Duke University
Department of Physics

Physics 361 Spring Term 2020

WUN2K FOR LECTURE 20

These are notes summarizing the main concepts you need to understand and be able to apply.

- For a rotating frame on the surface of the Earth, taking into account noninertial forces, we define an *effective* acceleration of gravity $\vec{g} = \vec{g}_0 + (\vec{\Omega} \times \vec{r}) \times \vec{\Omega}$, where $\vec{g}_0$ is the radial acceleration of gravity, $\vec{\Omega}$ is the angular velocity of the Earth, and $\vec{r}$ is the position vector of an object in the rotating frame of the Earth. We often have $\vec{r} \sim \vec{R}$, where $\vec{R}$ is the vector from the center of the Earth to a point on the surface of the earth near the object under consideration.

- The effective force on an object at the surface of the Earth can then be written $\vec{F}_{\text{eff}} = \vec{F} + m\vec{g} + 2m\dot{\vec{r}} \times \vec{\Omega}$, where $\vec{F}$ is the sum of the external forces in the fixed frame, and $\dot{\vec{r}}$ is the velocity in the rotating frame.

- The last term in this expression is the Coriolis force, and it results in a deflection to the right of a particle's path in the Northern Hemisphere, and so a counterclockwise rotation. In the Southern Hemisphere, the Coriolis force results in a deflection to the left of a particle's path, and a clockwise rotation. The Coriolis force has a significant effect on air circulation in the atmosphere of the Earth.