Université Mohamed - KHIDER - BISKRA
Département de Génie Mécanique – Elasticity - 2025/2026
Responsable du Module : Pr. HECINI M.

Travaux Dirigés (Série N° 1)

Exercise N° 1 :

For n=2 write the expression explicitly $S_1 = x_i y_i$.
For n=3 write the expression explicitly $S_2 = A_{ijk} B_{ij}$.
For n=2 write the expression explicitly $S_3 = a_{ijk} b_{ij} c_k$.

Exercise N° 2 :

Use the summation convention to write the following expressions, specifying the value of n in each case :

$A= a_{j1}\, x_1 + a_{j2}\, x_2 + a_{j3}\, x_3$
$B= b_{11}\, d_{11} + b_{12}\, d_{12} + b_{13}\, d_{13} + b_{14}\, d_{14}$
$C= C^1{}_{11} + C^2{}_{12} + C^3{}_{13} + C^4{}_{14} + C^5{}_{15}$

Exercise N° 3 :

Let $e_1(1,0,0)$, $e_2(0,1,0)$, $e_3(0,0,1)$ be a basis of R^3 ; we define the vectors A and B by:

$A= 4\, e_1 +2\, e_2 + e_3$ $\qquad$ $B=3\, e_1 -5\, e_2 +2\, e_3$

1°) determine the scalar product $(A \cdot B)$ of the vectors A and B.
2°) determine the vector product $(A \wedge B)$ of the vectors A and B.
3°) determine the tensor product $(A \otimes B)$ of the vectors A and B.
4°) determine the angle between the vectors A and B.

Same thing for vectors $\quad A=(2, 1, 3) \quad B= (1, 2, 4)$

Exercise N° 4 :

Show that : $\quad I+(*n)^2 = {}^t(n)\,(n)$ $\quad$ with $\quad {}^t n = (n_1 , n_2 , n_3)$ a unit vector

Exercise N° 5 :

We consider the basis $\{f_j\}$ of R^3 defined by the following vectors:

$$f_1 = (1, 0, 0) \qquad f_2 = (\frac{1}{2}, \frac{3}{2}, 0) \qquad f_3 = (\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}})$$

and the vector : $\quad A= 8\, e_1 + 6\, e_2 + 3\, e_3$

1°) is the basis $\{f_j\}$ orthonormal ?
2°) determine the projections of vector A on the vector axes f_1 , f_2 et f_3 .
3°) determine the components of vector A in the basis (f_1 ,f_2 ,f_3).

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Travaux Dirigés (Série N° 1 - bis)

Exercise N° 6 :

We consider the vector function defined by $F=(u_1, u_2, u_3)$ such that :

$$u_1 = 8\,x_1 + 6\,x_2$$
$$u_2 = 10\,x_1 - 8\,x_2$$
$$u_3 = 12\,x_3$$

1°) Determine the tensor GradF .

2°) Determine the transpose of the tensor Grad F denoted Grad^t F.

3°) Determine the tensor A such that A= (Grad F + Grad^t F)/2.

4°) Determine the eigenvalues and eigendirections of the tensor A

Exercise 07

Determine the eigenvalues and eigenvectors of the following matrices :

$$M_1 = \begin{bmatrix} 4 & 3 & 0 \\ 3 & -8 & 0 \\ 0 & 0 & 2 \end{bmatrix}, \quad M_2 = \begin{bmatrix} 13 & 0 & 0 \\ 0 & 12 & -2 \\ 0 & -2 & 6 \end{bmatrix} \; et \quad M_3 = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -6 & 0 \\ 1 & 0 & 4 \end{bmatrix}$$

Exercise N° 8 :

a) Demonstrate the following properties of the gradient, for scalar fields $f(x_1, x_2, x_3)$ and $g(x, y, z)$:

Grad(f+g) = Grad(f) + Grad(g)

Grad(af) = αGrad(f)

Grad(f.g) = gGrad(f) + fGrad(g)

b) Let the scalar function be : $f(x_1, x_2, x_3) = x_1^2 x_2 (2 + x_2 x_3^3)$

Determine the Gradient of f.

Determine the Laplacian of f.