	UNIT-II
Q.No	**Questions**
1.	**Dr. S. Pradeep** S -> NP VP NP -> Det N | 'Arjun' VP -> V NP | VP PP PP -> P NP Det -> 'a' |'the' N -> 'tiger' | 'forest' V -> 'hunts' P -> 'in' **Symbol — Meaning** S — sentence NP — noun phrase VP — verb phrase PP — prepositional phrase Det — determiner N — noun V — verb P — preposition a) Elimination of Left recursion (1 mark) b) Remove the null production (1 mark) c) Remove the unit production (1 mark) d) Convert to CNF (2 marks) e) Convert to GNF (3 marks) f) Convert to PDA (5 marks) g) Acceptance of PDA by Final State / Empty Stack (2 marks)
2.	Consider following grammar declarationlist → declaration | declarationlist declaration declaration → type idlist T idlist → idlist ',' I | I type →int | float | char T → ; I → ID (a) Identification of terminal and non-terminal (3 marks) (b) Simplification of Grammar (5 marks) (c) Conversion of GNF (6 marks) (d) PDA creation (6 marks) (e) String acceptance and Rejection (5 marks) Sol: a)

Terminal = {;, ;, ID, int, float, char, }

Non Terminal = {declarationlist, declaration, idlist, type, T, I}

↳ No useless Symbol, null Production

↳ Eliminating unit Production.

declarationlist → type idlist T | declarationlist declaration

declaration → type idlist T

idlist → idlist ',' I / ID

type → int / float / char

T → ;

I → ID

↳ CNF

Let X_{A7} → type idlist

Y_{A8} → ','

Z_{A9} → [illegible] YI

$A_7 A_5$

declarationlist → XT / declarationlist declaration

A_7

declaration → XT

A_2

idlist → idlist Z / ID

A_3

type → int / float / char

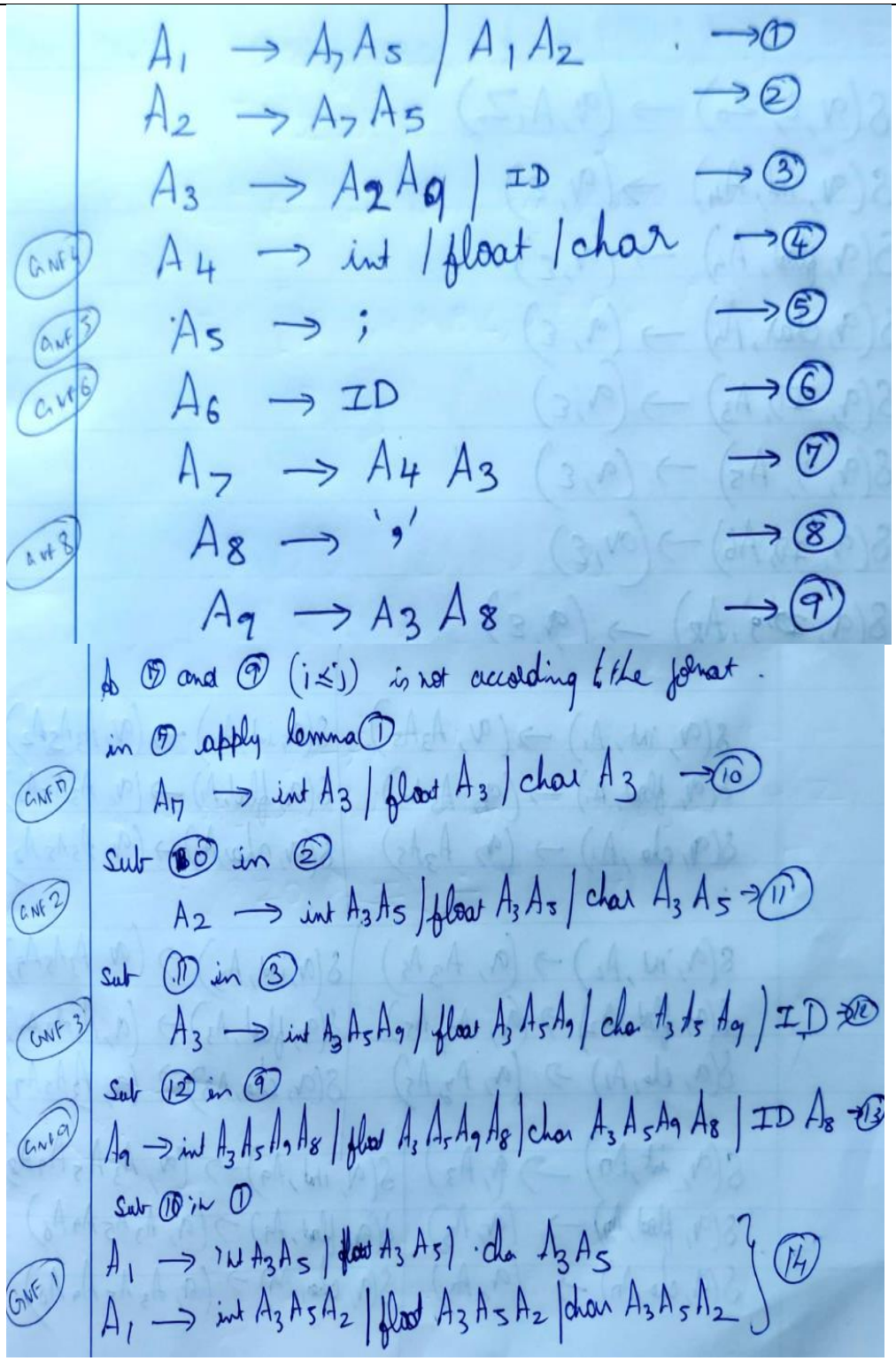
A_4

T_{A_5} → ;

I → ID

A_6

c)


A1 → A7 A5 | A1 A2 → 1
A2 → A7 A5 → 2
A3 → A2 A9 | ID → 3
GNF4 A4 → int | float | char → 4
GNF5 A5 → ; → 5
GNF6 A6 → ID → 6
A7 → A4 A3 → 7
GNF8 A8 → ',' → 8
A9 → A3 A8 → 9
A → 9 and 9 (i ≤ j) is not according to the format.
in 9 apply lemma 1
GNF10 A7 → int A3 | float A3 | char A3 → 10
Sub 10 in 2
GNF2 A2 → int A3 A5 | float A3 A5 | char A3 A5 → 11
Sub 11 in 3
GNF3 A3 → int A3 A5 A9 | float A3 A5 A9 | char A3 A5 A9 | ID → 12
Sub 12 in 9
GNF9 A9 → int A3 A5 A9 A8 | float A3 A5 A9 A8 | char A3 A5 A9 A8 | ID A8 → 13
Sub 10 in 1
GNF1 A1 → int A3 A5 | float A3 A5 | char A3 A5
A1 → int A3 A5 A2 | float A3 A5 A2 | char A3 A5 A2 } 14

d)

$\delta(q, \varepsilon, Z_0) \rightarrow (q, A_1 Z_0)$

$\delta(q, int, A_4) \rightarrow (q, \varepsilon)$

$\delta(q, float, A_4) \rightarrow (q, \varepsilon)$

$\delta(q, char, A_4) \rightarrow (q, \varepsilon)$

$\delta(q, ID, A_3) \rightarrow (q, \varepsilon)$

$\delta(q, ;, A_5) \rightarrow (q, \varepsilon)$

$\delta(q, ID, A_6) \rightarrow (q, \varepsilon)$

$\delta(q, ',', A_8) \rightarrow (q, \varepsilon)$

$\delta(q, int, A_1) \rightarrow (q, A_3 A_5)$

$\delta(q, float, A_1) \rightarrow (q, A_3 A_5)$

$\delta(q, char, A_1) \rightarrow (q, A_3 A_5)$

$\delta(q, int, A_1) \rightarrow (q, A_3 A_5 A_2)$

$\delta(q, float, A_1) \rightarrow (q, A_3 A_5 A_2)$

$\delta(q, char, A_1) \rightarrow (q, A_3 A_5 A_2)$

$\delta(q, int, A_2) \rightarrow (q, A_3 A_5)$

$\delta(q, float, A_2) \rightarrow (q, A_3 A_5)$

$\delta(q, char, A_2) \rightarrow (q, A_3 A_5)$

$\delta(q, int, A_3) \rightarrow (q, A_3 A_5 A_9)$

$\delta(q, float, A_3) \rightarrow (q, A_3 A_5 A_9)$

$\delta(q, char, A_3) \rightarrow (q, A_3 A_5 A_9)$

$\delta(q, int, A_7) \rightarrow (q, A_3)$

$\delta(q, float, A_7) \rightarrow (q, A_3)$

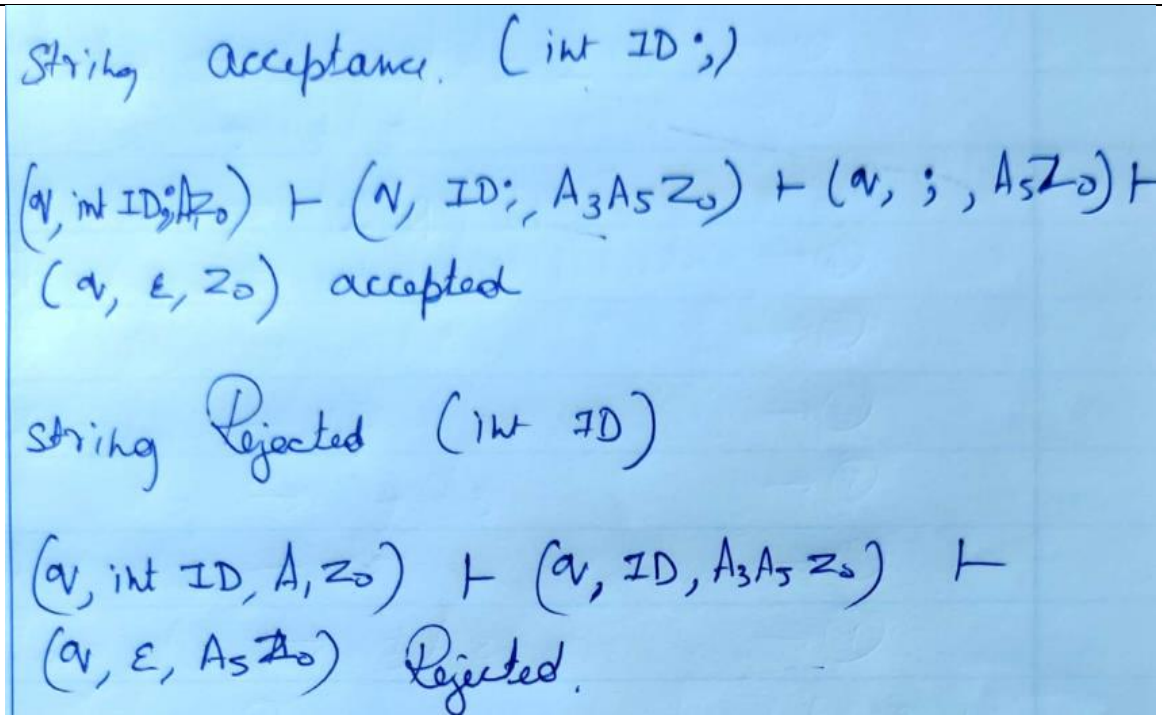
$\delta(q, char, A_7) \rightarrow (q, A_3)$

$\delta(q, int, A_9) \rightarrow (q, A_3 A_5 A_9 A_8)$

$\delta(q, float, A_9) \rightarrow (q, A_3 A_5 A_9 A_8)$

$\delta(q, char, A_9) \rightarrow (q, A_3 A_5 A_9 A_8)$

e)



3.

A telephone operator was asked to prioritize the calls based on the roles the people hold in the organization. The calls will be made by the personnel among the departments. The following are the Context Free Grammars that would assist the telephone operator in prioritizing the calls:

Executive_Committee→Risk Committee **manager** Security_Committee

Security_Committee→Security Committee **chief_ operating_ officer**

Local_Security_Committees

Security_Committee→ Security_Committee **chief_ operating_ officer** Information_Security|

Security_Committee→ Information_Security

Information_Security→**zonal_officers| nodal_officers | regional_officers**

Local_Security_Committees→Information_Asset_Owners **marketing_officer** Site_Security

Risk Committee→**guards**

Site_Security→**guards**

Information_Asset_Owners→**information_manager**

Local_Security_Committees→**monitoring_guard**

[terminals are in bold]

Convert the grammar to GNF

4.	**Dr. K. Vijaya** Consider the following grammar S1->S1 FW S2|S2 S2->S2 PW S3|S3 S3->**cat|dog** FW-> **Fought with** PW->**Played with** [Hint: terminals are indicated in bold] a. Can the string " Cat Fought With dog" be derived unambiguously. b. Optimize the grammar – 3 marks c. Convert the given grammar to Chomsky Normal Form (CNF) – 5 marks d. Convert the given grammar to Greibach Normal Form (GNF) – 7 marks e. Write Leftmost Derivation, Rightmost Derivation and Parse Tree for the string "the boy went to the school" – 3 marks f. Convert the given grammar to Pushdown Automata – 7 marks
5.	**Dr. M. Kowsigan** Engineering is all about Engineering added with Technology or only knowing Technology. Likewise, to know about Technology, one should be strong in both Technology and Fundamentals or at least Fundamentals. Finally, that Fundamentals what we learn gives the best outcome as knowledge. From the above scenario, construct the Grammar and write down the productions. Check whether input string id+id*id can be derived unambiguously. Also optimize the grammar.
6.	**Dr.T.Veeramakali** An equity trader invested in two stocks with different quantities where the quantity is represented as x and y respectively, and the unit price of the stocks was a and b respectively. He then realized that during market crash, whenever he invested in a third stock with the same quantity as that of his first stock, he could make a reasonable profit and so he invested in a third stock of quantity x. So, the stocks that would achieve profits would be represented as $a^xb^yc^x$ where c is the unit price of the third stock. a. Construct a grammar to generate all such strings. (3 marks) b. Reason out if the language can be generated by a regular grammar or not (no need to write detailed proof). (3 marks) c. Design a suitable automaton to accept all such strings. (5 marks) d. Show the sequence of leftmost derivations for the string $a^2b^1c^2$ using your grammar. (3) e. Show the sequence of instantaneous descriptions (IDs) leading to an accepting state for the string $a^2b^1c^2$ using the automaton. (3 marks) What change should be made to the language so that the language cannot be generated using a CFG? Justify using pumping lemma that your language cannot be accepted by any CFG.

7.	**Dr. K.Sornalakshmi** Seetha is applying for driving license. She checks for the eligibility in RTO office. It says the first mandatory eligibility is age. The age (A) must be from 18 to 59. The optional eligibility is educational qualification (Q). It can be undergraduate (ug), postgraduate (pg), diploma (dip). Define context free grammar (CFG) for the given scenario. Check whether the person who holds a post graduate degree but 61 years is eligible to get the diving license. Also normalize the grammar suited to form binary tree.
8.	**Dr.S.Sadagopan** Ram wants to design a machine which takes input address in the form of text segment. This text segment may in turn be in the form of a text paragraph and text segment separated by comma or just a text paragraph. The text paragraph will be list of words or single phrase. The single phrase can be a number or name (which are terminals). Whereas the list of words will again lead to text segment confined within (). Design a CFG for the above scenario. And find out whether the Rams address "124 NRRstreet" can be derived from a CFG constructed for this scenario? Also convert the grammar to CNF.
9.	**T.Nathezhtha** Infer and analyze the following productions and frame a well defined Grammar. Sandy has two boxes. First Box contains a small gum, a Big Pencil and a small Eraser. The second box contains small eraser, Big Ruler and a small sharpener. Big Pencil contains a small eraser at the back of it. The Big Ruler contains a small key chain attached to it. Write suitable CFG and convert to GNF.
10	**Mrs. Sindhu/DSBS** Archeological department of Tamilnadu Government has taken an initiative to identify the actual date of the discovered antique pieces. The department is maintaining a statistical database mandatorily entering the historical date Design CFG for analysing date in proper format and storing. The mandatory condition for the CFG de sign is as follows. The date format should be Date-Month-Year (dd-mm-yyyy). In addition, parse the given input strings. a. 24-08-1752 b. 01-12-0679
	UNIT-III

11	Consider following push down automata (Hint: i = if, t = then, g = goto) ™(q_1,∑,Z) →(q_1 , SZ) ™(q_1,20,N) →(q_1 , ∑) ™(q_1,),Y) →(q_1 , ∑) ™(q_1,>,X) →(q_1 , ∑) ™(q_1,10,W) →(q_1 , ∑) ™(q_1,a,V) →(q_1 , ∑) ™(q_1,t,T) →(q_1 , ∑) ™(q_1,g,G) →(q_1 , ∑) ™(q_1,i,S) →(q_1 , DTGN) ™(q_1,(,D) →(q_1 , VXWY) (a) Convert the given PDA to CFG (10) (b) Simplify the grammar (2) (c) Convert to GNF form (5) (d) write the formal definition for both given PDA and Converted grammar (4) (e) Identify the string w=if (a<10) then goto 20 and write the ID for string acceptance (4) Sol: a)

a)

PDA to CFG

$[q_1 N q_1] \rightarrow 20$ (A)
$[q_1 Y q_1] \rightarrow)$ (B)
$[q_1 X q_1] \rightarrow >$ (C)
$[q_1 W q_1] \rightarrow 10$ (D)
$[q_1 V q_1] \rightarrow a$ (E)
$[q_1 T q_1] \rightarrow t$ (F)
$[q_1 G q_1] \rightarrow g$ (G)

} Pop Rule.

$[q_1 Z q_1] \rightarrow \varepsilon$ (H) $[q_1 S q_1]$ (J) $[q_1 Z q_1]$ (H)

$[q_1 S q_1] \rightarrow i$ (K) $[q_1 D q_1]$ (F) $[q_1 T q_1]$ (G) $[q_1 G q_1]$ (A) $[q_1 N q_1]$

$[q_1 D q_1] \rightarrow ($ (K) $[q_1 V q_1]$ (E) $[q_1 X q_1]$ (C) $[q_1 W q_1]$ (D) $[q_1 Y q_1]$ (B)

b) for simplicity I had renamed.

↳ Let S be the start grammar.
↳ All grammar are reachable and generative.

c)

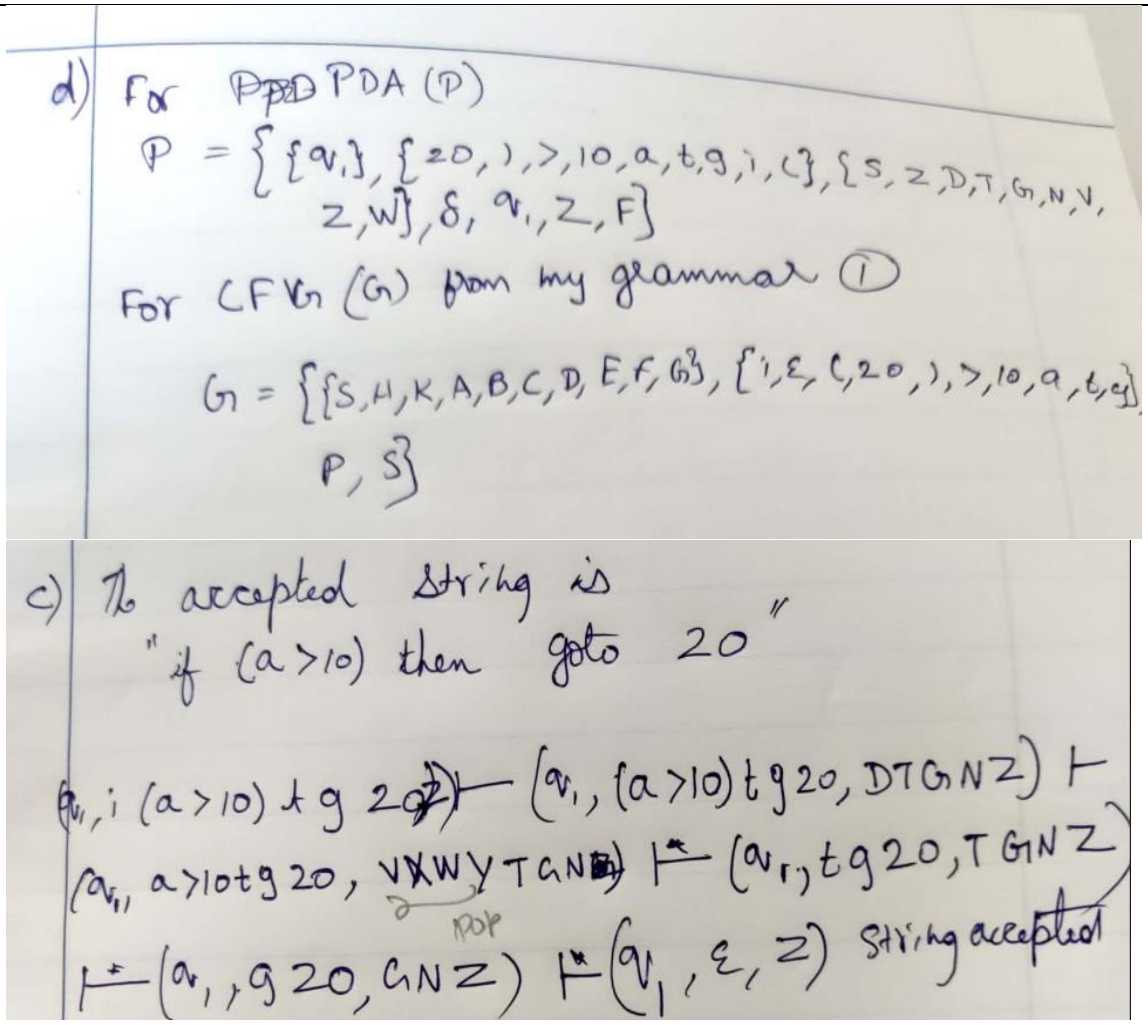
$S \rightarrow i\,K\,F\,G\,A$
$H \rightarrow \varepsilon\,J\,H$
$K \rightarrow (\,E\,C\,D\,B$

$A \rightarrow 20$
$B \rightarrow)$
$C \rightarrow >$
$D \rightarrow 10$
$E \rightarrow a$

$F \rightarrow t$
$G \rightarrow g$

} - (1)

The converted grammar is GNF form.

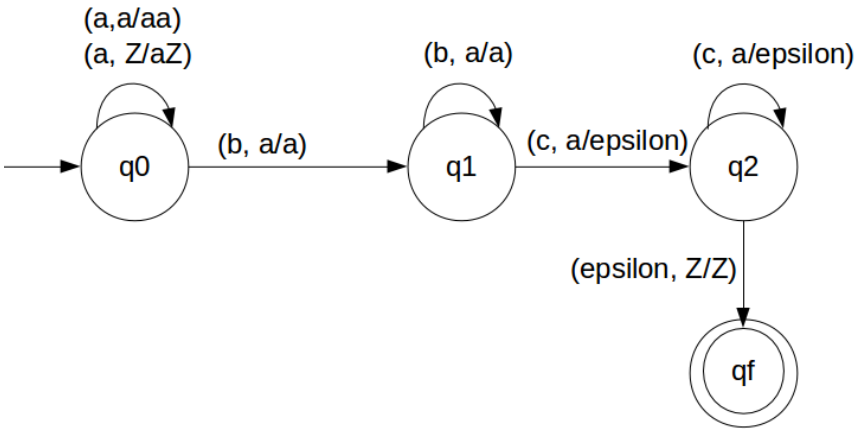


12 **Dr. T.Y.J.Nagamalleswari**

A company named "FLA Designs and Solutions" launched a portal for the benefits of their employees. In this context, the employees need to be registered newly in the portal. For password generation the guidelines given as follows.

i. The password is combination of alphabets, digits and special characters.
ii. The password should start with an alphabet and end with digit
iii. The number of alphabets should be equal to number of digits and number of special characters greater than the number of alphabets.
iv. All the symbols should occur consecutively.

Also validate the automata for an example string.



where a represents alphabet, b represents special characters, and c represents digits

Example string aabbbbcc

13 **Dr. P. Balaji Srikaanth**

Consider the following set of grammars. These grammars generate infinite language of strings. Find the following:

The Symbol S is the starting symbol

S→wvS| wv
S→wV |wv ;V→vS
S→SS | wv
S→wV |w ;V→vS
S→wV ;V→vS|w
S→wV | v ;V→vS
S→wV ;V→vS |v
S→wV ;V→vS | wv

Identify the language generated by these grammars and find the pattern of language used in majority of grammars (4)
The pairs of grammar that generate same language(6)
Convert the one of the grammar found in previous question to CNF (5)
Convert the Grammar to GNF (10 mark)

14 **Dr. Kayalvizhi Jayavel**

A PDA is defined as M={ Q,Σ,Γ,δ,q_(0,) Z_(0,) F} and its definition is as following:

Q={ a ,b} ,
Σ={x,y},
Γ={ Z_0,S},
δ is given as follows:

1.δ (a,ϵ,ϵ)=(a,Z_0)
2.δ(a,x,Z_0)=(a,SZ_0)
3.δ (a,x,S)=(a,SS)
4.δ(a,y,S)=(a,S)
5.δ(a,ϵ ,S)=(b,ϵ)
6.δ(b,ϵ,S)=(b,ϵ)
7.δ(b,y,S)=(p,SS)

	8.$\delta(b,y,Z\_0)=(b,\epsilon)$ Describe the working of the PDA (4) Show the ID moves for the input xyyxxyyxy (3) Find out the any of the possible input at when the PDA enter state b for the first time with all inputs consumed and the stack has the contents as SSZ_0 i.e., what is $(b,\epsilon,SSZ\_0)\vdash$? (10) Convert the above PDA to CFG (8)
15	**Dr.S.Nagadevi** A company organized an annual celebration event for all its employees. The employees participated in various games of the events. One such game is picking the ball from the pool. The employee has to pick the balls in the order specified. The one who is picking all the balls in the specified order at the earliest is the winner. The colored balls are Red, Green, Violet, Yellow. **Case (i):** First, they should pick 'n' number of red balls then 'm' number of green balls then 'n' number of Violet balls and at last 'p' number of yellow balls. **Case (ii):** Or else, first they should pick 'n' number of red balls then 'm' number of green balls then '2n' number of Violet balls and at last 'p' number of yellow balls. The order should not vary. Design a single Push Down Automata to check the order and constraints of the game satisfying both the cases. Explain the designed PDA with example strings. **<u>Evaluation Scheme for student reference</u>** 1. Identification of Non-deterministic Pushdown Automata – 2 marks 2. Writing Language and giving example strings for the given scenario – 4 marks 3. Construction of Non-deterministic PDA for the given statement – 8 marks 4. Formal Definition of Constructed PDA – 5 marks 4. Example for First case – 3 marks 5. Example for Second case – 3 marks
16	**Dr. R. Srinivasan** Read the Following Scenario and answer the following questions Consider there are two color cubes (Blue and Green) they are equal in number. The logic is Blue cube to be taken and stack all the blue cubes first. Later once no more blue cubes available for each green cubes remove one blue cubes from the stack. Make sure stack should be clear. a. Generate the accepting language for above Scenario – 3 Marks b. List the PDA and CFG Tuple representation for above scenario – 4 Marks c. Frame the 3 rules for give scenario for PDA to CFG conversion – 3 marks d. Design PDA transitions for the given scenario – 3 marks e. Illustrate using a PDA Diagram for the above scenario – 2 marks f. Using elimination rules for each transitions generate Context Free Grammer from given PDA – 8 marks g. List the final productions - 2 Marks
17	**Dr. Saisandhiya D** Consider the HTML table tags we have <tr> for table row and <td> for cell definition. For each row <tr>we have cell tag definition <td> cell content here</td>. Construct a push down automata to check the balancing of <td> and </td> tags and <tr> </tr> tags. Order need to be considered has to follow i.e., <tr> <td>cell definition</td> <td>cell definition</td>

	</tr> The automata for just check the balance in count of table row tags and cell definition tags . Assume, for the strings in the language, that all the cell contents are removed and only tags are present. i) Write the language with simple string accepted by the automata. (3) ii) Construct a Grammar for the above scenario (8) iii) Convert the grammar to GNF (9) iv) Construct the PDA diagram, along with transition function (5)
18	**Dr. G. Abirami** The esteem institute conducts the placement for all the final year students. The students participated in various rounds of the placements. One such round is choosing the pattern of the written exam. The student has to choose the questions in the order specified. The one who is choosing all the questions in the specified order of answering at the earliest is the winner. The questions are MCQ, FILL IN THE BLANKS, MATCH THE FOLLOWING, DESCRIPTIVE. Case (i) First, they should choose and answer 'n' number of MCQ then 'm' number of FILL IN THE BLANKS then 'n' number of MATCH THE FOLLOWING and at last 'p' number of DESCRIPTIVE. Case (ii) Or else First, they should choose and answer 'n' number of MCQ then 'm' number of FILL IN THE BLANKS then '2n' number of MATCH THE FOLLOWING and at last 'p' number of DESCRIPTIVE. The order should not be changed. Design the suitable pushdown automata to check the order and satisfies the above cases. Illustrate with an example pattern. **Evaluation Scheme for student reference** 1. Identification of Non-deterministic Pushdown Automata – 2 marks 2. Writing Language and giving example strings for the given scenario – 4 marks 3. Construction of Non-deterministic PDA for the given statement – 8 marks 4. Formal Definition of Constructed PDA – 5 marks 4. Example for First case – 3 marks 5. Example for Second case – 3 marks
19	**Mrs. Safa** Let Σ = {a, b, c, +, ×,(,)}. Design a PDA whose language is {w | w is a valid algebraic expression}.The Open bracket should be always end with close bracket. L is the language in which given alphabets abc. Apply the logic, represent the necessary transition function and diagram with tuple representation.