# Department of Applied Sciences (Mathematics)

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| **Institute / School Name** | Chitkara University, Himachal Pradesh/CSOET |
| **Program Name** | B.E.(CSE) |
| **Course Code** | AM103 |
| **Course Name** | Discrete Structures |
| **Batch** | 2020 |
| **Semester** | III |
| **Lecture / Tutorial (per week)** | 4-0-0        **Course Credits**    4 |
| **Course Coordinator Name** | Dr. Neha Kumra |

## 1 Scope of the Course

The course provides the ability to develop the mathematical foundations, abstraction and formalization of reasoning for the problems related to computer science engineering to arrive at substantiated conclusions.

## 2 Course Learning Outcomes

CLO1: To demonstrate the application of Discrete mathematical principles in investigating and solving a variety of real time problems related to Sets , Relations and Functions.

CLO2: To be able to analyze and solve real time scientific problems using combinatorics.

CLO3: To analyze a given problem and to be able to apply the theory and techniques of Lattice,Logic and Boolean algebra.

CLO4: To comprehend Graph Theory and its relevance within the context of computer science and finding solutions of problems through  shortest path algorithms.

## 3 Recommend books

**1**: 'Elements of Discrete Mathematics', by C.L.Liu, McGraw-Hill.

**2**: 'Discrete Mathematics' by Babu Ram, Pearson Education India.

**3**: 'Discrete Mathematics' by Lipschutz/Lipson, Schaum Series, $2^{nd}$   Edition, TMH, Edition.

**4**: 'Discrete Mathematics and its Applications' by Kenneth H. Rosen, McGraw- Hill.

**5: '**Logic and Discrete Mathematics' by Trembly/Grassmann, Pearson Education**.**

**6:** 'The Discrete Mathematics', Chitkara University Publications.

## 4 Other readings and relevant websites

| S.No. | Link of Journals, Magazines, websites and Research Papers |
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| Link 1 | http://download.nos.org/srsec311new/L.No.15-A.pdf |
| Link 2 | http://faculty.simpson.edu/lydia.sinapova/www/cmsc180/LN180_Johnsonbaugh-07/L17-EquivalenceRel.htm |
| Link 3 | http://web.cs.wpi.edu/~cs504/s00m/notes/recurrence/solve/step2/step2.html |
| Link 4 | http://www.iep.utm.edu/prop-log/ |
| Link 5 | http://plato.stanford.edu/entries/boolalg-math/ |
| Link 6 | http://www.hamilton.ie/ollie/Downloads/Graph.pdf |
| Link 7 | https://digitalcollections.dordt.edu/cgi/viewcontent.cgi?article=1434&context=faculty_work |
| Link 8 | http://staff.scem.uws.edu.au/cgi-bin/cgiwrap/zhuhan/dmath/dm_readall.cgi?page=16 |
| Link 9 | https://www.youtube.com/watch?v=WN3Rb9wVYDY |

## 5 Course Plan

| Lecture Number | Topics |
|---|---|
| 1-5 | **Introducing sets:**  Properties & Operations on sets, Subsets, Power set, Inclusion-exclusion principle. Principle of duality, Cartesian product of sets, Partition of sets, Minsets, Maxsets. |
| 6-8 | **Introduction to relations**: Types of relation, Pictorial & Matrix representation of relation, Inverse relation, Composition of relation, Properties of relation. |

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|---|---|
| 9-10 | Equivalence relation, Partial order relation. |
| 11-12 | **Introduction to functions**: Types of functions, Domain & Range of functions, Inverse function, Injective, Surjective, Bijective & Composition of functions, Recursive function. |
| **IEC1(Lecture 1-12)** | |
| 13-15 | Permutations & Combinations, Pigeonhole principle. |
| 16-20 | **Recurrence relation**: Homogeneous and Non-homogeneous recurrence relation with constant coefficients. |
| 21-24 | **Characteristic polynomial & Introduction to generating functions:** Methods of generating functions. |
| **ST-1(Lecture 1-24)** | |
| 25-26 | **Logic**: Propositions & logical operators, Truth table, Laws of logic & Quantifiers, Validity of arguments, Truth values. |
| 27-30 | **Lattices**: Definition of lattice, Sub lattice, Isomorphic lattices, Bounded lattice, Distributive lattice, Complemented lattice, Modular lattice. |
| 31-32 | **Boolean Algebra**:  Atoms, Boolean expressions, Applications of Boolean algebra to switching theory & Logic Gates. |
| 33-34 | **Graph Theory:** Introduction to graphs & Sub graphs. Directed & Undirected graph, Order& Size of graph, Degree of vertex, Source, Sink, Eccentricity, Trial, Walk, Path, Distance, Diameter, Cycle, Wheel. |
| **IEC2(Lecture 25-34)** | |
| 35-36 | Multi graph, Planer graph, Pseudo graph, Weighted graph, Regular, Complete and Traversable graph,Isomorphism of graphs, Sub graphs, Complement of graph. |
| 37 | Adjacency Matrix, Adjacency List, Incidence Matrix. |
| 38-39 | Complete Bipartite graph & Spanning Graph, Cut vertex, Cut edge, Region, Eulerian & Hamiltonian graphs. |
| **ST-2 (Lecture 25-39)** | |
| 40 | **Euler's formula & its applications** : Traveling salesman problem, Konigsberg Bridge problem, Chromatic number & Graph coloring by Welch Polch  Algorithm. |
| 41-43 | **Tree**: Binary tree, Traversing binary tree, Rooted & spanning tree, Algebraic expression tree, Depth-First Search Algorithm, Breadth-First Search Algorithm. |
| 44-46 | **Shortest path algorithm:** Kruskal's Algorithm, Dijikstra's Algorithm |
| 47-48 | Warshall's Algorithm, Prim's Algorithm |
| **ETE(Lecture 1-48)** | |

**6    Evaluation Scheme:**

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|---|---|---|
| Component 1 | Internal Evaluation Components(IEC's)* | 10 |
| Component 2 | Sessional Tests (STs)** | 30 |
| Component 3 | End Term Examination*** | 60 |
| | **Total** | **100** |

*There will be two IEC's (Internal Evaluation Components) one is before ST-1 & other is before ST-2.

**There are three Sessional Tests (STs) for all theory papers. The average of the two will be taken as final internal assessment.

***The End Term Comprehensive examination will be held at the end of semester.

The mandatory   requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

7. <u>**SYLLABUS**</u>

| Contents | Lectures |
|---|---|
| **Introducing sets:** Properties & operations on sets, Subsets, Power set, Inclusion exclusion principle, Principle of duality, Cartesian Product of Sets, Partition of sets, Minsets, Maxsets. | 5 |
| **Introduction to relations**: Types of relation, Pictorial & Matrix representation of relation, Inverse relation, Composition of relation, Properties of relation, Equivalence relation, Partial order relation | 5 |
| **Introduction to functions**: Types of functions, Domain & Range of functions, Inverse function, Injective, Surjective, Bijective & Composition of functions, Recursive function, Permutations & Combinations, Pigeonhole principle | 5 |
| **Recurrence relation**: Homogeneous and Non-homogeneous recurrence relations with constant coefficients. | 5 |
| **Characteristic polynomial & Introduction to generating functions:** Methods of generating functions. | 4 |
| **Logic**: Propositions & Logical operators, Truth table. Laws of logic & Quantifiers, Validity of arguments, Truth values. | 3 |
| **Lattices**: Definitions of lattice, Sub lattice, Isomorphic lattices, Bounded lattices, Distributive lattices, Complemented lattices, Modular lattice. | 6 |
| **Boolean Algebra**: Atoms of Boolean algebra, Boolean expressions, Applications of Boolean algebra to switching theory & Logic Gates. | 3 |
| **Graph Theory:** Introduction to graphs & Sub graphs. Directed & Undirected graph, Order& Size of graph, Degree of vertex, Source, sink, Eccentricity, Trial, Walk, Path, Distance, Diameter, Cycle, Wheel. | 14 |
| Multi graph, Planer graph, Pseudo graph, Weighted graph, Regular, Complete and Traversable graph. Isomorphism of graphs, Sub graphs, Complement of graph, Adjacency Matrix , Adjacency List, Incidence Matrix, Regular, complete and Traversable graph. | |
| Complete Bipartite graph & Spanning Graph, Cut vertex, Cut edge, Region, Eulerian & Hamiltonian graphs. | |
| **Euler's formula & its applications:** Traveling salesman problem, Konigsberg Bridge problem, Chromatic number & Graph coloring by Welch polch Algorithm. | |
| **TREES**: Binary trees, Traversing binary trees, Rooted & Spanning tree, Algebraic expression trees, Depth-First Search Algorithm, Breadth-First Search Algorithm. | 10 |
| **Shortest path algorithm:** Kruskal's Algorithm, Dijikstra's Algorithm, Warshall's Algorithm, Prim's Algorithm. | |

8. **This Document is approved by:**

| Designation | Name | Signature |
|---|---|---|
| Course Coordinator | Dr. Neha Kumra | |
| Deputy Dean | Dr. Sita Ram Sharma | |
| Date | 5 July,2021 | |