1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S \rightarrow A\}$$

3.
$$A \rightarrow bAa$$

 $5. A \rightarrow a$

$$\rightarrow$$
 a 6. B \rightarrow AbB

S
$$8. B \rightarrow \varepsilon$$

2. Convert the given grammar to the Greibach Normal Form

G=
$$(V_N, V_T, P, S,), V_N=\{S, A, B, C\}, V_T=\{a, b\},$$

P= $\{1. S \rightarrow a A \qquad 2. A \rightarrow b \qquad 3. A \rightarrow B A \rightarrow B A \qquad 3. A \rightarrow B A \qquad 3. A \rightarrow B A \rightarrow B A \qquad 3.$

$$2. A \rightarrow b$$

$$3. A \rightarrow B A$$
 $4. B \rightarrow C$

5.
$$C \rightarrow a$$
 6. $C \rightarrow B S$ }.

3. For the given grammar $G=(V_N, V_T, P, S_r), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e,f,g,e\},$

$$P=\{1.S \rightarrow Ag$$

$$2. A \rightarrow a b c B$$

$$3. B \rightarrow C d$$

$$\begin{array}{cccc}
\{1.5 \to Ag & 2.A \to abCB & 3.\\
4.C \to e & 5.C \to CfD
\end{array}$$

$$6. D \rightarrow e$$
 },

build the matrix of simple precedence, analyze the *abcefedg* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b a^{2n} \mid m, n \in N\}$ Present the analysis of the word.

Varianta 2

1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B,\,C\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S \rightarrow aB \quad 2. S \rightarrow AC$$

4. A
$$\rightarrow$$
ASC
8. C \rightarrow ϵ 9. C \rightarrow BA}

}.

8. B $\rightarrow \epsilon$ }.

2. Convert the given grammar to the Greibach Normal Form

$$G\!\!=\!\!(V_N\!,\,V_T\!,\,P,\,S,\!),\,V_N\!\!=\!\!\{S,\,A,\,B,\,C\},\,V_T\!=\!\!\{a,\,b\},$$

5. $A \rightarrow BC$ 6. $B \rightarrow b$

$$P=\{1. S \rightarrow AC$$

2.
$$C \rightarrow a$$

$$3. B \rightarrow a A 4. B \rightarrow B C$$

5.
$$A \rightarrow b$$
 6. $A \rightarrow SB$ }.

3. For the given Push Down Automaton $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F), Q=\{q0,q1,q2\}, \Sigma=\{a,b,d\}, \Gamma=\{a,b,A,B,D\}, q0=\{q0\}, Z0=\{q0\}, Q1=\{q0\}, Q2=\{q0\}, Q3=\{q0\}, Q4=\{q0\}, Q4=\{q$ ε }, F={q2} $\delta(q1, \varepsilon, \varepsilon) = \{(q2, \varepsilon)\}\$

$$\delta(q0,\!d,\!\epsilon) = \{(q1,\!D)\}$$

$$\delta(q1,b,\,\epsilon) = \{(q1,B)\}$$

$$\delta(q2,d,D) = \{(q2, \varepsilon)\}$$

$$\delta(q2,b,B) = \{(q2, \epsilon)\}$$

a) Present the PDA in the graph form.

- b) Present the PDA in the table form.
- c) Analyze the word: *dbbbbd*.

4. For the given grammar $G = (V_N, V_T, P, S_r), V_N = \{S, B, D, A\}, V_T = \{a, b, c, d\},$

$$P=\{1.S \rightarrow dA$$

$$2. A \rightarrow E$$

$$3. A \rightarrow E c A$$

$$4. E \rightarrow b D$$

$$A. E \rightarrow b D$$

$$5.D \rightarrow a$$
 $6. D \rightarrow a D$

build the matrix of simple precedence, analyze the *dbaacba* string and construct the derivation tree.

Varianta 3

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S,A,B\}, V_T = \{a,b\}$$

$$P = \{1. S \rightarrow a B 2. S \rightarrow b a A 3. A \rightarrow a \}$$

$$4. A \rightarrow a S$$

}.

$$5. A \rightarrow b A a B$$
 $6. B \rightarrow A$

G=
$$(V_N, V_T, P, S,), V_N=\{S, A, B, C\}, V_T=\{a, b\}, P=\{1. S \rightarrow B C 2. C \rightarrow B B 3. C \rightarrow \epsilon\}$$

2.
$$C \rightarrow B B$$

3.
$$C \rightarrow a \ 4. A \rightarrow b$$

7. B→ B S

$$5. B \rightarrow C A$$

3. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, B, D, A\}, V_T=\{a,b,c,d\},$

$$P = \{ 1. S \rightarrow dA \qquad 2. A \rightarrow D \qquad 3. A \rightarrow D c A 4. D \rightarrow b E \qquad 5. E \rightarrow a \qquad 6. E \rightarrow a E$$

$$5. E \rightarrow a$$

$$3. A \rightarrow D c A$$

$$6. E \rightarrow a E$$

4. Construct pushdown automata for the following language:

 $L = \{a^n b^m a^k \mid m, n, k \in N, k < m\}$ Present the analysis of the word.

Varianta 4

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S,A,B\}, V_T = \{a,b\}$$

$$P=\{1. S \rightarrow a B 2. S \rightarrow A B \quad 3. A \rightarrow a\}$$

$$A \rightarrow a$$
 4. $A \rightarrow a S$

$$5. A \rightarrow ABAB$$
 $6. B \rightarrow A$ $7. B \rightarrow bS$ $8. B \rightarrow \varepsilon$

$$7 \text{ B} \rightarrow \text{b S}$$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow b A \qquad 2. A \rightarrow B C \qquad 3. B \rightarrow b \quad 4. B \rightarrow A \}$$

$$3. B \rightarrow b \quad 4. B \rightarrow A$$

5.
$$C \rightarrow B$$
 6. $C \rightarrow a$ }.

3. For the given grammar $G=(V_N, V_T, P, S_r), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P=\{1.S \rightarrow E$$

 $4. F \rightarrow a b D$

$$2. E \rightarrow F$$

$$5.D \rightarrow R c$$

3.
$$E \rightarrow F e E$$

6. $R \rightarrow d$ 7. $R \rightarrow R d$

build the matrix of simple precedence, analyze the abdceabdc string and construct the derivation tree.

4. Construct pushdown automata for the following language:

$$L = \{a^m b^m b^n a^n \mid m, n \in N\}$$
 Present the analysis of the word.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

P=
$$\{1. S \rightarrow a B 2. S \rightarrow A B \quad 3. A \rightarrow a \quad 4. A \rightarrow a S \\ 5. A \rightarrow A B A B \quad 6. B \rightarrow A \quad 7. B \rightarrow b S \quad 8. B \rightarrow \epsilon \}$$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P = \{ 1. S \rightarrow b A \qquad 2. A \rightarrow B C \qquad 3. B \rightarrow b \quad 4. B \rightarrow A \qquad 5. C \rightarrow B \qquad 6. C \rightarrow a \}.$$

3. For the given grammar $G = (V_N, V_T, P, S_n), V_N = \{S, A, B, C, D\}, V_T = \{a, b, c, d, e, f, g, e\},$

$$P=\{ \begin{array}{ccc} 1. \ S \rightarrow A \ e \\ 4. \ E \rightarrow D \end{array} \qquad \begin{array}{ccc} 2. \ A \rightarrow b \ a \ F \\ 5. \ E \rightarrow E \ b \ D \end{array} \qquad \begin{array}{c} 3. \ F \rightarrow E \ d \\ 6. \ D \rightarrow c \end{array}$$

build the matrix of simple precedence, analyze the *bacbcde* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n a^n b^{2n} \mid m, n \in N\}$ Present the analysis of the word.

Varianta 6

1. Present the Context Free Grammar in Chomsky Normal Form

$$\begin{split} G &= (V_N, V_T, \, P, \, S), \, V_N \!\! = \{S, \! A, \! B\}, \, V_T = \{a, \! b\} \\ P &= \{1. \, S \, \rightarrow \, a \, B \, 2. \, S \, \rightarrow \, b \, a \, A \quad 3. \, A \!\! \rightarrow \, a \quad \quad 4. \, A \!\! \rightarrow \, a \, S \\ 5. \, A \!\! \rightarrow \, b \, A \, a \, B \quad 6. \, B \!\! \rightarrow \, A \quad 7. \, B \!\! \rightarrow \, B \, S \quad 8. \, B \, \rightarrow \, \epsilon \, \}. \end{split}$$

2. Convert the given grammar to the Greibach Normal Form

$$\begin{aligned} &G{=}(V_N,\,V_T,\,P,\,S,),\,V_N{=}\{S,\,A,\,B,\,C\},\,V_T{=}\{a,\,b\},\\ &P{=}\{\,1.\,S\rightarrow B\,\,C & 2.\,C\rightarrow B\,\,B & 3.\,C\rightarrow a & 4.\,A\rightarrow b & 5.\,B\rightarrow C\,\,A & \}. \end{aligned}$$

3. For the given grammar $G = (V_N, V_T, P, S_1), V_N = \{S, A, B, D\}, V_T = \{a, b, c, d\},$

$$P = \{ 1. S \rightarrow A \ a \ b \ H \qquad 2. H \rightarrow R \ c \qquad 3. R \rightarrow f \\ 4. R \rightarrow R \ d \ f \qquad 5. A \rightarrow e \qquad 6. A \rightarrow A \ d \ e \qquad \},$$

build the matrix of simple precedence, analyze the *edeabfdfc* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b^n a^k \mid m, n \in \mathbb{N}, k = n - 1\}$ Present the analysis of the word.

Varianta 7

1. Present the Context Free Grammar in Chomsky Normal Form

$$\begin{aligned} &G{=}(V_N,\,V_T,\,P,\,S),\,V_N{=}\{S,\,A,\,B,\,C\},\,V_T{=}\{a,\,b\} \\ &P{=}\{1.\,S{\to}aB\quad 2.\,S{\to}AC & 3.\,A{\to}a & 4.\,A{\to}a \end{aligned}$$

1.
$$S \rightarrow aB$$
 2. $S \rightarrow AC$ 3. $A \rightarrow a$ 4. $A \rightarrow ASC$ 5. $A \rightarrow BC$ 6. $B \rightarrow b$ 7. $B \rightarrow bS$ 8. $C \rightarrow \epsilon$ 9. $C \rightarrow BA$

2. Convert the given grammar to the Greibach Normal Form

$$\begin{aligned} &G = (V_N, \, V_T, \, P, \, S,), \, V_N = \{S, \, A, \, B, \, C\}, \, V_T = \{a, \, b\}, \\ &P = \{ \, 1. \, S \rightarrow \, A \, C \qquad 2. \, C \rightarrow a \qquad 3. \, B \rightarrow a \, A \quad 4. \, B \rightarrow B \, C \qquad \qquad 5. \, A \rightarrow b \qquad 6. \, A \rightarrow S \, B \, \, \}. \end{aligned}$$

3. For the given grammar $G = (V_N, V_T, P, S_1), V_N = \{S, F, L, E\}, V_T = \{a, b, c, d, e\},$

$$P = \{ \begin{array}{ccc} 1. \ S \rightarrow L \ dX & 2. \ X \rightarrow D & 3. \ L \rightarrow c \ a \\ 4. \ L \rightarrow L \ a & 5. D \rightarrow b & 6. \ D \rightarrow D \ e \ b \end{array} \}.$$

build the matrix of simple precedence, analyze the *caaadbebeb* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n a^m a^{2n} \mid m, n \in N\}$ Present the analysis of the word.

Varianta 8

8. B $\rightarrow \epsilon$ }

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P=\{1. S \rightarrow A \qquad 2. S \rightarrow aB \qquad 3. A \rightarrow bAa \qquad 4. A \rightarrow aS$$

$$5. A \rightarrow a \qquad 6. B \rightarrow AbB \qquad 7. B \rightarrow BS \qquad 8. B \rightarrow \epsilon \}$$

7. B→BS

6. B \rightarrow AbB **2.** Convert the given grammar to the Greibach Normal Form

$$\begin{aligned} &G = (V_N, \, V_T, \, P, \, S,), \, V_N = \{S, \, A, \, B, \, C\}, \, V_T = \{a, \, b\}, \\ &P = \{\, 1. \, S \rightarrow \, a \, A \qquad 2. \, A \rightarrow b \qquad 3. \, A \rightarrow B \, A \, 4. \, B \rightarrow \, C \qquad \qquad 5. \, C \rightarrow a \qquad 6. \, C \rightarrow B \, S \, \, \}. \end{aligned}$$

3. Construct pushdown automata for the following language:

 $L = \{a^n b^m a^k \mid m, n, k \in \mathbb{N}, k < m\}$ Present the analysis of the word.

4. For the given grammar $G=(V_N, V_T, P, S_r)$, $V_N=\{S, A, B, C, D\}$, $V_T=\{a,b,c,d,f,g\}$,

$$P = \{ 1. S \rightarrow A \quad 2. A \rightarrow A E \qquad 3. E \rightarrow A D$$

$$4. A \rightarrow a \qquad 5. A \rightarrow b \qquad 6. D \rightarrow c \qquad 7. D \rightarrow d \qquad \}$$

build the matrix of simple precedence, analyze the *baacdad* string and construct the derivation tree.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B,\,D\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S \rightarrow aB \quad 2. S \rightarrow DA$$

$$2. S \rightarrow DA \qquad 3. A \rightarrow a$$

$$5 A \rightarrow hDAR6 B \rightarrow h$$

3.
$$A \rightarrow a$$
 4. $A \rightarrow BD$

5. A
$$\rightarrow$$
bDAB6. B \rightarrow b

7. B
$$\rightarrow$$
 BA

8. D
$$\rightarrow \varepsilon$$
 9. D \rightarrow BA}

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$G = (V_N, V_T, P, S_r), V_N = \{S, A, B, C\}, V_T = \{a, b\},\$$

 $P = \{1. S \to b A \qquad 2. A \to S C \qquad 3. B \to A \quad 4. A \to a \qquad 5. A \to B C$

3. For the given grammar
$$G = (V_N, V_T, P, S_0), V_N = \{S, A, B, C\}, V_T = \{a, b, c, d, e, f\}, P = \{1. S \rightarrow L d F 2. F \rightarrow E 3. L \rightarrow c a\}$$

$$\{C_T\}, V_T = \{a, b, c, d, S_T\}$$

3. $L \rightarrow c \ a$

$$4. L \rightarrow L a$$

$$5.E \rightarrow b$$

6.
$$E \rightarrow E e b$$
 }.

build the matrix of simple precedence, analyze the *caadbeb* string and construct the derivation tree.

4. For the given Push Down Automaton $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F), Q=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B\}, q0=\{q0\}, q1,q2\}$ Z0={ ε }, F={q2}

$$\delta(q0,a,\epsilon) = \{(q1,A)\}$$

$$\delta(q1,b, \varepsilon) = \{(q1,B)\}$$

$$\delta(q2,b,B) = \{(q2, \varepsilon)\}$$

$$\delta(q1, c, \epsilon) = \{(q2, \epsilon)\}$$

6. $C \rightarrow b$ }.

$$\delta(q2,a,A) = \{(q2, \varepsilon)\}$$

- a) Present the PDA in the graph form.
- b) Present the PDA in the table form.
- c) Analyze the word: abbcbba.

Varianta 10

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

 $5. A \rightarrow AabB$

$$P = \{1. S \rightarrow a B\}$$

2.
$$S \rightarrow B A$$

6. $B \rightarrow \epsilon$

$$\begin{array}{ccc}
3. \text{ A} \rightarrow & a \\
7. \text{ B} \rightarrow & \text{b S} & 8.
\end{array}$$

$$\rightarrow$$
 a 4. A \rightarrow b B
8. B \rightarrow a A B A }

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow b B \qquad 2. A \rightarrow B A\}$$

$$2. A \rightarrow B A$$

$$3. B \rightarrow A C \quad 4. A \rightarrow B$$

5.
$$A \rightarrow b$$
 6. $C \rightarrow a$ }.

3. Construct pushdown automata for the following language:

 $L = \{a^{2m}b^na^n|m, n \in \mathbb{N}\}$. Present the analysis of the word.

4. For the given grammar $G=(V_N, V_T, P, S_r)$, $V_N = \{S, A, B, C, D\}$, $V_T = \{a, b, c, d, e, f\}$,

$$P=\{ 1. S \rightarrow A \qquad 2.A \rightarrow a D \}$$

$$2.A \rightarrow aD$$

$$3. D \rightarrow b$$

$$4. D \rightarrow b D$$

$$5. D \rightarrow A c$$
 },

build the matrix of simple precedence, analyze the *ababbc* string and construct the derivation tree.

Varianta 11

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A\}$$

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P = \{1. S \rightarrow a B \quad 2. S \rightarrow b A \quad 3. A \rightarrow 5. A \rightarrow A b a B \quad 6. B \rightarrow A$$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S,), V_N=\{S, A, B, C\}, V_T=\{a, b\},$$

$$P=\{1. S \rightarrow C A\}$$

$$2. C \rightarrow A B$$

3.
$$A \rightarrow C$$
 4. $A \rightarrow a$

5. B
$$\rightarrow$$
 b \}.

3. For the given grammar $G = (V_N, V_T, P, S_r), V_N = \{S, A, B, C, D\}, V_T = \{a, b, c, d, e, f, g, e\},$

$$P=\{\begin{array}{ccc} 1. \ S \rightarrow A & 2. \ A \rightarrow E \\ 4. \ E \rightarrow a & 5.E \rightarrow \end{array}$$

$$5.E \rightarrow b$$

$$\begin{array}{ccc}
3. A \rightarrow A & c & E \\
b & 6. E \rightarrow d & D
\end{array}$$

7. D
$$\rightarrow A e$$
 }

build the matrix of simple precedence, analyze the *daecdbe* string and construct the derivation tree.

4. For the given Push Down Automaton $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F), Q=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{\epsilon\}, F=\{q2\}, C=\{a,b,c\}, C=\{a,b,c\},$

$$\delta(q0, \varepsilon, \varepsilon) = \{(q1, \varepsilon)\}\$$

$$\delta(q1,b,\,\varepsilon) = \{(q1,B)\}\$$

$$\delta(q1,a,\varepsilon) = \{(q1,A)\}$$

$$\delta(q1, c, \varepsilon) = \{(q2, \varepsilon)\}$$

$$\delta(q2,b,B) = \{(q2, \varepsilon)\}$$

$$\delta(q2,a,A) = \{(q2, \varepsilon)\}\$$

a) Present the PDA in the graph form.

- b) Present the PDA in the table form.
- c) Analyze the word: aaacaaa.

Varianta 12

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P = \{1. \text{ S} \rightarrow \text{a B} \quad 2. \text{ S} \rightarrow \text{b A} \quad 3. \text{ A} \rightarrow \text{B} \quad 4. \text{ A} \rightarrow \text{A S} \\ 5. \text{ A} \rightarrow \text{b B A B} \quad 6. \text{ A} \rightarrow \epsilon \quad 7. \text{ B} \rightarrow \text{b} \quad 8. \text{ B} \rightarrow \text{b S} \}$$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow b C \qquad 2. B \rightarrow C A \qquad 3. A \rightarrow a \}$$

$$A. C \rightarrow B$$
 $B. C \rightarrow B$ $A. C \rightarrow B$

3. Convert the given context free grammar to the Push Down Automaton

$$G=(V_N, V_T, P, S), V_N=\{S, A, B, D\}, V_T=\{a, b\}$$

$$P=\{1. S \rightarrow aB$$
 2

2. S
$$\rightarrow$$
 DA

3.
$$A \rightarrow a$$

7. $B \rightarrow BA$

$$4. A \rightarrow BD$$

5. A
$$\rightarrow$$
bDAB 6. B \rightarrow b

7. B
$$\rightarrow$$
 BA

8. D
$$\rightarrow \epsilon$$
 9. D \rightarrow BA}

4. For the given grammar $G=(V_N, V_T, P, S_r), V_N=\{S, F, L, E\}, V_T=\{a,b,c,d,e\},$

$$P = \{ 1. S \rightarrow dA \qquad 2. A \rightarrow E \\ 4. E \rightarrow bD \qquad 5.D \rightarrow a \}$$

$$5D \rightarrow a$$

$$3. A \rightarrow E c A$$

$$6. D \rightarrow a D$$

build the matrix of simple precedence, analyze the *dbaacba* string and construct the derivation tree.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P=\{1. S \rightarrow A \quad 2. S \rightarrow aB\}$$

$$4. A \rightarrow aS$$

$$3. A \rightarrow a$$

5.
$$A \rightarrow a$$
 6. $B \rightarrow AbB$

8. B
$$\rightarrow \epsilon$$
 }

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow A C\}$$

2.
$$C \rightarrow b A$$

$$=\{a, b\},\$$
 3. $A \rightarrow S$ 4. $A \rightarrow b$

$$5. B \rightarrow A$$
 6

6. B
$$\rightarrow$$
 a $\}$.

3. For the given grammar $G = (V_N, V_T, P, S_r), V_N = \{S, B, D, A\}, V_T = \{a, b, c, d\},$

$$P = \{ 1. S \rightarrow dA \}$$

$$2. A \rightarrow D$$

$$3. A \rightarrow D c A$$

$$4. D \rightarrow b E$$

$$5. E \rightarrow a$$

6.
$$E \rightarrow a E$$
 },

build the matrix of simple precedence, analyze the dbacbaa string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b^m a^k \mid m, n, k \in \mathbb{N}, m+n=k\}$ Present the analysis of the word.

Varianta 14

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P = \{1. \ S \rightarrow Ab$$

2. S
$$\rightarrow$$
aB3. A \rightarrow bAa

4. A
$$\rightarrow$$
aS
8. B \rightarrow ϵ 9. A \rightarrow a }

2. Convert the given grammar to the Greibach Normal Form

G=(V_N, V_T, P, S,), V_N={S, A, B, C}, V_T={a, b},
P={ 1. S
$$\rightarrow$$
 a A 2. A \rightarrow b 3. A \rightarrow B A

 $5. A \rightarrow B$

2.
$$A \rightarrow b$$

6. B→AbB

$$3. A \rightarrow B A 4. B \rightarrow C$$

5.
$$C \rightarrow a$$
 6. $C \rightarrow B S$ }.

3. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, B, D, A\}, V_T=\{a,b,c,d\},$

$$P=\{1. S \rightarrow E$$

 $4. F \rightarrow a b D$

$$2. E \to F$$
$$5.D \to R c$$

$$3. E \rightarrow F e E$$

$$6. R \rightarrow d$$

7.
$$R \rightarrow R d$$

build the matrix of simple precedence, analyze the abdceabdc string and construct the derivation tree.

4. For the given PDA $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F)$ given in the table form

δ	a	b	c	d	3
→ q0	q0 ε A	q0 ε B		-	q1 ε ε
q1	q2 ε ε	-	-	-	
* q2	q0 A ε	q0 B ε	-	-	-

- a) Present the PDA in the graph form.
- b) Present the PDA in the analytical form.
- c) Analyze the word: abbabba.

Varianta 15

1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B,\,D\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S \rightarrow aB\}$$

$$2. S \rightarrow DA$$

3.
$$A \rightarrow a$$

7. $B \rightarrow BA$

4. A
$$\rightarrow$$
 aBD

8. D \rightarrow ϵ 9. D \rightarrow BA 10. B \rightarrow a }

6. B
$$\rightarrow$$
 D

2. Convert the given grammar to the Greibach Normal Form
$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},$$

5.
$$A \rightarrow B C$$
 6. $C \rightarrow b$ }.

 $P=\{1. S \rightarrow b A\}$ $2. A \rightarrow S C$ 3. $B \rightarrow A$ 4. $A \rightarrow a$

3. For the given grammar
$$G = (V_N, V_T, P, S_n)$$
, $V_N = \{S, A, B, C, D\}$, $V_T = \{a, b, c, d\}$, $P = \{1, S \rightarrow A e 2, A \rightarrow b \ a \ F 3, F \rightarrow E \ d\}$

$$2. A \rightarrow b \ a F$$

$$3. F \rightarrow E d$$

$$4. E \rightarrow D$$

$$5. E \rightarrow E b D$$

 $6. D \rightarrow c$ }, build the matrix of simple precedence, analyze the

bacbcde string and construct the derivation tree.

4. For the given PDA $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F)$ given in the table form

δ	a	b	с	d	3
→ q0	q0 ε A	q0 ε B		-	q1 ε ε
q1	=	q2 ε ε	-	-	
* q2	q0 A ε	q0 B ε	-	-	-

a) Present the PDA in the graph form.

 $5. A \rightarrow AabB$

- b) Present the PDA in the analytical form.
- c) Analyze the word: abbbbba.

Varianta 16

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P = \{1. S \rightarrow a B\}$$

2. S
$$\rightarrow$$
 aB A
6. B \rightarrow ϵ

 $7. B \rightarrow b S$

4.
$$A \rightarrow b B$$

8. B
$$\rightarrow$$
 a A B A 9. A \rightarrow a }

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},$$

$$P=\{1. S \rightarrow b B\}$$

2.
$$A \rightarrow B A$$

$$3. B \rightarrow A C \quad 4. A \rightarrow B$$

5.
$$A \rightarrow b$$
 6. $C \rightarrow a$ }.

3 For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P = \{ 1. S \rightarrow A \ a \ b \ H \\ 4. R \rightarrow R \ d \ f \}$$

$$2. H \rightarrow R c$$
$$5. A \rightarrow e$$

$$3. R \rightarrow f$$

$$6. A \rightarrow A d e$$

analyze the *edeabfdfc* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b a^k \mid m, n \in \mathbb{N}, k = n - 1\}$ Present the analysis of the word.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P = \{1. S \rightarrow a B 2. S \rightarrow b A \quad 3. A \rightarrow B \quad 4. A \rightarrow a \}$$

5. A
$$\rightarrow$$
 A b a B 6. B \rightarrow a 7. B \rightarrow b S 8. B \rightarrow ϵ 9. A \rightarrow a }

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow C A$$
 $2. C \rightarrow A B$ $3. A \rightarrow C$ $4. A \rightarrow a$ $5. B \rightarrow b \}.$

3. For the given grammar $G = (V_N, V_T, P, S_r), V_N = \{S, A, B, C, D\}, V_T = \{a, b, c, d, e\},$

$$P=\{1. S \rightarrow A e$$

$$2. A \rightarrow b \ a \ B$$

$$3. B \rightarrow C d$$

$$P = \{ 1. S \to A e \\ 4. C \to D \}$$

$$5. C \rightarrow C b D$$

$$6. D \rightarrow c$$
 },

build the matrix of simple precedence, analyze the bacbcbcde string and construct the derivation tree.

4. For the given Push Down Automaton $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F), Q=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{q0,q1,q2\}, \Sigma=\{q0,q1,q2\}, \Sigma=\{q0,q1,q2\},$ ε }, F={q2}

$$\delta(q0,c,\epsilon) = \{(q1,C)\}$$

$$\delta(q1,b, \varepsilon) = \{(q1,B)\}$$

$$\delta(q_1, \varepsilon, \varepsilon) = \{(q_2, \varepsilon)\}$$

6. B \rightarrow a }.

6. $A \rightarrow BA$ }.

 $5. B \rightarrow A$

$$\delta(q_2,c,C) = \{(q_2,\epsilon)\}$$

$$\delta(q2,c,C) = \{(q2, \varepsilon)\}\$$

$$\delta(q_1,b,\epsilon) = \{(q_1,b)\}\$$

 $\delta(q_2,b,B) = \{(q_2,\epsilon)\}\$

- b) Present the PDA in the table form.
- c) Analyze the word: *cbbbbc*.

Varianta 18

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P=\left\{\,1.\;S\;\rightarrow\;a\;B\;2.\;S\;\rightarrow\;b\;A\qquad\quad3.\;A\;\rightarrow\;a\qquad\quad4.\;A\;\rightarrow\;A\;S\right.$$

5. A
$$\rightarrow$$
 b B A B 6. A \rightarrow ϵ 7. B \rightarrow A 8. B \rightarrow b S } **2.** Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{ 1. S \rightarrow b C \qquad 2. B \rightarrow C A \qquad 3. A \rightarrow a \quad 4. C \rightarrow B \qquad 6. C \rightarrow b \}.$$

3. For the given grammar $G = (V_N, V_T, P, S_n), V_N = \{S, A, B, C, D\}, V_T = \{a, b, c, d\},$

$$P=\{1.S \rightarrow dB\}$$

$$2. B \rightarrow C$$

$$3. B \rightarrow C c B$$

4.
$$C \rightarrow b A$$

5. A \rightarrow a

$$5. A \rightarrow a$$

$$6. A \rightarrow a A$$
 },

build the matrix of simple precedence, analyze the dbacbaaa string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b^m a^{n+1} \mid m, n \in N\}$ Present the analysis of the word.

Varianta 19

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P=\{1. S \rightarrow aA \quad 2. S \rightarrow aB \quad 3. A\}$$

2.
$$S \rightarrow aB$$
 3. $A \rightarrow bAa$
6. $B \rightarrow AbB$ 7. $B \rightarrow BS$

4. A
$$\rightarrow$$
B
8. B \rightarrow ϵ }

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

3. For the given grammar
$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a,b,c\},$$

$$P=\{ 1. S \rightarrow aA$$

$$2. A \rightarrow C$$

$$3. A \rightarrow C \ b A$$

4.
$$C \rightarrow dB$$

$$5. B \rightarrow b$$

$$6. B \rightarrow a B$$

build the matrix of simple precedence, analyze the *adbbdb* string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^{2n}b^ma^n \mid m, n \in N\}$ Present the analysis of the word.

Varianta 20

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, L, A, I\}, V_T = \{a,b\}$$

$$P= \{ \begin{array}{ccc} 1. \text{ S} \rightarrow & L & 2. \text{ L} \rightarrow & \text{aA I} \\ 5. \text{ L} \rightarrow & L \text{ b I} \end{array}$$

$$3. L \rightarrow a A$$

$$6. A \rightarrow I$$

4. L
$$\rightarrow$$
 L a A

7. I \rightarrow b 8. I \rightarrow ϵ }.

 $5. A \rightarrow b$

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P = \{1. S \rightarrow aC \quad 2. C \rightarrow BA \quad 3. C \rightarrow aC \quad 2. C \rightarrow BA \quad 3. C \rightarrow aC \quad 2. C \rightarrow BA \quad 3. C \rightarrow aC \quad 4. C \rightarrow AC \quad$$

$$C 2. C \rightarrow BA 3. C \rightarrow a 4. B \rightarrow A$$

3. For the given grammar
$$G=(V_N, V_T, P, S_n), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$$

$$P=\{ 1. S \rightarrow L dX 4. L \rightarrow aL$$

$$2. X \rightarrow D$$

 $5. D \rightarrow b$

3.
$$L \rightarrow c \ a$$

6. $D \rightarrow eDb$ },

build the matrix of simple precedence, analyze the string *aaaacadeebbb* and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^n b^{2n} a^n \mid m, n \in N\}$ Present the analysis of the word.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, \ V_T, P, S), \ V_N = \{S, A, B\}, \ V_T = \{a, b\}$$

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

P=
$$\{1. S \rightarrow a B 2. S \rightarrow aA B \quad 3. A \rightarrow a \quad 4. A \rightarrow B \\ 5. A \rightarrow A B aA B \quad 6. B \rightarrow aA \quad 7. B \rightarrow b S \quad 8. B \rightarrow \epsilon\}$$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow b A$$
 2. $A \rightarrow B C$ 3.

P={ 1. S
$$\rightarrow$$
 b A 2. A \rightarrow B C 3. B \rightarrow b 4. B \rightarrow A 3. For the given PDA M=(Q, Σ , Γ , δ , q0, Z0, F) given in the table form

δ	a	b	c	d	ε
→ q0	q0 ε A	q0 ε B	q1 ε ε	-	
q1	-	-	q2 ε ε	-	
* q2	q0 A ε	q0 B ε	-	-	-

- a) Present the PDA in the graph form.
- b) Present the PDA in the analytical form.
- c) Analyze the word: *abbccbba*.

 $4. A \rightarrow dD$

4. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P=\{1.S \rightarrow C$$

2.
$$C \rightarrow B c A$$

5. $D \rightarrow B e$

$$3. A \rightarrow b$$

7.
$$B \rightarrow B b a$$
 },

6. $B \rightarrow a$ build the matrix of simple precedence, analyze the abacdae string and construct the derivation tree.

Varianta 22

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P= \{1. S \rightarrow a B 2. S \rightarrow b a A \quad 3. A \rightarrow a \\ 5. A \rightarrow b A a B \quad 6. B \rightarrow a A \quad 7.$$

a 4. A
$$\rightarrow$$
 B
7. B \rightarrow B S 8. B \rightarrow ϵ }.

3. A
$$\rightarrow$$
 b A a B 0. B \rightarrow aA 7. B \rightarrow 2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow B C$$
 $2. C \rightarrow B B$ $3. C \rightarrow a 4. A \rightarrow b$

$$5. B \rightarrow C A$$
 }.

5. C →B

6. $C \rightarrow a$ }.

3. For the given grammar $G=(V_N, V_T, P, S_0), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P=\{ 1. S \rightarrow A \\ 4. C \rightarrow a \}$$

$$3. A \rightarrow A c C$$

$$6. C \rightarrow d D$$

$$7. D \rightarrow A e$$

build the matrix of simple precedence, analyze the dacbebeca string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^{2m}b^ma^k \mid m, n, k \in N\}$ Present the analysis of the word.

Varianta 23

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B, C\}, V_T=\{a, b\}$$

$$P=\{1. S\rightarrow aB$$
 2. $S\rightarrow AaC$

3.
$$A \rightarrow a$$
 4. $A \rightarrow ASC$

6. B
$$\rightarrow$$
b 7. B \rightarrow C 8. C \rightarrow ϵ 9. C \rightarrow BA}

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S,), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow A C\}$$

2.
$$C \rightarrow c$$

2.
$$C \rightarrow a$$
 3. $B \rightarrow a A$ 4. $B \rightarrow B C$

$$5. A \rightarrow b$$

6. A
$$\rightarrow$$
 S B $\}$.

3. For the given PDA $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F)$ given in the table form

δ	a	b	c	d	ε
→ q0	q0 ε A	q0 ε B	q1 ε ε	-	-
q1	-	-	-	-	q2 ε ε
* q2	q0 A ε	q0 B ε	-	-	-

- a) Present the PDA in the graph form.
- b) Present the PDA in the analytical form.
- c) Analyze the word: abcba.
- 4. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P = \{ 1. S \rightarrow B \}$$

$$2. B \rightarrow C$$

$$3. B \rightarrow C c B$$

4. $C \rightarrow a d D$

 $5. D \rightarrow A e$

 $6. A \rightarrow b$

7.
$$A \rightarrow A b$$
, 8. $B \rightarrow d$ },

build the matrix of simple precedence, analyze the adabcd string and construct the derivation tree.

Varianta 24

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P=\{1. S \to Aa$$
 2. S -

2. S
$$\rightarrow$$
aB3. A \rightarrow bAa
6. B \rightarrow AbB 7. B \rightarrow BS

$$\begin{array}{c} 4. \ A \rightarrow B \\ 8. \ B \rightarrow \epsilon \ \end{array} \}$$

2. Convert the given grammar to the Greibach Normal Form

$$C_{-}(V_{Y}, V_{x}, \mathbf{P}, \mathbf{S}), V_{Y}_{-}(\mathbf{S}, \mathbf{A}, \mathbf{P}, \mathbf{C}), V_{x}_{-}(\mathbf{a}, \mathbf{b})$$

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S,\!),\,V_N\!\!=\!\!\{S,\,A,\,B,\,C\},\,V_T\!=\!\!\{a,\,b\},$$

$$P=\{1. S \rightarrow a A \qquad 2. A \rightarrow b \qquad 3. A \rightarrow B A \quad 4. B \rightarrow C$$

3.
$$A \rightarrow B A$$
 4. $B \rightarrow C$ 5. $C \rightarrow a$ 6. $C \rightarrow B S$ }.

3. Convert the given context free grammar to the Push Down Automaton

$$G \!\!=\!\! (V_N,\, V_T,\, P,\, S,),\, V_N \!\!=\!\! \{S,\, A,\, B,\, C\},\, V_T \!=\!\! \{a,\, b\},$$

$$P=\{1. S \rightarrow b A\}$$

5. A \rightarrow a

$$2. A \rightarrow B C$$

$$3. B \rightarrow b \quad 4. B \rightarrow A$$

5.
$$C \rightarrow B$$
 6. $C \rightarrow a$ }.

4. For the given grammar
$$G = (V_N, V_T, P, S_1)$$
, $V_N = \{S, A, B, C, D\}$, $V_T = \{a, b, c, d, e, f, g\}$,

$$P=\{1.S \rightarrow Cf\}$$

$$5. D \rightarrow g A$$

$$3. B \rightarrow D c$$

$$6. A \rightarrow d$$

$$7. A \rightarrow e$$

build the matrix of simple precedence, analyze the abgdcf string and construct the derivation tree.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, \, P, \, S), \, V_N \!\! = \{S,\! A,\! B\}, \, V_T = \{a,\! b\}$$

$$P = \{1. S \rightarrow a B\}$$

$$2. S \rightarrow aB A$$

$$3. A \rightarrow B$$
 $4. A \rightarrow b B$

7.
$$B \rightarrow b S$$

8. B
$$\rightarrow$$
 a A B A

2. Convert the given grammar to the Greibach Normal Form

$$G\!\!=\!\!(V_N\!,\,V_T\!,\,P,\,S,\!),\,V_N\!\!=\!\!\{S,\,A,\,B,\,C\},\,V_T\!=\!\!\{a,\,b\},$$

$$P=\{1. S \rightarrow b B\}$$

$$2. A \rightarrow B A$$

$$V_T = \{a, b\},$$

3. B \rightarrow A C 4. A \rightarrow B

5.
$$A \rightarrow b$$
 6. $C \rightarrow a$ }.

9. $A \rightarrow a$

3. Convert the given context free grammar to the Push Down Automaton

$$G = (V_N, V_T, P, S), V_N = \{S,A,B\}, V_T = \{a,b\}$$

$$P=\{1. S \rightarrow a B\}$$

$$2. S \rightarrow B A$$

3.
$$A \rightarrow a$$
 4. $A \rightarrow b$ B

$$5. A \rightarrow A a b B \qquad 6. 1$$

$$8. B \rightarrow a A B A$$

4. For the given grammar
$$G=(V_N, V_T, P, S_r), V_N=\{S, A, B, C\}, V_T=\{a,b,c,d,e,f\},$$

$$P = \{ 1. S \rightarrow B c \\ 4. A \rightarrow f \}$$

$$2. S \rightarrow B \ c \ d \ C$$
$$5. A \rightarrow A \ b \ f$$

3.
$$C \rightarrow A e$$

$$6. B \rightarrow a$$

$$B \rightarrow a$$

$$7. B \rightarrow B b a$$
 },

build the matrix of simple precedence, analyze the *abacdfbfe* string and construct the derivation tree.

Varianta 26

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

$$P = \{1. S \rightarrow a B \ 2. S \rightarrow b A\}$$

 $5. A \rightarrow AbaB$

$$\begin{array}{ccc} b & A & 3. & A \rightarrow & B \\ 6. & B \rightarrow & a & 7. \end{array}$$

B 4. A
$$\rightarrow$$
 a S
7. B \rightarrow b S 8. I

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S,), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow C A\}$$

$$2. C \rightarrow A B$$

3.
$$A \rightarrow C$$
 4. $A \rightarrow a$

5. B
$$\rightarrow$$
 b \}.

3. For the given Push Down Automaton $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F), Q=\{q0,q1,q2\}, \Sigma=\{a,b,c\}, \Gamma=\{a,b,A,B,C\}, q0=\{q0\}, Z0=\{q0\}, Q0=\{q0\}, Q0=\{q$ ε }, F={q2}

$$\delta(q0, \varepsilon, \varepsilon) = \{(q1, \varepsilon)\}\$$

 $P=\{1.S \rightarrow Aa$

4. $C \rightarrow f$

$$\delta(q1,b,\,\epsilon) = \{(q1,B)\}$$

$$\delta(q_{1,a}, \epsilon) = \{(q_{1,A})\}$$

$$\delta(q1,\,\epsilon,\,\epsilon) = \{(q2,\,\epsilon)\}$$

$$\delta(q2,b,B) = \{(q2, \varepsilon)\}$$

$$\delta(q_2, a, A) = \{(q_2, \epsilon)\}$$

- b) Present the PDA in the table form.
- c) Analyze the word: aaaaaa.
- 4. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e,f\},$

$$2. S \rightarrow A \ a \ b \ B$$
$$5. C \rightarrow C \ d \ f$$

$$3. B \rightarrow C c$$

$$6. A \rightarrow e$$

$$7. A \rightarrow A d e$$

}, build the matrix of simple precedence,

analyze the *ededeabfdfc* string and construct the derivation tree.

Varianta 27

4. A→ASC

1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B,\,C\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S\rightarrow aB \quad 2. S\rightarrow AC \\ 5. A\rightarrow BC \quad 6. B\rightarrow b$$

8.
$$C \rightarrow \varepsilon$$
 9. $C \rightarrow BA$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},$$

$$P=\{1. S \rightarrow A C\}$$

2.
$$C \rightarrow a$$

$$3. B \rightarrow a A \quad 4. B \rightarrow B C$$

5.
$$A \rightarrow b$$
 6. $A \rightarrow SB$ }.

3. For the given PDA $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F)$ given in the table form

δ	a	b	С	d	3
→ q0	q0 ε A	q0 ε B	q1 ε ε	-	-
q1	•	-	-	Q2 ε ε	-
* q2	q0 A ε	q0 B ε	-	-	-

- a) Present the PDA in the graph form.
- b) Present the PDA in the analytical form.
- c) Analyze the word: *abcdba*.

4. For the given grammar
$$G=(V_N, V_T, P, S_r), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e,f,g,e\},$$

$$P=\{1.S \rightarrow Ag\}$$

$$2. A \rightarrow a b c B$$

$$3. B \rightarrow C d$$

4.
$$C \rightarrow e$$

5.
$$C \rightarrow CfD$$

$$6. D \rightarrow e$$
 },

build the matrix of simple precedence, analyze the *abcefedg* string and construct the derivation tree.

1. Present the Context Free Grammar in Chomsky Normal Form

$$G=(V_N, V_T, P, S), V_N=\{S, A, B\}, V_T=\{a, b\}$$

$$P=\{1. S \rightarrow A$$

$$4. A \rightarrow aS$$

6. $C \rightarrow B S$ }.

 $5. A \rightarrow a$

6. B→AbB

7. B→BS

8. B $\rightarrow \epsilon$ }

5. $C \rightarrow a$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow a A\}$$

2.
$$A \rightarrow b$$

$$3. A \rightarrow B A 4. B \rightarrow C$$

3. For the given grammar $G=(V_N, V_T, P, S_1), V_N=\{S, B, D, A\}, V_T=\{a,b,c,d\},$

$$P=\{1.S \rightarrow dA$$

$$\rightarrow dA$$
 2. A

$$2. A \rightarrow B \qquad 3. A \rightarrow B \ c \ A$$

$$4. B \rightarrow b D$$
 $5. D \rightarrow a$

$$6. D \rightarrow a D$$
 },

build the matrix of simple precedence, analyze the dbaacbaaa string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{ab^m a^{2m} \mid m, n, k \in N\}$ Present the analysis of the word.

Varianta 29

1. Present the Context Free Grammar in Chomsky Normal Form

$$G\!\!=\!\!(V_N,\,V_T,\,P,\,S),\,V_N\!\!=\!\!\{S,\,A,\,B,\,D\},\,V_T\!\!=\!\!\{a,\,b\}$$

$$P=\{1. S \rightarrow aB\}$$

$$2. S \rightarrow DA$$

3.
$$A \rightarrow a$$

4.
$$A \rightarrow BD$$

5. A
$$\rightarrow$$
bDAB6. B \rightarrow b

7. B
$$\rightarrow$$
 BA

8. D
$$\rightarrow$$
 ϵ 9. D \rightarrow BA}

2. Convert the given grammar to the Greibach Normal Form

$$\begin{array}{l} G = (V_N, \, V_T, \, P, \, S,), \, V_N = \{S, \, A, \, B, \, C\}, \, V_T = \{a, \, b\}, \\ P = \{\, 1. \, S \rightarrow \, b \, A \qquad \qquad 2. \, A \rightarrow S \, C \qquad \qquad 3. \, B \rightarrow . \end{array}$$

2. A
$$\rightarrow$$
 S C

3.
$$B \rightarrow A$$
 4. $A \rightarrow a$

5.
$$A \rightarrow B C$$

6.
$$C \rightarrow b$$
 }.

3. For the given grammar $G=(V_N, V_T, P, S_r), V_N=\{S, B, D, A\}, V_T=\{a,b,c,d\},$

$$P=\{1.S \rightarrow dB\}$$

$$4. A \rightarrow D$$

$$2. B \rightarrow a$$
 $3. B \rightarrow a A$
 $5. A \rightarrow D c A$ $6. D \rightarrow a A$

$$6. D \rightarrow b B$$
 $7. A \rightarrow c$

build the matrix of simple precedence, analyze the dabacba string and construct the derivation tree.

4. Construct pushdown automata for the following language:

 $L = \{a^{2n}b^na^n \mid m, n \in N\}$ Present the analysis of the word.

Varianta 30

1. Present the Context Free Grammar in Chomsky Normal Form

$$G = (V_N, V_T, P, S), V_N = \{S, A, B\}, V_T = \{a, b\}$$

 $5. A \rightarrow AabB$

$$P = \{1. S \rightarrow a B\}$$

6. B→ ε

3.
$$A \rightarrow a$$
 4. $A \rightarrow b B$

 $8. B \rightarrow a A B A$

2. Convert the given grammar to the Greibach Normal Form

$$G=(V_N, V_T, P, S_1), V_N=\{S, A, B, C\}, V_T=\{a, b\},\$$

$$P=\{1. S \rightarrow b B\}$$

$$2. A \rightarrow B A$$

$$3. B \rightarrow A C \quad 4. A \rightarrow B$$

 $7. B \rightarrow b S$

5.
$$A \rightarrow b$$

6.
$$C \rightarrow a$$
 }.

3. For the given PDA $M=(Q, \Sigma, \Gamma, \delta, q0, Z0, F)$ given in the table form

δ	a	b	С	d	3
→ q0	q0 ε A	q0 ε B	-	-	q1 ε ε
q1	-	-	-	q2 ε ε	-
* q2	q0 A ε	q0 B ε	-	-	-

- a) Present the PDA in the graph form.
- b) Present the PDA in the analytical form.
- c) Analyze the word: abdba.

4. For the given grammar $G=(V_N, V_T, P, S_r), V_N=\{S, A, B, C, D\}, V_T=\{a,b,c,d,e\},$

$$P = \{ 1. S \rightarrow A \}$$

 $4. B \rightarrow a b D$

$$2. A \rightarrow B$$

$$3. A \rightarrow B e A$$

$$5. D \rightarrow C d$$

6.
$$C \rightarrow c$$

7.
$$C \rightarrow C c$$

}, build the matrix of simple precedence,

analyze the *abcdeabcccd* string and construct the derivation tree.