Faculty: Information Technology **Department: Computer Science** **Course title: Design and Analysis of** **Algorithms (1501321)**		**Instructor:** **Lecture's time:** **Semester:** **Office Hours:**

Course description:

It is intended to teach algorithms for solving real problems that arise frequently in computer applications, to teach basic principles and techniques of computational complexity. The basic concepts of the main design techniques which are divide-and-conquer, greedy, dynamic programming, branch and bound, and backtracking will be covered. Algorithms to be discussed will be selected from several areas such as Searching, Sorting, Graph Applications, and Others.

Aims of the course:

Students are expected to:
1. Study asymptotic notations complexity types, and complexity measures.
2. Master general tools and techniques for analyzing computer algorithms.
3. Gain basic knowledge about the general principles and good algorithm design techniques for developing efficient computer algorithms.
4. Demonstrate familiarity with major algorithms in several areas and underlined data structures, implementing and comparing algorithms in selected applications such as search, sort and fundamental graph algorithms.

Intended Learning Outcomes (ILOs):

Upon successful completion of this course, students will be able to:

A. Knowledge and Understanding
A1. Concepts and Theories:
   - Understand basic terms associated with algorithms; such as time and space complexities, Big O notation, Big Omega notation, Big Theta notation, etc.
   - Understand the algorithms analysis criteria

A2. Contemporary Trends, Problems and Research:
   - Apply the algorithms and design techniques to solve modern problems

A3. Professional Responsibility:
   - Abide by laws and regulations of software development and design

B. Subject-Specific Skills
B1. Problem solving skills:
   - prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains;

B2. Modeling and Design:
   - Learn about the Design of sorting algorithms, searching algorithms, and Graph Algorithms using the Several Design Techniques or Strategies.

B3. Application of Methods and Tools:
   - Convert the algorithms to code using a programming language such as JAVA

C. Critical-Thinking Skills
C1. Analytic skills:
   - Analyze and evaluate various sorting algorithms, analyze and evaluate various searching algorithms, analyze and evaluate various minimum spanning tree algorithms.

- Analyze the complexities of various problems in different domains.

C2. Strategic Thinking:
- Understanding divide-and-conquer, greedy, branch-and-bound, backtracking, and dynamic programming Design strategies.

C3. Creative thinking and innovation:
- Learn about solving problems using new techniques.

D. General and Transferable Skills (other skills relevant to employability and personal development)

D1. Communication: Express and communicate ideas in written and oral forms

D2. Teamwork and Leadership: Be cooperative members of a team

D3. Organizational and Developmental Skills: plan, prioritize, and achieve defined goals

D4. Ethical and Social Responsibility: Understand that they are accountable for their actions and there must be a balance between economic growth and the welfare of the society and environment

Course Structure:

Week	Credit Hours	ILOs	Topics	Teaching Methodologies	Assessment methods
1 , 2	**6**	A1, A2, A3, B1, B2, B3	**Review** 1. Review I: Math Review. Proof Methods Review. 2. Review II: Recursion and Induction.	T: Lecture & Discussion. L: Reading lecture notes and Consulting the Text.	Class discussions and questions,
3 , 4 , 5	9	A1, A2, A3, B1,	**Analyzing Algorithms and Problems: Principle and Examples.** 1. Definition of a Computer-Based Algorithm, Main Issues related to a Computer-Based Algorithm 2. Analyzing Algorithms and Problems. 3. Classifying functions by Their Asymptotic Growth Rates. 4. Searching an Order Array. and Algorithms	T: Lecture & Discussion. L: Reading lecture notes and Consulting the Text.	Exams, In class questions, and Quizzes
6 , 7 , 8 , 9	12	A1, B2, B3, C1, C2, C3	**Sorting** 1. Selection and Insertion Sort. 2. Divide and Conquer. 3. Merging Sorted Sequences 4. Merge Sort 5. Quick Sort 6. Heap Sort	T: Lecture & Presentation L: Consulting the Text.	Exams and Assignment 1
10 , 11	6	C1, C2, C3, D1, D2, D3, D4	**Basics of Strategies of Designing Algorithms:** - Divide-and-Conquer, - Greedy, - Dynamic Programming - Branch and Bound - Backtracking	T: Lecture & Presentation L: Consulting the Text.	Exams and Class Participation
12 , 13 ,	9	C1, C2, C3, D1,	**Graphs and Graph Traversals**	T: Lecture & Presentation	Exams and Quizzes

| 14 | | D2, D3, D4 | 1. Definitions and Representations.
2. Traversing a Graph: Depth First, Breadth First Search (backtracking)
3. Strongly connected Components of a Directed Graph
4. Minimum Spanning Tree (Greedy Algorithm)
5. Single-Source Shortest Paths | L: Consulting the Text. | |
| 15 , 16 | | | **FINAL EXAMS PERIOD** | | |

References:

A. **Main Textbook:**

Sara Baase and Allen Van Gelder, "Computer Algorithms: Introduction to Design and Analysis", Third Edition, Addison-Wesley, 2000.

B. **Supplementary Textbook(s):**

1. Jeffrey J. McConnell, "Analysis of Algorithms: An Active Learning Approach", Second Edition, Jones & Bartlett, 2008.

2. *Richard Neopolitan and Kumarss Naimipour, "Foundations of Algorithms", Fourth Edition, Jones & Bartlett, 2011.*

3. *Horowitz Ellis, Sahni Sartaj & Rajasekaran Sanguthevar, "Fundamentals of Computer Algorithms", 2008.*

4. *Anany Levitin, Introduction to the Design and Analysis of Algorithms, 2nd edition, Pearson and Addison Wesley, 2007.*

5. *Jon Kleinberg, and Eva Tardos, Algorithm Design, Pearson and Addison Wesley, 2006.*

C. **Some Web Sites References:**

www.mitpress.mit.edu/algorithms/
http://www.softpanorama.org/Algorithms/index.shtml

Assessment Methods:

Methods	Grade	Date
First Exam	15%	
Second Exam	15%	
Assignments (Reports /Quizzes/ Sharing / Class Participation)	20%	
Final Exam	50%	

General Policies for the Course: The University adopts a number of general policies that the students must comply with:

(I) Lecture Management

　1- ZU is a university seeking to be distinguished with an outstanding reputation. The students have to behave in the most qualified manners during lectures, in order to reflect this good reputation.

　2- Students must absorb the course objectives and their significance from the first day of attendance, in order to work on achieving them throughout the course.

　3- Faculty members encourage students to inquiry and discussion, thus, students are to make the best of it to maximize their educational attainment.

　4- Students are not allowed to leave classrooms during lectures except for compelling conditions.

(II) Scientific Honesty

　The University prohibits students from following any actions inconsistent with the scientific honesty, such as cheating in exams whether by giving or receiving information, or submitting assignments done by others. In case of breach of this sort, the student will be subject to the effective university punishment, which he should be well aware of.

(III) Late Attendance or Absence for Lectures

　1- Students attending the lecture more than 10 minutes late will be marked as "late attendant", and every four late attendances will be count one day absence.

　2- Students attending the lecture more than 20 minutes late will be allowed to enter the classroom but will be marked as "absent".

　3- If absences exceed 15% of the lectures, the student will be deprived from the course, and will get the university zero mark for the course.

(IV) Absence from Exams

　1- Absentees from a short test (quiz) will not be allowed for a make-up test.

　2- Official excuses for missing any exam must be provided to the lecturer for the appropriate actions to be taken.

　3- Medical excuses must be officially signed and stamped by the Medical Center at the university.

　4- Any make up exam, if necessary, will be given only once during the same semester.

(V) Additional Instructions

　1- Cell phones must be turned off during lectures. Cell phones are prohibited during lectures and exams.

　2- Students should use scientific references and do extra reading for the courses.

　3- Students should hand over their assignments within the exact time.

　4- The student is advised to keep copies of his assignments as a reference and academic record for himself.

　5- Faculty member provides students with feedback about assignments and tests.

　6- Objection on final exam result is limited to the specific procedures developed by the university, and the students have to refer to the Department of Admission and Registration to view details.