Exam No: _____

GANPAT UNIVERSITY
B. TECH SEM-VI (Computer Engineering)
SECOND INTERNAL EXAMINATION – APRIL-MAY 2024
2CEIT601: Theory of Computation

TIME: 1 Hour **TOTAL MARKS: 20**

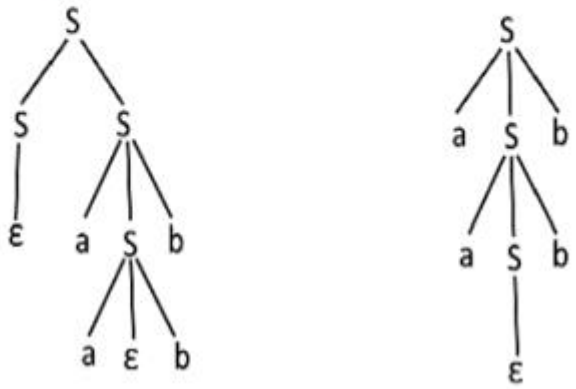
Instructions:
1) Figures to the right indicate full marks.
2) Be precise and to the point in your answer.
3) Assume suitable data, if necessary.
4) The text just below marks indicates the Course Outcomes Numbers, (CO) followed by the bloom's taxonomy level of the question, i.e., R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating.

Q.1 Convert the following CFG to Chomsky Normal Form (CNF). **[4]**
S → ASB **2A**
A → aAS|a|ε
B → SbS|A|bb
Solutions: first remove Null production, we get following grammar
S → ASB|SB|AS|S
A → aAS|a|aS
B → SbS|A|bb
After removal of Unit Production on the above Grammar, we get
S → ASB|SB|AS
A → aAS|a|aS
B → SbS|bb| aAS|a|As
Now in this Grammar S becomes Useless Production, So S is Starting symbol of the grammar, so we cannot convert the above grammar into CNF.

Q.2 (A) Define Ambiguous Grammar and check that the given grammar is ambiguous or not. **[4]**
S → aSb | SS **1R**
S → ε

Solution: Ambiguous Grammar: A grammar is said to be ambiguous if there exists more than one left most derivation or more than one right most derivation or more than one parse tree for a given input string.

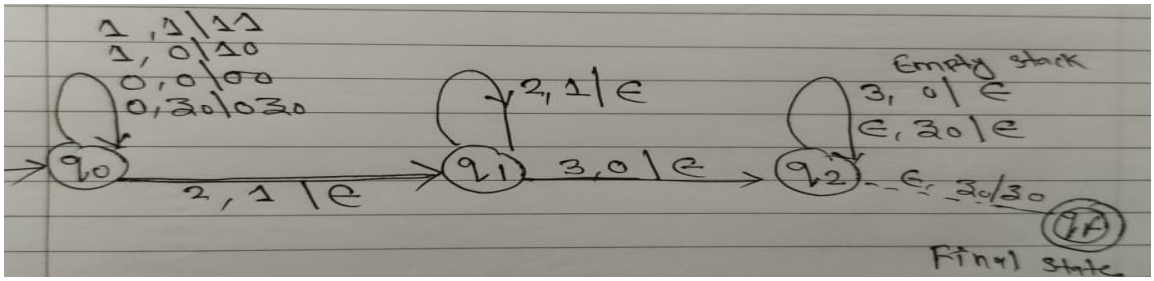
(1) It is **ambiguous** because for the string "aabb" the grammar can generate two parse trees.



(B) Define the Formal Grammar and its type.
Solutions: formal Definition of Grammar :
Any Grammar can be represented by 4 tuples – <N, T, P, S>
- **N** – Finite Non-Empty Set of Non-Terminal Symbols.
- **T** – Finite Set of Terminal Symbols.
- **P** – Finite Non-Empty Set of Production Rules.

- **S –** Start Symbol (Symbol from where we start producing our sentences or strings

Q.3 Construct a PDA for language L = {$0^n\ 1^m\ 2^m\ 3^n$ | n ≥1, m≥ 1} **[4]**
Solutions: **3C**



Q.4 Write the Context Free Grammar (CFG) for the following languages. **[4]**
(1) L= {$a^m\ b^n$ | m ≠ n} **1A**

Solutions: S→ X | Y
X →aXb| aBb
B →aB | a
Y→ aYb | aAb
A → bA| b

(2) L= {$a^n\ b^n$ | n ≥ 1}

Solutions: S → aSb | ab
(3) L= {Set of all palindromes over a's and b's}

Solutions: S → aSa | bSb | a | b | ε

(4) L= { Set of all balanced parenthesis}

Solutions: S→ (S)| SS | ε

Q.5 Apply Pumping lemma for regular language. Prove that L = {$a^n\ b^n$ | n ≥ 1} is not regular. **[4]**
Solutions: **2A**

- At first, we assume that **L** is regular and n is the number of states.
- Let w = $a^n b^n$. Thus |w| = 2n ≥ n.
- By pumping lemma, let w = xyz, where |xy| ≤ n.
- Let x = a^p, y = a^q, and z = $a^r b^n$, where p + q + r = n, p ≠ 0, q ≠ 0, r ≠ 0. Thus |y| ≠ 0.
- Let k = 2. Then $xy^2z = a^p a^{2q} a^r b^n$.
- Number of as = (p + 2q + r) = (p + q + r) + q = n + q
- Hence, $xy^2z = a^{n+q}\ b^n$. Since q ≠ 0, xy^2z is not of the form $a^n b^n$.
- Thus, xy^2z is not in L. Hence L is not regular.

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