MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2012/2013

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND TECHNOLOGY (MAIN CAMPUS)

SCS 304: AUTOMATA THEORY

Date: 13th December, 2012 *Time: 8.30 – 10.30 a.m.*

INSTRUCTIONS:

- Answer ALL questions in SECTION A and any other TWO questions from SECTION B.
- Write your registration number on all sheets of the answer book used.
- Use a NEW PAGE FOR EVERY QUESTION ATTEMPTED, and indicate the question number on the space provided on each page of the answer sheet.

SECTION A
ANSWEW ALL QUESTIONS IN THIS SECTION .

QUESTION 0NE

a. Let $G = (N, \sum, S, P)$ be the grammar defined by $N = \{S, A, B\}$, $\sum = \{a, b\}$ and P be the set of productions

$S \rightarrow ABABABA$
$A \rightarrow Aa$
$A \rightarrow \lambda.$
$B \rightarrow b.$

Show that the expression for the language generated by G Is $a^*ba^*ba^*ba^*$. A language consisting of all words containing exactly three bs. **(5 MARKS)**

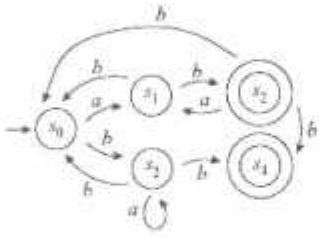
b. Let $G = (N, \sum, S, P)$ be the grammar defined by $N = \{S, A, B, C\}$, $\sum = \{a, b, c\}$, and P be the set of productions

$S \rightarrow aA$
$A \rightarrow aA$
$S \rightarrow bB$
$B \rightarrow Bb$
$A \rightarrow cC$
$C \rightarrow cC$
$B \rightarrow aA$
$C \rightarrow \lambda.$

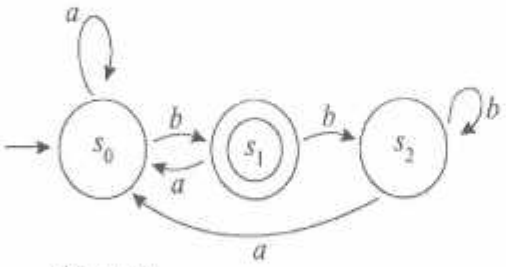
DRAW a corresponding automaton for this grammar. **(5 MARKS)**

c. Construct a grammar which generates the language L described by the expression **(ab)* ∨(ac)***. **(5 MARKS)**

d. Construct a grammar which generates the language accepted by the automatons below . **(5 MARKS)**



e. Which of the following words are accepted by the automaton? Below (5 MARKS)



(a) *aaabb*.
(b) *abbbabbb*.
(c) *bababa*.
(d) *aaabab*.
(e) *bbbabab*.

f. Find a deterministic automaton which accepts the language expressed by (a*(ba)*bb*a)*. **(5 MARKS)**

Question two

a. Let $\sum = \{a, b\}$.

(i) Give a regular expression for the set of all elements of $\sum^*$ containing exactly two *b*s or exactly two *a*s. **(2 MARKS)**

(ii) Give a regular expression for the set of all elements of $\sum^*$ containing an even number of *b*s. **(2 MARKS)**

(iii) Give a regular expression for the set of all elements of $\sum^*$ beginning and ending with *a* and containing at least one *b*. **(2 MARKS)**

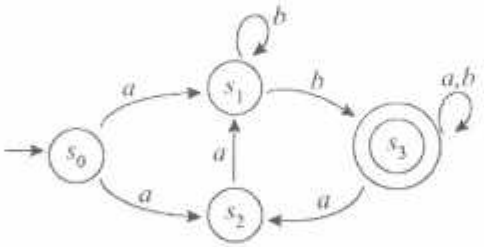
b. Find regular sets corresponding to the following expressions. If the set is infinite, list ten elements in the set: **(6 MARKS)**

a. **bc(bc)***

b. **(a ∨b* ∨ λ) (c∨d*)**

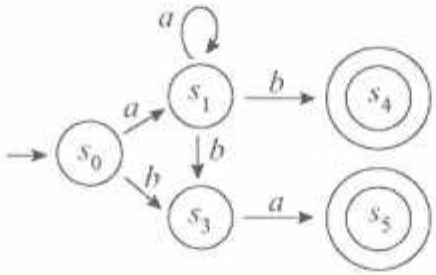
c. **(a ∨bc ∨d)***

c. Construct a deterministic automaton which accepts the same language as the nondeterministic automaton. Below. Describe the language that is accepted by both atomatons. **(8 MARKS)**

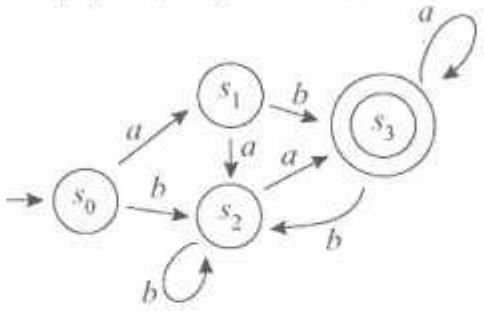


Question three

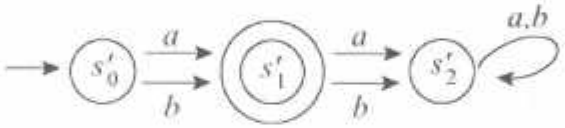
a. Using the following automaton below , use Kleens theorem to derive a regular expression that is accepted by the automaton **(8 marks)**



b. Let $L1$ be the language accepted by the automaton



and L_2 be the language accepted by the automaton



(a) Construct the automaton which accepts the language $L1 \cup L2$. **(4 marks)**

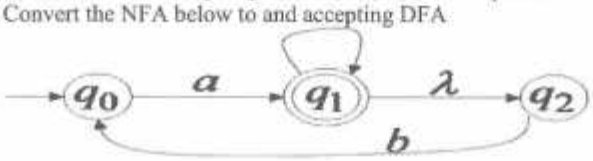
(b) Construct the automaton which accepts the language L1L2. . **(4 marks)**

(c) Construct the automaton which accepts the languages L_1^* and the automaton which accepts L_2^*. **(4 marks)**

Question Four (20 Marks)

(a) Convert the following **Regex** (0+1)*1(0+1) to a epsilon- NFA (5 MARKS)

(b) Convert the NFA below to and accepting DFA (5 MARKS)



a) Derive the following expression $x * (x + y000)$ from E in the grammar below **(10 MARKS)**

1. E► I
2. E► E+E
3. E► E*E
4. E► (E)
5. I ► x
6. I ► y
7. I ► Ix
8. I ► Iy
9. I ► IO
10. I ► I1

Question Five (20 Marks)

a) Construct the left most derivation of a tree that derives the expression in 4c above **(8 MARKS)**

b) Construct the parse trees for the expression $b + b * b$ and derive the ambiguity in the expression **(7 MARKS)**

c) Consider L $\{a^n b^n c^m d^m : n \geq 1, m \geq 1\} \cup \{a^n b^m c^m d^n : n \geq 1, m \geq 1\}$

A grammar for L is

S → AB /C
A → aAb / ab
B → cBd / cd

C → aCd / aDd
D → bDc / bc

Show that L is ambiguous when passing the string ***aabbccdd,*** by drawing the parse trees and the two leftmost derivations **(5 MARKS)**