KENYA METHODIST UNIVERSITY

END OF 1ST TRIMESTER 2010 EXAMINATIONS

FACULTY	**:**	**COMPUTING AND INFORMATICS**
DEPARTMENT	**:**	**COMPUTER INFORMATION SYSTEMS**
UNIT CODE	**:**	**CISY 305**
UNIT TITLE	**:**	**AUTOMATA AND FORMAL LANGUAGES**
TIME	**:**	**2 HOURS**

Instructions:

- *Answer question 1 and any other 2 questions.*

Question 1 (30 marks)

a) i) Define Automata theory. (2 mks)

ii) Explain the three main classes of study in automata theory. (6 mks)

iii) Define a production rule; using an example explain how the rule is applied. (4 mks)

b) Finite automata are a useful model for many important kinds of hardware and software. Discuss two of these software. (4 mks)

c) Using examples, explain the following terms used in automata and formal languages.

i) Alphabets

ii) Strings

iii) Languages

iv) Function (4 mks)

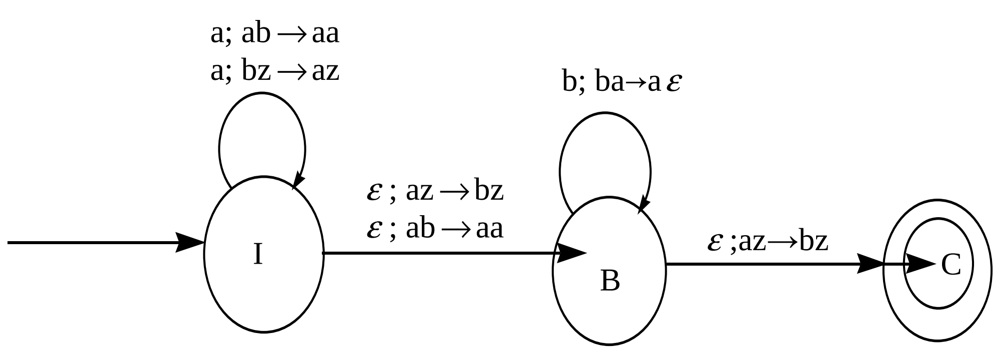
d) Using a diagram, describe a transition diagram for a deterministic finite automaton defined by A = (q, Σ, q_0, F) (6 mks)

e) Discuss computability theory. (2 mks)

f) Differentiate between recognizable and decidable languages. (2 mks)

Question 2 (20 marks)

a) Below is a PDA diagram, indicate the values of Q, Σ, Γ, q_o and F, then draw a transition function table to represent the PDA.



(10 mks)

b) Write a logical formula in predicate calculus (First Order Logic) that will represent the following English statement written in natural language.

"You can fool all of the people some of the time, you can fool some people all of the time, but you cannot fool all of the people all of the time." (6 mks)

c) Discuss four important properties of regular languages. (4 mks)

Question 3 (20 marks)

a) Give a formal definition of a Turing machine. (5 mks)

b) Define Kleen's star, prove $A^* = A^+$ iff εЄA (3 mks)

c) Describe two differences between deterministic finite automata and non deterministic finite automata. (2 mks)

d) Design a (finite state automaton) FSA for an automatic door controller has to open the door for incoming customers and not misbehave. The specification of it would be a person is a person is on pad 1(the front pad) and there is no person on pad 2(the rear pad) then open the door and stay open until there is no person on either pad 1 or pad 2.

   i) Determine the finite states (2 mks)

   ii) The set of acceptable alphabets (2 mks)

   iii) Determine M the formal definition of the door controller. (6 mks)

Question 4 (20 marks)

a) Use the grammar G given as ({S,A,B}, {a,b}, P,S) where P = {S→AB, (S→bA), (A→a), (A→as), (A→bAA), (B→b), (B→bs), (B→aBB} to construction the derivation trees for the strings;

   i) aaabb (4 mks)

   ii) abababba (4 mks)

b) Using examples differentiate languages from expressions. (2 mks)

c) Consider the following languages over Σ = {a,b} L1 = $\{a^m b^n : m>0, n>0\}$ L2 = $\{b^m a b^n : m>0, n>0\}$ and L3 = $\{a^m b^m : m>0\}$. Find a regular expression r over Σ such that Li = L(v) for I = 1, 2, 3 (6 mks)

d) Let M be the automaton with the following input set A state set S, and accepting state set Y: A = {a,b} S = {S0, S1, S2} and Y = {S2}. Suppose that S0 is the initial state of M, the next state function F is given by the table below;

F	a	b
→S0	S0	S1
S1	S1	S2
←S2	S2	S2

   i) Draw the state diagram D of M. (2 mks)

   ii) Describe the language L = L(M) accepted by M. (2 mks)