UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 3. Examination in Engineering: June 2014

Module Number: EE3305 **Module Name: Engineering Electromagnetism**

[Two Hours]

[Answer **all questions**, each question carries five marks]

Q1 a) Find the Laplacian of the scalar fields of

i) $V = \rho^2 z \cos 2\emptyset$

ii) $W = 10r \sin^2 \theta \cos \emptyset$ [2 Marks]

b) Let electric field density $\mathbf{D} = 2xy\ \mathbf{U}_x + x^2\ \mathbf{U}_y \text{C/m}^2$ and find

i) The volume charge density

ii) The flux through surface of $0 < x < 1$, $0 < z < 1$, $y = 1$ [3 Marks]

Q2. Given that Magnetic flux intensity $H_1 = -3\ \mathbf{a}_x + 5\ \mathbf{a}_y + 3\ \mathbf{a}_z$ A/m in region $y - x - 2 \leq 0$, where permeability $\mu_1 = 5\mu_0$, calculate

i) Flux density of B_1 [1 Marks]

ii) H_2 and B_2 in region $y - x - 2 \geq 0$, where $\mu_2 = 2\mu_0$ [4 Marks]

Q3. For a current distribution in free space,
$\mathbf{A} = (2x^2y + yz)\ \mathbf{U}_x + (xy^2 - xz^3)\ \mathbf{U}_y - (6xyz - 2x^2y^2)\ \mathbf{U}_z$ wb/m

a) Calculate Flux density, $\mathbf{B}$ [1 Marks]

b) Find the magnetic flux through a loop describe by $x = 1$, $0 < y, z < 2$. [2 Marks]

c) Show that $\nabla . \mathbf{A} = 0$, and $\nabla . \mathbf{B} = 0$ [2 Marks]

Q4. a) State the Biot-Sarvart law. [1 Mark]

b) A circular loop located on $x^2 + y^2 = \rho$, $z = 0$ carries a direct current of I along cylindrical coordinates of $a_\emptyset$.

Show that the magnetic field intensity $\mathbf{H}$ at $(0, 0, h)$ is given by

$$\mathbf{H} = \frac{I\rho^2}{2(\rho^2+h^2)^{\frac{3}{2}}}\ \mathbf{U}_z$$ [3 Marks]

c) If $I = 10$ A and $\rho = 3$, find $\mathbf{H}$ at $(0, 0, 4)$ and $(0, 0, -4)$. [1 Mark]