Math 111 Contemporary Mathematics **Name:** _____
Fall 2015 **Group Project**
Lecturer: Dr. Paullin

MA 111 is part of the UK-Core, and as such, has a requirement that all students do a project. The project for this course will involved our recently completed unit-Cryptography.

This project is designed for you to explore new ciphers using the cryptography techniques we learned in class. You are to work in groups of two to four students.

Project Components and Deadlines
Wednesday, November 4th: Group formation- Decide on Group Members and a Group Name and inform Dr. Paullin of who is in your group.
Friday, November 13th: Part 1-Worksheet due.
Friday, November 20th: Part 2-Cryptography Fun due.

Project Description
Previously in class, we considered the shift cipher:

$$\square + \Delta(mod 26) = \boxtimes$$

And then we looked at the Times cipher:

$$\star \cdot \square(mod 26) = \boxtimes$$

For this project, you will consider an affine cipher, described by the formula:

$$\star \cdot \square + \Delta(mod 26) = \boxtimes$$

The affine cipher combines the properties of a shift cipher and a times cipher.

Each group will be assigned a different affine cipher. Your project will consist of two parts. First you will complete a worksheet on your assigned cipher. The second part of the project is a fun activity using affine ciphers.

Group formation (5 points): Due November 4th

(1) Your group must have between two and four people.
(2) You should write down your group members' names to turn in, on the form given. When you turn in your group, you will be given an affine cipher that is yours and only yours.
(3) Name your group. Be Creative! If you don't name your group, you'll be assigned a number.
(4) Late penalty: 1 point for each day late.

Part 1-Worksheet (20 points): Due November 13th
Each group will turn in one worksheet for the entire group no later than November 13th.

(1) Your group's name or number, and all group members' full names should be on the worksheet.
(2) The worksheet is worth 20 points and will be graded for accuracy.
(3) You may get help from Dr. Paullin, the Mathskeller, or the Study. You need to show all work, including the finding of keys and the encryption/decryption algorithm set-up. Answers given without necessary work will be counted for 0 points. The point

of this worksheet is to show what you learned and that you have a working concept of cryptography methods.
(4) Late penalty: 2 points for each day late.

Part 2-Cryptography Fun (25 points): Due November 20th
This portion is due on Friday November 20th in class.

(1) Your group's name or number, and all group members' full names should be on the Coversheet.
(2) This part of the project involves some scavenger hunting around campus and the internet as well as some picture taking. You'll need a digital camera or a cell phone camera to complete this portion.
(3) This part is worth 25 points and will be graded for accuracy.
(4) You may get help from Dr. Paullin, the Mathskeller, or the Study. You need to show all work, including the finding of decryption keys and the decryption algorithm set-up. Answers given without necessary work will be counted for 0 points. The point of this portion of the project is to demonstrate your knowledge of cryptography methods and have a little fun.
(5) The last page of this final part is the Equitability Statement and Signatures. You have two options here. No matter which you choose, all of your group members must sign below the statement. Projects will not be accepted without all signatures.
(6) Late penalty: 2 points for turning it in on Monday November 23rd. 10 additional points off per day for each day after Thanksgiving break.

Math 111 Contemporary Mathematics
Fall 2015 **Group Project**
Lecturer: Dr. Paullin **Group Formation**

Group Members

Group Name:_____

Group Members

(1) _____

(2) _____

(3) _____

(4) _____

Math 111 Contemporary Mathematics **Group Name:** _____
Fall 2015 **Group Project**
Lecturer: Dr. Paullin **Part 1-Worksheet**

Names of all Group Members in this Group:

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

Affine Ciphers

The Affine Cipher is a combination of Times and Shift Ciphers. It is calculated using this notation:

$$\star \cdot \square + \Delta (mod 26) = \boxtimes$$

For Affine Ciphers, we have 2 encryption keys: $\star$ and Δ.
Answer the following questions about Affine Ciphers in general.

(1) A Shift Cipher $\square + \Delta (mod 26) = \boxtimes$ is a special case of the Affine Cipher. In order for an Affine Cipher to be a Shift Cipher, what is $\star$?

(2) A Times Cipher $\star \cdot \square (mod 26) = \boxtimes$ is a special case of the Affine Cipher. In order for an Affine Cipher to be a Times Cipher, what is Δ?

(3) We decrypted a Shift Cipher $\square + \Delta (mod 26) = \boxtimes$ with the formula $\boxtimes + \nabla (mod 26) = \square$. We decrypted a Times Cipher $\star \cdot \square (mod 26) = \boxtimes$ with the formula $* \cdot \boxtimes (mod 26) = \square$. How would you decrypt an Affine Cipher? Write your answer as a formula using $\square$ and $\boxtimes$.
(Hint: Start with the encryption formula for the Affine Cipher, and think about how we might "solve" for $\square$.)

Your Affine Cipher

Your Group was given an Affine Cipher unique to your group. Write it here.

Use your Affine Cipher to answer the following questions.

(4) In your cipher, what is the encryption key $\star$?

(5) In your cipher, what is the encryption key Δ?

(6) In your cipher, what is the decryption key ∇?

(7) In your cipher, what is the decryption key $*$?

(8) Use your cipher to encrypt the word: CODE

(9) Use your cipher to decrypt the letter: P

Math 111 Contemporary Mathematics
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Group Name:_____

Group Members

(1) _____

(2) _____

(3) _____

(4) _____

Math 111 Contemporary Mathematics
Fall 2015 **Group Project**
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Complete the following pages, showing all work in the area given. This includes showing how you found the decryption keys and the decryption algorithm. This is a bit of a scavenger hunt, so you'll need to use information from around campus and around the internet to solve the puzzles. Have fun, learn some things about UK, and Good Luck!

(1) A message was encrypted using the Affine Cipher $\star \cdot \square + \Delta(mod 26) = \boxtimes$, where:
$\star$ = The last two digits of the other class Dr. Paullin teaches, "MA 1___"
Δ = The number of the highest floor in Patterson Office Tower.
Decrypt the following message. Show all of your work.

AQHF

(2) A message was encrypted using the Affine Cipher $\star \cdot \square + \Delta (mod 26) = \boxtimes$, where:
$\star$ = The last digit of the street address number for the Blue Arby's near campus
Δ = The last two digits of the "Class of ___" on the Tug O' War historical marker near William T. Young Library.

Decrypt the following message. Show all of your work.

GSVO

(3) A message was encrypted using the Affine Cipher $\star \cdot \square + \Delta(mod 26) = \boxtimes$, where:
$\star$ = The last two digits of the year that Maxwell House was sold to UK
Δ = The number of players on the roster for the UK Men's Basketball team 2015, according to the UK Athletics webpage.

Decrypt the following message. Show all of your work.

JIXU

(4) A message was encrypted using the Affine Cipher $\star \cdot \square + \Delta (mod 26) = \boxtimes$, where:
$\star$ = The last digit of our classroom number
Δ = The first two digits of our classroom number
Decrypt the following message. Show all of your work.

TZAHB

(5) Use your decrypted messages from problems 1-4 in order to form a sentence. Make a sign with this sentence on it and take a photo of your entire group holding the sign in front of the Wildcat Statue near Memorial Coliseum.

Email this photo to Dr. Paullin at katherine.paullin@uky.edu.

You will earn 5 points for this task, but bonus points may be awarded for creativity, style, thoughtfulness, or entertainment value. Have fun with your photo!

Equitability Statement and Signatures

Please check the box next to the Option your group chooses, and then the whole group signs below that option.

☐ **Option 1**: Each member of our group contributed a fair share, and we should all earn the same grade.

(1) _____

(2) _____

(3) _____

(4) _____

☐ **Option 2**: If, for whatever reason, there was significant difference in contribution of the group members, you can choose to give the relative percentages of contribution. The total must add to 100%.

(For example, in a fictional group of four people, Dominic did way more than his share of the work, so they might turn in: Dominic 40%, Annie 20%, Eddie 20%, Barclay 20%. Or, in a fictional group of 3 people, Larry only came to one meeting and didn't really help, so they turned in Randy 46%, Yolanda 46%, Larry 8%.)

If you choose this option, your grades will be based on a pooled point system.

(1) _____ Percentage _____

(2) _____ Percentage _____

(3) _____ Percentage _____

(4) _____ Percentage _____