Transformer efficiency

For an ideal transformer, the electrical power supplied is equal to the electrical power output.

$$V\_{p}I\_{p}=V\_{s}I\_{s}$$

$$\frac{V\_{s}}{V\_{p}}=\frac{I\_{p}}{I\_{s}}$$

For a step-up transformer, while voltage is stepped up, the current is stepped down. For a step-down transformer, while the voltage is stepped down, the current is stepped up.

We can combine this with the transformer ratio:

$\frac{N\_{s} }{N\_{p}}$**=**$ \frac{V\_{s}}{V\_{p}}=\frac{I\_{p}}{I\_{s}}$

Just remember that the fraction for the current ratio is flipped in terms of primary and secondary compared to the voltage ratio and the turn ratio.

For a transformer that is x% efficient:

$$V\_{p}I\_{p}\* x\%=V\_{s}I\_{s}$$

$$\frac{V\_{s}I\_{s}}{V\_{p}I\_{p}}\*100=x\% $$

Transformers are not 10% efficient in reality:

The current flowing through the coils of wire will result in heating as the wires have a resistance. This leads to power loss. **Using low resistance windings reduces power loss by the heating effect.**

The changing magnetic flux cutting the soft iron core induces alternating currents (eddy currents) in the iron core. The eddy currents are such to oppose the changing magnetic flux that produced them (Lenz’s Law). They produce heat which leads to power loss. **Using a laminated iron core with layers of iron separated by insulator helps minimise eddy currents induced in the core itself, reducing power loss by heating.**

***The core is made of soft iron as this is easily magnetised and demagnetised, this helps improve the overall efficiency of the transformer.***