The Given equations are,

$$A + B = C + D \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$ikA - ikB = \kappa C - \kappa D \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

$$Ce^{\kappa L} + De^{-\kappa L} = A' e^{ikL} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$\kappa Ce^{\kappa L} - \kappa De^{-\kappa L} = ikA' e^{ikL} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Now, eliminating B from (1) and (2) and writing A in terms of C and D, we get,

$$2ikA = (ik + \kappa)C + (ik - \kappa)D$$

$$\Rightarrow A = \frac{1}{2}[(1 + \frac{\kappa}{ik})C + (1 - \frac{\kappa}{ik})D] \ldots\ldots\ldots\ldots\ldots(5)$$

Now, from (3) & (4) writing the value of C & D in terms of A' respectively, we get,

$$2\kappa Ce^{\kappa L} = (ik + \kappa)A' e^{ikL}$$

$$\Rightarrow C = \frac{1}{2}[(\frac{ik}{\kappa} + 1)A' e^{ikL} e^{-\kappa L}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

And

$$2D\kappa e^{-\kappa L} = (\kappa - ik)A' e^{ikL}$$

$$\Rightarrow D = \frac{1}{2}[(1 - \frac{ik}{\kappa})A' e^{ikL} e^{\kappa L} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

Putting the value of C & D from (6) & (7) in (5) we can get the value of A in terms of A'.

$$\Rightarrow A = \frac{1}{4}[(1 + \frac{\kappa}{ik})(1 + \frac{ik}{\kappa})e^{-\kappa L} + (1 - \frac{\kappa}{ik})(1 - \frac{ik}{\kappa})e^{\kappa L}]A' e^{ikL} \ldots\ldots\ldots \quad (8)$$

$$\Rightarrow 4ik\kappa A = [(2ik\kappa + \kappa^2 - k^2)e^{-\kappa L} + (2ik\kappa - \kappa^2 + k^2)e^{\kappa L}]A' e^{ikL}$$

$$\Rightarrow 4ik\kappa A = [(k^2 - \kappa^2)(e^{\kappa L} - e^{-\kappa L}) + 2ik\kappa(e^{\kappa L} + e^{-\kappa L})]A' e^{ikL}$$

Using,

$$\frac{e^{\kappa L} - e^{-\kappa L}}{2} = \sinh(\kappa L), \qquad \& \qquad \frac{e^{\kappa L} + e^{-\kappa L}}{2} = \cosh(\kappa L),$$

We have,

$$\Rightarrow 2ik\kappa A = [(k^2 - \kappa^2)\sinh(\kappa L) + 2ik\kappa\cosh(\kappa L)]A' e^{ikL}$$

Now the ratio between the transmission & incident amplitudes is given by,

$$\Rightarrow \frac{A'}{A} = \frac{2ik\kappa e^{-ikL}}{(k^2-\kappa^2)\sinh(\kappa L) + 2ik\kappa\cosh(\kappa L)} \quad \text{……...…(9)}$$

The transmission co-efficient is given by,

$$T = \frac{|A'|^2}{|A|^2} = \frac{\{2ik\kappa e^{-ikL}\}\{-2ik\kappa e^{ikL}\}}{\{(k^2-\kappa^2)\sinh(\kappa L)\}^2 - \{2ik\kappa\cosh(\kappa L)\}^2}$$

$$= \frac{4k^2\kappa^2}{(k^2-\kappa^2)^2\sinh^2(\kappa L) + 4k^2\kappa^2\cosh^2(\kappa L)} \text{ ……..……(10)}$$

Now, using

$$\cosh^2(\kappa L) = 1 + \sinh^2(\kappa L) \text{ ……………………………...(11)}$$

We get,

$$\mathrm{T} = \frac{4k^2\kappa^2}{4k^2\kappa^2 + (k^2+\kappa^2)^2\sinh^2(\kappa L)}$$

$$= \frac{1}{1 + \frac{1}{4}\left(\frac{k^2+\kappa^2}{k\kappa}\right)^2 \sinh^2(\kappa L)} \text{ ………………………….(12)}$$

Again,

$$\left(\frac{k^2+\kappa^2}{k\kappa}\right)^2 = \left(\frac{V}{\sqrt{E(V-E)}}\right)^2 = \frac{V}{E} \times \frac{V}{(V-E))} = \frac{1}{\varepsilon} \times \frac{1}{(1-\varepsilon)} \text{ ………(13)}$$

Therefore,

$$T = \frac{1}{1 + \frac{1}{4\varepsilon(1-\varepsilon)}\left(\frac{e^{\kappa L} - e^{-\kappa L}}{2}\right)^2}$$

$$\Rightarrow T = \{1 + \frac{(e^{\kappa L} - e^{-\kappa L})^2}{16\varepsilon(1-\varepsilon)}\}^{-1} \text{ ………………………………..(14)}$$

This is the required transmission co-efficient.