SUBJECT: **Practical Electronics**

AWARD RECEIVED: N5

ENTRY LEVEL
To be able to make good progress through this Course you should really have done some Physics first, at least at S2/3 Elective, or N4 Physics, or better still, N5 Physics – it will also be interesting and very useful for those students who have already done Higher Physics.

This Course is, clearly, intended for those students who have a particular interest in Electronics, perhaps with a particular interest in making circuits from individual components – either by using real equipment and soldering components together, or perhaps instead using 'virtual components' to make your circuits using a computer software package … or by using both methods.
The Practical Electronics Course is a very 'hands on', practical course and it would be very beneficial to anyone who would possibly like to have the option of working as an Electrician, or an Electrical or Electronics Engineer, or any other job in the Electronics industry … or, obviously, for those who are simply interested in learning a bit more about Electronics.

If you would like more information about this Course you could speak with Mr Reilly or your Physics teacher.

COURSE CONTENT
This is a very 'hands-on', practical Course, which is split up into 3 main topics, or 'areas', which cover the following activities :

Circuit theory and design: In this area, you will develop an understanding of the main, basic electrical concepts/theory and electronic components. You will analyse electronic problems, design solutions to these problems and explore issues relating to electronics.

Circuit simulation: In this area, you will use simulation software to help in the design, construction and testing of circuits and systems and to investigate their behaviour.

Circuit construction: In this area, you will gain experience in assembling a range of electronic circuits, using permanent and non-permanent methods. You will develop skills in practical wiring and assembly techniques, carrying out testing and evaluating how the circuits work.

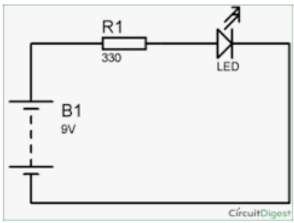
More specific detail of what you will learn, and do, in these areas of the Course is outlined below :,

__**Circuit theory :**__
Use appropriate SI units, scientific notation and the prefixes pico (p), nano (n). micro (µ), milli (m), kilo (k), and mega (M).
Use appropriate equations to determine voltage (V), current (I), resistance (R) or power (P) for a combination of resistors (i.e. a resistor network) supplied by a d.c. source. The network should contain a maximum of three resistors.

$\mathbf{V = I \times R}$

$\mathbf{R_T = R_1 + R_2}$ … along with… $\mathbf{1/R_T = 1/R_1 + 1/R_2}$,

$\mathbf{P = I \times V}$. … or… $\mathbf{P = I^2 \times R}$. …or… $\mathbf{P = V^2 / R}$

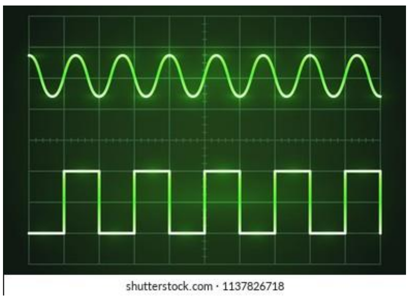


Use appropriate equations to determine voltage (V) or resistance (R) in a voltage divider circuit.

$\mathbf{V_1 / V_2 = R_1 / R_2}$ … or … $\mathbf{V_1 / R_1 = V_2 / R_2}$

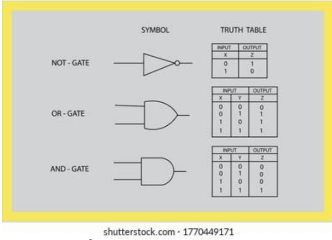
From an oscilloscope trace of a sinusoidal, or square, wave determine the peak voltage (V_p) and the period (T) and frequency (f) of the signal, given the Y-gain and '*time-base*' settings.

$\mathbf{f = 1 / T}$ … or … $\mathbf{T = 1 / f}$



Identify an oscilloscope trace/signal as either analogue or digital.
Describe the effect on the timing of the output waveform of changing the capacitance of a capacitor in a given circuit.
State that when a current flows in a conductor there is a magnetic field in the region surrounding the conductor.
State that the magnetic field can be made stronger by coiling the conductor.
Describe the operation of some electro-mechanical devices.

<u>Circuit design and simulation :</u>
Explain the benefits of electronic circuit simulation prior to circuit construction.
Identify two input logic gates from symbols.
Identify two input logic gates from truth tables.
Complete the truth table for an identified, two input, logic gate.
Determine the output and intermediate logic levels of a combinational logic circuit, consisting of a maximum of four inputs, and a maximum of two outputs.
Given a printout of a simulated circuit, identify potential faults
(eg incorrect supply voltage, incorrect resistor values or wrong component orientation)



Given a layout diagram of a circuit, identify potential faults (eg incorrect supply voltage, incorrect resistor values or wrong component orientation)
Compile a pre-power up checklist for a given simulation printout, layout diagram or circuit diagram.
Describe the operation of a number of simple circuits (eg. a transistor switching circuit, bi-stable switching circuit, 741 comparator)
Using a block diagram, design a circuit to solve a given problem.
Identify the input, process and output stages of a given circuit.
Given circuit diagrams, complete IC pin-out diagrams and circuit layout diagrams.
Given circuit layout diagrams, produce circuit diagrams.
Determine costs of constructing circuits given component codes and component costs.

<u>Circuit construction :</u>
Convert resistance values stated in ohms, kilo-ohms and mega-ohms from one notation to another
Determine the resistance of a resistor, and the tolerance (uncertainty) in this value, given its colour code
Calculate the maximum and minimum resistances of a given resistor with a specified tolerance (uncertainty)
Given a circuit specification and an incomplete circuit diagram, identify any missing key components and complete circuit diagrams.
Identify and draw the circuit symbols for, and describe the function of, the following components :

- power supplies
- resistors (…fixed-value, variable, LDR and thermistor)
- diodes
- capacitors
- transistors
- input/output devices (switch, relay, motor, buzzer, lamp, LED, solenoid and loudspeaker)
- connectors and wires
- fuses
- logic gates (AND, OR, NOT, NOR, XOR and NAND)
- ICs
- op-amp circuits (741 op-amp comparator mode only)
- voltmeter and ammeter

Select the appropriate scale and range on a multi-meter for measuring voltage, resistance and current.
Describe the use of a logic probe and continuity tester in circuit testing.
State at least two safety measures to be taken when soldering.
Describe the uses of prototype board, stripboard and p.c.b. in electronic design and construction.
Describe uses for each of the following cable types: multi-strand, ribbon, co-axial or fibre-optic.
State an advantage of colour coding or numbering bundled wiring.
Give examples of where either colour coding or numbering is used.

Physics teachers are usually always available either at lunchtimes and/or at the end of the day to give extra support with understanding the theory and to get help with the practical activities, if and when needed, throughout the year.

ASSESSMENT
There are 2 parts to the assessment for this Course :

1) an SQA Exam :
   - this is a fairly short Test, with a total of just 60 marks, and you're given 1 hour to do it.
   - the Test is worth 30% of the overall Total score for the Course.

2) a Practical Activity : … for this you will need to :
   - analyse a given problem
   - design an electronic solution/circuit to the problem
   - do a simulation of your solution/circuit to the problem
   - make a real circuit of your solution to the problem
   - test your solution circuit
   - write a short Report on your Activity
   - this Activity is worth 70% of the overall Total score for the Course.

The Course Award is Graded, from A to D, based on the combination of your Test and Practical Activity scores.

HOMEWORK
Due to the nature of the Course, there is not so much requirement for frequent, 'problem solving' Homework exercises to be completed. However, there will be some, so that you can check your understanding of the theory.
There will also be some practical tasks that you could do as Homework, so you can practice your soldering and 'circuit making' skills.
The Physics teachers are often available at lunchtimes and/or at the end of the day to give students help with their Homework.

TRANSFERABLE SKILLS
There are, clearly, many very useful and valuable transferable skills gained by studying N5 Practical Electronics – more detail of these can be found on the SQA website.
There are, clearly, many very good Employability Skills developed through this course that will be very beneficial to you.

PROGRESSION
There is very good progression from this Course on to N5 Physics or Higher Physics, as well as Electrical, Electronic and other Engineering course at College or University.
It also provides excellent preparation for employment, or further training, in the electrical and electronics areas of work.

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