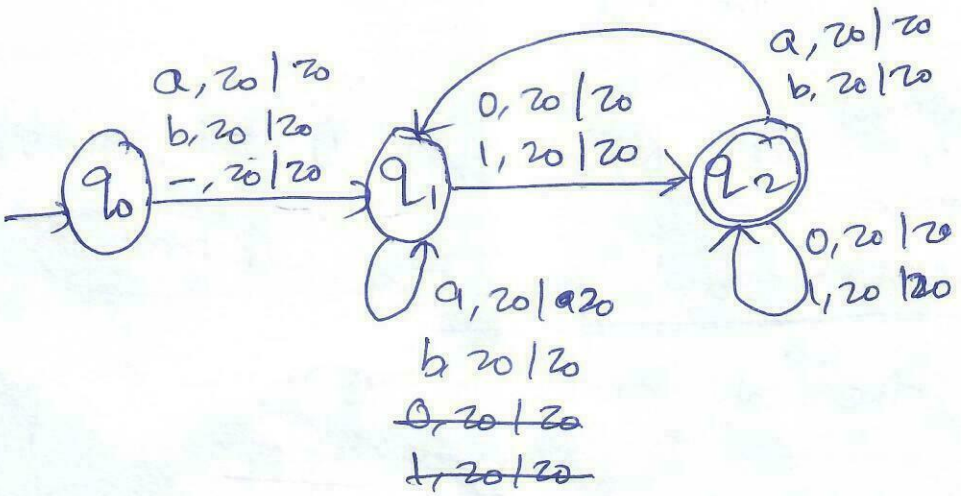
SRMIST - School of Computing | Set B

Answer key - 18CSC301T - FLA

① DPDA

$$\Sigma = \{a, b, 1, 0, -\}$$

i)



ii) ID "_ab10"

$(q_0, \_ab10, z_0)$
↓
$(q_1, ab10, z_0)$
↓
$(q_1, b10, z_0)$
↓
$(q_1, 10, z_0)$
↓
$(q_2, 0, z_0)$
↓
(q_2, ε, z_0)
↓

at end of i/p transition is in final state q_2 - i/p accepted

ID "a111b1a"

$(q_0, a111b1a, z_0)$
↓
$(q_1, 111b1a, z_0)$
↓
$(q_2, 11b1a, z_0)$
↓
$(q_2, 1b1a, z_0)$
↓
$(q_2, b1a, z_0)$
↓
$(q_1, 1a, z_0)$
↓
(q_2, a, z_0)
↓
(q_1, ε, z_0)

at end of i/p stack not empty and transition not in final state. Hence i/p rejected.

(2) a. ii) 23 (1 mark)

b. ii) Context Free language (1 mark)

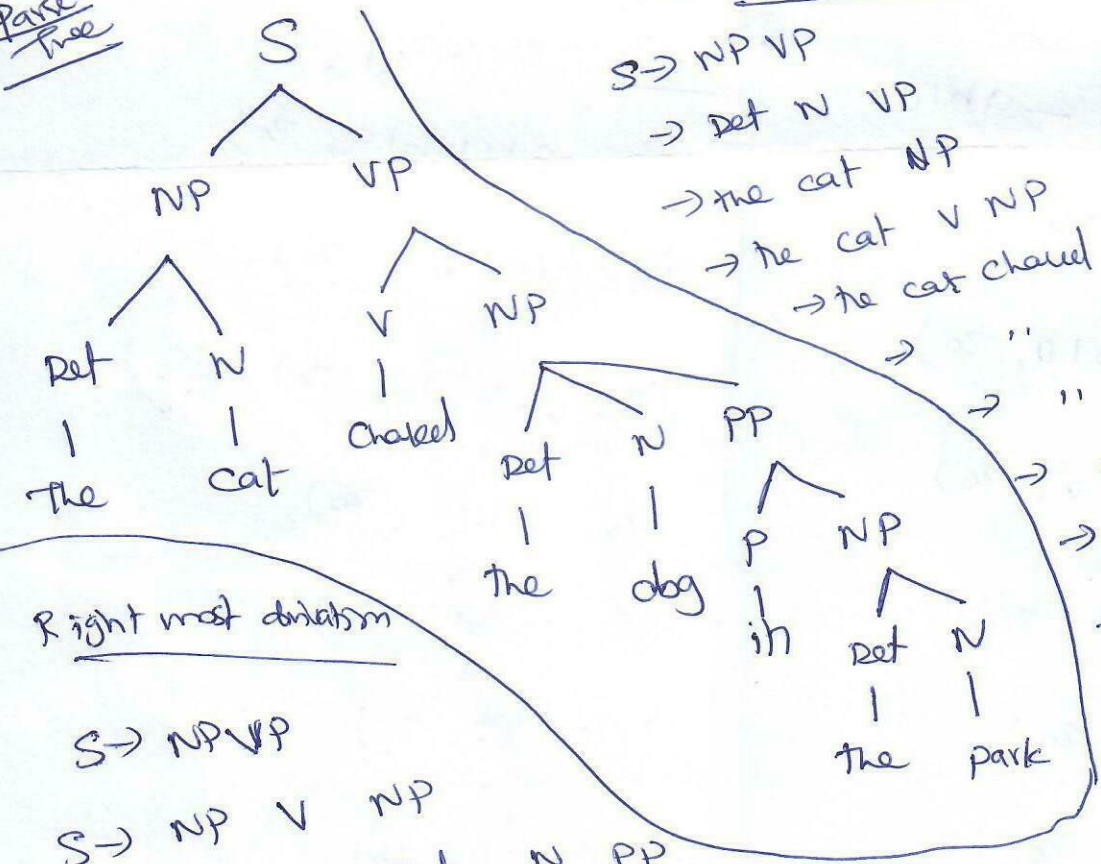
c. Terminals = {in, on, under, with, Chased, saw, bit, Played, slept, cat, dog, man, women, park, ball, The, a} (4 marks)

non terminal or variables = {S, NP, VP, PP, U, Det, N, V, P}

d. (10 marks) Derivation and parse Tree:

The cat chased the dog in the park

Parse Tree



Left most derivation

S → NP VP
→ Det N VP
→ the cat NP
→ the cat V NP
→ the cat chased NP
→ " Det N PP
→ " the dog PP
→ " P NP
→ " in Det N
→ " in the park

Right most derivation

S → NP VP
S → NP V NP
S → NP V Det N PP
S → N V Det N P NP
S → N V Det N P Det N
S → N V Det N P Det park
S → N V Det N P the park
S → N V Det N in the park
S → the cat chased the dog in the park

e) simplification

→ Useless symbol ⇒ U → U VP eliminate (4 marks)

→ no ε production

→ unit production VP → VNP | VP PP | V

VP → V NP | VP PP | chaad | saw | bit | played | slept

f) Chomsky normal form (4 marks)

NP → Det N PP

X_1 → Det N

NP → X_1 PP

N → cat | dog | man | woman | park | ball

V → chaad | saw | bit | played | slept

P → in | on | with | under

final grammar

S → NP VP

NP → Det N | X_1 PP

VP → V NP | VP PP | chadal | saw | bit | played | slept

PP → P NP

Det → he | a

(3) a) CFG (2 marks)

$L = \{wcw^R \mid w \in \{a,b\}\}$

S → aSa | bSb | c

b) no useless, ε and unit production. (4 marks)

A → a

B → B

X_1 → AS

X_2 → BS

S → ASA | BSB | c

S → X_1 A | X_2 B | c

(3) a. CNF — (4 marks)

$A \to a$
$B \to b$
$X_1 \to aS$
$X_2 \to bS$

$S \to X_1 A \mid X_2 B \mid c$

$S \to aSA \mid bSB \mid c$

d. CFG to PDA — (8 marks)

$S \to asa \mid bSb \mid c$

$PDA = \{ \{q\}, \{a, b, c\}, \{z_0, a, b, c, S\}, \delta, q, z_0, \phi \}$
($\{q\}$ = Q, $\{a, b, c\}$ = Σ, $\{z_0, a, b, c, S\}$ = Γ)

Transitions

for all variables

$\delta(q, \varepsilon, S) = (q, asa)$
$\delta(q, \varepsilon, S) = (q, bSb)$
$\delta(q, \varepsilon, S) = (q, c)$

for starting symbol

$\delta(q, \varepsilon, z_0) = (q, Sz_0)$

for all terminal symbols

$\delta(q, a, a) = (q, \varepsilon)$
$\delta(q, b, b) = (q, \varepsilon)$
$\delta(q, c, c) = (q, \varepsilon)$

for acceptance

$\delta(q, \varepsilon, z_0) = (q, \varepsilon)$

e. Deterministic PDA

f. $L = \{ w w^R \mid w \in \{a, b\} \}$

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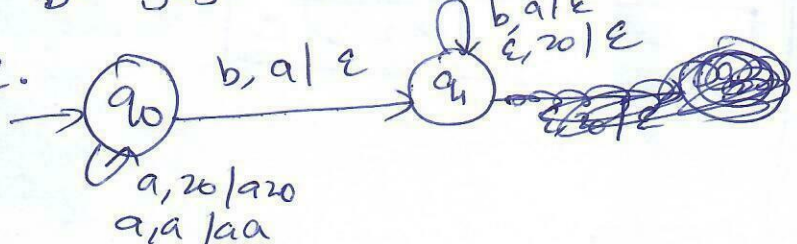
(4) a. yes. PDA has stack as memory unit where FA has no memory unit. — (1 mark)

b. yes. True. — (1 mark) — (4 marks)

c.



(d) PDA = $\{\{q_0, q_1, q_2\}, \{a, b\}, \{z_0, a, b\}, \delta, q_0, z_0, \{q_2\}\}$

$\delta(q_0, a, z_0) = (q_0, az_0)$

$\delta(q_0, a, a) = (q_0, aa)$

$\delta(q_0, b, a) = (q_1, \varepsilon)$

$\delta(q_1, b, a) = (q_1, \varepsilon)$

$\delta(q_1, \varepsilon, z_0) = (q_2, \varepsilon)$

4 marks

(e) i/p = "aabaabbb"

$(q_0, aabaabb, z_0)$

↓

$(q_0, abaabb, az_0)$

↓

$(q_0, baabb, aaz_0)$

↓

$(q_1, aabb, az_0)$

↓

no transition | i/p rejected.

→ 4 marks

(f) PDA to CFG

(V, T, P, S) $S = S$, $T = \{a, b\}$

6 marks

$V = \{S, [q_0 a q_0], [q_0 a q_1], [q_1 a q_0], [q_1 a q_1], [q_0 z_0 q_0], [q_0 z_0 q_1], [q_1 z_0 q_0], [q_1 z_0 q_1]\}$

$\delta(q_0, a, z_0) = (q_0, az_0)$

$[q_0 z_0 q_0] \to a\,[q_0 a q_0]\,[q_0 z_0 q_0]$

$[q_0 z_0 q_0] \to a\,[q_0 a q_1]\,[q_1 z_0 q_0]$

$[q_0 z_0 q_1] \to a\,[q_0 a q_0]\,[q_0 z_0 q_1]$

$[q_0 z_0 q_1] \to a\,[q_0 a q_1]\,[q_1 z_0 q_1]$

$\delta(q_0, b, a) = (q_1, \varepsilon)$

$[q_0 a q_1] \to b$

$\delta(q_1, b, a) = (q_1, \varepsilon)$

$[q_1 a q_1] \to b$

$\delta(q_1, \varepsilon, z_0) = (q_1, \varepsilon)$

$[q_1 z_0 q_1] \to \varepsilon$

$\delta(q_0, a, a) = (q_0, aa)$

$[q_0 a q_0] \rightarrow a [q_0 a q_0] [q_0 a q_0]$

$[q_0 a q_0] \rightarrow a [q_0 a q_1] [q_1 a q_0]$

$[q_0 a q_1] \rightarrow a [q_0 a q_0] [q_0 a q_1]$

$[q_0 a q_1] \rightarrow a [q_0 a q_1] [q_1 a q_1]$