Physics & Astronomy
Lecture Course Report (2016/17 session)

Course Title: *Electricity section only*
Module: PHY102
Lecturer(s): Dr C N Booth

General Comments:
Though the short answer question was done reasonably, attempts at the other two were rather poor. Many candidates showed a serious lack of mathematical ability, being unable to handle vectors or use simple geometry or calculus. A criticism of most scripts was that very little explanation was given for the working.

Exam performance:
Qu. 1 Compulsory short answers. (Average mark 12.1/20 from 129 attempts.)

(a) Magnitude and direction of field due to point charge: generally done well, though some people did not give the direction and a few could not work out components of vectors (e.g. divided by cosθ rather than multiplying).

(b) Current and voltage: done perfectly by most, but some calculations were not precise enough.

(c) Series/parallel capacitor network: almost everyone completed this successfully.

(d) Speed of proton in *E*-field: most answers were perfect, though some ignored electric charge.

(e) Definition of electric dipole moment: answered very poorly. Many did not explain what a dipole was; despite it being pointed out in the revision lecture that this was wrong, many talked about the torque on an (undefined) dipole in an electric field.

(f) Electric field of a dipole: most wrote a correct expression but could not take the limit properly. Many gave an answer of zero, or wrote an expression which evaluated to zero but then effectively said 0=1!

(g) Point at which combined field of two charges is zero: many unnecessarily produced a quadratic equation which either they could not solve or quoted an unphysical root as well as the correct one. Others found the point where the potential was zero!

(h) Drift velocity: almost no correct answers. Most did not distinguish between random (thermal) motion and drift velocity; most said it was dependent on derivative properties like resistivity (or on electric field) rather than mass or scattering time of carriers.

Qu. 2 Gauss's law, E from V: Done very poorly. The statement of Gauss's law was often sketchy. Almost no-one justified the choice of Gaussian surface. Hardly anyone even attempted to integrate the non-uniform charge density to get the contained charge, and many confused area and volume. Many said E was V/r, and those who did know it was a gradient could not do the partial differentiation. Several people treated $V(x,y,z)$ as a 3-component vector! (Average mark 7.9/20 from 55 attempts.)

Qu. 3 Power in capacitor decay; field and forces due to 3 charges in triangle: Also done extremely poorly. Many said instantaneous power was energy/time, rather than a derivative; others could not set up or perform the integral over time, or used the wrong limits. Few people manage to use simple geometry to find the distance to the charges correctly. A large number left distances in cm when calculating. Many simply added magnitudes of vectors rather than considering components, or could not find the component of a Coulomb's law force. Even those who did the question correctly failed to exploit the symmetry of the charges and instead did very complicated calculations. (Average mark 7.6/20 from 73 attempts.)

Overall section average: 49.3%