MACHAKOS UNIVERSITY

University Examinations 2019/2020

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING (TVET)

2502/103/M: MATHEMATICS

DATE: 24/3/2020 **TIME: 11.30-2.300 PM**

INSTRUCTIONS:
The paper consists of EIGHT questions. Answer any FIVE questions.
ALL questions carry equal marks.
Show all your working

1. a) Simplify the expressions

   i. $\frac{27x^3y^{-4}z^2}{8x^{-4}y^{-6}z}$ (4 marks)

   ii. $\frac{\log 27-\frac{1}{2}log9}{log81+\frac{1}{2}log9}$ (4 marks)

   iii. $\sqrt[3]{27a^6}b^9 \div \sqrt{\frac{1}{36}}a^3b^5 \times \sqrt{a^4}b^6$ (6 marks)

   b) Determine the values of p, q, and r such that $4x^2 - 3x + 12 = p(x + q)^2 + r$ (6 marks)

2. Solve the equations

   a) i) $2(13.5^{x+2}) = 7^{x+4}$

   ii) $2\log_3 x - \log_3(x-1) = \log_3(x-2)$ (10 marks)

   b) $\frac{x}{x+2} + \frac{3}{x+3} = 2$ (3 marks)

   c) $sin2\theta + sin4\theta \quad sin6\theta = 0\ for\ values\ of\ \theta\ between\ 0^0\ and\ 360^0.$ (7 marks)

3. a) Prove the identities

   i. $\frac{sin\theta}{1+cos\theta} + \frac{1+cos\theta}{sin\theta} = \frac{2}{sin\theta}$ (5 marks)

ii. Sinh 3x = 3sinh x + 4snh^{3}x (5 marks)

iii. Cosx + cos(x+120^0) + cos(x+240^0) = 0 (6 marks)

b) Express Z = (2-7j) in polar form (4 marks)

4. Solve

a) 3cosh x + 2sinh x = 14.31 correct to 4 decimal places (6 marks)

b) 4cosh 2x = 4 + sinh 2x correct to 3 decimal places (6 marks)

c) 5x – 3y – 2z = 31

2x + 6y + 3z = 4

4x + 2y – z = 30 (8 marks)

5. a) Find the value of tanA, when tan(A-45^0) = $\frac{1}{3}$ (5 marks)

b) Given that SinA = $\frac{12}{13}$ and Cos B = $\frac{4}{5}$ where A is obtuse and B is acute, determine the values of ;

i) Sin (A – B)

ii) Tan (A + B) (5 marks)

c) Express in polar co-ordinates the position :

i. P_1 (3 4)

ii. P_2(-5 -8) (5 marks)

d) obtain the Cartesian equations of;

r = 5(1 + 2cosθ) (5 marks)

6. a) Determine the value of P and Q such that 4cosh x – 5sinhx = Pe^x + Qe^{-x} (5 marks)

b) i) Derive the identity sinh(x-y) = sinhx coshy – coshx sinhy

ii) Use Osbornes rule to derive the identity for sech^{2}x from the corresponding trigonometric identity. (7 marks)

c) Obtain the

i. polar equation of the of the loci $x^2 + y^2 – 2x = 0$

ii. cartesian equations of the loci $x = t^2 + 4$ and $y = t – 3$ (8 marks)

7. a) Determine the inverse of $f(x) = \frac{x+4}{2x-5}$ (4 marks)

b) Determine the polar equation of the parabola $x^2 = 4(1 + y)$ (4 marks)

c) Convert

i. r = 3(1 + 2cosθ) to Cartesian form

ii. $x^2 + y^2 = 7x$ to polar form (8 marks)

d) Solve for x given $e^x – 1 = 2e^{-x}$ (4 marks)

8. a) Simplify 3 +2j + 5(3 – j) + j(3j – 4) expressing the result in the polar form (6 marks)

b) Express $\frac{2+3j}{3+4j}$ in the form a + bj (3 marks)

c) Solve the equation $\frac{jx}{1+jy} = \frac{3x+jy}{x+3y}$ (5 marks)

d) Use Demoivre's theorem to show that $\sin^5\theta = \frac{1}{16} sin5\theta - 5sin3\theta + 10sin\theta$

(6 marks)