Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (INFORMATION TECHNOLOGY/ COMPUTER & COMMUNICATION ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: PROGRAM ELECTIVE V - NATURAL COMPUTING [ICT 4011]

REVISED CREDIT SYSTEM
(25/11/2017)

Time: 3 Hours | MAX. MARKS: 50

Instructions to Candidates:

- Answer ALL questions.
- Missing data if any, may be suitably assumed.

1A. Design a Turing Machine to accept the language L, of strings over $\sum = \{a, b, c\}$ such that $L = \{ a^n b^n c^n \mid n \geq 1 \}$ — 5

1B. Design the transition set for a Pushdown Automata, to accept a language $L = \{a^n b^{2n} \mid n \geq 0\}$, over $\sum = \{a, b\}$. — 3

1C. Design a DFA, to accept a language $L = \{w \mid |w| \bmod 3 \geq |w| \bmod 2\}$, over $\sum = \{a\}$, where $w \in \sum^*$. — 2

2A. Explain with the help of an example, the steps involved in the process of designing scaffolded DNA Origami. — 5

2B. Compute the function f (i, v, j) used to solve the SAT problem by abstract Tile Assembly Model, for the formula $F = (x \vee y \vee z) \wedge (\bar{x} \vee \bar{y} \vee \bar{z}) \wedge (\bar{x} \vee \bar{y} \vee z)$, given i = (1, 0, 1) and v = (x, y, z). — 3

2C. Demonstrate the subset construction method to convert the following NFA (transitions shown in Table Q.2C) to DFA. — 2

Table Q.2C

δ	0	1
→A	{ A, B}	{A ,C}
B	{ D }	∅
C	∅	{ D }
*D	{ D }	{ D }

3A. Explain in detail the steps involved in Paddy Field Algorithm. 5

3B. Demonstrate the generation of a binary counter using the DNA Tile Assembly Model. 3

3C. Describe with the help of an example the process used in extracting the result in Adleman's approach of solving the Hamiltonian Path Problem in a graph. 2

4A. Apply the DNA Computation operations to solve the minimal cover set problem using the sticker model for the given data. Objects = {1, 2, 3, 4, 5} and Bags = {{1, 2, 4}, {2, 5, 4}, {2, 4}, {1, 3, 5}}. Indicate all the steps along with the DNA operations. 5

4B. Compute the evolution of the cells for time t = 1, 2 using the rules of game of life and **periodic boundary condition** for the given Cellular Automata at t = 0 in Fig. Q.4B, and also state its configuration. [Note: Shaded cells are dead cells] 3

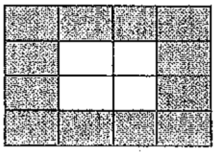

Fig. Q.4B

4C. Illustrate with the help of a quantum circuit how the bell states can be generated. 2

5A. Design a P-system of degree 4 that generates n^2, for any integer $n \geq 1$. Show the computations for n = 1 and n = 3. 5

5B. Compute the unitary operation performed by the circuit given in Fig. Q.5B, given two single qubit gates, $U_1 = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$ and $U_2 = \begin{bmatrix} e & g \\ f & h \end{bmatrix}$. Write the 4 x 4 matrix for the unitary operation. 3

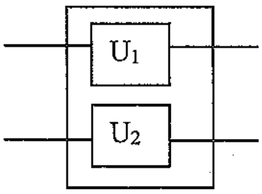

Fig. Q.5B

5C. Describe how peptide computing can be used to compare the quantity of an element in two multisets. 2