1.7: Coordinate Systems

Learning Objectives

By the end of this section, you will be able to

- Identify the key differences between Cartesian, cylindrical, and spherical systems.

The coordinate systems most commonly used in scientific and engineering analysis are the **Cartesian** [1], **cylindrical** [2], and **spherical** [3] systems. These systems are illustrated in Figures 1.7.1, 1.7.2, and 1.7.3, respectively.

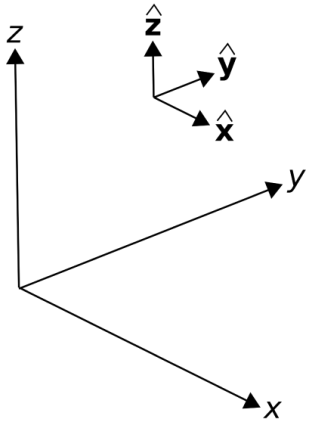

Figure 1.7.1: Cartesian coordinate system [4]

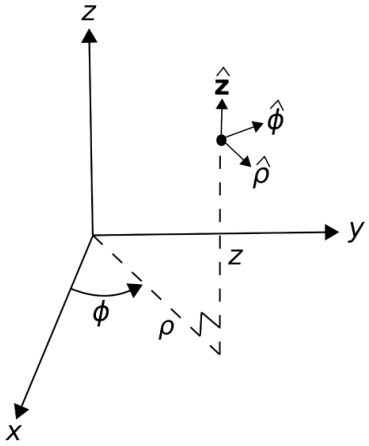

Figure 1.7.2: Cylindrical coordinate system. [5]

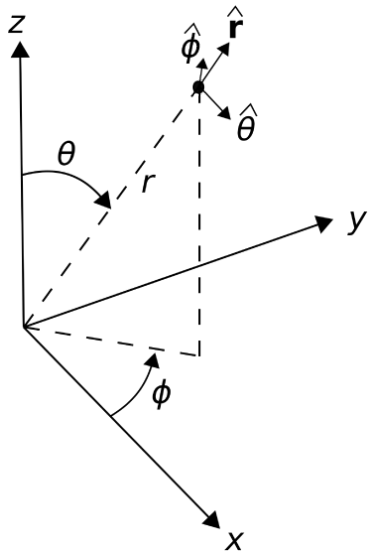

Figure 1.7.3: Spherical coordinate system. [6]

Note that the use of variables is not universal; in particular, it is common to encounter the use of r in lieu of ρ for the **radial coordinate** in the cylindrical system, and the use of R in lieu of r for the radial coordinate in the spherical system. The angle ϕ is typically called the **azimuthal coordinate** in both the cylindrical and spherical coordinates, while the angle θ is typically called the **polar coordinate** in spherical coordinates. In contrast to Cartesian coordinates, in which the coordinate unit vectors $\hat{x}$, $\hat{y}$, $\hat{z}$ always point in the same direction, the unit vectors in cylindrical and spherical coordinates will change direction based on the point in space that is being referenced, as indicated in the figures.

References

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3. Wikipedia contributors. Spherical coordinate system [Internet]. Wikipedia, The Free Encyclopedia.
4. Wikimedia Commons contributors. File:M0006 fCartesianBasis.svg [Internet]. Wikimedia Commons. (CC BY-SA 4.0; K. Kikkeri)
5. Wikimedia Commons contributors. File:M0096 fCylindricalCoordinates.svg [Internet]. Wikimedia Commons. (CC BY-SA 4.0; K. Kikkeri)
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