Pacific Community
Communauté du Pacifique

South Pacific Form Seven Certificate

# PHYSICS

## SYLLABUS

**2023**

EQAP

# GENERAL INFORMATION

The Office of the Educational Quality and Assessment Programme (EQAP) is located at:

3 Luke Street, Nabua
Suva
Fiji

Tel: (679) 3315600
Email: eqap@spc.int
Web: www.spc.int / www.eqap.org.fj

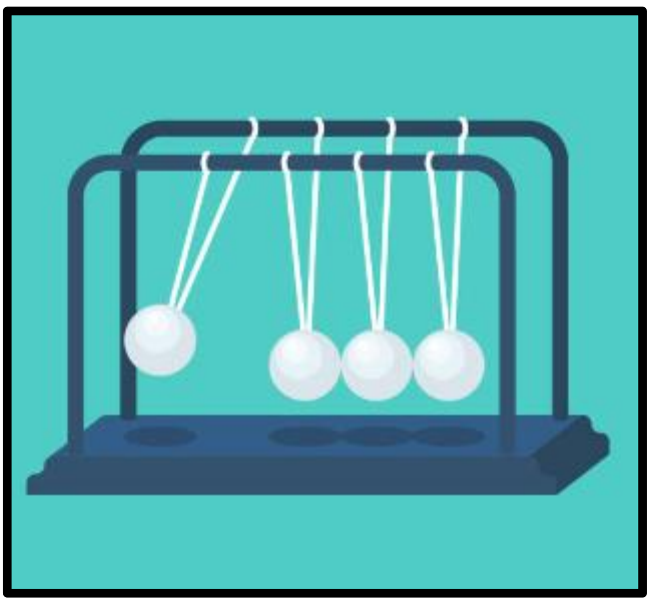
Any correspondence regarding this syllabus should be addressed to:

The Director EQAP
Pacific Community (SPC)
Private Mail Bag
Nabua
Fiji

January 2004: 1st Edition
January 2012: 2nd Edition
April 2017: 3rd Edition
January 2020: 4th Edition
January 2023: 5th Edition

**SOUTH PACIFIC FORM SEVEN CERTIFICATE**
**PHYSICS**

# CONTENTS



# 1. PREAMBLE AND RATIONALE

This syllabus defines the requirements for the South Pacific Form Seven Certificate Physics program.

Each of the student outcomes for the course is to be read in conjunction with the Explanatory Notes given for each outcome in this syllabus.

Students also require knowledge and understanding of outcomes from their national Year 12 or its equivalent, which are related to the specific outcomes of this syllabus.

This syllabus is derived from a revision of the Educational Quality and Assessment Programme (EQAP) syllabus and the New Zealand National Certificate of Educational Assessment (NCEA) Level 3 Physics Achievement Standards as published by New Zealand Qualifications Authority (NZQA).

The course is designed for students who wish to undertake university studies in Physics and other related fields.

Students will complete a course of study which contains a balance of qualitative and quantitative reasoning.

# 2. AIMS

The course of study is designed to stimulate student interest in, and enjoyment of, Physics by using a wide variety of strategies and contexts. This will be achieved by:

- developing in students an appreciation of the nature of Physics and its relevance to the everyday life of people;
- developing students' knowledge and understanding of concepts, principles and models in Physics;
- developing students' skills for problem solving in Physics;
- developing students' investigative skills in the determination of complex relationships, patterns and trends in Physics.

The course is also designed to help students develop the attitude and values that are appropriate for scientific investigations, problem solving, critical thinking, collaboration, tolerance, self-sufficiency and good judgement.

## 3. GENERAL OBJECTIVES

On completing the course of study, students should be able to:

- demonstrate knowledge and understanding of Physical phenomena, concepts, principles and models.
- demonstrate problem solving skills in Physics.
- apply concepts and principles to explain Physical phenomena, systems and devices.
- appreciate the power and limitations of Physical theories and models in Physics.
- carry out practical investigations to determine complex relationships and trends in Physical systems.

## 4. CONTENT COMPONENTS

The course content consists of the following strands and sub-strands, together with corresponding learning outcomes.

| Strand # | Strand Title | Sub strand | Sub-strand title |
|---|---|---|---|
| 1. | **Mechanics**<br>*By the end of this strand, students are able to demonstrate critical analysis and knowledge application of the physical phenomena, concepts, principles and relationships involved in mechanics.* | 1.1 | **Translational Motion**<br>*Students are able to demonstrate knowledge application of physical phenomena, concepts, and principles relating to translational motion.* |
| | | 1.2 | **Circular and Rotational Motion**<br>*Students are able to demonstrate knowledge application of the physical phenomena, concepts and principles relating to circular and rotational motion.* |
| | | 1.3 | **Simple Harmonic Motion**<br>*Students are able to demonstrate knowledge application of the physical phenomena, concepts and principles relating to simple harmonic motion.* |
| | | 1.4 | **Practical Investigation**<br>*Students are able to demonstrate skills necessary for successfully carrying out a practical investigation with guidance to determine a complex relationship or trend in a Physical system.* |
| 2. | **Waves**<br>*Students are able to demonstrate critical analysis and knowledge application of physical phenomena, concepts, principles and relationships related to* | 2.1 | **Wave Properties**<br>*Students are able to demonstrate knowledge application by describing, explaining the physical phenomena, concepts, principles and properties of waves.* |
| | | 2.2 | **Sound Waves**<br>*Students are able to demonstrate knowledge application by describing, explaining and solving* |

| | | | |
|---|---|---|---|
| | *waves.* | | *problems related to properties of sound waves.* |
| 3. | **Socio-Scientific Physics, Climate Change & Sustainability**<br>*By the end of this strand, students are able to identify concepts related to climate change and sustainability and carry out the research process that is guided by a research proposal/plan related to Socio-Scientific Physics, Climate Change & Sustainability.* | 3.1 | **Real life socio-scientific Physics**<br>*By the end of this sub-strand, students are able to demonstrate comprehensive knowledge application by describing, explaining and relating Physics to some real life situations.* |
| | | 3.2 | **Climate Change and Renewable Energy Sources**<br>*By the end of this sub-strand, students are able to demonstrate comprehensive knowledge application by describing, and explaining concepts related to climate change renewable energy sources.* |
| | | 3.3 | **Research Project**<br>*By the end of this sub-strand, students are able to demonstrate knowledge application by carrying out a research project that is guided by a research proposal/plan related to Socio-Scientific Physics, Climate Change & Sustainability.* |
| 4. | **Electricity and Electromagnetism**<br>*Students are able to demonstrate critical analysis and knowledge application, by explaining and solving problems related to the Physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.* | 4.1 | **DC Circuits and Capacitance**<br>*Students are able to demonstrate knowledge application of the Physical phenomena, concepts and principles relating to DC circuits and capacitance.* |
| | | 4.2 | **Electromagnetic Induction**<br>*Students are able to demonstrate knowledge application of the Physical phenomena, concepts and principles relating to electromagnetic induction.* |
| | | 4.3 | **AC Circuits**<br>*Students are able to demonstrate knowledge application of the Physical phenomena, concepts and principles relating to AC circuits.* |
| 5. | **Atomic and Nuclear Physics**<br>*Students are able to demonstrate critical analysis and knowledge application of the Physical phenomena, concepts, principles and relationships involved in Atomic and Nuclear Physics.* | 5.1 | **Atomic Physics**<br>*Students are able to demonstrate knowledge application by describing, explaining and solving problems related to the Physical phenomena, concepts, principles and relationships involved in atomic and nuclear Physics.* |
| | | 5.2 | **Nuclear Physics**<br>*Students are able to demonstrate knowledge application of nuclear physics by describing, explaining and solving problems related to the physical phenomena, concepts, principles and relationships in nuclear physics.* |

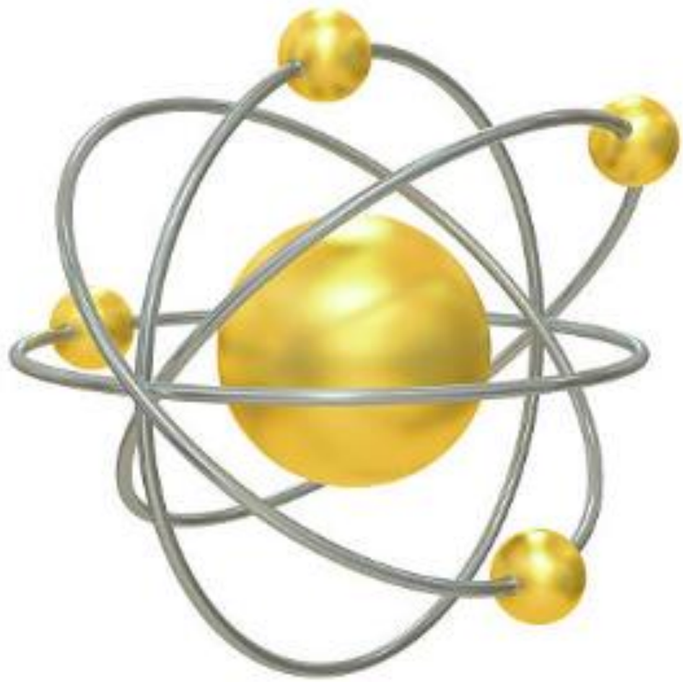
In stating or describing ideas, explaining relationships and solving problems in Physics, students are expected to:

- Apply formulae and/or use graphical, vectorial and phasor methods to find unknown quantities.
- Draw and interpret graphs and diagrams
- Give numerical answers to an appropriate number of significant figures, using SI units of measurements
- Indicate uncertainties in data calculations where necessary

A balance of quantitative and qualitative reasoning is encouraged in this Physics course.

- A qualitative treatment allows students to describe, in words and graphically, Physical situations which are not amenable to algebraic treatment at this level. Even when an algebraic treatment is possible, qualitative understanding should precede it.

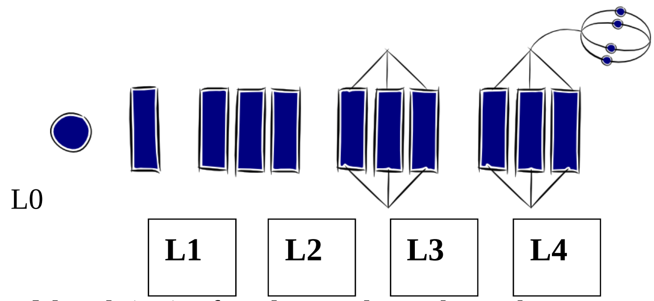
- A quantitative treatment allows students to analyse Physical situations mathematically. Students will be expected to use experimental uncertainty, correct use of significant figures and units of measurement. The formulae listed in the appendix prescribe the required depth of mathematical treatment. Formulae introduced earlier secondary levels (e.g. Years 11 and 12) may also be necessary to answer examination questions based on this syllabus.



# 5. UNPACKING LEARNING OUTCOMES

In this syllabus, Learning Outcomes are stated at three levels of generality: Major Learning Outcomes (MLOs) are stated at the strand level, Key Learning Outcomes (KLOs) are stated at the sub-strand level, and Specific Learning Outcomes (SLOs) are unpacked from the Key Learning Outcomes. Each SLO is a combination of a cognitive skill and a specific content component. Each SLO is given a skill level, level 1 – 4, and this skill level results from the categorisation of the cognitive skill that is embedded in the SLO using the SOLO taxonomy[1].

The SOLO taxonomy provides a simple, reliable and robust model for three levels of understanding – surface deep and conceptual (Biggs and Collis 1982).




At the **prestructural** level (L0) of understanding, the task is inappropriately attacked, and the student has missed the point or needs help to start. The next two levels, unistructural and multistructural are associated with bringing in information (surface understanding). At the **unistructural** level (L1), one aspect of the task is picked up, and student understanding is disconnected and limited. The jump to the multistructural level is quantitative. At the **multistuctural** level (L2), several aspects of the task are known but their relationships to each other and the whole are missed. The progression to relational and extended abstract outcomes is qualitative. At the **relational** level (L3), the aspects are linked and integrated, and contribute to a deeper and more coherent understanding of the whole. At the **extended abstract** level (L4), the new understanding at the relational level is re-thought at another conceptual level, looked at in a new way, and used as the basis for prediction, generalisation, reflection, or creation of new understanding (adapted from Hook and Mills 2011). [http://pamhook.com/solo-taxonomy/…]

The progression from Level 1 to Level 4 is exemplified in the progression from *define* → *describe* → *explain* → *discuss* with each succeeding level indicating a *higher or deeper level of understanding*, as follows:

- **define** – to state a basic definition of a concept [Unistructural or L1]
- **describe** – to give the characteristics of, or give an account of, or provide annotated diagrams. [Multistructural or L2]
- **explain** – to provide a reason for a relationship – an event and its impact, a cause and an effect, as to *how* or *why* something occurs. [Relational or L3]
- **discuss** – this means *linking biological ideas* (descriptions, explanations) to make generalisations to other situations, or predictions of unknown effects or impacts, or evaluations of a known situation with justifications. It may involve relating, comparing, analysing, and justifying. [Extended abstract level or L4]

1 Structure of Observed Learning Outcomes by Biggs and Collis (1982)

# 6. STRANDS, SUBSTRANDS AND LEARNING OUTCOMES

## Strand 1: Mechanics

**Major Learning Outcome 1:** By the end of this strand, students are able to demonstrate knowledge application and critical evaluation of the Physical phenomena, concepts, principles and relationships involved in mechanics.

### Sub-strand 1.1: Translational motion (EA)

**Key Learning Outcome:** By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of physical phenomena, concepts, and principles relating to translational motion.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **state** Newton's Second Law of motion. | 1 | Phy1.1.1.1 |
| 2 | **calculate** the magnitude/size of a force on an object in a given situation using Newton's Second Law. | 2 | Phy1.1.2.1 |
| 3 | **identify** the center of mass of a system in a context. | 1 | Phy1.1.1.2 |
| 4 | **calculate** the unknown parameters using the center of mass. | 2 | Phy1.1.2.2 |
| 5 | **identify** momentum within a given context. | 1 | Phy1.1.1.3 |
| 6 | **determine** the momentum of a moving object with reference to its center of mass. | 2 | Phy1.1.2.3 |
| 7 | **calculate** the impulse on an object. | 2 | Phy1.1.2.4 |
| 8 | **state** the relationship between momentum and velocity. | 1 | Phy1.1.1.4 |
| 9 | **show** that objects with bigger mass will have larger momentum and vice versa in a given situation. | 2 | Phy1.1.2.5 |
| 10 | **determine** the speed of a moving object given its momentum and mass. | 2 | Phy1.1.2.6 |
| 11 | **describe** qualitatively the collision of a moving object with a stationary object (but can move during collision). | 2 | Phy1.1.2.7 |
| 12 | **describe** qualitatively the collision of a moving object with an immovable object (fixed object/object moving in the opposite direction/object moving in the same direction). | 2 | Phy1.1.2.8 |
| 13 | **explain** why momentum is conserved in collision in terms of Newton's Third Law of motion. | 3 | Phy1.1.3.1 |
| 14 | **solve** problems that apply the principle of conservation of momentum during collision of a moving object with a stationary object (in one or two dimensions). | 3 | Phy1.1.3.2 |
| 15 | **solve** problems that apply the principle of conservation of momentum during collision of a moving object with an immovable object (both one and two dimension). | 3 | Phy1.1.3.3 |
| 16 | **solve** problems that apply the principle of conservation of momentum during collision of a moving object with another object moving in the same or opposite direction. | 3 | Phy1.1.3.4 |

| | | | |
|---|---|---|---|
| 17 | **solve** problems that apply the principle of conservation of momentum during collision of two moving objects travelling at a given angle. | 4 | Phy1.1.4.1 |
| 18 | **assess** collisions in different situations to identify if a collision is elastic or inelastic. | 4 | Phy1.1.4.2 |
| 19 | **discuss** the implications of high- speed vehicular collisions and suggest practical measures for safety. | 4 | Phy1.1.4.3 |
| 20 | **describe** the inertia of an object (e.g. vehicle as its tendency to remain in uniform motion or at rest using Newton's First Law of motion). | 2 | Phy1.1.2.9 |
| 21 | **explain** the reasons for Newton's First Law of Motion not being apparent in a given practical situation. | 3 | Phy1.1.3.5 |
| 22 | **explain** in terms of Newton's First and Third Laws why a freestyle swimmer moves faster through the water than a breaststroke swimmer of the same mass. | 3 | Phy1.1.3.6 |
| 23 | **compare** and comment on the forces acting on the tyres of front-wheel-drive cars and rear-wheel-drive cars. | 3 | Phy1.1.3.7 |
| 24 | **explain** the necessity for the introduction of low-speed zones in busy areas, or air bags in vehicles, with respect to the concepts of impulse and momentum. | 3 | Phy1.1.3.8 |
| 25 | **explain** the necessity of players of ball games often advised to "follow through" with respect to the concepts of impulse and momentum. | 3 | Phy1.1.3.9 |
| 26 | **assess** the effectiveness of some safety features of motor vehicles and suggest ways of improving them. | 4 | Phy1.1.4.4 |

The formulas related to the above content are listed under *Mechanics* in the Formulae page in **Appendix 1.**



SP

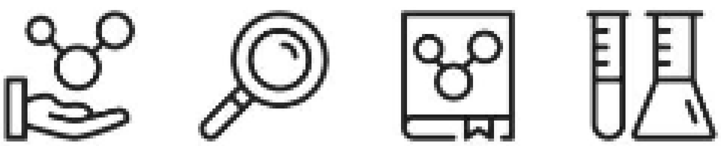
## Sub-strand 1.2: Circular and Rotational Motion (EA)

**Key Learning Outcome:** By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of the physical phenomena, concepts and principles relating to circular and rotational motion.

| SLO Nº | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **identify** uniform circular motion /centripetal force in a given context. | 1 | Phy1.2.1.1 |
| 2 | **identify** the type of force supplying the centripetal force acting on a body in uniform circular motion. | 1 | Phy1.2.1.2 |
| 3 | **convert** between radians and revolutions. | 2 | Phy1.2.2.1 |
| 4 | **describe** the role of gravity on satellite orbiting the earth. | 2 | Phy1.2.2.2 |
| 5 | **analyse** the forces involved in uniform circular motion for a range of objects, including satellites orbiting the Earth. | 3 | Phy1.2.3.1 |
| 6 | **derive** the orbital speed formula from Newton's Law of Gravitation and Newton's Second Law | 4 | Phy1.2.4.1 |
| 7 | **derive** equations of motion using the analogy between translational and rotational motion. | 3 | Phy1.2.3.2 |
| 8 | **solve** problems involving rotational motion with constant angular acceleration and constant angular speed. | 4 | Phy1.2.4.2 |
| 9 | **calculate** force on a satellite in circular orbit. | 2 | Phy1.2.2.3 |
| 10 | **describe** the angular momentum of a system in terms of the location and velocities of objects that make up the system. | 2 | Phy1.2.2.4 |
| 11 | **solve** problems that apply the principle of conservation of momentum for rotational motion. | 3 | Phy1.2.3.3 |
| 12 | **describe** the rotational inertia of a system in terms of the location and velocities of objects that make up the system. | 2 | Phy1.2.2.5 |
| 13 | **explain** the relationship between velocity, acceleration and resultant force of objects under the influence of 2 or more forces, e.g. in conical pendulums or banked corners. | 3 | Phy1.2.3.4 |
| 14 | **explain** the principle utilised by banked corners to allow vehicles to travel around corners safely. | 3 | Phy1.2.3.5 |
| 15 | **label** the direction of Net force/ Gravitational force/Normal force/ Frictional force on a banked curve. | 1 | Phy1.2.1.3 |
| 16 | **calculate** the horizontal/vertical component of force in a conical pendulum. | 2 | Phy1.2.2.6 |
| 17 | **resolve** the forces acting in a banking curve or on a conical pendulum. | 2 | Phy1.2.2.7 |

| | | | |
|---|---|---|---|
| 18 | **calculate** the tension force in the string of a conical pendulum. | 2 | Phy1.2.2.8 |
| 19 | **calculate** the speed of the mass of a conical pendulum. | 2 | Phy1.2.2.9 |
| 20 | **calculate** the banking angle for a given situation. | 2 | Phy1.2.2.10 |
| 21 | **calculate** the maximum velocity for a banked curve in a frictionless case or where friction is involved. | 2 | Phy1.2.2.11 |
| 22 | **predict**, with reasons, what will happen to a vehicle if it travels faster / slower than speed required to safely travel along a frictionless banked corner. | 4 | Phy1.2.4.3 |
| 23 | **calculate** angular momentum / rotational inertia of a system. | 2 | Phy1.2.2.12 |
| 24 | **convert** between linear distance / velocity / acceleration and angular displacement / velocity / acceleration of a rotating object. | 2 | Phy1.2.2.13 |
| 25 | **explain** how mass, radius and internal structure can be used to describe the rotational inertia of an object or system. | 3 | Phy1.2.3.6 |
| 26 | **relate** how rotational inertia affects the motion of an object or system. | 3 | Phy1.2.3.7 |
| 27 | **explain** the difference in the variables that translational inertia and rotational inertia depend on. | 3 | Phy1.2.3.8 |
| 28 | **predict** the impact of changing the axis of rotation of an object on its rotational inertia. | 4 | Phy1.2.4.4 |
| 29 | **describe** the total energy of a rolling object using both translational and rotational energy. | 2 | Phy1.2.2.14 |
| 30 | **calculate** the total energy of a rolling object using both translational and rotational energy. | 2 | Phy1.2.2.15 |
| 31 | **explain** how torque works to change rotational kinetic energy of an object or system. | 3 | Phy1.2.3.9 |
| 32 | **calculate** changes in energy of a system (rotational kinetic energy, translational kinetic energy, potential energy) when provided with angular or linear velocity. | 2 | Phy1.2.2.16 |
| 33 | **design** an experiment to explore effects of external torques on rotational kinetic energy. | 4 | Phy1.2.4.5 |
| 34 | **derive** an expression for the linear velocity of a solid cylinder / spherical ball as it leaves an inclined plane. | 4 | Phy1.2.4.6 |
| 35 | **identify** angular impulse within a given situation. | 1 | Phy1.2.1.4 |
| 36 | **predict** the behaviour of colliding bodies in a rotational collision situation by analysing angular impulse and change of angular. momentum. | 4 | Phy1.2.4.7 |

The formulas related to the above content are listed under *Mechanics* in the Formulae page in **Appendix 1.**





SP

## Sub-strand 1.3: Simple Harmonic Motion (EA)

**Key Learning Outcome:** By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of the physical phenomena, concepts and principles relating to simple harmonic motion.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **identify/locate** a position of minimum displacement / velocity / acceleration in SHM in a given context. | 1 | Phy1.3.1.1 |
| 2 | **illustrate** SHM with examples. | 2 | Phy1.3.2.1 |
| 3 | **calculate** the displacement/velocity/acceleration of a particle undergoing simple harmonic motion. | 2 | Phy1.3.2.2 |
| 4 | **calculate** the time or frequency of a particle undergoing simple harmonic motion. | 2 | Phy1.3.2.3 |
| 5 | **calculate** the angular frequency using either the formula ($\omega = 2\pi f$) or ($\omega = 2\pi/T$) of a particle undergoing simple harmonic motion. | 2 | Phy1.3.2.4 |
| 6 | **calculate** the angular frequency /spring constant / mass of a spring using the formula $\omega = \sqrt{\frac{k}{m}}$ | 2 | Phy1.3.2.5 |
| 7 | **calculate** the force acting on the mass at different positions in a simple harmonic motion. | 2 | Phy1.3.2.6 |
| 8 | **describe** oscillations in SHM in terms of amplitude, period and frequency. | 2 | Phy1.3.2.7 |
| 9 | **identify** a position of maximum displacement, velocity and acceleration in SHM in a given context. | 1 | Phy1.3.1.2 |
| 10 | **use** the equations of motion to solve problems in simple harmonic motion. | 3 | Phy1.3.3.1 |
| 11 | **analyze** SHM in terms of potential and kinetic energy. | 3 | Phy1.3.3.2 |
| 12 | **calculate** the kinetic/potential/total energy in Simple Harmonic motion. | 2 | Phy1.3.2.8 |
| 13 | **represent** Potential Energy, Kinetic Energy and Total Energy graphically. | 3 | Phy1.3.3.3 |
| 14 | **interpret** algebraic / graphical representations of SHM. | 3 | Phy1.3.3.4 |
| 15 | **describe** effects of damping / forced vibrations / resonance on SHM. | 2 | Phy1.3.2.9 |
| 16 | **determine** the maximum speed of an oscillating system. | 2 | Phy1.3.2.10 |
| 17 | **discuss** the difference between underdamped, overdamped and critically damped oscillations and justify their use in practical applications. | 4 | Phy1.3.4.1 |
| 18 | **explain** the link between SHM and wave motion | 3 | Phy1.3.3.5 |

| | | | |
|---|---|---|---|
| 19 | **solve** quantitative problems involving SHM. | 3 | Phy1.3.3.6 |
| 20 | **explain** what happens to the total energy/potential energy/kinetic energy of an object-spring system if the mass is doubled while keeping the amplitude unchanged. | 3 | Phy1.3.3.7 |
| 21 | **compare** and contrast SHM with uniform circular motion and justify their uses in practical applications. | 4 | Phy1.3.4.2 |

The formulas related to the above content are listed under *Simple Harmonic Motion* in the Formula page in **Appendix 1**.

## Sub-strand 1.4: Practical Investigation (IA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate skills necessary for successfully carrying out a practical investigation with guidance to determine a complex relationship or trend in a Physical system.

**Learning Outcomes:**

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **state** the necessary basic information often required in an investigation report (aim/purpose, question/hypothesis, rationale, background information, dependent and independent variables). | 1 | Phy1.4.1.1 |
| 2 | **list** the equipment/materials required for the investigation. | 2 | Phy1.4.2.1 |
| 3 | **describe** the method used in the investigation including the test for each variable. | 2 | Phy1.4.2.2 |
| 4 | **collect** and process data in data tables using correct units and uncertainties. | 2 | Phy1.4.2.3 |
| 5 | **draw** and label graphs. | 3 | Phy1.4.3.1 |
| 6 | **explain** why the method to be used is selected. | 3 | Phy1.4.3.2 |
| 7 | **maintain** a logbook of all work carried out in the investigation. | 3 | Phy1.4.3.3 |
| 8 | **calculate** relevant quantities from given data and graphs to highlight relationship between variables. | 2 | Phy1.4.2.4 |
| 9 | **interpret** processed data to show trends, relationships and patterns. | 3 | Phy1.4.3.4 |
| 10 | **draw** conclusion that is relevant to the data and linked back to the purpose and hypothesis or aim of the investigation. | 3 | Phy1.4.3.5 |
| 11 | **analyse** data by re-expressing data to determine relationship between variables, and determining the value, unit and significance of slope. | 3 | Phy1.4.3.6 |
| 12 | **write and e**xplain the equation derived from the analysis. | 3 | Phy1.4.3.7 |
| 13 | **identify** sources of errors and explain how to minimise these errors. | 3 | Phy1.4.3.8 |
| 14 | **provide** a theoretical explanation about the expected results from the investigation. | 3 | Phy1.4.3.9 |
| 15 | **list** bibliography/ references / acknowledgements. | 2 | Phy1.4.2.5 |
| 16 | **evaluate** findings in terms of reliability and validity of results and suggest improvements. | 4 | Phy1.4.4.1 |

| | | | |
|---|---|---|---|
| 17 | **evaluate** findings in terms of limitations and difficulties encountered in the investigation and suggest solutions for improvement. | 4 | Phy1.4.4.2 |
| 18 | **predict** and explain everyday phenomena using equations and graphs derived from the data obtained from the investigation. | 4 | Phy1.4.4.3 |
| 19 | **modify** or affirm existing scientific conceptions through experimentation and using other evidence. | 4 | Phy1.4.4.4 |

The list of investigations suitable for assessment purposes can be found in the **SPFSC Physics Laboratory Manual.**

## Strand 2: Waves

**Major Learning Outcome:** By the end of this strand, students are able to demonstrate knowledge application and critical evaluation of physical phenomena, concepts, principles and relationships related to waves.

### Sub-strand 2.1: Wave Properties (EA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by describing, explaining, evaluating the physical phenomena, concepts, principles and properties of waves.

| SLO No | Specific Learning Outcomes Students are able to: | Skill Level | Skill Code |
|---|---|---|---|
| 1 | **identify** wave characteristics - wavelength, amplitude, and speed in a given context | 1 | Phy2.1.1.1 |
| 2 | **list** variables that affect wave speed. | 2 | Phy2.1.2.1 |
| 3 | **solve** wave problems involving speed, distance, and time. | 2 | Phy2.1.2.2 |
| 4 | **explain** the difference between wave motion and particle motion. | 3 | Phy2.1.3.1 |
| 5 | **list** different types of waves. | 2 | Phy2.1.2.3 |
| 6 | **state** example of transportation of energy in waveform based on a given context. | 1 | Phy2.1.1.2 |
| 7 | **describe** the changes in the behaviour of waves undergoing diffraction. | 2 | Phy2.1.2.4 |
| 8 | **explain** how diffraction is affected by the wavelength of a wave. | 3 | Phy2.1.3.2 |
| 9 | **distinguish** between the effects of reflection, refraction and diffraction of waves. | 3 | Phy2.1.3.3 |
| 10 | **describe** examples of the applications or uses of reflection / refraction / diffraction in nature. | 2 | Phy2.1.2.5 |
| 11 | **describe** the setup for a double-slit diffraction pattern. | 2 | Phy2.1.2.6 |
| 12 | **identify** the reason for using monochromatic light in Young's double slit experiment. | 1 | Phy2.1.1.3 |
| 13 | **draw** the interference pattern in Young's double slit experiment. | 2 | Phy2.1.2.7 |

| | | | |
|---|---|---|---|
| 14 | **explain** how the interference pattern from a double slit diffraction setup is formed. | 3 | Phy2.1.3.4 |
| 15 | **use** Young's interference equations to calculate the location of nth constructive/destructive interference. | 3 | Phy2.1.3.5 |
| 16 | **use** Young's interference equations to calculate unknown quantities in a given set-up. | 3 | Phy2.1.3.6 |
| 17 | **predict** with reasons, how changes in any of the variables in Young's experiment will affect the interference pattern. | 4 | Phy2.1.4.1 |

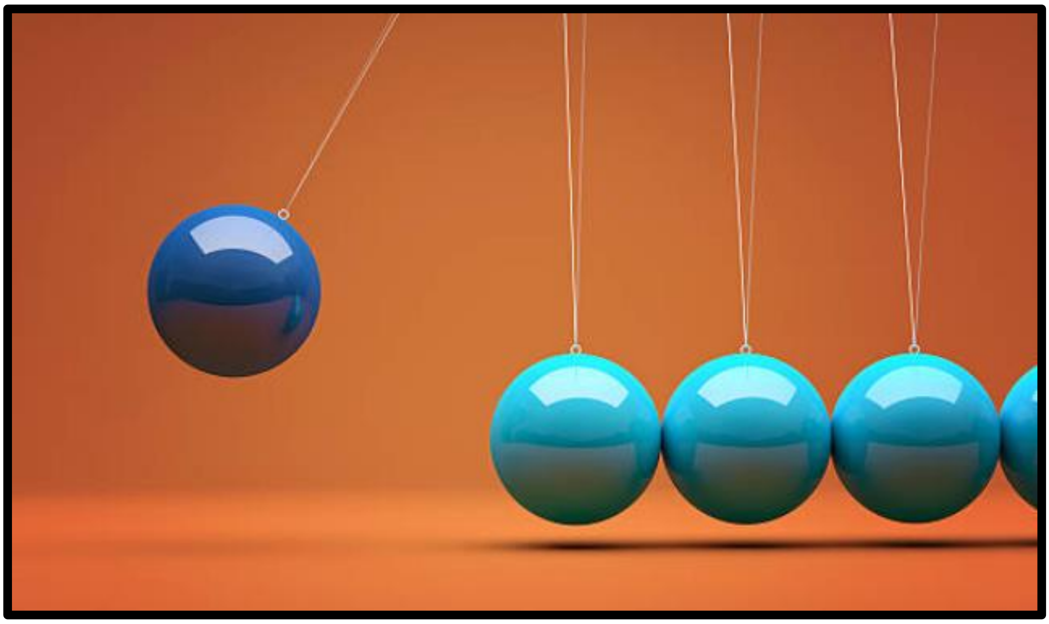
### Sub-strand 2.2: Sound Waves (EA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by describing, explaining and solving problems related to properties of sound waves.

| SLO No | Specific Learning Outcomes Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **identify** a standing wave in a given context. | 1 | Phy2.2.1.1 |
| 2 | **identify** the wavelength/amplitude of a standing wave in a diagram. | 1 | Phy2.2.1.2 |
| 3 | **label** the nodes and antinodes of a standing wave. | 2 | Phy2.2.2.1 |
| 4 | **calculate** the wavelength of a standing wave. | 2 | Phy2.2.2.2 |
| 5 | **draw** wave patterns for open pipe/ closed pipe/ strings/different instruments | 2 | Phy2.2.2.3 |
| 6 | **calculate** the frequency/period of a standing wave in a diagram. | 2 | Phy2.2.2.4 |
| 7 | **explain** how the harmonic series work for a given string musical instrument. | 3 | Phy2.2.3.1 |
| 8 | **identify** Resonant Frequency in a given context. | 1 | Phy2.2.1.3 |
| 9 | **discuss** a real-life application of forced vibrations/resonance. | 4 | Phy2.2.4.1 |
| 10 | **calculate** resonant frequency. | 2 | Phy2.2.2.5 |
| 11 | **describe** how beats are generated in waves. | 2 | Phy2.2.2.6 |
| 12 | determine an unknown using the wave speed formula. | 1 | Phy2.2.1.4 |
| 13 | **identify** a factor that affects loudness/pitch/timbre sound waves in a given context. | 1 | Phy2.2.1.5 |
| 14 | **explain** differences in effects of sound waves in terms of loudness, pitch and timbre | 3 | Phy2.2.3.2 |
| 15 | **interpret** textual information and diagrams in order to solve problems using the wave equation. | 3 | Phy2.2.3.3 |
| 16 | **predict** with reasons, how changes in the medium of wave travel will affect the properties of the wave. | 4 | Phy2.2.4.2 |
| 17 | **identify** the phenomenon of the Doppler Effect in a given | 1 | Phy2.2.1.6 |

| | | | |
|---|---|---|---|
| | situation. | | |
| 18 | **describe** examples of the Doppler Effect for both sound and light. | 2 | Phy2.2.2.7 |
| 19 | **explain** how the Doppler Effect changes the way sound is perceived when the source of sound is moving. | 3 | Phy2.2.3.4 |
| 20 | **explain** the difference in actual and apparent frequencies of sound waves when the source of sound is moving away (receding) from observer or approaching an observer. | 3 | Phy2.2.3.5 |
| 21 | **calculate** the apparent frequency of a wave when the source is receding / approaching a stationary observer. | 2 | Phy2.2.2.8 |
| 22 | **explain** the effects of differences in speeds of sound and light using real life examples/situations. | 3 | Phy2.2.3.6 |
| 23 | **describe** the characteristics of a standing wave in terms of frequency, wavelength, amplitude, period, speed. | 2 | Phy2.2.2.9 |

The formulas related to the above content are listed under *Waves* in the Formula page in **Appendix 1.**



## Strand 3: Socio-Scientific Physics, Climate Change & Sustainability

**Major Learning outcome**: By the end of this strand, students are able to identify concepts related to climate change and sustainability and carry out the research process that is guided by a research proposal/plan related to Socio-Scientific Physics, Climate Change & Sustainability.

### Sub-strand 3.1: Real life socio-scientific Physics (EA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by describing, explaining and solving problems related to renewable energy.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skills Level | SLO Code |
|---|---|---|---|
| 1 | **discuss** risks associated with excessive usage of cellphones on a child's / adult's health. | 4 | Phy3.1.4.1 |
| 2 | **explain** the use of Physics in mobile phone technology. | 3 | Phy3.1.3.1 |
| 3 | **discuss** how text messages travel from one cellphone to another. | 4 | Phy3.1.4.2 |
| 4 | **explore** use of Physics in medicine / other areas in real life. | 4 | Phy3.1.4.3 |
| 5 | **relate** the use of concept of Doppler effect to speed cameras. | 3 | Phy3.1.3.2 |
| 6 | **discover** the Physics behind some traditional knowledge in your local context. | 4 | Phy3.1.4.4 |

### Sub-strand 3.2: Climate Change and Renewable Energy Sources (EA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by describing, explaining concepts related to climate change renewable energy sources.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skills Score | SLO Code |
|---|---|---|---|
| 1 | **describe** the term climate change/ resilience/adaptation/ mitigation within given contexts. | 2 | Phy3.2.2.1 |
| 2 | **describe** an evidence of climate change evident around you. | 2 | Phy3.2.2.2 |
| 3 | **describe** the processes of global warming / sea level rise/ ozone depletion / greenhouse effect. | 2 | Phy3.2.2.3 |
| 4 | **explain** the effects of global warming /sea level rise / ozone depletion / greenhouse effect. | 3 | Phy3.2.3.1 |
| 5 | **explain** the purpose of Green Grid Initiative launched at the World Leaders Summit of COP26 UN Climate Change Conference in Glasgow in November 2021. | 3 | Phy3.2.3.2 |

| | | | |
|---|---|---|---|
| 6 | **reflect** on the initiatives of your country on the outcomes of the World Leaders Summit of COP26 UN Climate Change Conference. | 4 | Phy3.2.4.1 |
| 7 | **discuss** the causes and effects of climate change on a named community. | 4 | Phy3.2.4.2 |
| 8 | **discuss** the causes / effects / mitigation methods of global warming / sea level rise / ozone layer depletion / greenhouse effect. | 4 | Phy3.2.4.3 |
| 9 | **present** the objectives of an Act related to climate change / sustainable environment in your country. | 4 | Phy3.2.4.4 |
| 10 | **account** for the current status and the targets to be achieved pertaining to renewable energy sources in the country. | 4 | Phy3.2.4.5 |
| 11 | **identify** renewable / nonrenewable energy sources within a given situation. | 1 | Phy3.2.1.1 |
| 12 | **describe** the advantages /disadvantages of using fossil fuels. | 2 | Phy3.2.2.4 |
| 13 | **describe** reducing carbon footprint. | 2 | Phy3.2.2.5 |
| 14 | **explain** environmental impacts of renewable and non-renewable energy sources in relation to carbon footprints. | 3 | Phy3.2.3.3 |
| 15 | **discuss** the working principles of generating energy from solar / wind / hydro / biomass/ geothermal. | 4 | Phy3.2.4.6 |
| 16 | **discuss** the benefits of deriving electrical energy from solar in contrast to conventional energy generation. | 4 | Phy3.2.4.7 |

## Sub-strand 3.3: Research Project (IA)

**Key Learning Outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by carrying out a research project that is guided by a research proposal/plan related to Socio-Scientific Physics, Climate Change & Sustainability.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skills Score | SLO Code |
|---|---|---|---|
| 1 | **identify** a suitable title for the research paper. | 1 | Phy3.3.1.1 |
| 2 | **state** the necessary introductory information (aim, purpose, hypothesis, questions etc.) | 1 | Phy3.3.1.2 |
| 3 | **formulate** a research proposal/plan to carry out an inquiry or investigation into an aspect of socio-scientific Physics, climate change and sustainability issue in the Pacific | 4 | Phy3.3.4.1 |
| 4 | **analyse** quantitative/qualitative data gathered from available literature/findings | 4 | Phy3.3.4.2 |
| 5 | **evaluate** the findings from the research and propose appropriate adaptation and mitigation methods | 4 | Phy3.3.4.3 |
| 6 | **summarise** the findings of the research. | 3 | Phy3.3.3.1 |
| 7 | **write** a bibliography using an appropriate referencing style | 2 | Phy3.3.2.1 |

| | | | |
|---|---|---|---|
| 8 | **maintain** a logbook. | 3 | Phy3.3.3.2 |
| 9 | **interpret** data to show trends. | 3 | Phy3.3.3.3 |
| 10 | **draw** conclusions in relation to aim and/or hypothesis and relevant literature | 3 | Phy3.3.3.4 |

## Strand 4: Electricity and Electromagnetism

**Major Learning Outcome**: By the end of this strand, students are able to demonstrate knowledge application and critical evaluation, by explaining and solving problems related to physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.

### Sub-strand 4.1: DC Circuits and Capacitance

**Key Learning outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of the Physical phenomena, concepts and principles relating to DC circuits and capacitance.

| SLO No | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **state** Kirchhoff's current Law / Junction Rule/ voltage law/ Loop rule. | 1 | Phy4.1.1.1 |
| 2 | **write** Kirchhoff's current rule/ voltage rule in a given circuit. | 1 | Phy4.1.1.2 |
| 3 | **calculate** current/voltage/resistance using Ohm's and or Kirchhoff's Law. | 2 | Phy4.1.2.1 |
| 4 | **identify** internal resistance or capacitance within a given context. | 1 | Phy4.1.1.3 |
| 5 | **calculate** internal and effective resistance in a circuit. | 2 | Phy4.1.2.2 |
| 7 | **describe** the function of a capacitor in a circuit. | 2 | Phy4.1.2.3 |
| 8 | **explain** parallel plate capacitors and their capacitances. | 3 | Phy4.1.3.1 |
| 9 | **describe** a role of a dielectric in a capacitor. | 2 | Phy4.1.2.4 |
| 10 | **discuss** the process of increasing the capacitance of a dielectric capacitor. | 3 | Phy4.1.3.2 |
| 11 | **determine** capacitance given charge and voltage. | 2 | Phy4.1.2.5 |
| 12 | **calculate** parameters using the formula $C = \frac{k\varepsilon_o A}{d}$ | 3 | Phy4.1.3.3 |
| 13 | **write** expressions for total capacitance in series and in parallel arrangements. | 2 | Phy4.1.2.6 |
| 14 | **identify** series and parallel parts in the combination of connection of capacitors. | 2 | Phy4.1.2.7 |
| 15 | **calculate** the effective capacitance in series /parallel given individual capacitances. | 2 | Phy4.1.2.8 |
| 16 | **list** some uses of capacitors. | 2 | Phy4.1.2.9 |
| 17 | **calculate** the energy stored in a capacitor. | 2 | Phy4.1.2.10 |



SP

| | | | |
|---|---|---|---|
| 18 | **describe** the importance of the time constant, τ. | 2 | Phy4.1.2.11 |
| 19 | **calculate** the time constant for a given resistance and capacitance. | 2 | Phy4.1.2.12 |
| 20 | **explain** why batteries in a flashlight gradually lose power and the light dims over time. | 3 | Phy4.1.3.4 |
| 21 | **draw** voltage-time/current-time graph for given data for a capacitor. | 3 | Phy4.1.3.5 |
| 22 | **describe** what happens to a graph of the voltage/current across a capacitor over time as it charges/discharges. | 2 | Phy4.1.2.13 |
| 23 | **interpret** voltage/time and current/time graphs for a capacitor. | 3 | Phy4.1.3.6 |
| 24 | **identify** the time constant using Current / Voltage graphs. | 1 | Phy4.1.1.4 |
| 25 | **discuss** how a timing circuit works and suggest improvements to existing applications. | 4 | Phy4.1.4.1 |
| 26 | **state** the function of a stroboscope. | 1 | Phy4.1.1.5 |
| 27 | **calculate** the necessary speed of a strobe flash needed to freeze the movement of an object over a particular length. | 3 | Phy4.1.3.7 |

The formulas related to the above content are listed under *DC Circuits and Capacitance* in the Formula page **in Appendix 1**.

## Sub-strand 4.2: Electromagnetic Induction (IA & EA)

**Key Learning outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of the Physical phenomena, concepts and principles relating to electromagnetic induction.

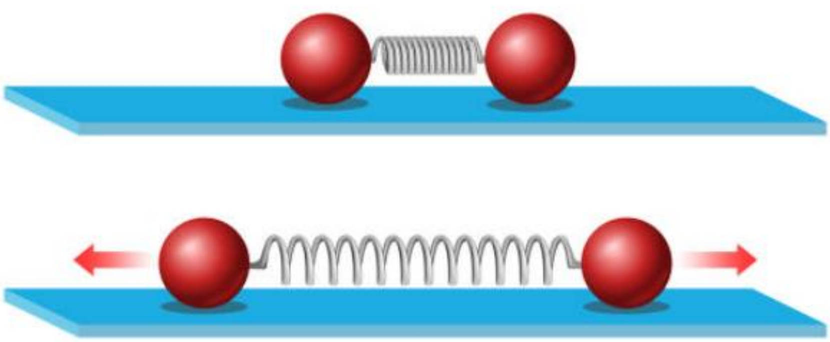
| SLO No | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **identify** magnetism / magnetic field / magnetic flux in a given context | 1 | Phy4.2.1.1 |
| 2 | **draw** characteristic magnetic field lines for simple magnets (bar magnets, horse shoe magnets) or current carrying wires / solenoids or filed lines of the earth | 1 | Phy4.2.1.2 |
| 3 | **distinguish** between geographic north and magnetic north | 2 | Phy4.2.2.1 |
| 4 | **calculate** the flux of a uniform magnetic field through a loop of arbitrary orientation. | 2 | Phy4.2.2.2 |
| 5 | **describe** the relationship between the rate of change of flux and the voltage induced across a conductor | 2 | Phy4.2.2.3 |
| 6 | **describe** methods to produce an electromotive force (emf) with a magnetic field or magnet and a loop of wire. | 2 | Phy4.2.2.4 |
| 7 | **calculate** emf, current, and magnetic fields using Faraday's Law. | 3 | Phy4.2.3.1 |
| 8 | **explain** the physical results of Lenz's Law | 3 | Phy4.2.3.2 |



SP

| | | | |
|---|---|---|---|
| 9 | **calculate** the induced voltage in a coil with a constant angular velocity in a uniform magnetic field | 2 | Phy4.2.2.5 |
| 10 | **calculate** emf, and force due to the motion of an object in a magnetic field. | 2 | Phy4.2.2.6 |
| 11 | **calculate** magnetic field, and torque due to the motion of an object in a magnetic field. | 3 | Phy4.2.3.3 |
| 12 | **identify** a transformer within a given context. | 1 | Phy4.2.1.3 |
| 13 | **explain** the working principle of a transformer. | 3 | Phy4.2.3.4 |
| 14 | **calculate** voltage, current, and/or number of turns given the other quantities in a transformer. | 2 | Phy4.2.2.7 |
| 15 | **list** the factors that affect the size and direction of the induced voltage of an inductor | 2 | Phy4.2.2.8 |
| 16 | **calculate** the inductance of an inductor. | 2 | Phy4.2.2.9 |
| 17 | **calculate** the energy stored/emf generated in an inductor. | 2 | Phy4.2.2.10 |
| 18 | **discuss** the factors that affect inductance (coil material, number of turns, coil length and coil area) in relation to real life examples. | 4 | Phy4.2.4.1 |
| 19 | **discuss** the impact of modern safety features on the set up and use of electric circuits. | 4 | Phy4.2.4.2 |
| 20 | **develop** a model using the principles of electromagnetic induction with correct technicalities. | 4 | Phy4.2.4.3 |
| 21 | **select** appropriate materials for model development. | 2 | Phy4.2.2.11 |
| 22 | **outline** the procedure for model development. | 2 | Phy4.2.2.12 |
| 23 | **work** collaboratively and productively to develop model. | 3 | Phy4.2.3.5 |
| 24 | **present** accurate information confidently. | 3 | Phy4.2.3.6 |
| 25 | **combine** presentation with ICT skills. | 3 | Phy4.2.3.7 |
| 26 | **relate** the principles of electromagnetic induction to the working of the model. | 3 | Phy4.2.3.8 |

The formulas related to the above content are listed under *Electromagnetic Induction* in the Formula page in **Appendix 1.**





SP

## Sub-strand 4.3: AC Circuits (EA)

**Key Learning outcome**: By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of the Physical phenomena, concepts and principles relating to AC circuits.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Level | SLO Code |
|---|---|---|---|
| 1 | **identify** the RMS voltage / current within a given context. | 1 | Phy4.3.1.1 |
| 2 | **state** the effect of capacitance/inductance on current in an AC circuit. | 1 | Phy4.3.1.2 |
| 3 | **sketch** voltage and current versus time in simple resistive /capacitive/inductive circuits. | 2 | Phy4.3.2.1 |
| 4 | **calculate** inductive and capacitive reactance. | 2 | Phy4.3.2.2 |
| 5 | **calculate** current and/or voltage in simple inductive, capacitive, and resistive circuits. | 2 | Phy4.3.2.3 |
| 6 | **calculate** the impedance in a RLC series circuit. | 4 | Phy4.3.4.1 |
| 7 | **calculate** the voltage / current/ resonant frequency/power in a RLC series circuit. | 2 | Phy4.3.2.4 |
| 8 | **draw** the circuit diagram for an RLC series circuit. | 2 | Phy4.3.2.5 |
| 9 | **explain** the significance of the resonant frequency. | 3 | Phy4.3.3.1 |
| 10 | **determine** maximum voltage output / angular frequency of a circuit. | 2 | Phy4.3.2.6 |
| 11 | **calculate** the reactance of a capacitor. | 2 | Phy4.3.2.7 |
| 12 | **determine** current of resonance. | 2 | Phy4.3.2.8 |
| 13 | **describe** the max value of current when the circuit is at resonance. | 2 | Phy4.3.2.9 |
| 14 | **calculate** rms voltage / current produced in a given situation. | 2 | Phy4.3.2.10 |
| 15 | **calculate** the peak (maximum) voltage / current. | 2 | Phy4.3.2.11 |
| 16 | **illustrate** peak and RMS voltages graphically. | 3 | Phy4.3.3.2 |
| 17 | **apply** formulae, graphical, vectorial and phasor methods to find unknowns. | 3 | Phy4.3.3.3 |
| 18 | **explain** the filtering out of low or high frequencies using capacitors/ inductors. | 3 | Phy4.3.3.4 |
| 19 | **discuss** with reason what could be added to the AC circuit to make the current and voltage of the supply run in phase. | 4 | Phy4.3.4.2 |
| 20 | **design** a system to act as low/ high frequency filter in a specific application involving AC circuits. | 4 | Phy4.3.4.3 |
| 21 | **calculate** the phase angle / power factor in a RLC series circuit. | 3 | Phy4.3.3.5 |

The formulas related to the above content are listed under *AC Circuits* in the Formula page in **Appendix 1.**

# Strand 5: Atomic and Nuclear Physics

**Major Learning Outcome**: By the end of this strand, students are able to demonstrate knowledge application and critical evaluation of the Physical phenomena, concepts, principles and relationships involved in Atomic and Nuclear Physics.

## Sub-strand 5.1: Atomic Physics (EA)

**Key Learning Outcome:** By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation by describing, explaining and solving problems related to the Physical phenomena, concepts, principles and relationships involved in atomic and nuclear Physics.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Score | SLO Code |
|---|---|---|---|
| 1 | **describe** the basic structure of the atom, the sub-structure of all matter. | 2 | Phy5.1.2.1 |
| 2 | **explain** Bohr's theory of the hydrogen atom. | 3 | Phy5.1.3.1 |
| 3 | **explain** Bohr's planetary model of the atom. | 3 | Phy5.1.3.2 |
| 4 | **discuss** the postulates and limitations of Bohr's theory. | 4 | Phy5.1.4.1 |
| 5 | **explain** the ionization of radiation in an atom. | 3 | Phy5.1.3.3 |
| 6 | **identify** Photoelectric Effect / photons / photoelectrons in a given context. | 1 | Phy5.1.1.1 |
| 7 | **describe** a typical photoelectric effect experiment. | 2 | Phy5.1.2.2 |
| 8 | **illustrate** the photoelectric effect using diagram. | 2 | Phy5.1.2.3 |
| 9 | **calculate** the work function of a material given the threshold frequency or vice versa. | 2 | Phy5.1.2.4 |
| 10 | **determine** the maximum kinetic energy of photoelectrons ejected by photons of a particular energy or wavelength. | 3 | Phy5.1.3.4 |
| 11 | **explain** Max Planck's contribution to the development of quantum mechanics. | 3 | Phy5.1.3.5 |
| 12 | **explain** why atomic spectra indicate quantization. | 3 | Phy5.1.3.6 |
| 13 | **explain** the term particle-wave duality means, and why it is applied to EM radiation. | 3 | Phy5.1.3.7 |
| 14 | **relate** the linear momentum of a photon to its energy or wavelength, and apply linear momentum conservation to simple processes involving the emission, absorption, or reflection of photons. | 3 | Phy5.1.3.8 |
| 15 | **explain** the relationship between the energy of a photon in joules or electron volts and its wavelength or frequency. | 3 | Phy5.1.3.9 |
| 16 | **calculate** the amount of energy given photon frequency or vice versa. | 2 | Phy5.1.2.5 |
| 17 | **calculate** the number of photons per second emitted by a monochromatic source of specific wavelength and power. | 2 | Phy5.1.2.6 |

| | | | |
|---|---|---|---|
| 18 | **identify** the ionisation energy of hydrogen atom is 13.6 eV. | 1 | Phy5.1.1.2 |
| 19 | **summarise** energy states using the energy-level diagram to show Lyman, Balmer and Paschen and Bracket spectral lines. | 3 | Phy5.1.3.10 |
| 20 | **draw** and interpret energy level diagrams. | 4 | Phy5.1.4.2 |
| 21 | **use** Rydberg's formula to calculate the wavelength of emitted photons. | 3 | Phy5.1.3.11 |
| 22 | **calculate** wavelengths for given frequencies in a spectrum. | 2 | Phy5.1.2.7 |
| 23 | **identify** the spectral region of emitted photons from a hydrogen atom. | 1 | Phy5.1.1.3 |

### Sub-strand 5.2: Nuclear Physics (EA)

**Key Learning Outcome:** By the end of this sub-strand, students are able to demonstrate knowledge application and critical evaluation of nuclear physics by describing, explaining and solving problems related to the physical phenomena, concepts, principles and relationships in nuclear physics.

| SLO No. | Specific Learning Outcomes<br>Students are able to: | Skill Score | SLO Code |
|---|---|---|---|
| 1 | **identify** a type or characteristic of alpha/beta/gamma radiations. | 1 | Phy5.2.1.1 |
| 2 | **explain** the process and results of nuclear radiation. | 3 | Phy5.2.3.1 |
| 3 | **explain** the relationships between the types of radiation—alpha emission/beta emission/gamma emission. | 3 | Phy5.2.3.2 |
| 4 | **calculate** mass deficit of a nucleus. | 2 | Phy5.2.2.1 |
| 5 | **identify** nuclear fission / fusion / half-life / radioactive dating in a given context. | 1 | Phy5.2.1.2 |
| 6 | **calculate** age of old objects by radioactive dating. | 2 | Phy5.2.2.2 |
| 7 | **balance** equations for nuclear reactions. | 2 | Phy5.2.2.3 |
| 8 | **calculate** energy released in the formation of specific isotopes. | 2 | Phy5.2.2.4 |
| 9 | **discuss** how fission fuel reacts and describe what it produces. | 4 | Phy5.2.4.1 |
| 10 | **distinguish** between controlled and uncontrolled chain reactions. | 3 | Phy5.2.3.3 |
| 11 | **relate** the release of energy due to nuclear fusion using the Einstein Equation. | 3 | Phy5.2.3.4 |
| 12 | **discuss** the processes of fusion energy generation and the risks it poses on human health. | 4 | Phy5.2.4.2 |
| 13 | **compare** and contrast any two types of radiations in terms of charge, penetrating power, ionizing ability and deflection | 4 | Phy5.2.4.3 |

| | | | |
|---|---|---|---|
| | by magnetic field | | |
| 14 | **discuss** the significance of half-life and its relation to the random nature of radioactive decay | 4 | Phy5.2.4.4 |
| 15 | **discuss** the use of half-life in Physics and medical sciences. | 4 | Phy5.2.4.5 |

The formulas related to the above content are listed under *Atomic and Nuclear Physics* in the Formula page in **Appendix 1**.

# 7. ASSESSMENT

Students will be assessed by:

- a three-hour written external examination 70%
- two internally assessed tasks 30%

Assessment may involve the use of skills and knowledge from Year 11 and 12 Physics that are relevant to the development of the South Pacific Form Seven Certificate Physics.

## 7.1 Internal Assessment

**Task 1: Research (15%)**

- Students will be assessed on learning outcomes from **Strand 3 (Socio-Scientific Physics, Climate Change & Sustainability) and from sub-strand 1.4: Practical Investigation.**
- **This task targets research skills and will be carried out in small groups/individuals.**
- The task will be assessed on the criteria specified in the Scoring Rubric for Task 1, which can be found in **page 32 onwards.**
- The details related to the task are provided below.

1. **Teacher Guidelines:**
   This task is designed to provide an insight to students on the current issues and international conventions (SDGs 7 & 13) related to Physics concepts. This task is new in this version of the SPFSC Physics syllabus, so it is important that you familiarise yourself well with the task expectations, the related SLOs and the scoring rubric. The task generally targets research skills and will be carried out in either small groups or individually. Teachers are advised to provide students with the guidance that they need but must avoid carrying out the task for the students. Students are to be guided in the choice of the research topic suitable to be described using Physics context. If students are to work in groups of twos or threes, ensure that there is a gender mix, and the teacher is to keep a record of this grouping.

   Teachers are to ensure that students are distributed across the different research topics. In other words, it must not be the case that majority of groups work on one research topic. Teachers are to ensure that students are guided with the necessary resources and skills required to carry out this research.

Each student (or group) is to submit a research proposal. Teachers are expected to guide students on how to write a simple research proposal. A lot of information are available on the internet. E.g. https://www.scribbr.com/research-process/research-proposal/

**2. Duration**

The research may take a period of 2-3 weeks of in class and out of class time. Students will need about a week to decide on the topic and proposal and confirm this with the teacher. The second week is for collection of information and data, collation and analysis.

**3. Student Guidelines for the task:**

Ensure that this research is related to physics concepts and that you are able to give evidence of the breadth of Physics understanding required. Find sources of information that will give reliable information. When the sources of information have been identified, write a list of them in such a way that your assessor will be able to find the information you have used.

- If a website is used as a source, the exact URL should be given.
- If a book is used as a source, the author, title, publisher and page reference(s) should be given.
- If a magazine or newspaper article is used as a source, the author, title of article, name of magazine or newspaper, publication date and page reference(s) should be given.
- If a picture is used in the report, its source must be referenced unless the picture is originally captured.
- Keep a log book where every needed or relevant information is recorded.
- Summarise the findings of each literature surveyed in the log book.
- If working in groups ensure that all members take active role in contributing towards the research project.

**4. Record of Literature survey**

| Type of resource (Book/ Journal/ Website etc) | Author(s) and editor (s) name (Surname, First name) | Title of publication/ website | Title of unit used (Chapter/ article/ webpage) | Publisher name and place of publication | Date of Publication/ copyright (use latest) | Page range | Volume and Issue Number | Date of access | URL |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

## 5. Summary of Literature survey findings

The table provided below could be used to collate the literature survey conducted. It is suggested that this table be drawn (or pasted) in your log book.

| | | |
|---|---|---|
| Research question<br>Put the chosen question here. If the research question needs to be broken into smaller questions, use a new page for each | | |
| Source: | | |
| Relevant Information | Key words | Reworded information |
| Record information from sources here. Only include what you need. | | List the key words here. A key word is a word or phrase that is important in answering the question and helps summarise what has been written. |
| Source: | | |
| Relevant Information | Key words | Reworded information |
| Write reference details here | | Use the key words to help write new sentences in your own words here. |
| Source | | |
| Relevant Information | Key words | Reworded information |
| | | |
| Summary<br>Summarise the reworded information here. The summary should answer the research question. | | |

## 6. List of six suggested themes or topics for research project:

a. Physics in Climate change.
b. Physics in medicine.
c. Physics in Renewable energy- affordable and clean energy (contextualize to your country).
d. Physics in Cellphones and potential cancer risks.
e. Physics in Sea Transportation
f. Physics in Air Transportation

**7. The Scoring Rubric**

The scoring rubric that will be used to score the research report is provided in the next section. Teachers are to make the scoring rubric available to students so that they are aware of the expectations on the research report, and how the report will be scored.

## Task 2: Model development: Application of theoretical knowledge (15%)

- Students will be assessed on learning outcomes from **Sub-strand 4.2. Electromagnetic Induction in Strand 4 (Electricity and Magnetism).**
- **This task targets research skills, practical skills, presentation skills, innovation and creativity and will be carried out in small groups under laboratory conditions.**
- The task will be assessed on the criteria specified in the Scoring Rubric for Task 2, which can be found in **page 34 onwards.**
- The details related to the task are provided below.

**Model Development Guidelines:**

**1. Teacher Guidelines:**

It is important that you familiarise yourself well with the task expectations, the related SLOs and the scoring rubric. The task targets research skills, practical skills, presentation skills, innovation and creativity and will be carried out in small groups under laboratory conditions. Teachers are advised to provide students with the guidance that they need but must avoid carrying out the task for the students. Students are to be guided in the choice of the model that they intend to develop, the sourcing of necessary materials and equipment, the use of laboratory equipment, the creation of videos, and putting together electronic equipment for presentations. Students are to work in groups of twos or threes, with a gender mix, and the teacher is to keep a record of this grouping.

Teachers are to ensure that groups are distributed across the different model topics. In other words, it must not be the case that majority of groups work on one model topic. Teachers are to also ensure that there is no borrowing of resources, but that each group is to go out of its way to secure the materials and equipment that it needs to create its model. This is important as innovation and creativity is critical to this task.

Teachers are to allocate the space for groups to create their models in. The Physics laboratory is the preferred space; however, some space in the classroom may also be appropriate.

**2. Duration/Conditions:**

The preparation for this model may take place over a period of 2 - 3 weeks of in class and out of class time. Students will need about a week to decide on a model and confirm this with the teacher and then source the equipment and materials that they will need. One week for the development of the model, which is to be accompanied by video shooting (using a smart phone) of the model development, then the third week for the presentation to the class. Other teachers in the school may be invited to view the presentations.

## 3. Student Guidelines for the task:

This task will require you to create a model based on a concept (and procedures) taken from the principles of electromagnetism (sub strand 4.2). The list of possible areas of model development are given in 4. below. You are to organise yourself into groups of threes or twos with a mix of gender and let your teacher know of your group members.

A topic for model development needs to be selected from the list below. Research widely on how to create the model and the materials and equipment that are necessary for creating the model. Gather your research findings and outline the materials and procedure that your group will use. Allocate roles to your group members including who is to get what equipment and/or materials. It is important that all group members contribute equally in the model development; not just one member getting materials and doing most of the work while the others just hang around and watch.

Create your model in the laboratory or in a space allocated by your teacher. As the development of the model begins, take pictures and short clip videos (on a smart phone) of the different steps and the final successful product. These pictures and videos will form part of your presentation. Prepare your presentation notes and allocate the different portions of the presentation to each group member. Again, it is important that every group member play an active role during the presentation. The presentation will involve the use of presentation slides and a presentation projector so that all students and your teacher can see the development of your model. Learn together how to create presentation slides and create links to videos and pictures, how to transfer pictures and videos from the smart phone to a computer, how to link the computer to a projector, and how to project PowerPoint slides during the presentation. It is expected that Form 7 students should be competent in these 21st century ICT skills.

## 4. List of topics for model development:

a. Construct a motor using reusable materials like magnets from old radios.
b. Making a tattoo machine from a motor.
c. Making a coconut scraper from a motor.
d. Generating an induced voltage with permanent magnets.
e. Generating an induced voltage with electromagnets.
f. Simple self-induction (when switching a circuit on and off)

The list above is not exhaustive. Teachers and students are encouraged to search the internet for ideas related to the above and other topics that may be found to be relevant. The topic has to be related to sub strand 4.2: Electromagnetism. Some extra information is provided in 7 below.

## 5. The Presentation

During the presentation, students are to showcase the following:
a. How they arrived at the decision on the model to develop.
b. How they obtained their materials and equipment.
c. The procedure that they followed during model development.
d. The product i.e. the working model
e. Relate the working model to the various principles of electromagnetism. This is important

- the working model may be good to show, but students' demonstration of understanding of the principles of electromagnetism that underline the model is equally important.

## 6. The Scoring Rubric

The scoring rubric that will be used to score the model and the presentation is provided in the next section. Teachers are to make the scoring rubric available to students so that they are aware of how their work will be scored.

## 7. Extra information on models

You may refer to the following sites as starting points. Both teachers and students are encouraged to explore the internet widely for relevant information.

a. https://www.phywe.com/en/physics/age-16-19/electricity/electromagnetic-induction/
b. https://www.youtube.com/watch?v=gpP7c-VN0x8
c. https://www.youtube.com/watch?v=UyqLpbg_HvY
d. https://www.youtube.com/watch?v=d9Y9v6txZ9k



SP

**TASK 1 – Research Project Assessment Criteria (15%)**

| SLO # | SLO Code | Skill Level | Learning outcome assessed (in brief) | Skill Level 1 | Skill Level 2 | Skill Level 3 | Skill Level 4 |
|---|---|---|---|---|---|---|---|
| 1. | Phy3.3.1.2 | 1 | State background information/ introduction | Background information/introduction given | | | |
| 2. | Phy3.3.1.1 | 1 | Identify a suitable title for the research paper. | Title is related to the themes of Strand 5. | | | |
| 3. | Phy3.3.4.1 | 4 | Formulate a research proposal/plan to carry out an inquiry or investigation into an aspect of socio-scientific physics, climate change and sustainability issue in the Pacific | States the aim/ purpose correctly.<br>OR<br>Writes an introduction<br>OR<br>States the current status contextualized to the country of origin. | States any two correctly Aim/purpose, introduction, current status | States any two correctly Aim/purpose, introduction, current status and partially correct method. | Correctly states the Aim/purpose, introduction, current status and correct method. |
| 4. | Phy3.3.4.2 | 4 | Analyse quantitative/qualitative data gathered from available literature/findings | Information is given but analysis/ comparison is not relevant. | Information is collated but comparison is partially correct. | Information is collated with comparison done that is very relevant and accurate. | Information is collated and correctly analysed with correct interpretation and significance of trends clearly expressed. |

SP

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. | Phy3.3.4.3 | 4 | Evaluate the findings from the research | States only one finding with evidence to support. | States two findings with sufficient evidence to support. | Relate the findings to the purpose and theory. | Uses evidence from the findings to support point of view about quality of findings |
| 6. | Phy3.3.3.1 | 3 | Summarise the findings of the research and propose appropriate adaptation and mitigation methods | One finding stated with appropriate recommendation. | Two findings stated with appropriate recommendations. | Three or more findings stated with appropriate recommendations. | |
| 7. | Phy3.3.2.1 | 2 | Write a bibliography using an appropriate referencing style | Bibliography is partially correct OR has less than 5 sources referenced. | Bibliography is correct and has more than 5 sources referenced. | | |
| 8. | Phy3.3.3.2 | 3 | Maintain a logbook | Log book is simple only | Log book has a number of items | Items in logbook are comprehensive and linked | |
| 9. | Phy3.3.3.3 | 3 | Interpret data to show trends | Data is stated | A number of data pieces are stated in an attempt to link them but trend is not clear or incorrect. | Data trends are correct and complete | |
| 10. | Phy3.3.3.4 | 3 | Draw conclusion in relation to aim/ hypothesis | One appropriate statement is made | Two appropriate statements are made but are not linked | Concluding statement shows relational thinking | |

Note that it is expected that students who successfully complete this sub-strand are able to demonstrate all of the above learning outcomes; however only selected learning outcomes will be assessed in Task 2 to contribute to its Internal Assessment weight of 15%. The breakdown will consist of 1 x Level 1, 2 x Level 3 and 2 x Level 4 learning outcomes.

SP

**TASK 2 – Application of theoretical knowledge (15%)**

| SLO Code | Skill Level | Learning outcome assessed (in brief) | Skill Level 1 | Skill Level 2 | Skill Level 3 | Skill Level 4 |
|---|---|---|---|---|---|---|
| Phy4.2.2.8 | 2 | List factors that affect the size and direction of induced voltage of an inductor. | States one factor only | Lists two or more factors | | |
| Phy4.2.4.1 | 4 | Discuss the factors that affect inductance | Only states one factor | States two or more factors, without linking these to how they affect inductance | States two or more factors, and link them to how they affect inductance | States two or more factors, link them to how they affect inductance and uses appropriate examples |
| Phy4.2.4.2 | 4 | Discuss the impact of modern safety features on the set up and use of electric circuits. | Only states one safety feature | States two or more safety features, without linking these to impacts on use of ECs | States two or more factors, and link them to how they impact use of ECs. | States two or more factors, link them to how they impact the use of ECs and uses appropriate examples |
| Phy4.2.2.11 | 2 | Selects appropriate materials for model development | Some materials are appropriate | All materials are appropriate | | |
| Phy4.2.3.5 | 3 | Work collaboratively and productively to develop model | Tends to work alone | Works collaboratively but on a selective basis | Is a good team worker | |

SP

| | | | | | | |
|---|---|---|---|---|---|---|
| Phy4.2.4.3 | 4 | Develop a model with correct technicalities | Model is not fully developed | Model is fully developed but has some technical issues | Model is fully developed and fully functioning but lack good appearance | Model is fully developed, fully functioning and has good appearance (aesthetic appeal) |
| Phy4.2.3.6 | 3 | Present accurate information confidently | Reads from text when presenting | Some pieces of information offered during presentation are not accurate | Presented information are accurate and confident with presentation skills | |
| Phy4.2.3.7 | 3 | Combines presentation with ICT skills | Present using paper and talk only | Uses presentation slides but not linked to pictures and/or videos; or needs assistance with using technology | Uses presentation slides confidently and articulates ideas well; slides linked to pictures and/or videos | |
| Phy4.2.3.8 | 3 | Relates the principles of electromagnetism to the workings of the model | Only states one principle | States two or more principles without linking directly to where they apply in the model | Clear linking of ideas when presenting | |

Note that it is expected that students who successfully complete this sub-strand are able to demonstrate all of the above learning outcomes; however only selected learning outcomes will be assessed in Task 2 to contribute to its Internal Assessment weight of 15%. The breakdown will consist of 2xLevel 2, 1xLevel 3 and 2xLevel 4 learning outcomes.


SP

## 7.2 Internal Assessment Blueprint

The IA blueprint for Physics is given below. The weighting for each strand and skill level is to be noted as these will be adhered to for assessment.

| | STRAND | Assessment Type | SKILL LEVEL/ SCORE | | | | Weight |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | |
| 1 | MECHANICS | EA | | | | | 30 |
| 2 | WAVES | EA | | | | | 15 |
| 3 | SOCIO-SCIENTIFIC PHYSICS, CLIMATE CHANGE & SUSTAINABILITY | IA | 1 | 0 | 2 | 2 | 15 |
| 4 | ELECTRICITY & MAGNETISM | EA | | | | | 11 |
| | | IA | 0 | 2 | 1 | 2 | 15 |
| 5 | ATOMIC & NUCLEAR PHYSICS | EA | | | | | 14 |
| | **Total number of items** | | **10** | **10** | **10** | **10** | **40** |
| | **Total score** | | **10** | **20** | **30** | **40** | **100** |




SP

## 7.3 External Assessment

The written examination will be **a three-hour written paper** and will test a range of knowledge, understanding and skills consistent with the aims, objectives and outcomes of this syllabus.

Real life situations will be used wherever possible. Requisite information about the context used will be supplied.

Students will be required to answer questions on each of the four sections specified for the external examination. Questions may require mathematical, graphical or diagrammatic answers or descriptive responses. Any mathematical analysis will be limited to the use of the formulae listed in the relevant section. All formulae listed will be supplied in the examination paper.

The approximate weighting for each section of the written paper will be as follows:

| Strand Number | Strand Title | Weighting |
|---|---|---|
| 1 | Mechanics | 30% |
| 2 | Waves | 15% |
| 4 | Electricity and Electromagnetism | 11% |
| 5 | Atomic and Nuclear Physics | 14% |
| **Total** | | **70%** |

## 7.4 Guidelines for Physics Laboratory Work

The Physics Laboratory Work carried out by students in schools meet the outcomes stated in this syllabus and consolidate their understanding of the concepts.

- The physics laboratory work must be carried out independently or in groups.
- Students (and teachers) can refer to the SPFSC Physics Laboratory Manual for instructions.
- Students must have a Physics Lab Book where they do their practical write-up which is submitted to their teacher at the end of every session for marking.
- Each practical must
  - ✓ have a clear purpose/aim
  - ✓ be based on a clear methodology or procedure
  - ✓ be suitably equipped so that results are valid and reliable
  - ✓ produce quantitative data (including appropriate number of significant figures and uncertainties)
  - ✓ include appropriate data processing, data analysis and discussion and evaluation of the results
  - ✓ have a conclusion
- Teachers are to refer to the Laboratory Scoring Rubric given to guide them assess/mark students laboratory work.
  - The list of possible practical activities that students can carry out is outlined in the SPFSC Laboratory Manual.

**Laboratory Report Scoring Rubrics**

| SLO # | SLO Code | Skill Level | Learning outcome assessed (in brief) | Skill Level 1 | Skill Level 2 | Skill Level 3 | Skill Level 4 |
|---|---|---|---|---|---|---|---|
| 1 | Phy1.4.1.1 | 1 | State aim/purpose, question/hypothesis, rationale, background information/introduction dependent and independent variables | Aim/purpose aim, question/hypothesis, rationale, background information/introduction dependent and independent variables is given/stated | | | |
| 2 | Phy1.4.2.1 | 2 | List the equipment/materials required for the investigation | Equipment list is not complete | All equipment are stated | | |
| 3 | Phy1.4.2.2 | 2 | Describe methodology | Methodology is outlined but not complete | Methodology is outlined and complete | | |
| 4 | Phy1.4.2.3 | 2 | Collect and process data into tables using correct units and uncertainties | Tables and/or graphs provided but not Complete with incorrect units and uncertainties | Tables and/or graphs provided and complete with correct units and uncertainties | | |
| 5 | Phy1.4.3.1 | 3 | Draw and label graphs | Graph is drawn but not mostly incomplete or has errors | Graph is drawn with most details correct | Graph is fully correct, with appropriate labels and scale | |
| 6 | Phy1.4.3.2 | 3 | Explain why the method used is selected | One appropriate idea on the method is given | More than one idea on method | Ideas on method linked to benefit/s | |
| 7 | Phy1.4.3.3 | 3 | Maintain a logbook | Log book is simple only | Log book has a number of items | Items in logbook are comprehensive and linked | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8 | Phy1.4.2.4 | 2 | Calculate relevant quantities from given data and graphs to highlight relationship between variables | One simple quantity calculated | More than one quantity calculated | | |
| 9 | Phy1.4.3.4 | 3 | Interpret processed data to show trends, relationships and patterns | Data is stated | A number of data pieces are stated in an attempt to link them but trend is not clear or incorrect. | Data trends are correct and complete | |
| 10 | Phy1.4.3.5 | 3 | Draw conclusion that is relevant to the data and linked back to the purpose and hypothesis or aim | One appropriate statement is made | Two appropriate statements are made but are not linked | Concluding statement shows relational thinking | |
| 11 | Phy1.4.3.6 | 3 | Analyse data by re-expressing data to determine the relationship between variables, and determining the value, unit and significance of slope | Data is given but analysis is not relevant | Slope is determined but not its significance | Significance of slope in relationship is expressed | |
| 12 | Phy1.4.3.7 | 3 | Write and explain the equation derived from analysis | Some attempt to write a derived equation is noted | Derived equation is written but no explanation of terms or equation given | Derived equation is written and explained | |
| 13 | Phy1.4.3.8 | 3 | Identify sources of error and explain how to minimize these errors | Only one source of error identified | Sources of error identified | Sources of error identified and explained | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14 | Phy1.4.3.9 | 3 | Provide a theoretical explanation about the expected results from the investigation with evidence. | Provide theoretical explanation only | Provide theoretical explanation with one evidence | Provide theoretical explanation with more than one evidence | |
| 15 | Phy1.4.2.5 | 2 | List bibliography / references/ acknowledgements | One source is acknowledged | Sources are acknowledged appropriately | | |
| 16 | Phy1.4.4.1 | 4 | Evaluate findings in terms reliability and validity of results and suggest improvements. | Finding stated, no improvement suggested and no link to reliability and validity of results | Findings stated with no link to reliability and validity of results and suggested improvements | Findings stated with some link to reliability and validity of results with improvement suggested | Findings evaluated in terms of reliability and validity of results and improvements suggested |
| 17 | Phy1.4.4.2 | 4 | Evaluate findings in terms of limitations and difficulties encountered in the investigation and suggest solutions for improvement | Findings stated, no mention of limitations and difficulties encountered, no solutions for improvement | Findings stated, mention of limitations but no mention of difficulties encountered and solutions for improvement | Findings stated, mention of limitations, mention of difficulties encountered but no solutions for improvement | Findings evaluated in terms of limitations and difficulties encountered in the investigation and suggested solutions for improvement |
| 18 | Phy1.4.4.3 | 4 | Predict and explain application of everyday phenomena using equations and graphs derived from the data obtained from the investigation | Concept is stated but not described or related to any prediction or everyday phenomena | Phenomena related to concept is described; no explanation or prediction | Phenomena related to concept explained, but unable to make a prediction using equations and graphs derived from data | Everyday phenomena related to concept is predicted and explained using equations and graphs derived from data |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | Phy1.4.4.4 | 4 | Modify or affirm existing scientific conceptions through experimentation and using other evidence. | Modified/affirmed existing scientific conceptions | Modified/affirmed existing scientific conceptions using other evidence | Modified/affirmed existing scientific conceptions using experimentation | Modified or affirmed existing scientific conceptions through experimentation and using other evidence. |

# Appendix 1: Formula Sheet

**Mechanics *Translational Motion***

1. $v_f = v_i + at$
2. $d = v_i t + \frac{1}{2}at^2$
3. $v_f^2 = v_i^2 + 2ad$
4. $d = \left(\frac{v_i + v_f}{2}\right)t$
5. $F = ma$
6. $E_k = \frac{1}{2}mv^2$
7. $E_p = mgh$
8. $W = Fd$
9. $E_p = \frac{1}{2}kx^2$
10. $P = \frac{W}{t}$
11. $p = mv$
12. $F_w = mg$

***Circular and Rotaional Motion***

13. $v = \frac{2\pi r}{T}$
14. $a = \frac{v^2}{r}$

**Mechanics (continued)**

15. $F = \frac{mv^2}{r}$
16. $a = \frac{4\pi^2 r}{T^2}$
17. $v = \sqrt{rg\tan\theta}$
18. $F_g = \frac{GMm}{r^2}$
19. $v = \sqrt{\frac{GM}{r}}$
20. $v = \sqrt{\frac{2GM}{r}}$
21. $\theta = \frac{d}{r}$
22. $\omega = \frac{\Delta\theta}{\Delta t}$
23. $\alpha = \frac{\Delta\omega}{\Delta t}$
24. $a = r\alpha$
25. $\omega_f = \omega_i + \alpha t$
26. $\theta = \omega_i t + \frac{1}{2}\alpha t^2$

**Mechanics (continued)**

27. $\omega_f^2 = \omega_i^2 + 2\alpha\theta$
28. $\theta = \left(\frac{\omega_f + \omega_i}{2}\right)t$
29. $\tau = Fr$
30. $\tau = I\alpha$
31. $L = I\omega$
32. $L = mvr$
33. $E_{kr} = \frac{1}{2}I\omega^2$
34. $T = \frac{1}{f},\ f = \frac{1}{T}$
35. $\omega = 2\pi f,\ \omega = \frac{2\pi}{T}$
36. $E_k = \frac{GMm}{2r}$
37. $U = -\frac{GMm}{r}$
38. $g = \frac{GM}{r^2}$

***Simple Harmonic Motion***

1. $v_{max} = \omega A$
2. $v = \omega\sqrt{A^2 - x^2}$
3. $a_{max} = -\omega^2 A = \frac{k}{m}A$
4. $a = -\omega^2 y$
5. $y = A\sin\omega t$
6. $v = \omega A\cos\omega t$
7. $a = -\omega^2 A\sin\omega t$
8. $F = kx$
9. $T = 2\pi\sqrt{\frac{m}{k}},\ f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$
10. $T = 2\pi\sqrt{\frac{l}{g}},\ f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$
11. $E = \frac{1}{2}kA^2$
12. $E = \frac{1}{2}m\omega^2 A^2$
13. $v = f\lambda$

**Waves**

1. $f' = \left(\frac{v \pm v_0}{v \mp v_s}\right)f$
2. $d = 1/N$

**Waves (continued)**

3. $\omega = 2\pi f$
4. $k = \frac{2\pi}{\lambda}$
5. $\text{Path Difference} = n \times \lambda$
6. $d\sin\theta = n\lambda$
7. $n\lambda = \frac{dx}{L}$

**Electricity and Electromagnetism**

***DC circuits and capacitance***

1. $E = \frac{F}{q}$
2. $E = \frac{k_e Q}{d^2}$
3. $W = Vq$
4. $V = \frac{kQ}{r}$
5. $V = Ed$
6. $C = \frac{Q}{\Delta V}$

**Electricity and Electromagnetism (continued)**

7. $C = \frac{\varepsilon_r \varepsilon_0 A}{d}$
8. $C_p = C_1 + C_2 + \ldots$
9. $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$
10. $\tau = RC$
11. $U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{Q^2}{2C}$
12. $I = \frac{\Delta Q}{\Delta t}$
13. $V = IR$
14. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
15. $R_s = R_1 + R_2 + \ldots$
16. $E = \rho J$

**Electricity and Electromagnetism (continued)**

17. $P = VI = I^2R = \frac{v^2}{R}$

***Electromagnetic Induction***

1. $F = Bvq$
2. $v = \frac{E}{B}$
3. $F = BIl\sin\theta$
4. $\tau = BANI\cos\theta$
5. $F = \frac{kI_1I_2 l}{r}$
6. $B = \frac{\mu_0 I}{2\pi r} = \frac{kI}{r}$
7. $r = \frac{mv}{Bq}$

**Electricity and Electromagnetism (continued)**

***Alternating Current Circuits***

1. $V = Bvl\sin\theta$
2. $\phi_B = BA\cos\theta$
3. $\varepsilon = -L\frac{dI}{dt}$
4. $E_L = \frac{1}{2}LI^2$
5. $V = \frac{-\Delta\phi}{\Delta t}$
6. $V_{rms} = \frac{V_{max}}{\sqrt{2}}$
7. $I_{rms} = \frac{I_{max}}{\sqrt{2}} = \frac{V_{rms}}{R_T}$
8. $V = BAN\omega\sin\omega t$

**Electromagnetic Induction and Alternating Current Theory (continued)**

9. $V = \frac{-M\Delta I}{\Delta t}$
10. $V = -L\frac{\Delta I}{\Delta t}$
11. $V_C = I\chi_C$
12. $\chi_C = \frac{1}{2\pi fC} = \frac{1}{\omega C}$
13. $Z = \frac{V_s}{I}$
14. $V_L = I\chi_L$
15. $\chi_L = 2\pi fL = \omega L$
16. $Z = \sqrt{R^2 + (\chi_L - \chi_C)^2}$
17. $P_f = \cos\phi = \frac{R}{Z}$
18. $f_o = \frac{1}{2\pi\sqrt{LC}}$
19. $\tan\phi = \frac{\chi_L - \chi_c}{R}$

**Atomic and Nuclear Physics**

1. $E = hf$
2. $E_k = eV$
3. $E_k = hf - \phi$
4. $\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$
5. $c = f\lambda$
6. $E_n = \frac{-hcR}{n^2} = \frac{-13.6\,eV}{n^2}$
7. $\lambda = \frac{h}{mv}$
8. $L = \frac{nh}{2\pi}$
9. $v = \frac{nh}{2\pi mr}$

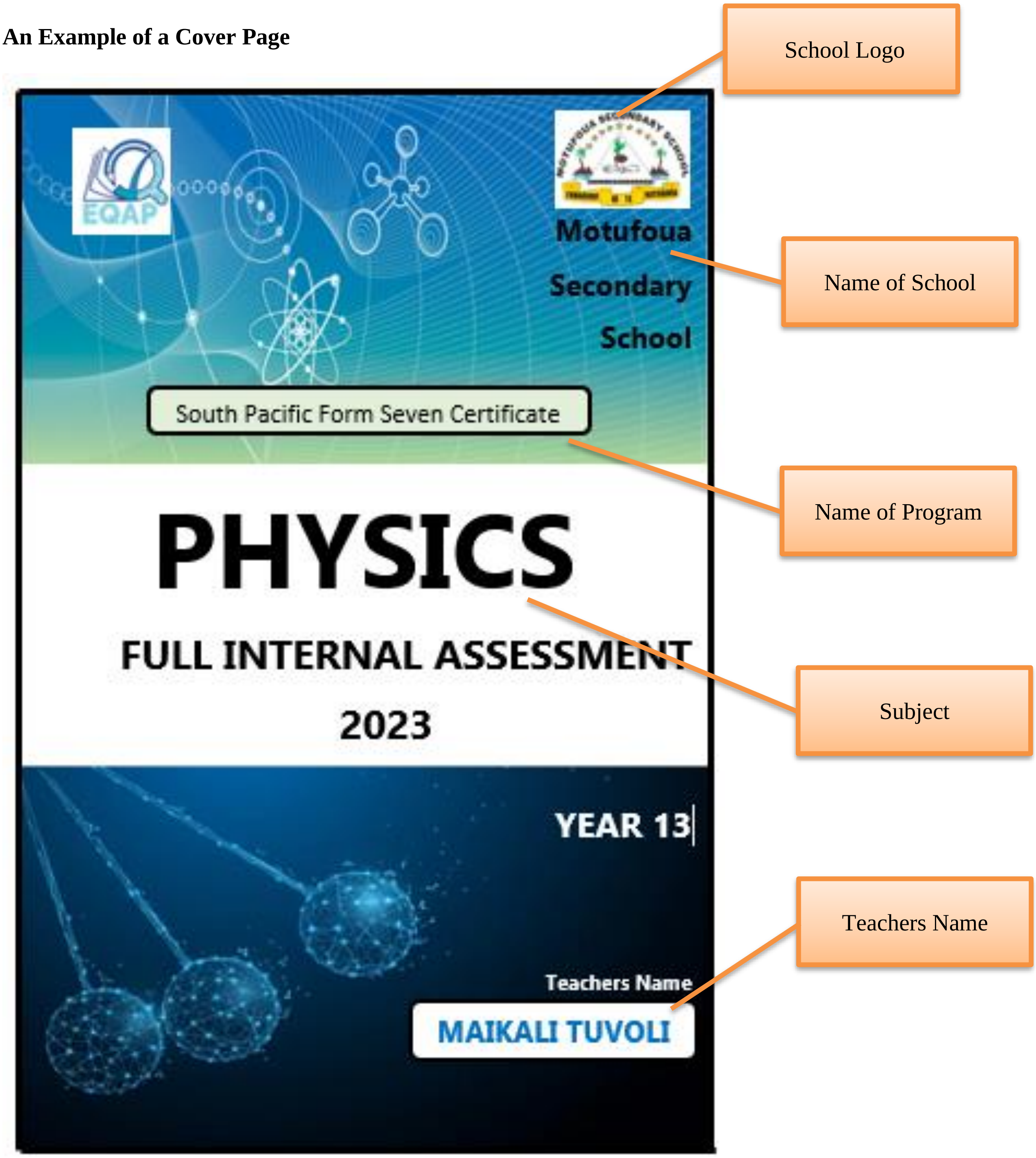
## Appendix 2: IA Programme Proposal Template

### Page 1 : Cover Page

The Cover Page will have the name of the:

- School
- Subject : FULL IA PROGRAM
- Teachers Name:

**An Example of a Cover Page**

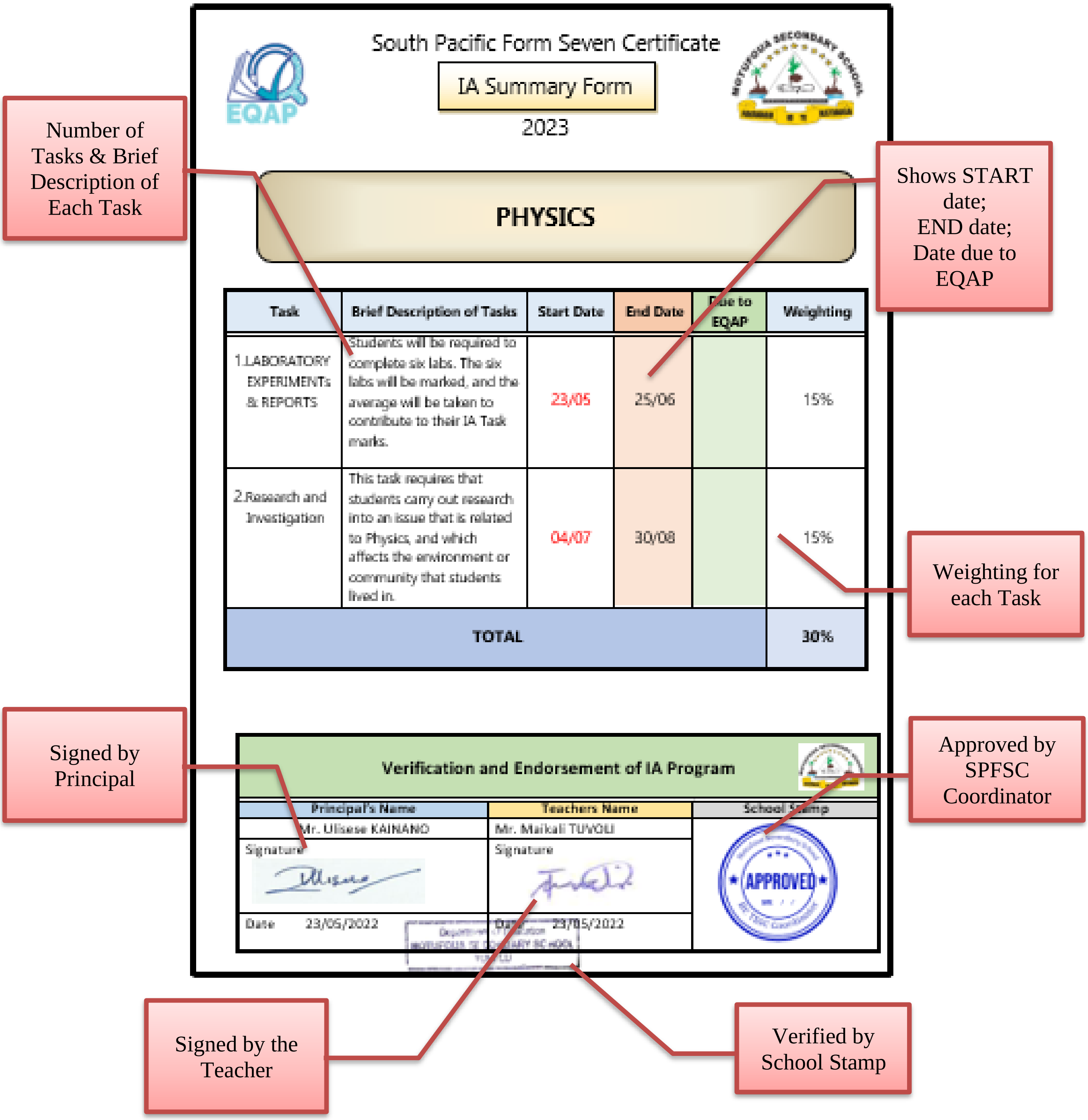


# Page 2 : IA SUMMARY FORM

The IA Summary Form must have the following:

- Number of Tasks
- Brief Description of the Tasks
- Start and End Dates
- Signature of Principal and Teacher
- School Stamp/Date

**An Example of an IA Summary Form**



South Pacific Form Seven Certificate

IA Summary Form

2023

PHYSICS

| Task | Brief Description of Tasks | Start Date | End Date | Due to EQAP | Weighting |
|---|---|---|---|---|---|
| 1.LABORATORY EXPERIMENTs & REPORTS | Students will be required to complete six labs. The six labs will be marked, and the average will be taken to contribute to their IA Task marks. | 23/05 | 25/06 | | 15% |
| 2.Research and Investigation | This task requires that students carry out research into an issue that is related to Physics, and which affects the environment or community that students lived in. | 04/07 | 30/08 | | 15% |
| TOTAL | | | | | 30% |

Verification and Endorsement of IA Program

| Principal's Name | Teachers Name | School Stamp |
|---|---|---|
| Mr. Ulisese KAINANO | Mr. Maikali TUVOLI | APPROVED |
| Signature | Signature | |
| Date 23/05/2022 | Date 23/05/2022 | |

## Pages 3-6:

**Task title: Task 1:___**
The title should be brief and include a reference to the particular syllabus topic or skill which is being assessed by the task.
Example: *"Research Topic – Investigation of a Social Issue."*

Learning Outcomes: List the Specific Learning Outcomes (SLOs) to be assessed by the task
These are found in the syllabus and need to be identified before the tasks are constructed. Example: *Describe a feature of ….*
*(Copy and paste directly from the aligned Syllabus: it must show strand, sub strand and SLOs)*
Assessment/Task:

**Describe the task as a form of assessment to measure student achievements of the above learning outcomes at different stages of the lesson/task implementation.**
*(Think of what are the best types of assessment for the above LOs so that your students can demonstrate they have achieved the learning outcomes. Also include how you will pre- assess their knowledge at the beginning of the lesson and how you will continuously assess them throughout the strand/topic to monitor their learning progress. The summative assessments are the final IA tasks.)*

*e.g.* Diagnostic: *(can be oral questions/short tests/ surveys/questionnaires to find out what students already know before the lesson)*

*Formative: 1. This is the formative use of the summative assessment such as the drafts submitted, self-assessment, peer assessment, teacher assessment of the drafts and specific feedback provided to improve the task. 2. For CATs – this can be similar items prepared by teachers using the SLOs and given to students for practice. After scoring, the feedback needs to be given to improve learning. If majority students not doing well then re-teach using another strategy, assess and monitor learning.*

*Summative: (these are the final IA tasks or the CATs to measure how much the students have learnt/achieved after the learning period)*

**Resources:**
List materials required for completing the task (for learning & demonstrating the achievement for the SLOs.
This must specify any material items such as books, documents, maps, stimulus material, equipment required by the task, including use of technology.

**Guidelines for the teacher on advance preparation requirements**
**time required** by the student for task completion (monitoring progress)
recommended dates/date range for task completion
organization of room and hardware to facilitate task completion (learning assessment).
(After the task has been completed and scored, teachers will need an IA score capture sheet to record the performance of all students in the class.)

**Guidelines for the teacher on task completion and task control**
This must specify:
- the role of the teacher during the period of task completion
- instructions that are to be given by the teacher to the students
- actions that are required of the teacher during task completion
- preparation by the students beforehand
- if students are required to prepare in advance of the task date, preparatory notes must indicate the requirements. For example, students may need to collect support materials for a task that is supervised in a classroom.

## Task outline for the student

This outline is a brief description of the task that the student is to complete. It is a general description without specific detail.

Example: *Your task is to focus on an important social issue. After investigating that issue, you need to process information collected and suggest possible courses of action that authorities could take.*

## Task detail for the student

This must provide a detailed description of the task in the sequence that the student would be expected to follow during task completion. This must clearly state:

what the student is expected to do

what the student is expected to record and present for assessment.

## Feedback & Support

Allocate time for:

Student's self-assessment and correction

Peer assessment, feedback, and time for improvement

Teacher assessment, feedback, and time for time improvement (NB: State how this will be carried out)

## Final submission & scoring

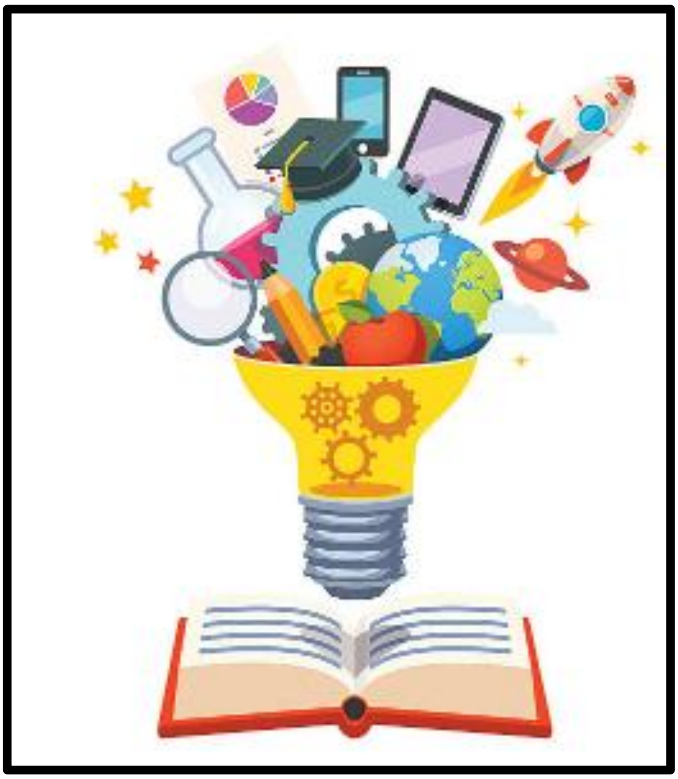
State when the final task is due and how it will be assessed. State how the school (HOD/SPFSC Coordinator) will monitor the scoring of the tasks.

## Scoring Rubric

Copy and paste directly from the aligned Syllabus the relevant scoring rubrics

Assessment score capture sheet for the task - This will be provided by EQAP

(Repeat 1-13 for other tasks)



# Appendix 3: IA Summary Form

South Pacific Form Seven Certificate

IA Summary Form
2023

PHY – IA

**PHYSICS**

| | | | | | |
|---|---|---|---|---|---|
| COUNTRY | | | | | |
| SCHOOL | | | | | |
| Task | **Brief Description of Tasks** | **Start Date** | **End Date** | **Date to EQAP** | **Weighting** |
| 1.Research | This task is designed to provide an insight to students on the current issues and international conventions (SDGs 7 & 13) related to Physics concepts. | | | | 15% |
| 2.Model Development | Students will be assessed on learning outcomes from Sub-strand 4.2. Electromagnetic Induction | | | | 15% |
| **TOTAL** | | | | | **30%** |

***Note***:

1. Be specific about dates, not just Week 3 Term 1, etc.
2. Assessment Schedules/Scoring Rubrics for the tasks will be provided by EQAP. Teachers must use these when scoring students' work.
3. All IA Score Capture Sheets will be provided by EQAP to schools.

| **Verification and Endorsement of IA Program** | | |
|---|---|---|
| **Principal's Name** | **Teachers Name** | **School Stamp** |
| | | |
| Signature | Signature | |
| Date | Date | |

**A full IA program is to be submitted together with this IA Summary Form.**

# Advisory Section

## General Notes:

Coursework requirements, the assessment tasks and weightings given to each task should be clearly explained to students at the beginning of the year's course. Results should be clearly recorded so that accurate information on each student's written and practical work is readily available. At the start of the year students should be given a copy of the assessment statement to be used.

It is expected that students will complete relevant and formative topic tests and practical activities for course completion. These are not directly prescribed in this syllabus but are expected to be part of the teaching and learning experiences for students.

The assessment statement, copies of all assessment tasks and assessment schedules used as well as all internal assessment work necessary for a sample of students must be available for verification on request until 30 November of the year of the examination.

The internally assessed score for each student shall be forwarded to the Educational Quality and Assessment Programme by the liaison teacher or the principal, by the date specified by the Director, on the score capture sheet provided by EQAP. The principal or liaison teacher will certify that the syllabus requirements have been fulfilled.

## Recommended Texts and Resources

1. Suggested Texts

(a) Possible Student Texts

The following texts are appropriate for this syllabus:

i) Physics Alive by R Campbell
ii) ESA Y13 Revision Guide by P. Bendall and P. Howison
iii) Senior School Physics by I. Jacobs
iv) Advanced Senior Physics by N. Barber and R. Osborne (no longer in print)
v) Year 13 Physics: Course Manual by Chris Rutter
vi) Physics-Year 13 by Trevor Castle, New Zealand Pathfinder Series

(b) Other texts
i) ESA Y13 Physics AME workbook by P Bendall
ii) ESA Y13 Physics Learning workbook by P BBendall
iii) Study Pass Reference notes – Y13 Physics www.studypass.co.nz

(c) Teacher resources
i) Conceptual Physics by Paul G Hewitt published by Pearson is an excellent resource textbook for teachers.
ii) Jacaranda Physics by Graeme Lofts, Dan O'Keefe, Pam Robertson,…

Websites:
NZ Institute of Physics www.nzip.org.nz
Institute of Physics www.iop.org
New Zealand Qualifications Authority (includes exemplar work similar to the standard expected by this syllabus) www.nzqa.govt.nz/Physics
NZ Ministry of Education www.tki.org.nz
NZ Curriculum Guides http://seniorsecondary.tki.org.nz/
NZ Assessment (NCEA)
http://www.tki.org.nz/e/community/ncea/

**Online Teaching applets**

- phet.colorado.edu
- https://www.sparknotes.com/psychology/psych101/sensation/section3/
- https://science.howstuffworks.com/science-videos.htm

## Notes for Measurements and Graphs

(a) Students are required to give answers with the appropriate significant figures. Working with significant figures:

(i) When quantities are added or subtracted, the answer should be rounded to the least number of decimal places of the quantities given.
ii) When quantities are multiplied or divided, the answer should be rounded to the least number of significant figures of the quantities given.
(b) Uncertainties in data calculations (i) Limit of reading for equipment:

The accepted limit of reading used for the South Pacific Form Seven Certificate is the smallest unit of measurement on the measuring device.
(ii) The half-range rule can be applied when a measurement is repeated for increased accuracy. Alternative methods are acceptable but should be documented to ensure overall consistency.

(c) Uncertainties in mathematical calculations.

(i) When measurements are added or subtracted, the absolute uncertainty values are added.
(ii) When measurements are multiplied or divided, the percentage uncertainty values are added.

(d) Error bars, best-fit lines and error lines

(i) Students will be expected to draw error bars on graphs using absolute uncertainty values.
(ii) Students will be expected to be able to draw best-fit lines for linear trends and an error line.

(e) Graphing conventions.

All graphs must include the following:

- appropriate title which identifies variables
- axes are labelled with both the name of the quantity and SI unit (in brackets)
- the independent variable is on the horizontal axis • there is an appropriate scale using equal intervals • data is clearly and accurately plotted.

## Suggested Teaching Programme

This is an example of a teaching programme (timeline) showing the time that needs to be spent on different learning outcomes on which teachers can base their schemes of work.

The programme allows for spare weeks for term holidays, time out, revision, exams etc.

With countries/schools in the region having a variety of term times, teachers will need to plan their own programmes using this programme as a guide. It is important that time is incorporated into the programme for students to carry out the work necessary for the internal assessment tasks.

## Teaching Programme – SPFSC Physics

| Week | Learning Outcomes | Syllabus Reference | Assessment |
|---|---|---|---|
| **Term I** | | | |
| 1. | Explain Physical phenomena, concepts and principles relating to translational motion | 1.1 | |
| 2. | Solve problems relating to translational motion | 1.1 | |
| 3. | Explain Physical phenomena, concepts and principles relating to circular and rotational motion | 1.2 | |
| 4. | Explain Physical phenomena, concepts and principles relating to circular and rotational motion | 1.2 | |
| 5. | Solve problems relating to circular and rotational motion | 1.2 | |
| 6. | Solve problems relating to circular and rotational motion | 1.2 | |
| 7. | Explain Physical phenomena, concepts and principles relating to simple harmonic motion | 1.3 | |
| 8. | Explain Physical phenomena, concepts and principles relating to simple harmonic motion/ Solve problems relating to simple harmonic motion | 1.3 | |
| 9. | Practical activities on Mechanics | 1.1-1.3 | |
| 10. | Explain Physical phenomena, concepts and principles relating to sound waves | 2.1 | |
| 11. | Solve problems relating to sound waves | 2.1 | |
| 12. | Explain Physical phenomena, concepts and principles relating to light waves/ Solve problems relating to light waves | 2.2 | |
| 13. | Revision/ formative assessment/ term test | | |
| **Term 2** | | | |
| 1 | Real life socio-scientific Physics | 3.1 | |
| 2 | Climate Change and Renewable Energy Sources | 3.2 | |
| 3 | Research Project | 3.3 | IA Task 1Starts |

| | | | |
|---|---|---|---|
| 4 | Research Project | 3.3 | |
| 5 | Explain Physical phenomena, concepts and principles relating to DC circuits and capacitance | 4.1 | IA Task 1 Ends |
| 6 | Explain Physical phenomena, concepts and principles relating to DC circuits and capacitance | 4.1 | |
| 7 | Solve problems relating to DC circuits and capacitance | 4.1 | |
| 8 | Explain Physical phenomena, concepts and principles relating to electromagnetic induction | 4.2 | IA Task 2 starts |
| 9 | Solve problems relating to electromagnetic induction | 4.2 | |
| 10 | Explain physical phenomena, concepts and principles relating to AC circuits | 4.3 | |
| 11 | Explain physical phenomena, concepts and principles relating to AC circuits | 3.3 | IA Task 2 ends |
| 12 | Practical activities on Waves and Electricity & Electromagnetism | 4.1-4.3 | |
| 13 | Revision/ formative assessment/ term test/ Common Assessment task | 4.3 | |
| **Term III** | | | |
| 1 | Solve problems relating to AC circuits | 4.3 | |
| 2 | Solve problems relating to AC circuits | 4.3 | |
| 3 | Explain Physical phenomena, concepts and principles relating to Atomic Physics | 5.1 | |
| 4 | Solve problems relating to Atomic Physics | 5.1 | |
| 5 | Solve problems relating to Nuclear Physics | 5.2 | |
| 6 | Practical activities on Atomic and Nuclear Physics Physics | 5.1-5.3 | |
| 7-8 | Revision and Study Week | | |
| 9-10 | SPFSC Physics Final Examination | | |

**THE END.**