# ELECTROMAGNETIC THEORY

**2021**

**<u>Homework #1</u>**

**<u>Deadline:</u> 17/3/2021**

**Problem 1:**

Three vectors drawn from a common point are given as follows:

$$\boldsymbol{A} = -2\boldsymbol{a}_1 - m\boldsymbol{a}_2 - m\boldsymbol{a}_3$$
$$\boldsymbol{B} = m\boldsymbol{a}_1 + \boldsymbol{a}_2 - 2\boldsymbol{a}_3$$
$$\boldsymbol{C} = \boldsymbol{a}_1 + (m+2)\boldsymbol{a}_2 + 2\boldsymbol{a}_3$$

Find $m$ for each of the following cases:

a. $\boldsymbol{A}$ is perpendicular to $\boldsymbol{B}$

b. $\boldsymbol{B}$ is parallel to $\boldsymbol{C}$

c. $\boldsymbol{A}, \boldsymbol{B}$ and $\boldsymbol{C}$ lie in the same plane.

**Problem 2:**

Consider the surface: $x^2 + 2y^2 + 4z^2 = 14$, find the unit vector normal to the surface at the point: $(\sqrt{2}, \sqrt{2}, \sqrt{2})$
Hint: Consider two differential length vectors tangential to the surface at that points

**Problem 3:**

Three infinitely long lines charge are located at x-axis, the line: x = 2, z = 2 (parallel to y-axis) and the line:
x = y = z, respectively. They have the same uniform line charge density: $\rho_{LO} = 4\pi\varepsilon_0$
Find the electric field intensity at the pointA (2,2,0)

**Problem 4:** Three infinite planes current sheets, each of a uniform current density, exist in the coordinate planes of a Cartesian
coordinate system. The magnetic flux density due to these current sheets are given at three points as follows: at
(1,5,3), $\boldsymbol{B} = B_0(a_x + 2a_y)$; at (6, -1,2), $\boldsymbol{B} = B_0(-a_x + 2a_y + a_z)$; at (1,2, -2), $\boldsymbol{B} = B_0(a_x + 2a_z)$;
Find the magnetic flux density at the following points:
a. (-1,1,4)
b. (-1,-2,-4)

**Problem 5:**

The forces experienced by a test charge $q$ at a point in a region of electric and magnetic fields **E** and **B**, respectively, are given as follows for three different velocities of the test charge, where $v_0$ and $E_0$ are constants.

$$\mathbf{F}_1 = qE_0(\boldsymbol{a}_x - \boldsymbol{a}_y - \boldsymbol{a}_z) \text{ for } \boldsymbol{v}_1 = v_0\boldsymbol{a}_x$$

$$\mathbf{F}_2 = \mathbf{0} \qquad \text{for } \boldsymbol{v}_2 = v_0\boldsymbol{a}_y$$

$$\mathbf{F}_3 = qE_0(\boldsymbol{a}_x + \boldsymbol{a}_y - \boldsymbol{a}_z) \text{ for } \boldsymbol{v}_3 = v_0\boldsymbol{a}_z$$

Find **E** and **B** at that point.