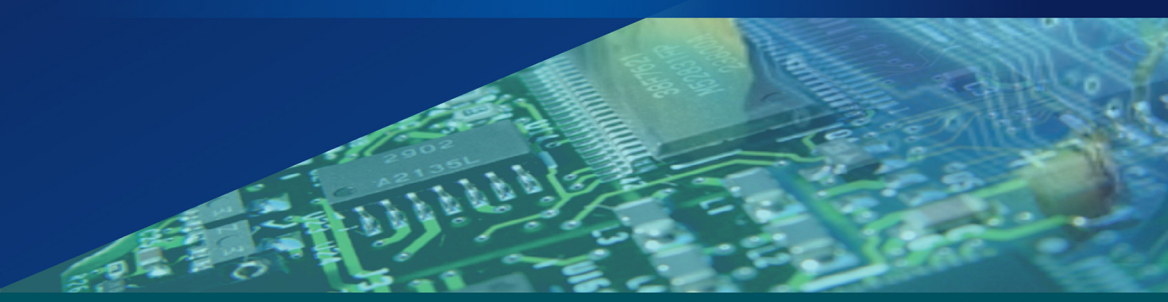
CBS Problems and Solutions Series

Problems and Solutions of

Control Systems

with Essential Theory

Sixth Edition



A.K. Jairath

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to

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my wife **Geeta** *and*
son **Varun**
who are my source of encouragement and inspiration
and
my dearest father **late Shri Ram Prasad Jairath** *and*
mother **Shrimati Prem Rani Jairath**
who are responsible for
what I am today.

Preface to the Sixth Edition

It gives me immense pleasure to bring out the sixth edition of my book which over the last 22 years has become immensely popular with the faculty as well as the students who are pursuing undergraduate programs and also those students who are appearing in the professional examinations like GATE, IES, etc. The sixth edition has been thoroughly revised and restructured to ensure that it is student-friendly. Problems which already existed have been suitably clubbed under new chapters for easier understanding of the topics. New problems have been added in each chapter to make the concepts more clear and to give the students extra problem-solving practice. Chapter on feedback and its effect on system performance has been added. Nyquist stability criterion chapter has been fully revised and the explanation for each problem in this chapter will ensure better assimilation. Chapter 1 has been revised and the concept of drawing block diagrams for practical systems have been explained in a very simple way. Students must know how to recognize controllers, processes/plants and feedback elements of various types of control systems. I am sure that the explanation of the basics will lay the foundation for the control system subject in totality and make understanding of the other related topics easier.

It will be my endeavour to keep on improving the book in the coming years and the faculty and students will be seeing new editions of this book shortly. I plan to include design problems with case studies in my future editions. My aim is to ensure that this book is error-free. My students in Amity University have helped me a lot in pointing out typing/spelling errors and I owe a lot to them. I will be grateful to all the readers of this book to point out such mistakes in future also. I will acknowledge their efforts suitably.

I thank my publishers, CBS Publishers & Distributors, in supporting my efforts. Ours have been a very long association and hope this bond will last forever.

AK Jairath

Preface to the Fifth Edition

It gives me immense pleasure in bringing out the fifth edition of this book which has the patronage of the student community all over India. The main endeavour of this book is to make available a series of worked exercises to assist students to prevail over difficulties in understanding and correlating with the theory. The objective has been not to just present an assortment of problems with solutions, but by means of straightforward preparatory problems leading to intricate ones, introduce the students to the fundamentals of control engineering. In keeping with the aim, this edition has been compiled in a fashion to ensure the following:

- Step-by-step mathematical explanation for better understanding.
- Basics are explained in simple language.
- All possible variations to the principles of control engineering have been explained and illustrated by solving different problems.
- The problems and their solutions are listed in the order of difficulty and complexity.
- Step-by-step explanation will help the students in saving time which can be devoted elsewhere, fruitfully.
- Most of the problems have appeared in different examinations. This will help the students gain more confidence in tackling the examinations.
- Essential theory included under each chapter in the beginning is to ensure that students do not refer to any textbook for cross reference. It will also help students to immediately correlate to various graphical illustrations depicted in the theory portions.
- To keep the size and cost of the book within realistic limits, introductory material in the form of indispensable theory to each chapter contains only the vital features of the topics.

I once again thank CBS Publishers & Distributors and their publishing staff for providing help and support. I sincerely hope that this edition of the book will be as popular as the previous ones.

AK Jairath

Prefaces to the Previous Editions

Preface to the Fourth Edition

A decade has passed and with the extreme cooperation from the students and the publisher, I present the fourth revised edition. The book has been thoroughly revised, especially the chapter on "Root-locus". Basic essential theory on sensitivity has been added in the fourth chapter. In addition, important solved problems in each chapter have been incorporated.

I have no doubt that the fourth revised edition, with minimum errors will help the readers to assimilate the subject better.

AK Jairath

Preface to the Third Edition

It is a matter of happiness for me that within a short span of seven years this book has become immensely popular and the students have benefited after reading it. It has been my endeavour to improve the book constantly. Keeping this in view, I have revised the third edition by adding most essential theory which will help students to assimilate the subject better.

I have no doubt that the present revised edition will be liked by all the readers.

AK Jairath

Preface to the Second Edition

It gives me immense pleasure and satisfaction in bringing out this book in your hands. This book contains typical examples in control system engineering divided into various chapters. A brief giving out the basic theory has been added at the begining of each chapter which I am sure will help the students in understanding the solved problems. Problems have been solved with detailed explanation for better assimilation.

Effort has been made to keep printing mistakes to the minimum. Even then if the students are able to find any technical or printing mistakes, please bring the same to the notice of the author for rectification in the next edition. Also, any suggestions to improve this book are welcome. I thank CBS Publishers & Distributors for their cooperation and help.

AK Jairath

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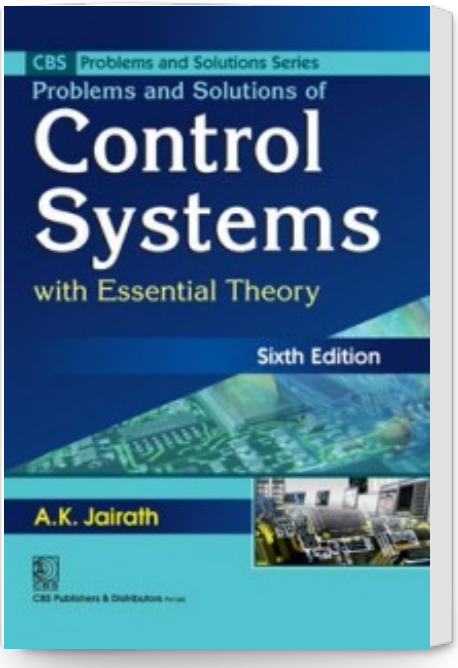
Problems And Solutions Of Control Systems



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