**W5 InLab Activity: Name: \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_**

*first*

*last*

**Problem 1: Method of Undetermined Coefficients**

Use Method of Undetermined Coefficients to find the IVP solution to the second-order linear non-homogeneous differential equation:

**DE:**

**a.** First find the general solution for the corresponding homogeneous equation:

The characteristic equation factors nicely over the integers. Show it.

The general solution for our homogeneous DE is:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**b.** Next find the particular solution to the original DE using the method of undetermined coefficients.

We need to guess a form which includes the forcing term and all its derivatives.

Since exponentials are proportional to their derivatives we only need that one term: Use *A* as the constant.

**Form of Guess:**  \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

To perform the substitution of the particular solution into the DE we also need the derivatives:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ and \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

Plugging into the DE, find *A*.

\_ \_ \_ \_ \_

Thus, the particular solution is: . . . and the general solution is:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**c.** Find the unique solution that matches the initial conditions.

First find the derivative: \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

Now find and .

The unique solution matching the initial conditions is: \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**Plot for Problem 1: in blue, in red**

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**Problem 2: Method of Undetermined Coefficients**

Use the Method of Undetermined Coefficients for solving the second-order linear non-homogeneous differential equation. Find the general form of the particular solution, the particular solution, and the general solution to the differential equations

**DE:**

**a.** First find the general solution to the homogeneous equation:

Since this is the same as the homogeneous **DE on Problem 1 and 2** we repeat:

**Done for you!**

The general solution for our homogeneous DE is:

**b.** Next find the particular solution to the original DE using the method of undetermined coefficients.

We need to guess a form which includes the forcing term and all its derivatives.

Use *A*, *B* and *C* as the unknown coefficients.

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

To perform the substitution of the particular solution into the DE we also need the derivatives:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ and \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

Plugging into the DE we find:

**Scalar Coefficients:**  \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**Coefficients of sin(2t):** \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**Coefficients of cos(2t):** \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

Solve for *A*, *B* and *C*:

Thus, the particular solution is: . . . . . . .

and the general solution to the non-homogeneous DE is:

**Problem 3: Method of Undetermined Coefficients**

Use the Method of Undetermined Coefficients for solving the second-order linear non-homogeneous differential equation. Find the general form of the particular solution, the particular solution, and the general solution to the differential equation.

**DE:**  **Warning**: The factor is already a homogeneous solution!

**a.** First find the general solution to the homogeneous equation:

Since this is the same as the homogeneous **DE on Problem 1 and 2** we repeat:

**Done for you!**

**b.** Next find the **FORM** of the particular solution to the original DE using the method of undetermined coefficients. We need to guess a form which includes the forcing termand all its derivatives:

**Repeat Warning**: The factor is already a homogeneous solution!

**i.** If this were not a homogeneous solution we would guess:

**Done for you!**

**ii.** But since is already a homogeneous solution, we must bump up (the entire guess) by a factor of *t*.

Write out the new guess using *A* and *B* as the constants:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**c.** Find the undetermined coefficients *A* and *B*.

To perform the substitution of the particular solution into the DE we also need the derivatives, which requires several applications of the product rule.

and

Plugging into the DE gives:

Now match all the coefficients to find *A* and *B*.

**Coefficient of :** \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**Coefficient of :** \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

**Coefficient of :**  \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

So *A*= \_ \_ \_ \_ and *B* = \_ \_ \_ \_

Thus, the particular solution is: \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

and the general solution to the non-homogeneous DE is: