Advanced Dynamics
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Module No # 07
Lecture No # 33
Spatial Kinematics of Rigid Bodies – I

In this lecture we are going to look at spatial kinematics of rigid bodies.

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We are going to look at kinematics in 3 dimensions we are going to look at a prototype problem which will essentially setup the background for kinematics of rotation about a fixed point.

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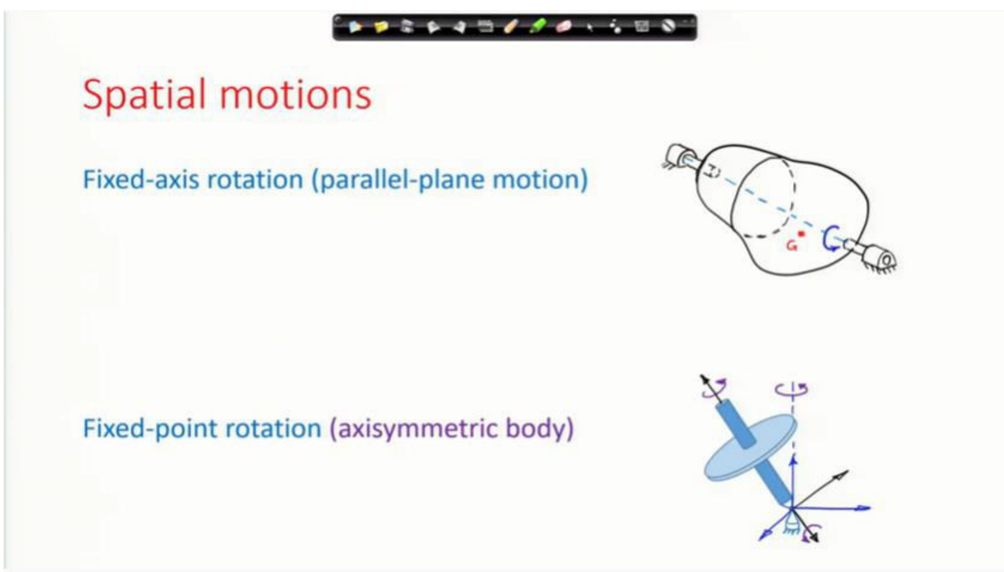

Spatial motions that we will consider will essentially be of 2 types, as shown in the slide above. When there exists a fixed rotation axis, it is called a fixed axis rotation or also known as parallel plane motion. The other is fixed point rotation of an axisymmetric body about a fixed point. Later, we will consider completely free motion of a rigid body.

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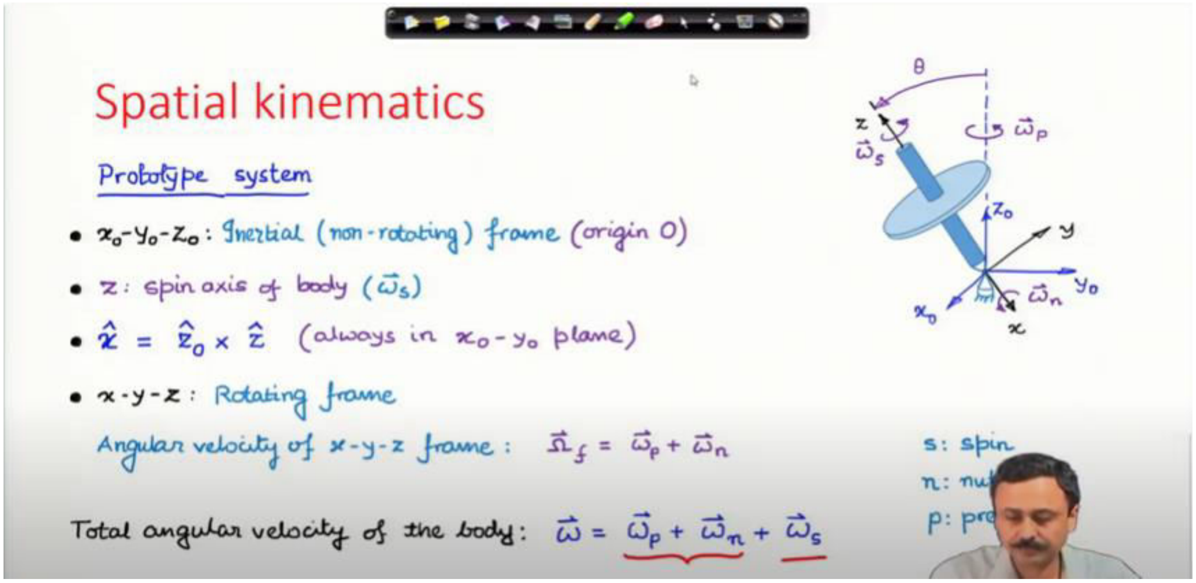

We are going to start with this prototype problem of rotation of a symmetric body about a fixed point. The parallel plane motion will be discussed a little later. In the above slide, I have shown in the figure an axisymmetric body rotating with a point fixed at the origin of the inertial x_0-y_0-z_0 frame shown. The setting up of the x-y-z frame, and the angular velocity of the body is expressed in terms of the spin, precession and nutation angular velocities.

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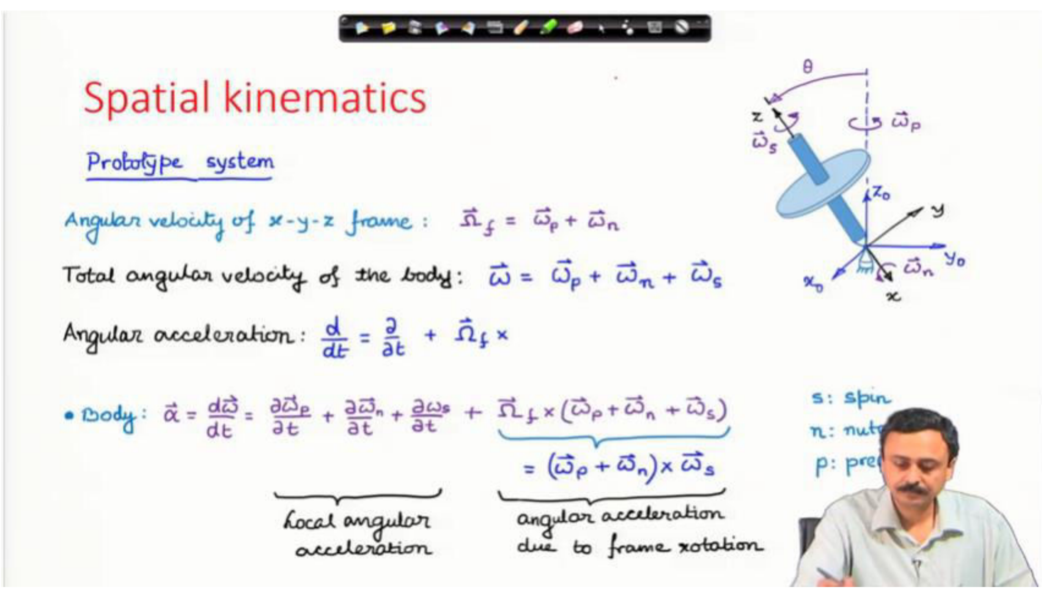

The above slide presents the calculation of the angular acceleration of the axisymmetric body.

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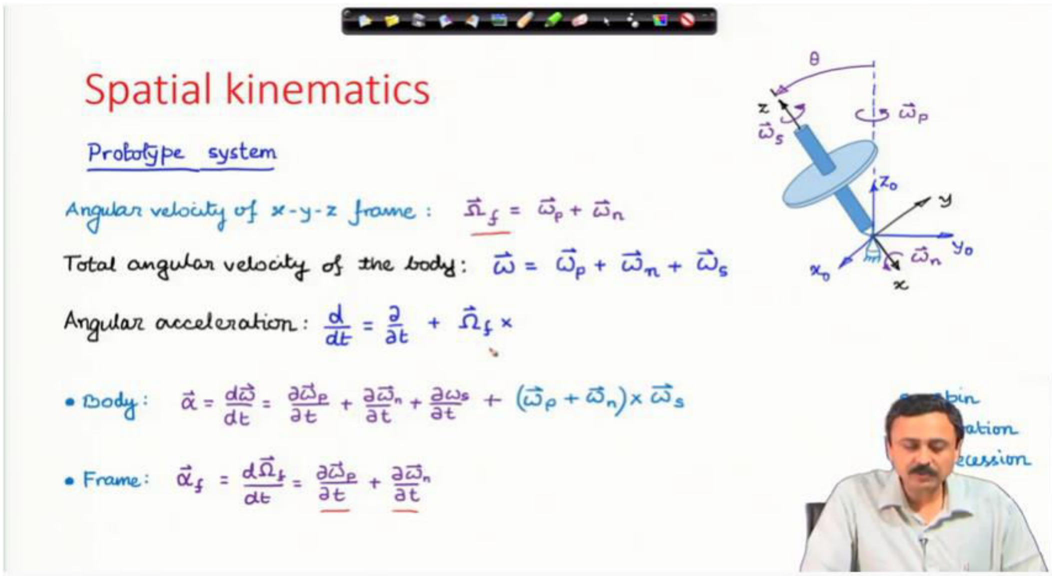

Next we look at the angular acceleration of frame, as shown in the above slide.

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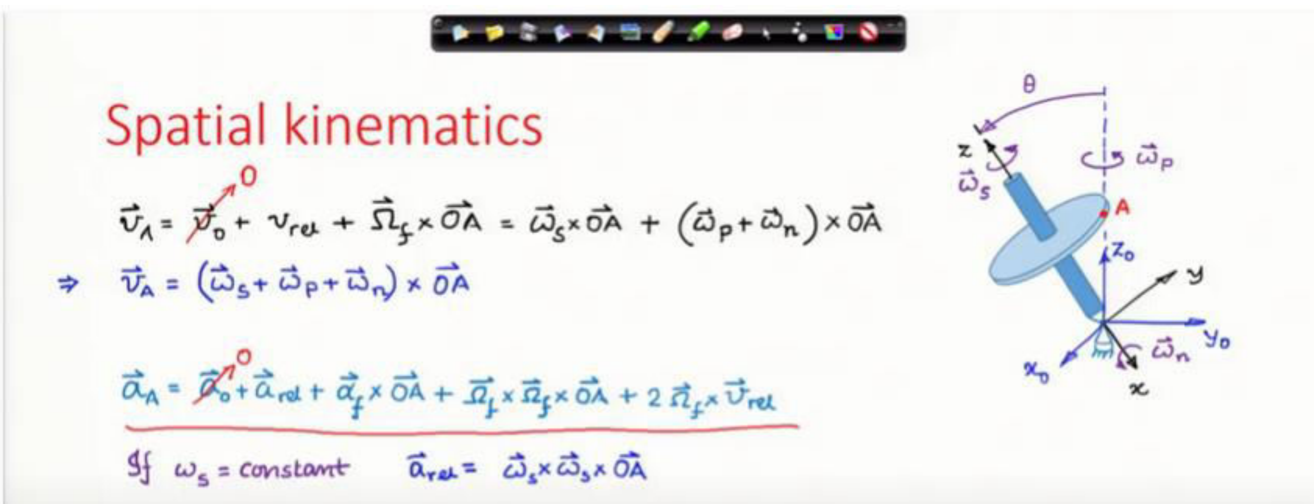

Consider now a point A as shown in red on the disk in the above figure. We can express the velocity and acceleration of A as presented above.

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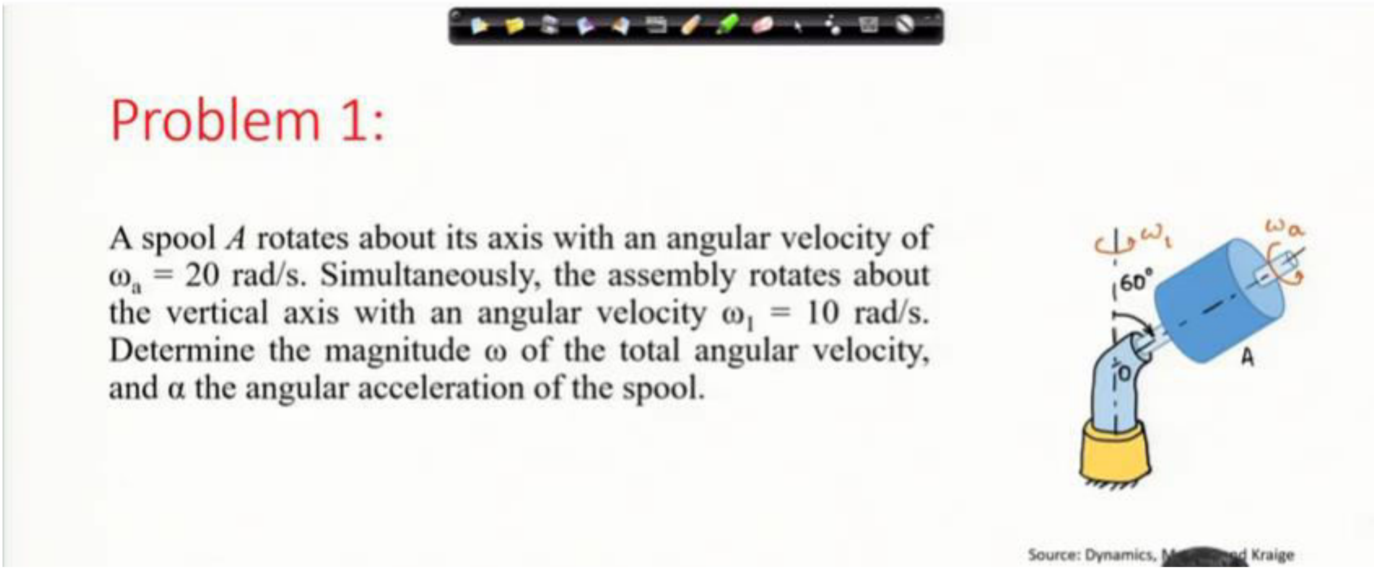

We consider the above problem.

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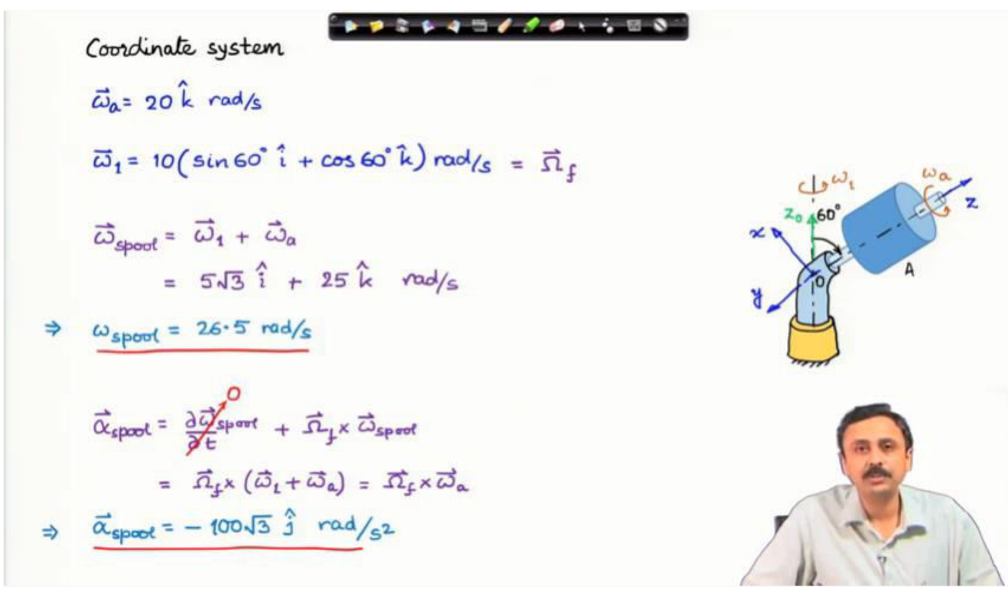

The detailed solution is presented above.

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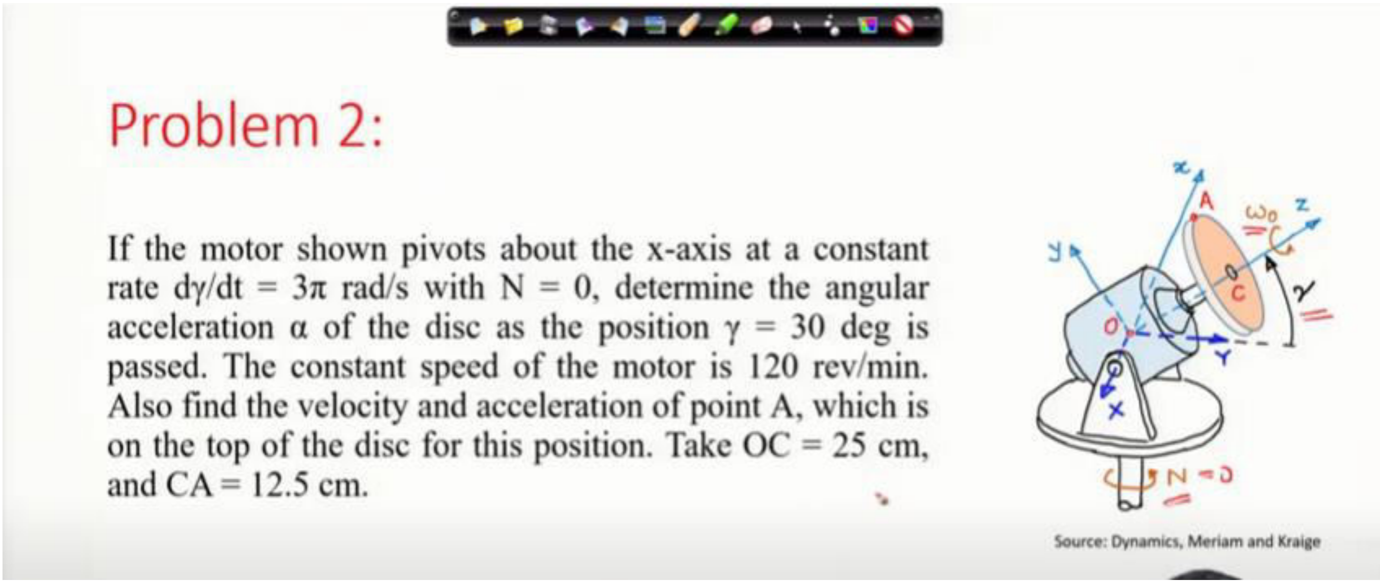

The next problem is shown above.

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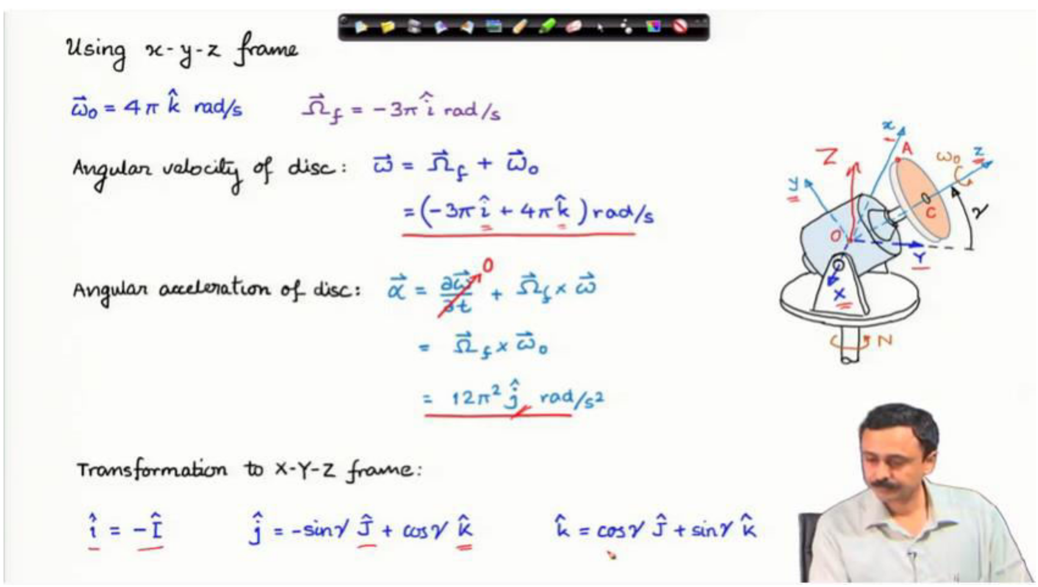

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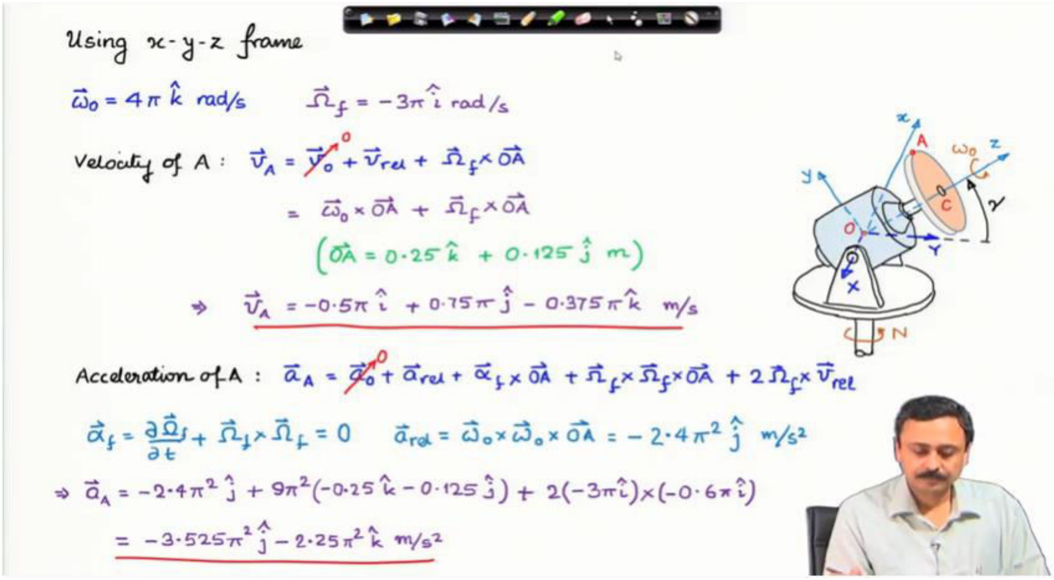

The detailed solution is presented in the 2 slides above.

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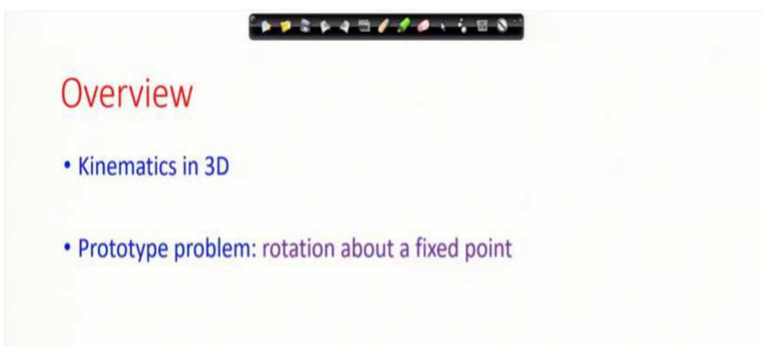

The discussions are summarized as shown above.