KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **MATH 222**

COURSE TITLE: **VECTOR ANALYSIS**

STREAM: **SESSION VI**

DAY: **MONDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **06/04/2009**

INSTRUCTIONS:

- Attempt **QUESTION ONE** and **ANY OTHER TWO** questions.

PLEASE TURN OVER

<u>Question One</u> (30 Marks)

(a) If $\vec{\ } = \ \hat{\ } + (3 \ \ -2 \ \ )\hat{\ } - (3 \ \ + 2 \ \ )$, find $\frac{\delta \ \vec{\ }}{\delta \ \delta}$ (3 marks)

(b) For what values of P are the vectors $\vec{\ } = \ \hat{\ } - 2\hat{\ } +$ and $\vec{\ } = 2 \ \hat{\ } + \ \hat{\ } - 4$ perpendicular? (3 marks)

(c) Evaluate $2\hat{\ } - 4 \ \ \times (\ \times 2\hat{\ })$ (2 marks)

(d) Find the unit tangent vector for a curve whose parametric equations are $=$, $= 2\cos 3$, $= 2\sin 3$ at $= 0$ (5 Marks)

(e) A particle moves along a curve whose parametric equations are $=$, $= \cos$, $=$.
Determine the velocity and acceleration at time t = o (5 marks)

(f) Evaluate

div $2 \ \ \hat{\ } - \ \ \hat{\ } + 3$ (3 marks)

(g) If $\vec{\ } = (5 \ \ -6 \ \ )\hat{\ } + (2 \ \ -4 \ \ )$, evaluate $\int \ \cdot \ \hat{\ }$ along the curve C in the xy – plane, $y = x^3$ from point (1, 1) to (2, 8) (5 marks)

(h) Show that the vector field $= (2 \ \ + \ \ )\hat{\ } + \ \hat{\ } + 2$ is conservative. (4 marks)

<u>Question Two</u> (20 Marks)

a) If $= \ \ + \ \ \hat{\ } +$, $\vec{\ } = \ \hat{\ } - \ \hat{\ } - 3$ and (2 Marks)

b) If $\vec{\ } = 2 \ \hat{\ } - \ \hat{\ } + 3$, Compute $\vec{\nabla} \cdot \ \vec{\ } \cdot \ \vec{\nabla} \times \vec{\ }$ at the point (1, 1, 1) (5 Marks)

c) Let $\vec{\ } = \ \hat{\ } + \ \hat{\ } +$ and $|\vec{\ }| =$, then deduce the form taken by $\vec{\nabla}$ (7 marks)

d) Prove that

$\vec{\nabla} \cdot \vec{\ } = 3$ (3 marks)

<u>Question Three</u> (20 Marks)

a) Show that the vector field $= \ \hat{\ } + \ \hat{\ } +$ is a gradient field. Hence or otherwise find the corresponding scalar potential. (10 Marks)

b) Find the unit normal vector to $\phi = \ \ = 1$ at (1, 1, 1) (5 Marks)

c) Calculate div $2 \quad \hat{} - \quad \hat{} + 3$ (5 Marks)

<u>Question Four</u> (20 Marks)

a) Evaluate $\int_{(\, , \,)}^{(\, , \,)} (\quad + \,) \quad + (y - \quad)$ along the path $= \, .$ (6 Marks)

b) If $\vec{} = (\quad + 2 \, \hat{} + \quad \hat{} + (\quad + 2 \,)$, evaluate $\int \vec{} \cdot \vec{}$ along the curve

$+ \quad = 1, \quad = 1$ from the point (0, 1, 1) to (1, 0, 1) (9 Marks)

c) Evaluate $\int$ where C is the segment of the line $= 2$ in the $-$ plane from

$(-1, -2, 0)$ to $(1, 2, 0$ (5 Marks)

<u>Question Five</u> (20 Marks)

a) Use Green's theorem to evaluate $\oint (3 \quad + 4 \,) \quad + (2 \quad - 3 \,)$ where C is a circle of radius 2 with centre (0, 0) (9 Marks)

b) Evaluate $\iint \quad \cdot$ ds where $= 2 \quad \hat{} + \quad + \quad$ and S is the surface bounded by

$= \quad , = \quad = 2, = 0$ and $1 \quad = 3$ (6 Marks)

c) Evaluate $\iint \quad \cdot$ where $= \hat{} + 2 \, \hat{} - 4$ and S is the surface of the plane $2 \quad + \quad = 6$ in the $-$ plane and $= 4$ (5 Marks)