**CS6307 ADVANCED ALGORITHMS**

**Prerequisites for the course:** Data Structures & Algorithms

**OBJECTIVES:**

- To familiarize with the main thrust areas in algorithms that will be sufficient for formulating and seeking known solutions to an algorithmic problem
- To understand how to formulate an approximation algorithm for an NP-complete problem
- To introduce the key concepts, problems, techniques and data structures within Computational Geometry
- To understand and analyze multithreading and parallel algorithms
- To learn linear programming models

| CS6307 ADVANCED ALGORITHMS | L | T | P | EL | CREDITS |
|---|---|---|---|---|---|
| | 3 | 0 | 4 | 3 | 6 |

| MODULE I | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 0 | 8 | 3 |

PRAM Models–List Ranking - Prefix sum - Sorting - Sum - Bitonic sort.

**SUGGESTED ACTIVITIES :**

- EL - Study of one or two problems having parallel solutions
- Practicals – Implementation of list ranking, prefix sum and bitonic sort using C with MPI
- Analysis of suitable PRAM models

**SUGGESTED EVALUATION METHODS:**

- Assignment - Based on EL
- Demonstration of programs

| MODULE II | L | T | P | EL |
|---|---|---|---|---|
| | 4 | 0 | 4 | 3 |

Sorting on: Butterfly - 2D Mesh. Matrix multiplication on: 2D Mesh - Hypercube.

**SUGGESTED ACTIVITIES :**

- EL – Study atleast two problems on any of the DCM
- Practicals – Implementation of sorting and matrix multiplication on 2D mesh using C with MPI

**SUGGESTED EVALUATION METHODS:**

- Assignment - Based on EL
- Demonstration of programs

| MODULE III | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 0 | 4 | 3 |

Prefix sum on: 2D Mesh - Butterfly. Sum on: 2D Mesh - Butterfly.

**SUGGESTED ACTIVITIES :**

- EL - Based on suggested reading by the course instructor
- Practical – Implementation of prefix sum and sum on 2D mesh using C with MPI

**SUGGESTED EVALUATION METHODS:**

- Assignment: Based on EL
- Quizzes: Based on first three modules
- Demonstration of programs

| **MODULE IV** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **6** | **0** | **4** | **3** |

Geometric Algorithms: Segment trees - kd-trees - 1D and 2D Range Search.

**SUGGESTED ACTIVITIES :**

- EL: Problems on segment trees and range search
- Practical – Implementation of segment trees

**SUGGESTED EVALUATION METHODS:**

- Based on EL
- Demonstration of programs

| **MODULE V** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **4** | **0** | **4** | **3** |

Line Segment Intersection - Closest Pair of Points - Range Trees – Voronoi diagram.

**SUGGESTED ACTIVITIES :**

- EL – Study of Voronoi diagram
- Practical – Implementation of line segment intersection and Voronoi diagram

**SUGGESTED EVALUATION METHODS:**

- Demonstration of programs

| **MODULE VI** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **5** | **0** | **4** | **3** |

Randomized Algorithms: Introduction - Randomized Selection - Randomized sorting.

**SUGGESTED ACTIVITIES :**

- Flipped Classroom – Types of Randomized Algorithms and analysis
- Practical – Implementation of randomized selection and quick sort

**SUGGESTED EVALUATION METHODS:**

- Quizzes: Based on Modules IV, V and VI
- Demonstration of programs

| **MODULE VII** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **5** | **0** | **0** | **3** |

Approximation Algorithms: Vertex cover - Metric TSP- Set Covering Problem

**SUGGESTED ACTIVITIES :**

- Assignment

**SUGGESTED EVALUATION METHODS:**

- Assignment problems

| **MODULE VIII** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **3** | **0** | **0** | **3** |

NP Complete: Clique Problem - Subset Sum Problem

**SUGGESTED ACTIVITIES :**

- EL – Studying proof for atleast one NP complete problem

**SUGGESTED EVALUATION METHODS:**

- Based on EL

| MODULE IX | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 0 | 4 | 3 |

Multithreaded Algorithms: Matrix Multiplication - Merge sort.

**SUGGESTED ACTIVITIES :**

- Quiz
- Practical – Implementation of multithreaded algorithms

**SUGGESTED EVALUATION METHODS:**

- Quizzes: Based on Modules VII, VIII and IX
- Demonstration of programs

| MODULE X | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 0 | 4 | 3 |

Solving system of linear equations - Simplex algorithm – Duality.

**SUGGESTED ACTIVITIES :**

- Assignments
- Practical – Implementation of simplex algorithm

**SUGGESTED EVALUATION METHODS:**

- Assignments
- Demonstration of programs

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Comprehend and propose algorithms for any given problem
- Construct and implement algorithms for simple geometrical problems
- Perform the design of parallel and multithreading algorithms
- Find approximate solution to a hard problem
- Formulate a linear programming model for a given problem

**TEXTBOOKS:**


1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, University Press, 2007.
2. Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Cliford Stein, “Introduction to Algorithms”, Third Edition, Prentice Hall, 2010.
3. Mark de Berg, Otfred Vheong, Marc van Kreveld and Mark Overmars, “Computational Geometry Algorithms and Applications”, Third Edition, Springer, 2008.


**REFERENCES:**


1. Gilles Brassard, Paul Bratley,” Algorithmics: Theory and Practice”, Prentice Hall,1998
2. J.A.Storer, “An Introduction to Data Structures and Algorithms”, Birkhauser Boston, 2002.
3. Michael Quinn, "Parallel Programming in C with MPI and OpenMP", Indian Edition, Tata McGraw Hill, 2017.

**EVALUATION PATTERN:**

| Category of Course | Continuous Assessment | Mid – Semester Assessment | End Semester |
|---|---|---|---|
| **Theory** | **40** | **20** | **40** |

**CO - PO Mapping:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| **CO2** | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | ✓ |
| **CO3** | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ |
| **CO4** | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ |
| **CO5** | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ |

**CS6308 JAVA PROGRAMMING**

Pre-requisites: None

**OBJECTIVES:**

- To learn about the fundamentals of Java language constructs
- To familiarize the student with Object Oriented Programming in Java
- To expose the student to creating UI
- To understand the concepts of parallel programming
- To develop web applications with Java

| CS6308 JAVA PROGRAMMING | L | T | P | EL | CREDITS |
|---|---|---|---|---|---|
| | 3 | 0 | 4 | 3 | 6 |

| MODULE I FUNDAMENTALS OF JAVA LANGUAGE | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 0 | 4 | 3 |

Introduction to Java, Java basics – Variables, Operators, Expressions, Control flow Statements, Methods, Arrays

**SUGGESTED ACTIVITIES :**

- Practical-Implementation of simple Java programs Using Java Basic Constructs and Arrays using any standard IDE like NETBEANS / ECLIPSE
- EL – Understanding JVM