Ontario eSecondary School
Course Outline
2022-2023

Ministry of Education Course Title: Physics, Grade 12, University Preparation	
Ministry Course Code: SPH4U	
Course Type: University Preparation	
Grade: 12	
Credit Value: 1.0	
Prerequisite(s): Physics, Grade 11, University Preparation	
Department: Science	
Course developed by: **George Murzaku**	**Date: September 1, 2017** **Revised: May 30, 2019**
Length: **One Semester**	**Hours:** **110**
This course has been developed based on the following Ministry documents: 1. *The Ontario Curriculum, Grades 11 and 12 Science, Revised 2008* 2. *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools (2010)*	

COURSE DESCRIPTION/RATIONALE

This course enables students to deepen their understanding of physics concepts and theories. Students will continue their exploration of energy transformations and the forces that affect motion, and will investigate electrical, gravitational, and magnetic fields and electromagnetic radiation. Students will also explore the wave nature of light, quantum mechanics, and special relativity. They will further develop their scientific investigation skills, learning, for example, how to analyse, qualitatively and quantitatively, data related to a variety of physics concepts and principles. Students will also consider the impact of technological applications of physics on society and the environment.

Units of Study	BIG IDEAS
Dynamics	● Forces affect motion in predictable and quantifiable ways. ● Forces acting on an object will determine the motion of that object. ● Many technologies that utilize the principles of dynamics have societal and environmental implications.
Energy and Momentum	● Energy and momentum are conserved in all interactions. ● Interactions involving the laws of conservation of energy and conservation of momentum can be analysed mathematically. ● Technological applications that involve energy and momentum can affect society and the environment in positive and negative ways.
Gravitational, Electric, and Magnetic Fields	● Gravitational, electric, and magnetic forces act on matter from a distance. ● Gravitational, electric, and magnetic fields share many similar properties. ● The behaviour of matter in gravitational, electric, and magnetic fields can be described mathematically. ● Technological systems that involve gravitational, electric, and magnetic fields can have an effect on society and the environment.
The wave nature of light	● Light has properties that are similar to the properties of mechanical waves. ● The behaviour of light as a wave can be described mathematically. ● Technologies that use the principles of the wave nature of light can have societal and environmental implications.
Quantum mechanics and Relativity	● Light can show particle-like and wave-like behaviour, and particles can show wavelike behaviour. ● The behaviour of light as a particle and the behaviour of particles as waves can be described mathematically. ● Time is relative to a person's frame of reference. ● The effects of relativistic motion can be described mathematically. ● New theories can change scientific thought and lead to the development of new technologies.

COURSE CONTENT

Unit	*Length*
0: Skills Handbook	5 hours
1: Motion on a plane	30 hours
2: Work, Energy, and Momentum	20 hours
3: Gravitational, Electric, and Magnetic Field	22 hours
4: Wave Nature of Light	13 hours
5: Modern Physics	13 hours
Culminating Project	5 hours
Final Exam	2 hours

UNIT DESCRIPTIONS

Unit 0 - Skills handbook

Students will learn how to properly use significant digits in their measurements and problem solving situations. They will learn to use unit analysis techniques to verify the correctness of their solutions or derived formula in their lab activities. Students will learn how to analyze measurement errors quantitatively and qualitatively.

Unit 1 - Motion on a plane

Students will investigate, in qualitative and quantitative terms, forces involved in uniform circular motion and motion in a plane, and solve related problems. They will demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane. Students will analyse technological devices that apply the principles of the dynamics of motion, and assess the technologies' social and environmental impact. Students will use critical thinking and inquiry skills to prepare, conduct, and write a lab investigation.

Unit 2 - Momentum and Energy

Students will investigate, in qualitative and quantitative terms, through laboratory inquiry or computer simulation, the relationship between the laws of conservation of energy and conservation of momentum, and solve related problems. They will demonstrate an understanding of work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions. Students will analyse, and propose ways to improve, technologies or procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these technologies or procedures. Students will use critical thinking and inquiry skills to prepare, conduct, and write a lab investigation.

Unit 3- Gravitational, Electric, Magnetic Field

Students will investigate, in qualitative and quantitative terms, gravitational, electric, and magnetic fields, and solve related problems. They will demonstrate an understanding of the concepts, properties, principles, and laws related to gravitational, electric, and magnetic fields and their interactions with matter. Students will analyse the operation of technologies that use gravitational, electric, or magnetic fields, and assess the technologies' social and environmental impact. Students will use critical thinking and inquiry skills to prepare, conduct, and write a lab investigation.

Unit 4 - Wave Nature of Light

Students will investigate, in qualitative and quantitative terms, the properties of waves and light, and solve related problems. They will demonstrate an understanding of the properties of waves and light in relation to diffraction, refraction, interference, and polarization. Students will analyse technologies that use the wave nature of light, and assess their impact on society and the environment. They will use critical thinking and inquiry skills to prepare, conduct, and write a lab investigation.

Unit 5 - Modern Physics; Quantum mechanics and Relativity

Students will investigate special relativity and quantum mechanics, and solve related problems. They will demonstrate an understanding of the evidence that supports the basic concepts of quantum mechanics and Einstein's theory of special relativity. Students will analyse, with reference to quantum mechanics and relativity, how the introduction of new conceptual models and theories can influence and/or change scientific thought and lead to the development of new technologies. They will use critical thinking and inquiry skills to prepare, conduct, and write a lab investigation.

TEACHING AND LEARNING STRATEGIES

The students will experience a variety of activities:

Whole-Class Activities (facilitated through discussion forums, video presentations)

Whole class activities are designed to introduce concepts and skills that are directly applicable to the workplace and to build on the content being studied during small group and individual activities. These activities include the following:

Teacher demonstrations through video conferencing, email, or videos provided of a teacher or student demonstrating the concepts and skills being studied. This helps the student and teacher create an atmosphere of trust and respect to aid in the online learning environment.

Video presentations and technological aids with videos embedded to enrich the course content and clarify concepts and skills being studied. Also the use of online pre-approved quizzes and games to help a student become more familiar with the concepts and skills being studied.

Diagnostic and review activities (audio and video recordings) can be student-lead or teacher lead to work as a review for students through audio and video made to share among each other to help reinforce the concepts and skills being studied.

Small Group Activities

The teacher sets up small group activities to provide opportunities for active and oral learning as well as to bolster practical communication and teamwork skills. The teacher plays a critical role during group activities by monitoring group progress as well as answering questions that arise and using questions to assist students in their understanding. In this way, the teacher also facilitates student understanding of effective learning, communication, and team building during group activities.

The small group activities include the following:

Paired or small group research activities students are able to share their work online with not only their teachers, but their classmates too. Students are able to share resources through online chat and video conferencing. The ability to learn from each other, work on teamwork skills, and practice communication are valued and encouraged throughout the course.

Comparison and evaluation of written work is very important in this course. This course focuses on giving many examples of correct work, and helping students build the skills needed to peer-correct and self-correct. Students are given a variety of texts to read through embedded links, to make comparisons with different texts, real life situations, and their own writing.

Practical extension and application of knowledge is used as an effective learning strategy in this course because it allows the students to read and listen to the texts and stories and reflect back with connections to themselves, other texts and the world. Students are encouraged to share their understandings through work submitted each day, phone conversations about course work, or videoconferencing.

Oral presentations in an online environment we have the equipment to have student either live video conference oral presentations, or make videos and submit them for their oral presentations. These oral presentations can be viewed by fellow students (when appropriate) and the teacher. Students can learn from one another, and from their teacher. Such activities include dramatic readings and performances.

Charts and graphs are used to present effective learning opportunities of concepts and skills to students who would benefit from visual objects to learn. Every student learns differently, and it is used to help students discover another way to present their information such as graphic organizers, lists, and pictures.

Individual Activities

The teacher should provide a variety of individual assignments to expand and consolidate the learning that takes place in the whole-class and small group activities. Individual activities allow the teacher to accommodate interests and needs and to access the progress of individual students. The teacher plays an important role in supporting these activities through the provision of ongoing feedback to the students, both orally and in writing. Teachers are encouraged to include individual activities such as the following in the course:

Research is completed in an online environment by teaching the students first about plagiarism rules and giving examples of good sources to use. The students are not only limited to the online search for information, but have the resources available by links on the Moodle page of information that has been scanned and uploaded.

Individual assignments are worked on at a student's own pace. The teacher can support the student in these activities with ongoing feedback.

Oral presentations are facilitated through the use of video conferencing and video recording.

Practical extension and application of knowledge helps students develop their own voice, and gives them the ability to make personal connections, and connections to the world throughout their course. Students are given a variety or reading and viewing texts to give them many chances to apply their new concepts, skills, and knowledge.

Ongoing project work is something that is valued in the earning of an English credit. The ongoing project can be submitted to the teacher for ongoing feedback in both written and oral work.

ASSESSMENT, EVALUATION, AND REPORTING

Assessment: The process of gathering information that accurately reflects how well a student is achieving the identified curriculum expectations. Teachers provide students with descriptive feedback that guides their efforts towards improved performance.

Evaluation: Assessment of Learning focuses on Evaluation which is the process of making a judgement about the quality of student work on the basis of established criteria over a limited, reasonable period of time.

Reporting: Involves communicating student achievement of the curriculum expectations and Learning Skills and Work Habits in the form of marks and comments as determined by the teacher's use of professional judgement.

STRATEGIES FOR ASSESSMENT

Assessment practices can nurture students' sense of progress and competency and information instruction. Many diagnostic tools, e.g. checklists, are used at regular intervals throughout the units to encourage students' understanding of their current status as learners and to provide frequent and timely reviews of their progress. Assessment of student acquisition of learning skills also occurs regularly through unobtrusive teacher observation and conferencing.

Teachers are encouraged to share goals with students early in the course and to connect unit learning experiences frequently and explicitly with big ideas, overall expectations, and performance tasks. The teacher is encouraged to involve students in the discussion, modification, or creation of rubrics, and teach students to use rubrics as a learning tool..

ASSESSMENT ACTIVITIES

- ❑ Homework assignments
- ❑ Individual conference meetings
- ❑ Discussion Forums
- ❑ Diagnostic tests and writing tasks
- ❑ Completed Templates & Graphic Organizers
- ❑ Lab report
- ❑ Video Assignment
- ❑ Reflections
- ❑ Oral presentations & Active Listening
- ❑ Tests & Exam
- ❑ Evaluations

EVALUATION

The final grade will be determined as follows:

- ❑ 70% of the grade will be based on evaluation conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- ❑ 30% of the grade will be based on a final evaluation administered at or towards the end of the course. This evaluation will be based on evidence from one or a combination of the following: an examination, a performance, and/or another method of evaluation suitable to the course content. The final evaluation allows the student an opportunity to demonstrate comprehensive achievement of the overall expectations for the course.

(*Growing Success: Assessment, Evaluation and Reporting in Ontario Schools*. Ontario Ministry of Education Publication, 2010 p.41)

	Weight
Course Work	**70**
Knowledge/Understanding	20
Thinking/Inquiry	15
Communication	15
Application	20
Final	**30**
Exam	20
Culminating Project	10

TERM WORK EVALUATIONS (70%):

Evaluation Item	Description	Category
Reflective research projects	Research-based projects for each unit based on applications of learned concept/law to real life problems	K,T,C,A
Problem sets	Problem sets supplement lessons and are used to assess whether or not students are meeting criteria for success	K,T,C
Multiple Choice Conceptual Test	These tests will evaluate the ability of a student to tackle own misconceptions	K/T
Multiple Choice Quiz	Multiple choice quizzes will evaluate the understanding of the content learned	K/A
Simulations/Lab experiment/Live interview evaluations	Video Lab report and lab reports are used to evaluate students' thinking and communication skills Live interviews are used to evaluate students through observation and conversation.	T,C
Unit Test(s)	Unit tests are based on curriculum expectations and cover the entirety of each unit	K, A

FINAL EVALUATIONS (30%):

Evaluation Item	Description	Category
Final Exam 20%	A final, written examination, covering all curriculum expectations for the course.	K,T,C,A
Culminating Project 10%	A comprehensive project, covering all overall curriculum expectations for the course.	K,T,C,A

AFL/AAL/AOL Tracking sheet:

Unit 0:

AAL	**AFL**	**AOL**
Lesson notes	Online quiz	Online Quiz
Discussion forum	Lesson Problem Set [Self-Check Answers]	
Gizmos Investigation		

Unit 1:

AAL	**AFL**	**AOL**
Discussion Forum	Conceptual test 1D Conceptual test 2D Conceptual test Dynamics Conceptual test Circular Motion	Quiz on Kinematics 1D, 2D, Dynamics, Circular Motion
Lesson notes	Online quiz 1D Online quiz 2D Online quiz Dynamics Online quiz Circular Motion	Unit Lab (Circular Motion) video report and written report
Gizmo investigation	Lesson Problem Sets [Self-Check Answers] → Kinematics 1D → Kinematics 2D → Dynamics → Circular Motion	Unit Test

Unit 2:

AAL	AFL	AOL
Discussion Forum	Conceptual test Energy Conceptual test Momentum	Quiz on Energy and Momentum
Lesson notes	Online quiz Energy Online quiz Momentum	Unit Lab (elastic energy) video report and written report
Gizmo investigation	Lesson Problem Sets [Self-Check Answers] → Energy → Momentum	Unit Test

Unit 3:

AAL	AFL	AOL
Discussion Forum	Conceptual test Electricity Conceptual test Magnetism	Quiz on Gravity, Electricity, and Magnetism
Lesson notes	Online quiz Gravitational Field Online quiz Electric Field Online quiz Magnetic Field	Unit Lab (Magnetic force) video report and written report
Gizmo investigation	Lesson Problem Sets [Self-Check Answers] → Electricity → Magnetism	Unit Test

Unit 4:

AAL	AFL	AOL
Discussion Forum	Conceptual test Optics	Quiz on Optics
Lesson notes	Online quiz Optics	Unit Lab (Double Slit) video report and written report
Gizmo investigation	Lesson Problem Sets [Self-Check Answers] → Optics (double slit, single slit, thin film interference)	Unit Test

Unit 5:

AAL	AFL	AOL
Discussion Forum	Conceptual test Relativity	Quiz on Modern Physics
Lesson notes	Online quiz Relativity Online quiz Quantum Mechanics	Unit Lab (Photoelectric Effect); video report and written report
Gizmo investigation	Lesson Problem Sets [Self-Check Answers] → Relativity → Quantum Mechanics	Unit Project: Video presentation of photons polarization and quantum mechanics

Finals

AOL
Culminating Activity; two options
Final Exam (6 complex problems with full solutions)

CONSIDERATION FOR PROGRAM PLANNING

Students learn best when they are engaged in a variety of ways of learning. Guidance and career education courses lend themselves to a wide range of approaches in that they require students to research, think critically, work cooperatively, discuss relevant issues, and learn through practice in a variety of settings. Helping students become self-directed, lifelong learners is a fundamental aim of the guidance and career education curriculum. When students are engaged in active and experiential learning strategies, they tend to retain knowledge for longer periods and develop meaningful skills. Active and experiential learning strategies also enable students to apply their knowledge and skills to real-life issues and situations.

ANTI-DISCRIMINATION EDUCATION IN GUIDANCE AND CAREER EDUCATION

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education teachers, where appropriate, to achieve this goal. Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs in all disciplines. Those beliefs are as follows: All students can succeed. Universal design and differentiated instruction are effective and interconnected means of meeting the learning or productivity needs of any group of students. Successful instructional practices are founded on evidence-based research, tempered by experience.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 percent of the students in Ontario's English language schools is a language other than English. Ontario's linguistic heritage includes several Aboriginal languages; many African, Asian, and European languages; and some varieties of English, such as Jamaican Creole. Many English language learners were born in Canada and raised in families and communities in which languages other than English were spoken, or in which the variety of English spoken differed significantly from the English of Ontario classrooms. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited. When they start school in Ontario, many of these students are entering a new linguistic and cultural environment.

THE ROLE OF TECHNOLOGY IN THE ENGLISH PROGRAM

Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' language learning. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these can help students to collect, organize, and sort the data they gather and to write, edit, and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning.

ACCOMMODATIONS

Accommodations will be based on meeting with parent, teachers, administration and external educational assessment report. The following three types of accommodations may be provided:

- ***Instructional accommodations:*** such as changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.
- ***Environmental accommodations:*** such as preferential seating or special lighting.
- ***Assessment accommodations:*** such as allowing additional time to complete tests or assignments or permitting oral responses to test questions.

Other examples of modifications and aids, which may be used in this course, are:

- Provide step-by-step instructions.
- Help students create organizers for planning writing tasks.
- Record key words on the board or overhead when students are expected to make their own notes.
- Allow students to report verbally to a scribe (teacher/ student) who can help in note taking.
- Permit students a range of options for reading and writing tasks.
- Where an activity requires reading, provide it in advance.
- Provide opportunities for enrichment.