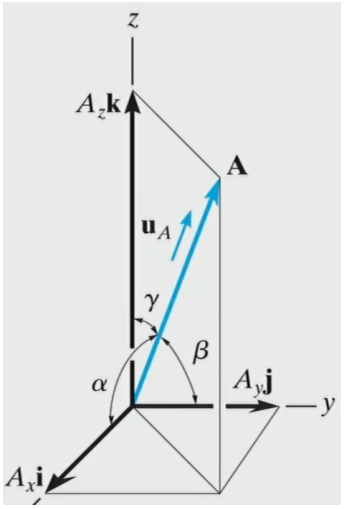
**Lecture 3 Note - *Vectors II***

*Textbook Chapter 2.5-2.8*

**3D Vectors:**




- Write 3D vectors using Cartesian Notation (XYZ coords).
- To remember which axis is which, use the right-hand rule: **Arm is Y, fingers X, thumb Z.**
- Vectors can be broken up into unit vectors, as usual. Note the Z-axis uses unit vector **K**.
- For direction, we use **α**, ***β***, and **γ** to label angles from the x/y/z axes. They measure directly from their native axis to the vector.
- Note $\mathbf{U_A}$ , the unit vector for vector **A**: $\boldsymbol{u_A} = \boldsymbol{A/A}$

$$\mathbf{u_A} = \frac{\mathbf{A}}{A} = \frac{A_x}{A}\mathbf{i} + \frac{A_y}{A}\mathbf{j} + \frac{A_z}{A}\mathbf{k}$$
$$\mathbf{u_A} = \cos\alpha\mathbf{i} + \cos\beta\mathbf{j} + \cos\gamma\mathbf{k}$$

- Since the magnitude of a unit vector is 1, we can find the 3rd angle if only 2 are given by taking the root of the sum of the squares:

$$u_A = \sqrt{\cos^2\alpha + \cos^2\beta + \cos^2\gamma} = 1$$
$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$\therefore \alpha = \sqrt{1 - cos^2\beta - cos^2\gamma}$$

$$\cos\alpha = \frac{A_x}{A}$$
$$\cos\beta = \frac{A_y}{A}$$
$$\cos\gamma = \frac{A_z}{A}$$

- There's a lot more addition, subtraction, and cartesian/unit vector stuff, but it all works the same as before, with 3 dimensions of course.

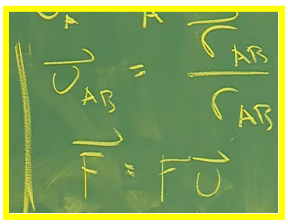
**Position vector:**

- A vector that indicates where one point is in relation to another point. Basically indicates how to get from A to B, i.e. how far is it and in what direction.
- $\boldsymbol{r_{AB}}$ is the symbol for a position vector, where A and B are the start and end points.
- To find a position vector, find the difference between the start and end coordinates. When expressed in cartesian notation you will have a nice vector.
    - Find magnitude (distance) by taking the root of the sum of the squares.

**Unit vector:**

- A unit vector tells us which way a vector points, and has a magnitude of 1.
- Unit vector $\boldsymbol{u_{AB}} = \boldsymbol{r_{AB}}/r_{AB}$, where $\boldsymbol{r_{AB}}$ is the pos. vector, and $r_{AB}$ the mag. of the pos. vector.
- Unit vector of $\boldsymbol{F} = F\boldsymbol{u}$, where ***F*** is the vector, *F* is magnitude, and *u* a unit vector.

**Bonus: When starting a problem, think about how you'll solve it before starting. Some ways are faster than others: Time saved = grades gained.**



Not included in these notes: How to find the angles of oblique vectors. See slide 7 of Lecture 3.