**Homework #2 Answers**

**CECS 378 – Spring 2021 Cappel**

**Due:** Wednesday, February 17th prior to class (11:59 PM)

**Homework #2 is focused on more modern cryptography. 4 total solutions all worth 25 points (100 total).**

This assignment will introduce you to several instances of modern cryptography and have you encrypt the plaintext. **Please show all of your work!**

**Problem 1 – Simplified DES**

Simplified DES (SDES) was designed for educational purposes only, to help students learn about modern cryptanalytic techniques.

SDES has similar properties and structure as DES but has been simplified to make it much easier to perform encryption and decryption by hand with pencil and paper.

Some people feel that learning SDES gives insight into DES and other block ciphers, and insight into various cryptanalytic attacks against them.

**Note:** The following You-Tube video may be of value when performing the Simplified DES problem:

<https://www.youtube.com/watch?v=QcKHfMgcnbw>

Let **K** be the key, **K** = 1001100010 in binary format.

Let **P** be the plain text message, **P** = 10011100 in binary format.

Find **K1** the key for round 1, **K2** the key for round 2, & **C** the cipher text message, where **K1**, **K2**, & **C** are in binary format.

K1 = 10110000

K2 = 00010011

C = 00110100

**Problem 2 – DES**

Data Encryption Standard (DES) is a symmetric-key algorithm for the [encryption](https://en.wikipedia.org/wiki/Encryption) of digital data. Although its short key length of 56 bits makes it too insecure for most current applications, it has been highly influential in the advancement of modern [cryptography](https://en.wikipedia.org/wiki/Cryptography).

**Note:** The following websites may be of value when performing the DES problem:

<http://page.math.tu-berlin.de/~kant/teaching/hess/krypto-ws2006/des.htm>

<https://www.youtube.com/watch?v=Sy0sXa73PZA> (Notice the spreadsheet included with the YouTube video – leverage it!)

<http://des.online-domain-tools.com/>

<https://www.rapidtables.com/convert/number/ascii-hex-bin-dec-converter.html>

Let **M** be the plain text message, **M** = 44 69 72 74 62 61 67 73 in hex format (where **M** is Dirtbags in ASCII text).

Let **K** be the hexadecimal key, **K** = 43 57 53 31 39 39 38 21 in hex format (where **K** is CWS1998! in ASCII text).

Solve for **C** the cipher text message, where **C** is in hex.

53 97 e0 17 62 32 86 24

**Problem 3 – RSA**

**Note:** A similar problem can be found in Chapter 21 in the textbook (pg. 649).

Perform encryption and decryption using the RSA algorithm, as in Figure 21.8 in the textbook, for the following:

p = 11; q = 3, e = 3, M = 8

n = 33; φ(n) = 20; d = 7

Encryption: C = 17 mod 33 = 17

Decryption: M = 8 mod 33 = 8

**Problem 4 – Diffie-Hellman**

**Note:** The following problem can be found in Chapter 21 in the textbook (21.12).

Consider a Diffie-Hellman scheme with a common prime q = 11 and a primitive root α = 2.

1. If user A has public key Ya = 9, what is A’s private key Xa? XA = 6
2. If user B has public key Yb = 3, what is the shared secret key K? K = 3