DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER VI [COMPUTER ENGINEERIG]
SUBJECT: (CE-623) THEORY OF AUTOMATA AND FORMAL LANGUAGES

Examination	**: Second Sessional**	**Seat No.**	: 103
Date	**: 05 / 02 / 2025**	**Day**	**: Wednesday**
Time	**: 2:30 PM to 3:45 PM**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed. **[12]**

CO3 N (a) Identify the language generated by the following grammar, where S is start variable. $\mathbf{S \to XY}$, $\mathbf{X \to aX \mid a}$, $\mathbf{Y \to aYb \mid \epsilon}$ [2]

A. $\{a^m b^n \mid m \geq n, n > 0\}$
B. $\{a^m b^n \mid m \geq n, n \geq 0\}$
C. $\{a^m b^n \mid m > n, n \geq 0\}$
D. $\{a^m b^n \mid m > n, n > 0\}$

CO3 N (b) Consider the following context-free grammar over the alphabet $\sum = \{a,b,c\}$ with S as the start symbol. $\mathbf{S \to abScT \mid abcT, T \to bT \mid b}$. Which one of the following represents the language generated by the above grammar? [2]

A. $\{(ab)^n(cb)^n \mid n\geq 1\}$
B. $\{(ab)^n cb^{m1} cb^{m2} \ldots\ldots cb^{mn} \mid n,m1,m2,\ldots,mn \geq 1\}$
C. $\{(ab)^n(cb^m)^n \mid n,m \geq 1\}$
D. $\{(ab)^n(cb^n)^m \mid n,m \geq 1\}$

CO3 N (c) Show that the following CFG is ambiguous: $\mathbf{S \to aSb \mid abS \mid \epsilon}$ [2]

CO3 N (d) Let $S, T \subseteq Q$. Is $\Lambda(S \cup T) = \Lambda(S) \cup \Lambda(T)$? Justify your answer. [2]

CO3 A (e) Let $M = (Q, \Sigma, q0, A, \delta)$ be an NFA. Show that for any $q \in Q$ and $a \in \Sigma$, $\delta^*(q, a) = \delta(q, a)$ [2]

CO3 N (f) In the Kleene's Theorem - Part I, consider the simplified case in which M_1 has only one accepting state. Suppose that we eliminate the Λ-transition from the accepting state of M_1 to q_2, and merge these two states into one. Either show that this would always work in this case, or give an example in which it fails. [2]

Q.2 Attempt *Any TWO* from the following questions. **[12]**

CO2 A (a) Using pumping lemma shows that $L = \{a^n b a^{2n}, n \geq 0\}$ can't be accepted by FA. [6]

CO2 A (b) In a certain programming language, identifiers are constructed according to the following rules: [6]

1. An identifier must start with a letter (uppercase or lowercase).
2. It may be followed by any number of letters, digits, or underscores (_).

3. An identifier cannot end with an underscore.
4. Identifiers are case-sensitive.

Find a context-free grammar (CFG) that formalizes these requirements.

CO2 A (c) Convert following CFG into its Chomsky Normal Form. Show each steps of the process. [6]

S → TU | V
T → aTb | ϵ
U → cU | ϵ
V → aVc | W
W → bW | ϵ

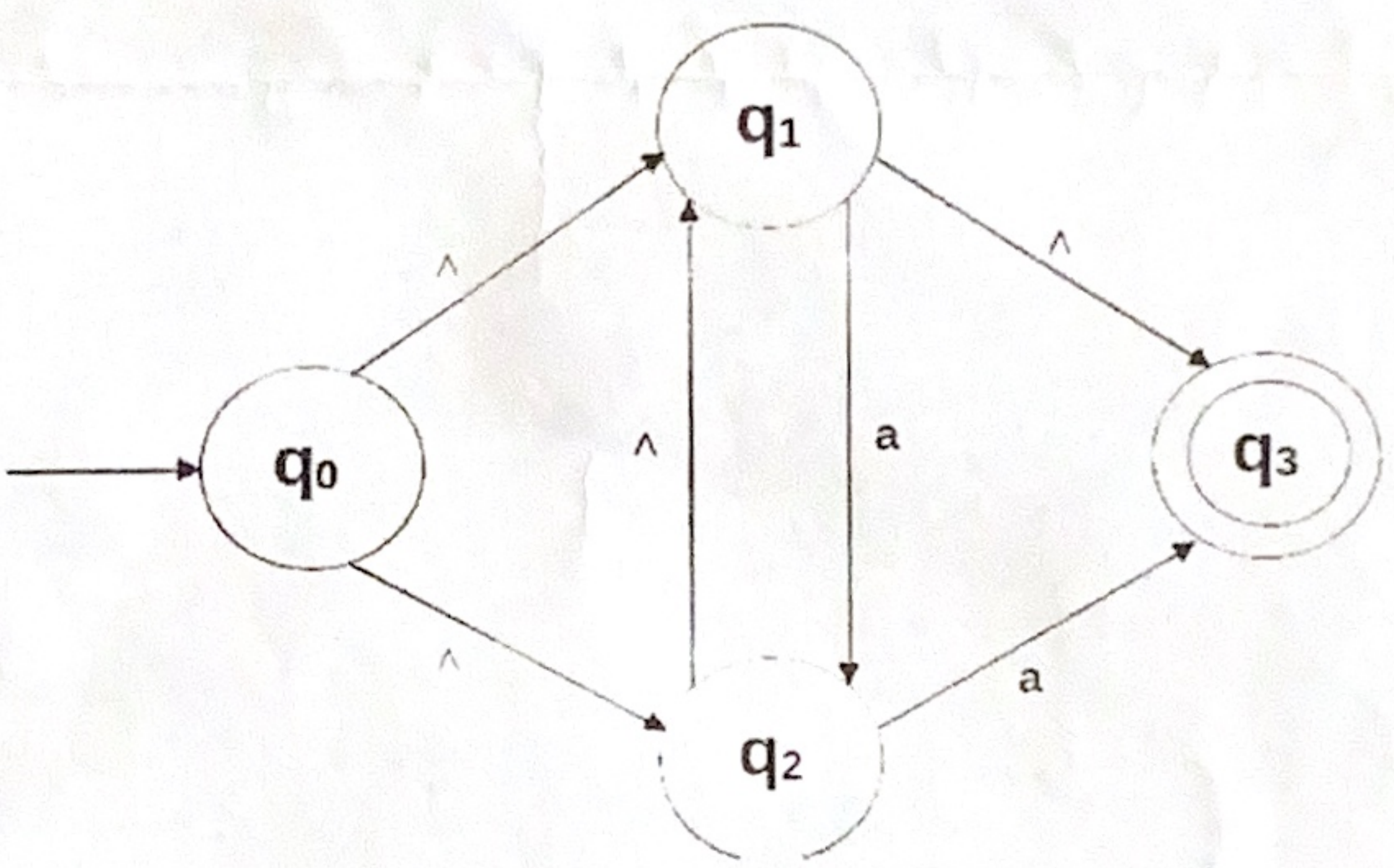
Q.3 Attempt the following question. **[12]**

CO3 U State and prove Kleene's Theorem – Part I. (Prove it for any 2 of the operators used in the recursive definition of Regular Languages).

OR

Q.3 Attempt the following questions. **[12]**

CO3 A (a) Convert the following NFA- ʌ to NFA. [6]



CO3 A (b) Following is an NFA. Using the subset construction, draw an FA accepting the same language. Label the FA states, as per the subset. [6]