PRACTICE PROBLEMS FOR THE FIRST MIDTERM

1. (a) Give the definition of:
    (i) a PDE.
    (ii) a linear operator
    (iii) a linear homogeneous equation.
    (iv) a linear inhomogeneous equation.
    (v) the characteristic curve of a linear PDE.
    (vi) the Laplacian.
    (vii) a harmonic function.
    (viii) 2nd order constant coefficient linear elliptic PDE.
    (ix) 2nd order constant coefficient linear hyperbolic PDE.
    (x) 2nd order constant coefficient linear parabolic PDE.

   (b) Write down
    (i) The general linear constant coefficient PDE in two variables.
    (ii) the PDE describing simple transport.
    (iii) the PDE describing a vibrating string.
    (iv) the PDE describing a vibrating drumhead.
    (v) the PDE describing simple diffusion.
    (vi) the PDE describing heat flow.

2. Solve the equation $xu_x + yu_y = 0$.
3. Solve the equation $yu_x + xu_y = 0$ with $u(0, y) = e^{-y^2}$.
4. 1.3.3.
5. 1.4.3.
6. Solve the equation $u_x + 2xy^2u_y = 0$ with $u(x, 0) = \phi(x)$.
7. (1.6.2).