AIN SHAMS UNIVERSITY
COLLEGE OF WOMEN FOR ARTS, SCIENCE AND EDUCATION,
MATHEMATICS DEPARTMENT

"ON THE INSTABILITY CONDITIONS FOR SOME PROBLEMS OF COUPLE - STRESSES IN FLUIDS"

A THESIS

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By

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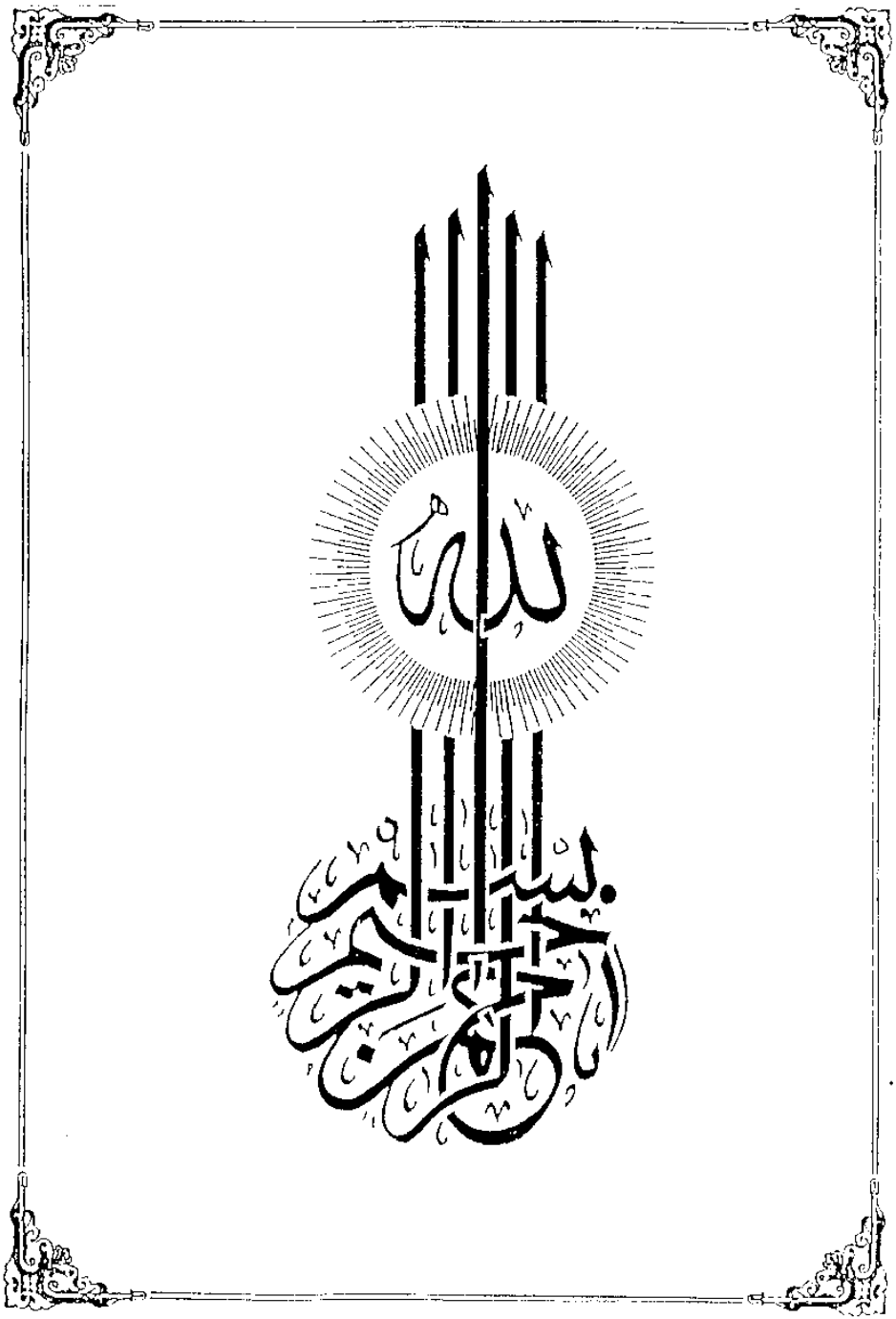

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SUMMARY

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The thesis is mainly concerned with the instability conditions for some problems of couple stresses in fluids.

The thesis consists of eight chapters:

Chapter 1: Includes an explanation of the main aspects of couple stresses and its various applications. We also discuss the concepts of continuous medium, the equations of motion, the electrohydrodynamics and analysis in terms of normal modes.

Chapter II: Includes a study of the Instability conditions of an unbounded dielectric, viscous, incompressible and couple stresses fluid under the influence of a vertical ac electric field, vertical temperature gradient and concentration.

The equations of motion are solved by applying linear perturbation theory and approximations analogous to the usual Boussinesq approximations and an eigenvalue equation is derived.

The analysis obtained is based on the linear perturbation and Hurwitz's theories. It is transpired that the couple stress has instability effect theoretically and numerically. Some special cases, are also discussed.

Also in this chapter, we study the effect of stability conditions on an infinite layer of a dielectric, couple stress and incompressible fluid confined between two

parallel vertical plates under the influence of ac electric field, concentration and temperature.

The power series method is used to obtain the eigenvalue equation theoretically.

Chapter III: Includes a study of the stability conditions on an infinite fluid confined between two parallel plates which are separated by a distance and inclined from the vertical axes by an angle and we consider an infinite layer of dielectric, viscous, couple stresses and incompressible fluids. It is assumed that the fluid layer is heated internally by a uniform distribution of heat sources.

The power series method is used to obtain the eigenvalue equation which is solved theoretically. A special case is obtained by Takashima.

Chapter IV: Includes an explanation of the effect of stability conditions on a horizontal infinite layer of dielectric, couple stress, viscous and incompressible in the presence of vertical dc electric field and a vertical temperature gradient. Applying linear perturbation theory, an eight - order equation, with varying coefficients, and the relevant boundary conditions are derived. The method of power series is used to obtain the eigenvalue relationship which is then computed theoretically. A special case is obtained by Takashima in the absence of couple stress.

Also in this chapter, we study the effect of the stability conditions on an unbounded viscous, couple

stresses and incompressible in the presence of a vertical temperature gradient and dc electric field. Applying the linear perturbation theory we obtain an eigenvalue equation.

The analysis is based on Hurwitz's theorem. Necessary and sufficient conditions for the stability of two - dimensional disturbances are discussed.

Chapter V: Includes an examinations of the effect coefficient of couple stress on an infinite layer of a dielectric, rotate with angular velocity, viscous and incompressible fluid confined between two horizontal planes in the presence of a vertical ac electric field and a vertical temperature gradient. Applying linear perturbation theory, a twelveth-order equation is derived.

Under the effect of boundary conditions, this equation is solved exactly and the eigenvalue relationship is obtained. Discussing the relation numerically, we find that the coefficient of couple stress has an inverse proportion with the angular velocity.

This chapter also contains a study of instability condition of unbounded rotating and couple stress fluid in the presence of a vertical ac electric field and a vertical temperature gradient.

Linear perturbation theory and the normal modes are applied to obtain a fourth - order eigenvalue equation. Discussion of the eigenvalue equation analytically and numerically revealed that the coefficient of couple stress

renders the system unstable.

Chapter VI: Deals with the Kelvin-Helmholtz instability conditions of an interface separating two viscous, couple stresses, incompressible and streaming fluids. Equations of motion are solved by applying boundary conditions at the interface and the normal modes. As a special case we discussed instability condition under equal kinematic viscosity, kinematic couple stress and velocities and we obtain a tenth-order equation.

The analysis is based on Hurwitz's theorem. It is shown that the coefficient of couple stress has a destabilizing effect on the interface.

This chapter also deals with the extension of Kelvin-Helmholtz instability conditions of viscous, couple stresses and incompressible of three interfaces between four fluids.

Equations of motion are solved by using boundary conditions. An 18 x 18 determinant is obtained. As a special case, we studied in the absence of couple stresses and non-viscous fluid, and we got a sixth-order eigenvalue equation. Discussion of instability condition of the equation numerically, shows that the system is unstable.

Chapter VII: Includes a study of the effect of Rayleigh-Taylor instability conditions of an interface separating two viscous, couple stresses and incompressible fluid. Equations of motion are solved by applying boundary conditions and the normal modes.

The analysis is based on the linear perturbation and Hurwitz's theories. The necessary and sufficient conditions of the instability are discussed analytically and it was found that the system is unstable.

In this chapter we also studied the extension of Rayleigh-Taylor instability conditions of viscous, couple stresses and incompressible of three interfacen between four fluids.

Equations of motion are solved by using boundary conditions and an 18 x 18 determinant is obtianed. As a special case in the absence of a couple stresses and non-viscous fluids, and we obtain the sixth-order eigenvalue equation.

Discussion of the eigenvalue equation analytically and numerically, revealed that the system is stable.

Chapter VIII: Includes a study of the stability conditions of couple stress unbounded viscous fluid mixture with dusty particles and vertical temperature gradient.

Applying the linear perturbation theory, we obtain a third-order eigenvalue equation. The analysis is based on Hurwitz's theorem.

Necessary and sufficient conditions for the stability of two-dimensional disturbances are studied analytically and numerically, revealed that the system is stable.

CHAPTER I