KENYA METHODIST UNIVERSITY

END OF 2ND TRIMESTER 2010 EXAMINATIONS

FACULTY	**:**	**SCIENCE AND TECHNOLOGY**
DEPARTMENT	**:**	**COMPUTER SCIENCE & BUSINESS INFORMATION**
UNIT CODE	**:**	**CISY 305**
UNIT TITLE	**:**	**AUTOMATA AND FORMAL LANGUAGES**
TIME	**:**	**2 HOURS**

INSTRUCTIONS:

- ***Answer Question ONE (Compulsory) and ANY OTHER TWO questions:***

Question One (30 Marks):

(a.) Define:
  i. Regular expression
  ii. Decision problem (2 marks)

(b.) For a set A, define:
  i. The powers A^n of A
  ii. The asterate A* of A (3 marks)

(c.) Define the equivalence relation $\approx$ and equivalence class for a state $p \in Q$ in a DFA (3 marks)

(d.) Give the set of strings matching each of the following patterns
  i. ϕ
  ii. ε (2 marks)

(e.) Describe the start configuration and next configuration for a Turing machine M (4 marks)

(f.) Give a deterministic finite state automaton that accepts the regular set
  $\{x \in \{a , b\}^* \mid x$ contains an even number of a's$\}$ (4 marks)

(g.) Distinguish between a pushdown automata (PDA) and a finite state automata (FSA) (2 marks)

(h.) Consider two DFAs A and B that accept the sets L(A) and L(B) respectively. Describe acceptance for a DFA C that accepts the set $L(A) \cap L(B)$ (3 marks)

(i.) Construct a non-deterministic finite state automaton, that accepts the set
  $\{x \in \{0,1\}^* \mid x$ ends with the string 101$\}$ (4 marks)

(j.) What is the meaning of the configuration (q,w,X) for a PDA M? (3 marks)

Question Two (20 Marks):

(a.) Briefly describe the halting problem (3 marks)

(b.) Define:

i. A monoid (1 mark)

ii. Prefix for a string x (2 marks)

iii. A pattern (2 marks)

(c.) Give an NFA, with four states, equivalent to the regular expression

(01+011+0111)* (4 marks)

(d.) List the equivalence classes of the collapsing relation ≈ and construct a minimal DFA for the following DFA

	a	b
→1	1	4
2	5	7
3F	3	2
4F	3	5
5	4	6
6	6	3
7	2	4
8	3	1

(8 marks)

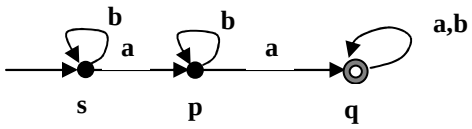
Question Three (20 Marks):

(a.) For a pushdown automata M, describe:

i. Configuration (2 marks)

ii. Acceptance (4 marks)

(b.) Consider the DFA:



Describe the set accepted by the automata (3 marks)

(c.) Consider the following two deterministic finite state automata:

	A	b
→1	1	2
2F	2	1

	a	b
→1	2	3
2	3	1
3F	1	2

use product construction to construct a DFA accepting the union of the two sets accepted by these automata (4 marks)

(d.) Convert the following grammar into Chomsky normal form

S→aSbb | T

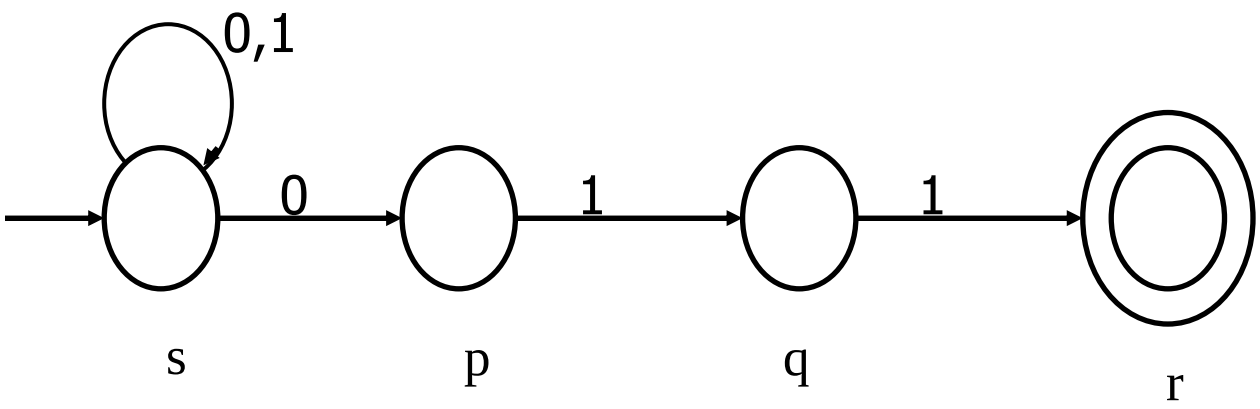
T→bTaa | S | ∈ (5 marks)

(e.) When is a turing machine said to be <u>total</u>? (2 marks)

Question Four (20 Marks):

(a.) Describe a deterministic one-tape turing machine and how it works. (4 marks)

(b.) Construct a DFA that accepts the same set as the following NFA: (7 marks)



(c.) Describe the Greibach normal form for a grammar G (2 marks)

(d.) Distinguish between L* and L^+ for a language L (2 marks)

(e.) Define:

i. State
ii. Transition
iii. Finite-state transition system (3 marks)

(f.) Give the regular expression equivalent to the following DFA

	a	b
→1	1	2
2F	2	1

(2 marks)