FIT 301: Mathematics for ICT

INTRODUCTION

This is one of the three courses designed for the Foundation in Information Technology (FIT) programme. This course consists of two parts which play an important role in Information Technology. The aim of this course is to introduce basic mathematical and statistical concepts as well as to develop analytical thinking. Practical skills, problem solving and computational techniques are also emphasized throughout the course.
After the successful completion of this course the learner will possess problem solving and analytical skills together with the required mathematical and statistical knowledge necessary for day to day life as well as in computing.

LEARNING OUTCOMES

After successfully completing this course, students will be able to:

- Apply basic mathematical and statistical concepts to real-world situations
- Illustrate mathematical intuition and abstract reasoning
- Apply probabilistic concepts for prediction in the face of uncertainty

ASSESSMENT CRITERIA

The formative evaluation procedure consists of 4 LMS based on-line assessments. The summative evaluation which is two hours computer based e-test.

Structure of Exams

- Formative Assessments-
  - 4 assessments consist of multiple-choice questions
- Summative Assessments-
  - One computer based e-test of two hours

OUTLINE OF SYLLABUS

Part I

Topic	Average learning hours *
1. Introduction to Numbers and Arithmetic	06
2. Introduction to Basic Algebra	07
3. Solving Equations	05
4. Fundamentals of Measurements	06
5. Introduction to Ratios and Proportions	04
6. Introduction to Percentages and Interest Rates	07
7. Time Related Problems	05
Total	**40**

Part II

Topic	Average learning hours *
8. Indices and Logarithms	06
9. Introduction to Sets	05
10. Logic and Truth tables	12
11. Relations and Functions	08
12. Techniques of Counting	07
13. Fundamentals of Statistics	12
14. Introduction to Probability	10
15. Fundamentals of Sequences and Series	07
16. Introduction to Differentiation	07
17. Introduction to Integration	06
Total	**80**

* Depending on the students capability this could vary.

REQUIRED MATERIALS

Supplementary Reading

Ref 1: New comprehensive mathematics for 'O' level by Greer, 2nd edition, Stanley Thornes (Publishers) Ltd.
Ref 2: Schaum's Outline series: Basic mathematics with application to science and technology by Kruglak H, Moore J.T, Mata-Toledo R. 2rd edition, MC Graw Hill.
Ref 3: Mathematics for computing by K.M.R.T. Karunaratna, Tharangee Printers Sri Lanka, 2002.
Ref 4: Schaum's Outline series: Theory and problems of statistics by Murray R. Spiegel, 2nd edition.
Ref 5: Schaum's Outline series: Probability by Seymour Lipshutz & Marc Lipson, McGraw-Hill International Edition, 2000.
Ref 6: Schaum's Outline series: Set theory and related topics by Seymour Lipshutz, 2rd edition, MC Graw Hill.

Note: Under the detailed syllabus, book numbers of relevant text are given for each topic only as a guideline for minimal references based on the recommended supplementary reading. These references are generally sufficient to understand the concepts and measure the expected depth of the content.

DETAILED SYLLABUS – PART I

1. Introduction to Numbers and Arithmetic (6 hrs.)

[Ref 1: pg 1-17, pg 62-71, pg 83-86], [Ref 2 : pg 1-8, pg 36-50, pg 61-94, pg 131-170, pg 214-242]

Instructional Objectives

- Identify types of numbers, arithmetic operations, prime numbers, fractions, indices, square roots and surds
- Estimate, approximate and use appropriate degrees of accuracy
- Explain what the number line is and what the absolute value of a number is
- Apply operations on different types of numbers, apply the laws of indices, and simplify surds
- State the basic rules involving the order of operations
- Recognize the need for such rules in mathematics

1.1 Types of numbers
1.2 The number line and the ordering of numbers
1.3 Basic mathematical operations
1.4 The order of operations
1.5 The absolute value of a number
1.6 Prime numbers and factors
1.7 Estimation of numbers
1.8 Introduction to exponents
1.9 Square roots and surds

2. Introduction to Basic Algebra (7 hrs.)

[Ref 1: pg 72-86, pg , pg 88-100, pg 174-178], [Ref 2: pg 61-94, pg 106-130]

Instructional Objectives

- Identify variables, numerical expressions and algebraic expressions
- Evaluate algebraic expressions when values for the variables are given
- Solve problems in which verbal phrases are translated into algebraic expressions
- Solve equations involving absolute values, and simplify algebraic expressions
- Identify rules of inequalities and solve problems

2.1 Introduction to algebraic expressions
2.2 Expanding and factorizing algebraic expressions
2.3 Working with formulas
2.4 Solutions of equations involving absolute values
2.5 Intervals on the number line
2.6 Rules of inequalities, solutions of inequalities

3. Solving Equations (5 hrs.) [Ref 1: pg 101-111],

[Ref 2: pg 214-242]

Instructional Objectives

- Recognize the need to use the quadratic formula to solve quadratic equations
- Solve quadratic equations using the techniques of factorizing
- Identify methods of solving simultaneous equations
- Imparting skills of applying quadratic and simultaneous equations to solve day-to-day life problems

3.1 Solving quadratic equations
3.2 Solving simultaneous equations
  3.2.1 Elimination method
  3.2.2 Substitution method

4. Fundamentals of Measurements (6 hrs.)

[Ref 1: pg 130-150, pg 289-310], [Ref 2: pg 276-305]

Instructional Objectives

- Determine the perimeter, area and volume of some geometric shapes
- Determine heights and distances using angles
- Solve problems involving the concepts length, area and volume

4.1 Introduction to perimeter, area and volume of objects of different shapes
4.2 Introduction to trigonometry
4.3 Problems involving angles of elevation and depression

5. Introduction to Ratios and Proportions (4 hrs.)

[Ref 1: pg 24-28], [Ref 2: pg 95-105]

Instructional Objectives

- Define ratios and proportions
- Solve problems involving ratios and proportions
- Apply proportions to solve percentage problems

5.1 Ratios
5.2 Proportions
5.3 Solving problems

6. Introduction to Percentages and Interest Rates (7 hrs.)

[Ref 1: pg 29-34, pg 47-53], [Ref 2: pg 51-60]

Instructional Objectives

- Define percentage, original price, discount, profit, loss, sales tax, tax rate, selling price, interest, interest rate and time
- Describe and apply procedures for finding discount, profit or loss, selling price and tax
- Analyze percentage problems
- Describe and apply formulas for finding simple interests and compound interests

6.1 Calculation of profit and loss
6.2 Percentage profit and discount
6.3 Working with tax
6.4 Calculation of simple interest and compound interest

7. Time Related Problems (5 hrs.)

[Ref 1: pg 199-215]

Instructional Objectives

- Describe the change in distance, volume with respect to time and work done with respect to time
- Calculate change in distance, volume with respect to time and work done

7.1 Distance and time
7.2 Work and time
7.3 Volume and time

DETAILED SYLLABUS – PART II

8. Indices and Logarithms (6 hrs.)

[Ref 1: pg112-118], [Ref 2: pg 171-213], [Ref 3 pg 1-25]

Instructional Objectives

- Identify and use index notation to solve problems
- Explain what logarithm is and solve problems with different bases of logarithms
- Summarize uses of logarithms and identify laws of logarithms

8.1 Indices
- 8.1.1 Integral and rational indices
- 8.1.2 Index laws
- 8.1.3 The graph of a^x

8.2 Logarithms
- 8.2.1 Definition
- 8.2.2 Laws of logarithm
- 8.2.3 Changing the base of logarithms
- 8.2.4 The graph of $\log_a x$

9. Introduction to Sets (5 hrs.)

[Ref 1: pg 356-367], [Ref 3: pg 27-61], [Ref 6]

Instructional Objectives

- Identify different methods of denoting sets
- Illustrate properties of set algebra using labeled Venn-diagrams
- Solve problems involving sets; for example finding the number of elements of sets

9.1 The concept of a set
9.2 Operations on sets (union, intersection, complement & relative complement)
9.3 Relations between sets (subset, equality, proper subset)
9.4 Introduction to power sets
9.5 Introduction to the laws of algebra of sets
9.6 Venn diagrams (Including labeled Venn diagrams)
9.7 Special Venn diagrams

10. Logic and Truth Tables (12 hrs.)

[Ref 3 pg 63-107]

Instructional Objectives

- Grasping the language of logic and constructing compound propositions
- Construct truth tables to determine the truth values of given compound propositions containing any combination of connectives (conjunction, disjunction and negation)
- Discuss logical operations, tautologies, contradictions, logical equivalence and laws of algebra of propositions
- Solve problems involving predicates and quantifiers

10.1 Propositions
- 10.1.1 Propositions and compound propositions
- 10.1.2 Basic logical operations (conjunction, disjunction and negation defined by truth tables)
- 10.1.3 Tautologies and contradictions
- 10.1.4 Logical equivalence
- 10.1.5 Laws of algebra of propositions

10.2 Predicates and quantifiers

11. Relations and Functions (8 hrs.)

[Ref 1: pg 382-389], [Ref 3: pg 109-198]

Instructional Objectives

- Describe relations
- Discuss types of relations and work with the different types of relations
- Explain what a function is and express functions using different notations
- Describe different types of functions and solve problems involving functions
- Construct new functions from given functions

11.1 Introduction to relations
- 11.1.1 Relations
- 11.1.2 Binary relations
- 11.1.3 Order relations (partial order and total order) and Equivalence relations

11.2 Introduction to functions
- 11.2.1 Functions
- 11.2.2 Functions as relations
- 11.2.3 One-to-one functions and onto functions
- 11.2.4 Bijections
- 11.2.5 Inverse functions
- 11.2.6 Composite functions

12. Techniques of Counting (7 hrs.)

[Ref 2: pg 408-416], [Ref 3: pg 199-224]

Instructional Objectives

- Define permutations and combinations
- Calculate the number of possible outcomes of elementary combinatorial processes such as permutations and combinations
- Use techniques of counting as tools in probability for large sample spaces

12.1 Introduction to counting
12.2 Basic counting principles (sum rule and product rule)
12.3 Introduction to permutations
- 12.3.1 Introduction
- 12.3.2 Permutations with repetitions

12.4 Introduction to combinations
12.5 Tree-diagrams

13. Fundamentals of Statistics (12 hrs.)

[Ref 1: pg 407-421], [Ref 2: pg 429-460], [Ref 4]

Instructional Objectives

- 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

13.1 Introduction to Statistics
13.2 Descriptive Statistics
  13.2.1 Types of data (qualitative, quantitative, continuous, discrete);
  13.2.2 Scales of measurement (nominal, ordinal, interval, ratio,)
13.3 Organization and summarization of data
  13.3.1 Frequency table, cumulative frequency table, histogram, frequency polygon, cumulative frequency polygon
  13.3.2 Bar charts, pie-charts, percentiles, 5- number summary, Box plot
13.4 Measures of location
  13.4.1 Mean
  13.4.2 Median
  13.4.3 Mode
13.5 Measures of dispersion
  13.5.1 Range
  13.5.2 Inter quartile range
  13.5.3 Variance
  13.5.4 Standard deviation

14. Introduction to Probability (10 hrs.)

[Ref 1: pg 422-427], [Ref 2: pg 417-428], [Ref 5 pg 59-180], [Ref 3: 225-252]

Instructional Objectives

- Define sample space and events related to random experiments.
- Introduce concept of probability and discuss ways to assign probabilities to events.
- Explain combined events and ways to find probabilities of such events.
- Discuss relative probabilities with respect to reduced sample space.
- Describe a convenient graphical tool to compute probabilities in a (finite) sequence of experiments.
- Explain methods to find probabilities of events (and related conditional events) for a given a partition of the sample space is available.
- Introduce two commonly encountered distributions and relate them to real life problems.

14.1 Introduction to probability
14.2 Sample space and events
14.3 Some basic theorems on probability space

14.4 Mutually exclusive events
14.5 Conditional probability and tree diagrams
14.6 Independent events
14.7 Total probability law and Bayes' theorem
14.8 The binomial distribution

15. Fundamentals of Sequences and Series (7 hrs.)

[Ref 1: pg 119-122]

Instructional Objectives

- Define sequences and series
- Identify the sequence of terms in a series
- Identify arithmetic progression and geometric progression, and use formulas to find the n^{th} term and the sum of the first n terms
- Find the sum to infinity of a series and convergence and divergence of series

15.1 The idea of a sequence
15.2 The idea of a series and the sequence of terms of a series
15.3 The sum of the first n terms of a series
15.4 Arithmetic progressions
  15.4.1 Formulae for the n^{th} term
  15.4.2 Formulae for the sum of the first n terms
15.5 Geometric progressions
  15.5.1 The formula for the n^{th} term
  15.5.2 The formula for the sum of the first n terms
15.6 The sum to infinity of a series and the convergence and divergence of a series

16. Introduction to Differentiation (7 hrs.)

[Ref 1: pg 179-189]

Instructional Objectives

- Explain what differentiation is
- Describe the properties of differentiation
- Solve problems involving differentiation

16.1 Introduction to differentiation
16.2 Properties and examples

17. Introduction to Integration (6 hrs.)

[Ref 1: pg 190-198]

Instructional Objectives

- Explain integration
- Know and apply the integrals of standard functions
- Explain the relation between integration and the area under a curve
- Solve problems involving integration

17.1 Integration as the inverse of differentiation
17.2 Integration of standard functions
(e^x, log x , sin x , cos x , tan x , sec x , cosec x , cot x)
17.3 The relation between integration and the area under the curve