UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

**The College of Graduate Studies and the College of Engineering Cordially Invite You to a**

**Master Thesis Defense**

Entitled

*PERFORMANCE OF ZIG-ZAG MICROCHANNEL HEAT SINK EMBEDDED WITH SQUARE AND CIRCULAR PIN FINS*

by

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Abstract

This study introduces the concept of utilizing Zig-Zag microchannels with pin-fins in heat sinks designed for electronic applications and subsequently analyzes their performance by evaluating key parameters such as thermal resistance, pressure drop, and the corresponding pumping power. The Zig-Zag Microchannel Heat Sink (MCHS) that has been devised is modelled numerical by solving the conservation of mass, momentum, and energy equations. The assessment of the Zig-Zag microchannel heat sink with integrated pin-fins considered the following design space: the planar dimensions, the width and depth of the microchannel, orientation and number of turns of the microchannel as well as the Reynolds number. Various mathematical models are solved through numerical methods using Computational Fluid Dynamics (CFD) techniques, incorporating diverse operating and geometric parameters. In Computational Fluid Dynamics CFD, the Semi-Implicit Method for Pressure-Linked Equations (SIMPLE) is used to solve the fundamental governing equations of laminar, incompressible, and steady-state fluid flow. Additionally, the performance of the Zig-Zag Microchannel Heat Sink (MCHS) is compared to that of straight microchannel heat sinks. When comparing the performance of the Zig-Zag Microchannel Heat Sink (MCHS) with that of straight microchannel heat sinks under identical operating conditions, the Zig-Zag MCHS demonstrates lower thermal resistance.

Increasing the pin-fins diameter shows improvement in the thermal resistance performance but also with a cost of an increase in pressure drop. The zig-zag square pin-fin with 5 number of turns enhances the thermohydraulic performance achieving the least thermal resistance and pressure drop. Increasing both width and depth of the microchannel show's improves in the thermohydraulic performance but also with a cost of an increases in power pumping more significantly than the other geometric parameters. On the other hand, increasing the zig-zag theta orientations shows good improvement in the thermohydraulic performance, reducing thermal resistance and pressure drop.