Scheme of Evaluation and Sample Solution for FLAT-2017

NOTE :- STEP MARKS SHOULD BE AWARDED WHERE EVER APPLICABLE.

Q.1.

a) Note that in the body of every production number of a's is twice the number of b.

b) FALSE.

$\Sigma = \{a, b\}$, Let $L = \{a^n b^n \mid n \geq 0\}$

$L = \{a^n b^n \mid n \geq 0\} \subset \Sigma^*$

where Σ^* is regular but L is not regular.

c) Let L be an infinite context-free language. Then there exists some positive integer m such that any $\omega \in L$ with $|\omega| \geq m$ can be decomposed as

$$\omega = uvxyz \text{ with}$$

$$|vxy| \leq m$$

$$|vy| \geq 1 \text{ such that } uv^i x y^i z \in L$$

for all $i = 0, 1, 2, \ldots$

d) ~~$h(a) = 0$~~,

$$h(a(a + a^* aa) + aaa)^*$$

$$= \max(\max(\overset{0}{h(a)}, h(a + a^* aa)), \overset{0}{h(aaa)}) + 1$$

$$= h(a + a^* aa) + 1$$

$$= \max(h(a), h(a^* aa)) + 1$$

$$= 1 + 1 = 2$$

e) $\boxed{S \to aaS \mid abS \mid baS \mid bbS \mid \lambda}$

f) $S \to aSB \mid bSA \mid a \mid b \mid aB$

$A \to a$

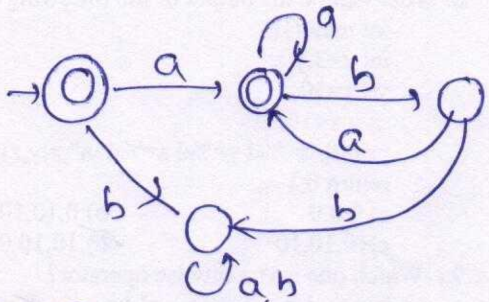
$B \to b$

g) If every grammar that generates L is ambiguous, then the language is called inherently ambiguous.

Example: $L = \{a^n b^n c^m\} \cup \{a^n b^m c^m\}$.

h) $L = \{a^n b^m \mid n > m\}$

i)



j) FALSE.

Lang. L is finite therefore L is recognized by PDA and also by Finite Automata.

Q.2

a) (i) $S \to 0S1 \mid 1S0 \mid 0S0 \mid 1S1 \mid 2$

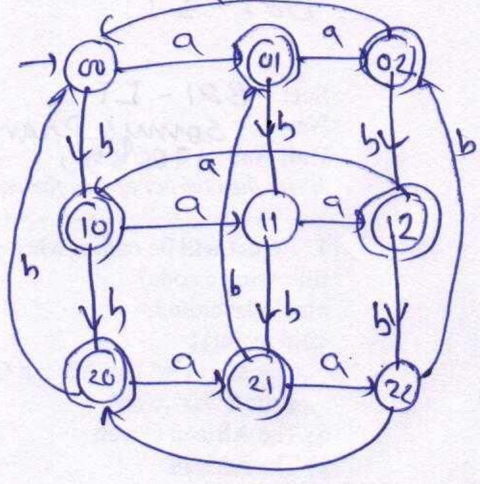
(ii) $S \to S_1 \mid S_2$, $S_1 \to AS_1$, $S_1 \to aS_1b \mid \lambda$. $A \to aA \mid a$ | $S_2 \to S_2B$, $S_2 \to aS_2b \mid \lambda$, $B \to bB \mid b$

b) considering A as initial state. λ-closure of $\{A\} \to \{A,B\}$

	0	1
{A,B}	{A,B,C}	{B,C}
{B,C}	{A,B}	{B,C}
{A,B,C}	{A,B,C}	{B,C}.

Q.3

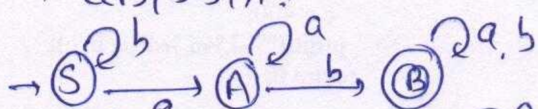
a) The language is regular as the following DFA accepts it.

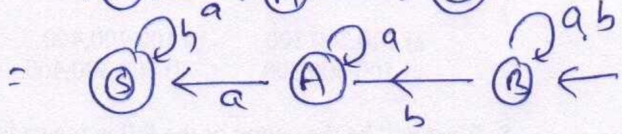


b) $S \to bS \mid aA$

$A \to aA \mid bB$

$B \to aB \mid bB \mid \lambda$

L = 

L^R = 

$B \to aB \mid bB \mid bA$

$A \to aA \mid aS$

$S \to bS \mid \lambda$.

$$\boxed{\begin{array}{l} B \to Ba \mid Bb \mid Ab \\ A \to Aa \mid Sa \\ S \to Sb \mid \lambda \end{array}}$$

where B is start variable.

Q.4

(a) Mark should be given based on ~~removal of~~ removal of λ - production removal of Unit - production etc.

(b) If possible, let $L = \{x^n y^m \mid n \neq m\}$ be regular.

that implies $\bar{L}$ is also regular

So, Now $\bar{L}$ is regular and $L(x^* y^*)$ is regular.

$\Rightarrow \bar{L} \cap L(x^* y^*)$

$\Rightarrow \{x^n y^n \mid n \geq 0\}$ is regular.

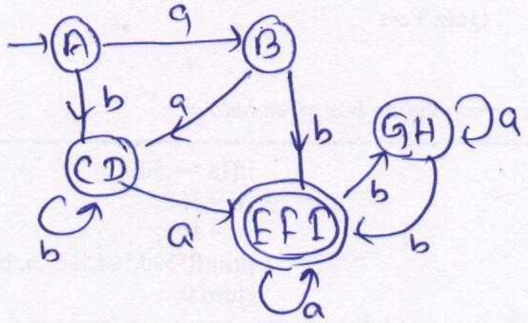
which is contradiction.

$\{x^n y^n \mid n \geq 0\}$ is not regular can easily be proved using pumping lemma.

Q-5

a) (i) indistinguishable pair : (C,D), (G,H), (E,F,I).

(ii)



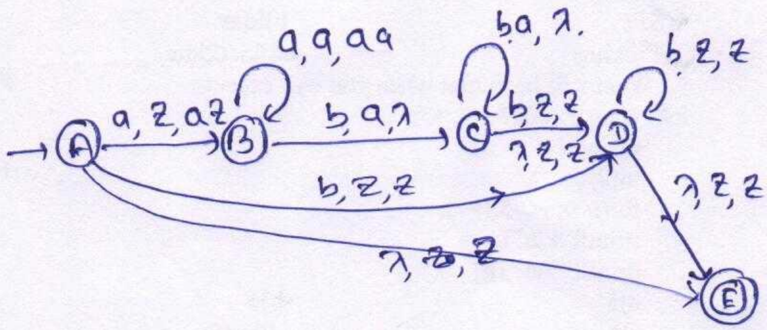
b) The family of regular language is closed under complementation and union.

Now $L \cap M = \overline{\bar{L} \cup \bar{M}}$

Therefore intersection of two regular language is also regular.

Q-6

a) $L = \{a^n b^m \mid m \geq n\}$.



b) $S \rightarrow SS$

(a) $S \rightarrow aS \mid Sb \mid ab$

for a string aababb there exist two left-most derivative form.

(i) $S \rightarrow aS \rightarrow aSS \rightarrow aabS \rightarrow aabSb \rightarrow aababb$

(ii) $S \rightarrow Sb \rightarrow SSb \rightarrow Sabb \rightarrow aSabb \rightarrow aababb$

(b) The language for the given grammar is

L = { any string that starts ~~at~~ with a and end with b }.

So unambiguous grammar for it is

$$\boxed{\begin{array}{l} S \rightarrow aAb \\ A \rightarrow aA \mid bA \mid \lambda \end{array}}$$

Q.7

a) $S \to ABA \mid aSa \mid bSb$
$A \to aA \mid aAb \mid B$
$B \to bB \mid \lambda$.

Removal of λ-production.

$S \to ABA \mid aSa \mid bSb \mid AB \mid BA \mid B \mid A \mid aa \mid bb$
$A \to aA \mid aAb \mid B \mid ab \mid a$
$B \to bB \mid b$

Removal of unit production

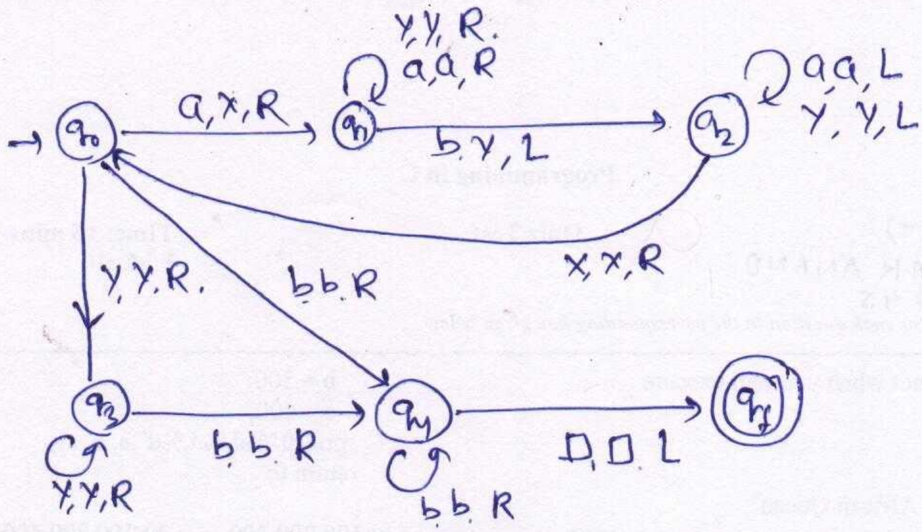
$S \to ABA \mid aSa \mid bSb \mid AB \mid BA \mid bB \mid b \mid aA \mid aAb \mid bB \mid b \mid ab \mid a$
$A \to aA \mid aAb \mid bB \mid b \mid ab \mid a$
$B \to aB \mid b$

b) If m be the max. no. of symbols in RHS, then for each production we have at most $(m-1)$ productions in CNF.
As we have $|P|$ productions, then we have $(m-1)|P|$ no. of production.
We will have exactly one production of the form $A \to a$ for each terminal a.
Hence our equivalent grammar in CNF will have at most

$$(m-1)|P| + |T|$$ number of productions.

Q.8

a)



b)

$S \to aABB \mid aAA$	$S \to aABB \mid aAA$
$A \to aBB \mid b$	$A \to aBB \mid b$
$B \to bBB \mid A$	$B \to bBB \mid aBB \mid b$

$\delta(q_0, \lambda, z) \longrightarrow \{(q_1, Sz)\}$

$\delta(q_1, \lambda, z) \longrightarrow \{(q_f, z)\}$ final state.

$\delta(q_1, a, S) \longrightarrow \{(q_1, ABB), (q_1, AA)\}$

$\delta(q_1, a, A) \longrightarrow \{(q_1, BB)\}$

$\delta(q_1, b, A) \longrightarrow \{(q_1, \lambda)\}$

$\delta(q_1, b, B) \longrightarrow \{(q_1, BB), (q_1, \lambda)\}$

$\delta(q, a, B) \longrightarrow \{(q_1, BB)\}$

end