Date:	23/ 5 /2022		Due: 1/6/2022
Course:	211/01	Homework 5	

(Hand-in Only answers to questions 1 – 4)

For questions 1,2 and 3 (TM design):

a- Give a plan/algorithm for your design (e.g., explain the function of each state).

b- Draw a diagram of the machine and write out δ-function

1. Construct a Turing machine that decides the language
$L=\{ w\in\{a, b, c\}^+ : n_a(w) = n_b(w) = n_c(w) \}$.

2. Construct a Turing machine to compute the function $f(w)=w\circ w^R$, where $w\in\{a, b\}^+$ (replace the input by function value).
(e.g. q_0 aab $\perp_M^*$ q_f aabbaa)

3. Let x be a positive integer represented in unary form. Construct a Turing machine to compute the function f(x) = x + 3 (replace the input by function value in unary form). (e.g. q_0 11 $\perp_M^*$ q_f 11111).

4. a) Design a grammar for $L = \{a^n b^{2n} c^{3n} , n > 0 \}$.
b) Design a grammar for $L = \{a^n b^m c^n d^m , m, n > 0 \}$.

5.

a) Explain Turing thesis and its consequences.
b) Explain the meaning of the Chomsky hierarchy.
c) Explain the difference between *recursive* and *recursively enumerable* language.
d) Name and explain at least two problems concerning Turing Machines that are not solvable (undecidable) on a Turing machine.
e) Name three problems that are undecidable for Context-free languages.
f) Name a language that is not recursive.
g) Name a language that is not recursively enumerable.