

A Book of Abstract Algebra | (2nd Edition)

Chapter 27, Problem 3EE

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ON

Problem

Recall the definition of $F(a)$. It is a field such that (i) $F \subseteq F(a)$; (ii) $a \in F(a)$; (iii) any field containing F and a contains $F(a)$.

Use this definition to prove parts 1–5, where $F \subseteq K$, $c \in F$, and $a \in K$:

$a + c$ is a root of $p(x)$ iff a is a root of $p(x + c)$; ca is a root of $p(x)$ iff a is a root of $p(cx)$.

Step-by-step solution

Step 1 of 3

Using definition of $F(a)$ and $F \subseteq K$, $c \in F$, $a \in K$. Prove that $a + c$ is a root of $p(x)$ iff a is a root of $p(x + c)$; ca is a root of $p(x)$ iff a is root of $p(cx)$.

Comment

Step 2 of 3

Assume $a + c$ is root of $p(x)$. Then $p(a + c) = 0$. And this implies a is a root of $p(x + c)$ because if we put $x = a$ in $p(x + c)$ and use the assumption. Then $p(a + c) = 0$.

Now assume a is root of $p(x + c)$. Then $p(a + c) = 0$. And this implies $a + c$ is a root of $p(x)$ because if we put $x = a + c$ in $p(x)$ and use the assumption. Then $p(a + c) = 0$.

Comment

Step 3 of 3

Assume ca is root of $p(x)$.

Then $p(ca) = 0$.

This implies a is a root of $p(cx)$ because if we put $x = a$ in $p(cx)$ and use the assumption. Then $p(ca) = 0$.

Now assume a is root of $p(cx)$. Then $p(ca) = 0$. And this implies ca is a root of $p(x)$ because if we put $x = ca$ in $p(x)$ and use the assumption. Then $p(ca) = 0$.

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