**SACE Physics Program 2 – Exemplar**

This program articulates with learning and assessment plan 2

|  | **Science Understanding** | **Science Inquiry Skills** | **Science as a Human Endeavour** | **Assessment** |
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| **1-1** | * 1. **Projectile Motion**

Review of motion concepts* Vectors, scalars, significant figures
* Terminology
* Conditions for projectile motion
* Equations of motion
 | * Projectile Launcher
* Angle of projection and range relationship
 |  |  |
| **1-2** | * Air resistance and drag force
 | * Dropping a ball bearing through a viscous liquid
* Terminal velocity
* Error analysis in experiments
 | * Swimming in syrup discussion
* Factors affecting aerodynamics
 | **Investigations folio task 1: Design Experiment** |
| **1-3** | * 1. **Forces and Momentum**
* Review of force concepts
* Momentum and Newton’s Second Law
* Conservation of momentum and Newton’s third law
* Momentum using vectors
 | * Simple collisions (formative experiment)
 | * Using momentum to predict neutrinos
 |  |
| **1-4** | * Momentum using multi-image diagrams
* Applications of momentum
* Rockets, solar sails
 | * Rocket demonstration
* Air tracks
 | * Analysis of scenes from movies
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| **1-5** | * 1. **Circular motion and gravitation**
* Circular motion concepts
* Applications (including banked curves)
* Gravitational field strength
* Law of Universal Gravitation
* Satellites
 | * Centripetal force with glass tube and stopper (formative experiment)
 | * Black holes, dark matter, other celestial bodies
 |  |
| **1-6** | * Kepler’s Laws of planetary Motion
* Satellites and their applications
 | * Predicting appearance of comets
* Predicting the mass of stars and planets, using their natural satellites
* Satellite tracking
 | * Hubble Space Telescope
 |  |
| **1-7** | **Review / Catch up time** |  |  | **SAT1: (Subtopics1.1, 1.2, 1.3)** |
| **1-8** | * 1. **Einstein’s relativity**
* Frames of reference
* Lorentz factor
* Time dilation
 | * Evidence supporting time dilation
 | * Evidence for Einstein’s postulates
* Evidence against Einstein’s postulates
* Twin paradox
 |  |
| **1-9** | * Length contraction
* Relativistic momentum
 | * Relativity and GPS
 | * Difficulties obtaining evidence for length contraction
 |  |
| **1-10** |  |  |  | *Formative Test on Subtopic 1.4* |
| **Term 2** |
| **2-1** | **2.1 Electric Fields*** Review of concepts
* Coulomb’s Law
* Vector addition and Coulomb’s Law
* Representations of electric fields
* Use of  and
* Principle of superposition (electric fields)
 | * Use of application/detector to measure electric field strength and test relationship

(formative experiment) | * Use and application of electric fields
 |  |
| **2-2** | * Hollow conductors
* Fields near sharp points
* Corona discharge

**2.2 Motion of charged particles in electric fields*** Work done and electric fields
* Using and
 | * Corona discharges
* van de Graaf generator
* Different units of energy
 | * Strong electric fields
* Particle accelerators
 |  |
| **2-3** | * Acceleration of charged particles in electric fields
* Use of equations of motion
 | * Teltron tube (formative experiment)
* Comparison between Subtopic 1.1 and sub-topic 2.2
 | * Cathode ray tubes
 |  |
| **2-4** | **2.3 Magnetic fields*** Representations of magnetic fields
* Magnetic fields in current carrying wires
* Use of

**2.4 Motion of charged particles in magnetic fields*** Concept of magnetic force
* Magnetic force acting on moving, charged particles
* Use of  and
 | * Use mobile application/detector to measure magnetic field strength to verify relationship (formative experiment)
* Realistic values of magnetic field strength
* Solenoids, electromagnets
* Current balance (formative experiment)
 |  | **Investigations Folio: Charge to mass ratio of an electron** |
| **2-5** | *
* Centripetal acceleration of charged particles at right angles to magnetic field
* Use of
* Function and operation of a cyclotron
* Use of
 | * Building a motor
* Teltron tube
* Charge to mass ratio of an electron (formative experiment)
 | * Loudspeakers
* Motors
* Generators
* Magnetic fields in electron microscopes
* Maglev trains
 |  |
| **2-6** | **Review / Catch up time** |  |  | **SAT2: (sub-topics 2.1, 2.2, 2.3, 2.4)** |
| **2-7** | **2.5 Electromagnetic Induction*** Concept of magnetic flux
* Electromagnetic induction
* Faraday’s Law and Lenz’s law

Solving problems using Faraday’s law and Lenz’s law | * Simulations
 | * Use and application of electromagnetic induction
 |  |
| **2-8** | * Generators
* Transformers
* Solving problems with
 | * Output of generators
 | * Transformers in everyday life
* AC, DC, Edison and Tesla
 | *Formative Test on sub-topic 2.5* |
| **2-9** |  |  |  |  |
| **2-10** | *Trial examinations* |  |  | *Formative trial exam* |
| **Term 3** |
| **3-1** | **3.1 Wave behaviour of light*** Generation of electromagnetic radiation from oscillating charges
* Use of antennas/polarisation
* Coherent, monochromatic, and incandescent light sources
* Constructive and destructive interference
* Principle of superposition
 | * Polarisation paradox
* Speckle effect
 | * Radio, WiFi, antenna
* Data storage
 | **Investigations Folio: SHE task** |
| **3-2** | * Young’s double slit experiment
* Calculations, graphs, problem-solving
* Use of  and
 | * Lasers and double slit
* Microwaves and double slit (formative experiment)
 |  |  |
| **3-3** | * Transmission diffraction grating
 | * Use of white light on transmission diffraction grating (formative experiment)
* Vapour lamps and spectra
* Element identification
 | * Transmission diffraction gratings and disks
 |  |
| **3-4** | **3.2 Wave-particle duality*** Photon model of light
* Use of  and

Photoelectric effect | * Formative: Photoelectric effect practical
* Solar sails
* Use of LEDs to measure Planck’s constant (formative experiment)
 | * ‘ultraviolet catastrophe’
* Use and application of the photoelectric effect
 |  |
| **3-5** | * X-rays
* Generating –X-rays
* Use of
* Wave behaviour of particles

Davisson-Germer experiment | * Electron microscopes
* X-rays in medicine
 | * Use and application of

X-rays* Significance of Davisson-Germer experiment
 |  |
| **3-6** | **3.3 The structure of the atom*** Line emission spectra
* Energy level diagrams

Line emission spectrum of hydrogen | * Flame tests
* Spectroscopes
* Simulations
 |  |  |
| **3-7** | * Line absorption spectrum
* Fraunhofer lines
* Fluorescence
* Incandescence
* Population inversion, metastable states, stimulated emission lasers
 | * Analysis of solar spectra
* Analysis of different absorption spectra
* Laser safety
 | * Identification of elements in stars
* Applications of lasers
* Relationship between spectra and temperature
 |  |
| **3-8** | **Review** **3.4 Standard Model*** Leptons, quarks, gauge bosons
* Types and charge of quarks
* Baryon, baryon numbers, lepton numbers
* Antimatter and use of
 | * Use of quarks/antiquarks to form many different kinds of particles
 | * LHC and contemporary particle physics
* Cyclotron at SAHMRI / PET scans
 | **SAT3: (Subtopics 3.1, 3.2, 3.3)** |
| **3-9** | * Conservation laws
* Fundamental forces
 | * Use of conservation laws to predict reactions between particles
 | * Development of the Standard Model
 |  |
| **3-10** | **Revision** |  |  |  |
| **Term 4** |
| **1** | **Revision** |  |  |  |
| **2** | **Revision** |  |  |  |
| **3** | **Revision** |  |  |  |