1: Measurements and uncertainties	1.1 – Measurements in physics 1.2 – Uncertainties and errors 1.3 – Vectors and scalars	**5,25 hours** (7 classes)	**Summative assessments** will be used as IB standard based tests at the end of every topic **Formative assessments** Quizzes Discussions Labs assessment according to IB methodology	CH. Hamper SL Physics, PEARSON 2014 M. Farrington Physics for the IB Diploma - workbook CAMBRIDGE university press 2017 J. Allum Physics -Study and Revision Guide HODDER Education 2017 PHET - Interactive simulation for science, University of Colorado Veritasium - YouTube MOZAIK education
	Topic 2: Mechanics	2.1 – Motion 2.2 – Forces 2.4 – Momentum and impulse 2.3 – Work, energy and power	**22,5 hours** (30 classes)		
	Topic 6: Circular motion and gravitation	6.1 – Circular motion 6.2 – Newton's law of gravitation	**6 hours** (8 classes)		
	Topic 3: Thermal physics	3.1 – Thermal concepts 3.2 – Modelling a gas	**12 hours** (16 classes)		
	Topic 5: Electricity and magnetism	5.1 – Electric fields 5.2 – Heating effect of electric currents 5.3 – Electric cells 5.4 – Magnetic effects of electric currents	**15,75 hours** (21 classes)		

	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 3 classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 2	Topic 4: Oscillations and waves	4.1 – Oscillations 4.2 – Travelling waves 4.3 – Wave characteristics 4.4 – Wave behaviour 4.5 – Standing waves	**15 hours** (20 classes)	**Summative assessments** will be used as IB standard based tests at the end of every topic MOCK **Formative assessments** Quizzes Discussions Labs assessment according to IB methodology	CH. Hamper SL Physics, PEARSON 2014 M. Farrington Physics for the IB Diploma - workbook CAMBRIDGE university press 2017 J. Allum Physics -Study and Revision Guide HODDER Education 2017 PHET - Interactive simulation for science, University of Colorado Veritasium - YouTube MOZAIK education
	Option C: Imaging	C.1 – Introduction to imaging C.2 – Imaging instrumentation C.3 – Fibre optics	**15 hours** (20 classes)		
	Topic 7: Atomic and nuclear physics	7.1 – Discrete energy and radioactivity 7.2 – Nuclear reactions 7.3 – The structure of matter	**15 hours** (20 classes)		
	Topic 8: Energy production	8.1 – Energy sources 8.2 – Thermal energy transfer	**8,25 hours** (11 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.

As the Group 4 Project should be done collaboratively among Subject Group 4 Science subjects, our students will go through a project concerning at least two of them: Biology and Chemistry, Biology and Physics or Chemistry and Physics. There are five main topics for them available for the period 2022-2024: Biochemistry of plant cells (Bi, Ch), Animal movements (Bi, Physics), Water properties (Ch, Physics), Water pollution (Bi, Ch), Soil pollution (Bi, Ch).
Each student group consisting of 3-4 participants will be asked to choose one of these topics and specify their project while discussing with lecturers.
The groups will spend 2,25 hours planning, 4,5 hours executing, 2 hours finalising their results and 1,75 hours presenting the project to other groups. While working on the projects, our teaching staff will always be available to support the students (discussions on / help with all aspects of the project while encouraging students’ independent work).
The Group 4 Project will start in May of the first IB DP year (3.75 hours in Y1) and finish up in October of the second year (6.25 hours in Y2).

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.
Practical activities (see below) Total 27 class (20,25 hours)
Individual investigation (internal assessment–IA) 10 hours
Group 4 project 10 hours

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

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Topic 1: Measurements and uncertainties	Investigating the relationship between the diameter of a plasticine ball and its mass (1 class)	Processing and analysis, Statistic (Excel)
Topic 2: Mechanics	The research of uniformly accelerated motion without an initial speed (2 classes)	Processing and analysis, Graph plotting (Video editor, Excel)
	Determining the acceleration of free-fall (2 classes)	Processing and analysis, Statistic (Excel)
	Projectile motion (1 class)	Video editor, Modelling, Simulation
	Investigating the relationship between acceleration and force (1 class)	Data logger - PASCO
Topic 6: Circular motion and gravitation	Gravity and orbits (1 class)	Simulation
Topic 3: Thermal physics	Measuring the specific heat capacity of a metal by the method of mixtures (2 classes)	Processing and analysis (Excel)
	Investigation of Boyle's law, Pressure law and Charles' law (2 classes)	Processing and analysis (Excel)
Topic 5: Electricity and magnetism	Measuring the resistivity of metal conductor (1 class)	Processing and analysis (Excel)
	Measuring the internal resistance (1 class)	Data logger- PASCO Graph plotting
	Observing the direction of magnetic force on a current-carrying conductor and on a charge moving in a magnetic field. Real observing and working with simulation (1 class)	Simulation

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Topic 4: Oscillations and waves	Measuring the mass of a body oscillating on a spring (2 classes)	Data logger PASCO
	Measuring the speed of sound (2 classes)	Processing and analysis (Audio software)
	Measuring the refractive index of glass (2 classes)	Processing and analysis, Statistic (Excel)
Option C: Imaging	Measuring of focal length (2classes)	Processing and analysis (Excel)
Topic 7: Atomic and nuclear physics	Investigating half-life (1 class)	Processing and analysis, Graph plotting (Video editor, Excel)
	Measuring the range of alpha particles in the air (1 class)	Data logger EDUPIX
Topic 8: Energy production	Observing the electromagnetic induction, which produces EMF through the changing magnetic field. Real observing and working with simulation (2 classes)	Simulation

General information
Internal assessment is an integral part of the course and is compulsory for both SL and HL students. It enables students to demonstrate the application of their skills and knowledge and to pursue their personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment requirements at SL and at HL are the same.
The internal assessment task will be one scientific investigation taking the write up should be about 6 to 12 pages long. Investigations exceeding this length will be penalized in the communication criterion as lacking in conciseness.

Scheduling
Y1: By the half of May of the first IB DP year, students are introduced to IA principles. In the following 4 weeks (half of June), students are shown the sample IAs. In the end of June students brainstorm ideas matching their interests which they can imagine working on in their own IAs. Before the end of the first school year each student submits one to three topics. Students can think about their topics during summer vacation.
Y2: Until 10th September of the second IB DP year they finally chose their topic. After this deadline, they are not allowed to change their choice of topic. By the beginning of December, students will submit their first draft. By the 5th January, they will complete their final draft of the IAs.

Assessment criteria
During the process of evaluation, Personal engagement (8%), Exploration (25%), Analysis (25%), Evaluation (25%), and Communication (17 %) will be considered.
For more detail see the Physics guide.

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 laboratory was modernised in 2021. It is equipped with a data projector and a smart board. There is a sufficient number of demonstration equipment and measuring instruments. These are both modern and historically valuable devices. Kits for independent work of students in groups are available for mechanics, electricity, optics and thermodynamics. Each workgroup has a laptop at its disposal. We own the PASCO digital measuring system (8 sets). Each kit contains a digital force meter, voltmeter, ammeter, position sensor, pressure gauge, thermometer and a magnetic induction probe. There is one set of EDUPix - Education laboratory set with Timepix particle detector.

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's classrooms are all equipped with computers, multimedia projectors, touch boards, speakers, and high-speed Wi-Fi. There is a computer lab and a well-equipped library with several multimedia and VR stations accessible to students. School library has a large number of books about physics in Czech language and there is a science magazine Scientific American in Czech language available. The school has purchased teacher resource materials for every subject including textbooks, subject guides and teaching methodology material. There is also a virtual link to the library of Western Bohemia University in Pilsen which enables students and teachers to use a wide variety of resources, magazine articles, fiction and non-fiction literature, etc.
There are also printing and scanning stations available to students and teachers enabling them to work with and create various teaching and learning materials.
Overall, the amount and quality of available resources is sufficient to give effective support to the Physics course.

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)
Option C: Imaging	You may have noticed that the Moon looks bigger when it is just up above the horizon. Students will be tasked with taking pictures of the moon on one night when it is above the horizon and high in the sky. By measuring the moon's diameter in both photos, they will find out that the diameter of the moon disc is the same in both cases. At school, students will discuss the causes of this phenomenon. They will be presented with images with optical illusions, where one object appears larger than another, even if it is the same size. The lesson should help students to understand that perception sometimes does not match the measurement. They will be asked to come up with other examples where sensory perception is different than measurement (colour – wavelength, individual perception of what is warm and what is cold – temperature measurement). Finally, students will be encouraged to observe the Moon again just above the horizon and high in the sky. They will create a paper roll that will be exactly the same diameter as the observed moon disc above the horizon. Then they will use the same roll to observe the moon high in the sky and verify that the diameter is the same. TOK question: Can sensory perception sometimes mislead the scientific observer?

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)
Topic 2: Mechanics	**Thinking skills:** Students will become familiar with Newton's laws of motion and the law of the conservation of momentum, then students should be able to predict how an object will move when they know the forces that affect it. **Communication, social and research skills:** Small groups of students will investigate the relationship between force and acceleration and measure the acceleration of a free fall. They will present their results to the others. **Self-management skills**: Doing physics homework in the time given and with the desired level of knowledge and expertise.

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)
Topic 3: Thermal physics	At the beginning of the lesson, students will be given the following situation: Imagine flying to the USA for holidays. In the hotel room, the air conditioner is set to 66. Do you know what this number means? Assuming you feel comfortable at 21 °C, do you need to increase or decrease the temperature? Students can vote. This task is the motivation to discuss different temperature scales used in different countries. Students will work in small groups. Each group will be tasked with finding information about Celsius and one other temperature scale (Rankin, Reamur, Farenheit). They will have to find out where this scale is not used anymore or is still in use, what its reference points are and how the temperature value of this scale is converted to Celsius, which is common in Europe. Representatives of groups will present their findings about temperature scales, which are not usual in our country to the others.

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
Topic 5: Electricity and magnetism	**Inquirers:** The lab exercises require students to design a procedure to evaluate natural phenomena (Ohm's law, internal resistance of battery) and will measure material property (resistivity). This enables students to develop applicable laboratory and research skills. **Thinkers:** Students will understand how resistors in series and in parallel affect the electrical current in the circuit. Based on this, they will be able to assess the electric current in more complex circuits. **Communicators**: In the laboratory, students work in groups and learn to communicate effectively **Open-minded:** Students will understand that physics describes the world and seeks to reveal the laws of nature. Some of the qualities we attribute to matter are the result of an agreement among scientists. Physics has revealed the existence of two kinds of electrical charge, but the fact that we refer to the electron charge as negative and the proton charge as positive is just an agreement, and this designation could be assigned the other way around. **Caring**: Electrical cells and batteries contain chemicals that are harmful to the environment. After they are discharged, they should be disposed of or recycled in a specific way and students learn to consider environmental issues **Risk-takers:** Working with high voltage and electric current can be life-threatening. Nevertheless, people have been able to build power grids all over the world which may seem dangerous but very beneficial