questions:15-24

Power = $L^0 = \{\varepsilon\}$ or $\{\lambda\}$, $L^n = L^{n-1}L$ if $n \geq 1$

Question 15

i) The language whose length is at most 2.

$(a+b)(a+b)$

ii) Language of even length.

$((a+b)(a+b))^*$

iii) Language starting and ending with the same letter

$a(a+b)^*a + b(a+b)^*b$

iv) Language starting and ending with the different letter

$a(a+b)^*b + b(a+b)^*a$.

~~Question 4~~

4 =

Question 16

Regular expression: Let 'L' be a language over an alp[habet], the 'L' is a regular language, if and only if there ex[ists] a regular expression 'R' over an alphabet such that L=

Identities of regular expression

L_1 $\emptyset + R = R$

L_2 $\emptyset R + R\emptyset = \emptyset$

L_3 $\varepsilon R = R\varepsilon = R$

L_4 $\varepsilon^* = \varepsilon$ and $\emptyset^* = \varepsilon$

L_5 $R + R = R$

L_6 $R^* R^* = R^*$

L_7 $RR^* = R^* R$

L_8 $(R^*)^* = R^*$

L_9 $\varepsilon + RR^* = \varepsilon + R^* R = R^*$

L_{10} $(PQ)^* P = P(QP)^*$

L_{11} $(P + Q)^* = (P^* Q^*)^*$

L_{12} $(P+Q)R = PR + QR$

$R(P+Q) = RP + RQ$

Regular expression are used for representing set of string in algebraic fashion.

Question 17

Let 'A' be a non-empty alphabet the expression 'r' and its corresponding language $L(r)$ is defined as;

- The symbol Υ (empty word) and the pair ( ) expression are regular expression.
- each letter a in A is a regular expression.
- If r is a regular expression, then r^* is a regular expression.
- If r_1 and r_2 are regular expressions, then $r_1 \cup r_2$ is a regular expression.
- If ~~~~ r_1 and r_2 are regular expression, then $r_1 r_2$ is a regular expression.

The symbols are; ( ), $*$, $\cup$, Υ

Question 18

$A = \{a, b\}$

i) Let $r = b^*$: The language $L(\cdot)$ consists of all power of 'a' including Υ.

ii) Let ~~r~~ $= aa^*$: The $L(r)$ consists of all positive power of 'a' excluding the empty word.

iii) Let $r = a \cup b^*$: The $L(r)$ consists of 'a' or any word in b.

iv) Let $r = (a \cup b)^*$: The language consists of all words over Σ

v) Let $r = aa(a \cup b)^*$: The language must begin with aa

vi) Let $r = (a \cap b)^*$: The language consists of word with either in a or b.

Question 19

$\Sigma = \{a, b\}$

$L_1 = \{b^m a^n \mid m > 0, n > 1\}$

$L_2 = \{a^n b^m a \mid m > 1, n > 0\}$

$L_3 = \{ab^m \mid n > 0\}$

Solution

$L_1 = \{baa, bbaa, bbaaa, \ldots\}$

$L_2 = \{abba, abbba, aabba, \ldots\}$

$L_3 = \{ab, abb, abbb, abbbb, \ldots\}$

Question 20

Regular set is any set represented by a regular expression, or any set that denotes the value of the regular expression is called a regular set

i A string in $L(R_1 + R_2)$ is a string from R_1 or a string from R_2.

. A string in $L(R_1R_2)$ is a string from R_1 followed by a string from R_2

A string in $L(R^*)$ is a string obtained by concatenating n-element for some $n \geq 0$.

Question 21

$\{1, 0\}$ = Contain set $\{1\}$, $\{0\}$ and are represented by 1 and 0 respectively

ii) $\{baab\}$ = comprises of set $\{a\}$. $\{b\}$. It is obtained by concatenating b, a, a and b

iii) $\{01, 10\}$ = is the union of $\{01\}$ and $\{10\}$ the we have $01 + 10$

iv) $\{$epsilon$, 10\}$ = is the union of $\{\varepsilon\}$ and $\{10\}$ then we have $T + 10$

v) $\{abb, a, b, bba\}$ = is represented by $abb + a + b + bba$

vi) $\{$epsilon$, a, aa, aaa, \ldots\}$ = It represents sets $\{a\}^*$

vii) $\{$epsilon$, 11, 1111, 11111, \ldots\}$ represents the set $\{1\}^*$

Regular expression for the set $1(1)^*$

Question 22

i) Set of all strings of a's and b's ending is aa

$\{aaa, aaa, baa, bbaa, \ldots\}$

ii) Set of all strings of 0's and 1's beginning with 1 and ending with 0

$\{10, 110, 1110, \ldots\}$

iii) Set of $\{$epsilon$, 11, 1111, 1111, \ldots\}$

Represents set $\{1\}^*$, the regular expression for the set $1(1)^*$

Question 23

i Grammar may ~~be~~ defined as finite set of rules used to describe languages

(i) A languages is a set of strings generated by grammar while grammar are finite set of rules used to describe language.

Question 24.

$G = \{V, T, S, P\}$

G is defined as a quadruple i.e $G = \{V, T, S, P\}$

V is known as variable

T is known as ~~set of~~ finite object known as terminals (small letter)

S is known as start symbol

P is a finite set of production e.g.

Consider the grammar

$G = \{\{S\}, \{a, b\}, S, P\}$ with P given by

$S \to aSb$

$S \to T$

Solution

$S \to aSb \to aTb \to ab$

$S \to aSb \to aaSbb \to aaTbb \to aabb$

$S \to aSb \to aaSbb \to aaaSbbb \to aaaTbbb \to aaabbb$

$\{T, ab, aabb, aaabbb, \ldots\}$

$\{a^n b^n \mid n \geq 0\}$