Marks: 30   **Time: 1 Hour 15 Minutes+**
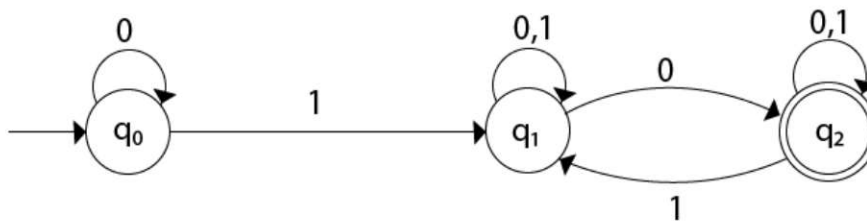   **15 Minutes Script Upload Time**

Professionalism	Excellence	Respect

Answer all the questions. The weight of each question is mentioned at the right side

1. **a)** Design a DFA over the language $\{0,1\}^*$ that accepts all strings that end with 010.   **2**

   b) Convert the following NFA to a DFA: **4**

2. **a)** Write regular expressions for the following languages on the alphabet $\{0,1\}$:   **3**
   - **i.** The set of all strings whose length is divisible by 3
   - **ii.** The set of strings that consist of alternating 0's and 1's
   - **iii.** The set of strings with at most one pair of consecutive 0's

   b) Based on the DFA given below, find out whether the following pairs of states are equivalent. Justify your answer.   **3**
   - **i.** q0 and q2
   - **ii.** q1 and q3
   - **iii.** q2 and q3
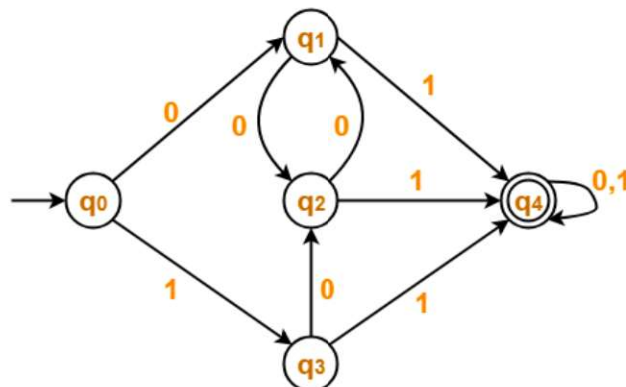
3. **a)** Design a PDA that accepts the string $a^{2n}b^{3n}$.   **3**

   b) Consider the context-free grammar $G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \in\}$. Determine whether the following statements are true: **3**
   - **i.** G is ambiguous
   - **ii.** G produces all strings with equal number of a's and b's

4. Begin with the grammar: **6**

$$S \rightarrow 0A0 \mid 1B1 \mid BB$$
$$A \rightarrow C$$
$$B \rightarrow S \mid A$$
$$C \rightarrow S \mid \epsilon$$

a) Eliminate ϵ-productions.
b) Eliminate any unit productions in the resulting grammar.
c) Eliminate any useless symbols in the resulting grammar.
d) Put the resulting grammar into Chomsky Normal Form.

5. a) What are the differences between a PDA and an $\in$-NFA? **2**

b) Give a formal (7-tuple) definition of a Turing machine. Describe each notation. **4**

GOOD LUCK!
(Please return this question paper with the answer script)