



GWANDA STATE UNIVERSITY

EMI/EMR: 2201

FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENTS OF MINING AND METALLURGY

APPLIED MATHEMATICS

EPOCH MINE CAMPUS

MR R.G. MOYO

2021 EXAMINATIONS

Time : 3 hours

Candidates should attempt **ALL** questions from Section A and **ANY THREE** questions from Section B.

Instruments and Materials

- Calculator.
- Graph paper
- Statistical Tables

SECTION A (40 marks)

Answer ALL questions from this section.

A1. Define the following terms

- (a) Interpolation [2]
- (b) Numerical differentiation [2]
- (c) Probability [2]
- (d) Truncation error [2]
- (e) Hypothesis testing [2]

A2. (a) Construct a linear interpolation function given the 2 data points (3, 2) and (5, 8) [3]
 (b) Given the table below

x	1.3	1.4	1.45	1.5	1.55	1.6
$f(x)$	4.77	5.677	6.182	6.732	7.3028	7.9248

Evaluate

- (i) $f'(1.5)$ using the backward difference method [2]
- (ii) $f'(1.4)$ using the central difference method [2]
- (iii) $f''(1.5)$ [3]

A3. Mr. R. G. delivers an average of two lectures per week at GSU. Assuming that the number of lectures delivered can be modelled by a Poisson distribution, find the probability that he conducts

- (a) exactly three lectures in a given week [2]
- (b) more than four lectures in a given week [2]
- (c) exactly four lectures in a given fortnight [3]
- (d) no lectures on a given day, assuming that GSU operates on a five-day week. [3]

A4. (a) Use Simpson's rule with $n = 2$ to obtain an approximation to $\int_0^{\frac{\pi}{4}} x \cos x dx$ [5]
 (b) Solve $y' = \frac{x-y}{2}$ on $[0,3]$ with $y(0) = 1$ and $h = 1$ using the Euler's method. Hence calculate the error if $y(x) = 3e^{-\frac{x}{2}} + x - 2$ [5]

SECTION B (60 marks)

Answer ANY THREE questions from this section.

- A5.** (a) Determine the local truncation error (LTE) when solving an initial value problem using the Taylor's method [4]
 (b) Use Taylor's method of order $N = 3$ to solve $y' = 2x - y$ over $[0, 3]$ using $y(0) = 1$ and $h = 1$ [16]

- A6.** (a) During the 2014 World cup in a certain University, the probability that there was electricity on any particular day was $\frac{1}{3}$. In case that there was no electricity, a generator would be switched on. Independently, the probability that Welton watched a soccer match being screened live was $\frac{1}{4}$.
 (i) Represent the above information by a means of a tree diagram. [2]
 (ii) Find the probability that there was no electricity and Welton did not watch the match being screened live. [2]
 (b) 'Ntozonke Mine' needs to purchase cars for its top managers. The table below displays data on age and price for a sample of eleven cars being sold by Toyota car company. Ages are in years while prices are in thousand dollars.

Age	5	4	6	5	5	5	6	6	2	7	7
Price	8.5	10.3	7	8.2	8.9	9.8	6.6	9.5	16.9	7	4.8

- (i) Draw a scatter diagram for price against age [4]
 (ii) Calculate the equation of the regression line of price on age of the car [4]
 (iii) Draw the line of the equation on a scatter diagram in (i) and use it to estimate the price of a 3 year old car. [4]
 (iv) Find the product-moment correlation co-efficient and comment on it [4]
- A7.** (a) Define the following terms
 (i) Runge-Kutta method of order four (RK_4) [2]
 (ii) First order ordinary differential equation [3]
 (b) Apply Runge-Kutta method of order four (RK_4) to solve an initial value problem $y' = -2xy^2, y(0) = 1$ from $x = 0$ to $x = 0.9$ with $h = 0.3$ [15]

- A8.** (a) Outline the steps followed when carrying out a χ^2 test. [5]
- (b) The following data shows the ownership of satellite dishes by different social classes in a randomly chosen sample of 150 households at Gwanda State University.

Social class	Number of people who own satellite dishes	Number of those without a satellite dish
Executive staff	15	10
Academic Staff	23	8
Students	54	40

Test at 5% level of significance to establish if there is an association between ownership of a satellite dish and social class at GSU. [15]

- A9.** (a) Given that $f(x) = xe^x$, use a three-point formula with $h = 0.1$ and $h = 0.001$ to find approximations to $f''(2.5)$. Compare the calculated values with the true value of $f''(2.5)$. Comment on the effect of changing your step size. [15]
- (b) Discuss the applicability of interpolation and numerical differentiation in a mineral processing plant. [5]

END OF QUESTION PAPER

*“Do not worry about your difficulties in mathematics.
I can assure you mine are still greater.”* Albert Einstein