27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT/ BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

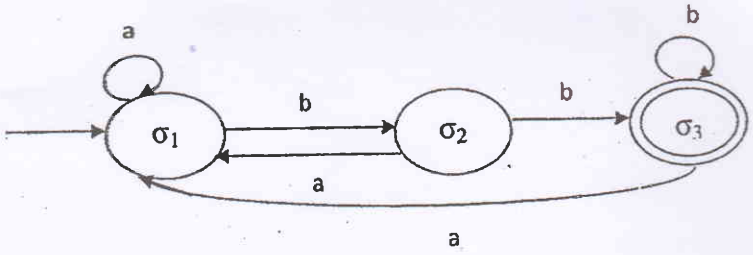
Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All questions**.*
- ✓ *The figures **in the margin** indicate **Full Marks**.*
- ✓ *Assume **suitable data** if necessary.*

1. Define the terms Tautology, Contradiction and Logical Equivalences. Show that $\neg A \rightarrow \neg B$ and $B \rightarrow A$ are Logically Equivalent. State the converse, contrapositive and inverse of the statement, "A positive integer is prime only if it has no divisors other than 1 and itself". [3+2+3]
2. Show that the premises "There is someone in this class who has been to Pokhara. Everyone who goes to Pokhara visit the Sarankot. Therefore, someone in this class has visited the Sarankot." [8]
3. Use mathematical induction to verify: [8]

   $1^2 - 2^2 + 3^2 - 4^2 + \ldots\ldots\ldots + (-1)^{(n+1)} n^2 = (-1)^{n+1} n(n+1)/2$
4. a) Stafe the closure properties of Regular Language. [3]

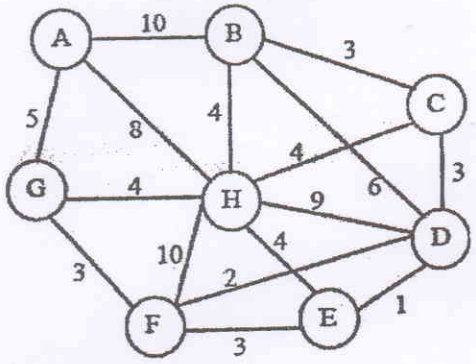
   b) Let L be the set of strings accepted by the FSA shown below. Now construct a FSA that accepts the strings $L^R = \{X_n \ldots\ldots X_1 | X_1 \ldots\ldots X_n \in L\}$ [5]



5. i) Find the language L(G) overs, {a,b,c} generated by the grammer,G with production: S→aSb, aS→Aa, Aab→c. [4+4]

   ii) Write a grammer that generates the string over {a,b} not ending with ab.
6. Find the solution of recurrence relation of $a_n = 5a_{n-1} - 6a_{n-2} + 3n + 2^n$. with initial condition $a_0 = 0, a_1 = 1,$ and $a_2 = 2$. [8]
7. Prove the theorem, "An undirected graph has an even number of vertices of odd degree." Describe complete graph and bipartite graph. [3+5]
8. What is chromatic number of $K_5, K_{m,n}$ and C_p for $P \geq 3$, explain with suitable figure. How Euler graph is different from Hamilton graph, explain? [5+3]

9. Use Dijkstra's algorithm to find the length of a shortest path from the vertices A to other in the graph below. [8]



10. Write short notes on: [4+4]

i) Max Flow and Min cut Theroem
ii) Plannar Graph

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47 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

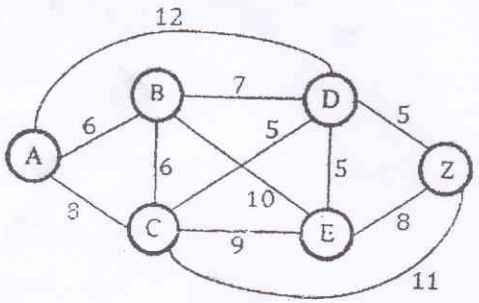
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Use rules of inference to show that the hypothesis "If my cheque book is in office, then I have paid my telephone bill", "I was looking for phone bill at breakfast of I was looking for phone bill in my office", "If I was looking for phone bill at breakfast then my cheque book is on breakfast table", "If I was looking for phone bill in my office then my cheque book is in my office", "I have not paid my phone bill" imply the conclusion "My cheque book is on my breakfast table." [8]
2. Write the inverse, converse and contrapositive of the statement "I visit temple only if it's Saturday". Prove that if n is a positive integer, then n is even if and only if $7n + 4$ is even. [3+5]
3. Define tableau method with its significances? Use mathematical induction to prove the formula for the sum of a finite number of terms of Geometric Progression: [4+4]

   $\sum_{j=0}^{n} ar^j = a + ar + ar^2 + ... + ar^k = \frac{ar^{n+1} - a}{r-1}$,
   when $r \neq 1$, where n is non-negative integer.

4. Given a language, $L = \{w \in \{a, b\}^* : w$ contain at-least three 'b' s$\}$

   Write the regular expression for L and design a Finite State Automata that accepts the Language L. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
5. Consider the regular grammar $G=\{N, T, P, \sigma\}$ where N = set of non-terminal symbols = $\{\sigma, C\}$, T = set of terminal symbols = $\{a, b\}$, P is the set of production rules = $\{\sigma \rightarrow b\sigma, \sigma \rightarrow aC, C \rightarrow bC, C \rightarrow b\}$ and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to the given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [3+5]
6. State linear homogeneous and non-homogeneous recurrence relation with examples. Find all solutions of the recurrence relation: $a_n = 2a_{n-1} + 2n^2$ with initial condition $a_1 = 4$. [3+5]
7. Use Dijkstra's algorithm to find the length of shortest path from vertex A to vertex Z in the following weighted graph. Also highlight the shortest path/paths in the graph: [8]



8. State Handshaking Theorem for undirected graph. Define bipartite graph with suitable example. Draw the figure for Complete Bipartite Graph $K_{3,4}$ and determine its chromatic number. [2+2+2+2]

9. How does Hamiltonian circuit differ from Euler circuit? Define Planar and Regular graphs with suitable examples. [4+2+2]

10. Write short notes on: [4+4]

    a) Tree and its applications
    b) Max-flow Min-cut Theorem

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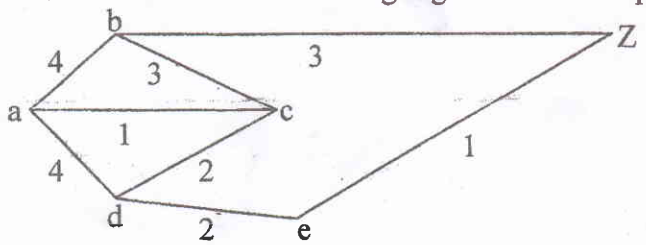
47 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Hypothesis: "If today is Sunday then I will have a test in MFC and IT. If my IT teacher is sick then I will not have a test in IT. Today is Sunday and my IT teacher is sick." Conclusion: "I will have a test in MFC." Use rule of inference to prove it. [8]
2. What do you mean by weak principle of mathematical induction? Prove that $5^n - 1$ is divisible by 4 for all $n \geq 1$ using Induction method. [3+5]
3. What are the central ideas of formal and informal proofs? Prove that $\sqrt{2}$ is irrational. [4+4]
4. Define Non-Deterministic Finite State Automata. Design a finite-state automation that accepts only those set of strings over {a,b} which ends with *aba*. Precisely, only those strings which end with *aba* should accepted and other strings over {a,b} should be rejected. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
5. Consider the regular grammar G = (N, T, P, σ) where N =set of non-terminal symbols = {σ, C), T = set of terminal symbols = {a, b}, P is the set of production rules = {a→bσ, σ→aC, C→bC, C→b}and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to the given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [4+4]
6. What do you understand by recurrence relation? Explain in brief. Setup a recurrence relation for the sequence representing the number of moves needed to solves Hanoi Tower puzzle. [3+5]
7. Draw neat and clean graphs of: W_6 (a wheel with 6 peripheral vertices), K_6 (a complete graph with 6 vertices, Q_3 (a 3 dimensional hypercube) and $K_{2,5}$ (complete bipartite graph). Use graph coloring technique to color each of these graphs and state their respective chromatic numbers. [4+4]
8. Find the shortest path from vertex a to vertex Z Highlight the shortest paths in the graph. [6+2]



9. Explain the Euler circuit and Hamilton circuit with example. State the necessary and the sufficient conditions for them. [2+2+2+2]
10. Write short notes on: [4+4]
    i) Spanning Trees
    ii) Max-flow min-cut theorem

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Using resolution principle, prove that the hypotheses "If today is Tuesday then I will have a test in Discrete Structure or Microprocessor". If my Microprocessor teacher is sick then I will not have a test in Microprocessor." and "Today is Tuesday and my Microprocessor teacher is sick." lead to the conclusion that "I will have a test in Discrete Structure". [8]

2. Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. Draw the tableau for the formula $(T \vee S) \rightarrow \neg Q$ where $\neg$ denotes the negation of variable, $\vee$ denotes the disjunction of variables and $\rightarrow$ is the symbol for implication. [5+3]

3. State the contrapositive and inverse of the conditional statement, "If it snows tonight then I will stay at home". Using mathematical induction technique, prove that the following statement is true: $3+3*5+3*5^2+.....3*5^n=3(5^{n+1}-1)/4$ whenever n is nonnegative integer. [2+6]

4. Differentiate between a Finite State Machine and a Finite State Automation. Design a Finite State Automata that accepts precisely those string over {a,b} that contains an even no. of a's. Your design should include the proper definition of the Finite State Automata, transition table and the transition diagram. [2+6]

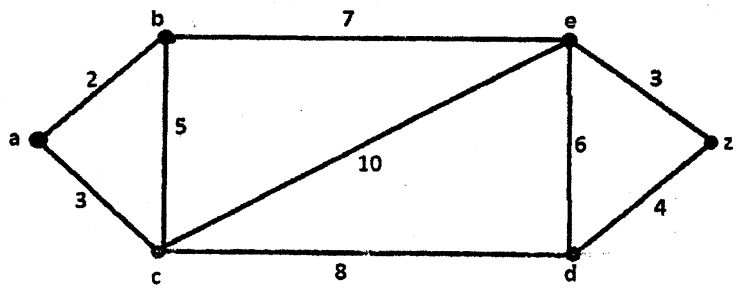
5. Consider the regular grammar G = (N, T, P, σ) where N = set of non-terminal symbols = {σ, C}, T = set of terminal symbols = {a,b}, P is the set of production rules = {σ→bσ, σ→aC, C→bC, C→b} and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [4+4]

6. Find all the solutions of the recurrence relation: [8]
$a_n = 5a_{n-1} - 6a_{n-2} + 2^n$ with initial conditions $a_0 = 1$ and $a_1 = 4$

7. Explain the Euler path and Euler circuit with the help of a diagram. State the necessary and the sufficient conditions for Euler circuits and paths. [5+3]

8. Draw neat and clean graphs of: C_7 (a cycle with 7 vertices), K_5 (a complete graph with 5 vertices), Q_3 (a 3 dimensional hypercube) and $K_{3,4}$ (complete bipartite graph). Use graph coloring technique to color each of these graphs and state their respective chromatic numbers. [4+4]

9. Use Dijkstra's algorithm to find the length of shortest path in the following weighted graph. Also highlight the shortest path/paths in the graph: [8]



10. Write short notes on: [4+4]
    i) Maximum Flow Mincut Theorem
    ii) Handshaking Theorem

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47 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Use resolution to show the hypothesis "It is note raining or Sita has her umbrella," "Sita does not have her umbrella or she does not get wet," and "It is raining or Sita does not get wet" imply that "Sita does not get wet." [8]

2. Use mathematical induction to show that [8]

$1^3 + 2^3 + ... + n^3 = [n(n + 1)/2]^2$

whenever n is a positive integer.

3. State the converse, contrapositive and inverse for the conditional statement, "I go to the beach whenever it is a sunny summer day." [3]

4. Why is a tableau method important in propositional logic? Draw the tableau for the formula [2+3]

$\Phi = (p \wedge \neg q) \rightarrow s$

Where $\neg$ denotes the negation of a variable, $\wedge$ denotes the conjunction of variables and $\rightarrow$ denotes the implication.

5. Differentiate between Finite State Machines and Finite State Automata. Design a Finite State Automata that accepts precisely those strings over {a, b} that contain an odd number of b's. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]

6. Consider the regular grammar G = (N, T, P, σ) where N = Set of Non-Terminals = {σ, A, B}, T = Set of Terminals = {a, b} with productions. [4+4]

σ→aA, σ→bB, A→a, B→a and starting symbol σ.

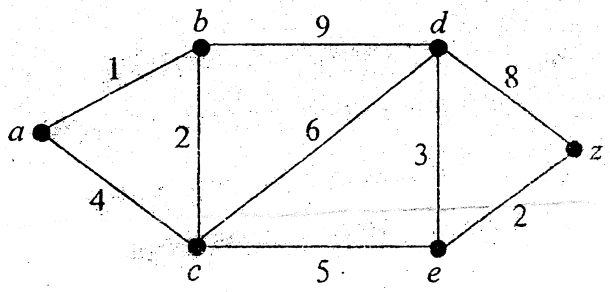
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

7. Find all solutions of the recurrence relation [8]

$a_n = 3a_{n-1} + 2^n$

with initial condition $a_0 = 5$.

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



9. Draw the figure for the complete graph with 6 vertices (This is usually denoted by K_6). Define the term graph coloring and the chromatic number of a graph coloring. What is the chromatic number of the complete graph K_6? [2+2+2+2]

10. Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram. State the necessary and sufficient conditions for Euler circuits and paths. How is Euler circuit different from the Hamiltonian circuit? [3+2+2]

11. Write short notes on: [3+3+3]

a) Spanning tree
b) Cutsets and Cutvertices
c) Application of trees

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37 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. If P = F, Q = T, S = T, R = F, then find truth value of: [4+4]
   a) $(S \rightarrow (P \wedge \overline{R}) \wedge ((P \rightarrow (R \vee Q)) \wedge S)$
   b) $((P \wedge \overline{Q}) \leftrightarrow (Q \wedge R)) \rightarrow (S \vee \overline{Q})$
2. Using rules of inferences, show that the hypothesis "It is not rainy today and its hotter than yesterday", "We will go for movie only if it is rainy", "If we do not go for movie, then we will go for shopping", and "If we go for shopping, then we will be home by sunset" lead to the conclusion "We will be home by sunset". You are required to show each steps and give reasons for those steps before you come to desired conclusion from the hypothesis. [8]
3. Prove by Mathematical Induction: [8]
   $1.2.3 + 2.3.4 + 3.4.5 + \ldots\ldots + n(n+1)(n+2) = n(n+1)(n+2)(n+3)/4$
4. Design a Finite State Machines (FSM) that performs binary serial addition. Define DFA and NDFA. Construct DFA that recognize the language "The set of bit brings that do not contain three consecutive 0's. Show only necessary figures and state diagrams. [3+2+3]
5. Define and differentiate between context-sensitive, context free and regular grammars with suitable examples. Explain in short the role of regular expressions. [6+2]
6. What do you understand by recurrence relation? Explain in brief. Derive and solve the recurrence relation for Tower of Hanoi puzzle. [2+6]
7. Is $K_{3,3}$ graph a planar graph? Explain it with suitable reasons. [4+4]
8. Define Regular and Bipartite graphs with suitable examples. [3+3]
9. Define level and height of tree? What is full m-ary tree and balanced tree? [2+2]
10. State the handshaking theorem for the undirected graph and use it to prove the theorem that an undirected graph has an even number of vertices of odd degree. [2+4]
11. Write down the short notes on the following: [4+4]
    a) Maximum Flow Mincut Theorem
    b) Graph Coloring

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37 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Construct an argument using rules of inference to show that the hypotheses "Randy works hard," "If Randy works hard, then he is a dull boy," and "If Randy is a dull boy, then he will not get the job" imply the conclusion "Randy will not get the job." [8]

2. Use mathematical induction to show that [8]
$1^2 + 2^2 + \bullet\bullet\ \bullet\bullet + n^2 = n(n+1)(2n+1)/6$
whenever n is a positive integer.

3. State the converse, contrapositive and inverse for the conditional statement, "A positive integer is a prime only if it has no divisors other than 1 and itself." [3]

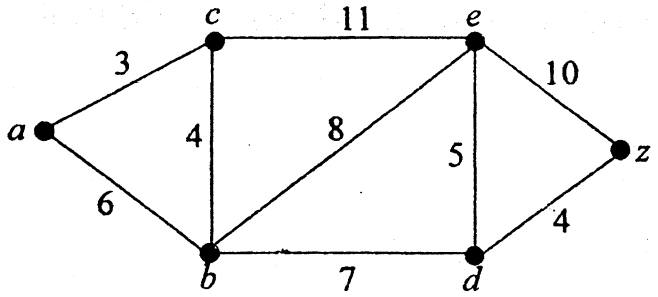
4. Define satisfiable and unsatisfiable formulas. Draw the tableau for the formula [2+3]
$\Phi = \neg((p \wedge q) \vee r)$
where $\neg$ denotes the negation of a variable, $\vee$ denotes the disjunction of variables and $\wedge$ denotes the conjunction of variables.

5. Define Finite State Machines. Design a Finite State Automata that accepts precisely those strings over {a, b} that contain two consecutive a's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6]

6. Consider the regular grammar G = (N, T, P, σ) where N= Set of Non-Terminals = {σ, A, B}, T= Set of Terminals = {a, b} with productions [4+4]
$\sigma \to a$, $\sigma \to bB$, $A \to bA$, $A \to aB$, $A \to b$, $A \to a$, $B \to b$ and starting symbol σ.
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

7. Find all solutions of the recurrence relation [8]
$a_n = 2a_{n-1} + 2^n$
with initial condition $a_0 = 2$.

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



9. Draw the figure for the complete graph with 5 vertices (This is usually denoted by K_5). Define the term graph coloring and the chromatic number of a graph in graph coloring. What is the chromatic number of the complete graph K_5. [2+2+2+2]

10. Construct an influence graph for the board members of a company if the President can influence the Director of Research and Development, the Director of Marketing, and the Director of Operations; the Director of Research and Development can influence the Director of Operations; the Director of Marketing can influence the Director of Operations; and no one can influence, or be influenced by, the Chief Financial Officer. [4]

11. How is Euler circuit different from the Hamiltonian circuit? Explain [3]

12. Write short notes on [3+3+3]
    a) Spanning tree and its applications
    b) Network Flows
    c) Regular graphs

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37 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt **All** questions.*
- *The figures in the margin indicate **Full Marks**.*
- *Assume suitable data if necessary.*

1) Using rules of inferences, show that the hypotheses "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." You are required to show each steps and give reasons for those steps before you come to the desired conclusion from the hypotheses. **(8)**

2) Use mathematical induction to prove that **(8)**
$3 + 3 \cdot 5 + 3 \cdot 5^2 + \ldots\ldots + 3 \cdot 5^n = 3(5^{n+1} - 1) / 4$
whenever n is a nonnegative number.

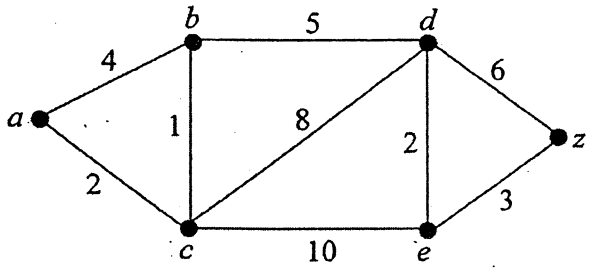
3) Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. Draw the tableau for the formula $(T \vee S) \rightarrow \neg Q$ where $\neg$ denotes the negation of a variable, $\vee$ denotes the disjunction of variables and $\rightarrow$ is the symbol for implication. **(5+3)**

4) Design a finite-state automaton that accepts only those set of strings over $\{a, b\}$ which starts with *baa*. Precisely, only those strings which begin with *baa* should be accepted and other strings over $\{a, b\}$ should be rejected. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. **(3+2+3)**

5) Discuss regular expressions and regular languages in detail with suitable examples. Explain the different properties of regular languages. **(4+4)**

6) Find all solutions of the recurrence relation **(8)**
$a_n = 2a_{n-1} + 3^n$
with initial condition $a_1 = 5$.

7) Use Dijkstra's algorithm to find the length of the shortest path between the vertices *a* and *z* in the weighted graph displayed below. **(8)**



8) Draw the figure for the complete bipartite graph $K_{3,4}$ and the cycle graph with 5 vertices (This is usually denoted by C_5). What is the chromatic number of the drawn complete bipartite graph $K_{3,4}$ and the cycle graph C_5. **(2+2+2+2)**

9) State the handshaking theorem for the undirected graph and use it to prove the theorem that an undirected graph has an even number of vertices of odd degree. **(2+4)**

10) Write short notes on: - **(4+3+3)**
   a) Eulerian graph
   b) Hamiltonian graph
   c) Spanning tree

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37 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure *(CT551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1 Construct an argument using rules of inference to show that the hypotheses "If it does not rain or if it is not foggy, then the sailing race will be held and the lifesaving demonstration will go on," "If the sailing race is held, then the trophy will be awarded," and "The trophy was not awarded" imply the conclusion "It rained." You are required to show each step and give reasons for those steps before you come to the desired conclusion from the hypotheses. [8]

2 Use mathematical induction to prove the inequality $n < 2^n$ for all positive integers n. [8]

3 Why tableau method is important in the propositional logic? Draw the tableau for the formula set [2 + 6 = 8]
$\Phi = \{(p \wedge \neg q) \rightarrow s, \neg q \vee \neg r, p \wedge t\}$
where $\neg$ denotes the negation of a variable, $\vee$ denotes the disjunction of variables, $\wedge$ denotes the conjunction of variables and $\rightarrow$ denotes the implication.

4 Differentiate between Deterministic Finite State Automata and Non-Deterministic Finite State Automata. Design a Finite State Automata that accepts precisely those strings over {a, b} that contain an even number of a's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6 = 8]

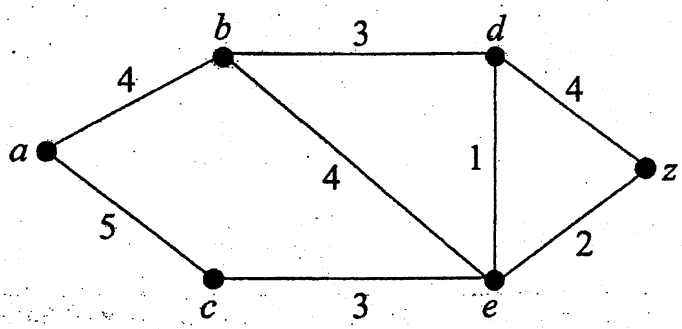
5 Consider the regular grammar defined by T={a, b}, N={σ, C} with productions [4 + 4 = 8]
$\sigma \rightarrow b\sigma$, $\sigma \rightarrow aC$, $C \rightarrow bC$, $C \rightarrow b$ and starting symbol σ.
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

6 Find all solutions of the recurrence relation [8]

$a_n = 7a_{n-1} - 16a_{n-2} + 12a_{n-3} + n4^n$

with initial condition $a_0 = -2$, $a_1 = 0$ and $a_2 = 5$.

7 Use Dijkstra's algorithm to find the length of the shortest path between the vertices *a* and *z* in the weighted graph displayed below. [8]



8 Draw the figure for the complete bipartite graph $K_{4,5}$ and the cycle graph with 6 vertices (This is usually denoted by C_6). What is the chromatic number of the drawn complete bipartite graph $K_{4,5}$ and the cycle graph C_6. [2+2+2+2]

9 Define a tree and discuss its various properties as well as applications of trees. [1+2+4=7]

10 Write short notes on: - [3+3+3=9]

a) Eulerian graph
b) Max flow, min cut theorem
c) Planar and regular graphs

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