# 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: 2HOURS

## DATE: Pick DateMay2016

**Instructions to Candidates**
You should have the following for this examination
-*Answer Booklet, examination pass and student ID*
This paper consists of **FIVE** questions. Attemptquestion ONE (Compulsory) and any other TWO questions.
**Do not write on the question paper.**

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

| xi | 1.0 | 3.0 | 5.0 | 7.0 | 9.0 |
|---|---|---|---|---|---|
| fxi | 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.

| xi | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| fxi | 1 | 2 | 4 | 8 | 16 | 32 |

(8 marks)
(c) Evaluate the following integrals over the given region D:
$$\iint_D 4xy - y3dA$$ : D is the region bounded by $y=\sqrt{x}$  and  $y=x^3$ .          (7 marks)

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

## Question TWO

(a)   Evaluate $\displaystyle\int_0^{1.2} e^{-x^2/2}\,dx$ 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 m/s | 0 | 0.6 | 1.7 | 2.8 | 4.9 | 7 | 9.2 | 10.8 | 12.0 |
|-------|---|-----|-----|-----|-----|---|-----|------|------|
| t 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 $\displaystyle\int_1^{s} \log_e x\,dx$ 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.
$$\dfrac{d^2x}{dt^2} + 7\dfrac{dx}{dt} + 12x = 0;$$
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 $\dfrac{dx}{dt}$ is 6 cm/s.
Solve the equation for $x$.                                                   (8 marks)

(b)   Determine the particular solution to the differential equation
$$\dfrac{d^2y}{dx^2} + ay = 12\,\text{Cos3x given}$$
When x = 0, y = 2 and $\dfrac{dy}{dx} = 3$                                     (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:
$\dfrac{dx}{dt} = K(a\text{-}x)$ where K is a constant and '$a$' is the concentration at time t=0 when x=0;
Determine $x$ in terms of $t$.                                                (6 marks)

(b)   Solve the following differential equation

(i)      xdy/dx=y +x$^3$ given x=1 when y=3.                       (6 marks)

(ii)      $(y-x)\dfrac{dy}{dx} = \dfrac{y^2}{x} - y + \dfrac{x^2}{y}$ 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)      $\displaystyle\int_{y=0}^{3} \int_{x-1}^{\sqrt{4-y}} (x+y)\,dx\,dy$                          (6 marks)

(ii)      $\displaystyle\int_{0}^{1} \int_{0}^{1} \int_{\sqrt{x^2+y^2}}^{3} xyz\,dz\,dy\,dx$                        (6 marks)