EXAMINATION COVERSHEET

Spring 2023 Final Examination

UNIVERSITY
OF WOLLONGONG
IN DUBAI

THIS EXAMINATION CONTENT IS STRICTLY CONFIDENTIAL
Students must comply with requirements stated in the Examination Policy & Procedures

Student Number:	
First Name:	
Family Name:	
Date of Examination: (DD/MM/YY)	**06/07/2023**
Subject Code:	**Math 142**
Subject Title:	**Essentials of Engineering Mathematics**
Time Permitted to Write Exam:	2 Hours
Total Number of Questions:	**9 written questions**
Total Number of Pages *(including this page):*	**10**

INSTRUCTIONS TO STUDENTS FOR THE EXAM

1. Please note that subject lecturer/tutor will be unavailable during exams. *If there is a doubt in any of the exam questions i.e. problem solving etc. students should proceed by assuming values etc. Students should mention their assumption on the question paper.*
2. Answers must be written (and drawn) in black or blue ink ball pen.
3. Any mistakes must be crossed out. Whitener and ink erasers must not be used.
4. Answer ALL/ 9 questions. The marks for each question are shown next to each question.
5. Total marks: 100. This Exam is worth 40% of your final marks for MATH 142.

EXAMINATION MATERIALS/AIDS ALLOWED
Approved Calculator and Formula Sheet

Exam Unauthorised Items - Students bringing these items to the examination room must follow the instructions of the invigilators with regards to these items.

6. Bags, including carrier bags, backpacks, shoulder bags and briefcases
7. Any form of electronic device including but not limited to mobile phones, smart watches, MP3 players, handheld computers and unauthorised calculators;
8. Calculator cases and covers, opaque pencil cases
9. Blank paper
10. Any written material

NOTE: The University does not guarantee the safe-keeping of students' personal items during examinations. Students concerned about the safety of their valuable items should make alternative arrangements for their care.

EXAM QUESTION PAPER, INCLUDING EXAM ANSWER PAPER OR ANY OTHER PAPER PROVIDED FOR USE BY THE STUDENT MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

Problem 1 (12 points)

(**6pts**) A) Suppose a nuclear power plant generate heat at a rate of $R(t) = 5000e^{-0.01t}$ megawatts/hour, where t is measured in hours since the start of the day. The power plant operates indefinitely. What is the total heat energy generated by the power plant? i.e. $\int_0^\infty R(t)dt$.

(**6pts**) B) Suppose a nuclear power plant generate heat at a rate of $R(t) = \dfrac{5000}{\sqrt{t-1}}$ megawatts/hour, where t is measured in hours since the start of the day. The power plant operates from 1 hour to 24 hours. What is the total heat energy generated by the power plant over the 23-hour period? i.e. $\int_1^{24} R(t)dt$.

Problem 2 (12 points)
Show that the equation is separable and solve the initial value problem

$$\left(1+y^2\right)x^2dx - ydy = 0, \qquad y(0) = 1.$$

Problem 3 (10 points)
Show that the equation is linear and solve it.

$$\frac{dy}{dx} = x - y.$$

Problem 4 (12 points)
Show that the equation is exact and solve the initial value problem

$$(4xy + 1)\,dx + \left(2x^2 + \cos y\right)\,dy = 0, \qquad y(1) = 0.$$

Problem 5 (12 points)
Show that the equation is homogeneous and solve it.

$$(x - y)\,dx + xdy = 0.$$

Problem 6 (10 points)
Find $\lim_{n\to\infty} a_n$.

1. $a_n = 2n \sin\left(\frac{1}{n}\right)$,

2. $a_n = \frac{\cos(2n)}{2^n}$

Problem 7 (10 points)
Find the sum of the following series

1. $\sum_{n=2}^{\infty} \frac{2}{n^2-1}$,

2. $\sum_{n=1}^{\infty} \frac{2^n}{3^{n-1}}$

Problem 8 (12 points)
Determine the interval of convergence of the power series

$$\sum_{n=1}^{\infty} \frac{(-1)^n (x-3)^n}{2n}.$$

Problem 9 (10 points)
Find a power series representation for the function

$$f(x) = \frac{x}{9 + x^2}$$

and determine the interval of convergence.

End of the Exam