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Advanced Continuum Mechanics
Home assignment number 1, 1999

x, y are cartesian coordinates in the plane. Elliptical coordinates are defined by

$$x = c \cosh \mu \cos \theta, y = c \sinh \mu \sin \theta.$$

c is a positive constant. Sketch the coordinate lines and show that the curves $\mu = const$ (the θ lines) are ellipses. Also show that the semi-major axis is $a = c \cosh \mu$ and the semi-minor axis $b = c \sinh \mu$. Show that $c^2 = a^2 - b^2$ is the same for all these ellipses. Further, show that the $\mu = const$ curves (μ lines) are hyperbolas, orthogonal to the ellipses. Determine their a and b values and $c^2 = a^2 + b^2$. Conclude that all foci coincide.

Now calculate the affinities. First using the coordinate basis, then using the natural orthonormal basis.

Determine the gradient of a scalar field Φ. For a vector field **a** calculate the gradient.

Finally, for a symmetric tensor field **T** calculate the divergence.