King Fahd University of Petroleum & Minerals
Department of Mathematics & Statistics
Math 472   Major Final (211)
Time Allowed : 120 Minutes

Name: _____ ID#: _____

Instructor: _____ Sec #: _____ Serial #: _____

- Mobiles are not allowed in this exam.

- Answers should be neat, clear, and legible.

- Show all steps

- Write your answers in 4 significant digits

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 $f(x) = \ln(x + 2)$. $\bar{x}_k = \cos\left(\dfrac{2k - 1}{2n}\pi\right)$, $k = 1, 2, \cdots, n$

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

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

Write the discretized system of equations into matrix form.

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

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

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:

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

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