A Book of Abstract Algebra | (2nd Edition)

Chapter 29, Problem 1EG

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Problem

Let $F \subseteq K$ and $a, b \in K$. We have seen on page 295 that if a and b are algebraic over F, then $F(a, b)$ is a finite extension of F.

Use the above to prove part.

If a and b are algebraic over F, then $a + b$, $a - b$, ab, and a / b are algebraic over F. (In the last case, assume $b \neq 0$.)

Step-by-step solution

Step 1 of 2

Consider a field F and an extension K of F. Suppose that a and b are algebraic over F. The objective is to prove that $a+b,\ a-b,\ ab,\ a/b$ are algebraic over F.

Comment

Step 2 of 2

Let a and b are algebraic over F.

Then $F(a,b)$ is a finite extension and hence an algebraic extension.

Since every element of $F(a,b)$ is algebraic over F , $a+b,\ a-b,\ ab,\ a/b$ are all algebraic over F.

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