Introduction to control engineering

Synopsis:

This book is intended to serve as a text book for a first course in control system engineering in higher institutes and universities. The text has been written through the experience of the authors in teaching this subject. Control systems are found in a broad range of applications within various engineering disciplines namely electrical, mechanical, chemical or aerospace engineerings. This book emphasizes particularly on the principle, design and analysis of feedback control system. The contents have been written to be suitable for all branches of engineering.

Introduction to control engineering

Table Of Content:

Mass–spring system

Damper

Spring–damper system

Mass–spring–damper system

Rotational System

Gear System

Hydraulic System

Position control system: A servo-mechanism

Walking lever

Liquid Level System

Interacting liquid level system

Thermal System

Electrical System

Other Systems

Block Diagram Manipulation Method

Concept

Blocks in series

Blocks in Parallel

Negative Feedback

Signal Flow Graph

Concept

Algebra of Signal Flow Graph

Definitions

Mason’s Gain Formula

Further Readings

CHAPTER 3 TIME RESPONSE OF A CONTROL SYSTEM

Time Response: An Introduction

Concept

Time Response

Mathematical Model

Laplace Transform

Concept

Property of Laplace Transform

Laplace Transform of Derivatives

Laplace Transform of an Integral

Laplace Transform of a Unit Step Function

Laplace Transform of a Ramp Function

Laplace Transform of an Impulse Function

Laplace Transform of a Sinusoidal Function

Solving Differential Equation using Laplace Transform

Transfer Function

Classification of Dynamic Systems

System Classification

Step Response of a First Order System

First Order System

Step Response of a First Order System

Step Response of a Second Order System

Second Order System

Step Response of a Second Order System

Effectiveness of a Feedback System

Feedback Control System

Graphical Representation of Frequency Response Data

Nyquist Diagram

Concept

Differentiator

Integrator

First Order Lag

Second Order System

Transfer Operators in Series

Stability Analysis using Nyquist Diagram

Nyquist Stability Criterion

Degree of Stability

Gain and Phase Margins

Bode Diagram

Concept

Straight–line Asymptotic Approximation for Gain Plot

Straight–line Asymptotic Approximation of Phase Shift Plot

First Order Lead

Bode Plot of Combination of Several Lead and Lag Elements

Effect of Gain K

Integrator

Differentiator

Second Order Lag

Modelling using Bode Diagram

Stability Analysis using Bode Diagram

Method

Further Readings