UNIVERSITI PUTRA MALAYSIA

RAYLEIGH-BENARD CONVECTION IN MICROPOLAR FLUIDS WITH INTERNAL HEAT GENERATION

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RAYLEIGH-BENARD CONVECTION IN MICROPOLAR FLUIDS WITH INTERNAL HEAT GENERATION

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

July 2013

To My Beloved Family.

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

RAYLEIGH-BENARD CONVECTION IN MICROPOLAR FLUIDS WITH INTERNAL HEAT GENERATION

By

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July 2013

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Rayleigh-Bénard convection is the heat transfer process which due to buoyancy forces that occurred in a plane horizontal layer of micropolar fluids heated from below. The effect of feedback control and magnetic field on the onset of Rayleigh-Bénard convection in a horizontal micropolar fluids layer in the presence of heat generation has been studied. The fluid layer with various boundary conditions at the lower and upper boundaries, and perfectly heat conduction are investigated theoretically based on the linear stability analysis. The various boundary conditions are assumed to be rigid-rigid, rigid-free and free-free. The resulting eigenvalue problems are solved analytically using the Galerkin method. The critical Rayleigh numbers are obtained and the influences of various parameters have been analyzed. It is found that the rigid-rigid surface is the most stable system, and the effect of feedback control as well as the magnetic field always stabilized the system is shown.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

OLAKAN RAYLEIGH-BENARD DI DALAM BENDALIR MIKROPOLAR DENGAN PENJANAAN HABA DALAMAN

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Olakan Rayleigh-Bénard merupakan suatu proses pemindahan haba yang disebabkan oleh daya keapungan bagi lapisan mengufuk bendalir mikropolar yang dipanaskan dari bawah. Kesan kawalan suap balik dan medan magnet ke atas olakan Rayleigh-Bénard dalam lapisan bendalir mikropolar mengufuk dengan kehadiran penjanaan haba dalaman dikaji. Sistem dengan pelbagai syarat sempadan pada sempadan bawah dan atas, dan konduksi haba yang sempurna telah dikaji secara teori berdasarkan teori kestabilan linear. Syarat sempadan yang pelbagai ini diandaikan seperti tegar-bebas, tegar-tegar dan bebas-bebas. Masalah nilai eigen yang diperoleh diselesaikan secara analitik menggunakan kaedah Galerkin. Nombor kritikal Rayleigh diperolehi dan kesan ke atas beberapa kaedah parameter telah dianalisa. Didapati system permukaan tegar-tegar adalah yang paling stabil, manakala kesan kawalan suap balik dan medan magnet sentiasa menstabilkan system juga ditunjukkan.

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DECLARATION

I declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

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IZZATI KHALIDAH KHALID

Date: 25 July 2013

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