

سامية محمد مصطفى



شبكة المعلومات الجامعية

# بسم الله الرحمن الرحيم



سامية محمد مصطفى



شبكة المعلومات الجامعية



# شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم





سامية محمد مصطفى



شبكة المعلومات الجامعية

# جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



سامية محمد مصطفى



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# بعض الوثائق الأصلية تالفة





سامية محمد مصطفى

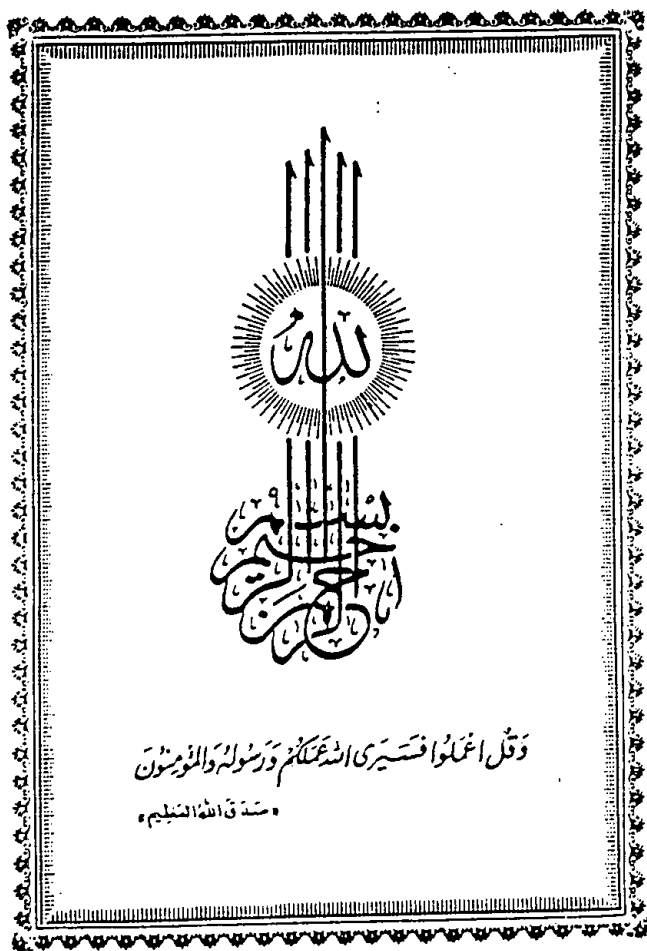


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بالرسالة صفحات  
لم ترد بالأصل





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CAIRO UNIVERSITY  
FACULTY OF ENGINEERING

TURBULENT BOUNDARY LAYER AND HEAT TRANSFER  
CHARACTERISTICS OVER A ROUGH FLAT PLATE IN  
PRESSURE GRADIENTS.

By

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B.Sc. Mech. Power Engineering  
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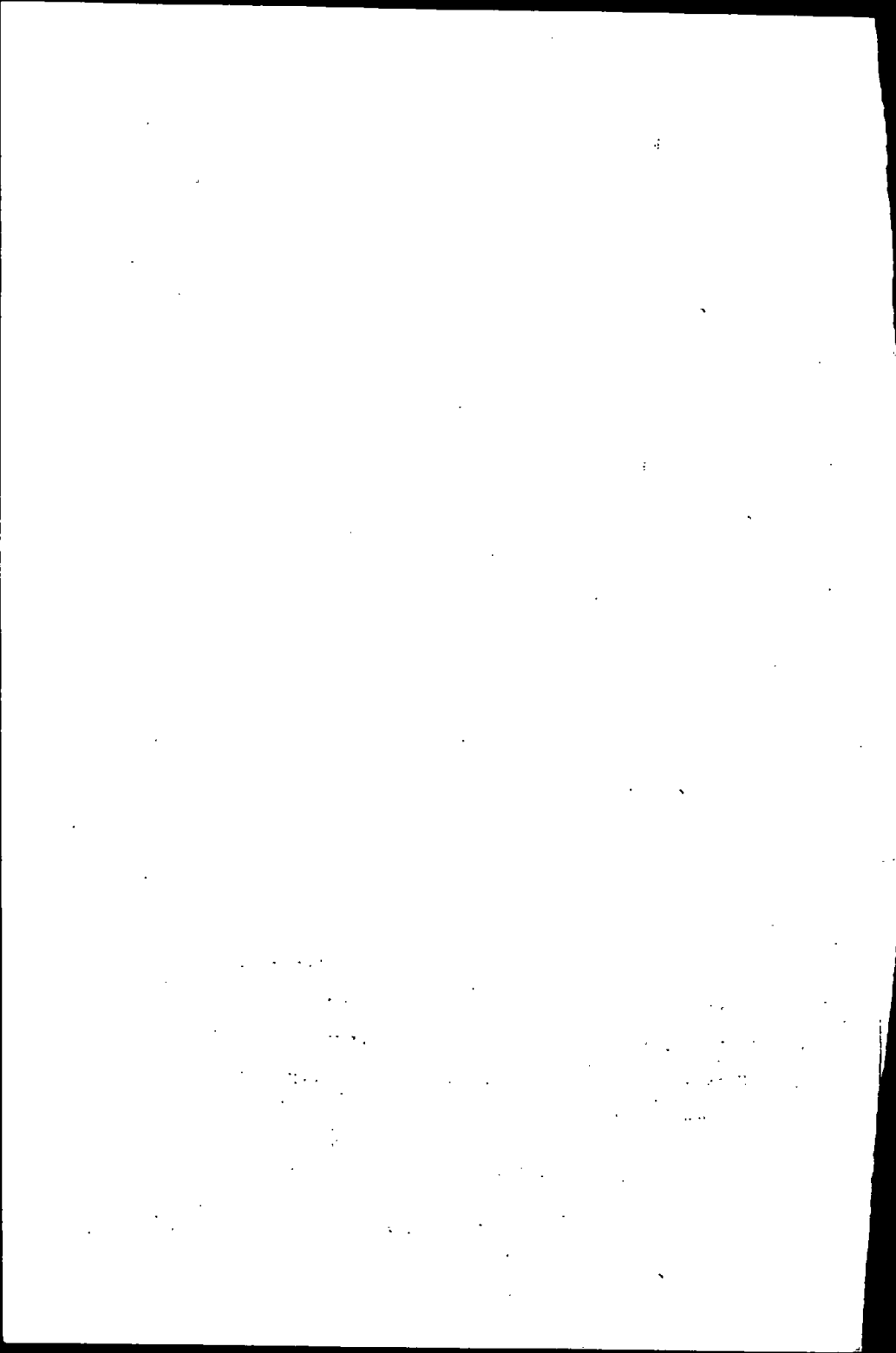
A Thesis

Submitted for the Degree of Doctor of Philosophy  
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Supervisors

Prof.Dr. M.S. Abdel-Salam	Prof.Dr. M.F. Abd-Rabbo
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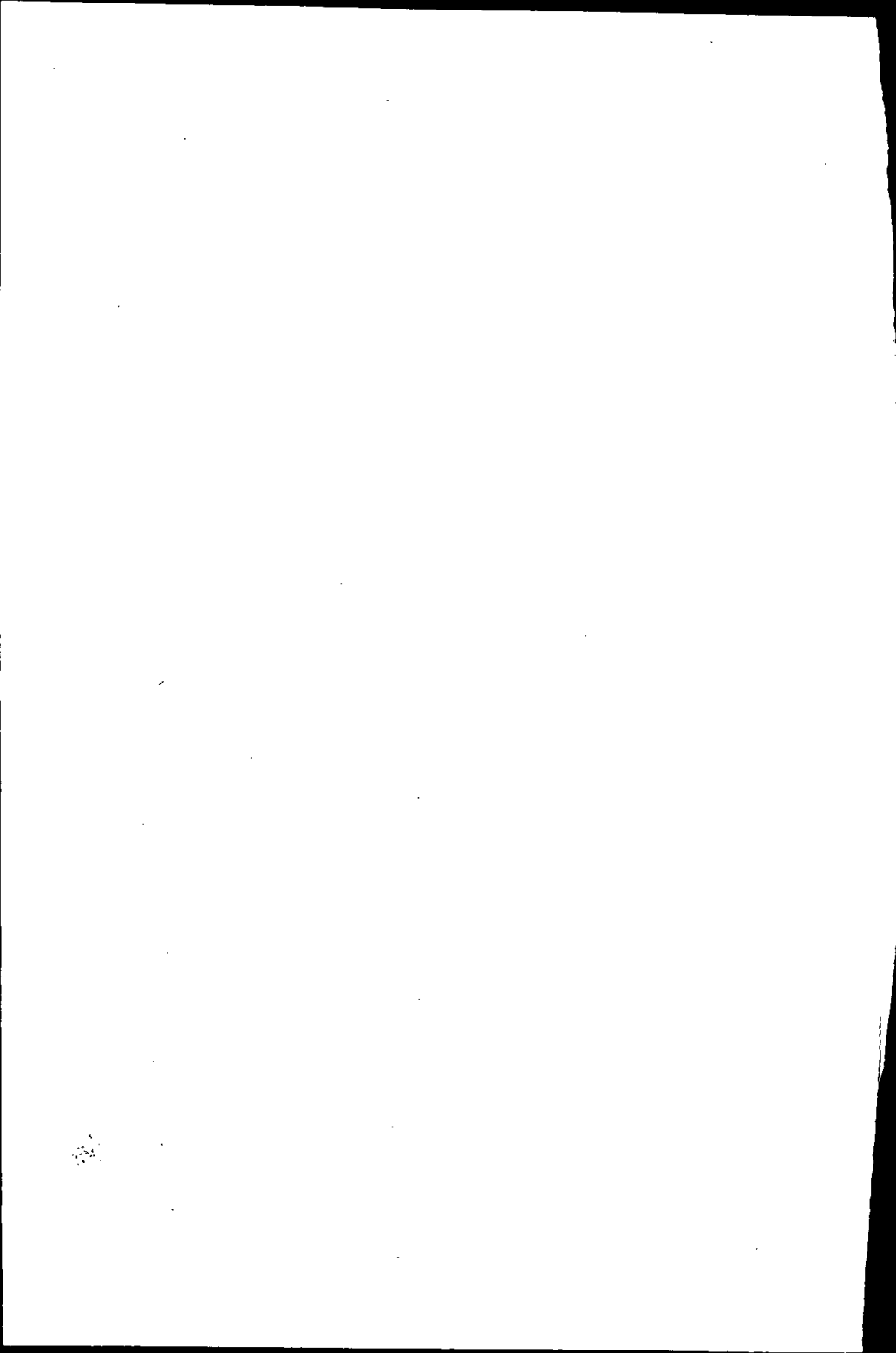
### ACKNOWLEDGEMENTS

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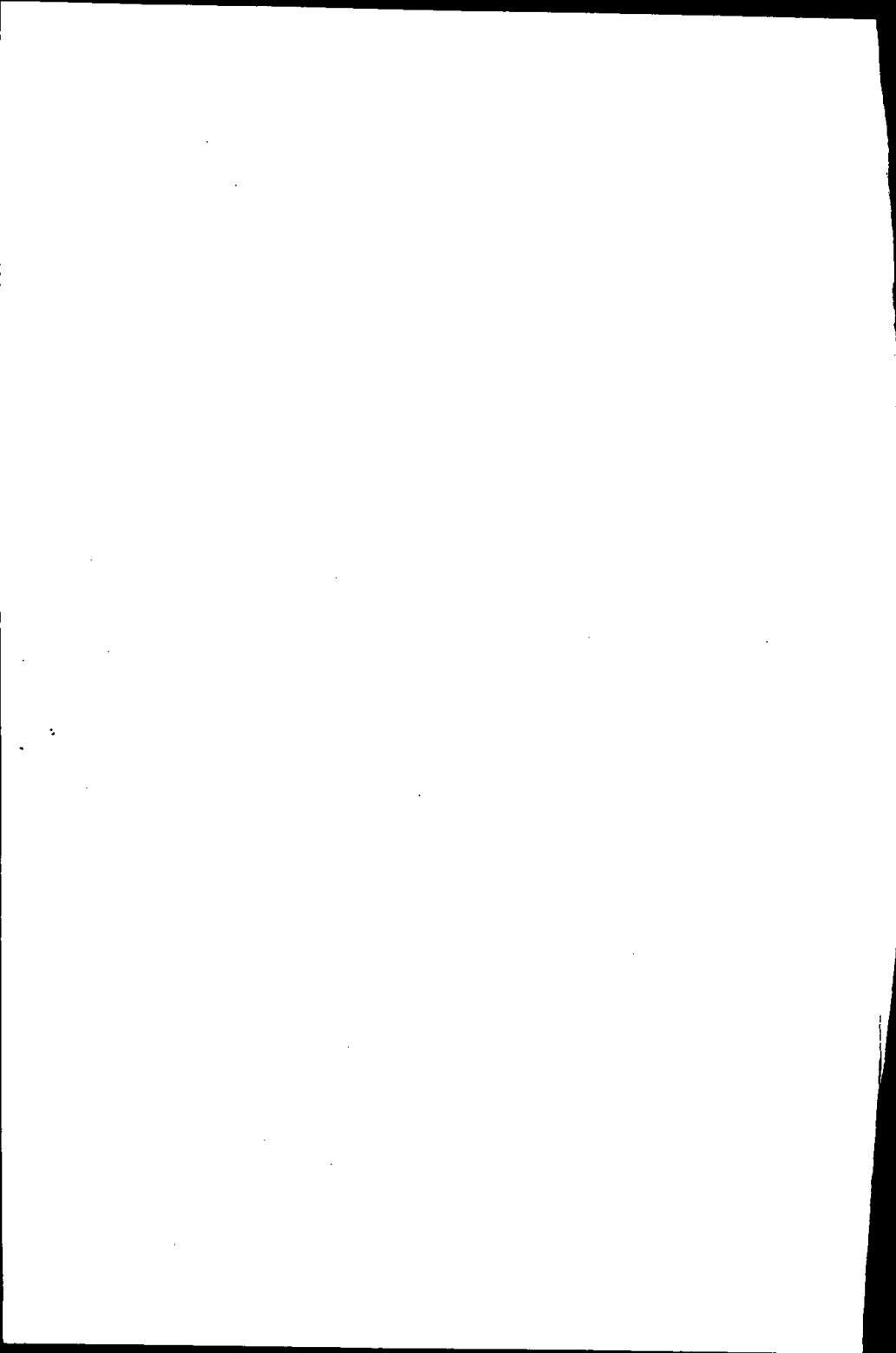
Sincere thanks are due to the Faculty of Engineering at Shoubra, where the apparatus was constructed and installed.

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# ABSTRACT



TURBULENT BOUNDARY LAYER AND HEAT TRANSFER  
CHARACTERISTICS OVER A ROUGH FLAT PLATE IN  
PRESSURE GRADIENTS

ABSTRACT

In the present work, the turbulent convective heat transfer characteristics over a rough flat plate in both zero and adverse pressure gradient flows were investigated. Experimental and theoretical investigations were performed. A test set-up was designed and constructed for this investigation. A flat plate of 320 mm length and 120 mm width, made of brass was taken as the heating surface. The heating surface was placed at a distance of 1130 mm from the beginning of the test section. The heating plate was heated by means of electric heaters. The heating condition was adjusted to supply uniform heat flux to the plate. The roughness elements were taken as rectangular brass ridges. The ridges height must be sufficiently small compared with the local boundary layer thickness for the ridges to lie in the logarithmic part of the undisturbed velocity profile. The ridges were equally spaced along the heating surface to obtain uniformly distributed roughness arrays. The equivalent sandgrain roughness was calculated. For the equilibrium adverse pressure gradient flow, the freestream velocity was varied as  $U \propto x^{-0.215}$ .



For the turbulent boundary layer over the smooth test surface in both pressure gradients, the two-dimensionality of the flow was verified by seeking to satisfy equality between the two sides of the integrated two-dimensional Von Karman momentum equation. The drag coefficient for the turbulent boundary layer flow over a single ridge as well as ridge arrays for both pressure gradients was determined by the momentum defect method. The present results for the drag coefficient showed good agreement when compared with the available previous results.

A new correlation for the average heat transfer coefficient was obtained for the smooth heating surface. Correlations given by previous investigators for the smooth plate were compared with the present results. The comparison showed that the present results are considered to be a substantial verification of the apparatus design, instrumentations and the method of calculation.

A series of experiments for the heating rough surface subjected to both pressure gradients was carried out at different roughness densities. The equivalent sandgrain roughness was calculated and it was varied in the range of 0.77 to 12.1 mm. Generally, both the local heat transfer coefficient and the local Stanton number increases with the equivalent sandgrain roughness for both pressure gradients. The values of the local heat transfer coefficient and the local Stanton number for adverse pressure gradient flow are