

The objective of this homework is to test your understanding of the content of Module 2—Laplace transforms, transfer functions, partial fraction expansion, and ODE solutions. Provide neat solutions, with well-written answers. You need to have the Laplace transform table around you when you're doing the homework. Due date of the homework is: **Thursday, January 30th at 1pm.**

You have to upload a scanned version of your solutions on Blackboard. If you don't have a scanner around you, you can use Cam Scanner—a mobile app that scans images in a neat way, as if they're scanned through a copier. Here's the link for Cam Scanner: <https://www.camscanner.com/user/download>.

1. Using Laplace transforms, solve the following differential equation for  $y(t)$ :

$$y'(t) - y(t) = e^{3t},$$

given that the initial value for  $y(t)$  is  $y(0) = 2$ .

2. Using Laplace transforms, solve the following differential equation for  $y(t)$ :

$$y''(t) - 10y'(t) + 9y(t) = 5t,$$

given that  $y(0) = -1$  and  $y'(0) = 2$ . Verify your answers on MATLAB via the `ilaplace` command.

3. For this differential equation:

$$y''(t) - 6y'(t) + 15y(t) = 2u(t),$$

solve the following problems:

- (a) The transfer function  $\frac{Y(s)}{U(s)}$ .
- (b) The poles and zeros (if any) of the transfer function.
- (c) Given that  $u(t) = \sin(3t)$ ,  $y(0) = -1$ ,  $y'(0) = -4$ , find  $y(t)$  using partial fraction expansion. You might need to solve multiple linear equations with multiple unknowns. Do not panic.
- (d) Verify your answers on MATLAB via the `ilaplace` command.