

## B5.2-R4: AUTOMATA THEORY AND COMPILER DESIGN

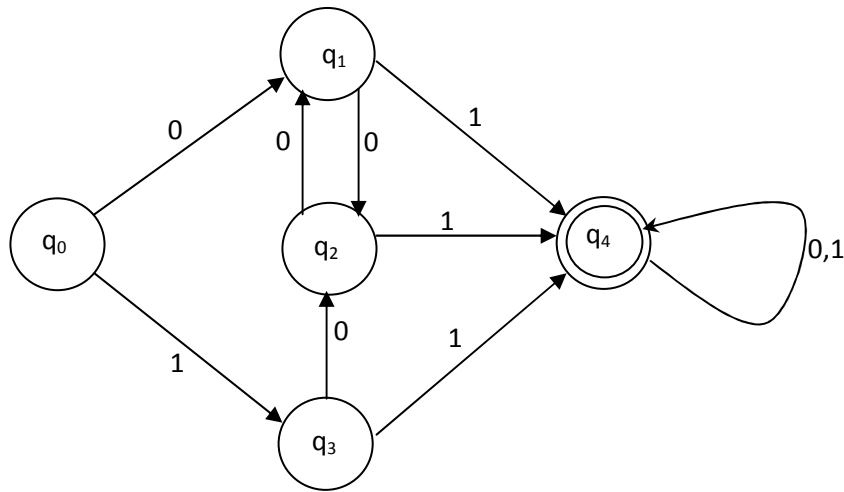
**NOTE:**

1. Answer question 1 and any FOUR from questions 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

**Time: 3 Hours**

**Total Marks: 100**

1.
  - a) For finite sets  $S_1$  and  $S_2$ , give condition on  $S_1$  and  $S_2$  necessary and sufficient to ensure that  $S_1 = (S_1 \cup S_2) - S_2$ .
  - b) Design a Mealy machine to get 1's complement of a given binary integer.
  - c) Generate the language for the grammar defined over  $\Sigma = \{0,1\}$  as  $S \rightarrow 1S1 \mid 0S0 \mid 1 \mid 0 \mid \epsilon$
  - d) Design a Turing machine that recognizes all strings consisting of even number of 1's.
  - e) What is the difference between syntax and semantics?
  - f) Explain *l-value* and *r-value*?
  - g) Give two reasons why a programmer might sometimes want control flow to be deterministic? **(7x4)**
  
2.
  - a) How many subsets does the set  $\{1,2,\dots,n\}$  have that contains no two consecutive integer?
  - b) Construct a minimum state automaton equivalent to the DFA



- c) Show that the language  $L = \{a^n b^l : n \neq l\}$  is not regular? **(6+6+6)**
  
3.
  - a) If  $G$  is the grammar  $S \rightarrow SbS \mid a$ , show that  $G$  is ambiguous?
  - b) Construct a reduced grammar equivalent to the grammar
 
$$S \rightarrow aAa$$

$$A \rightarrow Sb \mid bCC \mid DaA$$

$$C \rightarrow abb \mid DD$$

$$E \rightarrow aC$$

$$D \rightarrow aDA$$
  - c) What kind of parser (top-down or bottom-up) is most common in production compilers and why? **(5+8+5)**

- 4.**
- Show that regular expression sets are closed under the following operations:
    - Union
    - Concatenation
  - Convert the following CGF to CNF  
 $S \rightarrow abSb \mid a \mid aAb$   
 $A \rightarrow bS \mid aAAb$
  - What formal machine captures the behavior of a scanner? A parser? Discuss in brief. **(5+8+5)**
- 5.**
- Convert the grammar  $S \rightarrow aSb \mid A, A \rightarrow bSA \mid S \mid \Lambda$  to a PDA that accepts the same language by empty stack.
  - Show that the grammar  $S \rightarrow 0A2, A \rightarrow 1A1, A \rightarrow 1$  is not an LR(0).
  - Explain how to manage space for inherited attributes in a bottom up parser. **(8+6+4)**
- 6.**
- Design a Turing machine for the language  $L \{0^x0 \mid x \in \{0,1\}^*\}$ .
  - Enumerate the similarities and differences between context free grammar and tree grammar.
  - Discuss the mechanism of implementation of enumeration controlled loops in a programming language. **(9+4+5)**
- 7.**
- Describe different techniques for code optimization.
  - What are the sets represented by the following regular expression:
    - $(11 + 0)^* (00 + 1)^*$
    - $(1 + 01 + 001)^* (\epsilon + 0 + 00)$**(8+10)**