Sohag University | **1st Year Elec. Eng. Department**
Faculty of Engineering | **Fields Theory (1-a)**
First Semester 2018-2019 | **Sheet #1**

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1- Given the vectors $\mathbf{M} = -10\,\mathbf{a}_x + 4\,\mathbf{a}_y - 8\,\mathbf{a}_z$ and $\mathbf{N} = 8\,\mathbf{a}_x + 7\mathbf{a}_y - 2\,\mathbf{a}_z$, find: a) a unit vector in the direction of $-\mathbf{M} + 2\mathbf{N}$, b) the magnitude of $5\,\mathbf{a}_x + \mathbf{N} - 3\mathbf{M}$, c) $|\mathbf{M}||2\mathbf{N}|(\mathbf{M}+\mathbf{N})$.

2- Given points $A(8,-5,4)$ and $B(-2,3,2)$, find: a) the distance from A to B, b) a unit vector directed from A towards B, c) a unit vector directed from the origin to the midpoint of the line AB, d) the coordinates of the point on the line connecting A to B at which the line intersects the plane $z = 3$.

3- A vector field is specified as $\mathbf{G} = 24xy\,\mathbf{a}_x + 12(x^2 + 2)\,\mathbf{a}_y + 18z^2\,\mathbf{a}_z$. Given two points, $P(1,2,-1)$ and $Q(-2,1,3)$, find: a) $\mathbf{G}$ at P, b) a unit vector in the direction of $\mathbf{G}$ at Q, c) a unit vector directed from Q toward P, d) the equation of the surface on which $|\mathbf{G}| = 60$.

4- Given the vector field $\mathbf{E} = 4zy^2 \cos 2x\,\mathbf{a}_x + 2zy \sin 2x\,\mathbf{a}_y + y^2 \sin 2x\,\mathbf{a}_z$ for the region $|x|$, $|y|$, and $|z|$ less than 2, find: a) the surfaces on which $E_y=0$, b) the region in which $E_y=E_z$, c) the region in which $\mathbf{E}=0$.

5-Two vector fields are $\mathbf{F} = -10\,\mathbf{a}_x + 20\,x(y-1)\,\mathbf{a}_y$ and $\mathbf{G} = 2x^2y\,\mathbf{a}_x - 4\,\mathbf{a}_y + z\,\mathbf{a}_z$. For the point $P(2,3,-4)$, find: a) $|\mathbf{F}|$. b) $|\mathbf{G}|$, c) a unit vector in the direction of $\mathbf{F} - \mathbf{G}$, d) a unit vector in the direction of $\mathbf{F} + \mathbf{G}$.

6- Given the points $M(0.1,-0.2,-0.1)$, $N(-0.2,0.1,0.3)$, and $P(0.4,0,0.1)$, find: a) the vector $\mathbf{R}_{MN}$, b) the dot product $\mathbf{R}_{MN} \cdot \mathbf{R}_{MP}$, c) the scalar projection of $\mathbf{R}_{MN}$ on $\mathbf{R}_{MP}$, d) the angle between $\mathbf{R}_{MN}$ and $\mathbf{R}_{MP}$.

7- Describe the surfaces defined by the equations: a) $\mathbf{r} \cdot \mathbf{a}_x = 2$, b) $|\mathbf{r} \times \mathbf{a}_x| = 2$. Where $\mathbf{r} = (x, y, z)$.

8- Express in cartesian components, where $A(\rho = 4, \varphi = 40°, z = -2)$ and $B(\rho = 5, \varphi = -110°, z = 2)$. a) the vector at A that extends to B, b) a unit vector at B directed toward A, c) a unit vector at B directed toward the origin.

9- Express in cylindrical components, where $C(3,2,-7)$ and $D(-1,-4,2)$. a) the vector from C to D, b) a unit vector at D directed toward C, c) a unit vector at D directed toward the origin.

10- Given point $P(r = 0.8, \theta = 30°, \varphi = 45°)$, and $\mathbf{E} = 1/r^2\,(\cos\varphi\,\mathbf{a}_r + \sin\varphi \sin\theta\,\mathbf{a}_\varphi)$. a) Find $\mathbf{E}$ at P, b) Find $|\mathbf{E}|$ at P, c) Find a unit vector in the direction of $\mathbf{E}$ at P.

11- At point $P(-3,4,5)$, express the vector that extends from P to $Q(2,0,-1)$ in: a) rectangular coordinates, b) cylindrical coordinates, c) spherical coordinates.
