

Power Calculations

- perform simple power calculations using $P = V \times I$.

Resistors in series and parallel

- draw circuit diagrams containing resistors in series and parallel.

Resistor Calculations

- calculate the resistance of two or more resistors in parallel using:

$$\frac{1}{R_{\text{TOTAL}}} = \frac{1}{R_1} + \frac{1}{R_2} \text{ or } R_{\text{TOTAL}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Capacitor charging and discharging characteristics

- explain with the aid of diagrams and graphics the charging and discharging of a capacitor.

Capacitors

- use of capacitors in decoupling, smoothing and timing circuits.

Time Constant calculations

- use $T = C \times R$ to calculate simple time delays.

Alternating Current

- describe what is meant by an alternating current waveform.

Waveforms

- draw common waveforms i.e. sinusoidal, square; describe the meaning of peak frequency, cycle, and peak to peak voltage.

Testing Circuits

- use ammeters, voltmeters, and multimeters to measure current, voltage and resistance.

Transistor Circuit

- define current gain using $I_e = I_b + I_c$.
- complete simple calculations for NPN transistors based on:

$$h_{fe} = \frac{I_c}{I_b}$$

Potential Divider

- calculate the required values of resistance in potential divider circuits.

$$\text{Voltage out} = \frac{R_2}{R_1 + R_2} \times \text{Supply Voltage}$$

(Where R_1 is connected to supply voltage)

Operational Amplifier Calculations

- demonstrate an understanding of an op-amp used as a comparator
- *use the formula for an inverting amplifier*

$$\text{Gain} = \frac{-R_f}{R_{in}}$$

- *use the formula for a non-inverting amplifier*

$$\text{Gain} = \frac{R_f + R_{in}}{R_{in}}$$

Standard Pre-manufactured Components

Candidates should be able to:

Power Supplies

- understand the use and limitations of different types of battery for energy storage purposes;
- select appropriate types for simple specified applications, i.e. dry cells, ni-cads lead-acid, lithium;
- *understand the use of voltage regulators i.e. 78 series. Have a theoretical understanding of power supply circuits, including transformers, diode rectification capacitor smoothing, voltage regulation and current regulation.*

Switches

- understand the action of common switches; toggle, push button, micro, rotary and reed and select for appropriate situations;
- understand the terms pole, throw, normally closed, normally open, change over and common in relation to switches and relays i.e. SPST, SPDT, DPDT;
- construct and draw circuits for switching high current loads, i.e. *FET or* relay for switching motors, solenoids, etc.