



COMSATS University Islamabad (CUI)
Islamabad Campus
Terminal Exam Fall-2022

Program: BS (AI & DS)

Semester: III & IV

Subject: Differential Equations (MTH 242)

Date: January 25, 2023.

Total Marks: 50

Time Allowed: 3 hours

Instructor: Dr. M. Yousaf

Instructions for attempting paper:

Carrying of digital dairies is not allowed.

Mobile phones will not be allowed in the examination hall.

Answer all questions.

- Q1. The function $y_1(x) = \sin 3x$ is a solution of the given differential equation, use the reduction of order to find a second solution $y_2(x)$

$$y'' + 9y = 0 \quad (5)$$
- Q2. Solve the given differential equation by variation of parameters

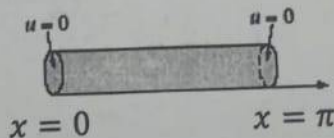
$$x^2 y'' + 10xy' + 8y = x^2 \quad (5)$$
- Q3. Solve the given system of differential equation by systematic elimination

$$Dx + y = t, \quad Dy - x = -t \quad (5)$$
- Q4. A thermometer is taken from an inside room to the outside, where the air temperature is 5°F . After 1 minute the thermometer reads 55°F , and after 5 minutes it reads 30°F .
 What is the initial temperature of the inside room? (5)
- Q5. Verify that the given functions form a fundamental set of solutions of the differential equation on the indicated interval. Form the general solution.

$$y'' - y' - 12y = 0, \quad e^{-3x}, \quad e^{4x}, \quad (-\infty, \infty) \quad (5)$$
- Q6. Find the general solution of the following Bessel's equation on $(0, \infty)$

$$x^2 y'' + xy' + \left(25x^2 - \frac{4}{9}\right)y = 0 \quad (5)$$
- Q7. Find the general solution of the following differential equation by using method of Frobenius, as $x = 0$ is the regular singular point.

$$xy'' + 2y' - xy = 0 \quad (10)$$
- Q8. Consider a thin rod of length $L = \pi$ with an initial temperature $f(x) = 100^\circ$ throughout. Assumed that the ends of the rod are held at zero temperature for all time $t > 0$ and the temperature of the rod is determined by the boundary-value problem



$$a^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}, \quad 0 < x < \pi, \quad t > 0$$

$$u(0, t) = 0, \quad u(\pi, t) = 0, \quad t > 0, \quad u(x, 0) = 100, \quad 0 < x < \pi. \quad (10)$$

Solve the boundary value problem for $u(x, t)$.

a^2



COMSATS University Islamabad, Islamabad
Department of Computer Science
Terminal Examination Fall-2022

Program: BCS 5(A&B)
Subject: Differential Equations
Instructor: Dr. Javeria Nawaz Abbasi

Total Marks: 50
Date: January 25, 2023
Time Allowed: 3 hours

Instructions for attempting paper:

FA20-BCS-024

1. Carrying of digital dairies is not allowed.
2. Mobile phones will not be allowed in the examination hall.
3. Answer all questions.
4. Questions (1-6) carry 7 marks question 7 is of 8 marks.

✓ Question 1: Define Homogeneous Equation, Degree of Homogeneous equation and use the concept to show that the solution of $(2\sqrt{xy} - y)dx - xdy = 0$ is $\sqrt{xy} - x = C$.

✓ Question 2: Find a second solution of the differential equation $9y'' - 12y' + 4y = 0$; where $y_1 = e^{2x/3}$.

✓ Question 3: A dead body was found within a closed room of a house where the temperature was constant 70°F . At the time of discovery, the core temperature of the body was determined to be 85°F . One hour later, a second measurement showed that the core temperature of the body was 80°F . Assume that the time of death corresponds to $t = 0$ and that the core temperature at that time was 98.6°F . Determine how many hours elapsed before the body was found.

✓ Question 4: Solve the given differential equation by undetermined coefficients

$$2y'' + 3y' - 2y = 4x^2 - 4x - 11, \quad y(0) = 0, y'(0) = 0.$$

✓ Question 5: Solve the Cauchy-Euler equation

$$x^2 y'' - 3xy' + 3y = 4 + 3x.$$

✓ Question 6: Consider the IBVP

$$u_t(x, t) = u_{xx}(x, t), \quad -1 < x < 1, t > 0,$$

$$u(-1, t) = u(1, t),$$

$$u_x(-1, t) = u_x(1, t),$$

$$u(x, 0) = x + 1.$$

(Consider only for $\gamma > 0$).

✓ Question 7: Find the general solution of the given differential equation

$$x^2 y'' + xy' + (25x^2 - 4/9)y = 0.$$

Ass the Best