

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) $\bar{I} = \int x^2 e^x dx$ by parts (3mks)

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

(iii) $\bar{I} = \int \sin^3 x dx$ 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)