Assignment - 02

[Pushdown Automata - Q.(1, 4)]

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Course Title : Automata & Computability

Course Code : CSE331

Section : 20

Group type : Solo (1 member only)

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Ans. to the Q. NO - 01

There are five cases where knowledge from CSE331 (Automata & Computability) - can be applied are described below :-

a) Designing compilers :-

The concept of finite automata & context-free grammars are used to design lexical analyzers and parsers, which are essential components of compilers.

b) Pattern matching :-

Regular expressions - based on finite automata are widely used in search engines, text editors, data validation (like email/phone input formats).

c) Designing & Verifying Protocols :-

Finite State machines help in modeling and verifying communication protocols (e.g. TCP handshake, network authentication sequences, etc.)

[P.T.O.]

d) Natural Language Processing (NLP):-

Context-free grammars are the most core foundational element in parsing sentences and analyzing the syntactic structure of human languages.

e) Artificial Intelligence Rule Engines:

Implementation of simple-rule based AI engines using state-based logic, where theory of automata helps define valid transitions and decisions.

Answer to the Q. NO - 04 (a)

(3)(a)

Given,

$$L = \{ w \in \{a, b, c, p, q, r, \#\}^* : a^i \# r^n c^k p^{2x} q^y r^z b^j$$

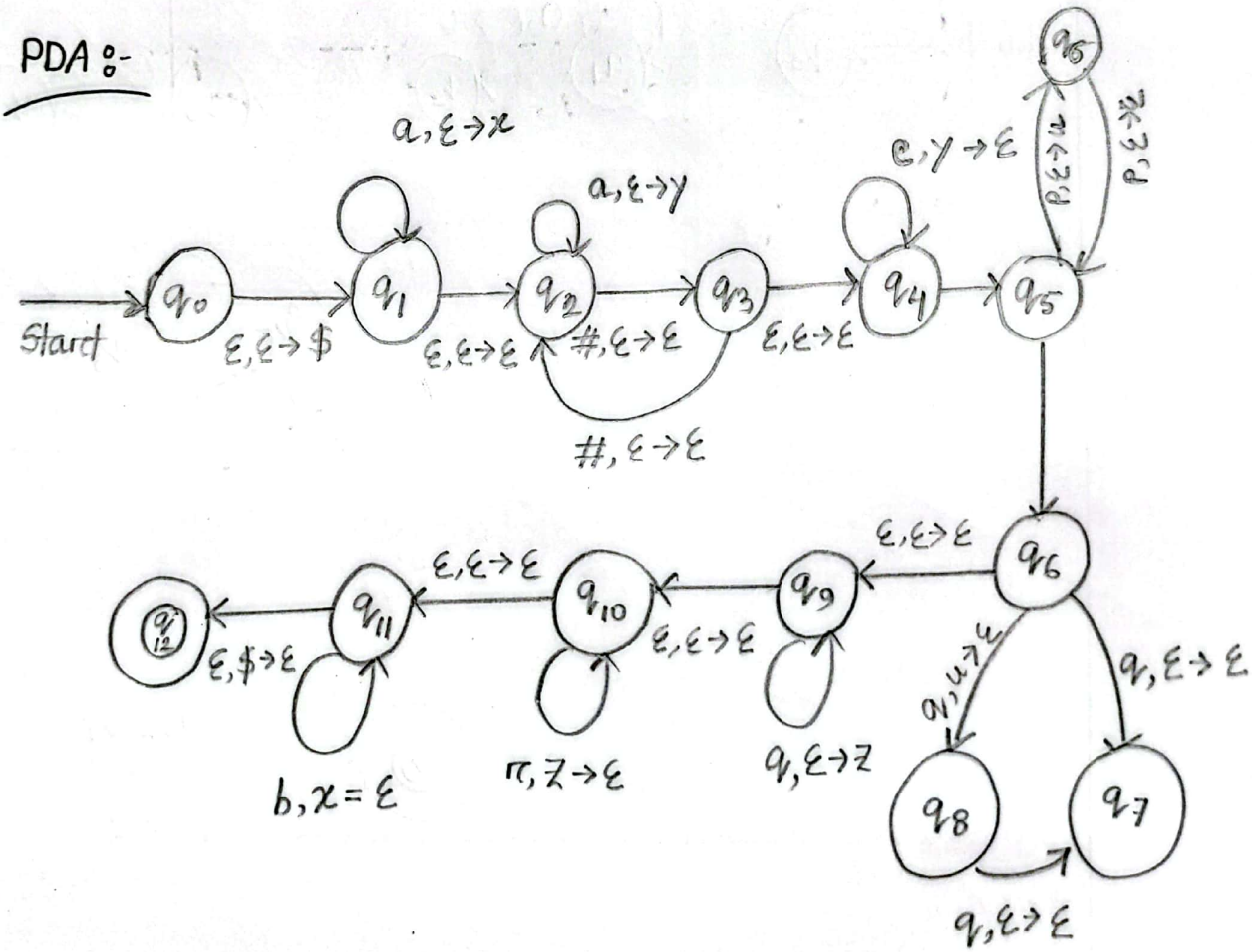
where, $i = j + k$,

$y = 3x + z$,

n is odd and

$i, j, k, n, x, y, z \geq 0 \}$

PDA :-

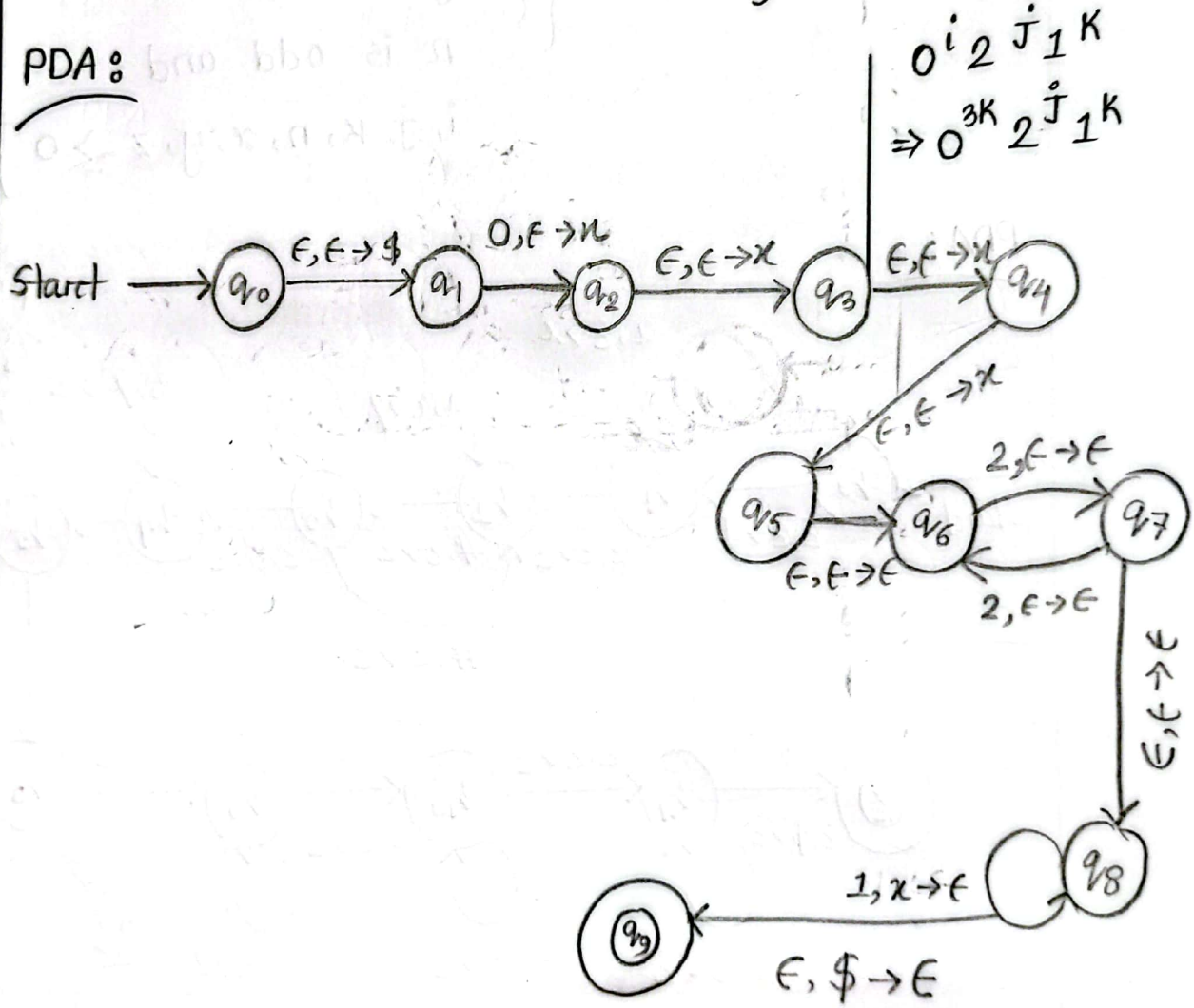


Answer to the Q. NO - 04 (b)(ii)

Given,

$$L = \{ w \in \{0,1,2\}^* : w = 0^i 2^j 1^k, \text{ where } i = 3k, \; j \text{ is odd}, \; i, j, k \geq 0 \}$$

PDA:



Answer to the Q. NO- 04(b)(iii)

Given,

$$L = \{w \in \{0,1,2\}^* : w = 0^i 2^j 1^k, \text{ where}$$

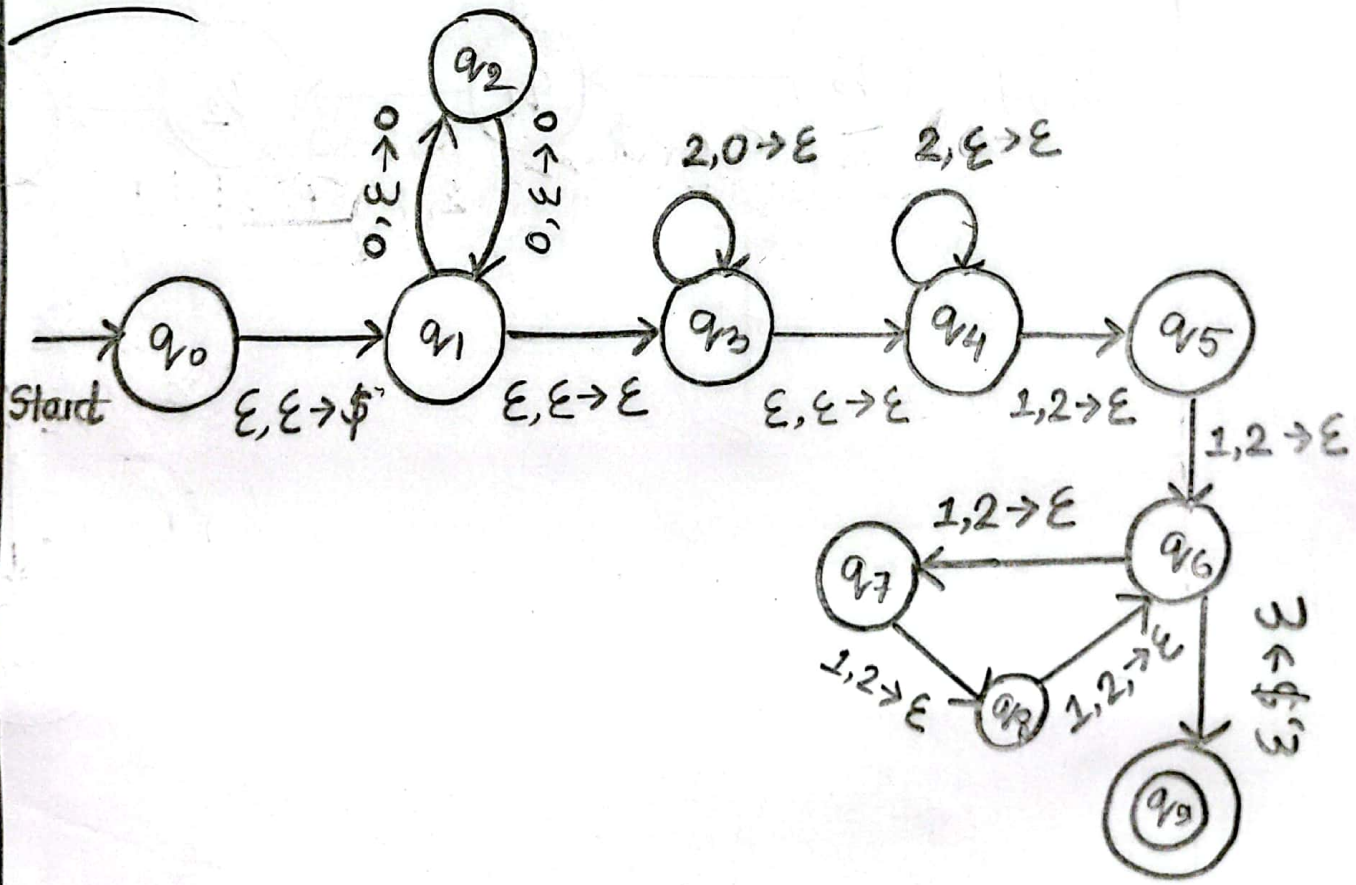
i is a multiple of two,

k is two more than a multiple of 3,

$j = k + i$,

$i, j, k \geq 0\}$

PDA:



Ans. to the Q. NO-04(b)(iv)

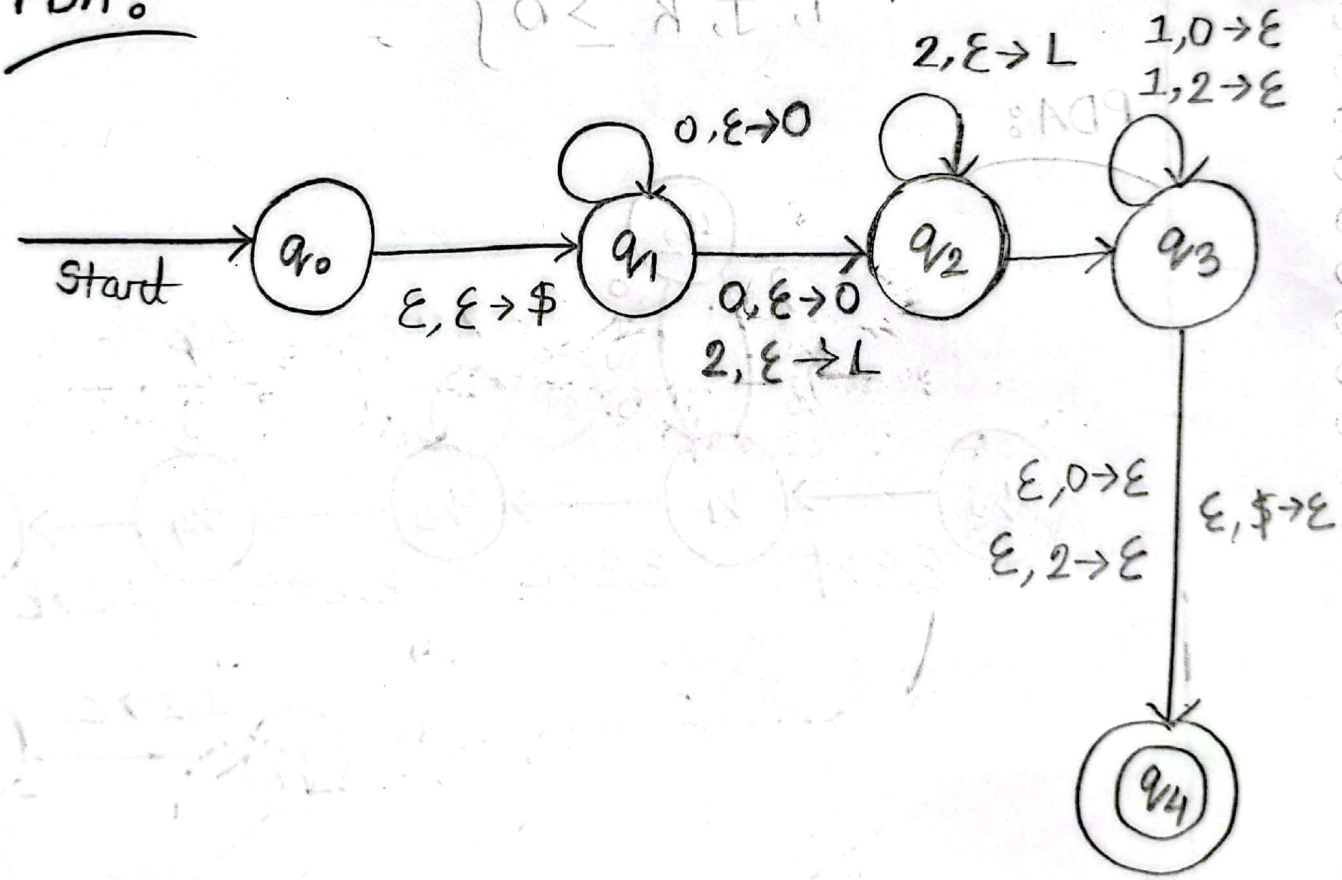
Given,

$$L = \{\omega \in \{0,1,2\}^* : \omega = 0^i 2^j 1^k,$$

where $i+j > k$ and

$i, j, k \geq 0\}$

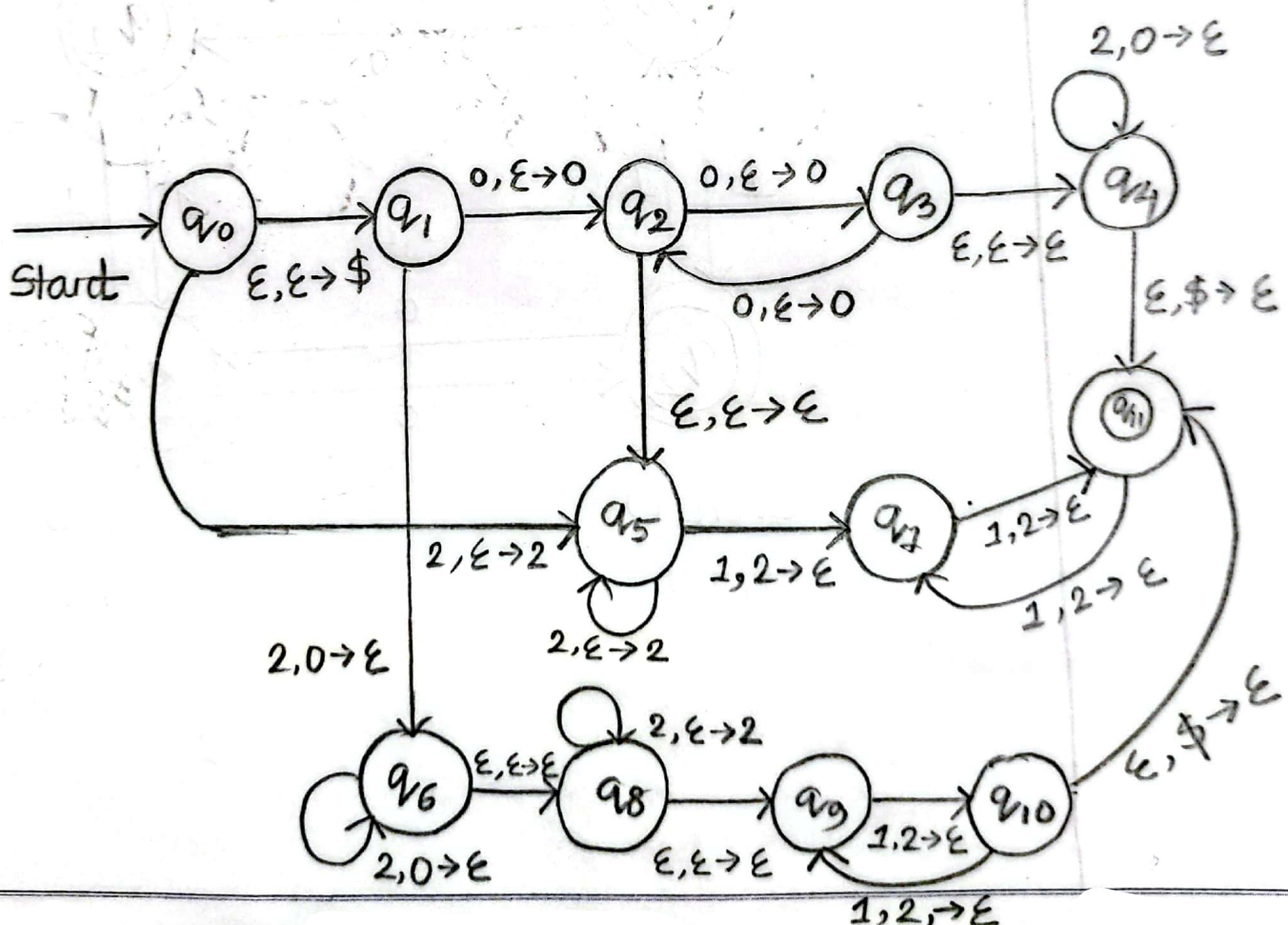
PDA:



Answer to the Q. NO-04 (b)(v)

Given, $L = \{ w \in \{0,1,2\}^* : w = 0^i 2^j 1^k,$ where, $i+k$ is even, $j = i+k$ and $j >= 1 \}$

PDA:

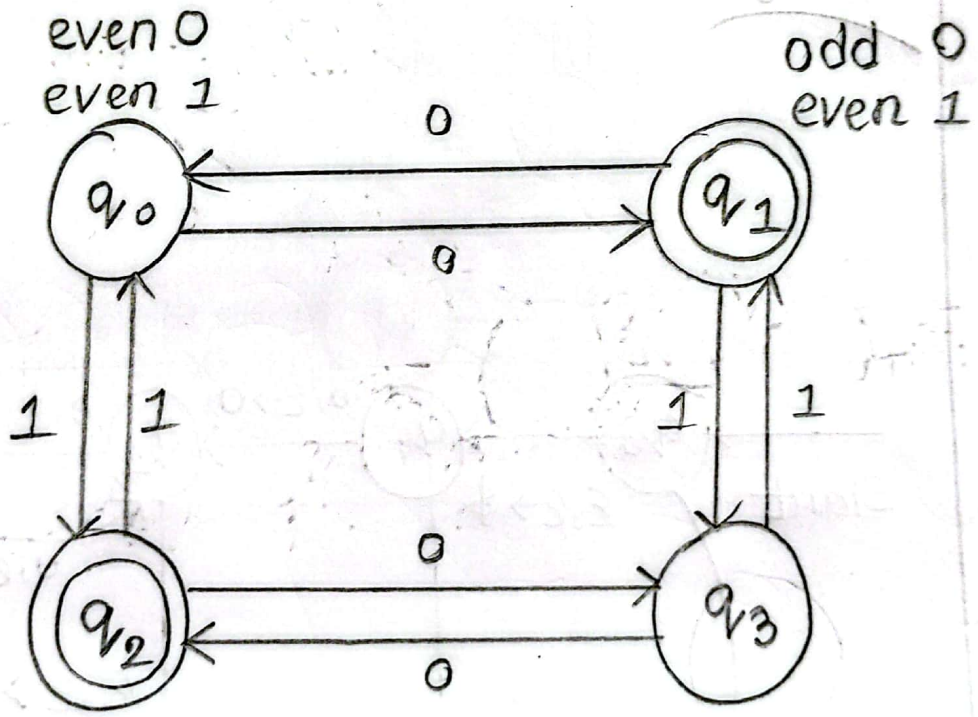


Ans. to the Q. NO-04 (c)

Given,

$L = \{w \in \{0,1\}^* :$ the parity of 0s and 1s is different in $w\}$

PDA:

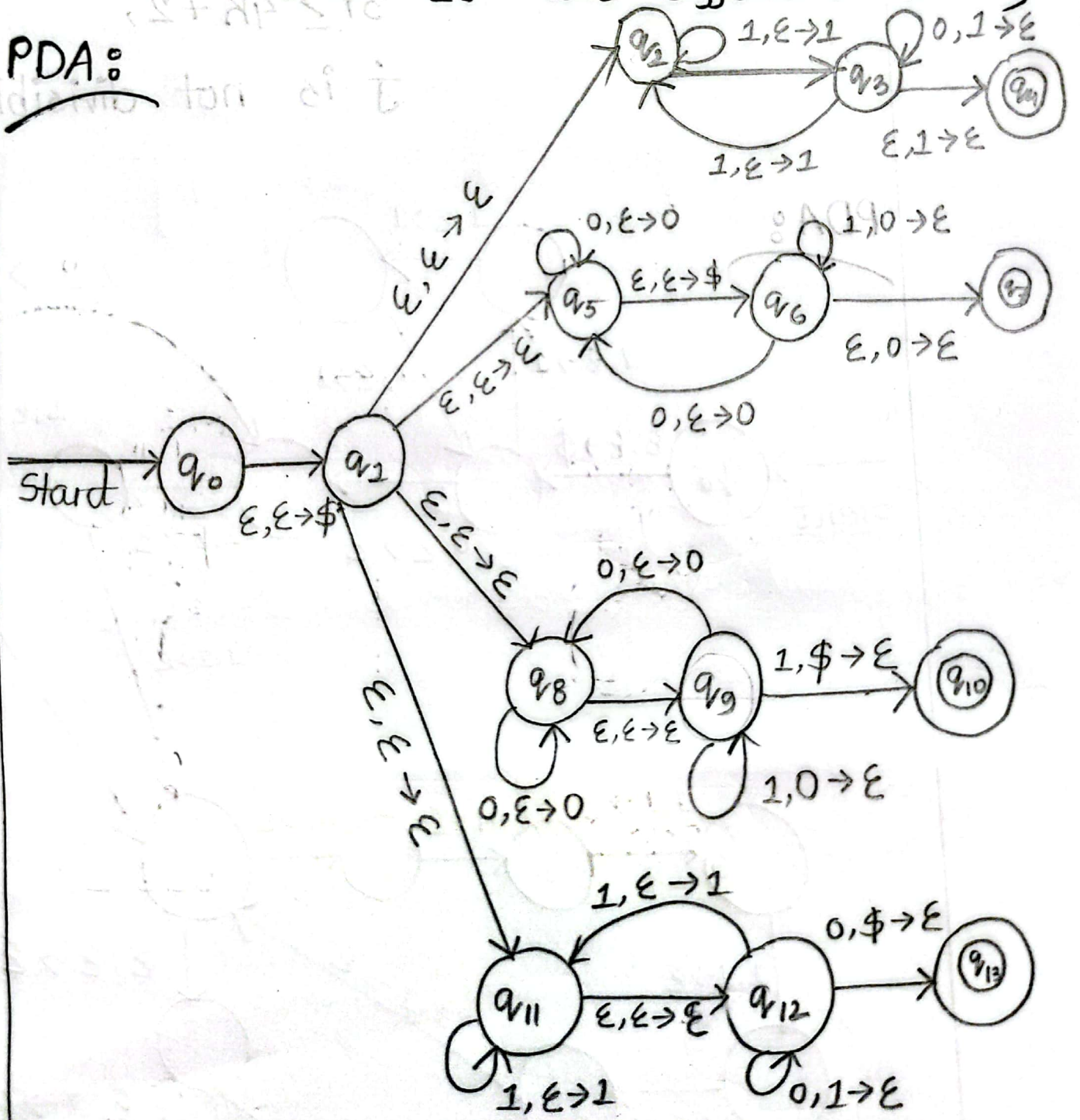


Ans. to the Q. NO – 04 (d)

Given,

$L = \{w \in \{0,1\}^* : \text{the number of 0s and 1s are different in } w\}$

PDA:

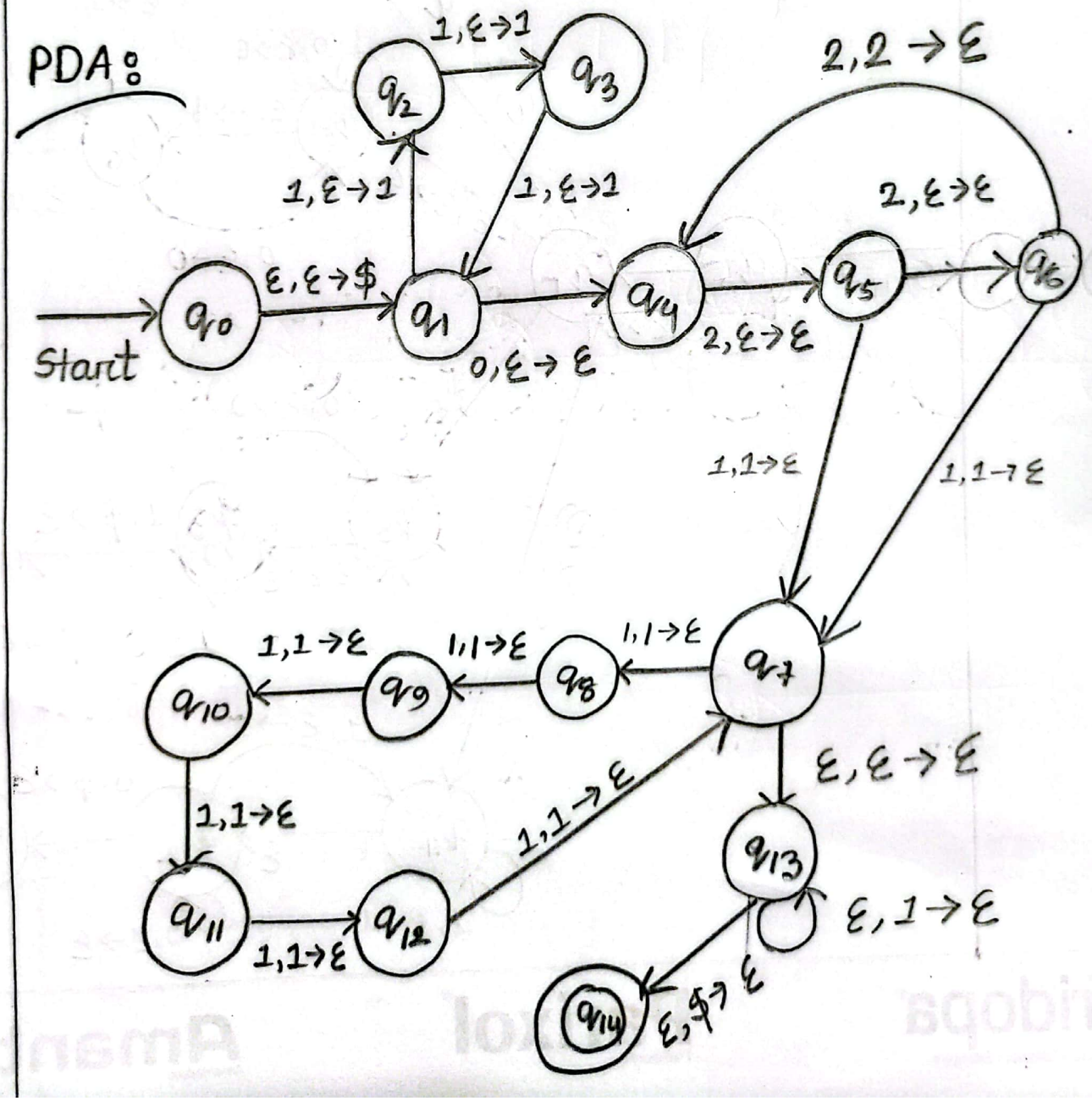


Ans. to the Q. NO-04(e)

Given,

$$L = \{ 1^i 0 2^j 1^k \mid i, j, k > 0,\ 3i \geq 4k+2,\ j \text{ is not divisible by } 3 \}$$

PDA:



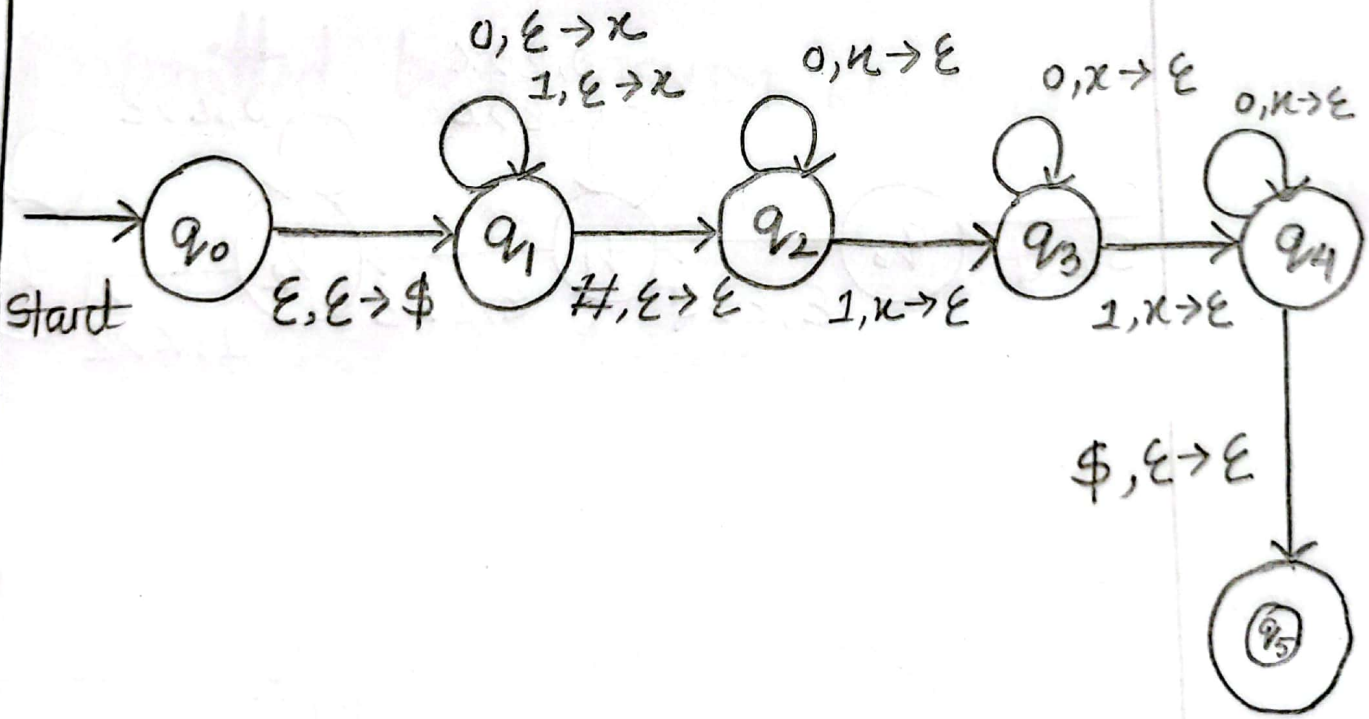
Ans. to the Q.NO - 04(f)

Given,

$L_1 = \{ w \in \Sigma^* : w$ contains exactly two 1s$\}$

$L_2 = \{ x \# y : x \in \Sigma^*, y \in L_1, |x| = |y| \}$

PDA for L_2 :



Ans. to the Q. NO - 04(g)

Given,

$L_1 = \{ w \in \Sigma^* : w$ contains at least three 1s$\}$

$L_2 = \{ x \# y : x \in (\Sigma\Sigma)^*, y \in L_1, |x| = |y| \}$