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Extension and Closure of a Field for Engineering Purpose

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Abstract : Fields are important objects of study in algebra since they provide a useful generalization of many number systems, such as the rational numbers, real numbers, and complex numbers. In particular, the usual rules of associativity, commutativity and distributivity hold. Fields also appear in many other areas of mathematics; see the examples below. When abstract algebra was first being developed, the definition of a field usually did not include commutativity of multiplication, and what we today call a field would have been called either a commutative field or a rational domain. In contemporary usage, a field is always commutative. A structure which satisfies all the properties of a field except possibly for commutativity, is today called a division ring ordivision algebra or sometimes a skew field. Also non-commutative field is still widely used. In French, fields are called corps (literally, body), generally regardless of their commutativity. When necessary, a (commutative) field is called corps commutative and a skew field-corps gauche. The German word for body is Körper and this word is used to denote fields; hence the use of the blackboard bold to denote a field. The concept of fields was first (implicitly) used to prove that there is no general formula expressing in terms of radicals the roots of a polynomial with rational coefficients of degree 5 or higher. An extension of a field k is just a field K containing k as a subfield. One distinguishes between extensions having various qualities. For example, an extension K of a field k is called algebraic, if every element of K is a root of some polynomial with coefficients in k. Otherwise, the extension is called transcendental. The aim of Galois Theory is the study of algebraic extensions of a field. Given a field k, various kinds of closures of k may be introduced. For example, the algebraic closure, the separable closure, the cyclic closure et cetera. The idea is always the same: If P is a property of fields, then a P-closure of k is a field K containing k, having property, and which is minimal in the sense that no proper subfield of K that contains k has property P. For example if we take P (K) to be the property 'every non-constant polynomial f in K[t] has a root in K', then a P-closure of k is just an algebraic closure of k. In general, if P-closures exist for some property P and field k, they are all isomorphic. However, there is in general no preferable isomorphism between two closures.

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