2nd Class Test

on

Formal Languages & Automata Theory

B.C.S.E. 3rd Year 1st Semester

Session 2021-2022

Full Marks: 15

All questions carry equal marks

Time: 40 minutes (for answering) +20 minutes (for uploading)

1. The language $L = \{0^i21^i \mid i \geq 0\}$ over the alphabet {0, 1, 2} is:

(A) not recursive (B) recursive and a deterministic context free language
(C) a regular language (D) not a deterministic context free language but a context free language

2. Let $L=L_1 \ L_2$ where L_1 and L_2 are languages defined below:
$L_1 = \{a^m b^m c\ a^n b^n \mid m, n \geq 0\}$
$L_2 = \{a^i b^j c^k \mid i, j, k \geq 0\}$

Then L is
(A) Not recursive (B) Regular
(C) Context free but not regular (D) Recursively enumerable but not context free

3. A student wrote two context-free grammars **G1** and **G2** for generating a single C-like array declaration. The dimension of the array is at least one. For example,

```
int a[10][3];
```

The grammars use D as the start symbol, and use six terminal symbols **int ; id [ ] num.**

Grammar **G1**

D→int L;

L→id[E

E→num]

E→num][E

Grammar **G2**

D→int L;

L→idE

E→E[num]

E→[num]

Which of the grammars correctly generate the declaration mentioned above?

(A) Both **G1** and **G2** (B) Only **G1** (C) Only **G2** (D) Neither **G1** nor **G2**

4. A Context Free Grammar (CFG) is said to be in Chomsky Normal Form (CNF) if all productions are of the form A→BC or A→a

Let G be a CFG in CNF. To derive a string of terminals of length n, the number of productions to be used is :

(A) 2n-1 (B) 2n (C) 2n+1 (D) 2^n

5. Identify the language which is not Context free:

(A) $\{ww^R|w\epsilon\{0,1\}^*\}$ (B) $\{a^nb^n|n\geq 0\}$ (C) $\{ww|\ w\epsilon\{0,1\}^*\}$ (D) $\{a^nb^mc^md^n|n,m\geq 0\}$

6. Consider the pushdown automaton (PDA) below which runs over the input alphabet (a, b, c). It has the stack alphabet {Z0, X} where Z0 is the bottom-of-stack marker. The set of states of the PDA is {s, t, u, f} where s is the start state and f is the final state. The PDA accepts by final state. The transitions of the PDA given below are depicted in a standard manner. For example, the transition (s, b, X) → (t, XZ0) means that if the PDA is in state s and the symbol on the top of the stack is X, then it can read b from the input and move to state t after popping the top of stack and pushing the symbols Z0 and X (in that order) on the stack.

(s, a, Z0) → (s, XXZ0)
(s, ϵ, Z0) → (f, ϵ)
(s, a, X) → (s, XXX)
(s, b, X) → (t, ϵ)
(t, b, X) → (t,.ϵ)
(t, c, X) → (u, ϵ)
(u, c, X) → (u, ϵ)
(u, ϵ, Z0) → (f, ϵ)

The language accepted by the PDA is

(A) {albmcn| l=m=n} (B) {albmcn| l=m} (C) {albmcn| 2l=m+n} (D) {albmcn| m=n}

7. Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true?

(A) L2 – L1 is recursively enumerable. (B) L1 – L3 is recursively enumerable

(C) L2 ∩ L1 is recursively enumerable. (D) L2 ∪ L1 is recursively enumerable

8. Let L be a Context Free Language. Then there is an integer n such that for any z in with |z|≥n, z can be decomposed as z=uvwxy and uv^iwx^iy is in L ,for i=0,1,2,...

Let G be the grammar for L and G is in Chomsky Normal Form. If p be the number of variables in G then what will be the value of n in terms of p ?

(A) 2p (b) 2^p (C) 2^{p+1} (D) p^2

9. If L1 and L2 are context free languages, L1-L2 are Context free

(A) Always (B) Sometimes (C) Never (D) None of the Above

10. Which of the following is True about Context Free Languages (CFLs) ?

(A) CFLs are closed under Reversal (B) CFLs are closed under Homomorphism

(C) CFLs are closed under Inverse Homomorphism (D) All of the mentioned

11. Let S be an NP-complete problem and Q and R be two other problems not known to be in NP. Q is polynomial time reducible to S and S is polynomial-time reducible to R. Which one of the following statements is true?

(A) R is NP-complete (B) R is NP-hard

(C) Q is NP-complete (D) Q is NP-hard

12. Which of the following is true about NP-Complete and NP-Hard problems.

(A) If we want to prove that a problem X is NP-hard, we take a known NP-hard problem Y and reduce Y TO X

(B) The first problem that was proved as NP-complete was the Circuit satisfiability problem

(C) NP-complete is a subset of NP-hard

(D) All of the above

(E) None of the above

13. The Halting Problem of Turing machines is

(A) Recursive (B) Recursively Enumerable but not Recursive

(C) Recursive but not Recursively Enumerable (D) Not Recursively Enumerable

14. Which of the following statements is False?

(A) Every Regular language is also a Context free language

(B) Every subset of Recursively enumerable set is Recursive

(C) Every non deterministic Turing machine can be converted to an equivalent deterministic Turing machine.

(D) Every NFA can be converted into equivalent DFA

15. If L and L^C, read as complement of L, are Recursively enumerable then L is

(A) Regular (B) Context-free (C) Context-sensitive (D) Recursive