Sardar Vallabhbhai National Institute of Technology, Surat
Computer Engineering Department
B Tech II (Computer Engineering)) – Fourth Semester
CO202 – Theory of Computer Science
Mid Semester Examination, March 2020

Time: 11:00 to 12:30 Date: 2-3-2020 Marks: 30

Q.1 (a) Suppose r is a real number other than 1. Prove that for any n ≥ 0. [6]
$\sum_{i=1}^{n} r^2 = \frac{1-r^{n+1}}{1-r}$
(b) Prove that for every n ≥ 2, $1 + \sum_{i=2}^{n} 1/\sqrt{i} > \sqrt{n}$.
(c) Prove that for any n ≥ 0, $n(n^2 + 5)$ is divisible by 6.

Q.2 Design FA for [6]
(a) strings with next-to-last symbol 0
(b) strings ending with 11
(c) strings contain (atleaset) two consecutive a's and does not contain two consecutive b's

Q.3 (a) A machine is said to be a unit delay machine, if it produces as output the input strings delayed by a unit amount of time, that is, if input string is $a_1, a_2, \ldots a_k$ the output string is $0, a_1, a_2, \ldots a_{k-1}$ design such a finite state machine. [6]
(b) Design a finite state machine that gives a 1 as its output bit if and only if the last three bits received are all 1's, for example: input: 1011011101111 then output: 0000000100011
(c) Design a finite state machine that produced an output 1 when the input received contains an even number of 1's and produced an output 0, otherwise. Machine is called a parity check machine.

Q.4 (a) Design a finite state machine as a directed weighted graph giving model of a vending machine that sells candy bars for 15 cents a piece. The input signals correspond to a nickel (5 cents), a dime (10 cents) and 'press button P' for a candy bar. It is assumed that machine does not return any change. [6]
(b) Design a finite state machine that compares two binary numbers to determine whether they are equal and which of the two is larger.

Q.5 (a) Simplify the regular expression: [6]
$(1 + 00^*1) + (1 + 00^*1)(0 + 0 + 10^*1)^*(0 + 101^*)$
(b) Prove $(00^*1)^*1 = 1 + 0(0 + 10)^*11$
(c) Find a regular expression corresponding to
(i) the language of all string that not containing the substring 000.
(ii) the language of all strings that do not contain the substring 110.