1 a. Find whether string aabba is generated by the following grammar using CYK algorithm. Show the entire calculation table.

$$S \rightarrow AB$$
$$A \rightarrow BB \mid a$$
$$B \rightarrow AB \mid b$$

(4 marks)

1 b. Show that the following language is inherently ambiguous by identifying a string for which there will be two parse trees for any grammar generating L. Give the reason behind the inherent ambiguity of this language.

$$L = \{\, a^i b^i c^j \mid i, j \geq 0 \,\} \cup \{\, c^j b^i a^i \mid i, j \geq 0 \,\}$$

(1 mark)

2. Construct the Push down automata that accepts the following language and

show the steps for accepting the string *aabbbbccc* using instantaneous descriptions.

$$L = \{a^i b^j c^k \mid \min(i,j) \leq k\}$$

(5 marks)

3. Consider the following Turing Machine M with input alphabet {a,b}, blank symbol B. Rest of the components of the TM can be inferred from the following transition table.

	B	X	a	b
→ q0	(q2,B,L)	(q0,X,R)	(q0,a,R)	(q1,X,L)
q1		(q1,X,L)	(q0,X,R)	
q2	(q3,B,R)	(q2,X,L)		
*q3				

(i)   By giving trace (sequence of IDs) find whether **ababab**   is in the L(M) or not.
(ii)   By giving trace (sequence of IDs) find whether **aaabbba** is in the L(M) or not.

(5 marks)

4. 4. Prove or disprove the following statements (Your answer should be a mathematically valid one).

(a) $(A \leq_m B$ and B is a regular language$) \Rightarrow A$ is a regular language.

(b) The language $\{< M > \mid M$ is a Turing Machine and $L(M)$ is a regular language$\}$ is a decidable language.

(5 marks)