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 ELECTRICAL ENGINEERING (TVET)

2601/103/M: MATHEMATICS

DATE: 24/3/2020 **TIME: 11.30-2.30 PM**

INSTRUCTIONS:

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

QUESTION ONE

a) Simplify the expressions

i) $\frac{(1-x)^{\frac{1}{2}}-x(1-x)^{\frac{-1}{2}}}{1-x}$

ii) $\frac{\log 729-\frac{1}{3}log81+2log27}{\log 243-\frac{1}{3}log27+log9}$ (7 marks)

b) Solve the equations

i. $\log_3(2x-3) = -1$

ii. $3^{2x} = 4(3^x) + 3$

iii. $4^x = 2 + 16^{\frac{x}{4}}$ (13 narks)

QUESTION TWO

Solve

a) $5x - 3y - 2z = 31$

$2x + 6y + 3z = 4$

$4x + 2y - z = 30$ (8 marks)

b) $2\log_a(x+1) + \log_3 x = 1$ (6 marks)

c) $3\cosh x - 7\sinh x = 2$ correct to 3 decimal places (6 marks)

QUESTION THREE

a) i $\frac{1-cos\theta}{si\theta} + \frac{sin\theta}{1-cos\theta} = 2cosec\theta$

ii $\tan 3x = \frac{3tanx - tan^3x}{1-3tan^2x}$ (8 marks)

b) i $\cosh 2x = \frac{1+tanh^2x}{1-tanh^2x}$

ii $\tanh 3x = \frac{3tanhx+tanh^3x}{1+3tanh^2x}$ (6 marks)

c) $\cos x + \cos(x+120^0) + \cos(x+240^0) = 0$ (6 marks)

QUESTION FOUR

a) Given $Z = \frac{1}{2+J^3} + \frac{1}{1-J^2}$, express Z in the form a+bj (5 marks)

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

c) Given the complex numbers $z_1 = 2+5j$, $z_2 = 1-3j$ and $z_3 = 2+3j$ determine

$4z_1^2 + 3z_2z_3$. (7 marks)

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

QUESTION FIVE

a) Solve the following equation for for all values of θ between 0^0 and 360^0

$2\sin\theta - 3\cos\theta = =2$ (6 marks)

b) Solve for x given $3^{2x} = 4(3^x) + 3$ (4 marks)

c) Show that $\frac{1+tan^2B}{1+cot^2B} = tan^2B$ (6 marks)

d) Given that (a+b) + j(a-b) = 9+ 10j, find the values of a and b. (4 marks)

QUESTION SIX

a) Given that $\sin A = \frac{4}{5}$ and $\cos B = \frac{5}{13}$ where A is obtuse and B is acute, determine the values of

i. cos (A+B)

ii. tan (A+B) (7 marks)

b) Given that $p\cosh x + q\sinh x = 3e^x - 2e^{-x}$, determine the values of p and q. (7 marks)

c) Solve the equation $\frac{jx}{1+jy} = \frac{3x+jy}{x+3y}$ (6 marks)

QUESTION SEVEN

a) Express in polar co-ordinates the position :

i. P_1 (3 4)

ii. P_2(-5 -8) (6 marks)

b) Obtain the Cartesian equations of;

i. $r = 5(1 + 2\cos\theta)$

ii. $r = a\tan\theta$ (7 marks)

c) Find the cartesian equations of the loci;

i. $x = t^2 + 4$ and $y = t - 3$

ii. $x = 5\cos\theta$ and $y = 4\sin\theta$ (7 marks)

QUESTION EIGHT

a) Given the complex numbers $Z_1 = 4 + 3j$, $Z_2 = 1 + j$ and $Z_3 = 1 - 2j$, express

$Z = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3}$ in the form a + bj. (8 marks)

b) Use De Moivre's theorem to prove that $\text{Cos } 3\theta = 4Cos^3\theta - 3Cos\theta$ (5 marks)

c) Given that Z = j is one root of the equation $Z^4 - 2Z^3 + 3Z^2 - 2Z + 2 = 0$,

determine the other roots. (7 marks)