

Foundation in Information Technology (FIT)

FIT 303: Mathematics for ICT

Program Content

Course Code:	FIT 303		
Course Name:	Mathematics for ICT		
Credit Value:	8		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	60	120	220

Course Aim/Intended Learning Outcomes:

After successful completion of this course the students will be able to;

- Use mathematical operations, Display Numerical competency, Solve problems (Computational skills)
- Use mathematical language (oral, written, algebraic and graphical) (Communication skills)
- Develop and evaluate mathematical conjectures and conversations (Skills of inductive and deductive reasoning)
- Use mathematical knowledge and techniques to formulate and solve problems (Problem solving)
- Identify connections between important mathematical ideas and concepts, and use these in Information Technology.

Course Content:

Topic	Teaching (Hrs)	Practical (Hrs.)
1. Introduction to Numbers and Arithmetic	4	8
2. Indices and logarithms	4	8
3. Number systems	4	8
4. Ratios and proportions	4	8
5. Algebraic expressions	4	8
6. Equations	4	8
7. Inequalities	4	8
8. Measurements	4	8
9. Sets	4	8
10. Relations	4	8
11. Functions	4	8
12. Common functions and their graphs	4	8
13. Introduction to mathematical reasoning	4	8
14. Fundamentals of Statistics	4	8
15. Introduction to Probability	4	8
Total	60	120

1 Introduction to Numbers and Arithmetic (08 hrs.) [Ref 1: pg 1-33], [Ref 2: pg 1-17, pg 62-69, Pg 87]

Intended Learning Outcomes

- Describe factors, multiples, divisibility of integers and prime numbers
- Determine the above properties for given integers
- Carry out the prime factorization of an integer
- Use the above process to determine factors, greatest common divisor and least common multiple of integers
- Solve problems using these notions
- Identify rational numbers as terminating and recurring decimals
- Perform arithmetic operations on rational numbers
- Solve problems involving fractions
- Simplify expressions containing surds and basic mathematical operations
- Rationalize the denominator of an expression containing surds
- Recognize the existence of irrational numbers and identify surds as examples of such numbers
- Identify rational numbers and irrational numbers
- Identify number systems by the standard symbols \mathbb{N} , \mathbb{Z} , \mathbb{Q} , \mathbb{R} and $\mathbb{R} \setminus \mathbb{Q}$
- Determine the relations $<$, \leq , $>$ and \geq on real numbers
- Describe intervals on the number line
- Describe and use rounding off to approximate real numbers
- Perform mathematical operations on real numbers and simplify expressions involving absolute values

1.1. Natural numbers and Integers

- 1.1.1. Integers and their properties
- 1.1.2. Divisibility, prime numbers and factors
- 1.1.3. Unique factorization of natural numbers (integers)
- 1.1.4. Greatest common divisor and least common multiple

1.2. Rational numbers

- 1.2.1. Arithmetic with fractions

1.3. Real numbers

- 1.3.1. Square roots and surds
- 1.3.2. Existence of numbers that are not rational
- 1.3.3. The number line and the ordering of numbers
- 1.3.4. Absolute value of a real number
- 1.3.5. Intervals on the number line
- 1.3.6. Rounding off and approximate values of real numbers
- 1.3.7. Basic mathematical operations
- 1.3.8. The order of operations

2 Indices and Logarithms (08 hrs.) [Ref 1: pg 45-49, pg 54-69, pg 233-250], [Ref 2: pg 112-118]

Intended Learning Outcomes

- Write numbers of the form $\sqrt[n]{a}$ using indices
- Simplify expressions using rules of indices and logarithms
- Solve equations that involve indices

- Identify the relationship between logarithms and indices
- Solve equations that involve indices and/or logarithms
- Change the base of a logarithms and express numbers as powers of different bases

- 2.1 Indices
- 2.2 Integral and rational indices
- 2.3 Rules of indices
- 2.4 Logarithms
- 2.5 Rules of logarithms
- 2.6 Change of base of a logarithm

3 Number systems (08 hrs.) [Ref 1: pg 154-164], [Ref 2: pg 368-381]

Intended Learning Outcomes

- Describe the notion of a base and place value to give examples of number systems
- Convert a given number (in any of the bases 2, 8, 10 or 16) to a number in bases 2, 8, 10 and 16
- Describe how conversions between bases 2, 8 and 16 can be carried out easily and use it in computations and problem solving
- Perform mathematical operations on numbers represented in any of the bases 2, 8, 10 or 16
- Give an algorithmic description for addition, subtraction and multiplication in base 2

- 3.1 Place value and representation of numbers in base 10
- 3.2 Representing numbers in different bases
- 3.3 Binary, octa-decimal and hexadecimal numbers
 - 3.3.1 Conversion between these number systems
- 3.4 Mathematical operations in different bases

4 Ratios and Proportions (08 hrs.) [Ref 1: pg 34-44], [Ref 2: pg 24-34, pg 38-53, pg 199-215]

Intended Learning Outcomes

- Convert ratios into proportions and vice versa
- Determine the proportion and ratio of a quantity
- Manipulate ratios and proportions and solve problems
- Describe a percentage of a quantity and use it in expressing values such as rates, profit, loss and tax
- Perform computations related to percentages of profit and loss
- Perform computations related to tax and discount
- Perform computations involving simple interest and compound interest and compare them
- Perform computations related to velocity, work and time and volume and time
- Solve problems involving rate of change

- 4.1 Ratios
- 4.2 Proportions
- 4.3 Introduction to Percentages and Interest Rates
 - 4.3.1 Percentage of profit and loss
 - 4.3.2 Working with tax and discount
 - 4.3.3 Calculation of simple interest and compound interest

4.4 Time Related Problems

- 4.4.1 Distance and time
- 4.4.2 Work and time
- 4.4.3 Volume and time

5 Algebraic Expressions (08 hrs.) [Ref 1: pg 45-53, pg 70-113], [Ref 2: pg 72-86]

Intended Learning Outcomes

- Identify $\frac{1}{x^a}$ as x^{-a}
- Simplify algebraic expressions, including fractions and indices
- Expand binomial expressions $(x \pm y)^n$
- Recognize expansions of $(x \pm y)^n$ for $n = 2, 3$
- Factorize algebraic expressions
- Manipulate formulas to express one variable in terms of others

5.1 Introduction to algebraic expressions

5.2 Manipulating algebraic expressions

5.3 Expanding and factorizing algebraic expressions

5.4 Working with formulas

6 Equations (08 hrs.) [Ref 1: pg 114-125], [Ref 2: pg 88-111]

Intended Learning Outcomes

- Construct and solve linear equations
- Recognize the need to use the quadratic formula to solve quadratic equations
- Use factorization and completion of squares to solve quadratic equations
- Derive and use the formula $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to obtain the solutions to the quadratic equation $ax^2 + bx + c = 0$
- Describe the meaning of the solutions to the quadratic equation $ax^2 + bx + c = 0$ graphically
- Construct and solve quadratic equations
- Solve a pair of simultaneous equations in two unknowns by the elimination and substitution methods
- Construct a pair of simultaneous equations based on a given situation and determine the solutions
- Graphically explain the solution to a system of linear equations in two unknowns
- Solve equations of the form $|ax + b| = c$
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6.1 Solving quadratic equations

6.2 Solving simultaneous equations

6.2.1 Elimination method

6.2.2 Substitution method

6.2.3 Graphical interpretation

6.3 Equations involving absolute values

7 Inequalities (08 hrs.) [Ref 2: pg 174-178]

Intended Learning Outcomes

- Describe and use basic rules of inequalities
- Accept and use the inequalities $x^2 \geq 0$, $|x| \geq 0$
- Determine the solution to an inequality of the form $ax + b \gtrless c$ and graphically represent the solution set on the real line
- Solve a system of two linear inequalities and graphically interpret the solution
- Solve inequalities of the form $|ax + b| \gtrless c$ and graphically interpret the solutions
- Construct inequalities based on some information and determine the solution

7.1 Rules of inequalities

7.2 Solutions to an inequality

7.3 Systems of inequalities

7.4 Inequalities involving absolute value

8 Measurements (08 hrs.) [Ref 1: pg 251-278], [Ref 2: pg 130-150, pg 216-222, pg 289-320]

Intended Learning Outcomes

- Determine the perimeter and area bounded by triangles, quadrilaterals, circles and sectors of a circle
- Determine the perimeter and area of compound objects made of triangles, quadrilateral and sectors
- State the volume and surface area of a cube, cuboid, right pyramid (with triangular faces and square base), right circular cone, right circular cylinder and sphere
- Describe the surface area of the above solids by means of nets
- Perform computations and solve problems related to the surface area and volume of the above solids and compound shapes made of these solids
- Describe trigonometric ratios of a right angled triangle
- Use tables and a calculator to determine the values of the trigonometric ratios of a given angle and to determine the angle with a given trigonometric ratio
- Perform calculations related to trigonometric ratios
- Solve problems using trigonometric ratios, including that involve angles of elevation and depression

8.1 Perimeter, area and volume of objects of different shapes

8.1.1 Problems with compound shapes

8.2 Trigonometric ratios

8.2.1 Problems involving angles of elevation and depression

9 Sets (08 hrs.) [Ref 1: pg 141-153], [Ref 2: pg 356-367]

Intended Learning Outcomes

- Identify different methods of denoting sets
- Illustrate properties of set algebra using labeled Venn-diagrams
- Identify sets and describe the membership relation and the set operations union, intersection, complement and relative complement
- Identify and describe the notion of a universal set (of a problem)
- Determine the subset and equality relations between sets

- Describe and determine the power set of a set
- Describe and use basic properties of set operations
- Draw Venn diagrams to represent up to three subsets of a universal set and label the regions
- Use Venn diagrams to solve problems
- Describe the notion of ordered pairs and the Cartesian product of two or more sets

9.1 The concept of a set

9.2 Operations on sets

9.2.1 Union, intersection, complement, relative complement and Cartesian product

9.3 Relations between sets

9.3.1 Subset, equality, proper subset

9.4 Power set

9.5 Laws of algebra of sets

9.6 Venn diagrams

9.6.1 Labeled Venn diagrams

9.6.2 Special Venn diagrams

10 Relations (08 hrs.) [Ref 2: pg 382-389]

Intended Learning Outcomes

- Describe the concept of a relation and describe it schematically
- Give examples of relations from the real world
- Describe the reflexive, symmetric, anti-symmetric and transitive properties of a relation
- Determine whether a given relation has any of the above properties
- Describe order relations and equivalence relations
- Give examples of order relations and equivalence relations

10.1 Introduction to Relations

10.2 Binary relations

10.3 Order relations (partial order and total order)

10.4 Equivalence relations

11 Functions (08 hrs.) [Ref 1: pg 176-188], [Ref 2: pg 382-389]

Intended Learning Outcomes

- Describe a function as a rule and a function as a relation
- Describe the properties one-to-one, onto and bijective of functions
- Determine whether a given function satisfies the above properties
- Describe recursive ways of specifying functions and ways of computing them
- Describe and determine the composite function
- Describe and determine the invertibility and the inverse of a function

11.1 The notion of a function

11.2 Functions as relations

11.3 Domain (inputs), codomain and range (outputs)

11.4 One-to-one functions and onto functions

11.5 Bijections

11.6 Algorithmic approach to compute functions

- 11.6.1 Factorial function
- 11.6.2 Recursion
- 11.7 Composite function
- 11.8 Inverse function
- 11.9 Graph of a function

12 Common functions and their Graphs (08 hrs.) [Ref 1: pg 189-250, pg 279-291], [Ref 2: pg 151-167]

Intended Learning Outcomes

- Describe different types of functions and solve problems involving functions
- Sketch graphs of exponential, logarithm, trigonometric and polynomial (up to quadratic) functions
- Sketch curves of rational functions using a suitable graphing tool
- Determine the properties of the graphs of even and odd functions
- Describe properties of the above functions and use them in sketching graphs

- 12.1 Exponential functions
- 12.2 Logarithm functions
- 12.3 Logarithm functions as inverses of exponential functions
- 12.4 Trigonometric functions
- 12.5 Polynomial functions
- 12.6 Rational functions
- 12.7 Even and odd functions

13 Introduction to mathematical reasoning (08 hrs.) [Ref 1: pg 165-175]

Intended Learning Outcomes

- Describe logical operations and their truth tables
- Describe the notion of a proof and give examples
- Write direct, contrapositive, contradiction or induction (in the case of natural numbers) proofs for simple mathematical statements

- 13.1 Propositions
- 13.2 Mathematical proofs
 - 13.2.1 Direct proofs
 - 13.2.2 Contra positive
 - 13.2.3 Method of contradiction
 - 13.2.4 Induction

14 Fundamentals of Statistics (08 hrs.) [Ref 1: pg 388-402], [Ref 2: pg 407-421]

Intended Learning Outcomes

- Apply underlying statistical concepts and definitions
- Identify methods of summarization and organization of data numerically and graphically
- Apply different types of frequency distributions in problem solving
- Define the measures of central tendency, measures of dispersion and measures of position

- Identify the normal curve

14.1 Introduction to Statistics

14.2 Descriptive Statistics

14.2.1 Types of data (qualitative, quantitative, continuous, discrete)

14.2.2 Scales of measurement (nominal, ordinal, interval, ratio)

14.3 Organization and summarization of data

14.3.1 Frequency table, cumulative frequency table, histogram, frequency polygon, cumulative frequency polygon

14.3.2 Bar charts, pie-charts, percentiles, 5- number summary, Box plot

14.4 Measures of location

14.4.1 Mean

14.4.2 Median

14.4.3 Mode

14.5 Measures of dispersion

14.5.1 Range

14.5.2 Inter quartile range

14.5.3 Variance

14.5.4 Standard deviation

15 Introduction to Probability (08 hrs.) [Ref 1: pg 403-411], [Ref 2: pg 422-427]

Intended Learning Outcomes

- Define the sample space and events related to random experiments
- Describe the concept of probability and discuss ways to assigning probabilities to events
- Explain compound (composite) events and ways to find the probabilities of such events
- Discuss relative probabilities with respect to reduced sample spaces
- Describe a convenient graphical tool to compute probabilities in a (finite) sequence of experiments
- Explain methods to find probabilities of events (and related conditional probabilities) for a given partition of the sample space
- Use Binomial distribution and apply it in real life problems

15.1 Introduction to probability

15.2 Sample space and events

15.3 Some basic theorems on the sample space

15.4 Mutually exclusive events

15.5 Conditional probability and tree diagrams

15.6 Independent events

15.7 Total probability law and Bayes' theorem

15.8 The binomial distribution

Teaching /Learning Methods:

Foundation in Information Technology is a self-learning programme. Candidates can learn online at [VLE for FIT \(Virtual Learning Environment for FIT\)](#) where all course learning materials are available online.

Candidates will be provided with access to the [FIT VLE](#) at the registration for FIT Programme. Learners are

encouraged for higher and continuous engagement with learning at FIT VLE for successful completion of the course.

Assessment Strategy:

Continuous Assessment (Assignments):

Continuous assessment of the course consists of two assignments. Assignment 1 will cover the first half of the syllabus, while the assignment 2 will cover the second half of the syllabus.

Final Examination

The final examination of the **Mathematics for ICT course** will be an e-test which will be conducted in the supervised mode. The e-test will consist of 50 Multiple Choice Questions (MCQs). The duration of the e-test is 2 hours.

References/ Reading Materials:

Main References

Ref 1: Foundation Maths, Anthony Croft, Robert Davison, Pearson, 2016

Ref 2: New Comprehensive Mathematics for 'O' Level 2nd Edition 2nd Edition, Alex Greer, Oxford University Press (November 1, 2014)

Ref 3: Cambridge IGCSE® and O Level Additional Mathematics Coursebook, Sue Pemberton, Cambridge University Press; 2 edition (March 7, 2018)

Additional Resources

Free books:

1. Fundamentals of Mathematics, Denny Burzynski, OpenStax CNX
2. Intermediate Algebra, Lynn Marecek, OpenStax
3. Spiral Workbook for Discrete Mathematics, Harris Kwong, Open SUNY (2015), ISBN 13: 9781942341161
4. A Gentle Introduction to the Art of Mathematics, Joseph E. Fields, Independent Publishers
5. Discrete Mathematics with Applications (4th Edition), Susanna S. Epp, Cengage Learning (August 4, 2010)

Other references:

1. Discrete Mathematics DeMYSTiFied, Steven G. Krantz, McGraw Hill
2. Cambridge O Level Mathematics Coursebook, Audrey Simpson, Cambridge University Press; 2 edition (November 23, 2016)
3. Intermediate Algebra, 13th Edition, Margaret L. Lial, John Hornsby, Terry McGinnis, Pearson, 2020
4. Basic College Mathematics, Julie Miller and Molly O'Neill and Nancy Hyde, McGraw-Hill Education; 3 edition (January 27, 2014)
5. Basic College Mathematics, 6th Edition, Elayn Martin-Gay, Pearson, 2019
6. New Grade 9-1 GCSE Maths Edexcel Student Book – Foundation, Coordination Group Publications Ltd (CGP) (17 May 2019)
7. New Grade 9-1 GCSE Maths AQA Student Book – Higher, Coordination Group Publications Ltd (CGP) (30 May 2018)