Salahaddin University-Erbil
College of Engineering
Department of Water Resources Engineering
Second Year Students
1st Semester
2020-2021

Mathematics III

Vectors (Chap. 12)

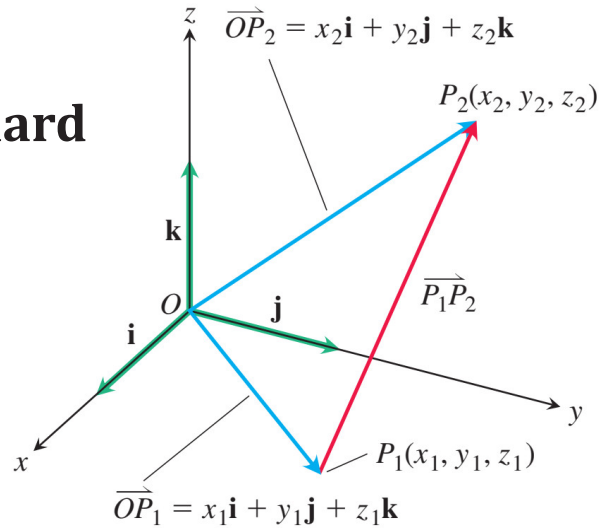
Lec 02

Edmodo Code:
hm892c

Sarkawt H. Muhammad

sarkawt.muhammad@su.edu.krd

Unit Vectors



A vector **v** of length 1 is called a **unit vector.** The **standard unit vectors** are:

i = (1, 0, 0), **j** = (0, 1, 0), and **k** = (0, 0, 1)

Any vector **v** = (v_1, v_2, v_3) can be written as a *linear combination* of the standard unit vectors as follows:

$$\mathbf{v} = (v_1, v_2, v_3) = (v_1, 0, 0) + (0, v_2, 0) + (0, 0, v_3)$$

$$= v_1(1,0,0) + v_2(0,1,0) + v_3(0,0,1)$$

$$= v_1\mathbf{i} + v_2\,\mathbf{j} + v_3\,\mathbf{k}$$

We call the scalar (or number) v_1 the **i-component** of the vector **v**, v_2 the **j-component**, and v_3 the **k-component.**

(Vector between two points) the component form for the vector from $P_1(x_1, y_1, z_1)$ to $P_2(x_2, y_2, z_2)$ is:

$$\overrightarrow{P_1P_2} = (x_2 - x_1)\mathbf{i} + (y_2 - y_1)\mathbf{j} + (z_2 - z_1)\mathbf{k}$$

Direction of vector

If $\mathbf{v} \neq \mathbf{0}$, then its length $|\mathbf{v}|$ is not zero: $\left|\frac{1}{|\mathbf{v}|}\mathbf{v}\right| = \frac{1}{|\mathbf{v}|}|\mathbf{v}| = 1$

That is, $\mathbf{v}/|\mathbf{v}|$ is a *unit vector* in the direction of $\mathbf{v}$, called **the direction** of the nonzero vector $\mathbf{v}$.

Summary

If $\mathbf{v} \neq \mathbf{0}$, then

1. $\frac{\mathbf{v}}{|\mathbf{v}|}$ is a unit vector called the **direction** of $\mathbf{v}$;

2. the equation $\mathbf{v} = |\mathbf{v}|\frac{\mathbf{v}}{|\mathbf{v}|}$ expresses $\mathbf{v}$ as its length times its direction.

EXAMPLE 3

Find a unit vector $\mathbf{u}$ in the direction of the vector from $P_1(1, 0, 1)$ to $P_2(3, 2, 0)$.

Direction of vector (Cont.)

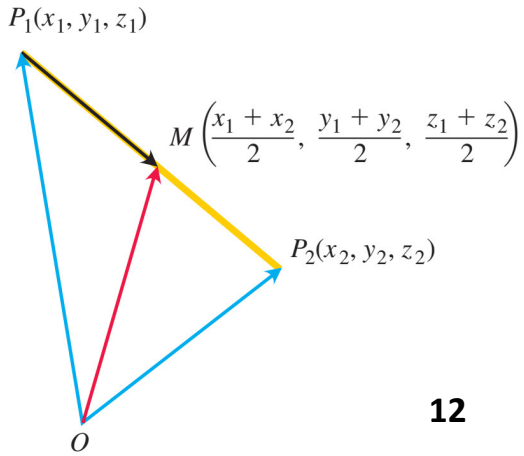
EXAMPLE 4

A force of 6 newtons is applied in the direction of the vector v = 2**i** + 2**j** - **k**. Express the force **F** as a product of its magnitude and direction.

Midpoint of a Line Segment

The **midpoint** M of the line segment joining points $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$ is the point:

$$M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2}\right)$$



EXAMPLE 5

Find the midpoint of the segment joining

$P_1(3, -2, 0)$ and $P_2(7, 4, 4)$