NMM2270 Fall 2024 Assignment 3

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Available: 00:01 on Oct. 15, 2024; Due: 11:59PM on Nov. 10, 2024
Total Points: 40.

Print Name: _____   Student Number: _____

Signature: _____   UWO email/ user ID: _____

Exam seating: Room _____   Row: _____   Seat: _____

This space is for you to flag potential issues with any questions.

How Your Assignment will be Graded!

1. Grading short questions (MCQs, T/F, Choice, or simply short questions) will be as follows:

   (a) 2 points for a correct answer and a correct justification.
   (b) 1 point for a correct answer and a wrong justification.
   (c) 1 point for a wrong answer and a correct justification.
   (d) 0 points for a wrong answer and a wrong justification.
   (e) 0.5 a point for reasonable effort in case the score is zero.
   (f) Zero in case cheating is strongly suspected.

2. Grading of long solution problems:

   (a) Full score for a perfect solution.
   (b) A score of zero in case cheating is strongly suspected!
   (c) A score of 60% for a reasonable effort even if the answers are not correct.
   (d) A score of 30% for any relevant attempt

Solve each of the following questions in full detail. Create one PDF file and upload it. Your last upload will be the only file graded. You have two weeks to finish the assignment.

1. (2 points) Find the general solution of $y''' + 6y'' + y' - 34y = 0$ if it is known that $y_1 = e^{-4x} \cos x$ is one solution.

2. (2 points) Rewrite the expression $e^{(3-5i)x}$ using Euler's formula.
   Justify your answer in full detail.

3. (2 points) True or False? The method of undetermined coefficients can be used to find a particular solution of the differential equation $y'' + 4y' + 20y = 3\cos(4x) - 2x\sin(4x)$.
   Justify your answer in full detail.

4. (2 points) True or False? Consider the differential equation $3x'' + 2x' + \pi x + ex^3 + e^2 x^5 = 0$ modeling a certain nonlinear spring system. If the initial conditions are $x(0) = -5$ and $x'(0) = 0$, then the behavior of the system satisfies $x \to \infty$ as $t \to \infty$.
   Justify your answer in full detail.

5. (2 points) True or False? $\sin\theta = \theta$ for θ close to π.
   Justify your answer in full detail.

6. (3 points) Fill the table below:
   For each equation, say whether it is homogeneous or nonhomogeneous and justify your choice.
   Justify your answer in full detail. Use extra space below the table if you need.

Homogeneous or not?			
Equation	Homogeneous	Nonhomogeneous	Justify your answer
$3y'' + x^2 y' - 3y = 0$			
$3y'' + x^2 y' - 3y = 2y$			
$3y'' + x^2 y' - 3y = x^3$			
$3y'' + x^2 y' = 3y$			
$3y'' + x^2 y' - 3y = 1$			
$3y'' + x^2 y' - 3 = 0$			

7. (3 points) The number $N(t)$ of people in a community who are exposed to a particular advertisement is governed by the logistic equation. Initially $N(0) = 500$, and it is observed that $N(1) = 1000$. Solve for $N(t)$ if it is predicted that the limiting number of people in the community who will see the advertisement is 50,000.

8. (4 points) Solve the differential equation $y'' - e^{-y'} = 0$.
   Justify your answer in full detail.

9. (5 points) Find the general solution of the differential equation

$$2x^2 y'' + 5xy' + \frac{25}{8}y = 0$$

.

Justify your answer in full detail.

10. (5 points) A 3 kg mass is attached to a spring whose constant is 27 N/m. The entire system is then submerged in a fluid that imparts a damping force numerically equal to 18 times the instantaneous velocity. Determine the position of the mass at t=4 seconds if it is initially released from rest from a point 175 centimeters above the equilibrium position. Round your answer to the nearest thousandth of a centimeter.
Show your answer in detail.

11. (5 points) Find the general solution of the higher-order differential equation

$$4y^{(4)} + 12y'' + 9y = 0$$

.

Justify your answer in full detail.

12. (5 points) Solve the initial-value problem

$$y'' + 2y' - 8y = -9\cos x - 2\sin x, y(0) = 4, y'(0) = -6$$

.

Justify your answer in full detail.