(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

CHEMISTRY

COURSE CODE: MAT 214

COURSE TITLE: VECTOR ANALYSIS

DATE: 16/01/18 **TIME:** 2 PM -4 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

(a) Given that **A** = 2i – 3j – k, and **B** = i + 4j – 2k, show that **A**×**B** = -**B** × **A**. **(5mks)**

(b) Find the unit vector parallel to the resultant of the vectors $\mathbf{r}_1$ = 2i + 4j – 5k, $\mathbf{r}_2$ = i + 2j + 3k ; Resultant vector R = $\mathbf{r}_1 + \mathbf{r}_2$. **(5mks)**

(c) Evaluate the directional derivative of $\varphi = x^2yz + 4xz^2$ at (1, -2, -1) in the direction 2i –j – 2k. **(5mks)**

(d) Determine the divergence and curl of the vector field **F** = $x_i + y_j$. **(5mks)**

(e) Convert (1, $\sqrt{3}$,2) to spherical coordinate system. **(3mks)**

(f) Convert $(\sqrt{6},\frac{\pi}{4},\sqrt{2})$ to sperical coordinate system. **(3mks)**

(g) State the following theorems.

(i)Stokes theorem. **(2mks)**

(ii) Greens theorem. **(2mks)**

QUESTION TWO (20 MARKS)

(a) Find the dot product **A** . **B** given that **A** = 3i + 3j and **B** = -5i. **(5mks)**

(b) Find θ for non zero vectors **A** and **B** where **A** = 2i – j + 3k and **B** =I + j + k. **(5mks)**

(c) Find a vector perpendicular to the plane determined by the 3 vectors **A** =(1, 3, 2), **B** = (4, -1, 1) and **C** =(3, 0, 2). **(5mks)**

(d) Determine a unit vector perpendicular to the plane of **P** = 2i – 6j- 3k and **Q** = 4i + 3j - k. **(5mks)**

QUESTION THREE (20 MARKS)

Use Green's Theorem to evaluate the following

(a) $\oint_c xydx - x^2y^3\,dy$where c is the triangle with vertices (0, 0), (0, 1) and (1, 1) positively oriented.

(b) Show how the Greens theorem may work with regions with holes. **(20mks)**

QUESTION FOUR (20 MARKS)

(a) State the divergence theorem.

(b) Using four points describe the divergence theorem.

(c) Use the divergence theorem to evaluate $\iint_S \boldsymbol{F}\cdot ds$ where **F** =xyi -$\frac{1}{2}y^2$j +zk and the surface consists of 3 surfaces z = 4- 3x^2 -3y^2, $1 \le z \le 4$ on the top, $x^2 + y^2 = 1$, $0 \le z \le 1$ on the sides and z = 0 on the bottom. **(20mks)**

QUESTION FIVE (20 MARKS)

(a) Find the gradient of the scalar field **W** = 10r $\text{Sin}^2\theta\text{Cos}\theta$. **(3mks)**

(b) Given**Q** = x^2y^2 +xyz, compute ∇**W** and the direction derivative $\frac{dW}{dl}$ in the direction 3a_x +4a_y + 12a_z at (2, -1, 0) . **(3mks)**

(c) Find the angle at which the line x= y = 2z intersects the ellipsoid $x^2 + y^2 + 2z^2 = 0$. **(14mks)**