Newton's second law is applicable to rotating frames of reference only when pseudo-forces are introduced. If the origin of a rotating frame is stationary, the pseudo-forces are

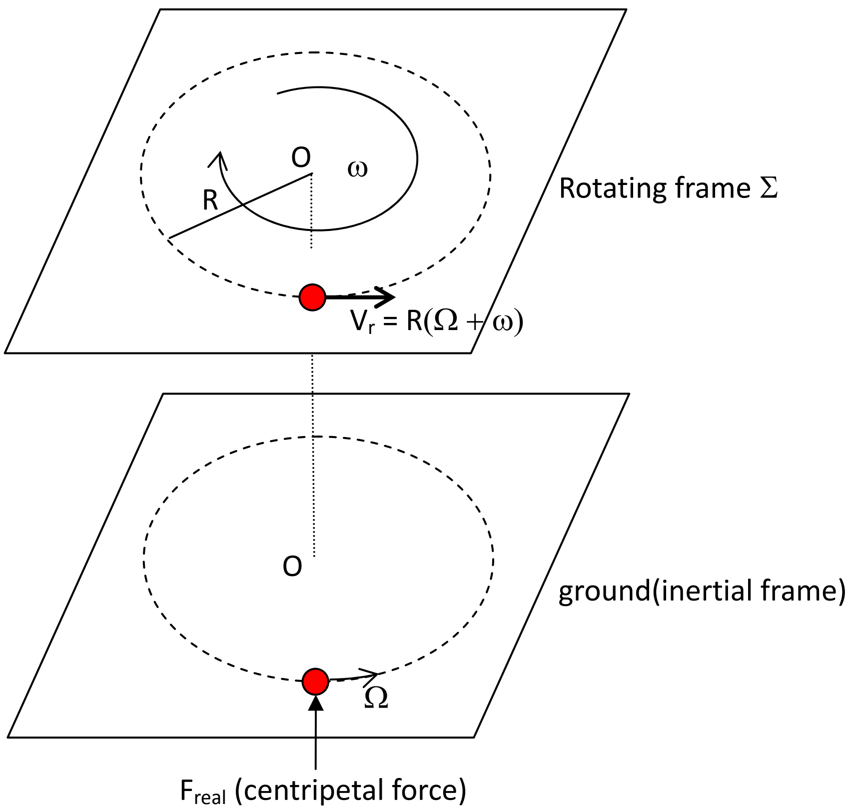
1. Centrifugal force: $-m\vec{\omega} \times (\vec{\omega} \times \vec{R})$
2. Coriolis force: $-2m\vec{\omega} \times \vec{v}_{rot}$,

Where $\vec{\omega}$ is the angular velocity of the rotating frame relative to an inertial frame,
$\vec{R}$ is the position vector of the particle from the origin of the rotating frame and
$\vec{v}_{rot}$ is the velocity of the particle relative to the rotating frame.

Hence, Newton's second law becomes

$$m\frac{d^2\vec{R}}{dt^2} = \vec{F}_{real} - \mathrm{m}\vec{\omega} \times (\vec{\omega} \times \vec{R}) - 2\mathrm{m}\vec{\omega} \times \vec{v}_{rot}$$

Example:
A particle of mass m rotates uniformly about O on ground (assumed to be stationary) with angular velocity Ω. Another frame of reference Σ with the rotation axis passing through O rotates with angular velocity ω in the ***opposite*** sense of Ω.



With respect to Σ, the particle m rotates with $\Omega + \omega$ and hence its velocity is purely tangential, $v_{rot} = (\Omega + \omega)R$. The forces (real and fictitious) acting on it are

Real force (centripetal force) : $m\Omega^2 R$ (radially towards O)

Pseudo-forces: centrifugal force: $m\omega^2 R$ (radially away from O)

Coriolis force : $2m\omega v_{rot} = 2m\omega R(\Omega + \omega)$ (radially towards O)

Hence, an observer in Σ accounts for the motion of m by the "net" force

Net force = $m\Omega^2 R - m\omega^2 R + 2m\omega R(\Omega + \omega)$

$= m\Omega^2 R + 2m\omega\Omega R + m\omega^2 R$

$= m(\Omega+\omega)^2 R$ (towards O)

This result is totally consistent with Newton's laws of motion that whenever a mass rotates with $\Omega + \omega$, the force required is $m(\Omega+\omega)^2 R$.