



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:
DIPLOMA IN MARINE ENGINEERING
EMR 2309: ENGINEERING MATHEMATICS VI
END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: Pick Date May 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE:

Q.1 (a) Given the following data, estimate $f(1.83)$ using Newton – Gregory forward difference Interpolation Polynomial.

| | | | | | |
|----------|-----|--------|--------|--------|--------|
| x_i | 1.0 | 3.0 | 5.0 | 7.0 | 9.0 |
| $f(x_i)$ | 0 | 1.0986 | 1.6094 | 1.9459 | 2.1972 |

(7 marks)

(b) Given the following data estimate $f(4.12)$ using Newton-Gregory backward difference Interpolation Polynomial.

| | | | | | | |
|----------|---|---|---|---|----|----|
| x_i | 0 | 1 | 2 | 3 | 4 | 5 |
| $f(x_i)$ | 1 | 2 | 4 | 8 | 16 | 32 |

(8 marks)

(c) Evaluate the following integrals over the given region D:

$$\iint_D 4xy - y^3 dA \quad ; \quad D \text{ is the region bounded by } y = \sqrt{x} \text{ and } y = x^3. \quad (7 \text{ marks})$$

- (d) Given that $\frac{4xy}{x^2 - y^2} \frac{dy}{dx} = 1$ and $y = 0; x = 1$, show that $(\sqrt{x})(x^2 - 5y^2) - 1$
(8 marks)

Question TWO

- (a) Evaluate $\int_0^{1.2} e^{-x^{2/2}} dx$ correct to 3 significant figures using 6 intervals by using
6 intervals by using
- (i) Trapezoidal Rule (6 marks)
(ii) Simpsons Rule (4 marks)

- (b) The velocity V of a car has the following values for corresponding values of time t from $t=0$ to $t=8s$.

| | | | | | | | | | |
|-----------------|---|-----|-----|-----|-----|---|-----|------|------|
| $V \text{ m/s}$ | 0 | 0.6 | 1.7 | 2.8 | 4.9 | 7 | 9.2 | 10.8 | 12.0 |
| $t \text{ s}$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Determine the approximate distance travelled by the car using Simpson's rule with 8-intervals.
(6 marks)

- (c) Determine the value of $\int_1^s \log_e x dx$ using the mid Ordinate rule with 8 intervals,
giving your answer correct to 4 significant figures. (4marks)

Question THREE

- (a) The Oscillations of a heavily damped pendulum satisfy the differential equation.

$$\frac{d^2x}{dt^2} + 7 \frac{dx}{dt} + 12x = 0;$$

where x cm is the displacement of the bob at time t -seconds.

The initial displacement is equal to +3cm and the initial velocity i.e $\frac{dx}{dt}$ is 6 cm/s.
Solve the equation for x . (8 marks)

- (b) Determine the particular solution to the differential equation

$$\frac{d^2y}{dx^2} + ay = 12 \text{ Cos}3x \text{ given}$$

When $x = 0, y = 2$ and $\frac{dy}{dx} = 3$ (12 marks)

Question FOUR

- (a) In a chemical reaction in which x is the amount transformed in time t , the velocity of the reaction is given by:

$$\frac{dx}{dt} = K(a-x) \text{ where } K \text{ is a constant and 'a' is the concentration at time } t=0 \text{ when } x=0;$$

Determine x in terms of t . (6 marks)

- (b) Solve the following differential equation

(i) $x \frac{dy}{dx} = y + x^3$ given $x=1$ when $y=3$. (6 marks)

(ii) $(y-x) \frac{dy}{dx} = \frac{y^2}{x} - y + \frac{x^2}{y}$ given that when $x=1, y=3$. (8 marks)

Question FIVE

(a) Sketch the region R in the xy-Plane bounded by the curves $y^2 = 2x$ and $y=x$ hence determine the bound area. (8 marks)

(b) Evaluate the following integrals

(i) $\int_{y=0}^3 \int_{x-1}^{\sqrt{4-y}} (x+y) dx dy$ (6 marks)

(ii) $\int_0^1 \int_0^1 \int_{\sqrt{x^2+y^2}}^3 xyz dz dy dx$ (6 marks)