KABARAK UNIVERSITY

SUPPLEMENTARY/SPECIAL EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: MATH 112

COURSE TITLE: **GEOMETRY AND ELEMENTARY APPLIED MATHEMATICS**

STREAM: **Y1S1**

DAY: **TUESDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **17/03/2009**

Instructions:

Answer questions **ONE** and any other **TWO** questions.

PLEASE TURN OVER

Question One - (30mks)

(a) In a triangle ABC, $\underset{\sim}{OA} = \underset{\sim}{a}$, $\underset{\sim}{OB} = \underset{\sim}{b}$ and $\underset{\sim}{OC} = \underset{\sim}{c}$. M is a point on AB such that AM:MB = 2:3 and Q is a point on CM such that CQ:QM = 1:1. Express the position vector of Q in terms of $\underset{\sim}{a}$, $\underset{\sim}{b}$ and $\underset{\sim}{c}$. (4mks)

(b) A particle is acted upon by forces $F_1 = 4\underset{\sim}{i} + \underset{\sim}{j} - 3\underset{\sim}{k}$ and $F_2 = 3\underset{\sim}{i} + j - \underset{\sim}{k}$, thereby displacing it from the point $P = \underset{\sim}{i} + 2\underset{\sim}{j} + 3\underset{\sim}{k}$ to $Q = 5\underset{\sim}{i} + 4\underset{\sim}{j} + \underset{\sim}{k}$. Find the total work done. (4mks)

(c) Show that $\underset{\sim}{A} \times \underset{\sim}{B} = -(\underset{\sim}{B} \times \underset{\sim}{A})$ (4mks)

(d) Find the distance of the point (25,5,7)from the plane 12x + 4y + 3z = 3 (7mks)

(e) Find the modulus and principal value of the argument of the complex number -4 + 3i. (4mks)

(f) Find the value of λ for which the matrix below is singular. (3mks)

$$\begin{pmatrix} \lambda - 2 & 1 \\ 2 & \lambda - 3 \end{pmatrix}$$

(g) Find the condition necessary for the line y = mx + c to touch the ellipse.

$$\frac{x^2}{a^2} + \frac{y}{b^2} = 1$$ (4mks)

Question Two (20mks)

(a) Find the area of a triangle whose vertices are A(3,0,-1) , B(4,2,5) and C(7, -2, 4) (5mks)

(b) Find the angle between $\underset{\sim}{a} = 3\underset{\sim}{i} + \underset{\sim}{j} + 2\underset{\sim}{k}$ and $\underset{\sim}{b} = 2\underset{\sim}{i} - 2\underset{\sim}{j} + 4\underset{\sim}{k}$ (5mks)

(c) Use De Moivres theorem to show that $\tan 3\theta = \dfrac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$ (6mks)

(d) Determine the vector and parametric equations of line passing through A(1,4,2) and B(3, -1, 4) (4mks)

Question Three (20mks)

(a) Use the adjoint method to find the inverse of the matrix.

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 1 \\ 3 & 1 & -2 \end{pmatrix}$$

Hence solve the system of equations.

$x + 2y + 3z = 6$
$2x + y + z = 5$
$3x + y - 2z = 1$

(10mks)

(b) Find the volume of a parallelepiped with adjacent sides OP, OQ and OR where P(1,1,0), Q(1,0,1) and R(0,1,1) (6mks)

(c) Show that if $\underset{\sim}{A} = a_1 \underset{\sim}{i} + a_2 \underset{\sim}{j} + a_3 \underset{\sim}{k}$ then $\left|\underset{\sim}{A}\right| = \sqrt{\left(a_1^2 + a_2^2 + a_2^3\right)}$ (4mks)

Question Four (20mks)

(a) Find the equation of the plane through the points A(2,-1, 1), B(3, 2,-1) and C(-1, 3, 2) (7mks)

(b) A particle moves along the space curve $\underset{\sim}{r} = 3e^{-2t} \underset{\sim}{i} + 4\text{Sin } 3t \underset{\sim}{j} + 5\text{Cos } 3t \underset{\sim}{k}$. Find the magnitudes of its velocity and acceleration at t = 0. (6mks)

(c) Solve the following pair of equations by matrix method.

$2x + 3y = 2$
$x - 2y = 8$

(4mks)

(d) Find the distance of the point (1,3) from the line $2x + 3y - 6 = 0$ (3mks)

Question Five (20mks)

(a) If $\underset{\sim}{a} = 3\underset{\sim}{i} - \underset{\sim}{j} - 4\underset{\sim}{k}$, $\underset{\sim}{b} = -2\underset{\sim}{i} + 4\underset{\sim}{j} - 3\underset{\sim}{k}$ and

$\underset{\sim}{c} = \underset{\sim}{i} + 2\underset{\sim}{j} + \underset{\sim}{k}$ find $\left|2\underset{\sim}{a} - \underset{\sim}{b} + 3\underset{\sim}{c}\right|$ (3mks)

(b) (i) Obtain the polar equation of the locus $x^2 + y^2 - 2y = 0$ (3mks)

(ii) Obtain the Cartesian equation of the locus $2r^2 \sin 2\theta = C^2$ (3mks)

(c) Find the area of a parallelogram whose adjacent sides are $\underset{\sim}{a} = 3\underset{\sim}{i} + \underset{\sim}{j} - 2\underset{\sim}{k}$ and

$\underset{\sim}{b} = \underset{\sim}{i} - 3\underset{\sim}{j} + 4\underset{\sim}{k}$ (4mks)

(d) Find in terms of a and m the value of c which makes the line y = mx + c a tangent to the parabola $y^2 = 4ax$. Also obtain the coordinates of the point of contact. (7mks)