The Direction Angles:

$\forall$ vector $\vec{v} \in \mathbb{R}^3$, the direction of a non-zero vector $\vec{v}$ is completely determined by the angles α, β and γ between the vector $\vec{v}$ and the unit vectors $\vec{i}$, $\vec{j}$ and $\vec{k}$ respectively. therefore, the direction cosines of $\vec{v}$ are defined as follows: (by Theorem 2)

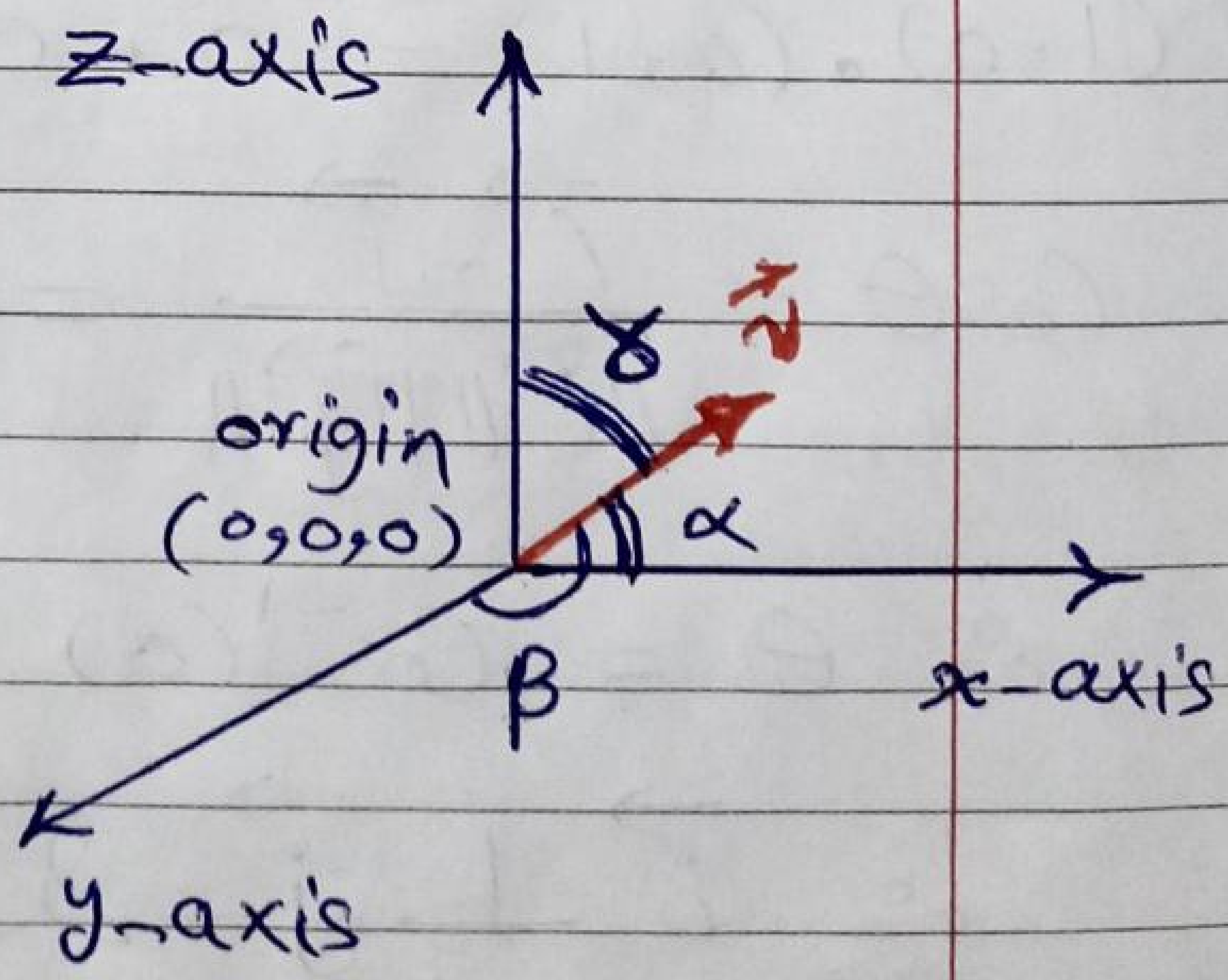
$$\cos\alpha = \frac{\vec{v}\cdot\vec{i}}{\|\vec{v}\|\,\|\vec{i}\|} = \frac{(v_1, v_2, v_3)\cdot(1,0,0)}{\|\vec{v}\|\,(1)}$$

$$= \frac{v_1+0+0}{\|\vec{v}\|} = \frac{v_1}{\|\vec{v}\|}$$

By the same way we have:

$$\cos\beta = \frac{v_2}{\|\vec{v}\|} \quad \& \quad \cos\gamma = \frac{v_3}{\|\vec{v}\|}$$

Note: It is true for $\mathbb{R}^2$ that:



$$\cos\alpha = \frac{\vec{v}\cdot\vec{i}}{\|\vec{v}\|\,\|\vec{i}\|}$$

$$= \frac{(v_1, v_2)\cdot(1,0)}{\|\vec{v}\|\left(\sqrt{1^2+0^2}\right)}$$