Students Learning Objectives: Physics Grade 12
Bilingual Syllabus (2010 – 2011)
Semester One

Student Learning Objectives: <u>Forces and Charges</u>
By the end of this Unit students should be able to….

1. recall that electric charges are separated when certain materials are rubbed against one another, in particular that Polythene becomes negatively charged and Perspex becomes positively charged when rubbed with cloth.
2. explain the charging of objects in terms of properties of electrons which are free to move.
3. distinguish between conductors and insulators.
4. recall and use Coulomb's law in the form $F = \frac{kQ_1Q_2}{r^2}$ for the force between two point charges in free space or air (where $k = 9.0 \times 10^9$ N m^2 C^{-2}).
5. recognize the analogy between certain qualitative and quantitative aspects of Coulomb's law of charge and Newton's law of gravitation.
6. show an understanding of the concept of an electric field as an example of a field of force and define electric field strength as force per unit positive charge acting on a stationary point charge.
7. represent an electric field by means of field lines.
8. recall and use $E = \frac{V}{d}$ to calculate the field strength of the uniform field between charged parallel plates in terms of potential difference and separation.
9. recall and use $E = \frac{kQ}{r^2}$ for the field strength of a point charge in free space or air.
10. calculate the forces on charges in uniform electric fields.
11. recall electric potential at a point as the potential energy of a unit positive charge at that point.
12. define potential difference as the energy transferred when a unit charge passes from one point to another.
13. recall and solve problems using $V = \frac{w}{Q}$.
14. recall the phenomenon of thermionic emission and recognize that the gain in kinetic energy of moving electrons is equal to the loss in electrical potential energy.

Student Learning Objectives: <u>Electricity</u>
By the end of this Unit students should be able to….

1. show that electric current is the rate of flow of charged particles.
2. define charge and the coulomb.
3. recall and solve problems using the equation $Q = It$.
4. recall the relationship between current in a wire and drift velocity of the moving electrons and use the equation $I = nAve$.
5. define potential difference and the volt.
6. recall and solve problems using $W = QV$.
7. define resistance and the ohm.
8. recall and solve problems using $V = IR$.
9. sketch and explain the I-V characteristics of a metallic conductor at constant temperature, a filament lamp and a semiconductor diode.
10. state Ohm's law.
11. recall the factors affecting resistance and solve problems using $R = \frac{\rho L}{A}$.
12. sketch the temperature characteristic of a thermistor (thermistors will be assumed to be the negative temperature coefficient type).
13. recall electrical power and solve problems using $P = VI$.
14. define electromotive force in terms of the energy transferred by a source in driving unit charge round a complete circuit.
15. recall Kirchhoff's first law abd appreciate the link to conservation of charge.
16. recall Kirchhoff's second law and appreciate the link to conservation of energy.
17. derive, using Kirchhoff's laws, the formulas for the combined resistance of two or more resistors in series and in parallel.
18. solve problems using the formulas for the combined resistance of two or more resistors in series or in parallel.
19. show an understanding of the use of a potential divider circuit as a source of variable potential difference.
20. interpret circuit diagrams containing sources, switches, resistors, ammeters, voltmeters, and/or other type of components.
21. Show understanding of the function of capacitors in simple circuits.
22. recall the charging and discharging of capacitors.
23. define capacitance and the farad.
24. solve problems using the formula $C = \frac{Q}{V}$.
25. deduce from the area under a potential-charge graph the equation W = ½QV.
26. recall and solve problems using $W = ½CV^2$.
27. solve problems using the formula for the combined capacitance of two or more capacitors in parallel and in series.

Student Learning Objectives: <u>Magnetic forces and fields</u>
By the end of this Unit students should be able to….

1. show an understanding that a magnetic field is an example of a field of force produced either by permanent magnets or by current-carrying conductors.
2. represent a magnetic field by field lines.
3. sketch the magnetic field line patterns around a long straight wire, of a flat circular coil and of a solenoid.
4. define magnetic flux density and the tesla,
5. show an appreciation that a force might act on a current-carrying conductor placed in a magnetic field.
6. predict the direction of the force on a charge moving in a magnetic field using Fleming's left-hand rule.
7. recall and solve problems using the equations $F = BI\ell$ and $F = BI\ell\sin\theta$.
8. recall and solve problems using $F = BQv\sin\theta$.
9. explain the force between two parallel current-carrying conductors and predict the direction of the force.
10. recall and solve problems using the equation $F = \dfrac{\mu_o I_1 I_2 \ell}{2\pi r}$.

Student Learning Objectives: <u>Electromagnetic Induction</u>
By the end of this Unit students should be able to….

1. describe electromagnetic induction using Faraday's model.
2. define magnetic flux and webar.
3. solve problems using $\Phi = B\,A$.
4. recall and solve problems using Faraday's law of electromagnetic induction and Lenz's law.
5. infer from appropriate experiments on electromagnetic induction:
   i. that a changing magnetic flux can induce an *emf* in a circuit;
   ii. that the direction of the induced *emf* opposes the change producing it;
   iii. the factors affecting the magnitude of the induced *emf*.
6. explain the working of an *a.c.* generator and a *d.c*. electric motor.
7. compare the ways a motor and a generator function, using the principles of electromagnetism.
8. show an understanding of the principle of operation of a simple iron-cored transformer and recall and solve problems using
   $\dfrac{N_s}{N_p} = \dfrac{V_s}{V_p} = \dfrac{I_p}{I_s}$ for an ideal transformer.
9. explain how the energy losses in a transformer may be reduced.
10. show an appreciation of the advantages of using high voltage and low current for the transmission of electrical energy.

SUGGESTED PRACTICALS FOR GRADE 12 (BILINGUAL) FIRST SEMESTER

1. To determine resistivity.

2. To verify Ohm's law.

3. To study the variations of potential difference across a given conductor by using (i) a rheostat. (ii) a potentiometer.

4. To find the strength of the magnetic field inside a solenoid.

5. To verify Faraday's Law of Electromagnetic Induction (and Lenz's Law).

END OF SEMESTER ONE

Student Learning Objectives: <u>Periodic Motion</u>
By the end of this Unit students should be able to….

1. understand and describe examples of simple harmonic motion.
2. investigate simple harmonic motion using graphs.
3. understand and use the terms amplitude, period, frequency and phase difference and express the period in terms of frequency.
4. describe, with graphical illustrations, the changes in displacement, velocity and acceleration during simple harmonic motion.
5. recognize and use the equations:
   i. $a = -(2\pi f)2 x$;
   ii. $x = A \sin 2\pi f t$;
   iii. $v = \pm 2\pi f \sqrt{A^2 - x^2}$

   as the defining equations of a simple harmonic motion.
6. determine the period of simple harmonic motion using the equations:
   i. $T = 2\pi \sqrt{\frac{\ell}{g}}$ for a simple pendulum, and
   ii. $T = 2\pi \sqrt{\frac{m}{k}}$ for a mass suspended on a spring.
7. describe the interchange between kinetic and potential energy during simple harmonic motion.
8. explain quantitatively the relationship between potential and kinetic energies of a mass in simple harmonic motion

Students learning Objectives: Physics Grade 12
Bilingual Syllabus (2010 – 2011)
Semester Two (cont.)

Student Learning Objectives: <u>Mechanical Waves</u>
By the end of this Unit students should be able to….

1. describe what is meant by wave motion as illustrated by vibration in ropes, springs and ripple tanks.
2. show an understanding of and use the terms displacement, wavelength, period, frequency, amplitude, phase difference and speed.
3. deduce, from the definitions of speed, frequency and wavelength, the wave equation $v = f\lambda$.
4. recall and uses the wave equation $v = f\lambda$.
5. show an understanding that energy is transferred due to a progressive wave.
6. recall the relationship $energy \propto (amplitude)^2$.
7. compare transverse and longitudinal waves.
8. analyse and interpret graphical representations of transverse and longitudinal waves.
9. show an understanding that polarisation is a phenomenon associated with transverse waves.
10. draw and interpret ray diagrams illustrating reflection and refraction.
11. associate refraction with a change in wave speed.
12. calculate the refractive index:
    i. using Snell's law, $n = \frac{\sin i}{\sin r}$.
    ii. using speed of light, $n_{medium\ 2} = \frac{speed\ of\ light\ in\ medium\ 1}{speed\ of\ light\ in\ medium\ 2}$
13. show an understanding of the terms critical angle and total internal reflection.
14. describe the application of total internal reflection in optical fibers.

Students learning Objectives: Physics Grade 12
Bilingual Syllabus (2010 – 2011)
Semester Two (cont.)

Student Learning Objectives: <u>Superposition of waves</u>
By the end of this Unit students should be able to….

1. explain and use the Principle of Superposition in simple applications.
2. recall the relationship between phase difference and path difference.
3. show an understanding of experiments that demonstrate stationary waves using a stretched string.
4. explain the formation of standing waves using a graphical method and identify nodes and antinodes.
5. explain the meaning of the term diffraction.
6. recall the effect of wavelength and gap size on the degree of diffraction of waves through a gap.
7. show an understanding of experiments which demonstrate diffraction including the diffraction of water waves in a ripple tank with both a wide and a narrow gap.
8. calculate the diffraction angle using the equation $\sin\theta = \frac{\lambda}{b}$.
9. show an understanding of experiments that demonstrate two-source interference and coherence using a ripple tank and diffraction grating.
10. recall and solve problems using Young's equation, $\frac{\lambda}{s} = \frac{x}{D}$ for double-slit interference using light.
11. recall and solve problems using the formula $n\lambda = d\sin\theta$ and describe the use of a diffraction grating to determine the wavelength of light.
12. recall the Doppler effect and calculate the changes in wavelength using the equation $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$.
13. recall the applications of the Doppler effect in speed traps and measuring blood flow.

<u>REFRANCE TEXT BOOKS</u>

1- Holt Physics
2- IB Diploma Programme Physics
3- Physics Collins Advanced Science

Student Learning Objectives: Atomic Physics
By the end of this Unit students should be able to….

1. calculate energy of quanta using Plank's equation.
2. explain the strength and weakness of Rutherford's model of the atom.
3. explain some of the important characteristics of the Bohr model of the atom.
4. identify, interpret, or explain the use of quantum numbers in orbital theory.
5. show how the Bohr model of the atom offered explanations for some physical phenomena, while failing to provide a suitable explanation for others.
6. define the photon.
7. explain how photons are used to describe the wave-particle duality of light.
8. explain that quantum theory helps to explain the photoelectric effect, the Compton effect.
9. calculate the De Broglie wavelength of matter waves.
10. state that quantum theory describes a region surrounding the nucleus which has the highest probability of locating an electron.

SUGGESTED PRACTICALS FOR GRADE 12 (BILINGUAL)

SECOND SEMESTER

1. To investigate the oscillations of a simple pendulum.
2. To investigate the vertical oscillation of a mass- spring system.
3. To investigate Snell's law, internal reflection and the critical angle.
4. To investigate stationary wave patterns.
5. To determine the refractive index.

END OF SEMESTER TWO