

King Fahd University of Petroleum and Mineral
College of Computing and Mathematics
Department of Mathematics

MATH436 – Discrete Models

Academic Year 2024-25

Term 242

Midterm Exam

Name:	
ID#:	

Question	Score	Max Score
1		10
2		10
3		15
4		10
5		10
6		10
7		10
Total		75

Time allowed: **100** Minutes

Question 1

The differential equation $\frac{d^2y}{dx^2} + 2y = 0$ has a power series solution $y = \sum_{k=0}^{\infty} c_k x^k$.

Determine the difference equation satisfied by c_k .

Question 2

- (a) Plot the curve $y_{k+1} - 1 = (y_k - 1)^2$
- (b) Find the fixed points
- (c) Find the exact solution by setting $x_k = \ln(y_k - 1)$

Question 3 Solve the difference equations

(a) $y_{k+1} + 4^k y_k = 0$

(b) $y_{k+1} - y_k = 1 + e^k$

Question 4 Consider the difference equation $y_{k+2} - (k+3)(k+2)y_k = 0$

Given that $y_k^{(1)} = (k+1)!$ is a solution, find a second linearly independent solution.

Question 5

- (a) Find the general solution of the homogeneous equation

$$y_{k+3} + 5y_{k+2} + 3y_{k+1} - 9y_k = 0.$$

- (b) Write the form of the particular solution of the inhomogeneous equation

$$y_{k+3} + 5y_{k+2} + 3y_{k+1} - 9y_k = k(-3)^k + 2$$

Question 6 Solve the initial value problem

$$\Delta^3 y_k = 0, \quad y_0 = 0, \quad y_1 = 2, \quad y_2 = 1$$

Question 7 Solve the difference equation

$$y_{k+2} - 7y_{k+1} + 10y_k = 2k + 3^k$$