



MCA DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Second Semester

MASTER OF COMPUTER APPLICATIONS

P13MAT202: Mathematical Foundations of Computer Science

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

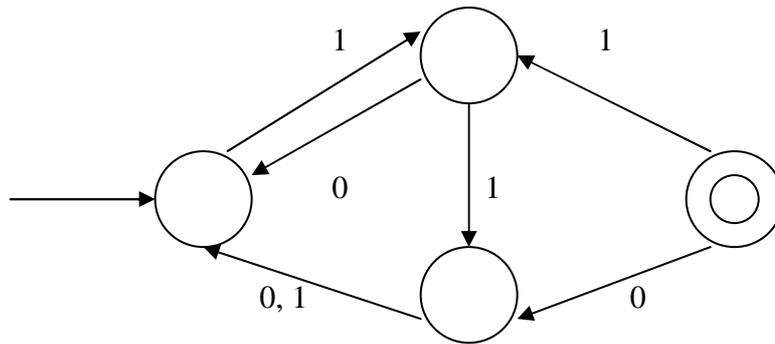
1. Find the rank of matrix $A = \begin{pmatrix} 1 & 1 & 2 \\ 1 & 2 & 5 \\ 5 & 3 & 4 \end{pmatrix}$
2. State Cayley Hamilton theorem.
3. If $A \subseteq B$ then prove that $A \cup (B - A) = B$.
4. Show that the function f defined by $f : Q \rightarrow Q$ such that $f(x) = 3x + 4$, for all $x \in Q$ is one-one.
5. Using truth table, prove that $\neg(p \vee q) = \neg p \wedge \neg q$
6. Let $A = \{1, 2, 3, 4, 5\}$. Determine the truth value of the statement: $(\exists x \in A)(x + 3 = 10)$.
7. Define a phrase structure grammar.
8. What do you mean by ambiguous grammar?
9. Construct a NFA for the language $L = \{ a^m b / m \geq 1 \}$.
10. How does an NFA differ from a DFA?

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

Q.No:11 is Compulsory

11. Which of the following strings are recognized by the DFA?



i) 010

ii) 1101

iii) 1111110

iv) 010101010

12. (i) Determine the eigen values and eigen vectors of the matrix $A = \begin{pmatrix} 2 & 0 & 4 \\ 0 & 6 & 0 \\ 4 & 0 & 2 \end{pmatrix}$. (8)

(ii) Solve the following system of equations: (8)
 $x + 2y + z = 3$; $2x + 3y + 3z = 10$; $3x - y + 2z = 13$.

13. (i) In a group of 200 people, each of whom is at least accountant or management consultant or sales manager, it was found that 80 are accountants, 110 are management consultants and 130 are sales managers, 25 are accountants as well as sales managers, 70 are management consultant as well as sales managers, 10 are all the three. Find the number of those people who are accountants as well as management consultants but not sales managers. (6)

(ii) Let $A = \{1, 2, 3\}$, $B = \{a, b, c\}$ and $C = \{x, y, z\}$ and let $R_1 = \{(1, a), (2, c), (3, a), (3, c)\}$ and $R_2 = \{(b, x), (b, z), (c, y)\}$ (10)

a) Find the composition relation $R_1 \circ R_2$.

b) Find the matrices M_{R_1} , M_{R_2} and $M_{R_1 R_2}$ of respective relations

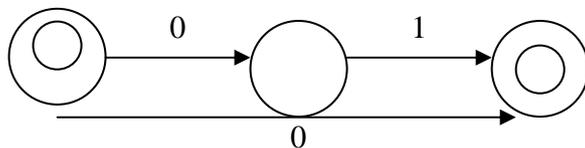
R_1 , R_2 and $R_1 \circ R_2$.

14. (i) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent by developing a series of logical equivalences. (6)

(ii) Obtain the principal disjunctive and conjunctive normal forms of $(p \rightarrow (q \wedge r)) \wedge (\neg p \rightarrow (\neg q \wedge \neg r))$. (10)

15. (i) Construct a grammar G generating $L = \{a^n b^n c^n, n \geq 1\}$. (8)
- (ii) State Pumping lemma and prove that $L = \{a^n / n \text{ is a prime number}\}$ is not regular. (8)

16. (i) Determine the language accepted by the NFA (8)



- (ii) Prove that if L is accepted by NFA, then there exists a DFA to accept L. (8)
