

بسم الله الرحمن الرحيم

University of Khartoum

Faculty of Mathematical Sciences and Informatics

Bachelors of Computer Science Program

# Content of Level Two

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**21-304**

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# Study Subjects

There were 13 studying subjects this level (7 of semester 3, and 6 of semester 4).

## Computer Field Subjects

### ❖ **Programming Fundamentals 2 (C2013)**

- Programming fundamentals concepts using Java Programming Language.
- Methods and Recursion.
- OOP concepts (Inheritance, Polymorphism).
- Exception Handling.

### ❖ **Discrete Structures (C2023)**

- Propositional, and Predicate Logic.
- Equivalent Laws, Rules of Inference, and Fallacies.
- Methods of proof.
- Basic Structures.

### ❖ **Data Structures (C2033)**

- How to Create Abstract Data Structure That Has Special Properties.
- Linked List, Stack, Queue, and Tree Implementation and Properties.
- Main Sorting and Searching Algorithms.

### ❖ **Files Management and Organization (C2043)**

- Storage Hierarchy.
- File Structures.
- Main Operations on a file using C++.
- Disks and Tapes.
- Buffers Management.
- Access Cost (Time, Buffers).
- File Organization.
- Indexing.
- Sorting and Searching (in memory and in the disk).

### ❖ **Object Oriented Programming (C2053)**

- Main concepts of the object oriented programming (OOP).

# Statistics Field Subjects

## ❖ Statistics and Probability (S2013)

- Refresh (Random Variables, Probability Distributions).
- Moments, Cumulant, and Factorial Moment Generating Functions.
- Joint Distributions.
- Independent Variables.
- Discrete Probability Distributions:
  - Binomial Distribution.
  - Poisson Distribution.
  - Uniform Discrete Distribution.
  - Bernoulli Distribution.
  - Polynomial Distribution.
  - Geometric Distribution.
  - Hypergeometric Distribution.
  - Negative Binomial (Pascal) Distribution.
- Continuous Probability Distributions:
  - Normal Distribution.
  - Uniform Continuous Distribution.
  - Exponential Distribution.
  - Gamma Distribution ( $\Gamma$ ).
  - Beta Distribution ( $\beta$ ).
  - Chi-Square Distribution ( $\chi^2$ ).

## ❖ Introduction to Inference Statistics (S2023)

- Distribution of a Single Random Variable Using Jacobean.
- Distribution of a Single Random Using Moments Generating Function.
- Sampling Distributions.
- Point and Interval Estimation.
- Confidence Interval for The Population Parameter.
- Hypothesis Testing.

# Mathematics Field Subjects

## ❖ Linear Algebra 2 (P2014)

- Vector Space.
- Subspace.
- Span, Basis, and Linear Independence.
- Dimensions and Coordinates.
- Linear Transformations and Its Properties.
- Matrix of Linear Transformation and Its Properties.
- Column Space, and Row Space
- Eigenvalues and Eigenvectors.
- Similar Matrixes and Diagonalization.
- Inner Product Space and Its Properties.
- Orthogonal Matrixes.
- Applications (Cryptology – Cryptography).

## ❖ Several Variables Functions (A2013)

- Introduction.
- Limits and Continuity.
- Partial Derivatives.
- Series Rule.
- Gradient and Directional Derivatives.
- Tangent Plans and Normal Lines.
- Maximum and Minimum Values.

## ❖ Ordinary Differential Equations 1 (A2023)

- Classification of ODEs (what, how, why).
- Methods of Solving First Order Differential Equations.
- Applications 1 (Populations Growth Models - Newton's Law of Cooling).
- Methods of Solving Higher Order Constant Coefficients ODEs.
- Applications 2 (Damped and Undamped Motions).

## ❖ Real Analysis (P2024)

- Real Numbers (Field and Order Axioms, Completeness Axiom, Countable Sets).
- Sequences (Convergence, Properties of Conv. Sequences, Monotonic Sequences, Cauchy Criterion, Subsequences, Upper and Lower Limits, Open and Closed Sets).
- Limit of Functions (Basic Theorems, Some Extensions of the Limit).
- Continuity (Convergence Functions, Uniform Continuity, Compact Sets).
- Series (Infinite Series, Convergent Series, Basic Theorems, Convergence Tests)

❖ **Ordinary Differential Equations 2 (A2033)**

- Methods of Solving Higher Order Variable Coefficients ODEs.
- Special Functions (Bessel's, Legendre's Equations, and Sturm-Liouville Problems).
- Solution of Systems of Linear Differential Equations.

❖ **Vectors Analysis (A2043)**

- Double Integral on a Plane.
- Triple / Volume Integral over a Vacuum.
- Gradient, Divergence, and Curl.
- Linear Integral on a Path (In Plane or Space).
- Surface Integral.
- Flux Surface Integral.
- Green's in the Plane, Gauss', and Stoke's Theorems.

**The End**