

**MATH 3403**  
TUTORIAL SHEET 3

1. Reduce the following second order operators to the appropriate canonical form, indicating whether it is elliptic or hyperbolic.

- (a)  $u_{xx} + 2u_{xy} + 5u_{yy}$
- (b)  $3u_{xx} + 10u_{xy} + 3u_{yy}$
- (c)  $u_{rr} + \frac{1}{r}u_r + \frac{1}{r^2}u_{\theta\theta}$

2. Classify the following operators as to type in the  $xy$  plane:

- (a)  $x^2u_{xx} + xu_{xy} - yu_{yy}$
- (b)  $u_{xx} + x^2yu_{yy}$
- (c)  $u_{xx} - xyu_{yy}$

3. Find the general solution of

$$u_{xx} - 5u_{xy} + 6u_{yy} = 0.$$

**Assignment** Question 1(c), 3.