THE UNIVERSITY OF THE WEST INDIES

ASSIGNMENT 1

SEMESTER I, 2020/2021

Code and Name of Course: **COMP2201 – Discrete Mathematics**

Assignment 1 - Individual Assignment	
AREA	**DESCRIPTION**
Objectives	To have a student apply the knowledge garnered during the first few weeks of the course
Title	Assignment 1 – Individual Assignment
Deliverable	The answers for the questions which follow the given case
Instructions	1. Review Lectures of the first three weeks of the course, the COMP2201Text and any other related Discrete Mathematics material 2. Read the Assignment 1 Sheet thoroughly 3. Submit the gradable solution by using the COMP2201 Assignment 1 - Individual located within the **ASSIGNMENTS** Section of the OURVLE COMP2201 Course Environment. This may also be accessed by choosing the Assignments section below "Activities"
Format	The solution for this assignment must be submitted as a Microsoft Word document. Your ID number should form part of the Microsoft Word file name. The file name should take the format "COMP2201 Assignment 1 Semester 1 2020-2021 XXXXXXXX" where XXXXXXXX represents the student ID number.
Upload Constraint	The solution for this assignment should be uploaded in the relevant space provided in OURVLE (See "Instructions" section above). A message indicating "File uploaded successfully" will acknowledge that the file has been sent successfully. Do **NOT** assume your project has been received if you do not get this acknowledgement.
Scoring Rubric	Your electronic submission will be evaluated on: 1. Your attempt of the compulsory questions 1, 4 and 7 2. The response submitted for each question (See detail individual marks below) – Maximum 50 marks The actual grade of 50 marks will be displayed. The actual grade allocated is the percentage of the maximum marks (5 points)
Late Assignments	Late assignments are accepted. These are however graded then 25% deducted for each day of late submission.

Expectation	It is expected that students will discuss means to a solution. The actual work written is expected to reflect each student's uniqueness. Where replication of work is identified, each paper will be graded. The allocated grade to each student's piece of work for where this anomaly is identified will be the grade divided by the number of replications discovered.
Due Date	**Sunday, October 4, 2020**

Question 1 [10 marks] – COMPULSORY

[The fraction of the marks attained for this question determines the fraction of the attained marks to be allocated for questions 2 and 3.]

(a) In order to determine the number of unordered k-selections of t types, the formulae is

$$^{k+t-1}C_{k} = {}^{k+t-1}C_{t-1}$$

Justify whether $k = t-1$. **[3]**

(b) State a simplified formula for the number of unique codewords, assuming a codeword such as

aei^%@9058XYAYJ

is made up of 3 distinct lowercase vowels of the English alphabet where order is important, 3 distinct special characters (with order not being important), 4 distinct digits where order is important, and 5 uppercase letters of the English alphabet where the letters may be repeated and the order is not important, all in the same order. For ease of reference, it is accepted that there are 32 special characters. **[2]**

(c) Develop a question that the third form of the Pigeonhole Principle may be used to solve. **[3]**

(d) Using the third form of the Pigeonhole Principle, solve the question in (c). **[2]**

Question 2 [5 marks]

(a) A computer access password consists of from three to ten letters chosen from the 23 in the Latin alphabet with repetitions not allowed. How many different passwords are possible? **[2]**

(b) If any seven letters (of the 24-letter Greek alphabet) could be used to form a twelve-letter words, how many words would have at least one repeated letter? **[3]**

Question 3 [6 marks]

Solve the following question using Tree Diagrams.

A six-person committee composed of Abba, Bull, Char, Dave, Eric and Ford is to select officer positions of chairman, deputy chairman, secretary and treasurer. How many selections are there in which either Ford is an officer and Char is secretary, or Abba is not chairman and Char is not an officer? **[6]**

Question 4 [5 marks] – COMPULSORY

[The fraction of the marks attained for this question determines the fraction of the attained marks to be allocated for questions 5 and 6.]

(a) What types of problems can the principles of modular arithmetic be used to solve? **[2]**

(b) Construct the Addition and Multiplication Tables in Z_{11}. **[3]**

Question 5 [2 marks]

By drawing Pascal's Triangle and applying Pascal's Identity, show that both methods may be used to determine equivalent values for the row of Pascal's triangle containing the following binomial coefficients $\binom{9}{k}, 0 \leq k \leq 8$ **[2]**

Question 6 [3 marks]

Expand the following expression using the binomial theorem: $(3x^2 - 2y + z^3)^4$ **[3]**

Question 7 [10 marks] – COMPULSORY

[The fraction of the marks attained for this question determines the fraction of the attained marks to be allocated for questions 8 and 9.]

(a) Given that the 300th day of a particular year Y is a Saturday, and the 200th day of year Y+1 is also a Saturday, use modular arithmetic to explain why the 100th day of year Y-1 falls on Monday. **[2]**

(b) The Greek Mathematician Euclid developed an algorithm to determine the Greatest Common Divisor (GCD) also known as the Highest Common Factor (HCF) of two given integers. The algorithm is based on the principle that the greatest common divisor of two numbers does not change if the larger number is replaced by its difference with the smaller number. Develop a new algorithm to determine the Greatest Common Divisor (GCD). **[3]**

(c) Using the solution provided for section (b) of this question, illustrate how your new algorithm would find the Highest Common Factor of 60720 and 170775. **[3]**

(d) Using the Euclidean Algorithm, illustrate how the Highest Common Factor of 60720 and 170775 would be determined. **[2]**

Question 8 [5 marks]

The function *lexicSort* takes a list of strings, *string_list* and returns *True* if the strings are sorted in an ascending lexicographic order; *False* is returned otherwise. Using any programming language taught in your first year at the university, write the function *lexicSort*. **[5]**

Question 9 [4 marks + Bonus 5 marks (to an assignment maximum of 50 marks)]

Let *f(n)* be defined by

$$f(1) = 4$$
$$f(n) = 64f\left(\frac{n}{4}\right) + 32n^3$$

if $n > 1$ and $n = 4^m$, where m is a positive integer.

(a) By using the principles of Recurrence Relation, find a general formula for *f*(n) **[4]**

(b) Hence show that $f(n) = \Theta(n^3 \log_4 n)$. **[Bonus - 5]**