

The background of the cover is a dark, textured surface. It features several glowing white and yellow circuit-like lines that branch out from the left side towards the center. These lines are composed of small circles connected by straight segments. A bright yellow and orange light source is positioned in the center, creating a lens flare effect. The background also contains various faint, semi-transparent icons and symbols, including a lightbulb, a gear, a house, a globe, and a bar chart, suggesting a technical or engineering theme.

CONTROL SYSTEMS **Analysis and Design Theory**

**Afaf Rozan Mohd Radzoi
Iza Sazanita Isa
Rohaiza Baharudin
Sarah Addyani Shamsuddin
Belinda Chong Chiew Meng**

© UiTM Press, UiTM 2025

All rights reserved. No part of this publication may be reproduced, copied, stored in any retrieval system or transmitted in any form or by any means; electronic, mechanical, photocopying, recording or otherwise; without prior permission in writing from the Director of UiTM Press, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
E-mail: penerbit@uitm.edu.my

UiTM Press is a member of
MALAYSIAN SCHOLARLY PUBLISHING COUNCIL



Cataloguing-in-Publication Data

Perpustakaan Negara Malaysia

A catalogue record for this book is available
from the National Library of Malaysia

ISBN 978-629-496-063-3

Cover design : Kamaliah Kamaruddin

Typesetting : Kamaliah Kamaruddin

Printed in Malaysia by: UiTM Printing Centre
College of Creative Arts
Universiti Teknologi MARA
40450, Shah Alam
Selangor

Table of Contents

<i>List of Figures</i>	ix
<i>List of Tables</i>	xvii
<i>Preface</i>	xix
<i>Acknowledgement</i>	xxi

CHAPTER 1

INTRODUCTION TO CONTROL SYSTEMS..... 1

Introduction.....	1
Classification of Control Systems.....	2
❑ Open-Loop Control System.....	2
❑ Closed-Loop (Feedback) Control System.....	3
Block Diagram.....	4
Examples of Open Loop Control Systems.....	7
Example of Closed-Loop Control Systems.....	9

CHAPTER 2

MATHEMATICAL MODELLING..... 13

Introduction.....	13
Models of Electrical Systems.....	13
❑ Passive Network.....	14
❑ Active Network.....	17
Models of Mechanical Systems.....	19
❑ Linear.....	19
❑ Rotational.....	21
Models of Electromechanical Systems.....	23
❑ Potentiometer.....	23
❑ Tachometer.....	24
❑ Field Control DC Generator.....	24
❑ Field Control DC Motor.....	25
❑ Armature Control DC Motor.....	27

Preface

This book is designed to introduce the theory of control systems engineering to undergraduate students. The study of control systems engineering is essential for all engineering fields, including electrical, mechanical, aerospace, biomedical, and chemical engineering. It is intended to be used as a supplement to all textbooks on control systems. It may also be used as a textbook in its own right. It consists of seven chapters arranged accordingly to suit the syllabus of control systems for diploma students or higher levels. This book presents less wording but a clear definition throughout all the chapters. There are also many exercises included after each chapter to strengthen students' knowledge in the respective chapters.

Acknowledgement

All praise and thanks be to Allah SWT, the most Merciful and the most Gracious, Lord of the universe. To Him we belong and to Him we shall return. Peace be upon him, Prophet Muhammad SAW, his family, his companion, and those who follow his path. Thanks to the Almighty Allah SWT for the opportunity, strength, and ability to complete this book. Sincere appreciation to all members of School of the Electrical Engineering, College of Engineering, UiTM Pulau Pinang Campus for their encouragement and support. Also, thank you to the students, who are the main motivation to complete this book. Last but not least, thanks to all who have directly and indirectly contributed to the completion of this book. May Allah SWT repay your kindness.