

Lesson Plan

Lesson: Understanding and applying Laplace transform to analyze electrical circuits for ECE 3709 Control Systems Engineering

Timeframe:

Pre-class: 1-2 hours to prepare the material

Post-class: 1 hour to go over examples

Materials needed:

Textbook, presentation and example handouts

Objectives:

Basic: 1. Understanding the definition of Laplace and inverse Laplace transform.

2. Laplace transform properties

3. Laplace transform table

4. Reviewing examples of Laplace and inverse Laplace transform.

Advanced: Applying them to circuit analysis.

Background (“Situation”):

Students should finish 2000 level courses and be familiar with Laplace transform from pre-requisite classes. However, some of them found the concept of Laplace transform confusing and difficult to apply them in the circuit analysis. I would like to link the mathematical concept (Laplace transform) with applications in electrical and computer engineering.

Introduction to Lesson:

The Laplace transform is a useful tool for dealing with linear systems described by ordinary differential equations. Laplace transform methods can be employed to study circuits in the s-domain. Laplace techniques

convert circuits with voltage and current signals that change with time to the s-domain so you can analyze the circuit's action using only algebraic techniques.

Connection constraints are those physical laws that cause element voltages and currents to behave in certain ways when the devices are interconnected to form a circuit. There are also constraints on the individual devices themselves, where each device has a mathematical relationship between the voltage across the device and the current through the device. I would like students to learn what connection constraints, device constraints, impedances, and admittances in the s-domain using Laplace transform.

Procedure:

Pre-class individual space activities and resources:

I will ask to form a group (2-3 students) to prepare the presentation. I will assign one topic (Laplace transform or inverse Laplace transform) to each group (e.g. even group number: Laplace transform, odd group number: inverse Laplace transform) and they will prepare the presentation about the topic. I will announce that I will randomly select one or two groups for each topic to present.

Steps	Purpose	Estimated time	Learning objective
Reviewing Laplace transform	Define the definition of Laplace transform	20 minutes	Understanding the concept of Laplace transform
Reviewing inverse Laplace transform	Define the definition of inverse Laplace transform	20 minutes	Understanding the concept of inverse Laplace transform

Going over Laplace and inverse Laplace transform examples	Familiarize the properties of Laplace transform	20 minutes	Applying the Laplace and inverse Laplace transform to various functions
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In-class group space activities and resources:

Steps	Purpose	Estimated time	Learning objective
Presentation of Laplace transform	Defining Laplace transform	15 minutes	Understanding Laplace transform
Presentation of inverse Laplace transform	Defining inverse Laplace transform	15 minutes	Understanding inverse Laplace transform
Explaining the meaning behind Laplace transform	Show the relation between t-domain and s-domain	15 minutes	Understanding why we use Laplace transforms
Going over examples	Familiarize Laplace and inverse Laplace transforms	15 minutes	Familiarize Laplace and inverse Laplace transforms
Applying to circuit analysis	Interpreting the circuit components for applying Laplace and inverse Laplace transform	15 minutes	Applying Laplace and inverse Laplace transforms to circuit analysis

Post-class individual space activities and resources:

Steps	Purpose	Estimated time	Learning objective
Doing homework problems	Reviewing the classroom material	1 hour	Reviewing the concept of Laplace transform and its application

Evaluation:

Analysis

From homework assignment, I can analyze the effectiveness of the class. I can check they understand the concept of Laplace transform and its application.

Connections to future lessons:

Laplace transform will be used to analyze more complicated control systems in the course. If students are not familiar with the concept, it would be difficult to apply to general control systems.