# A2023
# Ordinary Differential Equations I
# 2024

# Assignment

## Assignment 2

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**Issued:** 30 July 2024 **Total:** 40 Points

**Due:** 23:59, 11 July 2024

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1. Consider the following differential equation where y = y(x): [**15 Points**]

$$y'' - 4y' + 8y = (2x^2 - 3x)e^{2x}\cos(2x) + (10x^2 - x - 1)e^{2x}\sin(2x)$$

Find the general solution to the above equation (Use the undetermined coefficients method to find the particular solution). Show your full worked out solution.

2. A mass weighing 4 kg is attached to a spring with a spring constant $k = 100\,\text{N/m}$. The medium through which the mass moves offers a damping force numerically equal to 10 times the instantaneous velocity. The mass is initially released from a point 0.1 m **above** the equilibrium position with a downward velocity of 2 m/s. [**25 Points**]

   (a) Write the differential equation governing the motion of the mass. [4 Points]

   (b) Find the general solution of the differential equation. [5 Points]

   (c) Determine the specific solution that satisfies the initial conditions. [4 Points]

   (d) Find the time at which the mass passes through the equilibrium position for the first time. [3 Points]

   (e) Determine the maximum displacement of the mass from the equilibrium position. [3 Points]

   (f) Calculate the time at which the mass attains its maximum displacement. [2 Points]

(g) Determine the velocity of the mass at $t = 2\,\mathrm{s}$. [2 Points]

(h) Find the acceleration of the mass at $t = 2\,\mathrm{s}$. [2 Points]