Tutorial Sheet 4
(Modular Arithmetic)

1. Evaluate the following quantities.
    a)   38 mod 13   b) -46 mod 7   c)   64 mod 4   d)   5 mod 9

2. Which memory locations are assigned by the hashing function $h(k) = k$ mod 101 to the records of students with the following student numbers? You are required to solve the problem when collisions occur.

    a)   104578690   b)   432222187   c)   372201919   d)   501338810

3. A parking lot has 31 visit spaces, numbered from 0 to 30. Visitors are assigned parking spaces using the hashing function $h(k) = k$ mod 31, where k is the number formed from the first three digits on a visitor's license plate. Which spaces are assigned by the hashing function to cars that have the following first three digits on their license plates ? You are required to solve the problem when collisions occur.

    a)   317   b)   918   c)   007   d)   100

4. What sequence of pseudorandom numbers is generated using the linear congruential generator $x_{n+1} = (3x_n + 4)$ mod 7 with seed $x_0 = 2$?

5. Encrypt the message "DO NOT PASS GO" by using the following shift cipher functions
    a) $f(p) = (p + 13)$ mod 26
    b) $f(p) = (3p + 7)$ mod 26

6. Decrypt the following messages that were encrypted by using $f(p) = (p + 3)$ mod 26.
    a)   EOXH MHDQV
    b)   WHVW WRGDB
    c)   HDW GLP VXP