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Axisymmetric Rotating Flow over a Permeable Surface with Heat and Mass Transfer Effects

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Abstract : In this article, rotational flow above a permeable surface with a variable free stream angular velocity is considered. Main interest is to solve the associated heat/mass transport equations under different situations. Firstly, heat transport phenomena occurring in generalized vortex flow are analyzed under two altered heating processes, namely, the (i) prescribed surface temperature and (ii) prescribed heat flux. The vortex motion imposed at infinity is assumed to follow a power-law form □(r/r_0)□^((2n-1)) where r denotes the radial coordinate, r_0 the disk radius, and n is a power-law parameter. Assuming a similar solution, the governing Navier-Stokes equations transform into a set of coupled ODEs which are treated numerically for the aforementioned thermal conditions. Secondly, mass transport phenomena accompanied by activation energy are incorporated into the generalized vortex flow situation. After finding self-similar equations, a numerical solution is furnished by using MATLAB's built-in function bvp4c.

Keywords : bödewadt flow, vortex flow, rotating flows, prescribed heat flux, permeable surface, activation energy
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