# SNS COLLEGE OF TECHNOLOGY

**Coimbatore-36.**

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## COURSE CODE& NAME : *19CSB301* &AUTOMATA THEORY AND COMPILER DESIGN

## III YEAR/ V SEMESTER

## UNIT – I FINITE AUTOMATA AND REGULAR LANGUAGES

## Topic: Regular Expression & Identity Rules for RE

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# Regular Expression

## Regular Expression

Regular Expressions are used for representing certain sets of strings in an algebraic fashion.

1) Any terminal symbol i.e. symbols $\in \Sigma$ including $\wedge$ and $\Phi$ are regular expressions. $a, b, c, \ldots \quad \wedge, \Phi$
2) The Union of two regular expressions is also a regular expression. $R_1, R_2 \quad (R_1 + R_2)$
3) The Concatenation of two regular expressions is also a regular expression. $R_1, R_2 \rightarrow (R_1 . R_2)$
4) The iteration (or Closure) of a regular expression is also a regular expression . $R \Rightarrow R^* \quad a^* = \wedge, a, aa, aaa, \ldots$
5) The regular expression over $\Sigma$ are precisely those obtained recursively by the application of the above rules once or several times.

# Regular Expression

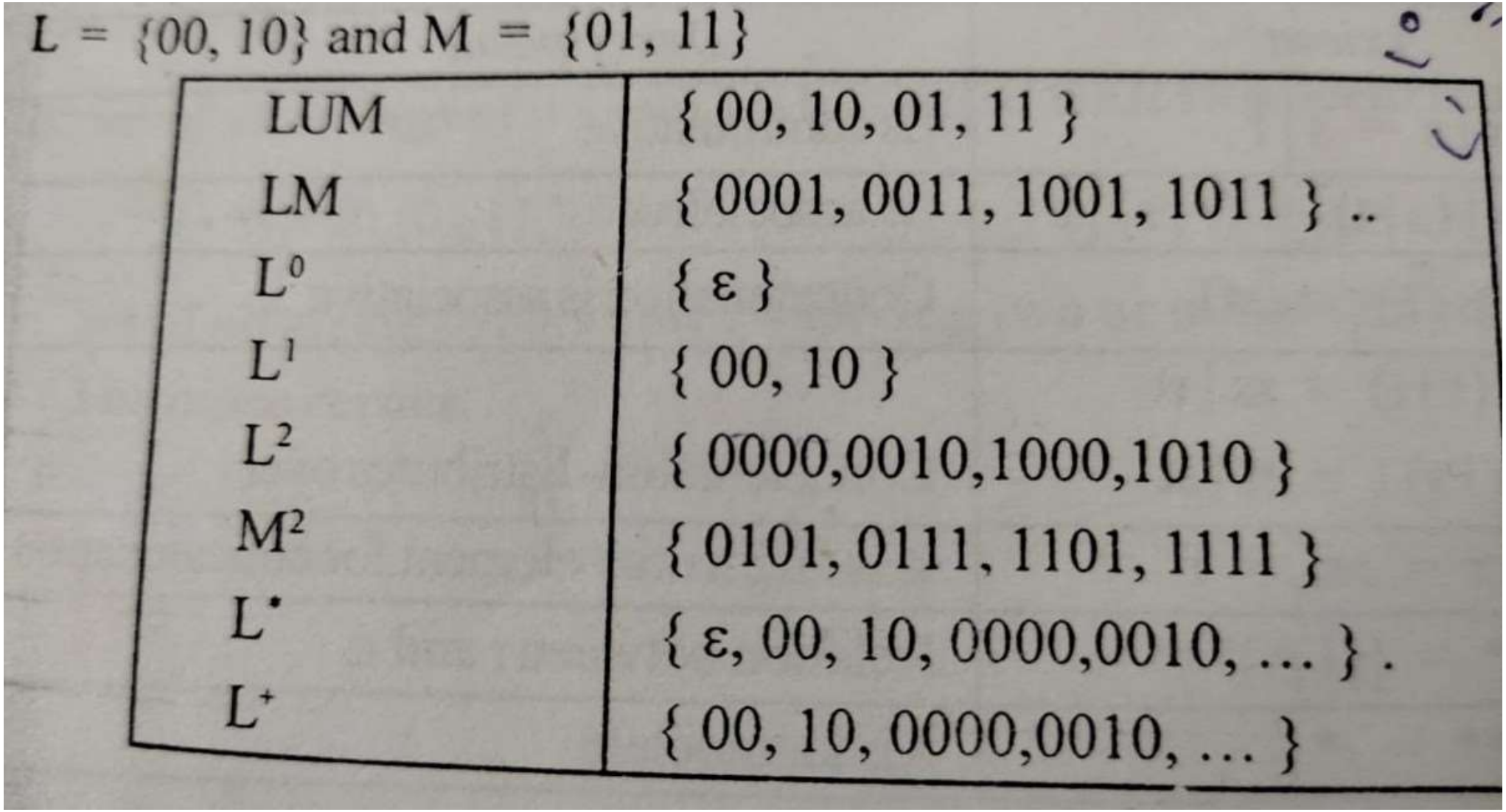
The language $L(r)$ denoted by any regular expression $r$ is defined by the following rules.

1. $\varnothing$ is a regular expression denoting the empty set,
2. $\lambda$ is a regular expression denoting $\{\lambda\}$,
3. For every $a \in \Sigma$, $a$ is a regular expression denoting $\{a\}$.

   If $r_1$ and $r_2$ are regular expressions, then

4. $L(r_1 + r_2) = L(r_1) \cup L(r_2)$,
5. $L(r_1 \cdot r_2) = L(r_1)\, L(r_2)$,
6. $L((r_1)) = L(r_1)$,
7. $L(r_1^*) = (L(r_1))^*$.

# Regular Expression



$L = \{00, 10\}$ and $M = \{01, 11\}$

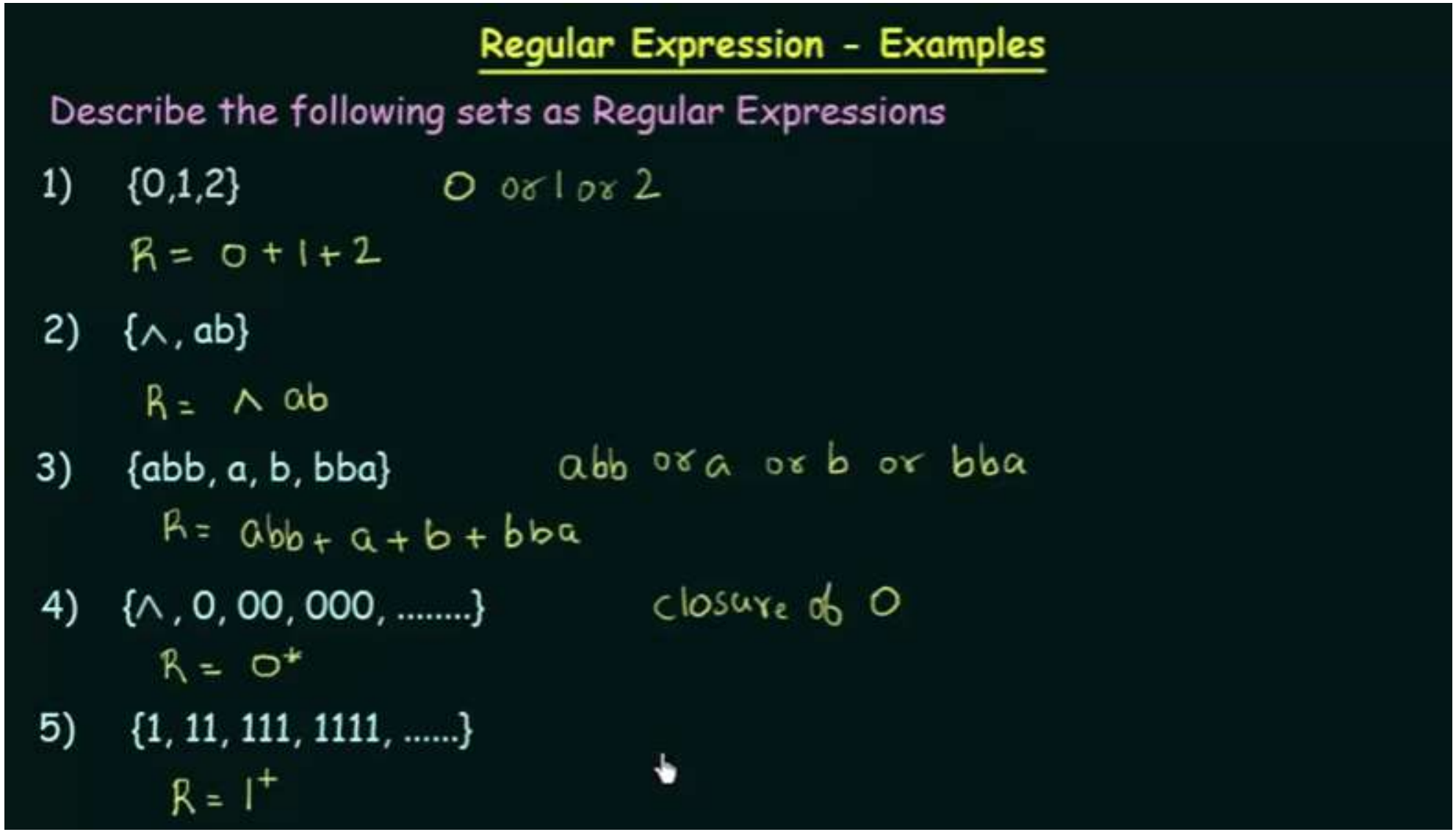
| | |
|---|---|
| LUM | { 00, 10, 01, 11 } |
| LM | { 0001, 0011, 1001, 1011 } .. |
| $L^0$ | { ε } |
| $L^1$ | { 00, 10 } |
| $L^2$ | { 0000,0010,1000,1010 } |
| $M^2$ | { 0101, 0111, 1101, 1111 } |
| $L^*$ | { ε, 00, 10, 0000,0010, ... } . |
| $L^+$ | { 00, 10, 0000,0010, ... } |

# Regular Expression

Let $\Sigma = \{a, b\}$. Give the regular set for the following regular expressions.

| | | |
|---|---|---|
| $a \mid b$ | = | $\{a, b\}$ |
| $(a \mid b)(b \mid a)$ | = | $\{ab, aa, ba, bb\}$ |
| $a^*$ | = | $\{\varepsilon, a, aa, aaa, \ldots\}$ |
| $a \mid a^* b$ | = | $\{a, b, ab, aab, \ldots\}$ |

# Regular Expression



# Regular Expression

## Identities of Regular Expression

1) $\emptyset + R = R$
2) $\emptyset R + R\emptyset = \emptyset$
3) $\epsilon R = R\epsilon = R$
4) $\epsilon^* = \epsilon$ and $\emptyset^* = \epsilon$
5) $R + R = R$
6) $R^*R^* = R^*$
7) $RR^* = R^*R$
8) $(R^*)^* = R^*$
9) $\epsilon + RR^* = \epsilon + R^*R = R^*$
10) $(PQ)^*P = P(QP)^*$
11) $(P + Q)^* = (P^* Q^*)^* = (P^* + Q^*)^*$
12) $(P + Q)R = PR + QR$ and

# References


- John E. Hopcroft and Rajeev Motwani and Jeffrey D. Ullman, “Introduction to Automata Theory, Languages and Computation”, Second Edition, Pearson Education, New Delhi, (2007) (UNIT-I )
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Thank
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