S.E. Sem - IV (ECS) (NEP 2020) May 2026 16/05/2026.

Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR **[20]**

a Given S = {1, 2, ..., 10} and a relation R on S, where R = {(x, y)| x + y = 10}. Is it reflexive, symmetric, transitive, antisymmetric?.

b What is a tautology? Check whether the following logical expression is tautology?

$[(p \rightarrow r) \wedge (\sim q \rightarrow p) \wedge \sim r] \rightarrow q$

c Design an FSM in which input is valid if it ends in "110" over $\sum = \{0,1\}$

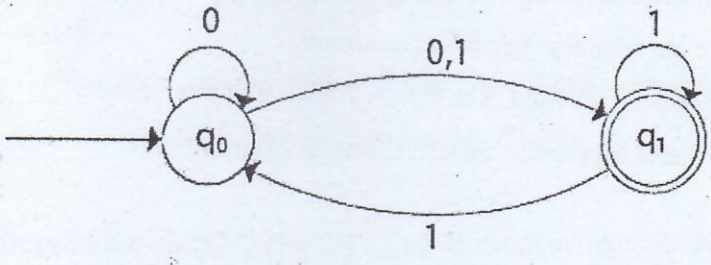
d Design NFA for the regular expression.

$$R = a(a + b)^* bb$$

e Differentiate between Moore Machine and Mealy Machine.

2 a Define Poset. Draw Hasse diagram which represents the partial order relation. **[10]**
$\{(a, b) | a \ divides \ b\}$ on {1,2,3,4,6,8,12,24,36,42}

b Convert the following NFA to DFA: **[10]**



3 a Explain Chomsky Hierarchy of Grammar. **[10]**

Consider the following grammar and create the leftmost, rightmost derivation for the string w= 0001101110

S → 0B / 1A

A → 0S / 1AA / 0

B → 1S / 0BB / 1

b What is a transitive closure? Find the transitive closure of R using Warshall's algorithm where A={1, 2, 3, 4, 5 } & **[10]**

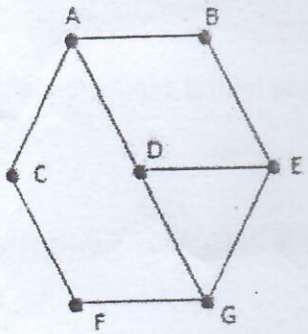
R={(1,2), (1,3), (1,5), (3,2), (3,4), (3,5), (4,3), (4,5), (5,2), (5,3)}.

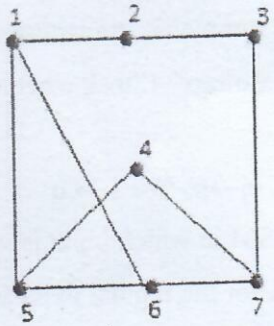
4 a Design PDA to check even palindrome over $\Sigma = \{0,1\}$ [10]

b Prove that language $L = \{ a^k b^k \}$ is not regular, where k is a natural number. [10]

5 a What are Isomorphic Graphs. [10]

Check whether the following graphs are Isomorphic or not? Justify





b Design a finite automaton to check divisibility by 3 to binary number. [10]

6 a Define the terms : [10]

i)Euler Circuit ii)Hamiltonian Circuit iii) Euler Graph iv) Hamiltonian Graph.

Give the example of a graph

1.Which has a Hamiltonian circuit but not the Eulerian circuit

2.Which is neither Hamiltonian nor Eulerian circuit

b Define the term bijective function. Let $f: R \rightarrow R$ be a function defined by $f(x) = 3x-4$. Whether a function is bijective? Justify your answer. [10]

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