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DEPARTMENT: COMPUTER SCIENCE (200 Level)

COURSE: ALGEBRA I (MAT 213)

Assignment

Solve $66x \equiv 111 \pmod{237}$

Solution

Since the *gcd*(66, 237) > 1, there is no solution.

However, we can divide the equation through by 3 to obtain a *gcd* of 1

$22x \equiv 37 \pmod{79}$

***gcd*(22, 79)**

$79 = 22(3) + 13$

$22 = 13(1) + 9$

$13 = 9(1) + 4$

$9 = 4(2) + 1$

$4 = 1(4)$

Hence, *gcd*(22, 79) = 1, thereby having a solution

Since $22x \equiv 37 \pmod{79}$ is the same as 37 = 22x + 79y which is equivalent to *gcd*(22, 79) = 1 and

1 = 22x + 79y, we can reverse the process to obtain x and y.

$1 = 9 - 4(2)$

$= 9 - [13 - 9(1)](2)$

$= 9(3) - 13(2)$

$= [22 - 13(1)](3) - 13(2)$

$= 22(3) - 13(5)$

$= 22(3) - [79 - 22(3)](5)$

$= 22(18) - 79(5)$

= 22(18) + 79(-5)

Therefore, x = 18 and y = -5

We have that,

$$1 = 22(18) + 79(-5)$$

Multiplying through by 37, we have

$$37 = 22(18)(37) + 79(-5)(37)$$

$$= 22(666) + 79(-185)$$

x = 666

Hence, the solution of the equation "66x ≡ 111 (mod 237)"

x = 34, 192.