Capacitors: Section Summary

1. A **capacitor** is a device that stores electric charge.
2. Any configuration of conductors that is separated by an insulating material has **capacitance** – that is, the ability to store charge.
3. The capacitance of any device is the ratio of the charge stored to the voltage across it. Mathematically:

   $C = Q/V$

   Capacitance is measured in farads (F). One farad equals one coulomb/volt.
4. A **parallel-plate capacitor**, consisting of two conducting plates of cross-sectional area (A) separated by a dielectric of thickness (d) and relative permittivity (ε_r) has a capacitance given by the expression:

   $C = \varepsilon_r \varepsilon_0 A/d$

   where ε_0 is the permittivity of free space (a vacuum).
5. A **dielectric** is the name given to the insulating material in a capacitor.
6. The maximum value of the applied electric field which the dielectric material can withstand without breaking down and conducting current is called the **dielectric field strength**. Capacitors have a particular maximum working voltage. This is less than the breakdown value and should not be exceeded in normal use.
7. For capacitors connected in series, the equivalent capacitance is given by the expression:

   $1/C_s = 1/C_1 + 1/C_2 + 1/C_3 + ...$
8. For capacitors connected in parallel, the equivalent capacitance is given by the expression:

   $C_p = C_1 + C_2 + C_3 + ...$
9. The energy (E) stored in the electric field of a capacitor, with capacitance (C) charged to a potential of (V) volts, is given by the expressions:

   $E = QV/2 = CV^2/2$