Ministry of Higher Education and Scientific Research Mohamed Boudiaf University of M'sila Institute of Urban Techniques Management Department of Architecture

Exam of Mathematics (1h30)

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Exercise 1 Calculate the following integrals:

1.
$$\int_0^{\pi} x \cos(x) dx$$
.

$$2. \int \frac{\cos(x)\sin(x)}{\sin(x)^2 + 1} dx.$$

3.
$$\iint_D x - y \, dx \, dy$$
, $D = \{x, y \in \mathbb{R} : 0 \le x - y \le 1, 1 \le x + 2y \le 2\}$.

4.
$$\iiint_D \sqrt{x^2 + y^2 + z^2} \, dx dy, \quad D = \{x, y \ge 0 : x^2 + y^2 + z^2 \ge 1, x^2 + y^2 + z^2 \le 16\}$$

Exercise 2 In $\mathbb{R}^{3\times 3}$, we consider the following matrices:

$$A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 3 & 0 \\ 0 & -1 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 2 & -1 \\ -1 & 2 & 1 \\ 0 & 0 & 1 \end{pmatrix}.$$

- 1. Determine the determinant det(A) and det(B).
- 2. Calculate the inverse matrics A^{-1} and B^{-1} .
- 3. Conclude the matrices $(AB)^{-1}$ and $(BA)^{-1}$.
- 4. Find x, y and z where

$$\begin{cases}
-x & +\frac{3}{2}y & +4z & = 1, \\
-\frac{1}{2}x & +\frac{3}{4}y & +\frac{3}{2}z & = 1 \\
x & -y & -2z & = 2
\end{cases}
\begin{cases}
-\frac{1}{2}x & +\frac{5}{2}y & +6z & = 2, \\
\frac{1}{4}x & -\frac{3}{4}y & -2z & = 1 \\
\frac{1}{4}x & -\frac{3}{4}y & -z & = 2
\end{cases}$$
(1)

Good luck