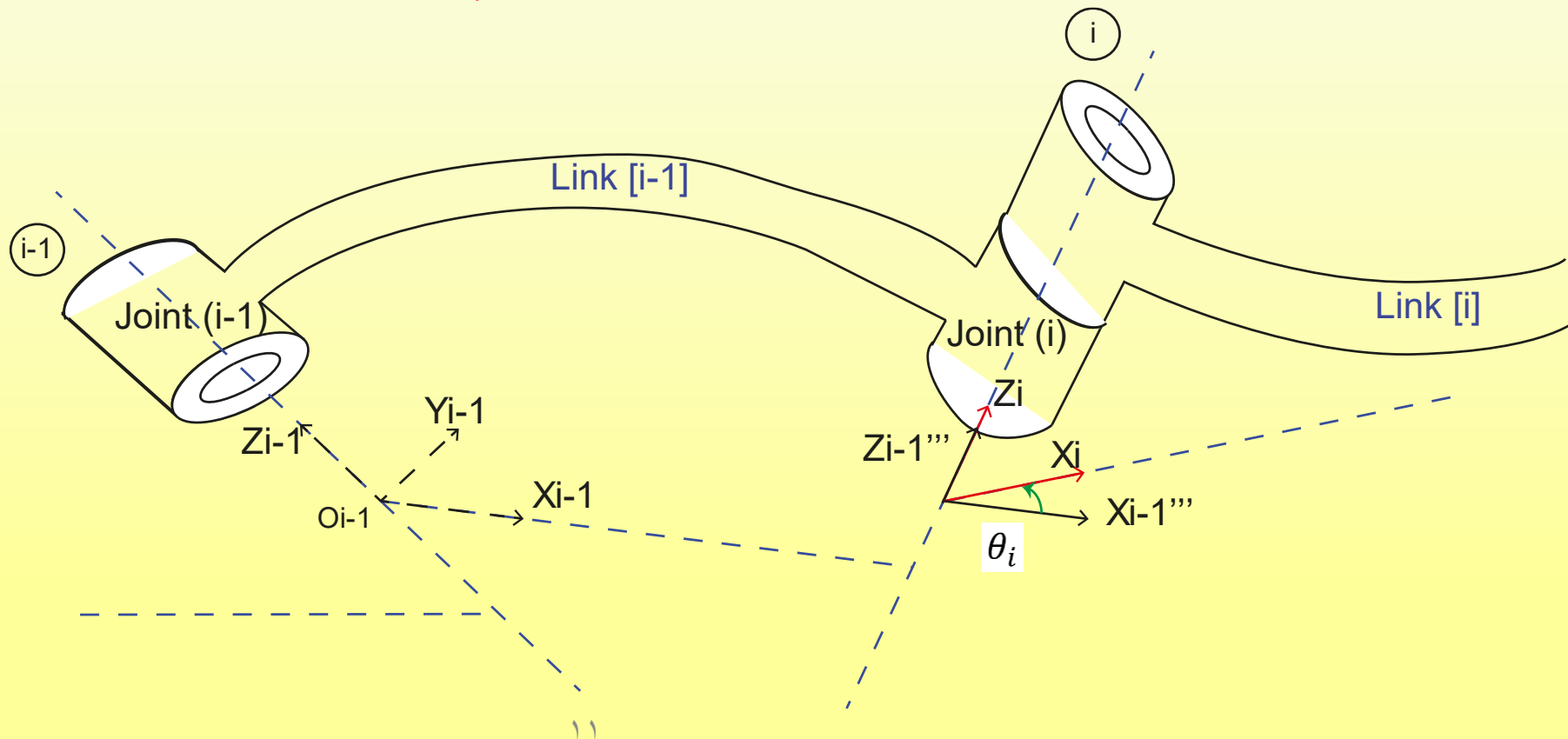


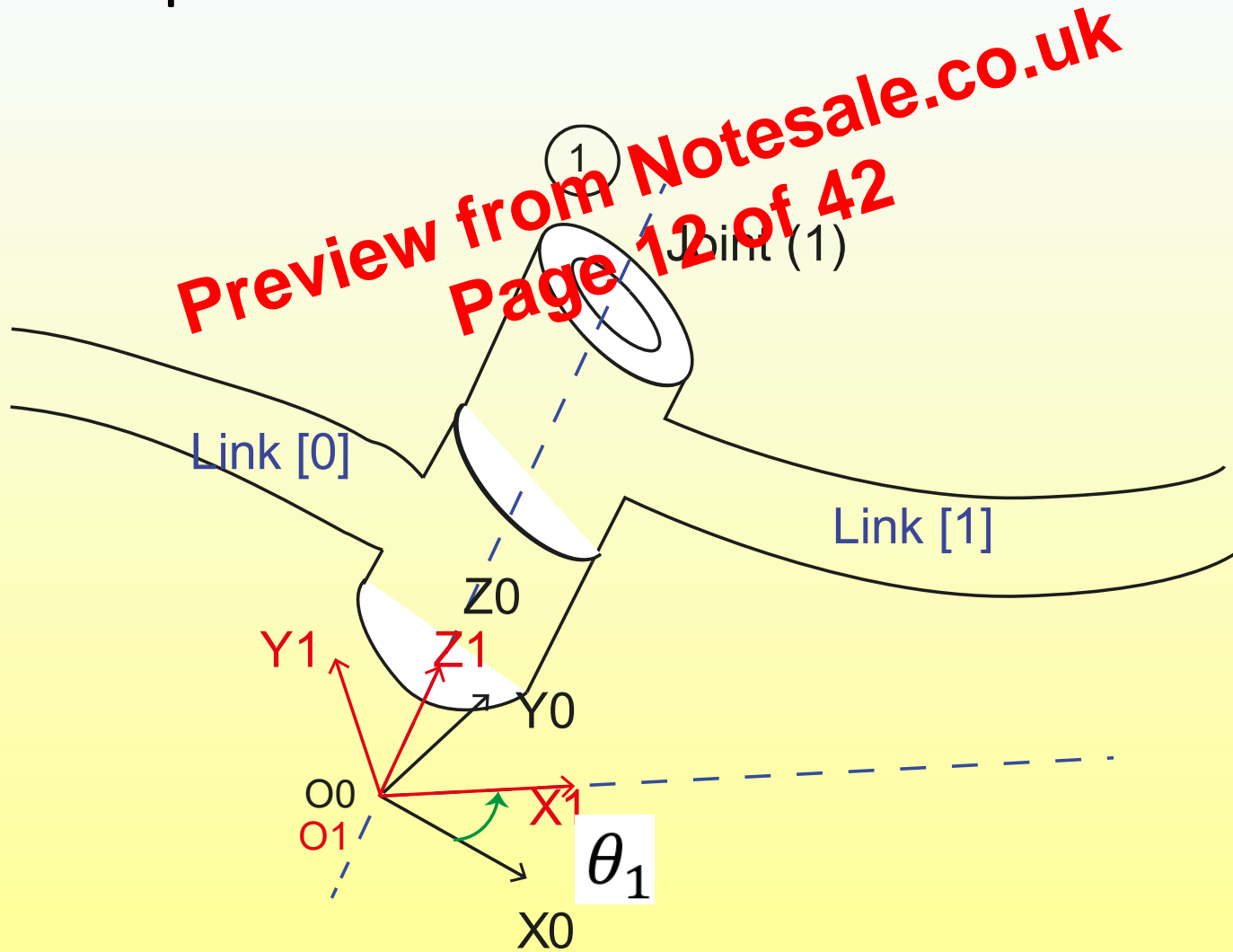
Motion from frame $i-1$ to frame i

Preview from Notesale.co.uk
Page 11 of 42



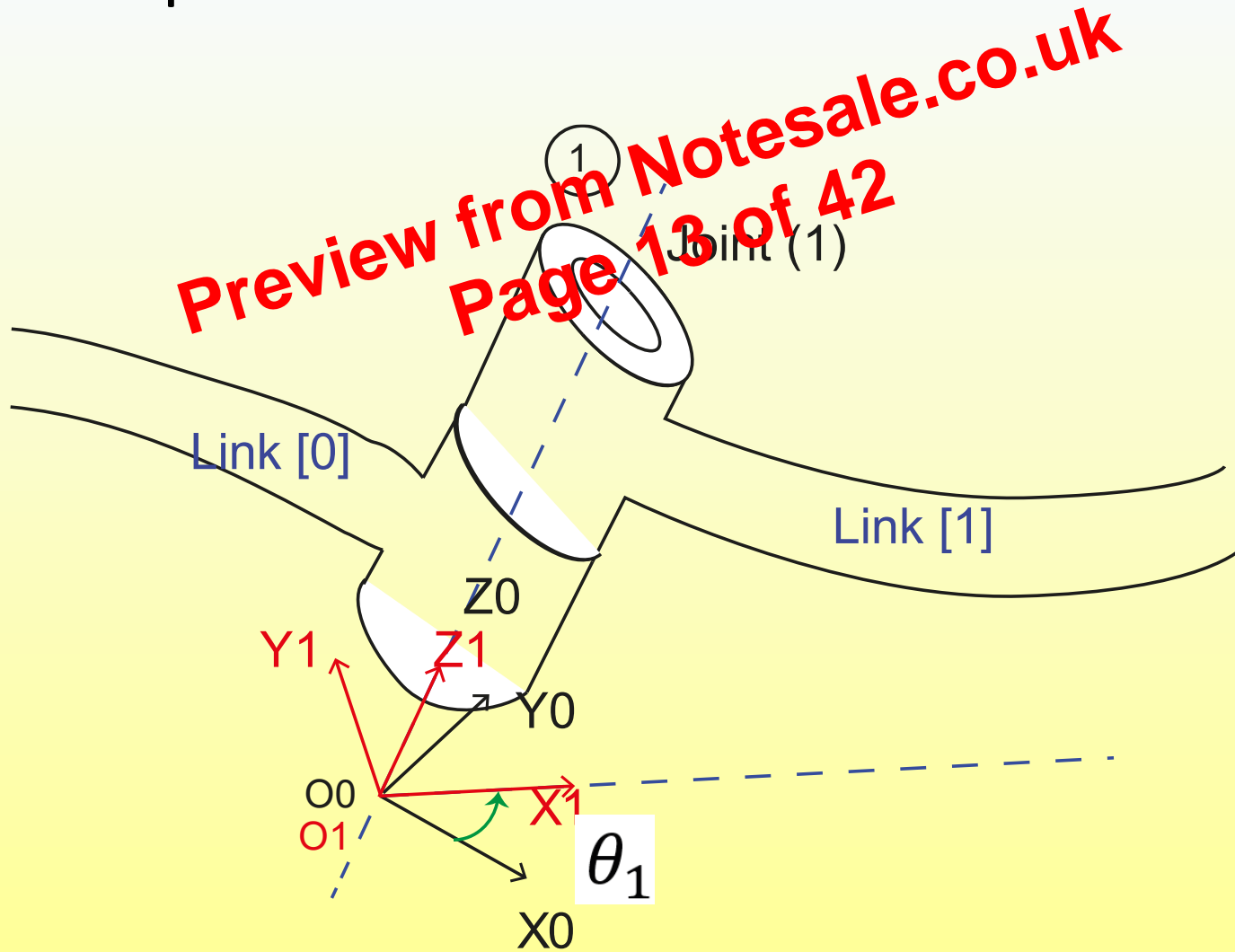
- Fourth motion:
 - Rotate around Z_i axis with an angle θ_i such that X_{i-1}''' coincides with X_i
 - Joint angle θ_i is constant for prismatic joint and variable for a revolute joint.
 - θ_i can be positive or negative.

Special cases: Link zero frame



- Assign frame 0 to link 0
- There is no joint zero !
- DH notation cannot be used to determine Z_0 nor o_0
- We select frame 0 to be coincident with frame 1 when joint1 variable is zero.
 - Both frames have the same Z-axis
 - For revolute joint: frames 1,0 have the same origin
 - For prismatic joint: frames 1,0 have the same orientation

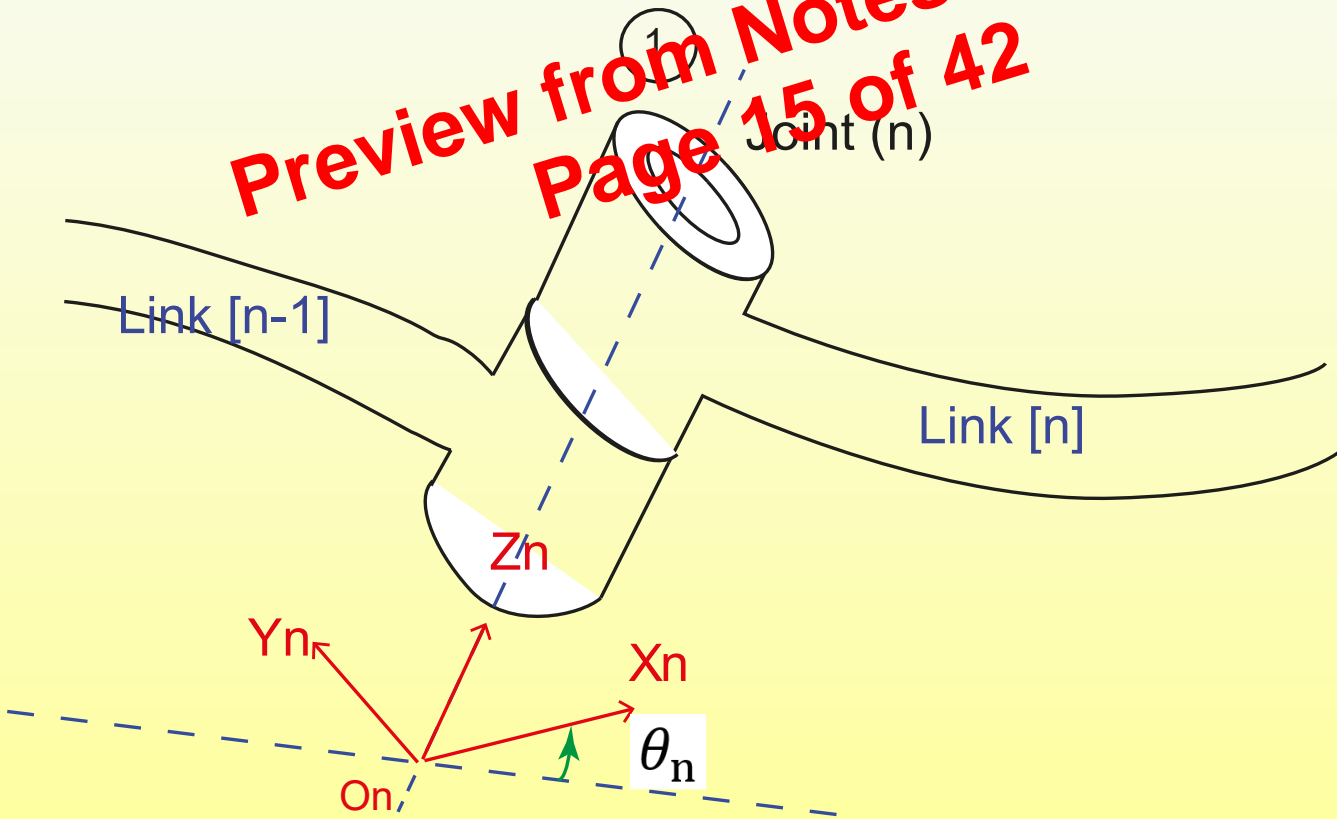
Special cases: Link zero frame



- Parameters a_0 and α_0 are always zero
- For revolute joint:
 - d_1 is zero
 - Only θ_1 is nonzero
- For prismatic joint:
 - θ_1 is zero
 - Only d_1 is nonzero

Special cases: Last link (n) frame

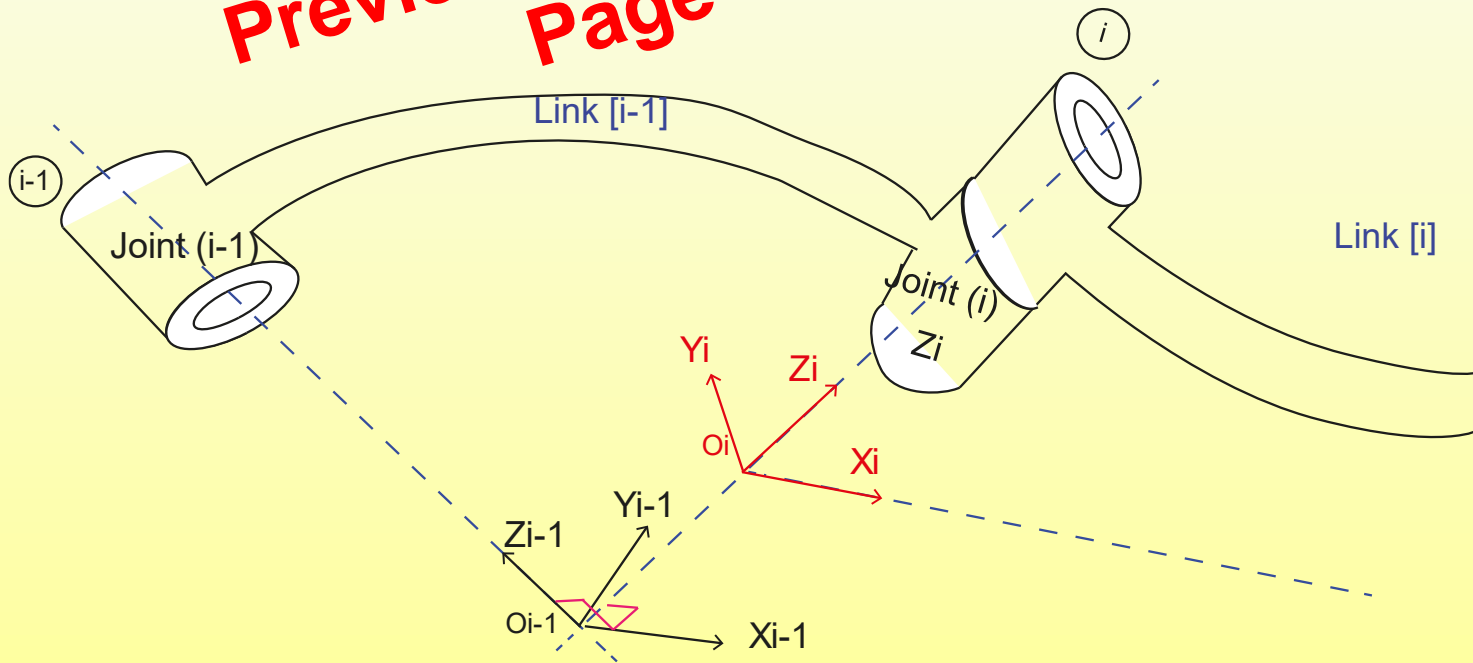
Preview from Notesale.co.uk
Page 15 of 42



- a_n and α_n are not needed
 - Let $a_n = 0$ and $\alpha_n = 0$
- For the revolute joint:
 - $d_n = 0$
 - θ_n is non-zero
- For the prismatic joint:
 - d_n is non-zero
 - $\theta_n = 0$

Special cases: Intersecting joint axes

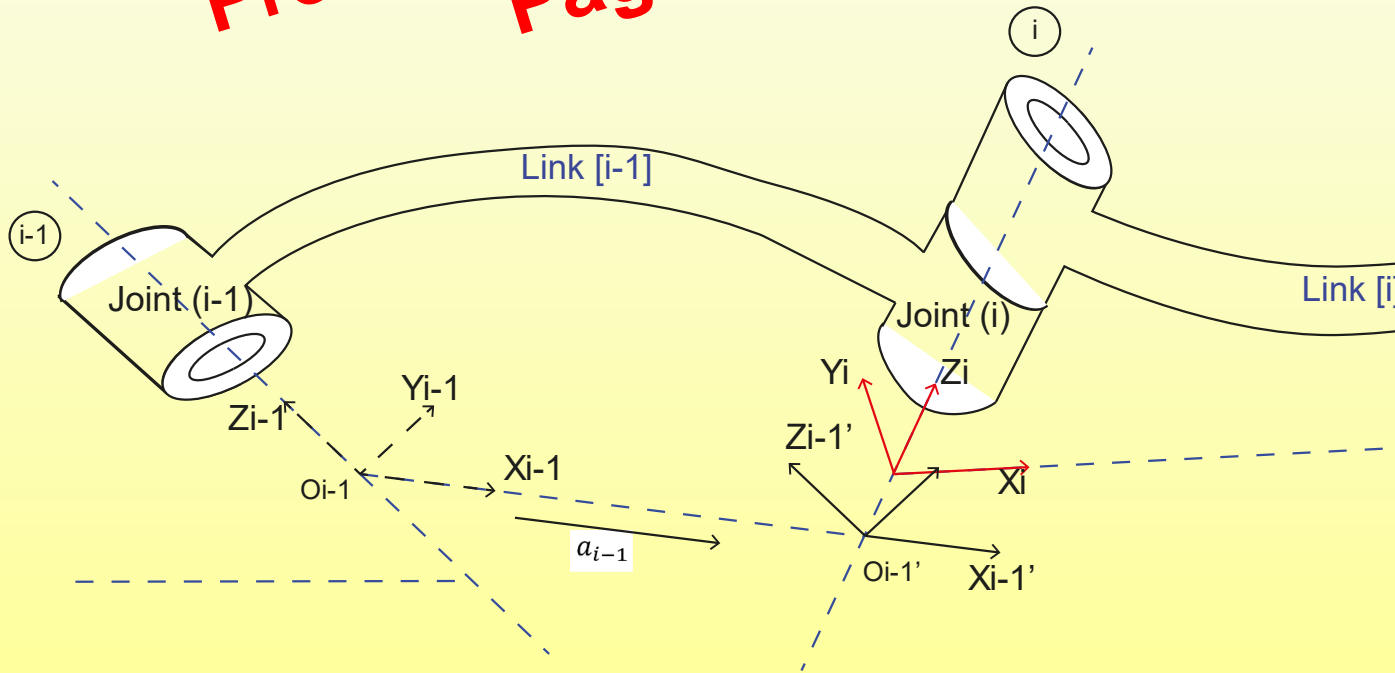
Preview from Notesale.co.uk
Page 16 of 42



- There is no common perpendicular line.
- Select the intersection point to be the origin of frame i-1.
- Choose X_{i-1} as the normal to both Z_{i-1} and Z_i . Use the direction of $Z_{i-1} \times Z_i$
- You will always have:
 - $a_{i-1} = 0$

Translation $T(a_{i-1})$

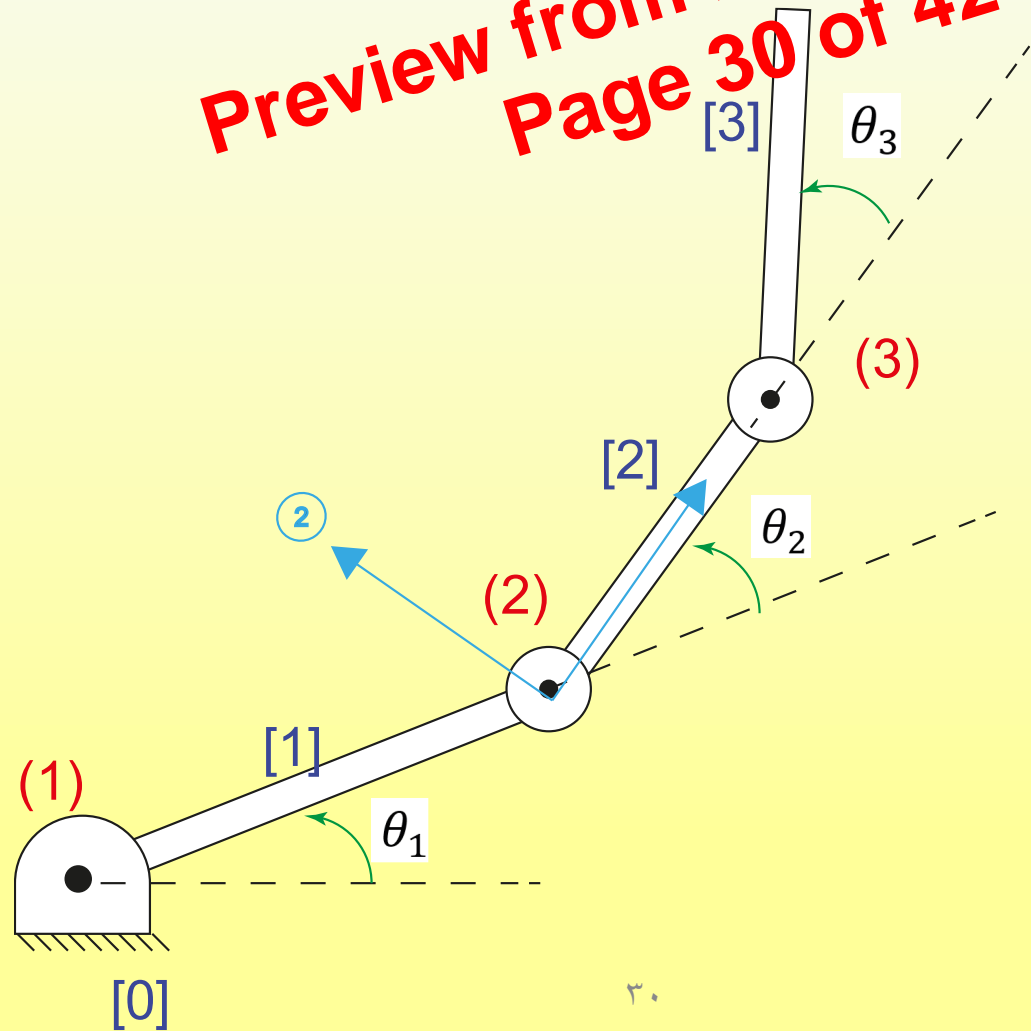
Preview from Notesale.co.uk
Page 20 of 42



- Translation by a_{i-1} in X_{i-1} direction.
- No rotation.

$$T(a_{i-1}) = \begin{bmatrix} 1 & 0 & 0 & a_{i-1} \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Assignment of link frames: frame 2



- Z_2 axis is the axis of joint 2
- Z_3 axis is the axis of joint 3
- Z_2 and Z_3 are parallel
 - There is no unique CPL line !
- o_2 is chosen to lie on plane.
 - This also makes $d_2 = 0$
- X_2 is chosen to point in the direction of CPL line from joint 2 to joint 3.
- Note that frame 2 is attached to link 2 and rotates with it.