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1.

a. Assuming $a \equiv b(mod\ m)$ we can expand the definition of that to get $m|(a-b)$. Any multiple of a number divisible by m is also divisible by m, therefore $m|\big(-1*(a-b)\big)$. Using some simple arithmetic this is equivalent to $m|(b-a)$, therefore $b \equiv a(mod\ m)$.

b. Assuming $a \equiv b(mod\ m)$ and $b \equiv c(mod\ m)$ we can expand those into $m|(a-b)$ and $m|(b-c)$. The sum of two numbers divisible by m is likewise divisible by m, therefore $m|\big((a-b)+(b-c)\big)$. Simplifying gives us $m|(a-c)$, which implies the result $a \equiv c(mod\ m)$.

2.

a. $a = 1234, n = 4321$

t	r
0	4321
1	1234
-3	619
4	615
-7	4
1075	3
-1082	1
-1082 < 0, final answer is 3239	0 stop here

b. $a = 24140, n = 40902$

t	r
0	40902
1	24140
-1	16762
2	7378
-5	2006
17	1360
-22	646
61	68
-571	34
The last value of r before 0 is not 1, there is no inverse	0 stop here

c. $a = 550, n = 1769$

T	r
0	1769
1	550
-3	119
13	74
-16	45
29	29
-45	16
74	13
-119	3

550	1
550 > 0, final answer is 550	0 stop here

3.
   a. Reducible: $x^3+1=(x+1)(x^2+x+1)$
   b. Irreducible
   c. Reducible: $x^4+1=(x+1)^4$
4.
   a. $1\ (mod\ 2)$
   b. $x+1(mod\ 3)$
5. $H(K|C)=-\left(\frac{1}{2}\left(\frac{3}{4}\log_2\frac{3}{4}+\frac{1}{4}\log_2\frac{1}{4}+0\log_2\frac{0}{2}\right)+\frac{1}{4}\left(\frac{1}{2}\log_2\frac{1}{2}+\frac{1}{4}\log_2\frac{1}{4}+\frac{1}{4}\log_2\frac{1}{4}\right)+\right.$
$\left.\frac{1}{8}\left(0\log_2 0+\frac{1}{2}\log_2\frac{1}{2}+\frac{1}{2}\log_2\frac{1}{2}\right)\right)=-\left(\left(\frac{3\log 3}{8\log 2}-1\right)+\left(-\frac{3}{8}\right)+\left(-\frac{1}{8}\right)\right)=\frac{3\log 3}{8\log 2}-\frac{3}{2}=0.9056$