

## Syllabus for Physics 321A

Numbers in parenthesis indicate section of Griffiths.

### Week 1 3/30-4/3

1. Definition of vectors (1.1.1.; 1.1.5)
2. Scalar and vector products, multiple products, gradient divergence,
3. Gauss' theorem, application to fluid flow and conservation law (1.1.2- 4; 1.2.1-2; 1.3.3) curl, Stokes' theorem (1.2.3-1.2.6; 1.3.4-5),

### Week 2 4/6-4/10

1. second derivatives, vector and scalar potentials (1.2.7) delta function sources, Dirac delta function (1.5.1-3)
2. Helmholtz theorem (1.6, Appendix B)
3. Electrostatics: Coulomb's law. electric field, Example: simple dipole (2.1.1-3), field of a charged ring

### Week 3 4/13-4/17

1. div and curl of electrostatic field (2.1.4-2.2.2), Gauss' law and applications (2.2.3-4)
2. Electrostatic potential, V from E, examples of spherical symmetry (2.3.1)
3. Potential of long wires, potential from a discrete charge distribution; a dipole (2.3.4)

### Week 4 4/20-4/24

1. electric field from V, dipole moments of molecules, the Debye unit defined, the Boltzmann probability
2. Average potential energy of a dipole in a thermal bath; energy of two dipoles (Ch. 4, probs 4.7, 4.8)
3. work and energy in electrostatics (2.4.1-2), energy of an NaCl crystal

### Week 5 4/27-5/1

1. energy in a continuous distribution; solid sphere, spherical shell (2.4.3, 2.4.4)
2. conductors, Laplace and Poisson's equation; uniqueness theorems, properties of harmonic functions (2.5, 3.1)
3. FIRST HOUR EXAM 5/1

### Week 6 5/4-5/8

1. relaxation method, method of images (3.1.3, 3.2)
2. method of images: charge in a grounded sphere, perfect screening (3.2.4)
3. screening of a charge in water

### Week 7 5/11-5/15

1. separation of variables; cartesian coordinates (3.3.1)
2. separation of variables; cylindrical coordinates, axial symmetry
3. cylindrical coordinates, general solution

## Week 8 5/18-5/22

1. separation of variables in spherical coordinates: azimuthal symmetry, Legendre polynomials (3.3.2)
2. Associated Legendre functions, spherical harmonics, gen'l sol'n in spherical coordinates (Boas, Ch. 12, Sec. 10)
3. SECOND HOUR EXAM

## Week 9 5/25-5/29

1. Memorial Day (no class)
2. field of volume distribution of dipoles (4.1-4.3)
3. linear dielectrics, dielectric constant (4.3-4.4)

## Week 10 6/1-6/5

1. displacement field, applications to high symmetry cases (4.3-4.4) formulation of solutions of Laplace's equation for dielectrics (4.4.2)
2. dielectric sphere in external field (4.4.2), forces on dielectrics, electrostatic energy (4.4.3, 4.4.4)
3. polarizability of molecules with a permanent dipole, polarization contribution to the hydrogen bond

TUESDAY 6/9 FINAL EXAM 8:30-10:20