PART IIA 2005

3F2 Systems and control

Principal Assessor: **Dr J M Maciejowski**

ENGINEERING TRIPOS PART IIA 2005
ANSWERS TO MODULE 3F2: SYSTEMS AND CONTROL

1. (c): $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $e^{At} = \begin{bmatrix} 1 & t \\ 0 & 1 \end{bmatrix}$

2. (c): $B = \begin{bmatrix} 0 \\ 0 \\ 1/T \end{bmatrix}$, $D = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

3. (a): $\dot{x} = Ax + Bu$ where

$$A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ v/p & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ v^2/ph & 0 & g/h & 0 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \\ 0 \\ bv/ph \end{bmatrix}$$

   (b): Poles are at $0, 0, \pm\sqrt{g/h}$

   (d): Yes it is possible.

4. (c): $0 < k < 312$. (Since the question says 'estimate' and expects the use of graphical root-locus methods, any answer reasonably close to 312 is acceptable.)