**Ordinary Differential Equations**

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**Textbook:**

1. Elementary Differential Equations and Boundary Value Problems.Ed8,BoyceR.C.DiPrima.JWS

**Foreward:**

* These lecture notes aim to review the material of the standard 2nd year differential equations course of engineering curricula and supplement it with an introduction to the study of partial differential equations.
* Ordinary differential equations are used in many engineering applications.
  + **First order ODE’s** describe many growth and decay phenomena.
  + **Second order ODE’s** describe osciallatory phenomena.
  + **Series solutions** are needed for the study of for example Bessel funcions that describe propagation of waves.
  + The method of **Laplace transform** is used in taking into account initial conditions.
  + **Systems of ODE’s** are used as models for all linear systems and find important applications in control theory. re are many fine textbooks part on ordinary differential equations is based
* Partial differential equations solvable by the method of separation of variables are also studied in a first course in differential equations. These topics are presented under the PDE headings.

**The notes on ODE’S consist of the following parts**

* Part 1: First order ordinary differential equations
* Part 2: Higher order ordinary differential equations
* Part 3: Series solutions
* Part 4: Laplace transform
* Part 5: Systems of ODE’s

**Part 4**

**Laplace Transform**

**The Laplace Transform**

The Laplace transform of a function f(t) is defined by

provided that the integral exists.

The Laplace transform is useful in finding solutions of initial value problems for O.D.E’s with constant coefficients, in particular when the input is discontinuous.

You should be familiar with using the table of Laplace transforms.

In applying the Laplace transform to the solution of **ODE**’s we use the following theorem**s:**

**Theorem.**

provided that certain technical conditions are satisfied.

It follows that

etc.

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| **Ex**: Solve  Let  You have to use partial fraction expansion: |

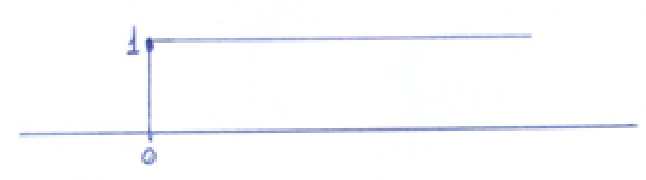
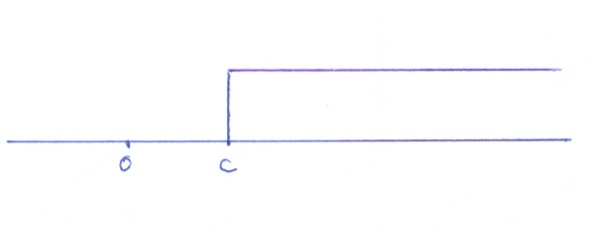
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| --- |
| **Ex** : Solve  Use partial fraction expansion: |

|  |
| --- |
| **Ex.** Solve    [ ]  From (1) and (3) we get  = |

**Step Functions**

Unit step function at t=0 is denoted by

Unit step function denoted by at t=c

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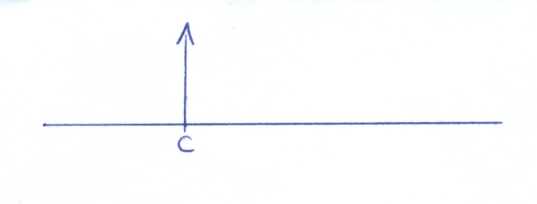
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| --- |
| **Ex:** Solve  C:\Documents and Settings\user\Desktop\sekiller (1)\3e.jpg |

|  |
| --- |
| Use partial fraction expansion  This means is applied standing at then the same function is substructed at |

**Impulse Functions**

An impulse is a function which is very large for a short time interval and zero otherwise. It can occur in practice as voltages or forces that act for a short time inteval.

It is defined by its effect under an integral sign. It is denoted by



and shown as an arrow at . Its Laplace transform is:

|  |
| --- |
| **Ex:**  Solve |

**The Convolution Integral**

The convolution of two function and is defined by

What makes it useful is the property

Conversely, if we want to compute the inverse Laplace tr. of a product and we know and we simply write

without doing any work such as partial fraction expansion.

|  |
| --- |
| **Ex:** |

**QUIZ Laplace Transform**

1. Use the Laplace transform to solve

Compare it with the standard solution

1. Solve
2. Solve
3. Give the solution as a convolution integral

**END OF PART 4**