Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (INFORMATION TECHNOLOGY/COMPUTER AND COMMMUNICATION ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2019

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

REVISED CREDIT SYSTEM
(26/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Mention any five advantages and limitations of Genetic Algorithm. Compare and contrast Genetic Algorithm and Genetic Programming. **5**

1B. Show by giving an example that, if M is an NFA that recognizes language C, swapping the accept and non-accept states in M doesn't necessarily yield a new NFA that recognizes $\bar{C}$. **3**

1C. Compare and contrast Peptide computing and DNA computing. **2**

2A. Consider $\Sigma = \{ \binom{0}{0} \binom{0}{1} \binom{1}{0} \binom{1}{1} \}$. A string $\sigma \in \Sigma^*$ can be interpreted as two binary numbers, for example $\sigma = \begin{bmatrix}1\\0\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix} = \begin{bmatrix}101100\\010011\end{bmatrix}$. where x, y $\in \{0, 1\}^*$. Design a DFA which accepts strings in Σ^* such that $2x - y \leq 2$. Note that, for such a DFA, transitions will be labelled with elements from Σ. **5**

2B. What are the various Search Termination (Convergence Criteria) conditions of a GA? **3**

2C. Suppose we define a restricted version of the Java programming language in which variable names must satisfy all of the following conditions:

i. A variable name can only use Roman letters (i.e., a, b, . . . , z, A, B, . . . , Z) or Arabic numerals (i.e., 0, 1, 2, . . . , 9); i.e., underscore and dollar sign are not allowed.
ii. A variable name must start with a Roman letter: a, b, . . . , z, A, B, . . . , Z.
iii. The length of a variable name must be no greater than 8.
iv. A variable name cannot be a keyword (e.g., if). The set of keywords is finite.

Let L be the set of all valid variable names in our restricted version of Java. Let L_0 be the set of strings satisfying the conditions i, ii & iii above; i.e., we do not require the last condition. Give a regular expression for L_0. **2**

3A. Suppose you're running a travel agency, and you need to move three people namely Vash, Rohan and Ishaan from Patna to Jabalpur. And suppose that you have booked 2 jets for this purpose, and you want to figure out who gets into which jet ,given the following information:

- Vash and Rohan are friends
- Vash and Ishaan are enemies
- Ishaan and Rohan are enemies

Show how Quantum Computing increases the efficiency when compared to regular non-quantum computing if you want to achieve the following goals:

- Maximize the number of friend pairs that share the same jet
- Minimize the number of enemy pairs that share the same jet

5

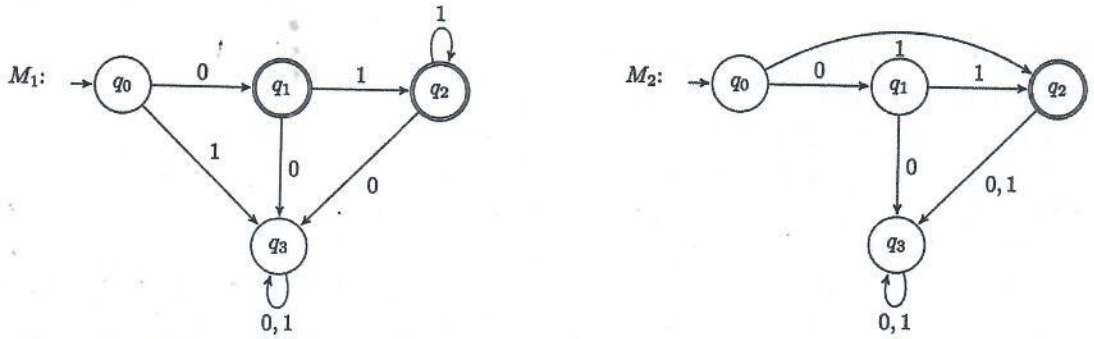
3B. Is the PDA to accept the language L(M) = { w|w ∈ (a+b)* and $n_a(w) = n_b(w)$ } deterministic? Justify. **3**

3C. Explain the DNA splicing system with an example. **2**

4A. What do you mean by breeding in Genetic Algorithm? Explain briefly the three steps in breeding cycle. **5**

4B. Consider the following two DFAs (deterministic finite automata) with Σ = {0, 1}:

(a) What languages (L_1 and L_2) do these two automata individually recognize?
(b) Give the formal definition for M_1.



4C. Define a Turing machine. How is it different from a PDA? **3** **2**

5A. Mention and elaborate any five advantages and applications of Evolutionary Computation. **5**

5B. Construct NFAs for the following languages.

(a) $L_1 = \{\omega|\omega$ is a string in which at least one a_i occurs even number of times (not necessarily consecutively), where $1 \leq i \leq 3$ over $\Sigma = \{a_1, a_2, a_3\}\}$.
(b) $L_2 = \{\omega|\omega$ contains two 0s separated by a substring whose length is a multiple of 3 $\}$, $\Sigma = \{0, 1\}$. **3**

5C. Compare and contrast Genetic Algorithm with other optimization techniques. **2**