**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 |  |
| **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** |  |  |  |