MODELING OF MICROPROCESSOR

BASED REACTOR CONTROL SYSTEM USING VHDL

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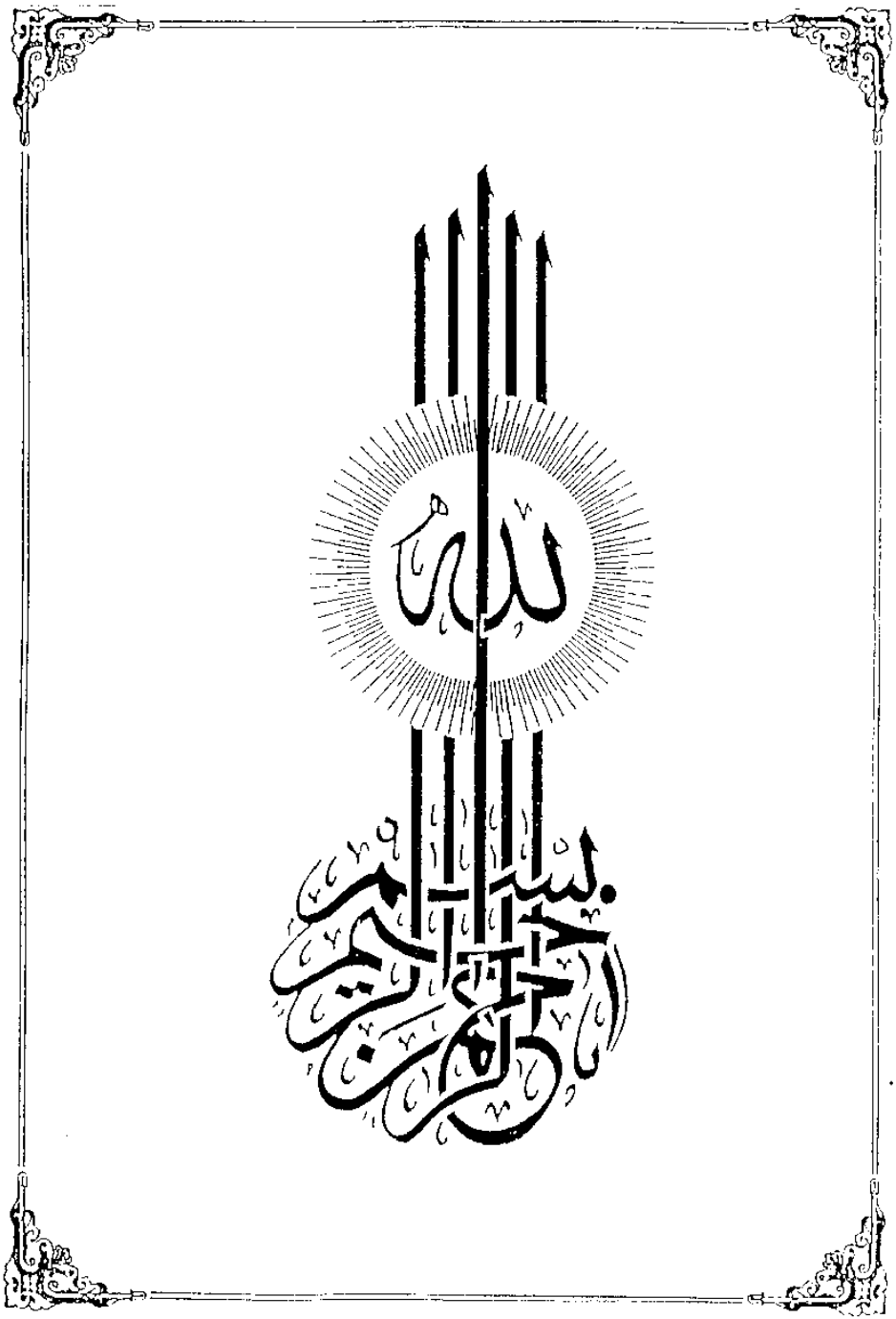

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ABSTRACT

In recent years significant progress has been made in discrete data and digital control systems.
Digital computers are used by control systems engineers for two basic purposes ,one is namely simulation and the other is computation .
They often rely on digital computer simulation to conduct the analysis and design of complex systems which do not conform to any analytical tools and also to check results obtained by analytical means .

This thesis is a modeling of a complete microprocessor based reactor control system using [VHDL] application to reactor control.
It includes two parts , the first is the simulation of 8085 microprocessor (as example for any other processor) using a hardware description language [VHDL] .
Each part of the 8085 is simulated , such as registers , memory ,`program counter , stack , I/O port and so on .The underlying simulation handles the instruction level of the 8085 microprocessor taking into consideration the execution time of each instruction . Thus the real 8085 microprocessor had been fully simulated .
The second part is an application for the first part ,by using the 8085 microprocessor as a proportional/integral controller (PI) ,to control a second order system in a closed loop . According to the use of digital controller , the thesis contents a model of digital to analog converter and a model of analog to digital converter (using a method of successive approximation) .

This had been implemented on the power regulating controller of the nuclear research reactor control system.

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Chapter 1

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INTRODUCTION

In recent year significant progress has been made in discrete data and digital control systems .These systems have gained popularity and importance , in all industries due to the advances made in digital computers ,and more recently in microcomputer as well as the advantage found in working with digital signals.

Digital computers are used by control systems engineers for two basic purposes namely simulation and computation of control systems dynamics.

Control engineers often rely on digital computer simulation to conduct the analysis and design of complex systems which do not conform to analytical tools. Computer simulations are also used to check the results obtained by analytical means.
The use of digital computer as controllers or processors is one of the important applications .
Many techniques had been developed for simulation of microprocessor using a VHDL as a hardware description language.
The hardware description language VHDL is a new hardware description language starting in 1981 by the very hardware high speed integrated circuit VHSIC program office of the department of defense for use as a standard language in the microelectronics community .
This language represents a new step in the evolution of language support for hard ware design.
VHDL is a comprehensive language that allows a user to deal with design complexity . The VHDL scope covers the general architectural level to the component (gate) level description . The language is hierarchical and mixed level simulation is supported.
The VHDL models of design behave like real hardware specially from the time point of view.

Brothers ,and others [4] had described a fast timing simulator based on very high speed integrated circuit (VHSIC) hardware description language (VHDL) for simulating the timing of digital microelectronics in pre-irradiation ,total dose ,and dose -rate radiation enviroments .

Alexanian and others [5] describe the digital filter section of the FERMI readout microsystem . The filter section , consisting of two separate filter blocks ,extracts the pulse amplitude and time information for the first-level trigger process and performs a highly accurate energy measurement for higher level triggering and data readout purposes . the filter section is modeled with the (VHDL) .

In [6] Morozov introduce an algorithm for generation of control and emergency signals for reactor actuators developed forminikum apparatus and computational resources is suggested in order to simplify the design and increase reactor reliability .

A microprocessor-based control system have been used in fossil power plants and are receiving grater acceptance for application in nuclear plant represented by Shah. and other [7] .

In [8] describe four hardware simulation models implementing the FASTBUS protocol .the models are written in the VHDL hardware description language to obtain portability ,i.e. without relations to any specific simulator .

The underlying thesis includes two parts :-

1- The first is a simulation of 8085 microprocessor using (VHDL) taking time of the execution of every instruction in our consideration .

2- The second is to use this 8085 simulation as a controller (Proportional integral controller) to control a second order system and to compute the gain of the power controller of the research reactor to give best response .