3. Consider the following grammar

S → NP VP | Aux NP VP | VP
NP → Det Nom
Nom → Noun | Noun Nom
VP → Verb
VP → Verb NP
Det → that | this | a | the
Noun → ball | flight | meal | man
Verb → book | include | hit
Aux → does

i. List the terminal and non-terminal symbols. 3 4 2 2

ii. Check if the above grammar could generate the string "the man hit the ball". 4 3 2 4

iii. Simplify the grammar. 7 5 2 4

iv. Convert the above CFG to Chomsky normal form (CNF). 4 3 2 4

v. How many productions in the CFG are already in CNF? 1 4 2 2

(A) 16 (B) 12
(C) 4 (D) 13

vi. The given productions are type _____ grammar. 1 4 2 2

(A) 0 (B) 1
(C) 2 (D) 3

(SCENARIO) → UNIVERSITY QUESTIONS

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given, S → NP VP | Aux NP VP | VP

NP → Det Nom

Nom → Noun | Noun Nom

VP → Verb

VP → Verb NP

Det → that | this | a | the

Noun → ball | flight | meal | man

Verb → book | include | hit

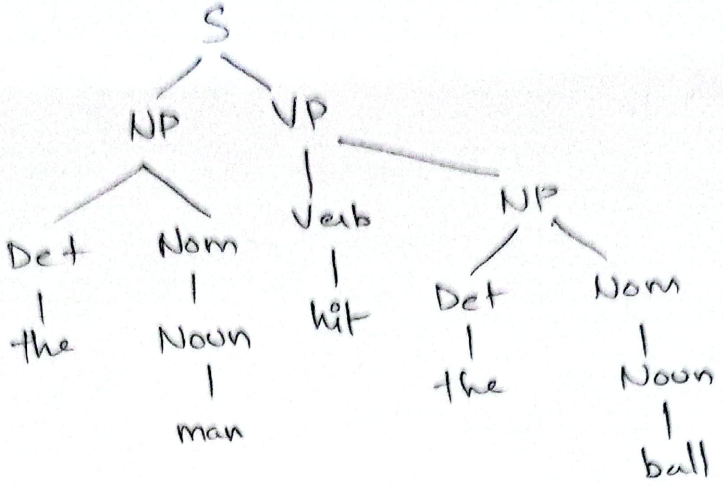
Aux → does

(i) terminals ⇒ {that, this, a, the, ball, flight, meal, man, book, include, hit, does}

non-terminal ⇒ {S, NP, Nom, VP, Det, Noun, Verb, Aux}

(ii) LMD or RMD or parse tree can be used to show

parse tree



(iii) Step 1 → no ∈ prod., now to remove unit production.

⇒ S → NP VP | Aux NP VP | verb NP | book | include | hit

NP → Det Nom

Nom → ball | flight | meal | man | Noun Nom

VP → Verb NP | book | include | hit

Det → that | this | a | the

Noun → ball | flight | meal | man

Verb → book | include | hit

Aux → does

→ removing useless production,

⇒ no useless production. (no non-generating & non-reachable symbols)

(iv) CFG → CNF

R_1 → NP VP

S → NP VP | Aux R_1 | verb NP | book | include | hit

NP → Det Nom

Nom → Noun Nom | ball | flight | meal | man

VP → verb NP | book | include | hit

Det → that | this | a | the

Noun → ball | flight | meal | man

Verb → book | include | hot

Aux → does

(v) (A) 16

(vi) (C) 2

2. Babu has to travel from his office to his home every day. He can use four routes, A, B, C and D. Each month he has to take route A and route D equally, and route B and route C equally. He has to travel in all the routes at least once. In each given duration he needs to take route A first for n number of days followed by taking up route B for m number of days, followed by route C and route D as per the given condition.

i.	Construct CFG for the above scenario.	3	3	2	4
ii.	Construct language for the CFG.	3	3	2	4
iii.	Derive the suitable string from the CFG using left most derivation, right most derivation and parse tree.	6	5	2	6
iv.	Check whether the grammar is ambiguous or not by taking any string of length at least six.	6	3	2	6
v.	Which among the following is not a part of the context free grammar tuple? (A) Variable (B) Start symbol (C) End symbol (D) Production	1	4	2	2
vi.	I: context free grammar is a subset of context sensitive grammar. II: Regular grammars are the most restricted type of grammars. (A) Both are false (B) Both are true (C) I is false and II is true (D) II is false and I is true	1	4	2	2

Routes A, B, C and D are considered as a, b, c and d respectively.

CFG

CFG, $G = (\{S, A\}, \{a, b, c, d\}, P, S)$

$P = \{ \quad S \rightarrow aSd \mid aAd$

$A \rightarrow bAc \mid bc \quad \}$

Language for the CFG.

$L(G) = \{a^n b^m c^m d^n \mid n \geq 1, m \geq 1\}$

Any string can be chosen. Let us take string = "aabcdd"

Left most derivation (2 Marks)

$$S \underset{lm}{\Rightarrow} aSd \underset{lm}{\Rightarrow} aaAdd \underset{lm}{\Rightarrow} aabcdd$$

Rightmost derivation (2 Marks)

$$S \underset{rm}{\Rightarrow} aSd \underset{rm}{\Rightarrow} aaAdd \underset{rm}{\Rightarrow} aabcdd$$

Parse Tree (2 Marks)

Ambiguous or Not.

Let string = "aabbbcccdd