

POKHARA UNIVERSITY

**Level:** Bachelor      **Semester:** Spring      **Year:** : 2018  
**Programme:** BCA      **Full Marks:** 100  
**Course:** Mathematical Foundation of Computer Science      **Pass Marks:** 45

Science

Geology

Candidates are required to give their answers in their own words as far as possible.

Cannabis

as procedure.

### *The figures in*

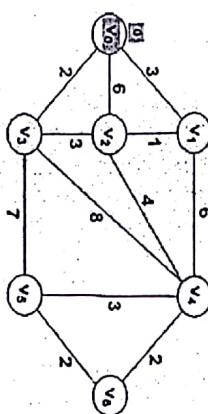
**Attempt all the questions.**

1. a) Define the terms graph, degree of vertex, path, circuit, cycle, adjacency matrix and incidence matrix.

b) What is a Hamiltonian Cycle? Prove that "A connected graph G is Eulerian if and only if each vertex has an even degree."

2. a) Use Dijkstra's algorithm to find the length of a shortest path between the vertices  $v_0$  and  $v_6$  in the weighted graph displayed in figure:

b) Use a relevant path finding algorithm to find the length of the shortest path between 'a' and 'f' in the following weighted graph.



- b) Use a relevant path finding algorithm to find the length of the shortest path between 'a' and 'f' in the following weighted graph.

```

graph LR
    a((a)) ---[2] d((d))
    a((a)) ---[4] b((b))
    d((d)) ---[3] c((c))
    d((d)) ---[1] f((f))
    c((c)) ---[3] b((b))
    c((c)) ---[1] f((f))
    b((b)) ---[2] e((e))
    e((e)) ---[1] c((c))

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3. a) 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," using rules of inferences

7

- b) Check whether the following relations are logically equivalent or not using truth table: 8

  - $(p \rightarrow q) \wedge (p \rightarrow \neg q) \Leftrightarrow \neg p$
  - $(p \leftrightarrow q) \Leftrightarrow (p \rightarrow q) \wedge (q \rightarrow p)$

i. a) Derive the characteristics equation for a linear homogeneous recurrence relation. 5

b) If  $a^2$  is an even number, then 'a' is an even number. Prove this statement by contradiction.

c) Using mathematical induction, prove that  $1+2+\dots+n = n(n+1)/2$ , where  $n$  is a positive integer. 5

5. a) Solve the recurrence relation  $a_n = 2a_{n-1} - a_{n-2}$  for  $n \geq 2$  and  $a_0=3$ ,  $a_1=6$ . 7

b) Find all the solution of the recurrence relation  $a_n = 3a_{n-1} + 2n$ . Also find the solution of the relation with initial condition  $a_1 = 3$ . 8

5. a) Explain the concept of Finite State Machine with an example. 7

b) Construct a DFA with transition table as well as transition diagram that accepts the multiple of 3. 8

7. Write short notes on any two: 2x5

  - Graph coloring
  - Regular Expression
  - Quantification

**POKHARA UNIVERSITY**

Level: Bachelor  
Programme: BCA  
Course: Mathematical Foundation of Computer Science

Semester: Fall  
Year : 2018  
Full Marks: 100  
Pass Marks: 45  
Time: 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

*Attempt all the questions.*

1. a) Explain the similarities and dissimilarities of directed graph and directed multi-graph. What do you mean by degree of graph? 7
- b) Define the term invariant. Explain different graph representation techniques. 8
2. a) Explain the bipartite and complete Graph. Construct a wheel and cube for  $K_5$ . 7
- b) What differentiates predicate from preposition? Explain tautology and contradiction. "If there is raining outside then it must be Sunday of July". Express it in term of converse, inverse and contra positive. 8
3. a) What free and bound variables? Let  $L(x,y)$  denotes  $x$  loves  $y$  where universe of discourse for  $x, y$  is set of all people in the world. Translate  $\forall x \exists y L(x,y), \exists y \forall x L(x,y), \exists x \forall y L(x,y)$  and  $\exists x \exists y L(x,y)$  into English. 8
- b) What is the difference between strong and weak induction? Prove that  $2 - 2 \cdot 7 + 2 \cdot 7^2 - \dots + 2(-7)^n = (1 - (-7)^{n+1})/4$  whenever  $n$  is a nonnegative integer. 7
4. a) What do mean by valid arguments. 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 life saving 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". 7
- b) What is forward and backward reasoning? Prove using proof of 8

equivalence that if  $n$  is a positive integer, then  $n$  is even if and only if  $7n + 4$  is even.

5. a) What is recurrence? Solve the recurrence relation  $a_n = 2a_{n-1} - a_{n-2}$  for  $n \geq 2$ ,  $a_0 = 3$  and  $a_1 = 6$ .
- b) What is Language? Explain different types of grammars.
6. a) What do you mean by DFA? Explain extended transition function of DFA with example.
- b) What is regular expression? List and explain its application. Explain how DFA is converted into regular expression?
7. Write short notes on any two:
  - a) Euler graph
  - b) Quantification
  - c) Inductive Definition

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define graph with its application? Explain the similarities and dissimilarities of multi-graph and pseudo graph. 7  
b) Define the term isolated vertex and pendent vertex. What do you mean by isomorphic graph? Explain when two graphs are called isomorphic. 8
  2. a) Explain the terms path, walk and circuit for a given find cut vertices and cut bridge. 7
  3. a) Define the term connected component. 7  
b) Express each of the following quantifications in English. 8  
i.  $\exists x P(x)$       iii.  $\forall x \neg P(x)$   
ii.  $\exists x \neg \neg P(x)$       iv.  $\neg \neg \forall x \neg P(x)$
  4. a) What do mean by prove by contradiction. Prove that if n is a positive integer, then n is even if and only if  $7n + 4$  is even. 7  
b) What is quantification? Let  $P(x)$  be the statement "x is happy," where the universe of discourse for x is the set of students. Express each of the following quantifications in English. 8  
i. Show that 5 divides  $n^2 - n$  whenever n is a nonnegative integer.  
b) What are valid arguments? 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. 7
  5. a) Explain characteristic equation? Solve the recurrence relation  $a_n = 5a_{n-1} - 7a_{n-2} + 3a_{n-3}$  for  $n \geq 3$ ,  $a_0 = 1$ ,  $a_1 = 9$  and  $a_2 = 15$ . 8  
b) What is recurrence relation? Give a recursive definition of the set of positive integers that are multiples of 5. 8
  6. a) Differentiate between DFA and NFA? List and explain general notations of DFA. 8  
b) What is regular expression? List and explain its application. 7  
Explain how DFA is converted into regular expression? 7
  7. Write short notes on any two: 2x5  
a) Complete bipartite graph .  
b) Explain free and bound variable  
c) Language
- i. The newspaper will not come if there is an inch of snow on the street. 8  
ii. It snows whenever the wind blows from the northeast.  
iii. That prices go up implies that supply will be plentiful.  
iv. It is necessary to read the textbook to understand the materials of this course.
  - a) What is Mathematical Induction? Use mathematical induction to 8

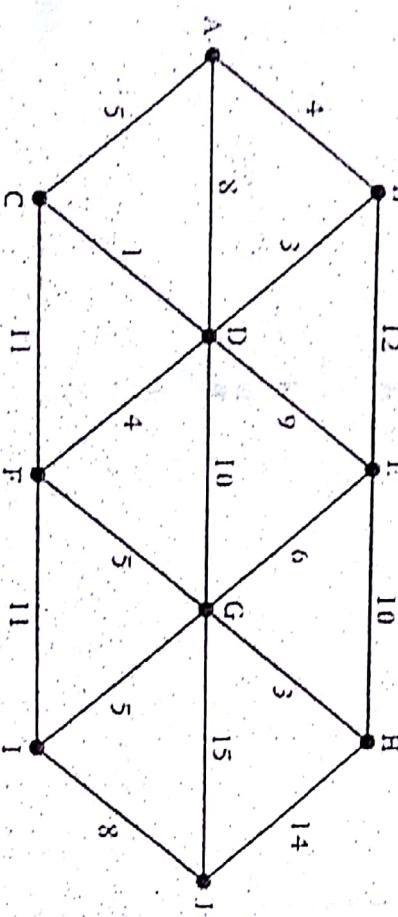
Course: Mathematical Foundation of Computer Science

*The figures in the margin indicate full marks.*  
**Attempt all the questions.**

- a) Define Euler graph, Hamiltonian graph, complete bipartite graph and isomorphic graph giving example of each.

b) What is a planar graph? Suppose that a connected planar graph has eight vertices, each of degree three. Into how many regions, is the plane divided by a planar representation of this graph?

a) Find the shortest path from A to J in the following graph.



- b) Define adjacency and incidence matrix. Write the adjacency matrix ; 7  
for the complete graph on 5 vertices K<sub>5</sub>.

a) Find the inverse, contra-positive and converse of the statement  
"If the Internet is down, then Ram cannot browse the websites." 5

b) Let L(x,y) be the statement " x loves y". Use the quantifiers to  
express each of the following statements:

  - Everybody loves Ram.

	F			g		
SU	a	b	c	a	b	c
$\sigma_0$	$\sigma_0$	$\sigma_1$	$\sigma_2$	0	1	0
$\sigma_1$	$\sigma_1$	$\sigma_1$	$\sigma_0$	1	1	1
$\sigma_2$	$\sigma_2$	$\sigma_1$	$\sigma_0$	1	0	0

- Is it FSA or not? If it is FSA then draw the transition diagram of equivalent FSA.

b) Define grammar and language. Write about different types of grammar.

Write short notes on any two:

  - a) Applications of Graph theory in computer science
  - b) Inference Rules for quantifiers
  - c) Recursive and Recurrence relation.

**POKHARA UNIVERSITY**

Level: Bachelor

Semester: Fall

Year : 2016

Full Marks: 100

Pass Marks: 45

Time: 3hrs.

5.

a)  $a_0 = 1$  and  $a_1 = 6?$

b) Suppose that a person deposits Rs. 10,000/- in a fixed account at a

integer and  $3n+2$  is odd, then  $n$  is odd by contradiction method.

How much will be in the account after 10 years? Solve the problem

with modelling it into recursion relations.

6. a) Determine whether the word  $cba$  belongs to the language

generated by the grammar  $G = (V, T, S, P)$  where  $V = \{a, b, c, A, B, C, s\}$ ,  $T = \{a, b, c\}$ ,  $S$  is the starting symbol, and the productions are

$S \rightarrow AB$

$A \rightarrow Ca$

$B \rightarrow Ba$

$C \rightarrow Cb$

$C \rightarrow b$

$C \rightarrow a$

$B \rightarrow Cb$

$C \rightarrow b$

$C \rightarrow a$

$B \rightarrow Ba$

$C \rightarrow cb$

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- race is held, then the trophy will be awarded," and "The trophy was not awarded" imply the conclusion "It rained."
- b) What are the common methods of proof? Prove that if  $n$  is an integer and  $3n+2$  is odd, then  $n$  is odd by contradiction method.
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**POKHARA UNIVERSITY**

Level: Bachelor  
Programme: BCA  
Semester – Spring Year : 2015

Full Marks : 100  
Pass Mark : 45

Course: Mathematical Foundation of Computer Science

Time : 3 Hrs

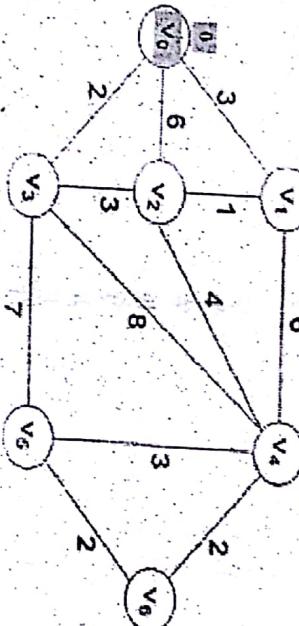
Candidates are required to give their answers in their own words as far as practicable.  
The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Discuss the various applications of graph theory in computer science with example.  
b) "A graph is a bunch of dots and lines where the line connects some pairs of dots", define this statement with degree of graph and types of graph suitable example.
2. a) What is adjacency matrix? How many paths of length 4 are there from first node to third node in the simple graph represented by the following adjacency matrix?

$$G = \begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

- b) Find the shortest path from  $V_0$  to  $V_6$  in the following graph?



3. a) Draw the transition diagram for the finite state machine ( $I, O, S, f, g, \sigma_0$ ) where  $I = \{a, b, c\}$ ,  $O = \{0, 1\}$ ,  $S = \{\sigma_0, \sigma_1, \sigma_2\}$  and

	F			G		
SVI	a	b	c	a	b	c
$\sigma_0$	$\sigma_0$	$\sigma_1$	$\sigma_2$	0	1	0
$\sigma_1$	$\sigma_1$	$\sigma_0$	$\sigma_0$	1	1	1
$\sigma_2$	$\sigma_2$	$\sigma_1$	$\sigma_0$	1	0	0

4. a) State the rules of Inference for quantified statements. Give an argument using the rules of inference to determine whether the conclusion follows from the given hypothesis or not.  
*To win a gold medal, the athlete must be very fit. If he does not win the gold medal, then either he arrives late for the game or his training was interrupted. If he is not fit for the game, he will blame his coach. If he blames his coach or his training is interrupted, then he will not get into the final. Therefore if he gets into the final, he will not have arrived late.*

- b) What is recurrence relation? Someone deposits \$10,990 in a savings account at a bank yielding 11% per year with interest compounded annually. How much money will be in the account after 27 years?

5. a) How can you solve linear homogeneous recurrence relation? Explain. Solve the given recurrence relation for the initial condition given.

$$a_n = 7a_{n-1} - 10a_{n-2} + 16n.$$

- b) Fibonacci series is given by the recurrence relation  $f_n = f_{n-1} + f_{n-2}$ ,  $n \geq 3$ , and initial conditions  $f_1=1$ ,  $f_2=2$ . Find the explicit formula for the fibonacci sequence.

6. a) Draw the transition diagram for the finite state machine ( $I, O, S, f, g, \sigma_0$ ) where  $I = \{a, b, c\}$ ,  $O = \{0, 1\}$ ,  $S = \{\sigma_0, \sigma_1, \sigma_2\}$  and

	F			G		
SVI	a	b	c	a	b	c
$\sigma_0$	$\sigma_0$	$\sigma_1$	$\sigma_2$	0	1	0
$\sigma_1$	$\sigma_1$	$\sigma_0$	$\sigma_0$	1	1	1
$\sigma_2$	$\sigma_2$	$\sigma_1$	$\sigma_0$	1	0	0

Is it FSA or not? If it is FSA then draw the transition diagram of equivalent FSA.

7. a) Define grammar and language. Write about different types of grammar.

- Write short notes on any two:

- a) Eular graph

- b) Formal and informal proofs

- c) Propositional logic

- a) Find the contra-positive, converse, inverse and negation of the statement "If it is sunny today, then we will go to the beach"

- b) Define grammar and language. Write about different types of grammar.

**POKHARA UNIVERSITY**

Level: Bachelor Semester – Fall Year : 2014  
 Programme: BCA Full Marks: 100  
 Course: Mathematical Foundation of Computer Science Pass Marks: 45 Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

- a) Verify that the following argument is valid by using the rules of inference:

If Clinton does not live in France, then he does not speak French.  
 Clinton does not drive a Datsun.

If Clinton lives in France, then he rides a bicycle.

Either Clinton speaks French, or he drives a Datsun.

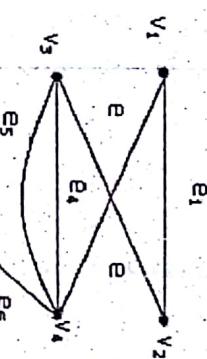
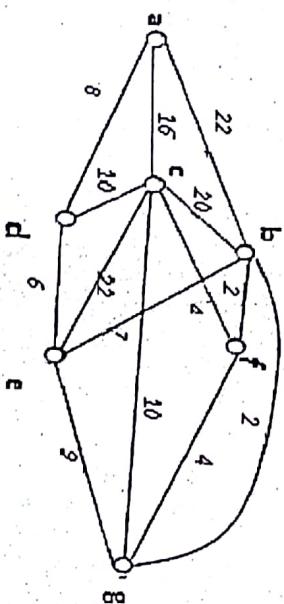
Hence, Clinton rides a bicycle.

Show that  $p \leftrightarrow q$  and  $(p \rightarrow q) \wedge (q \rightarrow p)$  are logically equivalent.

b) Define complete graph, complete bipartite graph, isomorphic graph, planar graph giving example of each.

b) What is strongly connected graph? A connected planar graph has 20 vertices, each of degree 3. How many edges and faces are there?

- a) What are the major applications of graph theory? Find the shortest path and its cost from vertices 'a' and 'g' in the following weighted graph (assume data if any required):



4.

- a) Solve the recurrence relation  $a_n - 6a_{n-1} + 8a_{n-2} = 3$  where  $a_0 = 10$  and  $a_1 = 25$

b) A factory makes custom sports cars at an increasing rate. In the first month only one car is made, in the second month two cars are made, and so on, with  $n$  cars made in  $n$ th month.

i. Set up a recurrence relation for the numbers of cars produced in first  $n$  months by the factory.

ii. Find the explicit formula for the number of cars produced in first  $n$  months.

5. a) State the principles of Mathematical Induction. Prove by Mathematical induction that for all integers  $n \geq 4$ ,  $3^n > n^3$ .

b) If an integer  $a$  is such that  $a-2$  is divisible by 3 than  $a^2-1$  is divisible by 3. Prove it by using direct proof method.

6. a) Draw the transition diagram for the finite state machine  $(I, O, S, f, g, \sigma_0)$  where  $I = \{a, b, c\}$ ,  $O = \{0, 1\}$ ,  $S = \{\sigma_0, \sigma_1, \sigma_2\}$  and

	f			g		
SI	a	b	c	a	b	c
$\sigma_0$	$\sigma_0$	$\sigma_1$	$\sigma_2$	0	1	0
$\sigma_1$	$\sigma_1$	$\sigma_2$	$\sigma_0$	1	1	1
$\sigma_2$	$\sigma_2$	$\sigma_1$	$\sigma_0$	1	0	0

Is it FSA or not? If it is FSA then draw the transition diagram of equivalent FSA.

- b) Consider the following grammar where  $T = \{a, b\}$ ,  $N = \{\sigma, A\}$  with production rules  $\{\sigma \rightarrow b\sigma, \sigma \rightarrow aA, A \rightarrow a\sigma, A \rightarrow bA, A \rightarrow a, \sigma \rightarrow b\}$ . Determine whether the given grammar is context-sensitive, regular or context-free, or none of these.

7. Write short notes on any two:

- a) Grammar  
 b) Rules of inference for quantified propositions

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

3. a) Give an argument using rules of inference to show that the conclusion follows from the hypothesis.

Hypothesis: "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." Conclusion: "It rained"

- b) Using induction, verify that  $1(1)! + 2(2)! + 3(3)! + \dots + n(n)! = (n+1)! - 1$

4. a) Prove the following relations are logically equivalent using truth table

$$\text{i)} (p \rightarrow q) \wedge (p \rightarrow \neg q) \Leftrightarrow \neg p$$

$$\text{ii)} (p \wedge \neg q) \rightarrow \neg(p \leftrightarrow r) \Leftrightarrow \neg p \vee q \vee \neg r$$

- a) What is pseudograph? Illustrate that the maximum number of edges in a single graph with  $n$  vertices is  $n(n-1)/2$

- b) Define the terms Eulerian trail and Eulerian circuit with necessary diagrams

- c) How does a planar graph contrast with Hamiltonian Graphs? Enlist the applications of Hamiltonian Graphs in your own words.

- a) Determine a shortest path between vertices  $a$  to  $g$  as shown below:



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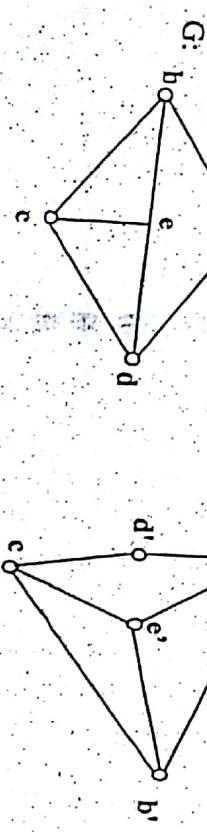
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7. Write short notes on any two:

- a) Directed and Undirected graph

- b) Predicate and quantifier

- c) Proving techniques



$G'$ :

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**POKHARA UNIVERSITY**

Level: Bachelor

Semester – Spring

Year : 2013

Course: Mathematical Foundation of Computer

Science

Pass Marks: 45

Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.  
Attempt all the questions.

a) Candidates are required to give their answers in their own words as far as practicable.

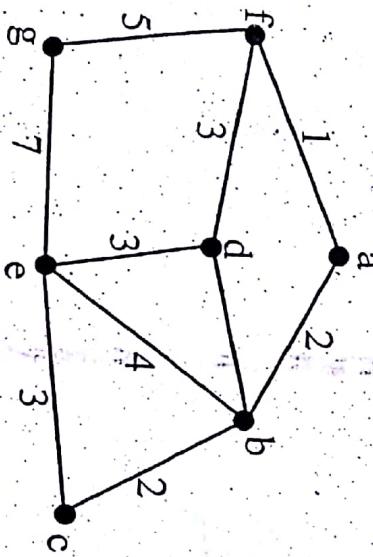
The figures in the margin indicate full marks.

a) Define complete bipartite graph, Hamiltonian graph, Euler graph and Regular graph with example.

b) What is planar graph? A connected planar graph has nine vertices having degrees 2, 2, 2, 3, 3, 3, 4, 4 and 5. How many edges and faces are there?

a) Show that  $K_5$  is nonplanar graph.

b) Apply Dijkstra's shortest path algorithm to find a shortest path and length of the shortest path between vertices a and e in the graph given below.



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

With  $a_0 = 2$  and  $a_1 = ?$

6. a) Determine whether the word  $cbaab$  belongs to the language generated by the grammar  $G = (V, T, S, P)$ , where  $V = \{a, b, c, A, B, C\}$ ,  $T = \{a, b, c\}$ ,  $S$  is the starting symbol, and the productions are:

$$S \rightarrow AB$$

$$A \rightarrow Ca$$

$$B \rightarrow Ba$$

$$B \rightarrow Cb$$

$$C \rightarrow b$$

$$C \rightarrow cb$$

$$C \rightarrow b.$$

- a) Use Mathematical Induction to prove that:  
 $2 \times 7^n + 3 \times 5^n - 5$  is a multiple of 24.
- b) What do you mean by logical equivalence? Show that the implication and its contra positive are logically equivalent.

4. a) Verify the validity of the following argument by using rules of inference:

If Sanjay does not work in a bank, then he is not a bank manager.  
Sanjay does not use Tally.  
If Sanjay works in a bank, then he uses GNCash.  
Either Sanjay is a bank manager or he uses Tally.

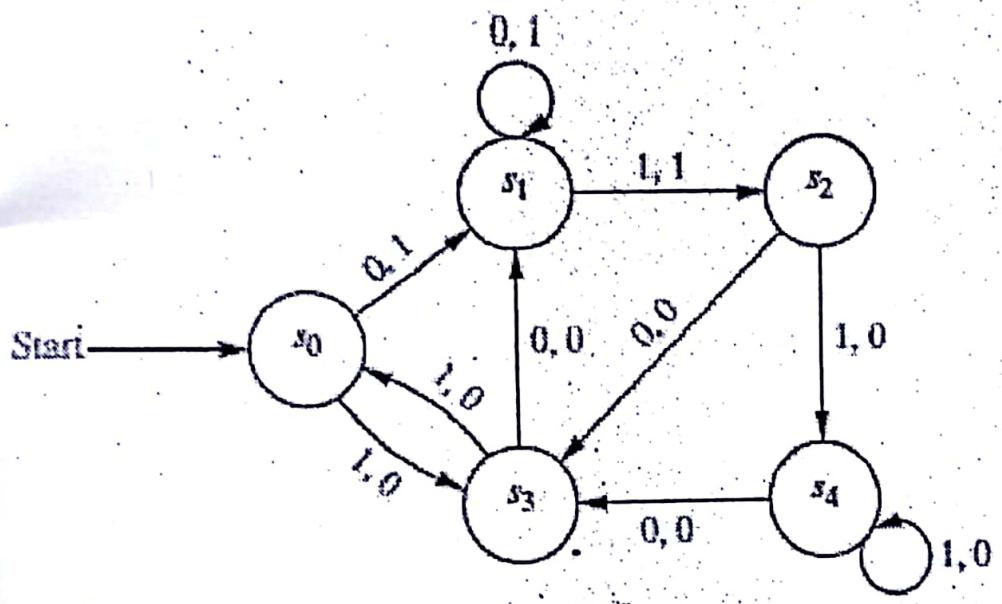
Hence, Sanjay uses GNCash.

b) Give an argument using the rules of inference to determine whether the conclusion follows from the given hypothesis or not. To win a gold medal, the athlete must be very fit. If he does not win the gold medal, then either he arrives late for the game or his training was interrupted. If he is not fit for the game, he will blame his coach. If he blames his coach or his training is interrupted, then he will not get into the final. Therefore if he gets into the final, he will not have arrived late.

Model the following problem using recurrence relation: Suppose that a person deposits \$10,000 in a saving account at a bank yielding 11% per year with interest compounded annually. How much will be in the account after 30 years?

- b) What is the solution of the recurrence relation:  

$$a_n = a_{n-1} + 2a_{n-2}$$
  
 With  $a_0 = 2$  and  $a_1 = ?$



Write short notes on any two:

2×5

- Directed and Undirected graph
- Predicate and quantifier
- Recursive and Recurrence relation