Intro to Proofs Day 20 Outline (This class meets for 110 minutes.)

**Need: Quizzes, new proof portfolio problem, which proof technique when worksheets**

PART 1: Synthesis (0-20 minutes)

**Section 6.3 #2a and 2b**

* f: Z\_5 to Z\_5 by f(x) = x^2+4 (mod 5). Then f(0)=4, f(1)=0, f(2)=3, f(3)=3, f(4)=0. Neither an injection nor a surjection
* f: Z\_6 to Z\_6 by g(x) = x^2+4. Then f(0)=4, f(1)=5, f(2)=2, f(3)=1, f(4)=2, f(5)=4. Neither an injection nor a surjection

**Section 4.1 #15**

* d/dx(e^ax) = ae^(ax). Prove for each n in N, d^n/dx^n(e^(ax)) = a^ne^(ax). Base case easy. Inductive step if d^k/dx^k(e^(ax)) = a^k e^(ax) then d^(k+1)/dx^(k+1) is the derivative of the k^th derivative. So the derivative of a^k e^(ax) which is a\*a^k e^(ax).

PART 2: Section 6.3 on Injections and Surjections [20-50 minutes]

**Page 2 of the Section 6.2 worksheet**

* Have them generate their own examples. Each group is responsible for writing one on the board. Use arrow diagrams. Then, if time, try to determine function formula).

**Example- proving injection**

* Do an example of proving injection? If f(x) = x^3-1 then f is an injection.

**Proving Injection – they do exercise.**

**Example – Proving surjection**

* Do an example of proving surjection. Use f(x) = x^3-1 again. Scratch work : y=x^3-1. Let x = (y+1)^(1/3).

**Proving Surjection – they do exercise**

**Disproving injection/surjection. Let them try then go over.**

-----------------------------------------------BREAK----------------------------------------------------

PART 3: Which proof technique when (60-80 minutes)

**They get colored sheets.**

* Each group tries to categorize into any proof technique we’ve used so far.
* Tapes to board under “direct proof, proof by contrapositive, proof by contradiction, proof by induction, proof by cases.
* We go over based on most disagreement. Give them hard copies. But emphasize that the solutions are online.

PART 4: Composition of Functions (80-100 minutes), if time

**Do example**

* F: Z to Z>=0 define by f(x) = x^2. Then G: Z>= 0 to {0,1,2} defined by g(z) = z (mod 3).
* What’s g(f(1)), g(f(2)), g(f(-5))?
* What do you notice about domain/codomain

**If time: They do exercise 1 on worksheet.**

PART 5: Quiz (100-110 minutes)

Synthesis: Section 6.3 #9a on page 319 f(x,y) = (2x,x+y). Whether this is an injection/surjection is in the back of the book. Make sure you justify your conclusions.

Preview Activity: Composition of functions?