Use the extended Euclid algorithm to find the inverse of 19

(a) mod 29
(b) mod 39
(c) mod 49
(d) mod 59

I placed each solution on a separate page, to make it easier for you to do each problem, then check your answer.

(a)

29 = 19 + 10
19 = 10 + 9
10 = 9 + 1

1 = 10 – 9 = 10 – (19 – 10) = 2*10 – 19 = 2* (29 – 19) – 19 = 2 * 29 – 3 * 19.
Thus $19^{-1} \equiv_{29} -3 \equiv_{29} 26$
Check this answer: 19*26 = 494 = 17*29 + 1

(b)

$39 = 2*19 + 1$

$1 = 39 - 2*19.$

Thus $19^{-1} \equiv_{39} -2 \equiv_{39} 37$

Check: $19*37 = 703 = 18*39 + 1$

(c)

$49 = 2*19 + 11$
$19 = 11 + 8$
$11 = 8 + 3$
$8 = 2*3 + 2$
$3 = 2 + 1$

$1 = 3 – 2$
$= 3 – (8 – 2 *3) = 3*3 -8$
$= 3*(11 – 8) – 8 = 3*11 – 4*8$
$= 3*11 – 4 (19 – 11) = 7*11 – 4*19$
$= 7*(49 – 2*19) – 4*19 = 7*49 -18*19$
Thus $19^{-1} \equiv_{49} -18 \equiv_{49} 31$
Check: $19*31 = 589 = 12*49 + 1$

(d)

$59 = 3*19 + 2$
$19 = 9*2 + 1$

$1 = 19 - 9*2$
$= 19 - 9*(59 - 3*19)$
$= 28*19 - 9*59$
Thus $19^{-1} \equiv_{59} 28$
Check: $19*28 = 532 = 9*59 + 1$