

Physics 106b  
Problem set number 6  
Due Wednesday, February 24, 1999

**Notes about course:**

- Note that there is a “Ph106” box in room 335, which can be used for submitting homework sets.
- TAs:

Yi Li	lym@its.caltech.edu	Tue 4-5	176 Watson
Chiyan Luo	chiyan@cco.caltech.edu		
Federico Spedalieri	federico@cco.caltech.edu	Mon 4-6	201 Synchrotron
- Web page URL:  
<http://www.cithec.caltech.edu/~fcp/ph106/>

Reading: Jackson Chapter 2, sections 2.1 through 2.11. We’ll skip the Finite Element Analysis, as well as the other “numerical methods” in this course, but you should glance at it anyway to be aware of its existence. These methods are of great practical importance, but “canned” software is available to those who need it.

28. (a) Jackson problem 1.12.  
(b) Prove that  $C_{ij} = C_{ji}$  for coefficients of induction  $C_{ij}$ .
29. Jackson problem 2.2.
30. Consider a potential problem with Neumann boundary conditions on the plane  $z = 0$  (and at infinity). The region of interest is the  $z \geq 0$ .
- (a) Write down the Green’s function  $G(\mathbf{x}, \mathbf{x}')$ .
- (b) Consider the boundary condition on the  $z = 0$  plane:

$$E_z = \begin{cases} E_0 & x^2 + y^2 < a \\ 0 & \text{otherwise.} \end{cases}$$

Using cylindrical coordinates  $(\rho, \phi, z)$ , obtain an integral representation for the potential in the region  $z > 0$ .

31. Jackson problem 2.7 (note similarity, and difference, with preceding problem).
32. Conformal mapping exercise: Consider a two-dimensional potential problem with a (line) charge of strength  $q$  at  $w_0$ . It lies inside a circular (*i.e.*, cylindrical in three dimensions) grounded conductor, of radius  $R$ . Consider a conformal map of the form:

$$w = \frac{az + b}{cz + d}.$$

Determine the conditions for this to correspond to a map of the interior of the circle to the upper half-plane. Use this mapping and the solution to the potential for the case of a charge in the upper half-plane with boundary condition  $\Phi(y = 0) = 0$  to solve the boundary value problem for the circle.