



**PES UNIVERSITY, Bangalore**  
(Established under Karnataka Act No. 16 of 2013)  
**Department of Computer Science & Engineering**

**Automata Formal Languages & Logic**

**Question Bank - Unit 3**

**Questions from the Prescribed Textbook**

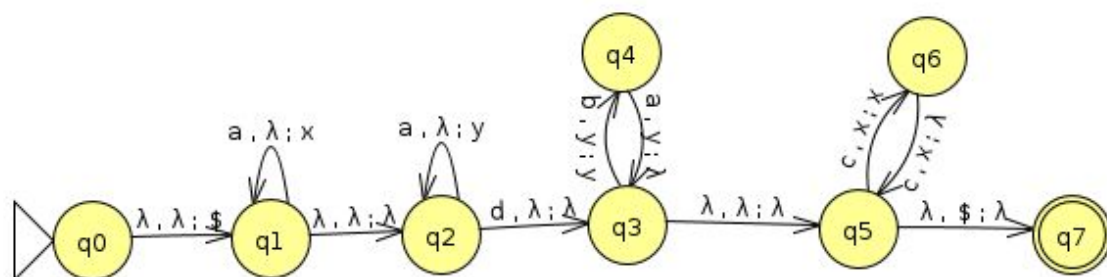
Topic	Exercise No.	Question No's
Pushdown Automata	7.1	1-17

**Extra Questions**

1. Create a PDA that recognizes the following context free languages:  
 $L = \{a^*wc^k \mid w \in \{a,b\}^* \text{ and } k = |w|_a \text{ (} k = \text{the number of } a\text{'s in } w\text{)}\}$
2. Construct a PDA for the language of all non palindromes over  $\{a,b\}$ .
3. Consider the language  $L = \{a^nba^n \mid n \geq 0\}$ . Design the deterministic pushdown automata that recognizes the language.
4. Construct a PDA for the language over  $\{a,b,c\}$   $L = \{ucv : u,v \in \{a,b\}^*, u \neq v\}$ .
5. Construct a PDA for the language over  $\{a,b,c\}$   $L = \{w \in \{a,b,c\}^* \mid 2.\#_a(w) \leq \#_b(w) \leq 3.\#_c(w)\}$ .
6. Construct a PDA for the language over  $\{a,b,c\}$   $L = \{ucv \mid u,v \in \{a,b\}^*, u \neq v \text{ but } |u| = |v|\}$ .
7.  $a^nbab^n, n > 0$ . Make sure that the PDA is deterministic
8.  $a^n b^m c^k$  where  $2n = m$  and  $k \geq 2$ . Make sure that the PDA is deterministic.
9. Construct a PDA for the language  $L = a^n b^m$  where  $m = n \bmod 3$ . How much stack memory do you need to handle this language?
10. The language of subtraction, that is, strings of the form  $a^n b^m c^k$  where  $k = n - m$  if  $n \geq m$  or else  $k = m - n$ . Show an accepting sequence of configurations for the input aabbbbcc. Show the rejecting sequence of configurations for the input aaaabbccc.

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11. Construct a PDA for the language  $\{w \in \{a,b\}^* : P(w)\}$ , where  $P(w)$  is the property:
  - a.  $|w|$  is odd and the middle symbol of  $w$  is  $b$ .
  - b.  $w$  starts and ends with the same symbol.
12.  $a^n b^m$  where  $m = n \times 3$ . Make sure that the PDA is deterministic.
13. Design a PDA to accept the language is the set of all strings of 0's and 1's such that no prefix has more 1's than 0's.
14.  $a^n b^m$  where  $n$  is a multiple of 3 and  $m$  is  $n/3$ . Make sure that the PDA is deterministic.
15. Construct a PDA for the language over  $\{a,b,c\}$   $L = \{ab(ab)^n(ba)^n \mid n \in \mathbb{N}\}$ .
16. Construct a PDA that recognizes the language  $\{a^{2^n} b^n \mid n \geq 0\}$  over  $\Sigma = \{a,b\}$ .
17. Proper nesting of parentheses and flower brackets. For example,  $\{((()))()(({}))\{\{\}\}\}$ . Show how it rejects  $\{(){}(({}))\}$ .
18.  $a^n b^n a^m b^m$ ,  $n \geq 0$ ,  $m \geq 0$ . Show, along with two different accepting sequences of configurations, how non-determinism works to accept the string  $aaabbbb$  in two different ways.
19.  $a^n b^m a^m b^n$ . Can this be a deterministic PDA? Explain.
20. Consider the following PDA:



- a. Show that the PDA accepts the string  $aaadbabacc$ .
- b. Which language  $L$  does the given PDA accept?