

**FACULTY OF ENGINEERING AND TECHNOLOGY**  
**ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT**  
**CERTIFICATE IN ELECTRICAL AND ELECTRONICS ENGINEERING**

**UNIT CODE: 1250**

**ENGINEERING MATHEMATICS III**

**SPECIAL / SUPPLEMENTARY EXAMINATIONS**

**SERIES JANUARY 2016**

**PAPER DURATION 2HRS**

**INSTRUCTIONS TO CANDIDATES**

**Candidates must have answer Booklet, Mathematics Tables, Scientific Calculation, No Mobile Phone, Question one compulsory and any other two.**

**Question one:**

(a) (i) Given that  $a(x) = 4x$ ,  $b(x) = x^2$ ,  $C(x) = x-5$  and  $d(x) = \sqrt{x}$   
Find  $f(x) = a(b(c[d(x)]))$  (2mks)

(ii) If  $f(x) = x^2$  express as simply as possible  $f\left(\frac{a+h}{h}\right) - f(a)$  ( $h \neq 0$ )

(b) (i) Prove from definition and series of  $e^x$  and  $e^{-x}$  that (2mks)  
$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \dots$$

(ii) If  $\tanh x = 1/3$  find  $e^{2x}$  (2mks)

(iii) If  $2\cosh x + 4\sinh x = Ae^x + Be^{-x}$ . Find A and B (3mks)

(c) Integrate:

(i)  $I = \int x(3-2x)^4 dx$  by putting  
 $u = 3 - 2x$  (4mks)

(ii)  $I = \int \frac{dx}{(3x+2)^2}$  (3mks)

(d) Determine the following

(i)  $\int (3x^4 - 4x^{1/3} + 3) dx$  (3mks)

(ii)  $\int 3\cos 2x dx$  (3mks)

(iii) Verify by integration that the area of the triangle formed by the line  $y = 2x$ , the ordinates.

$x = 0$  and  $x = 6$  and the x-axis is 36 square units (3mks)

**QUESTION TWO:**

(a) (i) Given that  $f : x \rightarrow 5x + 1$  and that  $g : x \rightarrow x^2$  express the composite function.  $fg$  and  $gf$  in their simplest possible forms. (3mks)

(ii) Given that  $f(x) = x^3$  find  $f(a + h) - f(a - h)$  ( $h \neq 0$ ) (3mks)

(b) Given that  $f(x) = 25 - x^2$  and that  $g(x) = \sqrt{x}$  find where possible the values of

(i)  $gf(0)$  (2mks)

(ii)  $gf(4)$  (2mks)

(iii)  $gf(13)$  (3mks)

(c) (i) The domain of  $f$  is  $\mathbb{R}$  (where  $\mathbb{R}$  is a set of real numbers)

$f : x \rightarrow 1$  when  $x < 0$  and

$f : x \rightarrow x^2 + 1$  when  $x \geq 0$

sketch the graph of the function (3mks)

(ii) Given that  $f(x) = 10x$  and  $g(x) = x + 3$ . Find  $fg(x)$  and  $(fg)^{-1}(x)$   
Verify that if  $b = fg(a)$  then  $(fg)^{-1}(b)$  (4mks)

### QUESTION THREE

- (a) Using Simpson's rule with 8 intervals, evaluate  $\int_1^3 y \, dx$  where the values of  $y$  at regular intervals of  $x$  are given.

x	1.0	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
y	2.45	2.80	3.44	4.20	4.33	3.97	3.12	2.38	1.80

(12mks)

- (b) (i) Find the area bounded by

$Y = 5 + 4x - x^2$ , the  $x$ -axis and the ordinates  $x = 1$  and  $x = 4$  (3mks)

- (ii) Given that volume of solid of revolution is given by  $\int_a^b \pi y^2 \, dx$

By rotating about the  $x$  – axis. Find the volume of the solid generated by rotating about the  $x$  – axis, the area under  $y = 5\cos 2x$  from  $x = 0$  to  $x = \frac{\pi}{4}$

4  
(5mks)

## QUESTION FOUR

(a) (i) Find all first and second partial derivative of  
 $z = 3x^2 + 2xy + 4y^2$  (3mks)

(ii) If  $V^2 = X^2 + Y^2 + Z^2$  Show that  
$$\frac{d^2v}{dx^2} + \frac{d^2v}{dy^2} + \frac{d^2v}{dz^2} = \frac{z}{v}$$
 (8mks)

(b) (i) Determine the approximate area between the curve  
 $y = x^3 + x^2 - 4x - 4$ , the ordinates  $x = -3$  and  $x = 3$  and the x- axis by  
applying Simpsons rule. (3mks)

(ii) Compare the results of b(i) above with the true area obtained by  
Integration (6mks)

## QUESTION FIVE

(a) Integrate each of the following as per method indicated

(i)  $\int x^2 e^x dx$  by parts (3mks)

(ii)  $\int \frac{1}{(x+1)^2(x^2+4)} dx$  by partial fractions (5mks)

(iii)  $\int \sin^3 x dx$  by trigonometric formation (3mks)

(b) Evaluate the following

(c)  $I = \int_1^2 \int_0^3 x^2 y dx dy$  (4mks)

(d)  $I = 3 \int_1^3 \int_{-1}^1 \int_0^3 (x + 2y - 2) dx dy dz$  (5mks)