K to 12 BASIC EDUCATION CURRICULUM
SENIOR HIGH SCHOOL – SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) SPECIALIZED SUBJECT

Grade: 12
Subject Title: General Physics 2

Quarters: General Physics 2 (Q3 & Q4)
No. of Hours/Quarter: 40 hrs /quarter
Prerequisite (if needed): General Physics 1

Course Description: Electricity and magnetism; optics; the basics of special relativity, atomic and nuclear phenomena using the methods and concepts of algebra, geometry, trigonometry, graphical analysis, and basic calculus

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Electric Charge, Coulomb's Law, Electric Fields, and Electric Flux	*The learners demonstrate an understanding of:* 1. Electric charge 2. Insulators and conductors 3. Induced charges 4. Coulomb's Law 5. Electric forces and fields 6. Electric field calculations 7. Charges on conductors	*The learners are able to:* Use theoretical and experimental approaches to solve multiconcept and rich-context problems involving electricity and magnetism	*The learners:* 1. Describe using a diagram charging by rubbing and charging by induction	**STEM_GP12EM-IIIa-1**
			2. Explain the role of electron transfer in electrostatic charging by rubbing	**STEM_GP12EM-IIIa-2**
			3. Describe experiments to show electrostatic charging by induction	**STEM_GP12EM-IIIa-3**
			4. State that there are positive and negative charges, and that charge is measured in coulombs	**STEM_GP12EM-IIIa-4**
			5. Predict charge distributions, and the resulting attraction or repulsion, in a system of charged insulators and conductors	**STEM_GP12EM-IIIa-5**
			6. Calculate the net electric force on a point charge exerted by a system of point charges	**STEM_GP12EM-IIIa-6**
			7. Describe an electric field as a region in which an electric charge experiences a force	**STEM_GP12EM-IIIa-7**
			8. Draw electric field patterns due to	**STEM_GP12EM-IIIa-8**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			systems with isolated point charges	
			9. Use in calculations the relationship between the electric field and the electric force on a test charge	**STEM_GP12EM-IIIa-9**
			10. Calculate the electric field due to a system of point charges using Coulomb's law and the superposition principle	**STEM_GP12EM-IIIa-10**
			11. Predict the trajectory of a point charge in a uniform electric field	**STEM_GP12EM-IIIa-11**
	8. Electric flux and Gauss's Law 9. Electric charge, dipoles, force, field, and flux problems		12. Calculate electric flux	**STEM_GP12EM-IIIb-12**
			13. Use Gauss's law to infer electric field due to uniformly distributed charges on long wires, spheres, and large plates	**STEM_GP12EM-IIIb-13**
			14. Solve problems involving electric charges, dipoles, forces, fields, and flux in contexts such as, but not limited to, systems of point charges, classical models of the atom, electrical breakdown of air, charged pendulums, control of electron and proton beams, electrostatic ink-jet printers	**STEM_GP12EM-IIIb-14**
Electric Potential	1. Electric potential energy 2. Electric potential 3. Equipotential surfaces 4. Electric field as a potential gradient 5. Electric potential		1. Relate the electric potential with work, potential energy, and electric field	**STEM_GP12EM-IIIb-15**
			2. Evaluate the potential at any point in a region containing point charges	**STEM_GP12EM-IIIc-16**
			3. Determine the electric potential function at any point due to highly symmetric continuous- charge distributions	**STEM_GP12EM-IIIc-17**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			4. infer the direction and strength of electric field vector, nature of the electric field sources, and electrostatic potential surfaces given the equipotential lines	**STEM_GP12EM-IIIc-18**
			5. Infer the distribution of charges at the surface of an arbitrarily shaped conductor	**STEM_GP12EM-IIIc-19**
			6. Calculate the electric field in the region given a mathematical function describing its potential in a region of space	**STEM_GP12EM-IIIc-20**
			7. Perform an experiment involving electric fields and equipotential lines and analyze the data – identifying and analyzing discrepancies between experimental results and theoretical expectations when appropriate	**STEM_GP12EM-IIIc-21**
			8. Solve problems involving electric potential energy and electric potentials in contexts such as, but not limited to, electron guns in CRT TV picture tubes, conditions for merging of charge liquid drops, and Van de Graaff generators	**STEM_GP12EM-IIIc-22**
Capacitance and Dielectrics	1. Capacitance and capacitors a. Capacitors in series and parallel b. Energy stored and electric-field energy in capacitors 2. Dielectrics		1. Deduce the effects of simple capacitors (e.g., parallel-plate, spherical, cylindrical) on the capacitance, charge, and potential difference when the size, potential difference, or charge is changed	**STEM_GP12EM-IIId-23**
			2. Calculate the equivalent capacitance of a network of capacitors connected in series/parallel	**STEM_GP12EM-IIId-24**
			3. Determine the total charge, the charge on, and the potential difference across each capacitor in the network given the capacitors	**STEM_GP12EM-IIId-25**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			connected in series/parallel	
			4. Determine the potential energy stored inside the capacitor given the geometry and the potential difference across the capacitor	**STEM_GP12EM-IIId-26**
			5. Predict the effects on the final potential difference and change in potential energy of a capacitor when either the geometry or charge is changed	**STEM_GP12EM-IIId-27**
			6. Determine the energy density and the electric field inside a capacitor with a given configuration	**STEM_GP12EM-IIId-28**
			7. Describe the effects of inserting dielectric materials on the capacitance, charge, and electric field of a capacitor	**STEM_GP12EM-IIId-29**
			8. Solve problems involving capacitors and dielectrics in contexts such as, but not limited to, charged plates, electroscopes, batteries, camera flashlamps, Geiger counters, and coaxial cables	**STEM_GP12EM-IIId-30**
Current, Resistance, and Electromotive force	1. Current, resistivity, and resistance 2. Ohm's law 3. Energy and power in electric circuits 4. Electrical safety		1. Distinguish between conventional current and electron flow	**STEM_GP12EM-IIId-32**
			2. Apply the relationship charge = current x time to new situations or to solve related problems	**STEM_GP12EM-IIIe-33**
			3. Relate the drift velocity of a collection of charged particles to the electrical current and current density	**STEM_GP12EM-IIIe-34**
			4. Describe the effect of temperature increase on the resistance of a metallic conductor	**STEM_GP12EM-IIIe-35**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			5. Describe the ability of a material to conduct current in terms of resistivity and conductivity	**STEM_GP12EM-IIIe-36**
			6. Apply the relationship of the proportionality between resistance and the length and cross-sectional area of a wire to solve problems	**STEM_GP12EM-IIIe-37**
			7. Differentiate ohmic and non-ohmic materials in terms of their I-V curves	**STEM_GP12EM-IIIe-38**
			8. Define electromotive force (emf) as the work done by a source in driving a unit charge around a complete circuit	**STEM_GP12EM-IIIe-39**
			9. Differentiate emf of a source and potential difference (PD) across a circuit	**STEM_GP12EM-IIIe-40**
			10. Use the the relationship R = V/I to solve problems	**STEM_GP12EM-IIIe-41**
			11. Given an emf source connected to a resistor, determine the power supplied or dissipated by each element in a circuit	**STEM_GP12EM-IIIe-42**
			12. Describe the physiological effects of electrical shock; electrical hazards; safety devices and procedures	**STEM_GP12EM-IIIe-43**
			13. Solve problems involving current, resistivity, resistance, and Ohm's law in contexts such as, but not limited to, batteries and bulbs, household wiring, selection of fuses, and accumulation of surface charge in the junction between wires made of different materials	**STEM_GP12EM-IIIe-44**
	1. Devices for measuring currents and voltages		1. Operate devices for measuring currents and voltages	**STEM_GP12EM-IIIe-45**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
	2. Experiments on Ohmic and non-Ohmic materials		2. Plan and perform an experiment involving ohmic and non-ohmic materials and analyze the data – identifying and analyzing discrepancies between experimental results and theoretical expectations when appropriate	**STEM_GP12EM-IIIf-46**
Direct-Current Circuits	1. Resistors in series and parallel 2. Kirchoff's rules 3. R-C circuits		1. Draw circuit diagrams with power sources (cell or battery), switches, lamps, resistors (fixed and variable) fuses, ammeters and voltmeters	**STEM_GP12EM-IIIf-47**
			2. Evaluate the equivalent resistance, current, and voltage in a given network of resistors connected in series and/or parallel	**STEM_GP12EM-IIIg-48**
			3. Calculate the current and voltage through and across circuit elements using Kirchhoff's loop and junction rules (at most 2 loops only)	**STEM_GP12EM-IIIg-49**
			4. Describe the initial, transient, and steady state behavior of current, potential, and charge in a capacitor that is either charging or discharging	**STEM_GP12EM-IIIg-50**
			5. Solve problems involving the calculation of currents and potential differences in circuits consisting of batteries, resistors, and capacitors	**STEM_GP12EM-IIIg-51**
	4. Experiments with batteries-and-resistors circuits		6. Plan and perform experiment involving batteries and resistors in one or more electric circuits and analyze the data	**STEM_GP12EM-IIIg-52**
Force due to Magnetic Fields and Sources of Magnetic Fields	1. Magnetic fields 2. Lorentz Force 3. Motion of charge particles in electric and magnetic fields 4. Magnetic forces on current		1. Describe the interaction between poles of magnets	**STEM_GP12EM-IIIh-53**
			2. Differentiate electric interactions from magnetic interactions	**STEM_GP12EM-IIIh-54**
			3. Evaluate the total magnetic flux	**STEM_GP12EM-IIIh-55**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
	carrying wires		through an open surface	
			4. Explain why the magnetic flux on a closed surface is zero	**STEM_GP12EM-IIIh-56**
			5. Draw the magnetic field pattern around (1) a bar magnet, and (2) between the poles of two bar magnets	**STEM_GP12EM-IIIh-57**
			6. Describe the motion of a charged particle in a magnetic field in terms of its speed, acceleration, cyclotron radius, cyclotron frequency, and kinetic energy	**STEM_GP12EM-IIIh-58**
			7. Evaluate the magnetic force on an arbitrary wire segment placed in a uniform magnetic field	**STEM_GP12EM-IIIh-59**
	1. Biot-Savart Law 2. Ampere's Law		1. Evaluate the magnetic field vector at a given point in space due to a moving point charge, an infinitesimal current element, or a straight current-carrying conductor	**STEM_GP12EM-IIIh-60**
			2. Calculate the magnetic field due to one or more straight wire conductors using the superposition principle	**STEM_GP12EM-IIIi-62**
			3. Calculate the force per unit length on a current carrying wire due to the magnetic field produced by other current-carrying wires	**STEM_GP12EM-IIIi-63**
			4. Evaluate the magnetic field vector at any point along the axis of a circular current loop	**STEM_GP12EM-IIIi-64**
			5. Calculate magnetic fields for highly symmetric current configurations using Ampere's law	**STEM_GP12EM-IIIi-65**
			6. Solve problems involving magnetic fields, forces due to magnetic fields and the motion of charges and current-carrying wires in contexts such as, but not limited to, determining the	**STEM_GP12EM-IIIi-66**

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			strength of Earth's magnetic field, cyclotrons, mass spectrometers, and solenoids	
Integration of Electrostatic, Magnetostatics, and Electric Circuits Concepts	Refer to Week 1 to Week 9		1. Solve multiconcept, rich-context problems in electricity and magnetism using theoretical and experimental approaches 2. Assessment of the performance standard	**STEM_GP12EM-IIIj-67** (1 week including assessment of the performance standard)
Magnetic Induction, Inductance, AC, and LC Circuits	1. Magnetic induction 2. Faraday's Law 3. Alternating current, LC circuits, and other applications of magnetic induction	1. Use theoretical and, when feasible, experimental approaches to solve multiconcept, rich-context problems using concepts from electromagnetic waves, optics, relativity, and atomic and nuclear theory 2. Apply ideas from atomic and nuclear physics in contexts such as, but not limited to, radiation shielding and inferring the composition of stars	1. Identify the factors that affect the magnitude of the induced emf and the magnitude and direction of the induced current (Faraday's Law)	**STEM_GP12EM-IVa-1**
			2. Relate Faraday's experiments and Maxwell's evaluation to a given experiment	**STEM_GP12EM-IVa-2**
			3. Compare and contrast electrostatic electric field and nonelectrostatic/induced electric field	**STEM_GP12EM-IVa-3**
			4. Calculate the induced emf in a closed loop due to a time-varying magnetic flux using Faraday's Law	**STEM_GP12EM-IVa-4**
			5. Describe the direction of the induced electric field, magnetic field, and current on a conducting/nonconducting loop using Lenz's Law	**STEM_GP12EM-IVa-5**
			6. Compare and contrast alternating current (AC) and direct current (DC)	**STEM_GP12EM-IVb-6**
			7. Use analogies with the spring-mass system to draw conclusions about the properties of LC circuits	**STEM_GP12EM-IVb-7**
			8. Characterize the properties (stored energy and time-dependence of charges, currents, and voltages) of an LC circuit	**STEM_GP12EM-IVb-8**
			9. Perform demonstrations involving	**STEM_GP12EM-IVb-9**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			magnetic induction in contexts such as, but not limited to, power generation, transformers, radio tuning, magnet falling in a copper pipe, and jumping rings	
Light as an Electromagnetic Wave	1. Maxwell's synthesis of electricity, magnetism, and optics 2. EM waves and light 3. Law of Reflection 4. Law of Refraction (Snell's Law) 5. Dispersion 6. Polarization (Malus's Law) 7. Applications of reflection, refraction, dispersion, and polarization		1. Narrate Maxwell's line of reasoning in linking EM to light	**STEM_GP12OPT-IVb-10**
			2. Narrate the story behind Hertz's experiments	**STEM_GP12OPT-IVb-11**
			3. Relate the properties of EM wave (wavelength, frequency, speed) and the properties of vacuum and optical medium (permittivity, permeability, and index of refraction)	**STEM_GP12OPT-IVb-12**
			4. Apply the Law of Reflection	**STEM_GP12OPT-IVb-13**
			5. Explain the conditions for total internal reflection	**STEM_GP12OPT-IVb-14**
			6. Apply Snell's Law	**STEM_GP12OPT-IVb-15**
			7. Explain the phenomenon of dispersion by relating to Snell's Law	**STEM_GP12OPT-IVb-16**
			8. Cite evidence that EM wave is a transverse wave (polarization)	**STEM_GP12OPT-IVc-17**
			9. Calculate the intensity of the transmitted light after passing through a series of polarizers applying Malus's Law	**STEM_GP12OPT-IVc-18**
			10. Plan and perform an experiment involving ray optics and analyze the data – identifying and analyzing discrepancies between experimental results and theoretical expectations when appropriate	**STEM_GP12OPT-IVc-19**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			11. Plan and perform an experiment involving optical polarization and analyze the data – identifying and analyzing discrepancies between experimental results and theoretical expectations when appropriate (also perform using mechanical waves)	**STEM_GP12OPT-IVc-20**
			12. Solve problems involving reflection, refraction, dispersion, and polarization in contexts such as, but not limited to, (polarizing) sunglasses, atmospheric haloes, and rainbows	**STEM_GP12OPT-IVc-21**
Geometric optics	1. Reflection and refraction at plane and spherical surfaces 2. Mirrors 3. Thin lens		1. Explain image formation as an application of reflection, refraction, and paraxial approximation	**STEM_GP12OPT-IVd-22**
			2. Relate properties of mirrors and lenses (radii of curvature, focal length, index of refraction [for lenses]) to image and object distance and sizes	**STEM_GP12OPT-IVd-23**
			3. Determine graphically and mathematically the type (virtual/real), magnification, location, and orientation of image of a point and extended object produced by a plane or spherical mirror	**STEM_GP12OPT-IVd-24**
			4. Determine graphically and mathematically the type (virtual/real), magnification, location/ apparent depth, and orientation of image of a point and extended object produced by a flat and spherical surface or interface separating two optical media	**STEM_GP12OPT-IVd-25**
			5. Differentiate a converging lens from a diverging lens	**STEM_GP12OPT-IVd-26**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			6. Determine graphically and mathematically the type (virtual/real), magnification, location, and orientation of image of a point and extended object produced by a lens or series of lenses	**STEM_GP12OPT-IVd-27**
			7. Apply the principles of geometric optics to discuss image formation by the eye, and correction of common vision defects	**STEM_GP12OPT-IVd-28**
	4. Geometric optics 5. Image formation experiments		8. Solve problems in geometric optics in contexts such as, but not limited to, depth perception, microscopes, telescopes, and the correction of vision defects	**STEM_GP12OPT-IVe-29**
Interference and diffraction	1. Huygens' Principle 2. Two-source interference of light 3. Intensity in interference patterns 4. Interference in thin films 5. Diffraction from single-slits		1. Narrate the story behind Young's Two-slit experiments (wave versus particle)	**STEM_GP12OPT-IVf-31**
			2. Determine the conditions (superposition, path and phase difference, polarization, amplitude) for interference to occur emphasizing the properties of a laser (as a monochromatic and coherent light source)	**STEM_GP12OPT-IVf-32**
			3. Relate the geometry of the two-slit experiment set up (slit separation, and screen-to-slit distance) and properties of light (wavelength) to the properties of the interference pattern (width, location, and intensity)	**STEM_GP12OPT-IVf-33**
			4. Predict the occurrence of constructive and destructive reflection from thin films based on their thickness, index of refraction, and wavelength of illumination	**STEM_GP12OPT-IVf-34**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
			5. Relate the geometry of the diffraction experiment setup (slit size, and screen-to-slit distance) and properties of light (wavelength) to the properties of the diffraction pattern (width, location, and intensity of the fringes)	**STEM_GP12OPT-IVf-35**
			6. Solve problems involving interference and diffraction using concepts such as optical path length, phase difference, and path difference	**STEM_GP12OPT-IVf-g-36**
Relativity	1. Postulates of Special Relativity 2. Relativity of times and lengths 3. Relativistic velocity addition		1. State the postulates of Special Relativity and their consequences	**STEM_GP12MP-IVg-39**
			2. Apply the time dilation and length contraction formulae	**STEM_GP12MP-IVg-40**
			3. Apply the relativistic velocity addition formula	**STEM_GP12MP-IVg-41**
	4. Relativistic dynamics 5. Relativistic Doppler effect		4. Calculate kinetic energy, rest energy, momentum, and speed of objects moving with speeds comparable to the speed of light	**STEM_GP12MP-IVg-42**
			5. Apply the relativistic Doppler formula	**STEM_GP12MP-IVh-43**
			6. Solve simple problems in special relativity involving time dilation, length contraction, principle of invariance, mass-energy relation, relativistic velocity addition, and relativistic momentum	**STEM_GP12MP-IVh-44**
Atomic and Nuclear Phenomena	1. Photoelectric effect 2. Atomic spectra		7. Explain the photoelectric effect using the idea of light quanta or photons	**STEM_GP12MP-IVh-45**
			8. Explain qualitatively the properties of atomic emission and absorption spectra using the concept of energy levels	**STEM_GP12MP-IVh-46**
	3. Radioactive decay 4. Experiments on atomic and nuclear phenomena 5. Applications of atomic and nuclear concepts		9. Calculating radioisotope activity using the concept of half-life	**STEM_GP12MP-IVh-i-47**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Integration of Magnetic induction, Electromagnetic waves, Optics, and Modern Physics concepts	(Week 1 to Week 9 Concepts)		Assessment of the Performance Standard	(1 week)

Code Book Legend

Sample: STEM_GP12EM-IIIa-1

LEGEND		SAMPLE	
First Entry	Learning Area and Strand/ Subject or Specialization	Science, Technology, Engineering and Mathematics General Physics	**STEM_GP12EM**
	Grade Level	Grade 12	
Uppercase Letter/s	Domain/Content/ Component/ Topic	Electricity and Magnetism	
			-
Roman Numeral **Zero if no specific quarter*	Quarter	Third Quarter	**III**
Lowercase Letter/s **Put a hyphen (-) in between letters to indicate more than a specific week*	Week	Week 1	**a**
			-
Arabic Number	Competency	Describe using a diagram charging by rubbing and charging by induction	**1**

DOMAIN/ COMPONENT	CODE
Electricity and Magnetism	EM
Optics	OPT
Modern Physics Concepts	MP

References:

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Hewitt, Paul G. *Conceptual Physics, 11th Edition.* San Francisco: Pearson, 2010.

Resnick, Robert; Halliday, David; and Krane, Kenneth. *Physics Vol.2, 5th Edition.* New Jersey: John Wiley and Sons, 2002. (Reprinted in the Philippines by C & E Publishing)

Resnick, Robert; Halliday; David; and Krane, Kenneth. *Physics Vol.1, 5th Edition.* New Jersey: John Wiley and Sons, 2002. (Reprinted in the Philippines by C & E Publishing)

Serway, Raymond, and Belchner, Robert. *Physics for Scientists and Engineers with Modern Physics, 5th Edition.* Orlando: Harcourt College Publishing, 2000.

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Young, Hugh D., and Freedman, Roger A. *Sears and Zemansky's University with Modern Physics, 11th Edition.* San Francisco: Pearson, 2004.