Theorem:

When a moving body makes oblique elastic collision with another body of equal mass at rest, after the collision they move in mutually perpendicular direction.

Proof:

If the bodies are of equal mass, i.e. if $m_1 = m_2 = m$ (let)

By eq. (xi) $u_1 = v_1\cos\theta_1 + v_2\cos\theta_2$ ----- (xiv)

By (xii) $0 = v_1\sin\theta_1 + v_2\sin\theta_2$ ----- (xv)

And by eq. (xiii) $u_1^2 = v_1^2 + v_2^2$ ----- (xvi)

By $(xiv)^2 + (xv)^2$

$$u_1^2 = [\, v_1^2 \cos^2\theta_1 + v_2^2 \cos^2\theta_2 + 2\, v_1 \cos\theta_1\, v_2\cos\theta_2] +$$

$$[v_1^2\sin^2\theta_1 + v_2^2\sin^2\theta_2 - 2v_1v_2\sin\theta_1\sin\theta_2]$$

$$u_1^2 = v_1^2[\cos^2\theta_1 + \sin^2\theta_1] + v_2^2[\cos^2\theta_2 + \sin^2\theta_2]$$

$$+ 2v_1v_2\,\{\cos\theta_1\cos\theta_2 - \sin\theta_1\sin\theta_2\}$$

$$u_1^2 = v_1^2 + v_2^2 + 2v_1v_2\cos(\theta_1 + \theta_2)$$

$$u_1^2 = u_1^2 + 2v_1v_2\cos(\theta_1 + \theta_2)$$

$$2v_1v_2\cos[\theta_1 + \theta_2] = 0$$

$\because\ 2v_1v_2 \neq 0$, we get $\cos[\theta_1 + \theta_2] = 0$

So, $\theta_1 + \theta_2 = 90^0$

i.e. When a moving body makes oblique elastic collision with another body of equal mass at rest, after the collision they move in mutually perpendicular direction.