

**King Fahd University of Petroleum & Minerals**  
**Department of Mathematics & Statistics**  
**Math 472 Major Final (211)**

**Time Allowed : 120 Minutes**

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Name: \_\_\_\_\_ ID#: \_\_\_\_\_

Instructor: \_\_\_\_\_ Sec #: \_\_\_\_\_ Serial #: \_\_\_\_\_

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- Mobiles are not allowed in this exam.
  - Answers should be neat, clear, and legible.
  - Show all steps
  - Write your answers in 4 significant digits
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Question #	Marks	Maximum Marks
1		10
2		12
3		11
4		11
5		11
6		10
6		10
Total		75

**Q1** (10 points) Construct a least square approximation of the form  $bx^a$  for the following data

$(1, 1), (2, 4), (3, 8), (4, 12)$ .

**Q2** (12 points) Use Zero's of  $\tilde{T}_3$  and divided difference to construct a polynomial of degree

2 for the function  $f(x) = \ln(x + 2)$ .  $\bar{x}_k = \cos\left(\frac{2k-1}{2n}\pi\right)$ ,  $k = 1, 2, \dots, n$

**Q3** (11 points) Use Maclaurin series of  $f(x) = e^{-x}$  to construct a Padé approximation of degree 4 with  $n = 2$  and  $m = 2$ .

**Q4** (11 points) Use finite difference to approximate the solution of the boundary value problem

$$y'' = -3y' + 2y + 2x + 3, \quad 0 \leq x \leq 1, \quad y(0) = 2, \quad y(1) = 1, \quad h = 0.25$$

Write the discretized system of equations into matrix form.

**Q5** (11 points) Use linear shooting method to convert the boundary value problem

$$y'' = -3y' + 2y + 2x + 3, \quad 0 \leq x \leq 1, \quad y(0) = 2, \quad y(1) = 1$$

into TWO systems of first order differential equations.

**Q6** (10 points) Approximate the integral  $\int_0^2 \frac{1}{x^2 + 4} dx$  using composite Simpson's rule with  $n = 6$ . Also compute the absolute error.

**Q7** (10 points) Use the Newton forward-difference formula to construct interpolating polynomials of degree one, and two for the following data:

$$f(0.1) = -0.6205, \quad f(0.2) = -0.2840, \quad f(0.3) = 0.0066$$

Approximate  $f(0.25)$  value using each of the polynomials.