**Sample Questions**

**Information Technology**

**Subject Name:** Automata Theory **Course Code**: ITC404

**Semester: IV**

Multiple Choice Questions

|  | **Choose the correct option for following questions. All the Questions carry equal marks** |
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| 1. | Which of the following is not a regular expression? |
| Option A: | (0+1)\*. (00+11)\* |
| Option B: | (0+1)-(01+01)\*(0+1)\* |
| Option C: | (01+11+10)\* |
| Option D: | (1+2+0)\*(1+2)\* |
|  |  |
| 2. | which language  is represented by Regular expressions ? |
| Option A: | Recursive language |
| Option B: | Regular language |
| Option C: | Context free language |
| Option D: | Ambiguous Language |
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| 3. | The set of all strings over ∑ ={} in which a single 0 is followed by any number of 1’s or a single 1 followed by any number of 0’s is----- |
| Option A: | 01\* + 10\* |
| Option B: | 01\*10\* |
| Option C: | 0\*1 + 1\*0 |
| Option D: | 0\* |
|  |  |
| 4. | The language accepted by this DFA is |
| Option A: | ababaabaa |
| Option B: | abbbaa |
| Option C: | abbbaabb |
| Option D: | abbaabbaa |
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| 5. | Moore Machine is an application of: |
| Option A: | Finite automata without input |
| Option B: | Finite automata with output |
| Option C: | Non- Finite automata with output |
| Option D: | Non- Finite automata without output |
|  |  |
| 6. | In regular expressions, the operator ‘\*’ stands for------ |
| Option A: | Concatenation |
| Option B: | Addition |
| Option C: | Selection |
| Option D: | Iteration |
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| 7. | The number of elements present in the ε-closure(B) in the given diagram. |
| Option A: | 0 |
| Option B: | 1 |
| Option C: | 2 |
| Option D: | 3 |
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| 8. | Grammar is called ambiguous if --------------- |
| Option A: | Two or more productions have the same non-terminal on the left-hand side |
| Option B: | Derivation tree has more than one associated sentence |
| Option C: | There is a sentence with more than one derivation tree corresponding to it |
| Option D: | Brackets are not present in the grammar |
|  |  |
| 9. | S -> aSa  S->bSb  S->a  S->b  The language generated by the above grammar over the alphabet {a,b} is the set of |
| Option A: | All Palindromes |
| Option B: | All Odd length Palindromes |
| Option C: | All even length palindromes |
| Option D: | String with null value |
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| 10. | Unrestricted grammar is also called\_\_\_\_\_\_\_ Grammar |
| Option A: | Type 3 |
| Option B: | Type 2 |
| Option C: | Type 1 |
| Option D: | Type 0 |
|  |  |
| 11. | The Trees which represent derivations in CFG are called |
| Option A: | Parse tree |
| Option B: | Derivation Tree |
| Option C: | Both A and B |
| Option D: | Binary Tree |
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| 12. | A Multitape Turing machine is \_\_\_\_\_\_\_\_ powerful than a single tape Turing machine. |
| Option A: | More |
| Option B: | Less |
| Option C: | Equal |
| Option D: | Not equal |
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| 13. | At Pushdown automata is \_\_\_\_\_\_\_\_\_\_ if there is at most one transition applicable to each configuration. |
| Option A: | Deterministic |
| Option B: | Non-Deterministic |
| Option C: | Finite |
| Option D: | Non-Finite |
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| 14. | Select value of n, if Push down automata is defined using n-tuples: |
| Option A: | 7 |
| Option B: | 5 |
| Option C: | 6 |
| Option D: | 3 |
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| 15. | In pushdown automata notation, what does the symbol Z0 represents? |
| Option A: | An element of G |
| Option B: | Initial stack symbol |
| Option C: | Top stack alphabet |
| Option D: | Head |
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| 16. | The language recognized by Turing machine is: |
| Option A: | Context free language |
| Option B: | Context sensitive language |
| Option C: | Recursively enumerable language |
| Option D: | Regular language |
|  |  |
| 17. | In Multi Tape Turing machine there are |
| Option A: | Having more stack |
| Option B: | More than one input tapes of Turing machine |
| Option C: | Similar to the basic model of Turing machine |
| Option D: | More than one head going in only one direction |
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| 18. | Which of the following statement is false for a Turing machine? |
| Option A: | There exists an equivalent deterministic Turing machine for every non-deterministic Turing machine |
| Option B: | Turing decidable languages are closed under intersection and complementation |
| Option C: | Turing recognizable languages are closed under union and intersection |
| Option D: | Turing recognizable languages are closed under union and complementation |
|  |  |
| 19. | Which of the following is the most general phase structured grammar? |
| Option A: | Regular |
| Option B: | Context-sensitive |
| Option C: | Context free |
| Option D: | Recursive |
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| 20. | The concept of FSA is much used in this part of the compiler |
| Option A: | Lexical analysis |
| Option B: | Parser |
| Option C: | Code Generation |
| Option D: | Code Optimization |
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| 21. | Which symbol is used to represent a Transition Function of Finite Automata? |
| Option A: | β |
| Option B: | δ |
| Option C: | ∑ |
| Option D: | ε |
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| 22. | What is the language of Finite Automata? |
| Option A: | Recursive Language |
| Option B: | Context-Sensitive Language |
| Option C: | Regular Language |
| Option D: | Context-Free Language |
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| 23. | Number of states in NFA are |
| Option A: | Less than or equal to equivalent DFA |
| Option B: | Less than equivalent DFA |
| Option C: | Greater than equivalent DFA |
| Option D: | Greater than or equal to equivalent DFA |
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| 24. | What is the correct form of productions in Chomsky Normal Form? |
| Option A: | A →aB |
| Option B: | A →BC |
| Option C: | A → B |
| Option D: | A →Ba |
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| 25. | The language WWR is accepted by- |
| Option A: | Deterministic Pushdown Automata |
| Option B: | Non-Deterministic Finite Automata |
| Option C: | Deterministic Finite Automata |
| Option D: | Non-Deterministic Pushdown Automata |
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| 26. | The transition δ (q1,a,a) = (qf , ε) of PDA is - |
| Option A: | Performing delete and pop operation |
| Option B: | Performing delete operation only |
| Option C: | Performing pop operation only |
| Option D: | Performing push operation |
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| 27. | What is the language of the Turing machine? |
| Option A: | Regular language |
| Option B: | Context free language |
| Option C: | Recursive enumerable language |
| Option D: | Context sensitive language |
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| 28. | What is the limitation of regular grammar? |
| Option A: | Can generate simple strings |
| Option B: | Can only describe regular language |
| Option C: | Can’t generate long strings |
| Option D: | Too difficult to understand |
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| 29. | DFA designed to accept strings with no more than 2 a’s can accept: |
| Option A: | a b a b |
| Option B: | a b a a |
| Option C: | b a a a |
| Option D: | a b a b a b a b |
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| 30. | The length of Moore machine compared to Mealy machine is: |
| Option A: | Equal to Mealy machine for given input |
| Option B: | Smaller than Mealy machine for given input |
| Option C: | One smaller than Mealy machine for given input |
| Option D: | One longer than Mealy machine for given input |
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| 31. | Derivation process is one which- |
| Option A: | Parses given string |
| Option B: | Generates new string |
| Option C: | Convert string to right linear grammar |
| Option D: | Convert string to left linear grammar |
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| 32. | Language of PDA is: |
| Option A: | Recursively Enumerable language |
| Option B: | Regular Language |
| Option C: | Context sensitive language |
| Option D: | Context free language |
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| 33. | The tuple Σ in Turing machine represents- |
| Option A: | Tape symbol |
| Option B: | Output symbol |
| Option C: | Tape alphabet |
| Option D: | Input alphabet |
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| 34. | A Turing Machine can compute problems which are- |
| Option A: | Complex |
| Option B: | Simple |
| Option C: | Unsolvable |
| Option D: | Computable |
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| 35. | Which of the following languages are most suitable for implementing context free languages? |
| Option A: | C |
| Option B: | Perl |
| Option C: | Assembly Language |
| Option D: | Compiler language |
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| 36. | With reference to the process of conversion of a context free grammar to CNF, the number of variables to be introduced for the terminals are: S→AB0 A→001 B→A1 |
| Option A: | 3 |
| Option B: | 4 |
| Option C: | 2 |
| Option D: | 5 |
|  |  |
| 37. | Next move function δ of a Turing machine M = (Q, Σ  , Γ, δ, q0, B, F) is a mapping |
| Option A: | δ : Q x Σ  → Q x Γ |
| Option B: | δ : Q x Γ → Q x Σ x {L,  R} |
| Option C: | δ : Q x Σ → Q x Γ  x {L, R} |
| Option D: | δ  : Q x Γ  → Q x Γ x {L, R} |
|  |  |
| 38. | 1. Which of the following grammars are in Chomsky Normal Form: |
| Option A: | S→AB|BC|CD, A→AB B→CD, C→2, D→3 |
| Option B: | S→AB, S→BCA|0|1|2|3 |
| Option C: | S→ABa, A→aab, B→Ac |
| Option D: | S→ABa, A→AAB, B→Ac |
|  |  |
| 39. | 1. The lexical analysis for a high level language needs the power of which one of the following machine models? |
| Option A: | Turing Machine |
| Option B: | Deterministic pushdown automata |
| Option C: | Finite state automata |
| Option D: | Non-Deterministic pushdown automata |
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| 40. | Which of the following relates to Chomsky hierarchy? |
| Option A: | Regular<CFL<CSL<Unrestricted |
| Option B: | CFL<CSL<Unrestricted<Regular |
| Option C: | CSL<Unrestricted<CF<Regular |
| Option D: | CSL<Unrestricted< Regular<CF |
|  |  |
| 41. | (r+s)\* is equivalent to: |
| Option A: | s\*r\* |
| Option B: | (r\*s\*)\* |
| Option C: | r\*s\* |
| Option D: | rs |
|  |  |
| 42. | X→Y |α is the production rule for\_\_\_\_\_\_\_\_ |
| Option A: | Regular Grammar |
| Option B: | Context Free Grammar |
| Option C: | Right Linear Grammar |
| Option D: | Left Linear Grammar |
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| 43 | Let L={ab,aa,baa},then which of the following does not belong to the L\*? |
| Option A: | ε |
| Option B: | abab |
| Option C: | abba |
| Option D: | aaabbaa |
|  |  |
| 44. | *Epsilon*-closure of a state is a combination of self state and \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Option A: | Initial state |
| Option B: | Final state |
| Option C: | Non-epsilon reachable state |
| Option D: | ε reachable state |
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| 45. | Number of states required to accept the string that ends with 10. |
| Option A: | 1 |
| Option B: | 2 |
| Option C: | 3 |
| Option D: | 4 |
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| 46. | The finite automata is called NFA when there exists\_\_\_\_\_\_\_\_\_\_\_\_ for a specific input from current state to next state. |
| Option A: | More than one paths |
| Option B: | Single path |
| Option C: | No path |
| Option D: | Infinite paths |
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| 47. | Which of the following is FALSE: |
| Option A: | Any given mealy machine has an equivalent moore machine. |
| Option B: | Any given moore machine has an equivalent mealy machine. |
| Option C: | Mealy and moore machines are FSM with output capability. |
| Option D: | Moore machine does not have an equivalent mealy machine. |
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| 48. | The transition function of deterministic finite automata is \_\_\_\_\_\_\_\_\_\_ and non-deterministic finite automata is \_\_\_\_\_\_\_\_\_\_\_ |
| Option A: | δ: Q x ∑→Q       δ: Q x ∑→2Q |
| Option B: | δ: Q x ∑→Q       δ: Q x ∑→Q2 |
| Option C: | δ: Q x ∑→{Q,∑}         δ: Q x ∑→2Q |
| Option D: | δ: Q x ∑→{Q,∑}         δ: Q x ∑→Q |
|  |  |
| 49. | Generation of a language using specific rule is called\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Option A: | Optimization |
| Option B: | Derivation |
| Option C: | Analysis |
| Option D: | Transition |
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| 50. | In a production rule, if one non-terminal derives another non-terminal then it is called as\_\_\_\_\_\_\_\_ |
| Option A: | ε-Production |
| Option B: | Null Production |
| Option C: | Useless Symbol |
| Option D: | Unit Production |
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| 51. | Which of following does not belong to 4-tuples of CFG? |
| Option A: | Start Symbol |
| Option B: | Terminal Symbol |
| Option C: | Non-terminal symbol |
| Option D: | End symbol |
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| 52. | In simplification of grammar, the variable which produces an epsilon is called\_\_\_\_ |
| Option A: | terminal |
| Option B: | nullable |
| Option C: | Empty variable |
| Option D: | Useless symbol |
|  |  |
| 53. | Which of the following productions are not accepted by Chomsky Grammar? |
| Option A: | A→ABC |
| Option B: | A→BC |
| Option C: | A→a |
| Option D: | A→ ε |
|  |  |
| 54. | \_\_\_\_\_\_\_\_\_\_is accepted by Non-deterministic PDA but not by deterministic PDA. |
| Option A: | Even Palindromes |
| Option B: | Odd Palindromes |
| Option C: | Equal no of a’s and b’s |
| Option D: | String ending with a particular terminal |
|  |  |
| 55. | The language, {anbn | n>=1} is generated by the CFG: |
| Option A: | S → aSb | ab | ε |
| Option B: | S→ aaSbb | ε |
| Option C: | S → aaSbb | aabb |
| Option D: | S→aSb | ab |
|  |  |
| 56. | Transition function of Turing machine is given by: |
| Option A: | Q x ∑ →Q x ∑ x {L,R} |
| Option B: | Q\* x ∑ →Q x ∑ x {L,R} |
| Option C: | Q x ∑ \*→Q x ∑ x {L,R} |
| Option D: | Q x ∑ →Q\* x ∑\* x {L,R} |
|  |  |
| 57. | According to Chomsky hierarchy, Recursively Enumerable language comes under\_\_\_\_\_\_\_\_\_\_\_ |
| Option A: | Type 0 |
| Option B: | Type 1 |
| Option C: | Type 2 |
| Option D: | Type 3 |
|  |  |
| 58. | Which of the following can accept even palindrome over {a,b}? |
| Option A: | Deterministic Push down Automata |
| Option B: | Turing machine |
| Option C: | NDFA |
| Option D: | DFA |
|  |  |
| 59. | If*L* and  L’ are recursively enumerable, then*L* is |
| Option A: | regular |
| Option B: | Context sensitive |
| Option C: | Context free |
| Option D: | recursive |
|  |  |
| 60. | In a compiler, keywords of a language are recognized during: |
| Option A: | Parsing of the program |
| Option B: | Code generation |
| Option C: | Lexical analysis of the program. |
| Option D: | Data flow analysis |
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Descriptive Questions

| **10 marks each** |
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| 1. Explain the concepts, acceptance by final state and acceptance by empty stack of a Pushdown automata. Construct a PDA for the language, L={ a2nbn | n ≥ 1} |
| 2. Give a formal definition of Turing Machine (TM). Design a TM that performs the addition of two unary numbers. (transition table and diagram both are expected) |
| 3. Write a short note on Chomsky hierarchy. Convert the following grammar to Chomsky Normal Form:  S→ABA  A→ aA | ε  B→bB | ε |
| 4. Construct a Mealy machine and Moore machine for the following:  For input from, ∑\*, where ∑= (0,1), if the input ends in ‘101’, the output should be ‘x’; if the input ends in ‘110’, output should be ‘y’ otherwise output should be ‘z’. (transition table and diagram both are expected) |
| 5. Convert the given grammar G to CNF. G: S → a | aA | B |C , A → aB | ε , B →Aa, C →aCD | a, D → ddd. |
| 6. Design a Turing Machine for 2’s Complement of a binary number |
| 7. Design PDA for odd length palindrome let Σ = {0, 1}, 𝐿 = {wcw*R*} 𝑤ℎ𝑒𝑟𝑒 w ϵ Σ \* |
| 8. Construct DFA for given regular expression (a+b)\* aba (a+b)\* |
| 9. Design Turing Machine to accept language L={ anbncn | n≥1} |
| 10. Consider the following grammar  S→ aB | bA  A→ a | aS | bAA  B→ b | bS | aBB  with S as start symbol ,find Left most derivation, Right most derivation and parse tree for the string ‘bbaaabbaba’. |
| 11. Construct Turing Machine accepting palindromes over Σ={a,b} |

| **5 marks each** |
| --- |
| 1. Give formal definition of NFA. Construct a DFA equivalent to the NFA:  ( {p, q, r, s},{0,1},δ, p, {q,s}), where ‘δ’ is given by:     | ∑  Q | 0 | 1 | | --- | --- | --- | | →p | q,r | q | | q\* | r | q,r | | r | s | p | | s\* | -- | p | |
| 2. Consider the following CFG:  G = { (S, A), (a, b), P, S},  where P consists of :  S→aAS | a  A→SbA | SS | ba  Derive the string ‘aabbaa’ using leftmost derivation and rightmost derivation. |
| 3. Give regular expression for  a. All strings containing an even number of 0's over the alphabet {0,1}  b. All strings that do not end with ‘ab’ over the alphabet {a,b} |
| 4. Construct a DFA that reads a strings made up of {0,1} and accepts only those strings which end in either ‘00’ or ‘11’. (transition table and diagram both are expected) |
| 5. Briefly explain the types of Turing Machine. |
| 6. Construct a Context-free grammar equivalent to the following Push Down Automata ( described with the help of the given set of equations):  δ (q0, b, Z0 ) = {( q0,ZZ0) }  δ (q0, ε, Z0 ) = {( q0, ε) }  δ (q0, b, Z ) = {( q0,ZZ) }  δ (q0, a, Z ) = {( q1,Z) }  δ (q1, b, Z ) = {( q0, ε) }  δ (q1, a, Z0 ) = {( q0,Z0) } |
| 7. Construct DFA to accept strings that ends with substring 110 for Σ={0,1} |
| 8. Design a Moore machine which counts the occurrence of substring bab in an input string for Σ = {a, b}. |
| 9. Give Regular Expressions for  i) For all strings over a,b which contains exactly 3 occurrence of b over Σ={a,b}  ii) For all strings over 0,1 that starts with 10 and ends with 01 |
| 10. Let G be the grammar having the following set of production.  S→ABA,  A→aA | bA |  B→bbb  Find LMD and RMD for string “ababbbba” |
| 11. Write Short Note on Chomsky Hierarchy |
| 12. Compare and Contrast between FA, PDA and TM |
| 13. Give Regular Expression for a language over the alphabet Σ={a,b} containing at most two a’s |
| 14. Convert Following CFG grammar into CNF  Sa→AbB  A→Aa|a  B→bB|b |
| 15. Design PDA to check well formedness of parenthesis. |
| 16. Design a Moore Machine for binary adder |
| 17. State and explain closure properties of regular languages |
| 18. Differentiate between Moore and Mealy machine |