Abstract

Baraa A Khamis

Solutions of Some Viscous Fluid Flow Problems in Porous Mediums

The thesis is concerned with the flow of viscous-fluids through porous mediums. It consists of four chapters: Chapter one deals with the equations of motion of viscous fluids. Basic definitions of Porous media, porosity and permeability are given. Darcy's law and Brinkman equation are presented and discussed. Different types of boundary conditions for the velocity are discussed. In the second chapter, Darcy–Brinkman longitudinal flow through a porous tube with slightly corrugated wall is solved and discussed. The following assumptions are made: the corrugations are periodic sinusoidal waves of small amplitude, and the tube is filled with a sparse porous medium so that the flow can be described by the Darcy–Brinkman model. A perturbation technique is used to get the average flow rate up to order two of the normalized amplitude. The effects of the corrugations on the flow are investigated as functions of the flow direction, permeability, and the wavelength of the corrugations. It is found that the corrugations will have greater effects when it is nearer the Stokes' flow limit than the Darcian flow limit. In the third chapter, we examine Darcy–Brinkman axial flow through a porous tube with slightly corrugated wall. The following assumptions are made: the corrugations are periodic sinusoidal waves of small amplitude the tube is filled with a sparse porous medium so that the flow can be described by the Darcy–Brinkman model and the Reynolds number is also assumed to be low that the nonlinear inertia can be neglected. The effects of the corrugations on pressure are investigated as functions of the wave number of the corrugations, and permeability of the porous medium. It is found that the corrugations have greater effects when it is nearer the Stokes' flow limit than the Darcian flow limit. In the final chapter, the problem of axial flow through corrugated tube is considered. The corrugations are of small amplitude and are modeled by stationary random noise which are expected to be valid in most of practical applications. The study is based on the following assumptions: the tube is filled with a sparse porous medium so that the flow can be described by the Darcy–Brinkman model, and the Reynolds number is also assumed to be low that the nonlinear inertia can be neglected. A formula for the mean pressure is obtained as a function of frequency of corrugations and permeability of the medium, for any stationary random noise of the surface of the tube. As an example, the case of sinusoidal corrugations is considered.