ST MARY'S COLLEGE

FORM UPPER 6

SUBJECT: PHYSICS

COURSE OUTLINE 2014-2015

Term 1

Proposed Date/Week	Unit/Section	Topic	Modules
Week 1	Unit 2 Module 1 Electricity & Magnetism	Electrical Quantities	**1.1** Charge, **$Q = It$** 1.2 Coulomb definition 1.3 Volt definition **1.4** Electrical Energy, **$W = QV$** **1.5** Potential Difference, **$V = IR$** 1.6 Electrical Power, **$P = IV = I^2R – V^2/R$** 1.7 Resistivity definition and use: **$R = \rho L/A$** 1.8 Distinguish between **e.m.f.** and **p.d.** 1.9 Drift Velocity, v 1.10 Derive and use : **$I = n A v e$**
Week 2-3	Unit 2 Module 1 Electricity & Magnetism	Electrical Circuits	2.1 I-V Characteristics: metal conductor; semi-conductor; lamp 2.2 Thermistors : R-T characteristics 2.3 Electrical sources : primary; secondary; solar; generator; Internal resistance; e.m.f. ; p.d. ; load; Solve problems 2.4 Circuit diagrams 2.5 Kirchhoff's Laws : 1st - Principle of conservation of Charge; 2nd - Principle of conservation of energy 2.6 Derive & use formula for resistors in series 2.7 Derive & use formula for resistors in parallel 2.8 Potential Divider – fixed & variable p.d. sources 2.9 Wheatstone Bridge – comparing resistances **LABORATORY INVESTIGATION 1 : I-V Characteristics**
Week 4	Unit 2 Module 1 Electricity & Magnetism	Electric Fields	3.1 Electrical Conductors & Insulators – electron model 3.2 Applications of electrostatic phenomena 3.3 Hazards of charging by friction 3.4 Lightning rods 3.5 Coulomb's Law : **$F = Q_1Q_2/4\pi\varepsilon_o r^2$** 3.6 Field Strength : **$E = Q/4\pi\varepsilon_o r^2$** 3.7 Electric Field between parallel plates : **$E = V/d$** 3.8 Force on charged particle in uniform electric field : **$F = EQ$** **LABORATORY INVESTIGATION 2 : Wheatstone Bridge**
Week 5	Unit 2 Module 1 Electricity & Magnetism	Capacitors	4.1 The Farad **4.2 $C = Q/V$** **4.3 $C = \varepsilon A/d$** 4.4 Capacitors in series & parallel 4.5 Energy Stored in a Capacitor 4.6 Equations for capacitor discharge 4.7 Graphs for charging & discharging **LABORATORY INVESTIGATION 3 : Capacitor Discharge**

Week 6 - 7	Unit 2 Module 1 Electricity & Magnetism	Magnetic Fields Magnetic Forces	5.1 Flux density and Tesla 5.2 Magnetic flux patterns of wire, coil & solenoid 5.3 Expressions for magnetic flux 6.1 Fleming's Left Hand Rule 6.2 **$F = B\ I\ L \sin\theta$** 6.3 Current Balance 6.4 Direction of force on charge moving in magnetic field 6.5 **$F = B\ Q\ v \sin\theta$** 6.6 Charged particles moving in perpendicular B & E fields 6.7 Effect of Soft Iron Core on magnetic field due to solenoid 6.8 Principle of electromagnet & applications 6.9 Forces between current carrying conductors 6.10 Hall Effect 6.11 Hall Probe to measure flux density **LABORATORY INVESTIGATION 4 : Magnetic Field Patterns**
Week 8	Unit 2 Module 1 Electricity & Magnetism	Electro-Magnetic Induction	7.1 Magnetic Flux **$\phi = B\ A$** 7.2 The Weber 7.3 Induced e.m.f. & change in flux linkage 7.4 Faraday's Law of Electromagnetic Induction 7.5 Lenz's Law to determine direction of induced e.m.f. 7.6 Lenz's Law and Principle of Conservation of Energy 7.7 Applications of electromagnetic induction 7.8 Principle of operation of simple Transformer 7.9 Ideal Transformer equation : **$Ns/Np = Vs/Vp = Ip/Is$** **LABORATORY INVESTIGATION 5 : Hall Probe**
Week 9-10	Unit 2 Module 2 A.C. Theory & Electronics	Alternating Currents P-N Junction Diode	1.1 Frequency; Peak value; root mean square value of A.C. 1.2 A.C. equation : **$X = Xo \sin \omega t$** 1.3 Peak value = √2 [r.m.s. value] : **$I_{pk} = \sqrt{2}\ I_{r.m.s}$** 1.4 Uses of A.C. & high voltages - electrical transmission 2.1 Semiconductors : p-type & n-type materials 2.2 Depletion layer at a p-n junction 2.3 Forward & reverse biased current flow in a p-n diode 2.4 I-V characteristics of the p-n junction diode 2.5 Transistor as two p-n junction diodes 2.6 Diodes for half wave rectification 2.7 4 diodes bridge rectifier for full wave rectification 2.8 Full wave and Half wave rectification graphs 2.9 Capacitor smoothing of rectified A.C. & time constant RC 3.1 Electronic Input Devices: LDR, Thermistor, Microphone 3.2 Electronic Output Devices: LED; Buzzer; Relay **LABORATORY INVESTIGATION 6 : A.C. & Rectification**
Week 11-12	Unit 2 Module 2 A.C. Theory & Electronics	Operational Amplifiers	4.1 Properties of the IDEAL Operational Amplifier 4.2 Properties of the REAL Operational Amplifier 4.3 OP-AMP as a comparator 4.4 Saturation and Clipping in OP-AMPs : **$V_{out} \leq V_{supply}$** 4.5 Gain and Bandwidth of an OP-AMP 4.6 Gain-Frequency curve of a typical OP-AMP 4.7 Bandwidth from gain-frequency curve 4.8 Inverting and Non-inverting OP-AMPs 4.9 Concept of VIRTUAL EARTH in inverting amplifier

			4.10 GAIN of inverting and non-inverting amplifiers 4.11 Negative feedback – effect on gain and bandwidth 4.12 Single input amplifier circuits 4.13 High impedance of non-inverting amplifier 4.14 Inverting amplifier as a Summing Amplifier 4.15 Summing Amplifier circuits 4.16 Op-AMP as a Voltage Follower 4.17 Analysis of OP-AMP circuits 4.18 Timing Diagrams to analyze response of amplifier circuits **LABORATORY INVESTIGATION 7 : OP - AMPs**
Week 13-14	Unit 2 Module 2 A.C. Theory & Electronics	Logic Gates	5.1 Function of NOT; AND; OR; NAND;NOR; EXOR; EXNOR 5.2 Truth Tables of logic gates 5.3 Re-design logic gates using only NOR or only NAND gates 5.4 Analyze logic circuits to perform control functions 5.5 Truth tables for combination of logic gates 5.6 Timing diagrams to represent response of digital circuits 5.7 Half Adder – construction and operation 5.8 Full Adder : using 2 half adders and an OR gate 5.9 FLIP-FLOP : using 2 NOR or 2 NAND 5.10 Operation of a triggered bistable 5.11 3-Bit binary counter using Triggered bistables [T-flip-flops] 5.12 Application of digital systems in home and industry **LABORATORY INVESTIGATION 8 : LOGIC Gates**
WEEK 15	Unit 2		PAST PAPER REVISION

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Term 2

Proposed Date/Week	Unit/Section	Topic	Modules
Week 1-2	Unit 2 Module 3 Atomic & Nuclear Physics	Particulate Nature of Electro-magnetic Radiation	**1.1 $E = hf$** 1.2 Photoelectric emission 1.3 Problems of Classical Physics and photoelectric effect 1.4 Photon model to explain classical paradoxes 1.5 Work function; threshold frequency; cut-off wavelength; stopping potential; **1.6 $E = hf = ½ m v^2$; $E = hf = + eV$** 1.7 Electron-volt : unit of energy 1.8 Photoelectric effect as evidence for particle nature of EMR 1.9 X-ray production 1.10 Line and continuous X-ray spectra 1.11 Attenuation of X-rays : **$I = I_o e^{-\mu x}$** 1.12 X-rays in radiotherapy and imaging in medicine 1.13 Line spectra and discrete energy levels in isolated atoms **1.14 $\Delta E = hf = E_2 - E_1$** 1.15 Absorption and Emission line spectra 1.16 Wave-particle nature of matter 1.17 Electron diffraction – evidence of wave nature of particles 1.18 Interference & diffraction : wave nature of EMR 1.19 de Broglie wavelength : **$\lambda = h/p$**
Week 3	Unit 2 Module 3 Atomic & Nuclear Physics	Atomic Structure	2.1 Geiger-Marsden α-particle scattering experiment Evidence for nuclear model of the atom 2.2 **$A = Z - N$** Atomic number = Mass number – neutron number 2.3 Isotopes 2.4 Standard notation for representing a nuclide : $^{Z}_{A}X$, $^{14}_{7}N$ 2.5 Millikan's Oil Drop experiment – experimental design 2.6 Evidence for quantization of charge from Millikan's expt. **LABORATORY INVESTIGATION 9 : Atomic Models**
Week 4	Unit 2 Module 3 Atomic & Nuclear Physics	Nuclear Reactions	3.1 Definition of mass defect and binding energy 3.2 Calculation of mass defect & binding energy 3.3 **$E = m c^2$** : energy release in fission and fusion 3.4 Atomic mass unit (u) as a unit of energy 3.5 Graph of binding energy per nucleon vs nucleon number 3.6 Binding energy per nucleon re nuclear fusion & fission 3.7 Conservation of nucleon number, proton number, energy

			(mass) and charge in nuclear processes 3.8 Nuclear reactions in the form : ${}^{1}_{1}\boldsymbol{H} + {}^{2}_{1}\boldsymbol{H} = {}^{3}_{2}\boldsymbol{He}$
Week 5-6	Unit 2 Module 3 Atomic & Nuclear Physics	Radioactivity	4.1 Relate radioactivity and nuclear instability 4.2 Spontaneous and random nature of radioactive decay 4.3 Origins and hazards of background radiation 4.4 Experiments to distinguish between α , β, γ emissions 4.5 Write and interpret equations for radioactive decay 4.6 Environmental hazards of radioactive emissions – nuclear biohazards in the Caribbean environment 4.7 Safety precautions for handling & disposal of radioactive material 4.8 Activity, decay constant, half-life and relationship: **A = λN** 4.9 Law of radioactive decay : $\frac{dN}{dt} - -\lambda N$ and $N = N_o\, e^{-\lambda t}$ 4.10 Solve problems using : $T_{½} = \frac{\ln 2}{\lambda}$ 4.11 experiment to determine the half life of a radioactive isotope with a short half life 4.12 Radioisotopes as tracers for carbon dating & radiotherapy 4.13 Operation of simple radioactivity detectors : GM tube; cloud chamber; spark counter **LABORATORY INVESTIGATION 10 : Radioactivity**
Week 7	Unit 2 Module 1 Electricity & Magnetism	Electricity & Magnetism	PAST PAPER REVISION
Week 8	Unit 2 Module 2 A.C. Theory & Electronics	A.C. Theory & Electronics	PAST PAPER REVISION
Week 9	Unit 2 Module 3 Atomic & Nuclear Physics	Atomic & Nuclear Physics	PAST PAPER REVISION
Week 10	Unit 2	ALL topics	PAST PAPER REVISION
Week 11	Unit 2	ALL Topics	PAST PAPER REVISION

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Term 3

Proposed Date/Week	Unit/Section	Topic	Modules
Week 1	Unit 2 Module 1 Electricity & Magnetism	Electricity & Magnetism	PAST PAPER REVISION
Week 2	Unit 2 Module 2 A.C. Theory & Electronics	A.C. Theory & Electronics	PAST PAPER REVISION
Week 3	Unit 2 Module 3 Atomic & Nuclear Physics	Atomic & Nuclear Physics	PAST PAPER REVISION
Week 4	Unit 2	ALL topics	PAST PAPER REVISION