Power Supplies

- [ ] • select a dc power source to provide a suitable voltage for a particular purpose;
- [ ] • understand the use of low voltage regulators i.e. L7805 and 78L05.

Mechanical Switches

- [ ] • recognize and use the following types of switches: slide, toggle, rocker, push (PTM and PTB), key, micro, reed, rotary, membrane and tilt;
- [ ] • understand the terms: pole, throw, normally open, normally closed, in relation to SPST and SPDT switches;
- [ ] • use switches connected in series or parallel;
- [ ] • know how to eliminate the effect of switch bounce.

Resistors

- [ ] • understand and use resistors to control voltage and current in electronic circuits and use Ohms Law calculations to determine current flowing through a resistor and voltage across a resistor and determine the value of resistors in series;
- [ ] • use potentiometers or variable resistors within electronic circuits;
- [ ] • understand that LDRs and thermistors are types of variable resistors and know how their resistance varies with light and temperature respectively;
- [ ] • determine the value of a fixed resistor by using the resistor colour code and a multimeter and use the units of measurement correctly (limited to three colour band resistors + tolerance band);
- [ ] • use fixed resistors as pull-up and pull-down resistors connected to inputs;
- [ ] • know that resistors are commonly available in preferred value series, i.e. E24 (5%);
- [ ] • be aware that several resistors can be packaged in a single in line (SIL) resistor network or in a dual in line (DIL) IC.

Capacitors

- [ ] • understand that capacitors store electrical charge;
- [ ] • identify polarised and non-polarised capacitors and use the units of measurement correctly;
- [ ] • identify the anode and cathode leads of a polarised capacitor;
- [ ] • use a capacitor and resistor in combination to achieve a time delay;
- [ ] • understand the use of capacitors to smooth a dc voltage supply.

Diodes

- [ ] • understand that diodes allow current to flow in one direction only;
- [ ] • identify the anode and cathode leads;
- [ ] • use a diode to protect components from back electro-motive force (emf);
- [ ] • use a diode to protect components against incorrect battery polarity.

Light Emitting Diodes (LEDs)

- [ ] • understand that LEDs are special types of diodes that emit light;
- [ ] • identify the anode and cathode leads;
- [ ] • use LEDs in electronic circuits, calculate and select a suitable current limiting resistor from the E24 resistor range;
- [ ] • be aware that LEDs are available as bi-colour, tri-colour, and also as IR emitters.

Bi-polar Transistors

- [ ] • know how and when to use a bi-polar transistor;
- [ ] • recognize the circuit symbol for an NPN bi-polar transistor and photo transistor;
- [ ] • identify the base, emitter and collector leads;
- [ ] • draw the circuit diagram and understand the use of a Darlington pair transistor configuration used as a transducer driver (NPN only), i.e. BC548 and BC639;
- [ ] • be aware that a Darlington Pair can be packaged as a single transistor, i.e. BCX38;
- [ ] • be aware that Darlington driver transistors can be packaged as a transistor array consisting of several transistors packaged in a single IC, i.e. ULN2803 and ULN2003.

Field Effect Transistors

- [ ] • know how and when to use a Field Effect Transistor;
- [ ] • recognise the circuit symbol for a metal oxide silicon Field Effect Transistor (MOSFET) only;
- [ ] • identify the gate, drain and source leads of a MOSFET

Thyristors

- [ ] • know how and when to use a thyristor;
- [ ] • identify the gate, anode, and cathode leads;
- [ ] • use and describe the action of a thyristor as a latch in an electronic circuit;
- [ ] • understand that a thyristor latch is an example of a bistable circuit.

Relays

- [ ] understand that relays are used to interface between electrical circuits without any electrical connection by the use of magnetism.

Opto-isolators

- [ ] Opto-isolators use an infra-red emitting diode and a phototransistor to interface between electronic circuits without any electrical connection by the use of infra-red light.

Operational Amplifiers

- [ ] • understand the function of an operational amplifier and be able to describe the use of the non-inverting and inverting inputs;
- [ ] • use operational amplifiers which require a single power supply, i.e. 3140 IC;
- [ ] • use an operational amplifier as a comparator and an inverting amplifier;

- [ ] • know how to limit the gain of an operational amplifier by using an input resistor and a feedback resistor (negative feedback only).

Logic

- [ ] • understand that logic is used when circuits require more than one input;
- [ ] • use the following logic gates and construct their truth tables (limited to 2 inputs): AND, OR and NOT;
- [ ] • understand that logic gates respond to, and output, digital signals and distinguish these from analogue signals.

Microcontrollers

- [ ] • understand that microcontrollers are programmable integrated circuits;
- [ ] • demonstrate an awareness that a programming language can be used to integrate a variety of sub-system routines into one program and can be downloaded onto a microcontroller;
- [ ] • use a programming method to develop sub-system routines which include the following functions: start, stop, output, wait, decision, compare, expression, increment, decrement, pulse, sound, count, infrared and end;
- [ ] • be aware that decimal and binary numbers can be used to control the logic state of outputs;
- [ ] • show how sub-system routines can be combined to produce complex outcomes;
- [ ] • use digital and analogue input sensors with a microcontroller;
- [ ] • interface microcontrollers with a transducer driver;
- [ ] • interface microcontrollers with output devices which generate light or sound;
- [ ] • interface microcontroller with other types of ICs, i.e. 4017 IC and 4026 IC;
- [ ] • use an infrared receiver and transmitter with a microcontroller.

Potential Dividers

- [ ] • use a potential divider to control voltages in a circuit;
- [ ] • construct a constant voltage potential divider from two fixed resistors in series;
- [ ] • construct a variable voltage potential divider from a fixed resistor and an LDR or thermistor in series;
- [ ] • construct a potential divider consisting of an LDR or thermistor in series with a potentiometer or variable resistor to set a threshold switching voltage.

Electronic Switches

- [ ] How to use transistors, logic gates and microcontrollers as electronic switches.

Timers

- [ ] Candidates should be taught to use a capacitor and resistor in series to produce a time delay.

Integrated Circuits (ICs)

- [ ] • describe what is meant by a Dual In Line (DIL) IC package;
- [ ] • identify the pin numbers on a dual in line IC;
- [ ] • describe the use of an IC socket;
- [ ] • show awareness of dedicated ICs found in toys and greeting cards e.g. melody generators, siren generators and various other sounds.

Monostable Timers

- [ ] • use a 555 IC to produce a monostable time delay and calculate th0e time period;
- [ ] • understand how to adjust the time delay of the monostable.

Astable Circuits (Pulse Generators)

- [ ] • use a 555 IC as a pulse generator and calculate the frequency of the pulses;
- [ ] • understand equal and unequal mark space ratios;
- [ ] • understand how to adjust the frequency of the astable.

Counter

- [ ] counters to achieve simple counting i.e. 4017 IC and 4026 IC.

Interface Devices

- [ ] Candidates should be taught to select and use an appropriate amplifier/transducer driver for a particular purpose limited to Darlington drivers, op-amps, field effect transistors, bi-polar transistors and thyristors.

Output Devices

- [ ] Candidates should be taught to describe applications for, and use LEDs, buzzers, lamps, bells, loudspeakers, sirens, piezo sounders, solenoids and seven segment displays.

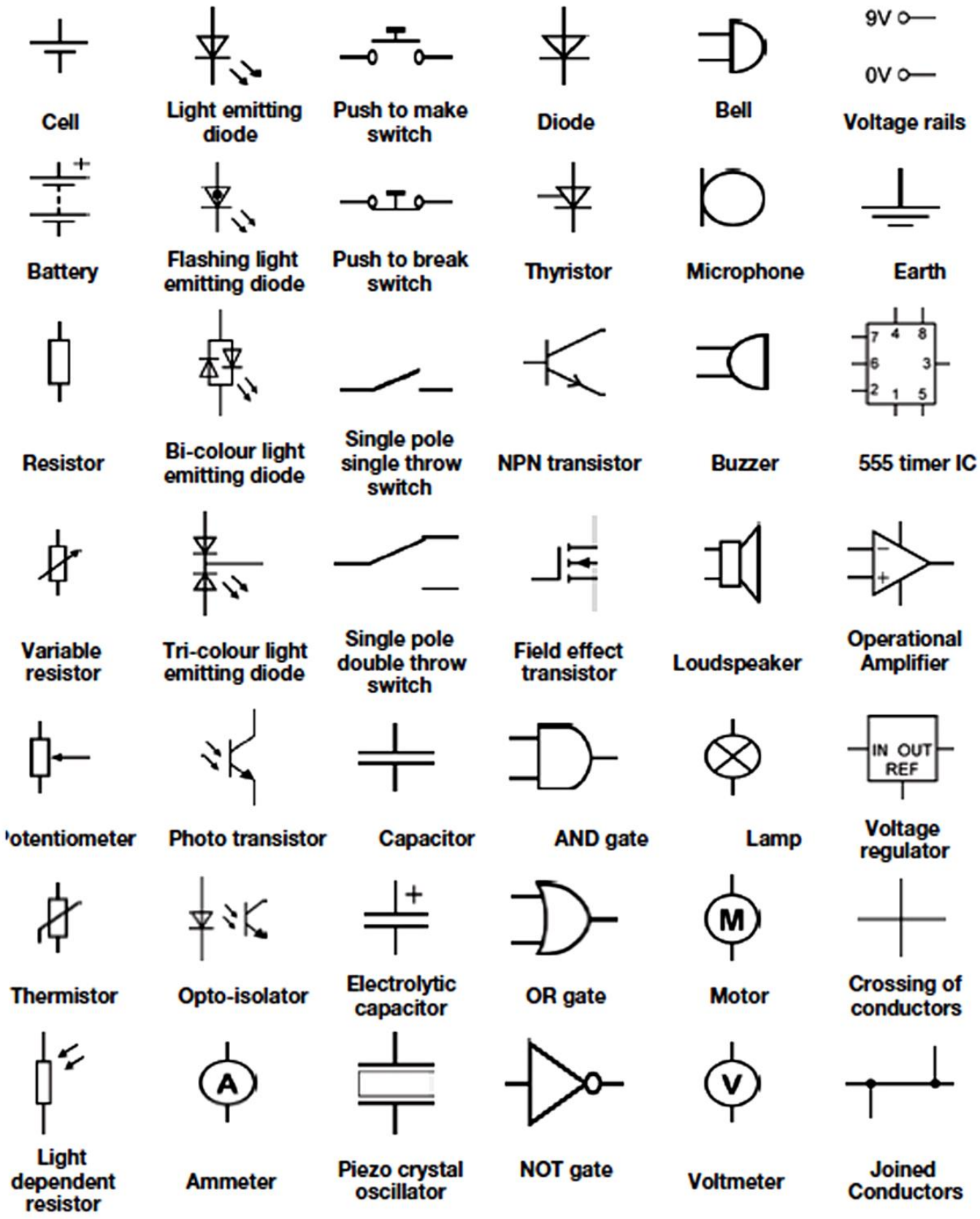
Transducer Input Devices

- [ ] Candidates should be taught to describe applications for, and use LDRs, thermistors, piezos, moisture sensors and microphones.

Smart Materials

- [ ] • describe how materials can be combined and processed to create more useful properties and how these changed materials are used in industrial application;
- [ ] • be aware of the use of smart materials, i.e. electro-luminescent materials, shape memory metals, polymer fibre optical cables, photovoltaic cells, piezoelectric cable, semi-conductor material and Quantum Tunnelling Composite (QTC).
- [ ] • have an awareness of the development and possible applications of nanoelectronics in the area of Design and Technology.

Required Circuit Symbols;



Required Calculations;

Calculations

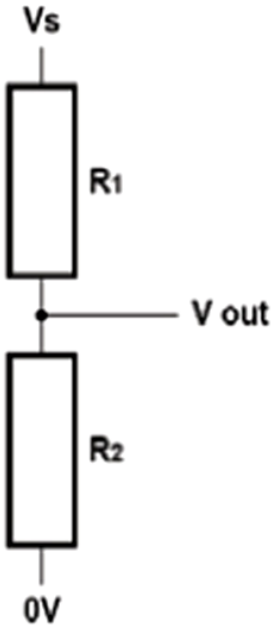
Candidates should be taught to use the formulae listed below:

(these formulae will be listed in the examination paper);

Potential Difference — Potential Difference = Current × Resistance ($V = I \times R$)

Series Resistors — $R_{total} = R1 + R2 + R3$ etc

Potential Divider



$$V\ out = \frac{R2}{R1 + R2} \times Vs$$

where V out = signal value

Vs = supply voltage

R1 and R2 are resistance values

Time Constant — Time Constant = Resistance × Capacitance ($T = R \times C$)

Astable Frequency for 555 — $$f = \frac{1.44}{(R1 + 2R2) \times C}$$

Mark Space Ratio — $$= \frac{\text{Time high}}{\text{Time low}}$$

Time High — $= 0.693 \times (R1 + R2) \times C$

Time Low — $= 0.693 \times R2 \times C$

Inverting Op.Amps — $$\text{Gain} = \frac{-Rf}{Rin}$$ Where Rf = feedback resistor value; Where Rin = input resistor value