TFS High School
5635 Yong St. Suite 206,
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COURSE OUTLINE

Physics 12, University Preparation
SPH4U

Department	Science
Instructor	Ms. Shiva Shirkhani
Course Development Date	September 2012
Ministry Course Code	SPH4U
Credit Value	1.00
Ministry Curriculum Document	Policy Document: *Science, the Ontario Curriculum, Grades 11 and 12, 2008 (Revised)* http://www.edu.gov.on.ca./eng/curriculum/secondary/2009science11_12.txt http://www.edu.gov.on.ca/eng/policyfunding/growsuccess.pdf
Prerequisites	SPH3U Physics 11, University preparation
Course Revision Date (TFS)	September 2020

COURSE DESCRIPTION:

This course is designed to provide student with an in-depth understanding of physics theories and applications. Students would be expected to explore and apply important concepts such as energy and its transformation, the forces that influence motion, investigate electrical, gravitational, magnetic forces, energies and fields and electromagnetic radiation. Students would also be introduced to the concept of light as particle and light as wave and apply the theory of light. Finally students would cover quantum mechanics, special relativity and the concept of time dilatation, length contraction, twine paradox and relativistic momentum and energy. Student will develop skills to apply their scientific knowledge in solving various problems in physics both qualitatively and quantitatively. Moreover, the impact of technological and the applications of physics on society will be covered.

OVERALL CURRICULUM EXPECTATIONS

Scientific Investigation Skills and Career Exploration

- Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analyzing and interpreting, and communicating);
- Identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.

Dynamics

- Analyze technological devices that apply the principles of the dynamics of motion, and assess the technologies' social and environmental impact;
- Investigate, in qualitative and quantitative terms, forces involved in uniform circular motion and motion in a plane, and solve related problems;
- Demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane.

Energy and Momentum

- Analyses, 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;
- 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;
- Demonstrate an understanding of work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions.

Gravitational, Electric and Magnetic Fields

- Analyze the operation of technologies that use gravitational, electric, or magnetic fields, and assess the technologies' social and environmental impact;
- Investigate, in qualitative and quantitative terms, gravitational, electric, and magnetic fields, and solve related problems;
- Demonstrate an understanding of the concepts, properties, principles, and laws related to gravitational, electric, and magnetic fields and their interactions with matter.

The Wave Nature of Light

- Analyze technologies that use the wave nature of light, and assess their impact on society and the environment;
- Investigate, in qualitative and quantitative terms, the properties of waves and light, and solve related problems;
- Demonstrate an understanding of the properties of waves and light in relation to diffraction, refraction, interference, and polarization.

Revolutions in Modern Physics: Quantum Mechanics and Special Relativity

- Analyze, 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;
- Investigate special relativity and quantum mechanics, and solve related problems;
- Demonstrate an understanding of the evidence that supports the basic concepts of quantum mechanics and Einstein's theory of special relativity.

UNITS, DESCRIPTION AND TIME

Unit	Unit Description	Time Frame
1.	**Dynamics** Students will review important concepts essential to their success such as: scientific notation, significant digits, vector operations, and fundamental mathematical tools. Principles of free body diagrams will be reviewed and extended to motion, force and energy concepts. By the end of the unit, students will demonstrate their understanding of the forces involved in uniform circular motion and motion in a plane. They will investigate forces involved in these modes of motion and have solved related problems. They will analyze technological devices that apply the principles of dynamics of motion, and through computer program, they study the concept of projectile of various configurations.	**25 hrs.**
2.	**Energy and Momentum** Students will be introduced to the concept of energy and conservation of energy. Students will have an understanding of application of work, energy, momentum. Understanding the laws of conservation of energy, students will extend these ideas to conservation of momentum in one and two dimensions. Through computer simulation and other modes of inquiry they will investigate the phenomena of momentum and solve related problems. Students would conduct analyses and propose solutions to problems and technological concepts that apply principles related to energy and momentum, and assess the social and environmental impact of these.	**23 hrs.**
3.	**Gravitational, Electric and Magnetic Fields** In this unit, the concept of force at a distance will be covered in depth and its relevance to gravitational, electrical and magnetic forces will be introduced. By the end of this unit, students will show their understanding of the concepts, properties, principles and laws related to gravitational, electric and magnetic fields, particularly with respect to their interactions with matter. They will investigate these phenomena graphically and through use of other electronic models. Students are expected to analyze the operation of few technologies that use these fields, and discuss the social and environmental impact of these technologies.	**23 hrs.**
4.	**The Wave Nature of Light** Students will build on concepts developed during Grade 10. Students will study aspects of light such reflection, refraction, diffraction and dispersion from both particle and wave theory point of view. Properties of waves will be discussed in a general sense, and the principles of diffraction, refraction, interference and polarization will be investigated theoretically and through simulation. Technologies that make use of the knowledge of the wave nature of light, and their social and environmental impacts, will be discussed.	**22 hrs.**
5.	**Revolutions in Modern Physics: Quantum Mechanics and Special Relativity** In this unit, some of the most exciting and counterintuitive concepts in physics, including Einstein's ideas about relativity, photoelectric effect, and particle physics, will be examined. Quantum mechanics and special relativity will be investigated mathematically and related problems will be solved. In light of the revolutionary ideas studied in this unit, students will discuss how the introduction of new conceptual models can influence and change scientific thought, and lead to the development of new technologies.	**15 hrs.**
	Final Evaluation The final assessment task is a proctored three hour exam worth 30% of the student's final mark.	**2 hrs.**
	Total	**110 Hrs.**

ASSESSMENT/EVALUATION STRATEGIES:

Diagnostic assessment is used at the beginning of a unit to assist in determining a starting point for instruction. Assessment for Learning (AFL) provides information to students as they are learning and refining their skills. Assessment as Learning (AAL) acts as a stepping-stone for students to begin applying their understanding using critical thinking; it bridges the gap between AFL and AOL. Assessment of Learning (AOL), at the end of units and course, provides students with the opportunity to synthesize/apply/demonstrate their learning and the achievement of the expectations. The following is a list of specific assessment/evaluation strategies that the teacher may use but is not limited to:

EVALUATION SCHEME

Percentage of Final Mark	Weight	Evaluation Categories
70%	36%	Tests and Quizzes (breakdown)
	24%	Labs and Assignments
	10%	Performance Task(research)
30%	10% 20%	Research Project Final Written Examination

Assessment will be ongoing to inform the students of their performance and the opportunity for success. Four achievement categories are illustrated in the chart.

K: Knowledge and Understanding 30%
I: Inquiry/Thinking 30%
C: Communication 20%
MC: Making Connections/Application 20%

TEACHING AND LEARNING STRATEGIES:

- Lecture
- Discussion
- Problem posing
- Brainstorming
- demonstration
- Mathematical problem solving
- Homework
- Critical thinking
- Assignment
- Investigative Inquiry
- Lab report
- Note making

ASSESSMENT STRATEGIES:

Quiz	Report	Presentation	Extended Investigations
Test (diagnostic)	Skills Checklist	Interview	Project

RESOURCES:

- Textbook: ***Nelson Physics 12***. Hirsch, Al, David Martindale, Charles Stewart et al.; Nelson Thomson Learning; 2003
- ***McGraw-Hill Ryerson Physics 12*** *(as reference).*Dick, Greg, Dr. Lois Edwards, David Gue et-al.; McGraw-Hill Ryerson; 2002
- Varied source handouts

ACHIEVEMENT CHART: SCIENCE, GRADES 9-12:

Categories	**50-59% (Level 1)**	**60-69% (Level 2)**	**70-79% (Level 3)**	**80-100% (Level 4)**
Knowledge and Understanding - Subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding)				
	The student:			
Knowledge of content *(e.g., facts, terminology, definitions, safe use of equipment and materials)*	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of content *(e.g., concepts, ideas, theories, principles, procedures, processes)*	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
Thinking and Inquiry **- The use of critical and creative thinking skills and inquiry, research, and problem-solving skills and/or processes**				
	The student:			
Use of initiating and planning skills and strategies *(e.g., formulating questions, identifying the problem, developing hypotheses, selecting strategies and resources, developing plans)*	uses initiating and planning skills and strategies with limited effectiveness	uses initiating and planning skills and strategies with some effectiveness	uses initiating and planning skills and strategies with considerable effectiveness	uses initiating and planning skills and strategies with a high degree of effectiveness
Use of processing skills and strategies *(e.g., performing and recording, gathering evidence and data, observing, manipulating materials and using equipment safely, solving equations, proving)*	uses processing skills and strategies with limited competence	uses processing skills and strategies with moderate competence	uses processing skills and strategies with considerable competence	uses processing skills and strategies with a high degree of competence
Use of critical / creative thinking processes, skills, and strategies *(e.g., analysing, interpreting, problem solving, evaluating, forming and justifying conclusions on the basis of evidence)*	uses critical / creative thinking processes, skills, and strategies with limited effectiveness	uses critical / creative thinking processes, skills, and strategies with some effectiveness	uses critical / creative thinking processes, skills, and strategies with considerable effectiveness	use critical / creative thinking processes, skills, and strategies with a high degree of effectiveness

Communication **- The conveying of meaning through various forms**				
	The student:			
Expression and organization of ideas and information *(e.g., clear expression, logical organization)* **in oral, visual, and/or written forms** *(e.g., diagrams, models)*	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences *(e.g., peers, adults)* **and purposes** *(e.g., to inform, to persuade)* **in oral, visual, and/or written forms**	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with a high degree of effectiveness	communicates for different audiences and purposes with considerable effectiveness
Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms *(e.g., symbols, formulae, scientific notation, SI units)*	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
Application **- The use of knowledge and skills to make connections within and between various contexts**				
	The student:			
Application of knowledge and skills *(e.g., concepts and processes, safe use of equipment, scientific investigation skills)* **in familiar contexts**	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills *(e.g., concepts and processes, safe use of equipment, scientific investigation skills)* **to unfamiliar contexts**	transfers knowledge and skills to unfamiliar contexts with limited effectiveness	transfers knowledge and skills to unfamiliar contexts with some effectiveness	transfers knowledge and skills to unfamiliar contexts with considerable effectiveness	transfers knowledge and skills to unfamiliar contexts with a high degree of effectiveness
Making connections between science, technology, society, and the environment *(e.g., assessing the impact of science on technology, people and other living things, and the environment)*	makes connections between science, technology, society, and the environment with limited effectiveness	makes connections between science, technology, society, and the environment with some effectiveness	makes connections between science, technology, society, and the environment with considerable effectiveness	makes connections between science, technology, society, and the environment with a high degree of effectiveness
Proposing courses of practical action to deal with problems relating to science, technology, society, and the environment	proposes courses of practical action of limited effectiveness	proposes courses of practical action of some effectiveness	proposes courses of practical action of considerable effectiveness	proposes highly effective courses of practical action

LEARNING SKILLS:

Learning Skills are skills and habits are essential to success in school and in the workplace. Teachers report achievement on the six Learning Skills in the table below using letter codes:

E = Excellent **G** = Good **S** = Satisfactory **N** = Needs Improvement.

Learning Skills	Sample Behaviors
Responsibility	The student fulfils responsibilities and commitments within the learning environment; completes and submits class work, homework, and assignments according to agreed-upon timelines; takes responsibility for and manages own behavior.
Organization	The student devises and follows a plan and process for completing work and tasks; establishes priorities and manages time to complete tasks and achieve goals; identifies, gathers, evaluates, and uses information, technology, and resources to complete tasks.
Independent Work	The student independently monitors, assesses, and revises plans to complete tasks and meet goals; uses class time appropriately to complete tasks; follows instructions with minimal supervision.
Collaboration	The student accepts various roles and an equitable share of work in a group; responds positively to the ideas, opinions, values, and traditions of others; builds healthy peer-to-peer relationships through personal and media-assisted interactions; works with others to resolve conflicts and build consensus to achieve group goals; shares information, resources, and expertise and promotes critical thinking to solve problems and make decisions.
Initiative	The student looks for and acts on new ideas and opportunities for learning; demonstrates the capacity for innovation and a willingness to take risks; demonstrates curiosity and interest in learning; approaches new tasks with a positive attitude; recognizes and advocates appropriately for the rights of self and others.
Self-Regulation	The student sets own individual goals and monitors progress towards achieving them; seeks clarification or assistance when needed; assesses and reflects critically on own strengths, needs, and interests; identifies learning opportunities, choices, and strategies to meet personal needs and achieve goals; perseveres and makes an effort when responding to challenges.

Academic Honesty: Cheating and Plagiarism:

Plagiarism is a serious offense. It is defined as taking words, phrasing, sentence structure, or any other element of the expression of another person's **ideas**, and using them as if they were your own. Plagiarism is a violation of another person's rights, whether the material taken is excessive or small. Students will be assisted in developing strategies and techniques to avoid plagiarism. They need to be aware that plagiarized term work will be penalized and could result in a mark of zero.

Assignment Policy, Missed Tests and Attendance: Please refer to Student Contract Form

Program Planning Considerations for Science

Teachers planning a program in Science must take into account considerations in a number of important areas. Essential information that pertains to all disciplines is provided in the companion piece to this document, *Science. The Ontario Curriculum, Grades 11 and 12: Some Considerations for Program Planning, 2008*. The areas of concern to all teachers include the following:

I. ***The Role of Technology in the Curriculum***. Using information technology will assist students in the achievement of many of the expectations in the curriculum regarding research, written work, analysis of information, and visual presentations.

II. ***English As a Second Language (ESL)*****:** Appropriate accommodations in teaching, learning, and evaluation strategies will be made to help ESL students gain proficiency in English, since students taking ESL at the secondary level have limited time in which to develop this proficiency.

III. Instructional Approaches:

a. Pairing and small group activities throughout the course to support learning
b. Student/teacher conferencing and tutoring as required

IV. Health and Safety in Science
V. Environmental Education
VI. Critical Thinking and Critical Literacy in Science
VII. Literacy, Mathematical Literacy, and Investigation (Inquiry/Research) Skills
VIII. The Role of Information and Communications Technology in Science