Indian Institute of Engineering Science and Technology, Shibpur

B. Tech. (CST) 4^{th} Semester Class Test, April 12, 2021

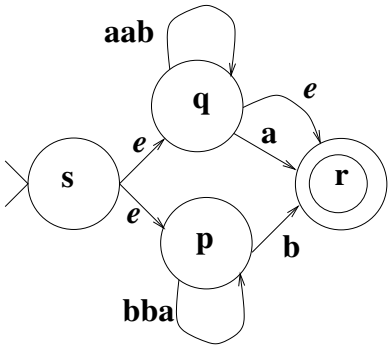
Theory of Computation (CS2204)

Full Marks: 20 Time: 45 Minutes

- **Attempt all questions. The number within square brackets ([ ]) at the end of each question indicates its marks.**
- **Answers should be precise and to the point.**
- **Make your own assumptions, if necessary, and state them at proper places.**

1. State whether the statement is true or false (1 mark)! Formally justify your answer (remaining marks)!
   (a) Any Context-Free Language over some alphabet Σ is a subset of some Regular Language over the same alphabet. [1 + 1]
   (b) From a given Non-Deterministic Finite Automaton (NDFA) M, a Push-Down Automatonn (PDA) M' can be systematically constructed, such that, $L(M) = L(M')$. [1 + 2]
   (c) Let Σ_1 and Σ_2 be two alphabets, such that, they do not have any common symbol (that is, $\Sigma_1 \cap \Sigma_2 = \phi$). There cannot be any common string between L_1, a language over Σ_1, and L_2, a language over Σ_2. [1 + 1]

2. From the following State Transition Diagram of a Non-Deterministic Finite Automaton (NDFA), systemetically construct an equivalent Deterministic Finite Automaton (DFA). Please show all the steps. [6]



3. As stated at its side, for **each** of the following languages construct a Finite Automaton (FA) **OR** a Pushdown Automaton (PDA) that accepts **OR** a Context-Free Grammar (CFG) that generates the language.
   (a) $\{\omega \in \{a, b\}^* \mid$ The number of a's in ω is divisible by 3.$\}$ [FA] [2]
   (b) $\{a^m b^n c^l \mid l, m, n \geq 0$ and $m \neq l + n\}$ [CFG] [3]
   (c) $\{a^m b^n \mid m, n \geq 0$ and $m \geq n\}$ [PDA] [2]