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At the end of section **3.1 Monitoring & Measuring A.C.** you should be able to :

- ❑ 1 describe a.c. as a current which changes direction and instantaneous value with time.

- ❑ 2 determine the frequency of an a.c. signal from its period.

$$T = \frac{1}{f}$$

- ❑ 3 determine the frequency and peak voltage of an a.c. supply using an oscilloscope.

- ❑ 4 state that the r.m.s. voltage is equivalent to a d.c. voltage that produces the same power.

- ❑ 5 state the relationship between the peak and r.m.s. values for a sinusoidally varying voltage and current.

- ❑ 6 carry out calculations involving peak and r.m.s. values of voltage and current.

$$V_{rms} = \frac{V_{peak}}{\sqrt{2}} \qquad I_{rms} = \frac{I_{peak}}{\sqrt{2}}$$

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At the end of section **3.2 Circuits** you should be able to :

- ❑ 1 state that voltage is defined as the energy transformed per unit of charge
- ❑ 2 carry out calculations involving the relationship between energy, voltage and charge.

$$V = \frac{W}{Q}$$

- ❑ 3 state that the energy supplied to each coulomb of charge which passes through a source is known as the electromotive force (e.m.f.).
- ❑ 4 state that the energy transformed into another form of energy by a circuit component is known as the potential difference (p.d.)
- ❑ 5 carry out calculations involving the relationships between power, current, voltage and resistance in circuits containing resistors.

$$V = IR \qquad P = IV = I^2R = \frac{V^2}{R} \qquad R_T = R_1 + R_2 + \cdots \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

- ❑ 6 state that a potential divider consists of a number of resistors, or other components, connected in series across a supply.
- ❑ 7 carry out calculations involving potential differences and resistances in potential divider circuits.

$$V_1 = \left(\frac{R_1}{R_1+R_2}\right)V_S \qquad \frac{V_1}{V_2} = \frac{R_1}{R_2}$$

- ❑ 8 state that an electrical source is equivalent to a source of e.m.f. (E) with a resistor in series, the internal resistance (r).
- ❑ 9 describe the principles of a method for measuring the e.m.f. (E) and internal resistance (r) of a source.
- ❑ 10 determine the e.m.f. (E), internal resistance (r) and short circuit current from a graph.
- ❑ 11 explain why the e.m.f. of a source is equal to the open circuit p.d. across the terminals of the source.
- ❑ 12 state that the closed circuit p.d. across the terminals of a source is equal to the terminal potential difference (t.p.d.).

- [ ] 13 state that the e.m.f. of a cell is equal to the sum of the t.p.d. and the lost volts.

- [ ] 14 carry out calculations involving the relationship between the e.m.f., t.p.d. and the lost volts.

$$E = V + Ir$$

- [ ] 15 state that R = r for maximum transfer of energy between a source and a load.

- [ ] 16 use the following terms correctly in context: electromotive force (E), internal resistance (r), lost volts, terminal potential difference (t.p.d.), short circuit and open circuit.

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At the end of section **3.3 Capacitors** you should be able to :

- ☐ 1 state that the charge Q on two parallel conducting plates is directly proportional to the p.d. V between the plates.
- ☐ 2 state that capacitance is the ratio of charge to p.d.
- ☐ 3 state that the unit of capacitance is the farad and that one farad is one coulomb per volt.
- ☐ 4 carry out calculations involving the relationship between capacitance, charge and potential difference.

$$C = \frac{Q}{V}$$

- ☐ 5 calculate the charge stored on a capacitor for a constant charging current.

$$Q = It$$

- ☐ 6 explain why work must be done to charge a capacitor.
- ☐ 7 state that the work done to charge a capacitor is given by the area under the graph of charge against p.d.
- ☐ 8 carry out calculations involving the relationships between capacitance, charge, potential difference and energy stored in a capacitor.

$$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$$

- ☐ 9 describe an experiment to investigate the variation of current in a capacitor and voltage across a capacitor with time, for the charging and discharging of capacitors.
- ☐ 10 draw qualitative graphs of current against time and of p.d. against time for the charge and discharge of a capacitor in a d.c. circuit containing a resistor and capacitor in series.
- ☐ 11 carry out calculations involving p.d. and current in CR circuits.

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At the end of section **3.4 Semiconductors & P-N Junctions** you should be able to :

- ❑ 1 state that materials can be divided into three broad categories according to their electrical properties – conductors, insulators and semiconductors.
- ❑ 2 state that the electrons in atoms are contained in energy levels and when atoms come together, the electrons then become contained in energy levels separated by gaps.
- ❑ 3 state that in conductors the highest occupied band is not completely full and this allows electrons to move therefore conduct. This band is known as the conduction band.
- ❑ 4 state that highly conductive metals have free electrons and partially filled electron bands. Some metals have overlapping valence and conduction bands. Each band is partially filled and therefore they are conductive.
- ❑ 5 state that in insulators the highest occupied band (called the valence band) is full. The band above the valence band is the conduction band.
- ❑ 6 state that for an insulator the gap between the valence band and the conduction band is large and at room temperature there is not enough energy available to move electrons from the valence band in to the conduction band where they would be able to contribute to conduction.
- ❑ 7 state that for a semiconductor the gap between the valence band and the conduction band is smaller and at room temperature there is sufficient energy available to move some electrons from the valence band in to the conduction band allowing some conduction to take place.
- ❑ 8 state that an increase in temperature increases the conductivity of a semiconductor.
- ❑ 9 state that the addition of impurity atoms to a pure semiconductor (a process called doping) decreases its resistance.
- ❑ 10 explain how doping can form an n-type semiconductor in which the majority of the charge carriers are negative, or a p-type semiconductor in which the majority of the charge carriers are positive.
- ❑ 11 describe the movement of the charge carriers in a forward/reverse-biased p–n junction diode.
- ❑ 12 state that p-n junctions are used in a number of devices.
- ❑ 13 state that LEDs are forward biased p-n junction diodes which emit photons when a current is passed through the junction.

- [ ] 14 explain how the movement of electrons across the p-n junction of an LED results in recombination with holes causing photons to be omitted.

- [ ] 15 state that solar cells are p-n junctions designed so that a potential difference is produced when photons are incident upon it. This is the photovoltaic effect.

- [ ] 16 explain how the creation of electron-hole pairs within the p-n junction of an solar cell causes a potential difference to be produced.