School of Mathematics

Course 432 — Classical Fields 2002–03
(SS Theoretical Physics, optional JS Theoretical Physics, JS & SS Mathematics)

Lecturer: N. H. Buttimore

Requirements/prerequisites: 221, 231, 241

Duration: 21 weeks.

Number of lectures per week: 3

Assessment:

End-of-year Examination: One 3-hour examination

Description: Lagrangian density for a field, Hamilton's variational principle, symmetry and conservation laws, Noether's conserved current, covariant field theory, free scalar and vector fields, four-vector potential, Lorentz force for charged particles.

Maxwell's equations for the antisymmetric field tensor describing electric and magnetic induction fields. Field equations with particles, Lorentz gauge, charge conservation.

Symmetric traceless gauge invariant stress tensor, particle and field energy-momentum and angular momentum conservation,

Green functions for Laplacian and d'Alembertian operators, Lienard-Wiechert potentials, velocity and acceleration fields for a moving charge, scattering, Thomson cross section.

Radiation from linear and circular accelerated motion, Larmor's formula, relativistic angular distributions, radiation damping, decay of radius for a circular orbit.

Relation of classical field theories and electrodynamics to quantum electrodynamics, quantum chromodynamics and gravity.

April 8, 2003