Step-1

Suppose that U and V are unitary matrices.

The objective is to show that UV is also unitary matrix by using the criterion $U^{H}U = I.$

As U and V are unitary matrices,

$U^{H}U = I$ and $V^{H}V = I.$

Step-2

Consider

$(UV)^{H}(UV) = (V^{H}U^{H})(UV) \qquad (UV)^{H} = V^{H}U^{H}.$

$= V^{H}U^{H}UV$

$= V^{H}IV \qquad U^{H}U = I.$

$= V^{H}V \qquad V^{H}I = V^{H}.$

$= I \qquad V^{H}V = I.$

Hence, the matrix UV is also unitary.