Magnetic Coupled Circuits

Definition

When two loops of a circuit with or without any physical contact affect each other with the help of magnetic fields, the circuits are said to be magnetically coupled.

Analysis

When two inductors are in proximity to each other, the magnetic flux caused by current in one coil links with the other coil, thereby inducing voltage in the other, this phenomenon is known as mutual inductance.

A diagram of a circuit

Description automatically generated

Assume ,Current flows in the coil creating (self-inductance) and links with both coils.

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links with inducing voltage in , only links with inducing voltage in .

and can be written in terms of I and L, and (where M is the mutual inductance).

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We can write and in the frequency domain as

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If a current leaves the dotted terminal of one coil, the reference polarity of the mutual voltage in the second coil is negative at the dotted terminal of the second coil. The coupling coefficient k is a measure of the magnetic coupling and is equal to .

Applications

One of the most used applications of magnetic coupled circuits is transformers. Transformer is a four terminal device containing two or more magnetic coupled coils. It’s used to change ac voltage levels, such transformers being termed step-up or step-down type to increase or decrease voltage level, respectively. transformers have become essential for the , transmission, distribution, and utilization of alternating current electric power. There are a lot of types of transformers liner transformer, ideal transformer, ideal autotransformer, and the three-phase transformer.