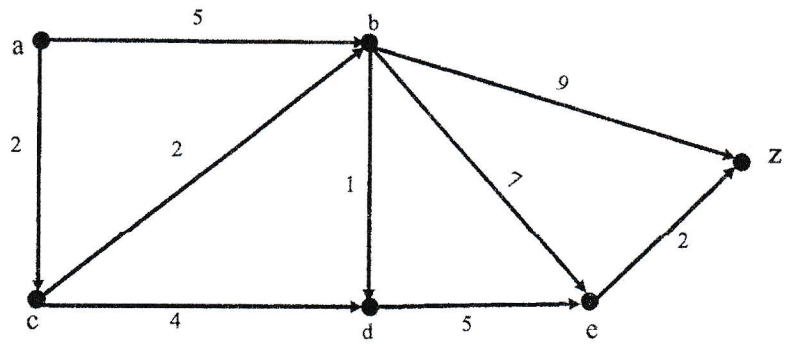
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

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

Subject: - Discrete Structure (*CT 551*)

- ✓ 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 "No humans can fly.", "Tweety is a bird or a human.", "Tweety can fly" implies the conclusion "Tweety is a bird". [8
2. Write the inverse, covers and contrapositive of the statement" If Covid Spreads then we will have online classes". Use a mathematical induction to prove, if n is non-negative integer, then (n^5-n) is divisible by 5. [3+5
3. Define consistency and Completeness of the Logical System. Draw Tableau for formula set:
   $\phi = \{(P \wedge Q) \vee R, P \rightarrow \neg Q, \neg P\}$ [2+6
4. Given a Language L= { Wε {a,b} × :W ends with 'ba'}. Write a regular expression and design a Finite state automata that accepts the language L. Your design should include proper definition of finite- state automation, transition table and transition diagram. [2+6
5. Consider the regular grammar [4+4
   G=(N,T,P,σ) where,
   Set of Non-Terminals, N = {σ,A,B}
   Set of Terminals, T = {a,b}
   Set of productions, P = {σ→ bB, σ → bA, A → aσ, B → bB, B → a, B → λ}
   and starting symbol σ.
   Construction a Non- Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into DFA.
6. Find all the solution of the recurrence relation: $a_n=6_{n-1} -8_{n-2} + 3^n$, where the initial conditions: $a_0=4$ and $a_1 = 10$. [8
7. Use Dijktra's algorithm to find the length of shortest path between vertices 'a' and 'z' in the graphs below. Also highlight the shortest path. [8



8. State Handshaking Algorithm for directed graph. Define Biparite graph with a suitable example. Draw a figure for complete biparite graph $K_{3,5}$ and determine its chromatic number. [2+2+2+2]
9. Define spanning tree with a suitable example. Prove that $K_{3,3}$ is non-planar graph. [3+5]
10. Write short notes on: [4+4]
    a) Breadth First and Depth First Traversal
    b) Cut Edges and Cut Vertices

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

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

Subject: - Discrete Structure *(CT 551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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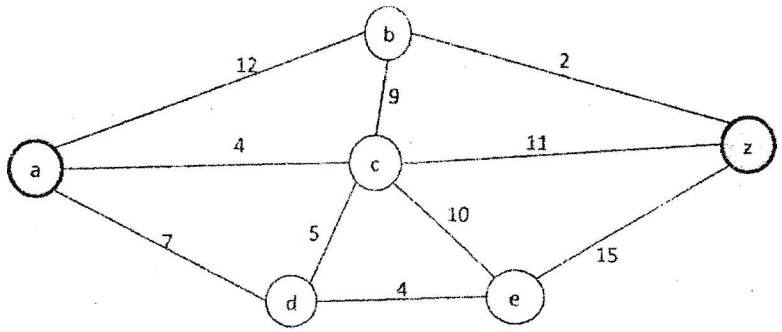
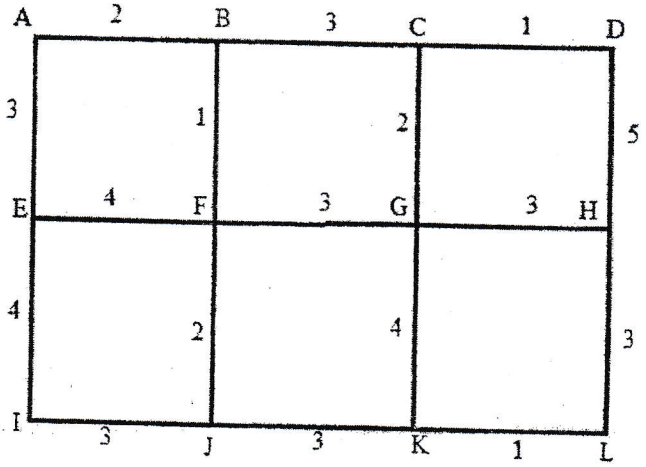
1. Define Valid Argument in Logic. "Somebody in this class enjoys whale watching. Every person who enjoys whale watching cares about ocean pollution. Therefore, there is a person in this class who cares about ocean pollution." Show whether the given argument is valid or not using rules of inference. [2+6]
2. What are "Counterexamples", explain with example. Use mathematical induction to prove: $1^3+2^3+3^3+\ldots+n^3=n^2(n+1)^4/4$ for all positive integer n. [2+6]
3. Prove that if n=ab, where a and b are positive integers, then $a\le\sqrt{n}$ or $b\le\sqrt{n}$. Determine whether the given expression is consistent or inconsistent using method of Tableaux: $(P\wedge Q\rightarrow R)\wedge(\neg P\rightarrow S)\wedge Q\wedge\neg R\wedge\neg S$ [3+5]
4. Define Finite state machine with example. Design a Finite State Automata that accepts precisely those strings over {a,b} that does not end with the substring "abb". 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 defined by T={a,b}, N={S, A} with productions S→bS, S→aA, A→bA, A→b and starting symbol S. [4+4]
   a) Construct a NDF A equivalen to the above given regular grammar.
   b) Convert the NDF A into equivalent DFA.
6. Find all solutions of recurrence relation: $a_n = 4a_{n-1}-4a_{n-2}+3^n$. Also, find the solution with initial conditions: $a_0=1$ and $a_1=2$. [8]
7. State and describe briefly the chromatic number of complete bipartitie graph $K_{3,4}$ and cycle C_5. Define Planar graph and show that K_5 is not a planar graph. [4+4]
8. Use Dijkstra's algorithm to find the length of shortest path form vertex 'a' to vertex 'z' in the following weighted graph. Also highlight the shortest path in the graph. [8]



9. Define Spanning Tree and Minimum Spanning Tree. Find the minimum spanning tree form the given graph below. [1+1+5]



10. Write short notes on: [3×3]

a) Max flow and Min cut theorem
b) Cut edges and Cut vertices
c) Euler graph.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Baisakh

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

Subject: - Discrete Structure *(CT 551)*

- ✓ 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. a) "A student in this class has not read the book" and "Everyone in this class passed the first exam" implies that conclusion "someone who passed the first exam has not read the book." [5]

   b) Let Q(x,y) denote (x+y=0). What is truth values of quantification $\exists y \forall x Q(x,y)$ and $\forall x \exists y Q(x,y)$. [3]

2. Show that $\{A \wedge C, (\neg A \vee B) \wedge (\neg B \vee \neg C)\}$ are unsatisfiability of the given set using method of tableaux. Prove that " If n is an integer and 3n+2 is odd, then n is odd." [5+3]

3. Use mathematical induction to prove that $7^{n+2}+8^{2n+1}$ is divisible by 57 for every non negative integer n. [8]

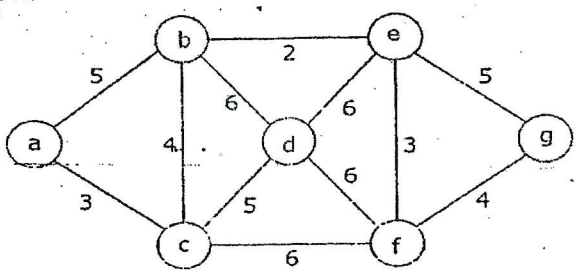
4. Design a FSA transition diagram that accepts the given set of string over {a,b}, [4+4]
   i) which starts with ab and ends with baa.
   ii) where every b is followed by a.

5. Design a Grammar to generate Palindrome for Binary Number. Consider the right linear Grammar N={N, T, P, S}, where N=set of non-terminal = {A, B, S}, T=Set of Terminal={a, b, c}, and P consists of the following rules: {S →abA/bbB/a, A→aA/bB/b, B→baB/aaaA}. Construct the NDFA equivalent to the given grammar. [4+4]

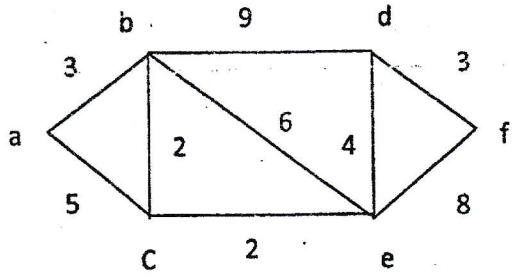
6. Find all the solutions of recurrence relation: [8]
   $a_n=3a_{n-1}+4a_{n-2}+3^n$ with initial conditions $a_0=1$ and $a_1=2$.

7. Are C_3 and C_6 bipartite, explain with figures. If G is a connected planar simple graph with E edges and V vertices, where V≥3, then prove that E≤ 3V-6. [4+4]

8. Define Binary tree, M-ary tree and Spanning tree. Find the minimal spanning tree from the graph given below. [3+5]



9. Use Dijkstra's Algorithm to find the length of shortest path from vertex a to vertex f in the following weighted graph. Also highlight the shortest path/paths in graph. [8]



10. Write short notes on: [4+4]
    a) Regular Graph with example.
    b) Max Flow and Min Cut Theorem

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

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

Subject: - Discrete Structure *(CT 551)*

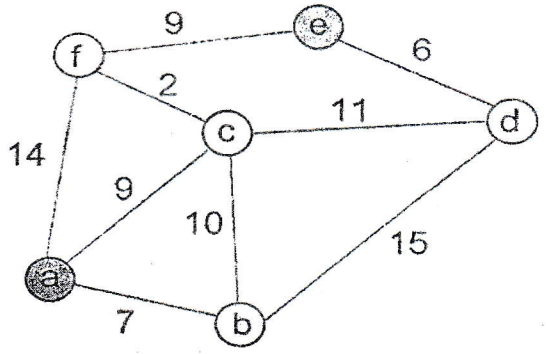
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Use rules of inference to show that the hypothesis "If you have password then you can log on to facebook." "If you can log on to facebook then you can create your page." "If you can create your page then you can post advertisement or you can create an event." "You cannot post advertisement or you cannot create an event." Imply the conclusion that "You donot have password." [8]
2. Define Universal and Existential quantifiers with example. Use mathematical induction to prove that $1 + 4 + 7 + \ldots + (3n - 2) = n(3n - 1) / 2$ for all non-negative integers n. [2+6]
3. State Converse, Contrapositive and Inverse for the conditional statements: "I will go for swimming only if it is a sunny day." [3]
4. Define satisfiable and unsatisfiable formula. Draw Tableau for formula set:
   $\Phi = \{P \rightarrow Q \vee R,\ P \vee \neg R,\ \neg(Q \vee R)\}$ [2+3]
5. Give a language, $L = \{w \in \{a, b\}^* : w$ contain substring 'aba'$\}$. 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 Finite State Automation, transition table and transition diagram. [2+6]
6. Consider the regular grammar

   $G = (N, T, P, \sigma)$ where
   Set of Non-Terminals, $N = \{\sigma, A, B\}$,
   Set of Terminals, $T = \{a, b\}$
   Set of productions, $P = \{\sigma \rightarrow aB, \sigma \rightarrow bA, \sigma \rightarrow \lambda, A \rightarrow aA, B \rightarrow aA, B \rightarrow a\}$
   and starting symbol σ.
   Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammer and convert this into equivalent DFA. [4+4]
7. Find all the solutions of recurrence relation: [8]

   $a_n = 3a_{n-1} + 4a_{n-2} + 3^n$ with initial conditions $a_0 = 1$ and $a_1 = 2$.
8. State and Explain Handshaking Theorem with example. Describe Cycle and Complete Bipartite Graphs along with their chromatic numbers. [4+4]

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



10. Define Spanning Tree and Minimum Spanning Tree with examples. Differentiate between Eulerian and Hamiltonian Graphs with examples. [4+4]

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

a) Max Flow and Min Cut Theorem
b) Cut Edges and Cut Vertices

27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

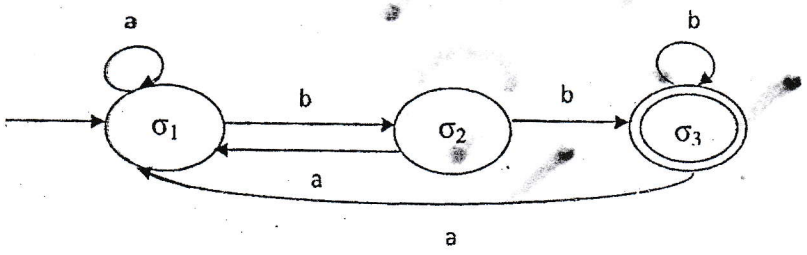
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT/ BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

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.*

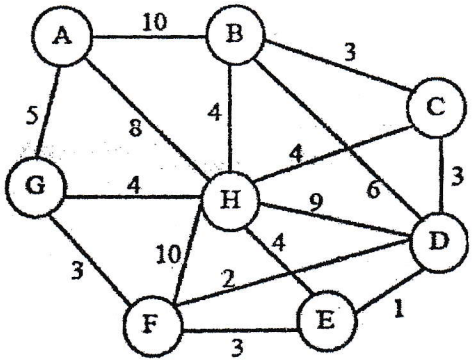
1. Define the terms Tautology, Contradiction and Logical Equivalences. Show that $\neg A \rightarrow \neg B$ and $B \rightarrow A$ are Logically Equivalent. State the converse, contrapositive and inverse of the statement, "A positive integer is prime only if it has no divisors other than 1 and itself". [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) State 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
2075 Baisakh

Exam.	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. a) Define proposition. List the various classes of propositions and describe about them. [1+2]

   b) Using rules of inferences show that the hypothesis " It is not rainy today and its hotter than yesterday", "we will go for shopping only if it is rainy", "If we do not go for shopping then we will go for swimming", and "If we go for swimming, then we will be home by sunset" lead to the conclusion "we will be home by sunset". Prove forming the each steps along with their justification. [5]

   c) Prove by mathematical induction

   "$4^{n+1}+5^{2n-1}$ is divisible by 21 for n as the positive integer". [8]

2. a) Design the finite state machine for the implementation of the S - R - Hip-Hop. Design the NDFSA that recognizes the substring starting with "abb" over the input I = {a, b}. [4+4]

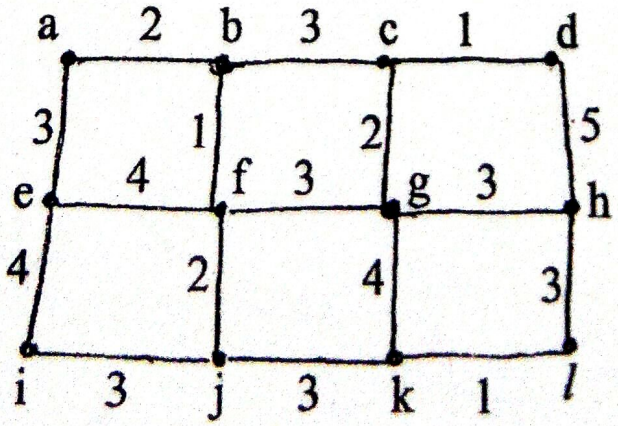
   b) Define the context sensitive, context- free and regular grammar. Formulate the regular grammar for integers. [3+5]

3. a) What is recurrence relation? Solve the R-R given by $a_n = 5a_{n-1} - 6a_{n-2} + 6^n$ giving the all solutions of it. [8]

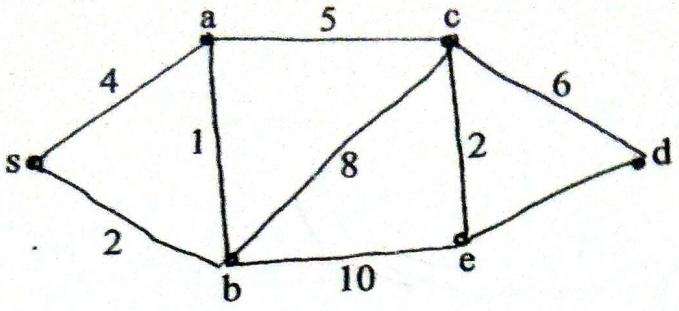
   b) List out the various proof techniques. Describe about the proof by contradiction and proof by equivalences using the suitable examples. [3+5]

4. a) Define planar graph. Is $K_{3,3}$ a planar graph? Use hand shaking theorem to find the edges of the graph which consists of 10 vertices each of degree six. [2+3+3]

   b) Use Kruskal's algorithm to find the minimum spanning tree for the weighted graph given below. [8]



5. a) Use Dijkstra's algorithm to find the length of the shortest path between the verticies s and d in the weighted graph given below. [8]



b) Write short notes on: [2×4]

(i) Eulerian path and circuits
(ii) Min-cut-Max flow theorem
(iii)Caraph Coloring
(iv)Bipartite and Complete bipartite graphs

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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)*

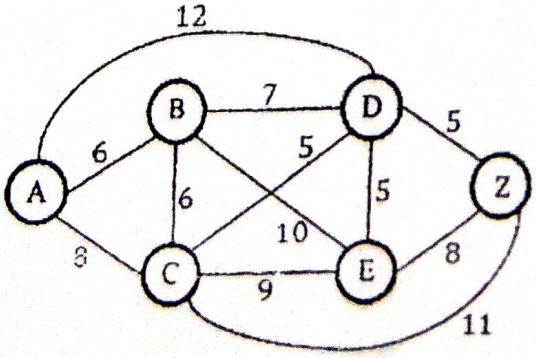
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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 ∈ {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, 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 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 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)*

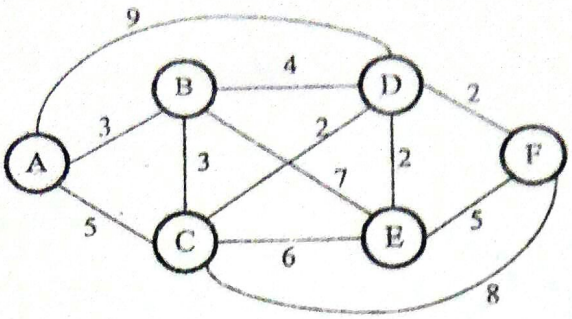
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Using rules of inference, prove that the *hypotheses "If I get my Christmas bonus and my friend are free, I will take a road trip with my friends.", "If my friends don't find a job after Christmas, then they will be free." and "I got my Christmas bonus and my friend did not find a job after Christmas."* Lead to the conclusion "I will take a road trip with my friends." [8]
2. State the principle of strong induction. Prove the formula for the sum of a finite number of terms of Geometric Progression: $\sum_{j=0}^{n} ar^j = a + ar + ar^2 + ... + ar^k = \frac{ar^{n+1} - a}{r-1}$ [3+5]

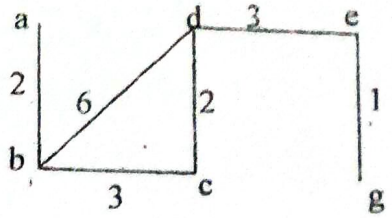
   When $r \neq 1$, where n is non-negative integer.
3. Explain the validity of arguments with suitable example. Use direct proof to prove "if x is odd then x^2 is also odd". [4+4]
4. How do you define a Finite State Automation (FSA)? Design a finite state automation that accepts precisely those strings over {a,b}that end with substring *aa*. Your design should include the proper definition of the finite state automation, transition table and the transition diagram. [2+6]
5. Write a grammar that generates the string having the given property. [4+4]
   i) String over {a,b} ending with ba
   ii) String over {a,b} starting with a
6. Find all the solutions of recurrence relation: [8]

   $a_n = 7a_{n-1} - 12a_{n-2} + 3^n$ with initial conditions $a_0 = 1$ and $a_1 = 4$
7. 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 and complete bipartite graph $K_{3,3}$? [2+1+1+2+2]

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



9. Prove that $K_{3,3}$ is not a planar graph. The labeled graph has 3 spanning trees. [4+4]



Find the two spanning trees of given Graph

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

i) MaxFlowMincut Theroem
ii) Cutsets and Cutvertices

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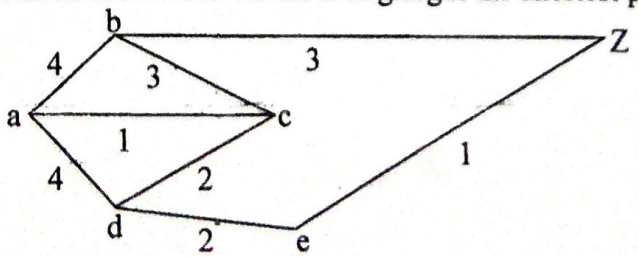
47 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

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]

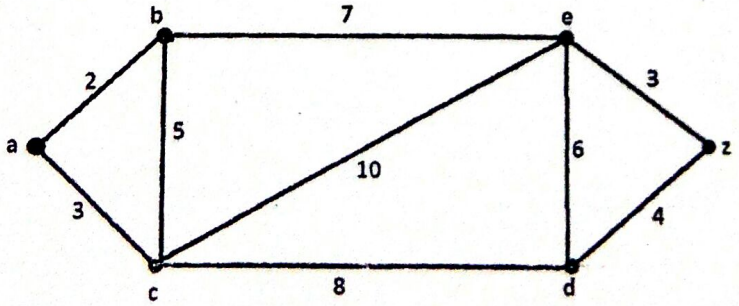
5. Consider the regular grammar G = (N, T, P, σ) where N = set of non-terminal symbols = {σ, C}, T = set of terminal symbols = {a,b}, P is the set of production rules = {σ→bσ, σ→aC, C→bC, C→b} and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to given regular 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
2072 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) We are given the following hypotheses: [8]

If the Chargers get a good linebacker then the Chargers can beat the Broncos

If the Chargers can beat the Broncos, then the Chargers can beat the Jets.

If the Chargers can beat the Broncos, then the Chargers can beat the Dolphins.

The Chargers get a good linebacker.

Show using the rules of inference that the conclusion, the Chargers beat the Jets and the Chargers can beat the Dolphins, follows from the hypotheses.

(2) Use mathematical induction to prove that [8]

$2 - 2\cdot7 + 2\cdot7^2 - \ldots\ldots\ldots + 2(-7)^n = (1-(-7)^{n+1})/4$ whenever n is a non negative integer

(3) Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. [3]

(4) Draw the tableau for the formula set [5]

$\Phi = \{p\rightarrow(r\wedge t), (t\vee s)\rightarrow\neg q, \neg\neg(p\wedge q)\}$

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.

(5) 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 odd number of b'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]

$\sigma\rightarrow a$, $\sigma\rightarrow bB$, $A\rightarrow bA$, $A\rightarrow aB$, $A\rightarrow b$, $A\rightarrow a$, $B\rightarrow b$ and starting symbol σ.

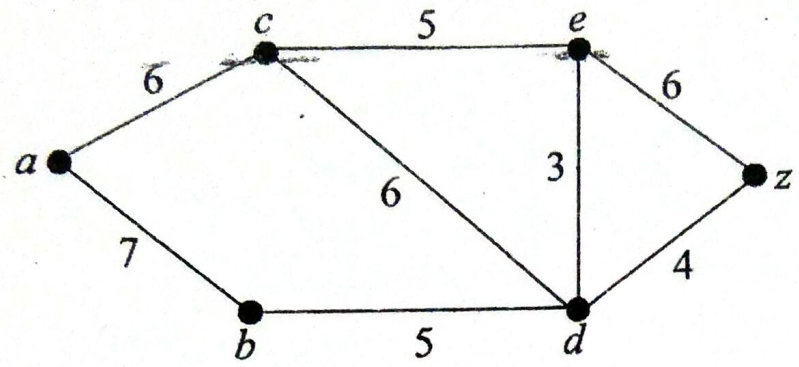
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

(7) 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 $a_2 = 5$.

(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) In a round-robin tournament the Tigers beat the Blue Jays, the Tigers beat the Cardinals, the Tigers beat the Orioles, the Blue Jays beat the Cardinals, the Blue Jays beat the Orioles, and the Cardinals beat the Orioles. Model this outcome with a directed graph. [4]

(10) 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]

(11) Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram. [3]

(12) Write short notes on: - [3+3+3]

a) Spanning tree
b) Max flow and Min cut theorem
c) Planar graphs

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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]

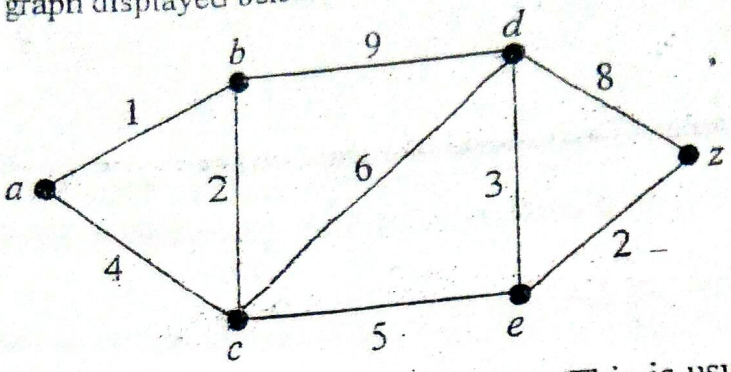
   $\sigma \rightarrow aA$, $\sigma \rightarrow bB$, $A \rightarrow a$, $B \rightarrow a$ and starting symbol σ.

   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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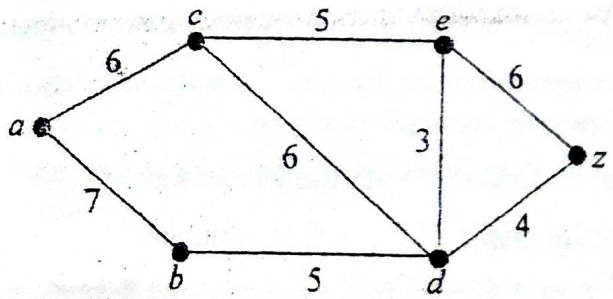
45. TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

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 hypothesis "All movies produced by John Sayles are wonderful. John Sayles produced a movie about coal miners imply the conclusion, "There is a wonderful movie about coal miners." You are required to show each step and give reasons for those steps before you come to the desired conclusion from the hypothesis. [8]
2. Use mathematical induction to show that 6 divides $n^3 - n$ whenever n is a nonnegative integer. [8]
3. 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) $((P \wedge \overline{Q}) \leftrightarrow (Q \wedge R)) \rightarrow (S \vee \overline{Q})$
4. Define Non-Deterministic Finite State Automata. Design a Finite State Automata that accepts precisely those strings over {a, b} that do not contain two consecutive a's. [2+6]
5. Construct the regular grammar to generate integers. Your construction should include the proper definitions of the grammar, which includes properly defined non-terminal symbols, terminal symbols, production rules and starting symbol. [8]
6. Find general solution of $\sqrt{a_n} = \sqrt{a_{n-1}} + 2\sqrt{a_{n-2}}$ with initial condition $a_0 = a_1 = 1$. [8]
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. In a round-robin tournament the Tigers beat the Blue Jays, the Tigers beat the Cardinals, the Tigers beat the Orioles, the Blue Jays beat the Cardinals, the Blue Jays beat the Orioles, and the Cardinals beat the Orioles. Model this outcome with a directed graph. [4]
9. 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]
10. State the necessary and sufficient conditions for Euler circuits and paths. [3]
11. Write short notes on: [3+3+3]
    a) Hamiltonian path and Hamiltonian circuit
    b) Max flow and Min cut theorem
    c) Planar graphs

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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]
$1^2 + 2^2 + \cdots + n^2 = n(n+1)(2n+1)/6$
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]
σ→a, σ→bB, A→bA, A→aB, A→b, A→a, B→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 $a_0 = 2$.

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]

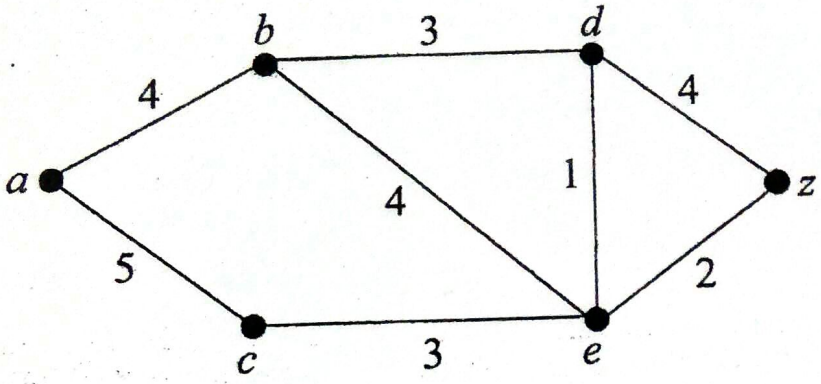
5 Consider the regular grammar defined by T={a, b}, N={σ, C} with productions [4 + 4 = 8]
$\sigma \rightarrow b\sigma$, $\sigma \rightarrow aC$, $C \rightarrow bC$, $C \rightarrow b$ and starting symbol σ.
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar 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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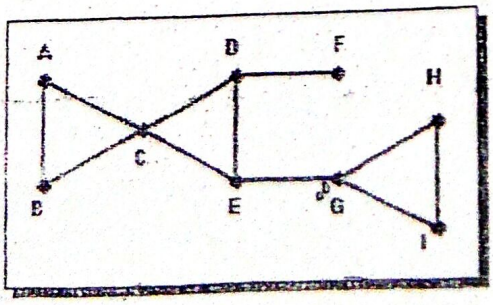
37 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
(20) **2069 Poush**

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 the truth table for $(p \vee \neg q) \rightarrow q$ and state the converse, contra-positive and inverse of each of these conditional statements. **[2+3+3].**
   I. If it snows tonight then I will stay at home
   II. A positive integer is a prime only if it has no divisors other than 1 and itself.
2. Show that $\neg (p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent by developing a series of logical equivalence. **[4]**
3. For the set of premises "If I play hockey, then I am sore the next day." "I use the whirlpool if I am sore." "I did not use the whirlpool". What relevant conclusion can be drawn? Explain the rules of inference used to draw the conclusion. **[4]**
4. Prove the theorem "if n is a positive integer, then n is odd if and only if n^2 is odd" using proof of equivalence. **[4]**
5. Use the mathematical induction to prove the inequality $n < 2^n$ for all positive integer n. **[4]**
6. Define DFA and NDFA. Construct DFA that recognize the language "The set of bit strings that do not contain three consecutive 0's. *[3+5]*
7. Let G be the grammar with vocabulary V={S, 0, 1}, the set of terminals T= {0, 1}, starting symbol S and Production rule {S→ 11S, S→0} What is L (G), the language of this grammar? Derive the derivation tree for the derivation 01111 of this grammar. **[5+3]**
8. What is a recurrence relation? Is there any such relation which exists for the Tower of Hanoi (TOH) puzzle. If yes, then derive. Also show that your solution is optimal. [2+4+2]
9. Define and draw the following graphs. [2×4]
   I. Complete Graph K_6
   II. Complete Bipartite Graph $K_{3,3}$
   III. Cycle Graph C_6
   IV. Wheel Graph W_6
10. Define cut vertex and cut edge (bridge) and find all the cut edges in the graph given below. *[2+2]*



11. Discuss Euler and Hamilton circuit with examples. [2+2]

12. Define planar graph and show that the complete graph K_5 is not planar and find the chromatic number of K_5. [4+1+3]

13. Write short notes on: [2×4]

(a) Max flow and Mincut theorem (b) Spanning tree

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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.

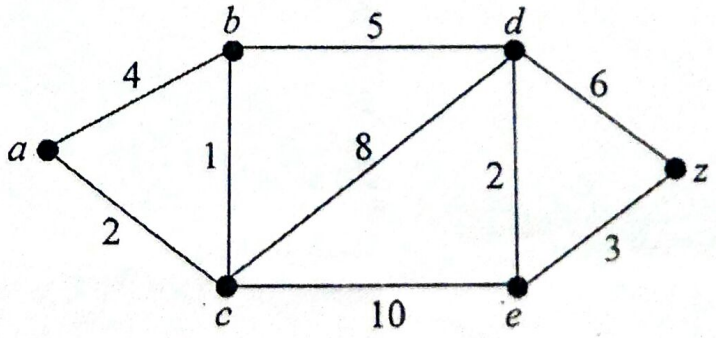
3) Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. Draw the tableau for the formula $(T \vee S) \rightarrow \neg Q$ where $\neg$ denotes the negation of a variable, $\vee$ denotes the disjunction of variables and $\rightarrow$ is the symbol for implication. **(5+3)**

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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INSTITUTE OF ENGINEERING
Examination Control Division
2068 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

- ✓ 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 "It is not sunny this afternoon and it is colder than yesterday," "We will go swimming only if it is sunny," "If we do not go swimming, then we will take a canoe trip," and "If we take a canoe trip, 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 the desired conclusion from the hypotheses. **(8)**

2) Use mathematical induction to prove that **(8)**
$2 - 2 \cdot 7 + 2 \cdot 7^2 - \ldots\ldots + 2 \cdot (-7)^n = (1 - (-7)^{n+1}) / 4$
whenever n is a nonnegative number.

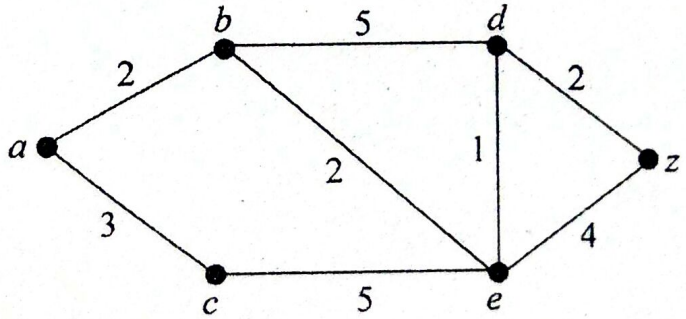
3) What is a tableau method and why is it important in propositional logic? Draw the tableau for the formula $\neg((p \vee q) \vee \neg p)$ where $\neg$ denotes the negation of a variable and $\vee$ denotes the disjunction of variables. **(2+2+4)**

4) Design a finite-state automaton that accepts only those set of strings over $\{a, b\}$ which ends with *aba*. Precisely, only those strings which end with *aba* 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) Define and differentiate between context-sensitive, context-free and regular grammars with suitable examples. **(3+2+3)**

6) Find all solutions of the recurrence relation **(8)**
$a_n = 2a_{n-1} + 2n^2$
with initial condition $a_1 = 4$.

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 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)**

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

10) Write short notes on **(3×3)**
   a) Planar and Regular graphs
   b) Cutsets and Cutvertices
   c) Application of trees

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