MTH401

DISCRETE MATHEMATICS

#Zero Lecture

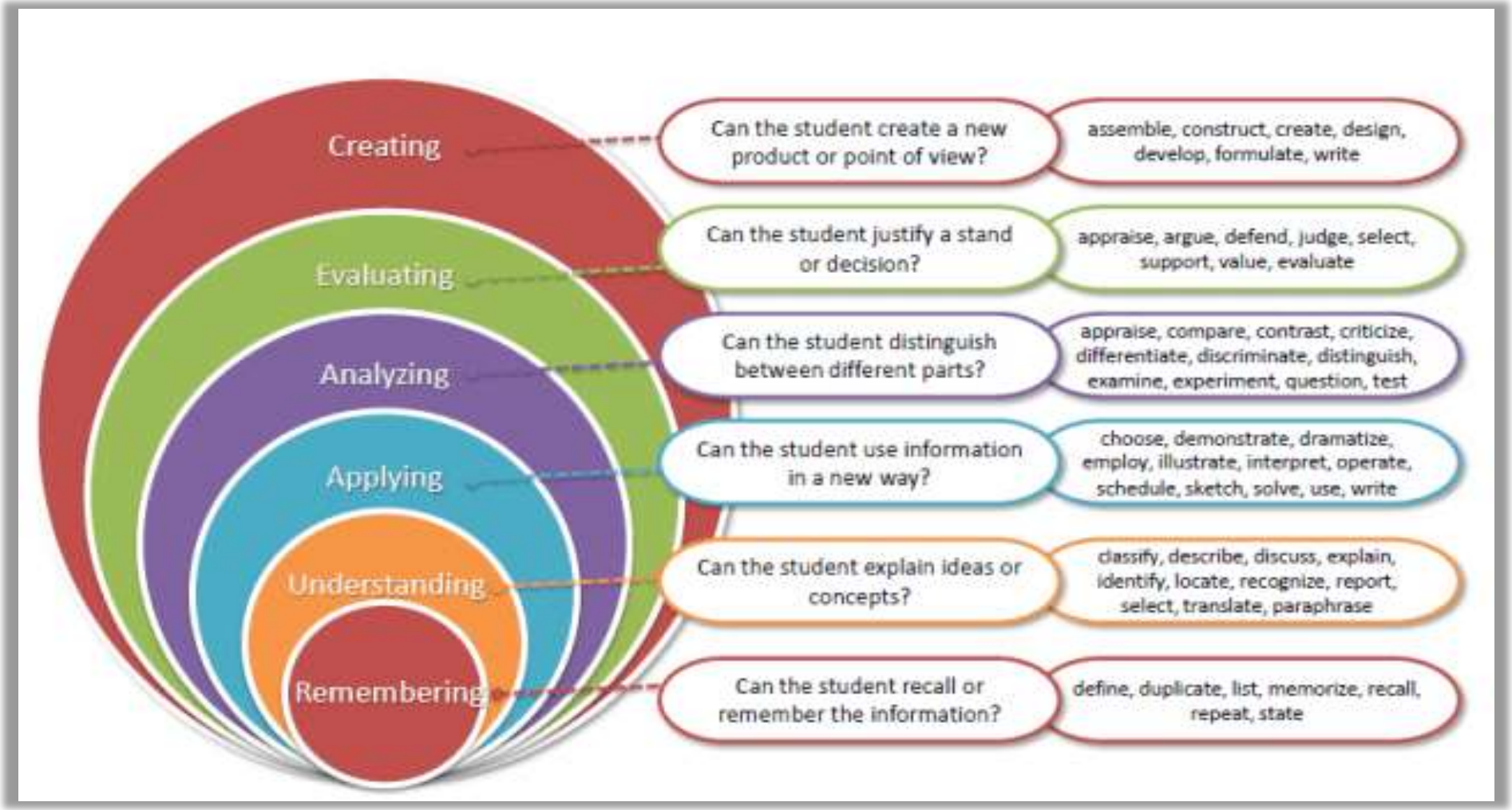
LTP and credit details

L – T – P : 3 – 0 - 0

(3 Lectures, 0 Tutorial, 0 Practical)

Credit:- 3

Bloom's Taxonomy



Course Outcomes

Through this course students should be able to

- understand several methods for proving or disproving particular logical propositions.
- describe the recursive processes that can be used for solving counting problems.
- apply the equivalence and partial order relation properties on graph.
- interpret various graph theoretic concepts and familiarize with their applications.
- learn about the chromatic number of a graph and the properties of tree graphs.

Programme Outcomes

- PO1 **Engineering knowledge::**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2 Problem analysis::**Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO5 Modern tool usage::**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PSO 1::**Demonstrate understanding of the principles and working of the hardware and software aspects of computer systems by applying knowledge in the areas such as Algorithms, Software Engineering, Networking & Security, Database Management Systems, Intelligent Systems, Operating Systems and System Architecture.

MOOCs details

This course is mapped with MOOCs "noc23_cs22 Discrete Mathematics by NPTEL)

Course Id	Discipline	Course Name	Duration	Course Start Date	Course End Date	Exam date	Link to join	Fee
noc23_cs22	**Computer Science and Engineering**	**Discrete Mathematics, IIT Ropar**	**12 Weeks**	23 Jan 2023	14 Apr 2023	29 Apr 2023	Discrete Mathematics - Course (nptel.ac.in)	**Rs 1000/**

If a student registers for this course and clear it then one academic task can be waived off depending upon the result.

Example : if a student get 50% marks in MOOCs exam then he will be awarded 50% marks for one academic task

If the student appears in both academic task and MOOC then best of the two will be considered

Syllabus Distribution: Unit-1

Logic and Proofs :

- Propositional logic
- Propositional equivalences
- Quantifiers
- Introduction to proof
- Direct proof
- Proof by contraposition
- Vacuous and trivial proof
- Proof strategy
- Proof by contradiction
- Proof of equivalence and counterexamples
- Mistakes in proof

Unit-2

Recurrence relations:

- Recurrence relation
- Modelling with recurrence relations
- Homogeneous linear recurrence relations with constant coefficients
- Method of the inverse operator to solve the nonhomogeneous recurrence relation with constant coefficient
- Generating functions
- Solution of recurrence relation using generating functions

Unit-3

Counting principles and relations

- Principle of inclusion-exclusion,
- Pigeonhole, generalized pigeonhole principle,
- Relations and their properties
- Combining relation and composition
- Representing relation using matrices and graph
- Equivalence relations, partial and total ordering relations,
- Lattice, Sub lattice, Hasse diagram, and its components

Unit-4

Graph Theory-I

- Graph terminologies
- Special types of graphs(complete, cycle, regular, wheel,
- Cube, bipartite and complete bipartite)
- Representing graphs
- Adjacency and incidence matrix
- Graph isomorphism,
- Path and connectivity for undirected and digraphs
- Dijkstra’s algorithm for the shortest path problem

Unit-5

Graph Theory-II

- Planner graphs
- Euler formula,
- Coloring of a graph and chromatic number
- Tree graph and its properties
- Rooted tree
- Spanning and minimum spanning tree
- Decision tree, infix, prefix, and postfix notation

Unit-6

Number theory and its application in cryptography

- Divisibility and modular arithmetic
- Primes, greatest common divisors and least common multiples,
- Euclidean algorithm, Bezout's lemma,
- Linear congruence, inverse of (a modulo m),
- Chinese remainder theorem,
- Encryption and decryption by Ceasar cipher and affine transformation,
- Fermat’s little theorem

Evaluation Criteria

Marks Breakup:

Attendance	05
CA (2 best out of 3 Tests)	25
MTE (MCQ)	20
ETE (Mix Category)	50
Total	**100**

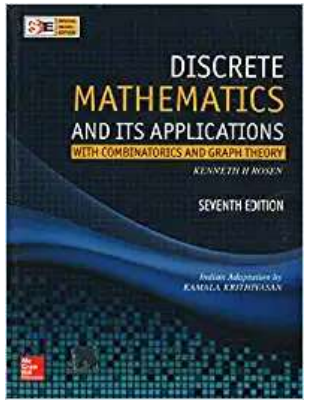
Books Required

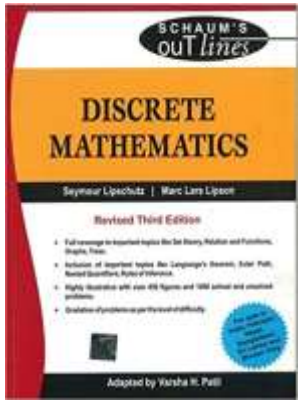
Text Book:

DISCRETE MATHEMATICS & ITS APPLICATIONS by KENNETH H ROSEN, MCGRAW HILL EDUCATION

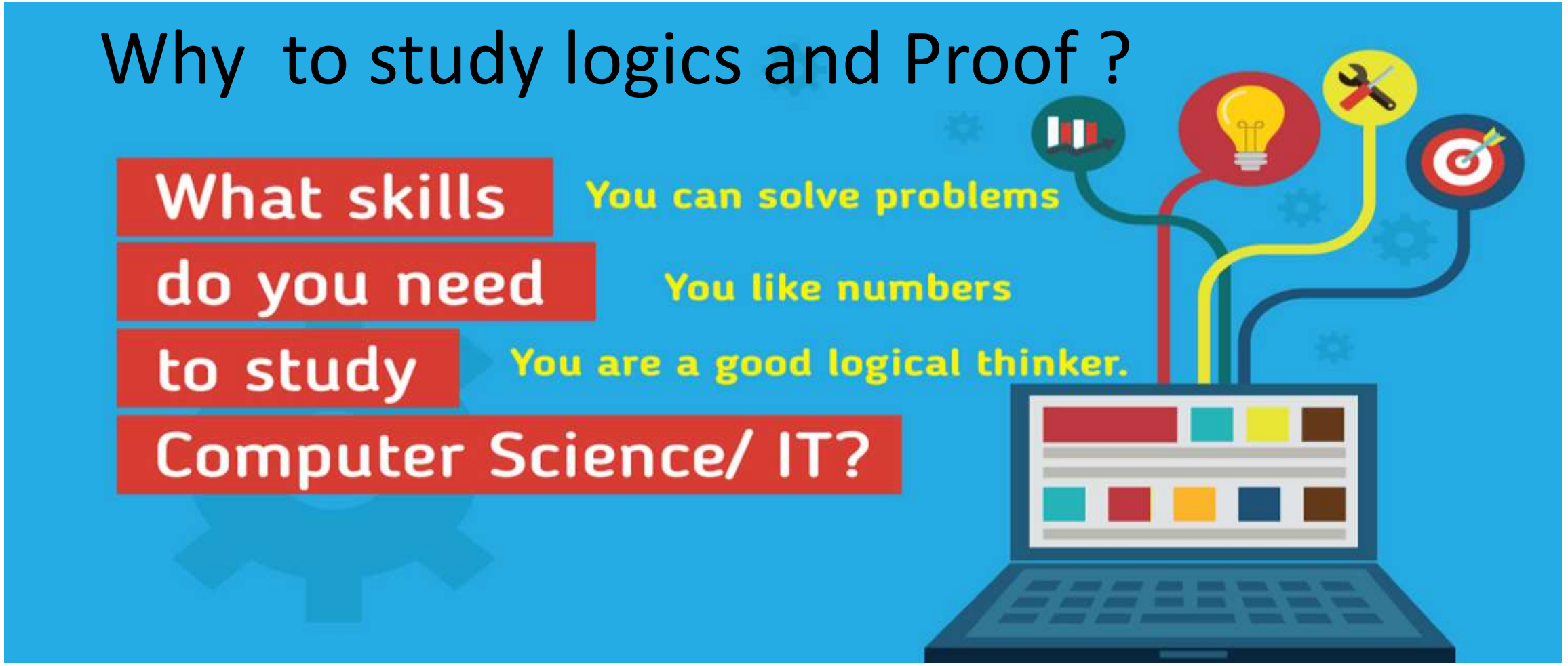
References Books:

DISCRETE MATHEMATICS (SCHAUM'S OUTLINES) (SIE) by SEYMOUR LIPSCHUTZ, MARC LIPSON, VARSHA H. PATIL, MCGRAW HILL EDUCATION





Why to study logics and Proof ?



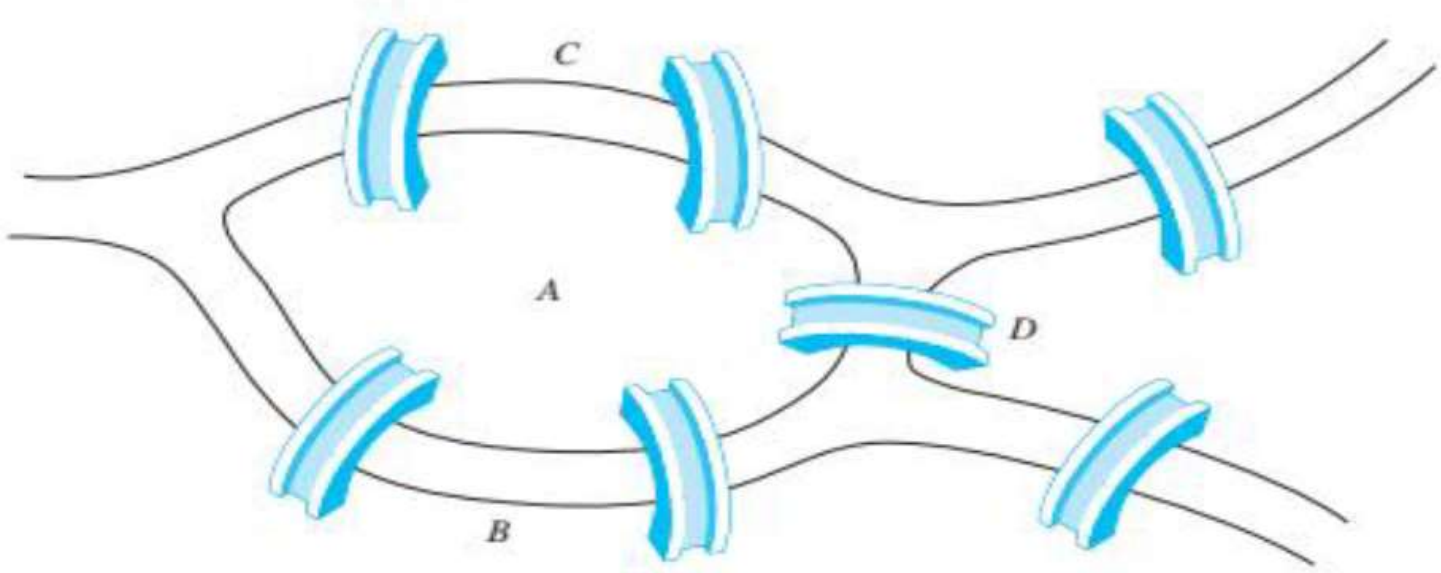
Computer programs are written in special, symbolic languages, e.g., Fortran, C++, Lisp, Prolog. These languages contain features of logical symbolism, and Lisp and Prolog are derived from formal languages for logic. Through such connections, the study of logic can help one in the design of programs.

Solution of tower of Hanoi game for n disk?

Discs	Moves
1	1
2	3
3	7
4	15
5	?
n	?

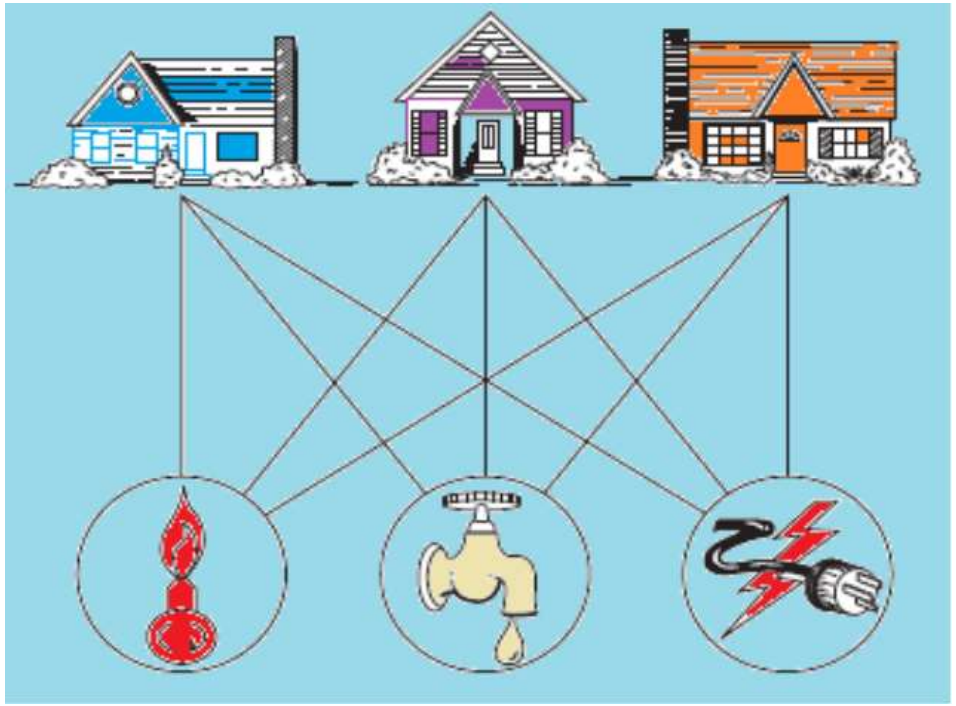
Solution of Tower of Hanoi game can be obtained by first order linear recurrence relation y_{k+1}-2$y_k = 1$ under Y(0)=0]. For more details please visit https://www.mathsisfun.com/games/towerofhanoi.html

The Seven Bridges of Königsberg



Is it possible to start at some location in the town, travel across all the bridges once without crossing any bridge twice, and return to the starting point.

Application of graph theory

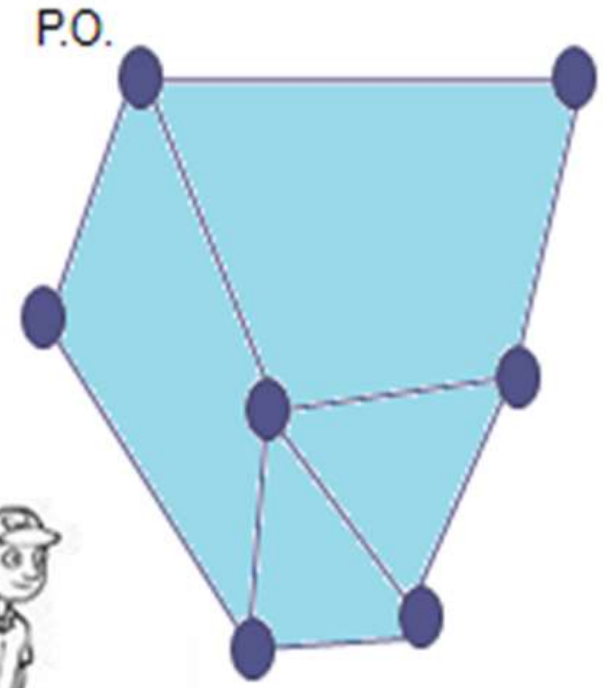


Consider the problem of joining three houses to each of three separate utilities, as shown in Figure .
Is it possible to join these houses and utilities so that none of the connections cross?

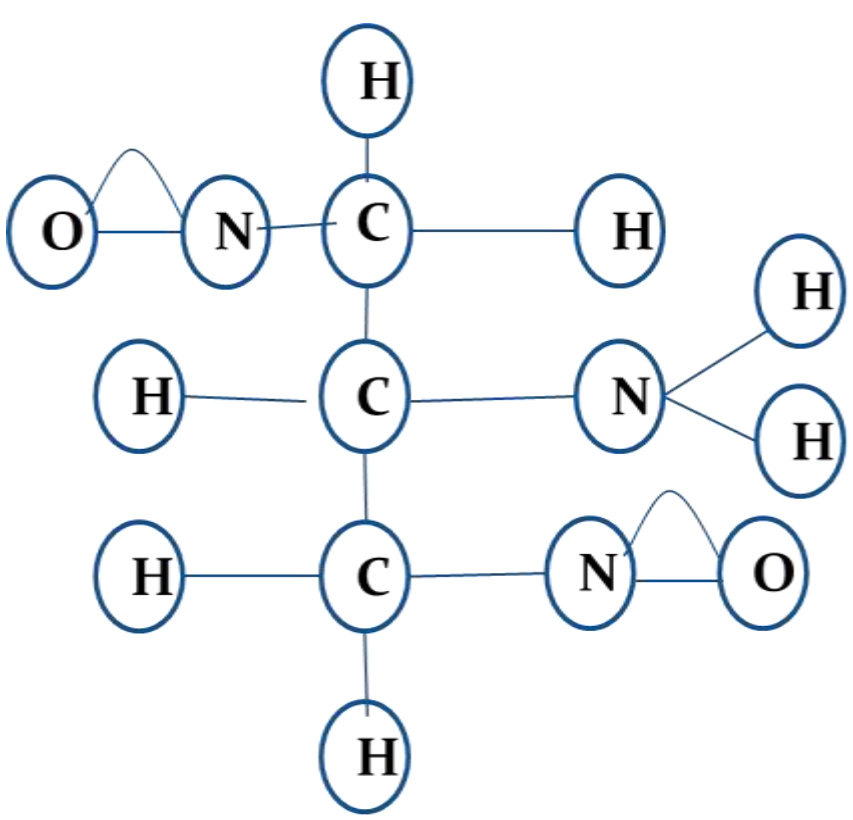
In this section we will study the question of whether a graph can be drawn in the plane without edges crossing. In particular, we will answer the houses-and-utilities problem.

Postman Problem

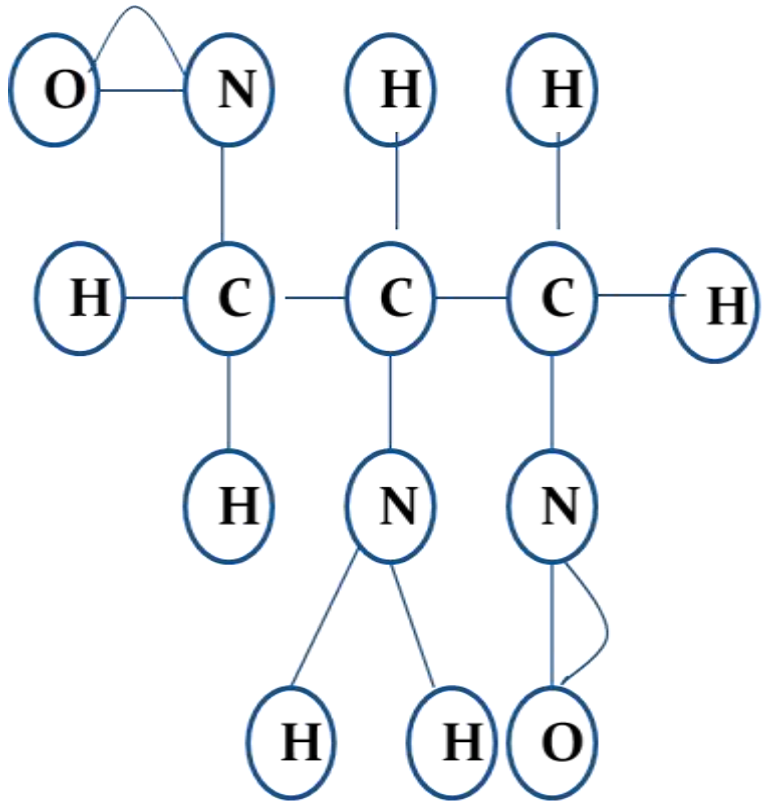
- A postman begins in the post office, has to traverse all the streets, and returns to the post office in a shortest possible distance.



Determining if two compounds with the same formula are identical.



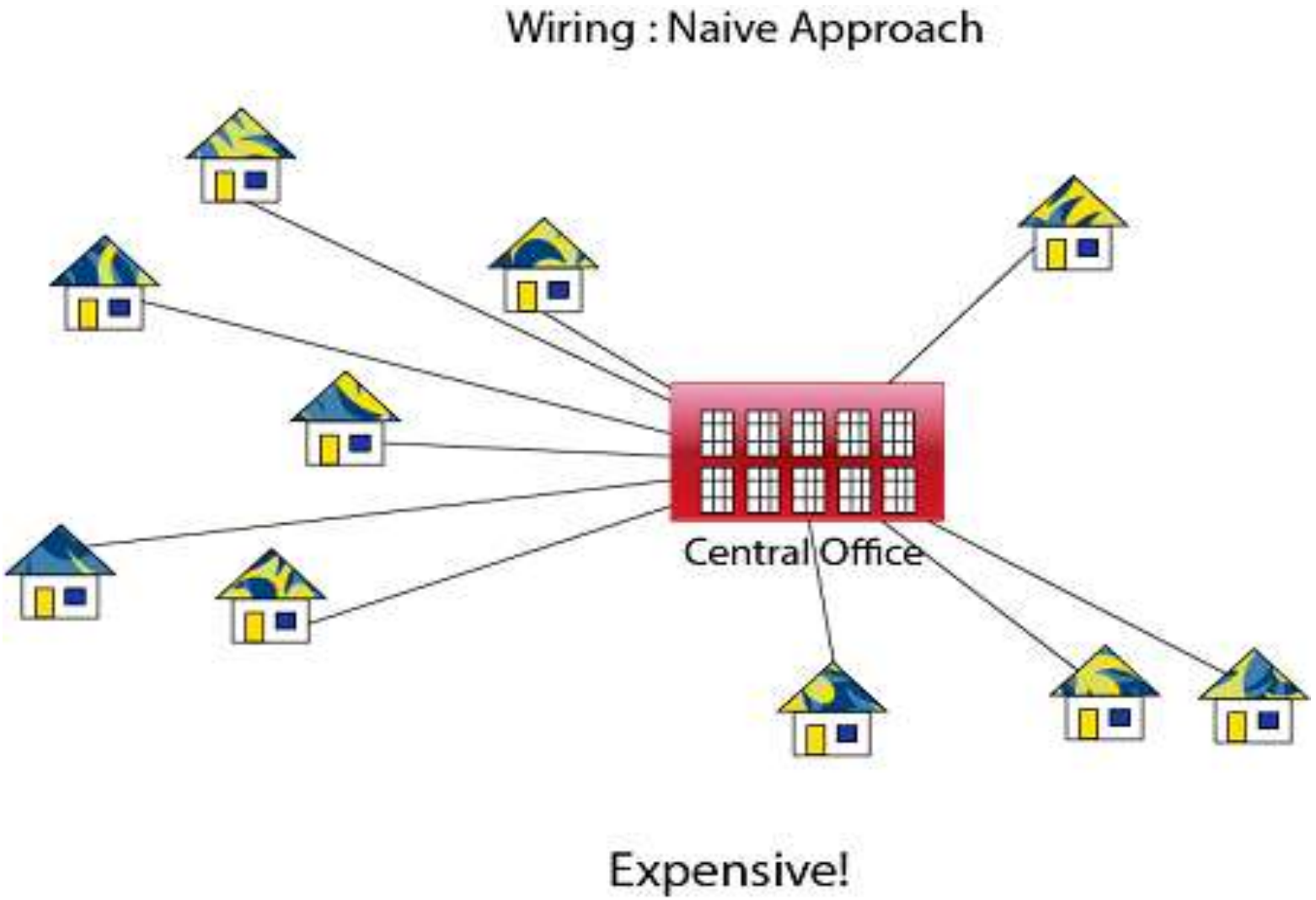
$C_3H_7N_2O_2$



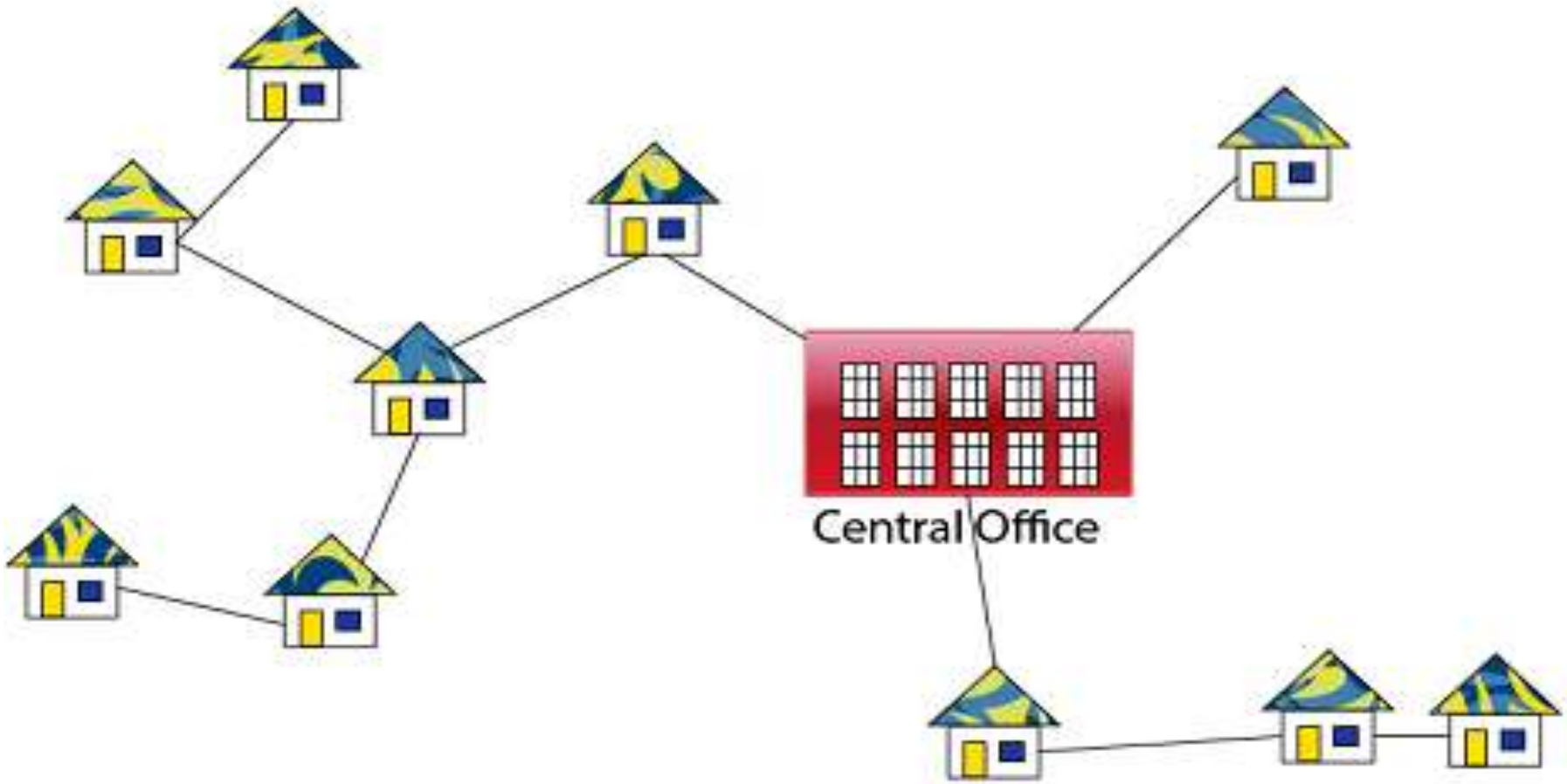
Graph isomorphism problem

Application of Minimum Spanning Tree

Problem laying Telephone Wire



Wiring : Better Approach



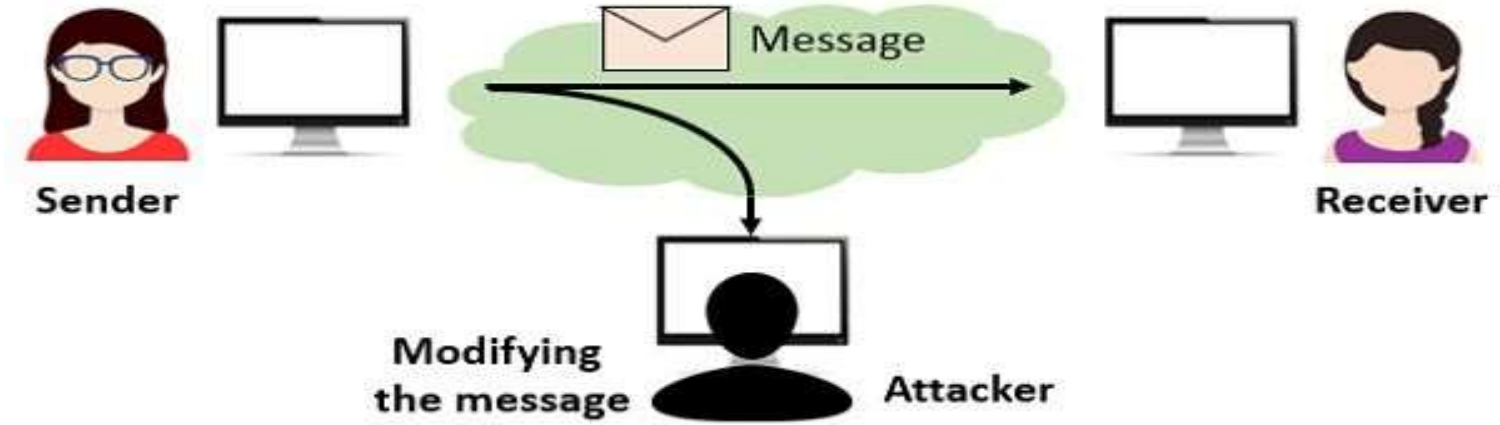
Minimize the total length of wire connecting the customers

Assignment problem

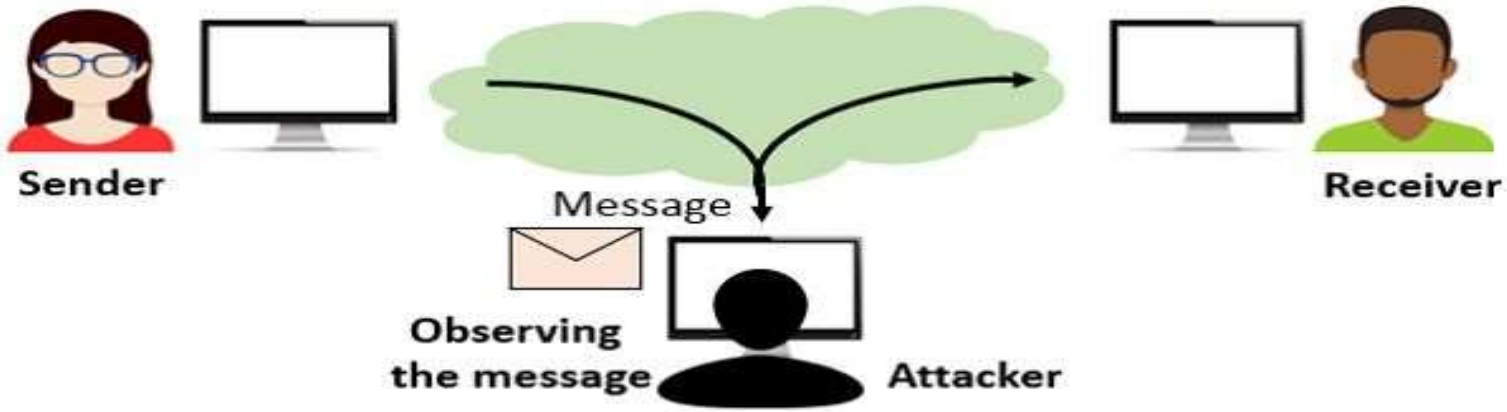
There are 50 students in the class and teacher needs to prepare minimum number of class test for them in a way such that no two consecutive students get the same assignment.

It can be done via graph coloring , teacher can find chromatic no. of graphical representation of students

Cryptography



Passive Attack



Active Attack

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India

Next Class: Logic

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India