

## MATH 8402: Assignment 1

**Problem 1.** [Temam-Mirantville, page 21, no.1] We consider the velocity field of a continuum given in Eulerian description

$$\mathbf{v} = (v_1, v_2, v_3) = (\sin t, \cos t, \alpha), \quad \alpha \geq 0.$$

Compute the *streamlines* and *trajectories* of the motion.

**Problem 2.** [Temam-Mirantville, page 22, no.4] We consider the motion of a continuum medium given in Lagrangian representation by:

$$\begin{aligned}x_1 &= X_1 \cos \omega t - X_2 \sin \omega t \\x_2 &= X_1 \sin \omega t + X_2 \cos \omega t \\x_3 &= X_3,\end{aligned}$$

$$\omega \in \mathcal{R}, t \geq 0.$$

- Calculate the Jacobian of the mapping  $\mathbf{X} \rightarrow \Phi(\mathbf{X}, t)$ .
- Give the Eulerian representation of the motion.
- Compute trajectories and streamlines

**Problem 3.** Let  $S, T$  be  $n \times n$  matrices such that  $\det S > 0$ . Let  $f(S) = \det S$ . Show that

$$f'(S) \cdot T = \text{tr}(T(\text{cof } S)^T),$$

where  $(\text{cof } S)^T = (\det S)S^{-1}$ .

**The assignment is due on Wednesday, February 6.**