**Academic Planner Presentation**

**On**

**Discrete Mathematics**

**By**

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**ACADEMIC PLANNER**

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**(1) Preamble/Introduction:**

* **Discrete mathematics** is the study of mathematical structures that are fundamentally discrete rather than continuous. In contrast to real numbers that have the property of varying "smoothly", the objects studied in discrete mathematics – such as integers, graphs, and statements in logic – do not vary smoothly in this way, but have distinct, separated values.
* Discrete mathematics therefore excludes topics in "continuous mathematics" such as calculus and analysis. Discrete objects can often be enumerated by integers. More formally, discrete mathematics has been characterized as the branch of mathematics dealing with countable sets (sets that have the same cardinality as subsets of the natural numbers, including rational numbers but not real numbers). However, there is no exact, universally agreed, definition of the term "discrete mathematics. Indeed, discrete mathematics is described less by what is included than by what is excluded: continuously varying quantities and related notions.
* The set of objects studied in discrete mathematics can be finite or infinite. The term **finite mathematics** is sometimes applied to parts of the field of discrete mathematics that deals with finite sets, particularly those areas relevant to business.
* Research in discrete mathematics increased in the latter half of the twentieth century partly due to the development of digital computers which operate in discrete steps and store data in discrete bits. Concepts and notations from discrete mathematics are useful in studying and describing objects and problems in branches of computer science, such as computer algorithms, programming languages, cryptography, automated theorem proving, and software development.
* Conversely, computer implementations are significant in applying ideas from discrete mathematics to real-world problems, such as in operations research.

**(2) Prerequisites**

1.Familiarity of concepts of statements logic and truth tables

2. Familiarity of concepts of sets, functions, and relations

3. Counting principles, permutations, and combinations

4. Basic concepts of graphs and trees

**(3) OBJECTIVES & SYLLABUS**

**Course Objectives**

1. **Simplify** and **evaluate** basic logic statements including compound statements, implications,inverses, converses, and contrapositives using truth tables and the properties of logic.
2. **Describe** binary relations between two sets; determine if a binary relation is reflexive, symmetric, or transitive or is an equivalence relation; combine relations using set operations and composition. the domain and range of a discrete or non-discrete function. And identify one-to-one functions, perform the composition of functions.
3. **Evaluate** Boolean functions and simplify expression using the properties of Boolean algebra
4. **Solve** problems using the principle of inclusion-exclusion.
5. **Determine**, graph functions such as a given graph is simple or multigraph, directed or undirected, cyclic or acyclic, and determine the connectivity of a graph.

**Course Outcomes**

* **Understand** and construct precise mathematical proofs
* **Apply logic** and set theory to formulate precise statements
* **Analyze** and solve counting problems on finite and discrete structures
* **Describe** and manipulate sequences
* **Implement** graph theory methods to solving computing problems

**(4) SYLLABUS**

***(4.1)*SYLLABUS – CMREC (AUTONOMOUS)- R22, Hyderabad.**

**UNIT - I**

**Mathematical logic:** Introduction, Statements and Notation, Connectives, Normal Forms, Theory of Inference for the Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

**UNIT – II**

**Set theory:** Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Functions.

**UNIT – III**

**Algebraic Structures:** Introduction, Algebraic Systems, Semi groups and Monoids, Lattices as Partially Ordered Sets, Boolean Algebra.

**UNIT - IV**

**Elementary Combinatory:** Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutation with Constrained Repetitions, Binomial Coefficient, The Binomial and Multinomial Theorems, The Principle of Exclusion.

**UNIT – V**

**Graph Theory:** Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler’s Formula, Multi-graphs and Euler Circuits, Hamiltonian Graphs, Chromatic Numbers, The Four-Color Problem.

**TEXT BOOK**

* Discrete Mathematical Structures with Applications to Computer Science: J.P. Tremblay, R. Manohar, McGraw-Hill, 1st ed.
* Discrete Mathematics for Computer Scientists & Mathematicians: Joe l. Mott, Abraham Kandel, Teodore P. Baker, Prentis Hall of India, 2nd edition.

**REFERENCE BOOKS**

* Discrete and Combinatorial Mathematics - an applied introduction: Ralph.P. Grimald, Pearson education, 5th edition.
* Discrete Mathematical Structures: Thomas Kosy, Tata McGraw Hill publishing co.
* Discrete Mathematics and Its Applications: Kenneth H. Rosen, Monmouth University (and formerly AT&T Laboratories), McGraw Hill publishing co.

**(4.2) SYLLABUS – GATE( 7% weightage)**

**UNIT-I**

Propositional and First-Order Logic

**UNIT-II & III**

Sets, Relations, Functions, Partial orders,

and Lattices. Monoids, Groups

**UNIT-IV**

Combinatorics: Counting, Recurrence Generating Functions

**UNIT V**

Graphs: Connectivity, Matching, Coloring

**(5) Expert Details**

**The Expert Details which have been mentioned below are only a few of the eminent ones known Internationally, Nationally and Locally. There are a few others known as well**

**International**

1. Frank Ruskey, University of Victoria , mail-id: [ruskey@cs.uvic.ca](mailto:ruskey@cs.uvic.ca) , Ph: 1-250-472-5794
2. David Pike, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, mail-id: [dapike@mun.ca](mailto:dapike@mun.ca) , Contact no:(709) 864-8096

**National**

# 1.Dr. P. Venkata Subba Reddy,Assistant Professor,Department of CSE,National Institute of Technology, Warangal - 506004, Telangana, INDIA,

# Mail id: [pvsr@nitw.ac.in](mailto:pvsr@nitw.ac.in), Ph: 8332969417.

2.Discrete Mathematics with Applications, Thomas Koshy, Elservier.

3.Logic and Discrete Mathematics, Grass Man & Trembley, Person Education

**Regional**

1)P.S. Kannan - M.Sc, P.G.D.C.A, M.Tech(IT) Head, Department of BCA, PES University, Bengaluru.

Rakesh S. - M.Sc (Maths), Asst. Prof., Department of Mathematics, Surana College, Bengaluru.

Discrete Mathematics (Blr Univ)

**Contact number telephone**: 8026721983

E-mail id- [kannan@pes.edu](mailto:kannan@pes.edu)

2)Dr.-m.v.s.s.n.-prasad JNTU Hyderabad, He is M.Sc., PGDCA, Ph.D., Head of General Section Department of Technical Education Govt. of A.P.

**(6) *Journals***

**International**

**1) The Research on Two Important Counter-examples of**

**Four-color Problem**

**LInk**:<file:///C:/Users/CSCJAVA23/Downloads/5.Four-color%20Problem%20(1).pdf>

**2)** **Spanning Tree Backbone in Multihop Wireless Networks**

**LInk**:<file:///C:/Users/CSCJAVA23/Downloads/5.3Spanning%20Tree%20(2).pdf>

**3)Reduce the recursive inclusive and exclusive principle for probability of union events**

**link:file:///C:/Users/CSCJAVA23/Downloads/2.Inclusion-Exclusion%20principle%20(1).pdf**

**4)** **Constructing extended Boolean functions from truth tables using the Mathematica system**

**link-file:///C:/Users/CSCJAVA23/Downloads/1.2Boolean%20functions%20using%20truth%20tables%20(1).pdf**

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***(7) Subject -Lesson plan***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S.NO | | CMREC(Autonomus syllabus) | | Sub-Topic | | No. of Lectures Required | | Suggested Books | Teaching Methods | | |
| **UNIT - I** | | | | | | | | | |
| **1** | | Mathematical Logic | Introduction | **L1** | | **T1** | | | **M1** |
| **2** | | Statement Notation | **L2-L3** | | **T1** | | | **M1** |
| **3** | | Connectives | **L4-L5** | | **T1** | | | **M2(PPT)** |
| **4** | | Normal Forms | **L6-L7** | | **T1** | | | **M2(PPT)** |
| **5** | | Theory of Inference for the Statement Calculus | **L8, L9** | | **T1** | | | **M1** |
| **6** | | The Predicate Calculus | **L10, L11** | | **T1** | | | **M1** |
| **7** | | Inference Theory of the Predicate Calculus. | **L12, L13** | | **T1** | | | **M1** |
| **8** | | Inference Theory of the Predicate Calculus. | **L14, L15** | | **T1** | | | **M1** |
| **UNIT-II** | | | | | | | | | |
| **9** | | Set Theory | Introduction | **L16** | | **T1** | | | **M1** |
| **10** | | Basic Concepts of Set Theory | **L17** | | **T1** | | | **M1** |
| **11** | | Representation of Discrete Structures | **L18** | | **T1** | | | **M1** |
| **12** | | Relation | **L19** | | **T1,R3** | | | **M1** |
| **13** | | ordering | **L20** | | **T1** | | | **M1** |
| **14** | | Functions | **L21** | | **T1,R3** | | | **M1** |
| **UNIT III** | | | | | | | | | |
| **15** | | Algebraic structure | Introduction | **L22** | | **T2** | | | **M1** |
| **16** | | Algebraic Systems | **L23** | | **T2** | | | **M1** |
| **17** | | Semi groups | **L24** | | **T2** | | | **M1** |
| **18** | | Monoids | **L25** | | **T2,R1** | | | **M1** |
| **19** | | Lattices as Partially Ordered Sets, | **L26** | | **T2,R1** | | | **M1** |
| **20** | | Boolean Algebra | **L27** | | **T2 R3** | | | **M1** |
| **21** | | Boolean functions | **L28** | | **T2** | | | **M1** |
| **UNIT IV** | | | | | | | | | |
| **24** | | **Elementary Combinatorics** | Basics of Counting | **L29** | | **T2,R3** | | | **M1** |
| **25** | | Combinations and Permutations | **L30** | | **T2,R3** | | | **M1** |
| **26** | | Enumeration of Combinations and Permutations | **L31** | | **T2** | | | **M2(PPT)** |
| **27** | | Enumerating Combinations | **L32** | | **T2,R3** | | | **M2(NPTEL)** |
| **28** | | Permutations with Repetitions | **L33** | | **T2,R3** | | | **M2(NPTEL)** |
| **29** | | Enumerating Permutation with Constrained Repetitions | **L34** | | **T2** | | | **M1** |
| **30** | | Binomial Coefficient | **L35** | | **T2** | | | **M1** |
| **31** | | The Binomial and Multinomial Theorems | **L36** | | **T2** | | | **M1** |
| **32** | | The Principle of Exclusion | **L37** | | **T2** | | | **M1** |
| **UNIT-V** | | | | | | | | | |
| **33** | | Graphs Theory | Basic Concepts | **L38** | | **T2,R3** | | | **M1** |
| **34** | | Isomorphism and Sub graphs | **L39** | | **T2,R3** | | | **M2(PPT)** |
| **35** | | Trees and their Properties | **L40** | | **T2,R3** | | | **M2(NPTEL)** |
| **36** | | Spanning Trees, | **L41** | | **T2,R3** | | | **M2(PPT)** |
| **37** | | Binary Trees | **L42** | | **T2** | | | **M1** |
| **38** | | Directed tree | **L43** | | **T2** | | | **M1** |
| **39** | | Tree Traversal | **L44** | | **T2** | | | **M1** |
| **40** | | Planar Graphs | **L45** | | **T2,R3** | | | **M1** |
| **41** | | Minimum Spanning Trees | **L46** | | **T2,R3** | | | **M1** |
| **42** | |  | Euler’s Formula | **L47** | | **T2,R3** | | | **M1** |
| **43** | |  | Multi-graphs and Euler Circuits | **L48** | | **T2,R3** | | | **M1** |
| **44** | |  | Hamiltonian Graphs | **L49** | | **T2** | | | **M1** |
| **45** | |  | Chromatic Numbers | **L50** | | **T2,R3** | | | **M1** |
| **46** | |  | The Four-Color Problem | **L51** | | **T2,R3** | | | **M1** |

**METHODS OF TEACHING:**

|  |  |  |
| --- | --- | --- |
| **M1 : Lecture Method** | **M4 : Presentation /PPT** | **M7 : Assignment** |
| **M2 : Demo Method** | **M5 : Lab/Practical** | **M8 : Industry Visit** |
| **M3 : Guest Lecture** | **M6 : Tutorial** | **M9 : Project Based** |

**(7) Suggested Books (prescribed and References)**

**TEXT BOOKS:**

1. Discrete Mathematics and its Applications with Combinatorics and Graph Theory- Kenneth H Rosen, 7th Edition, TMH.
2. Discrete Mathematical Structures with Applications to Computer Science: J.P. Tremblay, R. Manohar, McGraw-Hill, 1st ed.
3. Discrete Mathematics for Computer Scientists & Mathematicians: Joe l. Mott, Abraham Kandel, Teodore P. Baker, Prentis Hall of India, 2nd edition.

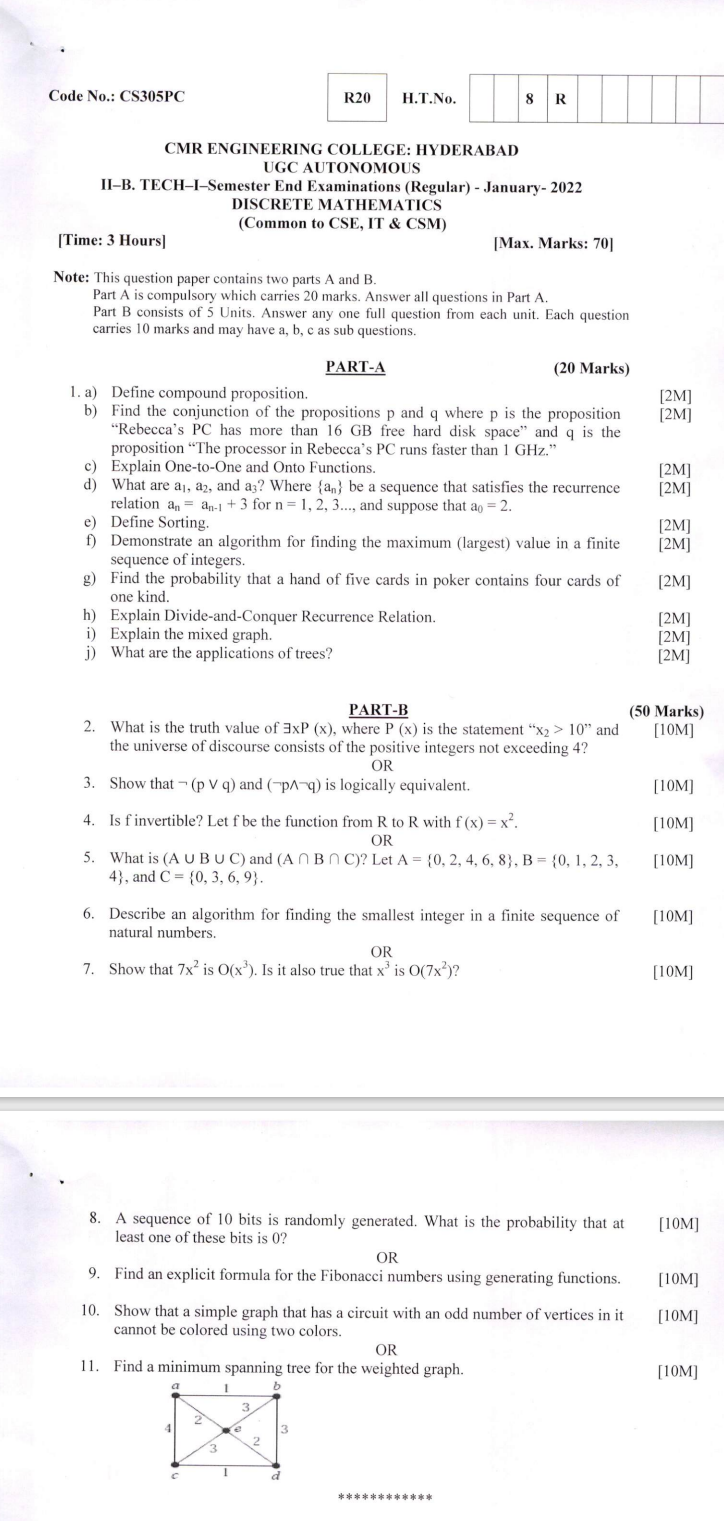
**REFERENCE BOOKS**

* Discrete Mathematics for Computer Scientists & Mathematicians: Joe L. Mott, Abraham Kandel, TeodoreP.Baker, 2nd ed, Pearson Education.
* Discrete Mathematics- Richard Johnsonbaugh, 7Th Edn., Pearson Education.
* Discrete Mathematics with Graph Theory- Edgar G. Goodaire, Michael M. Parmenter.
* Discrete and Combinatorial Mathematics - an applied introduction: Ralph.P. Grimald, 5th edition, Pearson Education.

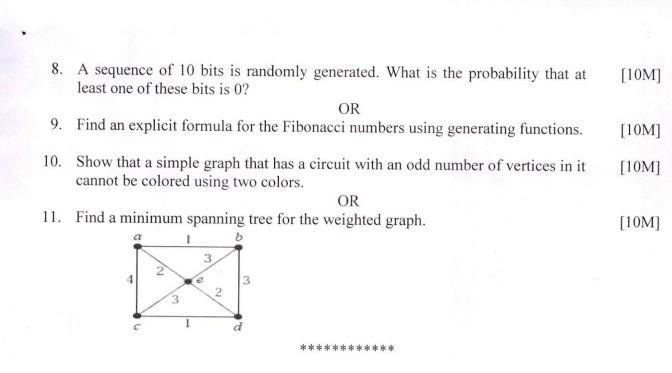
**(9) Websites for self-learning** **Resources**

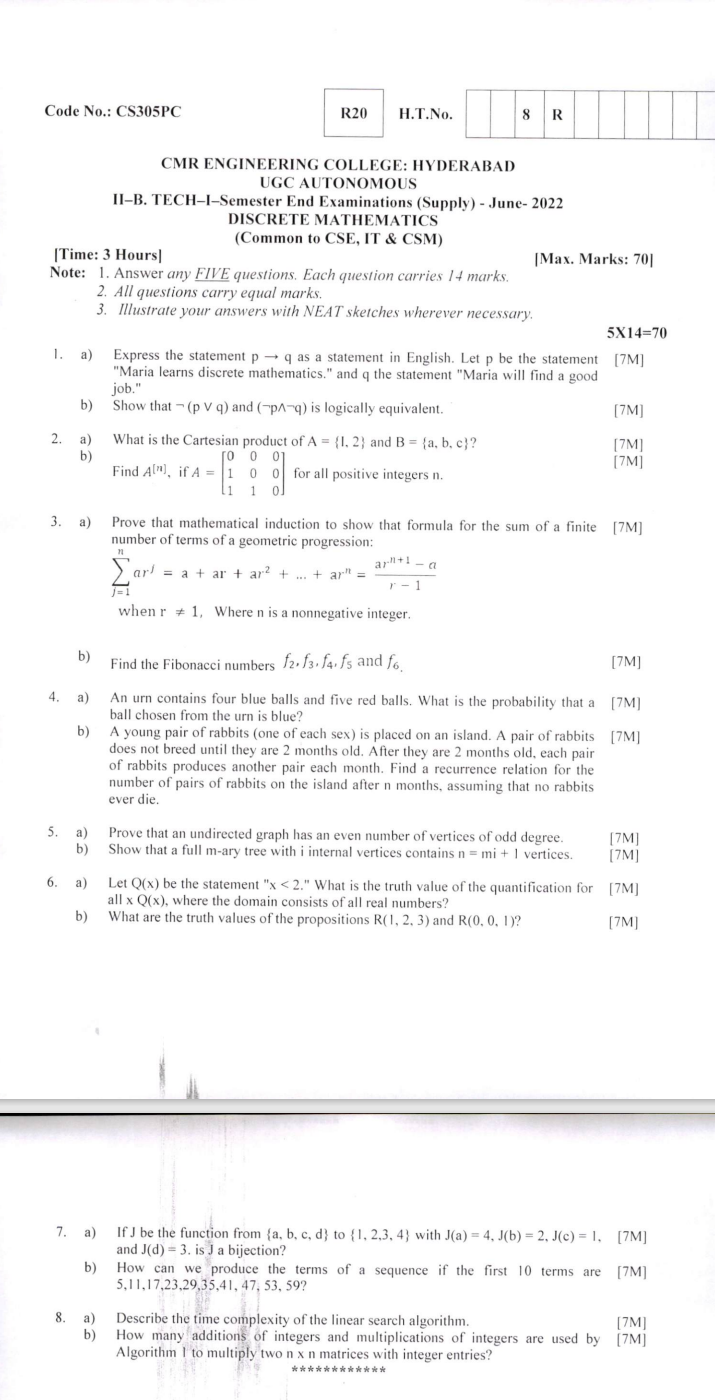
1. <https://www.coursera.org/learn/discrete-mathematics>
2. <https://www.tutorialspoint.com/discrete_mathematics/index.htm>
3. <https://www.javatpoint.com/discrete-mathematics-tutorial>
4. <https://www.guru99.com/breadth-first-search-bfs-graph-example.html>
5. https://www.geeksforgeeks.org/discrete-mathematics-tutorial/

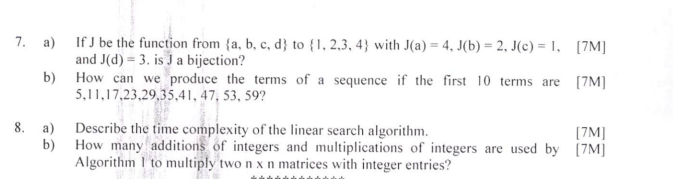
**(10) *QUESTION BANK***

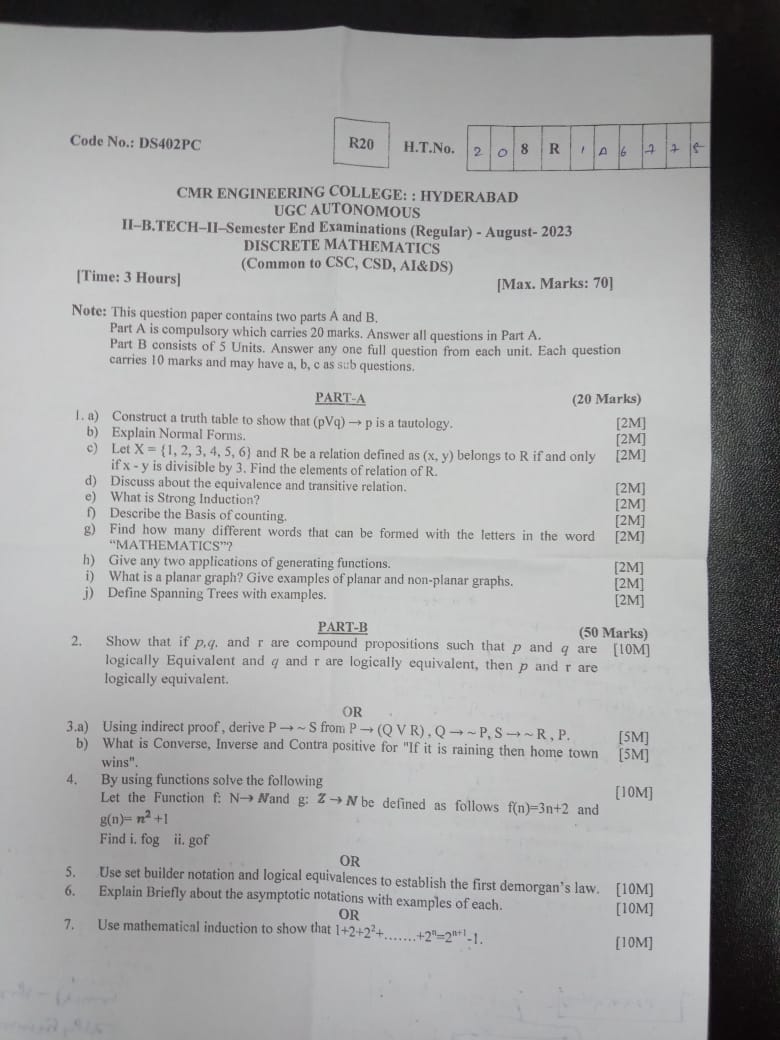


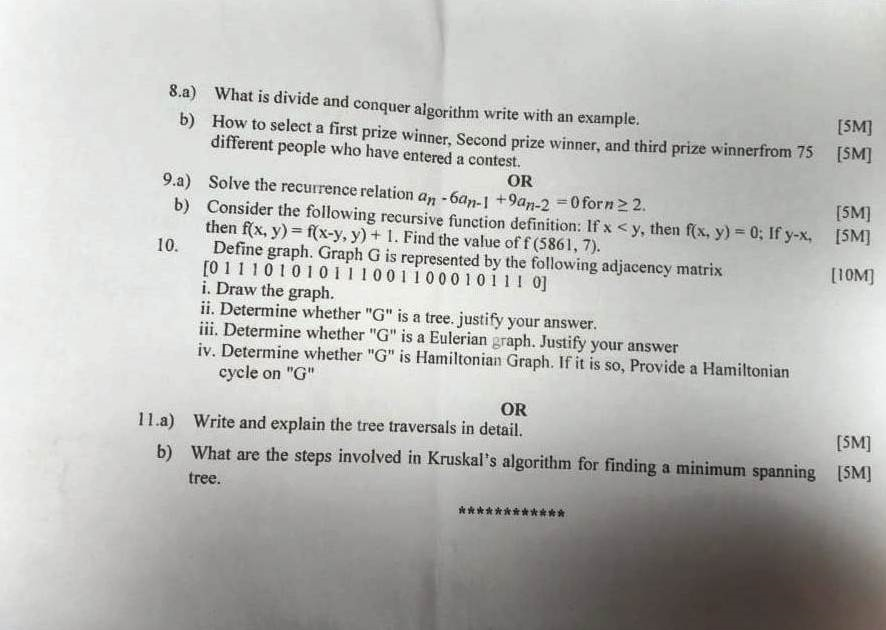


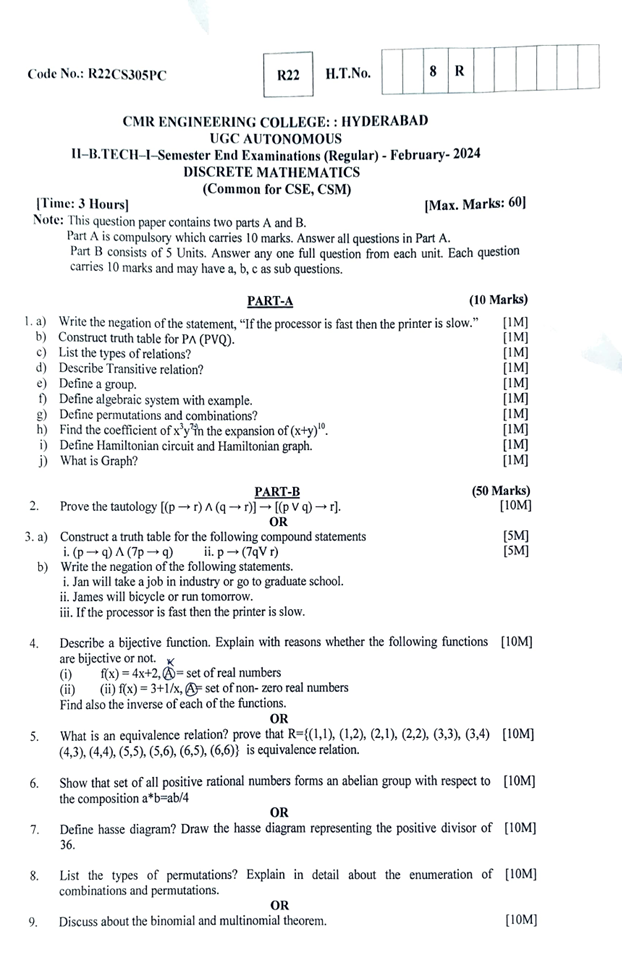


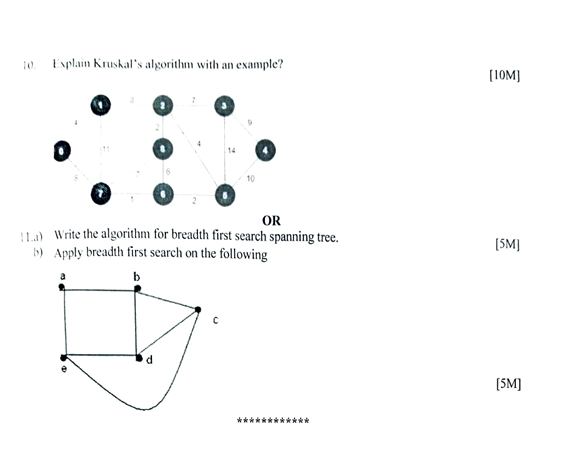












**11. QUESTION BANK**

**UNIT – I**

**Short Questions**

1. State which of the following sentences are propositions:

i) A triangle contains three lines ii) x+2 is a positive integer

1. Prove that {(p→q) →r}↔{(~pVq)→r} is a tautology.
2. Define Principal disjunctive normal form & Principal conjunctive normal form
3. Write down the following prepositions in symbolic form and find its negation:

“All integers are rational numbers and some rational numbers are not integers”

1. Give an indirect proof for each of the following statements:

i)If m is an even integer, then m+7 is an odd integer ii)If x& y are integers such that xy is odd, then x & y are both odd

**Long Answer Questions**

1)Translate the given statements into propositional logic using the propositions provided:

P: “The message is scanned for viruses”

Q: “The message was sent from an unknown system”

1. “The message is scanned for viruses whenever the message was sent from an unknown system.”
2. “It is necessary to scan the message for viruses whenever it

2)Explain the following: i) Normal Forms ii) Free and Bound Variables iii) Logical Equivalence iv) Resolution.

3) a) Obtain the principal disjunctive normal form of the following formula P ( P (Q ( Q R )))

b) Verify whether the proposition (( P q ) r ) s ((( P q ) r ) s).

4) a) Show that ( x )( p ( x ) Q ( x )) ↔(( x ) ( p ( x ) ( x ) (Q ( x )) is a logically valid statement.

b) Show the following using the automatic theorem.

i) P ( P Q ) P P Q R Apply 3 5 Assume x is a particular real number.

5)Determine whether the following two statements are logically equivalent.

1. x 2 orit is not the case that 1 x 3 ii) x 1 or either x 2 or x 3.

7)Construct the truth table for the following

1. q↔{(~p) V (~q)} b) [(p Λ q) V(~r)]↔p.

8) Find the disjunctive normal forms of the following a) (p V q V~q) Λ(p V~p) b) (~p→r) Λ(p↔q)

9) a) A direct proof b) An indirect proof and c) Proof by contradiction for the following statement

“ If ‘n’ is an odd integer then n+11 is an even integer

10)Prove that [ x,p(x) V x,q(x)] → x,[p(x) Vq(x)] through a counter example. Show that the converse of this is not true.

**Unit 2**

**Short questions**

1)Define Poset and distributive lattice.

2) Consider the following relations on the A={1,2,3}, f={(1,3),(2,3),(3,1)} g={(1,2),(3,1)},h={(1,3),(2,1),(1,2),(3,1)} which of these are functions?

3) Define Homomorphism & Isomorphism

4)Let f & g be functions from R to R defined by f(x)=ax+b and g(x)=1-x+x2 . If (gof) (x)=9x2 -9x+3 , determine a.b

5)Consider the sets A={a,b,c} and B={1,2,3} and the relations. R={(a,1),(b,1),(c,2),(c,3)} and S={(a,1),(a,2),(b,1),(b,2)} from A to B.Determine R͞,S͞,R⋃S,R⋂S,Rc ,Sc

6)Define set theory?

7) Show that the relation R={ (a,a),(a,b),(b,a),(b,b)(c,c)} on A={a,b,c} is an equivalence relation and find A/R also find partitions of A.

8) Let f:R→ 𝑅, 𝑔: 𝑅 → 𝑅, where R is the set of real numbers be given by f(x) = 𝑥 2 − 2 and g(x) = x+4 find fog and gof. State whether these functions are bijective or not.

9) Let R= { [1,1] [2,2] [3,3] [4,4] [5,5] [1,2] [2,1] [5,4] [4,5]} be the equivalence relation on A = {1,2,3,4,5}. Find equivalence classes and A/R.

10) Find the inverse of the function f(x) = ex defined from R to R+ .

11) If A = {1,2,3,4,5,6,7,8,9,10,11,12} and R= { (x,y)/x-y is multiple of 5} find the partition of A.

12) Let f(x)=x+2, g(x) = x-2, h(x) =3x find i) fog ii) fogoh.

13) Determine whether f(x) = 𝑥 2+1 𝑥 2+2 is bijective or not. 10) Give an example of relation which is symmetric but neither reflexive nor anti symmetric nor transitive.

**Long questions**

1)Explain Operations of set theory?

Let A={1,2,3,4,6} and R be a relation on A defined by aRb if and only if ”a” is a multiple of “b”. Represent the relation R as a matrix and draw its digraph.

2) Let A= {a,b,c,d} R be a relation on A that has the matrix Mr = [ 1 0 0 0 0 1 0 0 1 1 1 0 0 1 0 1 ].

Construct the digraph of R and list the in-degrees and out degrees of all vertices.

3) Let A={1,2,3} and R={(1,1),(2,2),(3,3)}. Verify that R is an equivalence relation.

4 ) Let A={1,2,3,4,6,8,12} on An define the partial ordering relation R by aRb iff a/b.

1. Draw the Hasse diagram for R. b) Write down the relation matrix for R.

5) Let A = {1,2,3,4,5} and R={(1,1),(2,2),(3,3),(1,3),(3,4),(3,5),(1,4),(4,4),(1,5),(2,3),(2,4),(2,5),(5,5)}.

Draw the Hasse diagram for R.

6 ) If A={1,2,3,5,30} and R is the divisibility relation, Prove that (A,R) is a lattice but not a distributive lattice.

7) In a distributive lattice, if a Λ b= a Λ c and a V b=a V c , Prove that b=c

8)Explain Relations and ordering?

9)Explain Functions?

10)Explain The Representation of Discrete Structure?

**Unit 3**

**Short Answer Questions**

1) Prove that for any three propositions P , Q, R the compound proposition

(𝑃 → (𝑄 → 𝑅)) → ((𝑃 → 𝑄) → (𝑃 → 𝑅)) is a tautology by 𝑖) with truth table ii) with laws of log

2) Show that the following set of premises are inconsistent 𝑃 → 𝑄, 𝑃 → 𝑅, 𝑄 → ~𝑅,

3) Show that the following argument is consistent p V q ∼ p \_\_\_\_\_\_\_\_\_ ∴ 𝐶 \_\_\_\_\_\_\_\_\_\_

4) Write a short notes on DNF and CNF.

5) Express the statement in words: “Every student in class has studied Calculus.” Using quantifiers.

6) Show using truth table that the statements ( p → q) and (∼ p V q ) are logically equivalent.

7)define semi group and monoids

8)define lattices with Example

**Long Questions**

1) Find PCNF without Constructing truth table (P→(Q∧R)) → (~ P→ (~ Q∧ ~R))

2) Use truth table to prove the following argument p→~q r → p q ∴ ~𝑟

3) Find PDNF by constructing its PCNF of (Q v P)⋀ (QVR)∧ (∼ (PV R) V ∼Q))

4) Find whether the following argument is valid or not “ No Engineering student is bad in studies “ “Anil is not bad in studies” Therefore “ Anil is an engineering student”

5) Without constructing truth table find PDNF of {(P →(Q ∧ R)) ∧ (~ Q∧∼ 𝑅 )}

6) Prove that the following argument is valid: “all dogs are carnivorous. “ “some animals are dogs.” Therefore” some animals are carnivorous”.

7) Is the following Conclusion valid derive from contradiction method. ~𝑞 p→q p ⋁ t ∴ 𝑡

8)Construct PCNF of (P⇔ 𝑄) → R

9)Obtain CNF of ((𝑃 → 𝑄) ⋀ ∼ 𝑄) → ~𝑃

10)Obtain DNF of (𝑄 → 𝑃) ⋀(~𝑃⋀𝑄)

11) Find PDNF by constructing the PCNF of (Q v P) ⋀ (QVR)∧ (∼ (PV R) V ∼Q)).

12)Explain Booleans Algebra rules

13)prove a) identity law b) commutative rule c) Associative Rules

14)Explain POSET?

**Unit 4**

**Short questions**

1. How many different orders can 3 men and 3 women be seated in a row of 6 seats if all members of same sex are seated in adjacent seats

2. A new state flag is to be designed with 6 vertical stripes in yellow, white, blue and red. In how many ways can this be done so that no two adjacent stripes have the same color?

3. In how many ways can a committee of 5 ladies and 4 gents be chosen from 9 ladies and 15 gents, if gent, A refuses to take part if lady, B is on the

Committee.

4. How many 5-card hands have 2 clubs and 3 hearts?

5. How many 5-card hands consist only of hearts?

6. How many 6 digit numbers are there with exactly one 5?

7. In how many ways can a committee of 5 ladies and 4 gents be chosen from 9 ladies and 15 gents, if gent, A refuses to take part if lady, B is on the committee.

8. How many different 8-bit strings are there that begin and end with one?

9.A new state flag is to be designed with 6 vertical stripes in yellow, white, blue and red.In how many ways can this be done so that no two adjacent stripes have the same color?

**Long questions**

1) Explain Binomial coefficient?

2) Explain Binomial and multinomial theorems?

3) Explain principal of Exclusion?

4) Describe Enumeration of permutation and combinations?

5) Differentiate permutation and combinations with example in detail?

6)A group of 8 scientists is composed of 5 psychologists and sociologists:

* In how many ways can a committee of 5 be formed?
* In how many ways can a committee of 5 be formed that has 3 psychologists and 2 sociologists?

7)How many different orders can 3 men and 3 women be seated in a row of 6 seats if all members of same sex are seated in adjacent seats

8) How many arrangements are there of 8.a, 6.b, 7.c in which each ‘a’ is on at least one side of another ‘a’.

9) In how many ways can we draw a heart or spade from ordinary deck of playing cards? a heart or an ace? an ace or a king? A card numbered 2 through 10?

**Unit 5**

**Short questions**

1) Define complete bipartite graph with example.

2) Define the following terms with suitable example i) Complete graph ii) Regular graph.

3) Define isomorphism of two graphs.

4) Define the following terms with suitable example i) Subgraph ii) Spanning graph.

5) Define dual of a planar graph and explain it through an example.

6) Define Chromatic number of a graph. Explain it through an example.

7) Draw K5 complete graph.

8) Let G be a 4-regular connected planar graph having 16 edges. Find the number of regions of G.

9)Draw a diagram of the graph G=(V,E) where V={A,B,C,D} , E={(A,B),(A,C),(A,D),(C,D)}

10) Define directed graph and directed edge set

11)Write the algorithm for breadth first search spanning tree.

12)What are the steps involved in Kruskal’s algorithm for finding a minimum spanning tree.

13)Write the difference between Hamiltonian graphs and Euler graphs

14) How many vertices will the following graph contain 16 edges and all vertices of degree 2.

**Long questions**

1)Define graph coloring and chromatic number of a graph and find the chromatic number of 𝑖)𝐾3,3

ii) cycle with even number of vertices.

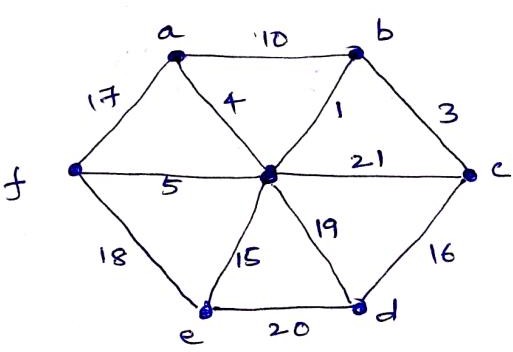
2) Define the following terms. Give one suitable example for each i) Euler circuit ii) Hamiltonian graph.

3) State and prove Euler’s theorem on plane graphs.

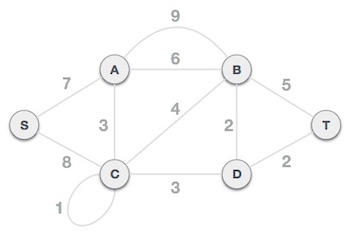
4) Define isomorphism of graphs. What are the steps followed in discovering the isomorphism?

5) Define dual and Isomorphism of graphs with example.

6) State and prove fundamental theorem of graph theory.

7)  b) Define Spanning tree. Apply Prim’s algorithm to find minimum spanning tree on the following weighted graph

8)Find the Minimum Cost of the Spanning Tree of the following Graph, by using Kruskal’s algorithm

.  (CO5)

**13. Assingment questions 1**

**Part A**

Q1. Define Tautology.

Q2. Define Well Formed Formula with Example.

Q3. Find the Cardinality of set of Even Positive Integers less than 20?

Q4. Define Domain and Range with Example.

Q5.Define Onto and One-to-One function.

**Part-B**

Q6.a. Construct the Truth table (i) PɅ(P V Q) (ii) ꓶP Ʌ (Q Ʌ P)

b. Prove the following Equivalence : P→(Q→R) ⇔P→(ꓶQVR) ⇔(PɅQ)→R

Q7.a. Explain the Normal Forms.

b. Obtain a CNF of (i) P Ʌ (P → Q) (ii) ꓶ(P V Q) ↔ (PɅ Q)

**Q8.a.** Show that R V S follows logically from the premises

CVD, (CVD→ꓶH), ꓶH → (AɅꓶB) and (AɅꓶB) → (RVS).

b. Obtain PCNF of (i) (P Ʌ ꓶQ) (ii) P ↔ Q

Q9.**a.** Solve the A ∩ (B ∩ C) = (A ∩ B) ∩ C.

**b.** If A={a, b, c} B={1,2} then solve i) A X B, ii) A X A, iii) B X B, iv) B X A.

Q10. Explain the properties of Relations.with Example.

Q11. a. Define Composition Relation.

Let A = {1,2,3} B= {p, q, r} C={x, y, z} Then relation R = { (1,p)(1,r)(2,p)(2,q) }

S= {(p, y), (q, x) (q, y), (r, z)} then compute i) RoS, ii)SoR, iii)(RoS)oR

b. Let A-={2,3,6,12,24,36} and the relation ≤ be such that x≤y if x devides y.Draw Hasse diagram of (A, ≤).

**Assignment questions 2**

**PART A**

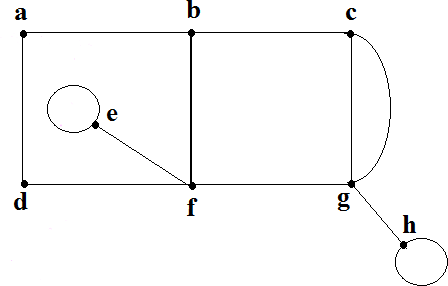
1) Show using truth table that the statements ( p → q) and (∼ p V q ) are logically equivalent.

2 )Define semi group and monoids.

3 )Define lattices with Example.

4) a)Define Spanning tree .

b) Find the degree of each region in the following planar graph



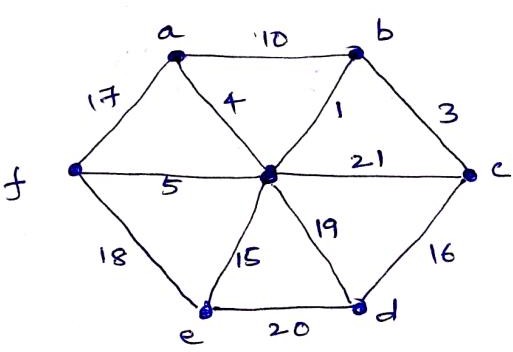
5) Define isomorphism of graphs. What are the steps followed in discovering the isomorphism

**PART B**

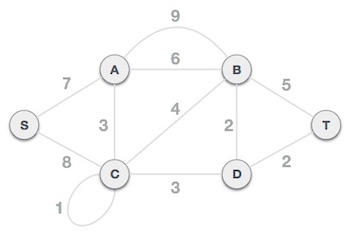
1)In how many ways can 14 people be distributed into 6 teams where in some order 2 teams have 3 each and 4 teams have 2 members each?

2)Find the number of permutations of the letters of TOMANDJERRY so that same letters do not appear together.

3 .a) Explain the steps involved in deriving a spanning tree from the given undirected graph using Breadth First Search algorithm, with an Example.

1. Define Spanning tree. Apply Prim’s algorithm to find minimum spanning tree on the following weighte graph

4) Find the Minimum Cost of the Spanning Tree of the following Graph, by using Kruskal’s algorithm



5) 2) Define the following terms. Give one suitable example for each

i) Euler circuit ii) Hamiltonian graph.

6) Explain Binomial and multinomial theorems?

7) Explain principal of Exclusion?

**CASE STUDY**

**Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.**

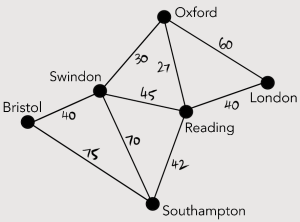
**CASE STUDY**

# Prim’s Algorithm – table form

[Prim’s algorithm](http://prims-algorithm/) is also suitable for use on distance tables or matrices, or the equivalent for the problem. This is useful for large problems where drawing the network diagram would be hard or time-consuming.

That tables can be used makes the algorithm more suitable for automation than [Kruskal’s algorithm](http://kruskals-algorithm/). The reason for this is that the data used would have to be sorted to be used with [Kruskal’s algorithm](http://kruskals-algorithm/). With [Prim’s algorithm](http://prims-algorithm/), however, it is only the minimum value that is of interest, so no sorting is normally necessary.

We will look again at our question that requires a minimum spanning tree for the network of towns in the south of England using main road connections. The network diagram is as shown in figure 1.

Figure 1: Network of road connections in southern England.

The network shown in Figure 1 can be represented by the adjacency matrix shown in Table 1.

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **Bristol** | – | × | × | × | 75 | 40 |
| **London** | × | – | 60 | 40 | × | 70 |
| **Oxford** | × | 60 | – | 27 | × | 30 |
| **Reading** | × | 40 | 27 | – | 42 | 45 |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **Swindon** | 40 | 70 | 30 | 45 | 70 | – |

Table 1: tabular version of road network. × means no direct link.

The tabular form of Prim’s algorithms has the following steps:

1. Select any vertex (town). Cross out its row. Select the shortest distance (lowest value) from the column(s) for the crossed out row(s). Highlight that value.
2. Cross out the row with the newly highlighted value in. Repeat step 1. Continue until all rows are crossed out.
3. Once all rows are crossed out, read off the connections. The column and the row of each highlighted value are the vertices that are linked and should be included.

## Example

First we will choose a town at random – Swindon – and cross out that row. Then we highlight the smallest value in the column for the crossed out row.

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **Bristol** | – | × | × | × | 75 | 40 |
| **London** | × | – | 60 | 40 | × | 70 |
| **Oxford** | × | 60 | – | 27 | × | 30 |
| **Reading** | × | 40 | 27 | – | 42 | 45 |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **~~Swindon~~** | ~~40~~ | ~~70~~ | ~~30~~ | ~~45~~ | ~~70~~ | ~~–~~ |

Table 2: Prim’s algorithm first iteration.

Next we need to cross out the row with the newly-highlighted value in (the Oxford row). Then we look for, and highlight, the smallest value in the columns for the two crossed out rows (Swindon and Oxford).

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **Bristol** | – | × | × | × | 75 | 40 |
| **London** | × | – | 60 | 40 | × | 70 |
| **~~Oxford~~** | ~~×~~ | ~~60~~ | ~~–~~ | ~~27~~ | ~~×~~ | ~~30~~ |
| **Reading** | × | 40 | 27 | – | 42 | 45 |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **~~Swindon~~** | ~~40~~ | ~~70~~ | ~~30~~ | ~~45~~ | ~~70~~ | ~~–~~ |

Table 3: Prim’s algorithm second iteration.

Next we need to cross out the row with the newly-highlighted value in (the Reading row). Then we look for, and highlight, the smallest value in the columns for the three crossed out rows (Swindon, Oxford, and Reading).

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **Bristol** | – | × | × | × | 75 | 40 |
| **London** | × | – | 60 | 40 | × | 70 |
| **~~Oxford~~** | ~~×~~ | ~~60~~ | ~~–~~ | ~~27~~ | ~~×~~ | ~~30~~ |
| **~~Reading~~** | ~~×~~ | ~~40~~ | ~~27~~ | ~~–~~ | ~~42~~ | ~~45~~ |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **~~Swindon~~** | ~~40~~ | ~~70~~ | ~~30~~ | ~~45~~ | ~~70~~ | ~~–~~ |

Table 4: Prim’s algorithm third iteration.

Next we need to cross out the row with the newly-highlighted value in (the Bristol row). Then we look for, and highlight, the smallest value in the columns for the four crossed out rows (Swindon, Oxford, Reading, and Bristol).

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **~~Bristol~~** | ~~–~~ | ~~×~~ | ~~×~~ | ~~×~~ | ~~75~~ | ~~40~~ |
| **London** | × | – | 60 | 40 | × | 70 |
| **~~Oxford~~** | ~~×~~ | ~~60~~ | ~~–~~ | ~~27~~ | ~~×~~ | ~~30~~ |
| **~~Reading~~** | ~~×~~ | ~~40~~ | ~~27~~ | ~~–~~ | ~~42~~ | ~~45~~ |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **~~Swindon~~** | ~~40~~ | ~~70~~ | ~~30~~ | ~~45~~ | ~~70~~ | ~~–~~ |

Table 5: Prim’s algorithm fourth iteration.

Next we need to cross out the row with the newly-highlighted value in (the London row). Then we look for, and highlight, the smallest value in the columns for the crossed out rows (Swindon, Oxford, Reading, Bristol, and Southampton).

|  | **Bristol** | **London** | **Oxford** | **Reading** | **Southampton** | **Swindon** |
| --- | --- | --- | --- | --- | --- | --- |
| **~~Bristol~~** | ~~–~~ | ~~×~~ | ~~×~~ | ~~×~~ | ~~75~~ | ~~40~~ |
| **~~London~~** | ~~×~~ | ~~–~~ | ~~60~~ | ~~40~~ | ~~×~~ | ~~70~~ |
| **~~Oxford~~** | ~~×~~ | ~~60~~ | ~~–~~ | ~~27~~ | ~~×~~ | ~~30~~ |
| **~~Reading~~** | ~~×~~ | ~~40~~ | ~~27~~ | ~~–~~ | ~~42~~ | ~~45~~ |
| **Southampton** | 75 | × | × | 42 | – | 70 |
| **~~Swindon~~** | ~~40~~ | ~~70~~ | ~~30~~ | ~~45~~ | ~~70~~ | ~~–~~ |

Table 6: Prim’s algorithm fifth and final iteration.

We’ve now selected a value from the last undeleted row. This means we’ve selected all the edges that we need to create the minimum spanning tree for the network. All we have left to do is write out the connections between the vertices.

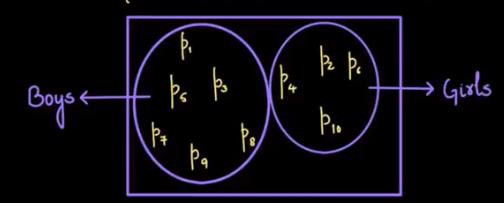
The connections in the network are found by taking the row and column headings for each selected value in the table. The edges are: {(Bristol, Swindon), (London, Reading), (Oxford, Swindon), (Reading, Oxford), (Southampton, Reading)}. This is the set of edges as in the minimum spanning tree generated by the [diagrammatic version of the algorithm](https://maths.shelswell.org.uk/prims-algorithm).

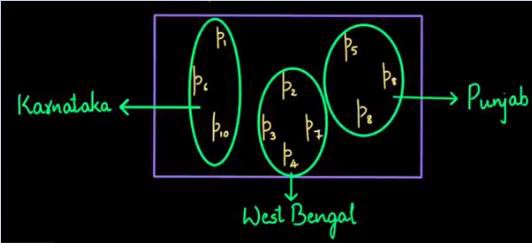
**2.Describe the Union and intersection of sets**

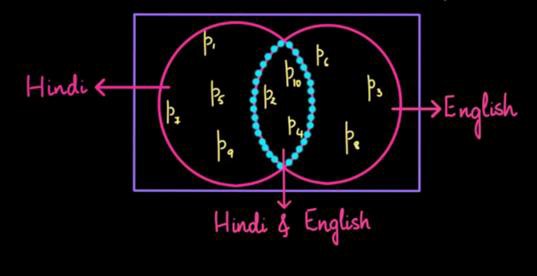
Let us now play around with sets by performing a few operations on that.

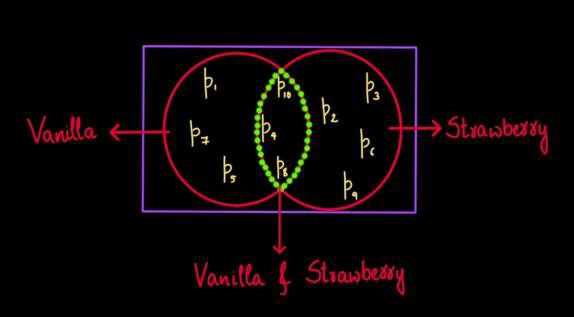
Let me consider a set Uwith10people:

*U*{*p*1,*p*2,*p*3,*p*4,*p*5,*p*6,*p*7,*p*8,*p*9,*p*10}

Instead of seeing it as a set I’m going to take a rectangle and put this people here in to this rectangle .In this some of them are boys ,and some of them are girls.

And then I’m going to use another circle to represent that these people are from different states. Some of them are from Karnataka, some people are from West Bengal, and some are from Punjab.

So these 10 people belong to 3 different states. And then let me go ahead and also tell you that some of them know Hindi, and some people know English, and guess what is in between, some of the people who know both Hindi as well as English.

So,*p*V∪S,for asimple reasonthathe neitherlikesvanilla norstrawberry.

**12. DM INNOVATIVE ASSIGNMENT QUESTIONS**

1)How to find the shortest path by using Graph Theory?

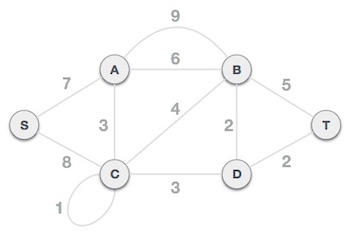
2)What is the Recursion process and write the applications of Recursion ?

3)What is the use of growth functions?

4)Explain the Rules of Inference?

5)Explain principle of inclusion exclusion with example?

6 Use Kruskal Algorithm to find a Minimum Spanning in the weighted graph shown in Figure below.



**(13) List of topics for student’s Seminars :-**

1. Mathematical logic
2. Free and bound variables, Rules of inference
3. Properties of binary relations
4. Posets ,lattice and properties
5. Homomorphism and isomorphism
6. Binomial coefficients and multinomial theorems
7. DFS, BFS
8. Spanning trees
9. Isomorphism and sub graphs
10. Euler circuits.
11. Hamiltonian Graphs

**(14)STEP/Course material in soft-copy**

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**(15)Expert Lectures with topics & Schedules (if any)**

**Subject Expert** Topics

1**)K.Ramana Reddy CMREC (CSE)**  **Graph Theory**

Contact number 9908535807

**2)Summaiyya Afreen CMRTC(AIML)**

Contact number 8050857651 **SET theory**

**3)DR.K Suma CMRTC(CSE)**

Contact number 9740888182 **DFS and BFS**

**16. Week wise Activity plan**

|  |  |  |
| --- | --- | --- |
| **S.no** | **week** | **activity** |
| 1 | 1 | Topic wise Test and topic wise question will give to the students |
| 2 | 2 | One minute question and topic wise question will give to the students |
| 3 | 3 | Seminar and topic wise question will give to the students |
| 4 | 4 | Snap Talk and topic wise question will give to the students |
| 5 | 5 | Seminar and topic wise question will give to the students |
| 6 | 6 | STORY BOARD and topic wise question will give to the students |
| 7 | 7 | Assignment and topic wise question will give to the students |
| 8 | 8 | Topic wise Test and topic wise question will give to the students |
| 9 | 9 | Classroom quiz sessions and topic wise question will give to the students |

**-----------------------THANK YOU--------------------------------------**