5.1.1 TFCS Assignment

(a) $L = \{ 0^n 1^n \mid n \geq 1 \}$ ⇒ set of all strings of one or more zeroes followed by equal no of ones

CFG ⇒ $M = \{ V, T, P, S \}$

$V = \{ S \}$ → set of non terminal symbols

$T = \{ 0, 1 \}$ → set of input symbols

P = Production rule	Derivation of 0011
$S \rightarrow 0S1$	S $S \rightarrow 0S1$
$S \rightarrow 01$	$0S1$ $S \rightarrow 01$
	0011 S → start symbol

5.b.1

b) $L = \{a^i b^j c^k, i, j, k \geq 0 \ (i \neq j)(j \neq k)\}$

CFG → $M = \{V, T, P, S\}$

$V = \{S\}$ set of non terminal symbols

$T = \{a, b, c\}$ → set of input symbols

P = Production rule :—

$S \rightarrow XC \quad [i \neq j]$

$S \rightarrow aY \quad [j \neq k]$

$X \rightarrow aXb$

$X \rightarrow a/b$

$Y \rightarrow bYC$

$Y \rightarrow b/c$

5.1.1

c) $G = \{ \{S\}, \{a, b\}, P, S \}$

$P \Rightarrow$ $S \to asa$

$S \to bSb$

$S \to a$

$S \to b$

$S \to \epsilon$

5.1.1 . $L = \{ 0^{2n} 1^n \mid n \geq 0 \}$

d) $G = \{ \{S\}, \{0, 1\}, P, S \}$

$P = \{ S \to 00S1,\ S \to 001,\ S \to \epsilon \}$

5.1.2

$S \rightarrow A1B \rightarrow (1)$

$A \rightarrow 0A \rightarrow (2) \mid \epsilon \rightarrow (3)$

$B \rightarrow 0B \rightarrow (4) \mid 1B \rightarrow (5) \mid \epsilon \rightarrow (6)$

$0^*1(0+1)^*$

a) 00101

Left Derivation		Right Derivation	
Derivation	Rule	Derivation	Rule
S	S → A1B → (1)	S	S → A1B → (1)
A1B	A → 0A → (2)	A1B	B → 0B → (4)
0A1B	A → 0A → (2)	A10B	B → 1B → (5)
00A1B	A → ϵ → (3)	A101B	B → ϵ → (6)
001B	B → 0B → (4)	A101	A → 0A → (2)
0010B	B → 1B → (5)	0A101	A → 0A → (2)
00101B	B → ϵ → (6)	00A101	A → ϵ → (3)
00101		00101	

5.1.2

(c) 00011

$S \to A1B \to (1)$

$A \to 0A \mid \epsilon$

$B \to 0B \mid 1B \mid \epsilon$

$0A \to (2)$ $\epsilon \to (3)$

$0B \to (4)$ $1B \to (5)$ $\epsilon \to (6)$

Left Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	A → 0A → (2)
0A1B	A → 0A → (2)
00A1B	A → 0A → (2)
000A1B	A → ε → (3)
0001B	B → 1B → (5)
00011B	B → ε → (6)
00011	

Right Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	B → 1B → (5)
A11B	B → ε → (6)
A11	A → 0A → (2)
0A11	A → 0A → (2)
00A11	A → 0A → (2)
000A11	A → ε → (3)
00011	

5.1.2

(b) 1001

$S \to A1B \to (1)$

$A \to 0A \mid \epsilon$

$B \to 0B \mid 1B \mid \epsilon$

$0A \to (2)$ $\epsilon \to (3)$

$0B \to (4)$ $1B \to (5)$ $\epsilon \to (6)$

Left Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	A → ε → (2)
1B	B → 0B → (4)
10B	B → 0B → (4)
100B	B → 1B → (5)
1001B	B → ε → (6)
1001	

Right Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	B → 0B → (4)
A10B	B → 0B → (4)
A100B	B → 1B → (5)
A1001B	B → ε → (6)
A1001	A → ε → (3)
1001	

5.4.7:

$E \to +EE \mid *EE \mid -EE \mid x \mid y$

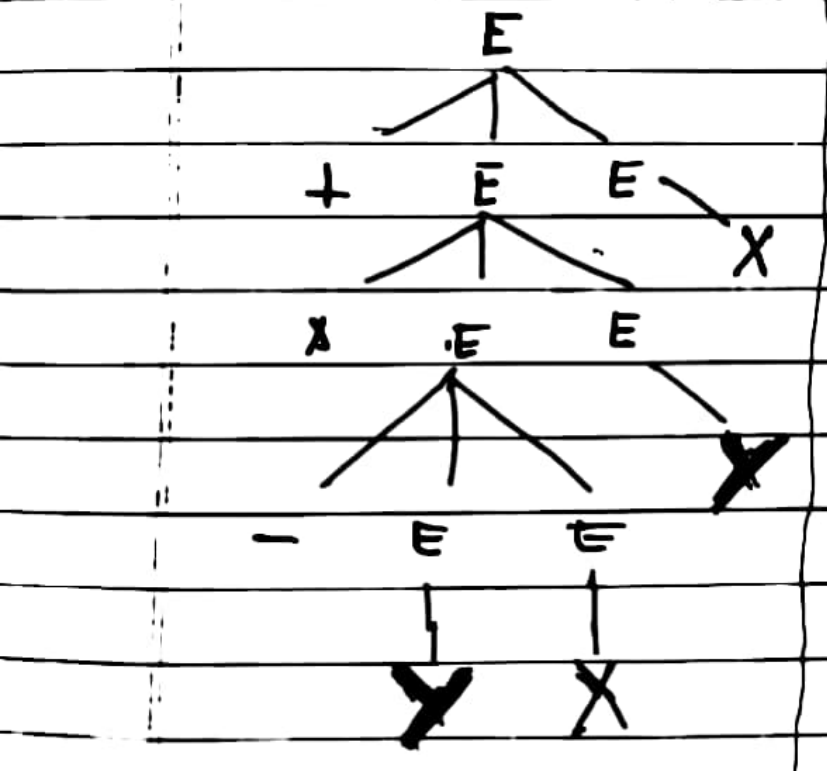
(1) (2) (3) (4) (5)

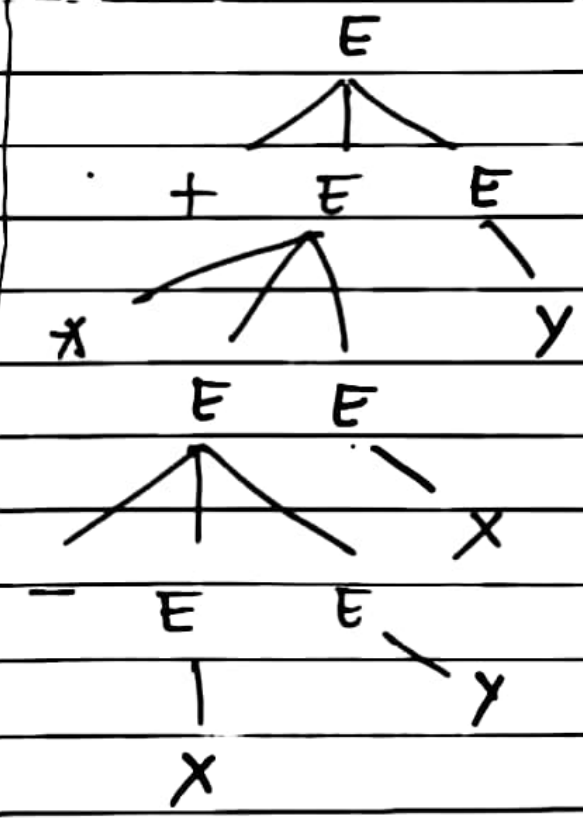
a) Left Derivation

Derivation	Rule
E	
+EE	E → +EE → (1)
+*EEE	E → *EE → (2)
+*-EEEE	E → -EE → (3)
+*-XEEE	E → x → (4)
+*-XYEE	E → y → (5)
+*-XYXE	E → x → (4)
+*-XYXY	E → y → (5)

Right Derivation

Derivation	Rule
E	
+EE	E → +EE → (1)
+EY	E → y → (5)
+*EEY	E → *EE → (2)
+*EXY	E → x → (4)
+*-EXY	E → -EE → (3)
+*-EYXY	E → y → (5)
+*-XYXY	E → x → (4)





b) Since left Derivative and Right Derivative results in required strings, the grammar considered here is unambiguous.

5.4.5 a) Ambiguity → For a given language CFG, if more than one parse trees exists ⇒ the CFG is ambiguous.
Generated sequences of left and right derivations are different ⇒ ambiguous.
Generated sequences of left and right derivations are same ⇒ unambiguous.
For the given language: S ⇒ A1B ①, A → 0A ② | ε ③,
B → 0B ④ | 1B ⑤ | ε ⑥
is ambiguous because sequence 0010101 can be produced by both left and right derivations as shown below

Left derivation		Right derivation	
Derivation	Rule	Derivation	Rule
S	S → A1B ①	S	S → A1B ①
A1B	A → 0A ②	A1B	B → 0B ④
0A1B	A → 0A ②	A10B	B → 1B ⑤
00A1B	A → ε ③	A101B	B → ε ⑥
001B	B → 0B ④	A101	A → 0A ②
0010B	B → 1B ⑤	0A101	A → 0A ②
00101B	B → ε ⑥	00A101	A → ε ③
00101		00101	

b) The grammer that is ambigious for this language

Consider generating 0 0 1 0 1 using grammar

$S \rightarrow A1B$ → (1) $0A \rightarrow$ (2) $\epsilon \rightarrow$ (3)

$A \rightarrow 0A / \epsilon$ ...

$B \rightarrow 1B / \epsilon$ $1B \rightarrow$ (4) $\epsilon \rightarrow$ (5)

Left Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	A → 0A → (2)
0A1B	A → 0A → (2)
00A1B	A → ϵ → (3)
00 1B	B → 1B → (4)
00 1B	B → ϵ
0011	

Right Derivation

Derivation	Rule
S	S → A1B → (1)
A1B	B → 1B → (4)
A11B	B → ϵ → (5)
A11	A → 0A → (2)
0A11	A → 0A → (2)
00A11	A → ϵ → (3)
0011	

Hence ambiguous, It is not possible to generate 0 0 1 0 1.