IT2105: Mathematics for Computing I

INTRODUCTION

This is one of the 4 modules designed for Semester 2 of Bachelor of Information Technology Degree program.

CREDITS: 03

LEARNING OUTCOMES

On completion of this course, students will be able to obtain the skills of discrete mathematics needed to analyze, model and solve problems in Information and Communication Technology.

MINOR MODIFICATIONS

When minor modifications are made to this syllabus, those will be reflected in the Virtual Learning Environment (VLE) and the latest version can be downloaded from the relevant course page of VLE. Please inform your suggestions and comments through the VLE. http://vle.bit.lk

ONLINE LEARNING MATERIALS AND ACTIVITIES

You can access all learning materials and this syllabus in the VLE: http://vle.bit.lk, if you are a registered student of BIT degree program. It is very important to participate in learning activities given in the VLE to learn this subject.

ONLINE ASSIGNMENTS

The assignments consist of two quizzes, assignment quiz 1 (It covers the first half of the syllabus) and assignment quiz 2 (It covers the second half of the syllabus). Maximum mark for a question is 10, minimum mark for a question is 0 (irrespective of negative scores). Final assignment mark is calculated considering 40% of assignment quiz 1 and 60% of assignment quiz 2. Pass mark for the online assignments in a course is 50. You are advised to do online assignments before the final exam of the course. It is compulsory to pass all online assignments to partially qualify to obtain year 1 certificate.

FINAL EXAMINATION

Final exam of the course will be held at the end of the semester. Each course in the semester 2 is evaluated using a two hour question paper which consists of 40-60 MCQs.

OUTLINE OF SYLLABUS

Topic	Minimum number of hours
1. Indices and logarithms	03
2. Sets	07
3. Logic	17
4. Relations and Functions	12
5. Boolean Algebra	03
6. Techniques of Counting	08
7. Probability	10
Total for the subject	**60**

REQUIRED MATERIALS

Main Reading:

Ref 1: Elementary Algebra for School, Metric Edition by H.S. Hall and R.S. Knight, A.I.T.B.S. Publishers & Distributors India, 2000.
Ref 2: Schaum's Outline series: Discrete Mathematics, 2nd Edition by Seymour Lipshutz & Marc Lipson, Tata McGraw-Hill India, 2003.
Ref 3: Discrete Mathematics by Olympia Nicodemi, CBS publishers and Distributors India, 2001.
Ref 4: Schaum's Outline series: Probability by Seymour Lipshutz & Marc Lipson, McGraw-Hill International Edition, 2000.

Supplementary Reading:

- Mathematics for Computing by K.M.R.T. Karunaratna, Tharangee Printers Sri Lanka, 2002.

DETAILED SYLLABUS

1. Indices and logarithms (03hrs) [Ex. Ref 1: pg. 273-275, 290-291, 380-381]

Instructional Objectives

- Transform expressions with indices and logarithmic expressions into forms which are more manageable.
- Represent graphically the basic expressions involving indices and logarithms.

Sub Topics

1.1. Index laws (for integral indices and rational indices), surds, e^x [Ref 1: pg. 265-273, 276-290]
1.2. Logarithms: Definition, laws of logarithms, change of base ($\log_b c = \log_a c \cdot \log_b a$) [Ref 1: pg. 370-380]
1.3. Graphs of a^x, $\log_a x$ [Ref 2: pg. 54-57]

2. Sets (07hrs) [Ex. Ref 2: pg. 12-26]

Instructional Objectives

- Illustrate properties of set algebra using Venn-diagrams.
- Prove various useful results of set algebra.

Sub Topics

2.1. Introduction to sets (sets of numbers (N, Z, Q etc)), subsets, proper subsets, power sets, universal set, null set, equality of two sets, Venn diagrams [Ref 2: pg. 1-5]
2.2. Set operations (union, intersection, complement and relative complement) [Ref 2: pg. 5-7]
2.3. Laws of algebra of sets (The idempotent laws, the associative laws, the commutative laws, the identity laws, the complement laws (i.e.: $A \cup A^c = E$, $A \cap A^c = \emptyset$, $(A^c)^c = A$, $E^c = \emptyset$, $\emptyset^c = E$), De Morgan's laws) proofs of the laws using labelled general Venn diagram, proofs of results using the laws [Ref 2: pg.7-9]

3. Logic (17hrs) [Ex. Ref 2: pg. 92-101]

Instructional Objectives

- Absorb the language of mathematical logic starting from the language of sets.
- Construct Propositions and to evaluate truth values.
- Examine the use of Predicates and Quantifiers.
- Select appropriate methods and applying them in the proof of mathematical statements.

Sub Topics

3.1. Propositions [Ref 2: pg. 78]
3.2. Propositional Logic [Ref 2: pg. 79-86]
  3.2.1. Negation, conjunction, disjunction defined by truth tables [Ref 2: pg. 79-80]
  3.2.2. Truth - tables of compound propositions [Ref 2: pg. 80-82]
  3.2.3. Tautologies and contradictions [Ref 2: pg. 82-83]
  3.2.4. Logical equivalence [Ref 2: pg. 83]
  3.2.5. Algebra of propositions [Ref 2: pg. 83-84]
  3.2.6. The conditionals p => q and p <=> q and their truth - tables. The equivalence of p => q to $(\sim p) \vee q$ and the equivalence of p <=> q to $((\sim p \vee q) \wedge ((\sim q) \vee p))$ [Ref 2: pg. 84-85]
  3.2.7. Arguments (for example deriving r => ~p from the premises p => q, r => ~q). Also arguments involving ordinary language [Ref 2: pg. 85-86]
3.3. Predicates and Quantifiers [Ref 2: pg. 87-92]
  3.3.1. Predicates involving one or more variables [Ref 2: pg. 87-88]
  3.3.2. The quantifiers $\forall$, $\exists$ [Ref 2: pg. 88-92]

3.3.3. Propositions involving unmixed and simple mixed quantifiers (for example $\forall x \in Z, \exists y \in N, y>x$) [Ref 2: pg. 88-92]

3.4. Types of Proofs [Ex. Ref 3: pg. 41, 82-83]
- 3.4.1. Direct proofs and proofs by contradiction [Ref 3: pg. 38-40]
- 3.4.2. Counter example [Ref 3: pg. 38-40]
- 3.4.3. Mathematical induction [Ref 3: pg. 79-82]

3.5 Applications : Digital Logic Circuits (This section is already covered under IT1204: Computer Systems I in Section 3: Boolean Algebra and digital Logic)

4. Relations and Function (12hrs)

Instructional Objectives
- Define a relation.
- Identify a relation as a directed graph
- Examine some properties of a relation
- Identify a function as a special type of relations
- Examine some characteristics by functions.

Sub Topics

4.1. Relations (04hrs) [Ex. Ref 2: pg. 38-49]
- 4.1.1. Ordered pairs and the Cartesian product of two sets [Ref 2: P27-28]
- 4.1.2. Definition of a relation, Relation from a set A to a set B, relation on a set A [Ref 2: pg. 28-29]
- 4.1.3. Relations as sets of ordered pairs [Ref 2: pg. 27]
- 4.1.4. Inverse of a relation [Ref 2: pg. 29]
- 4.1.5. Directed graph [Ref 2: pg. 29-30]
- 4.1.6. Equivalence Relations [Ref 2: pg. 35-37]
  - 4.1.6.1. Definition and examples [Ref 2: pg. 35-36]
  - 4.1.6.2. Equivalence classes [Ref 2: pg. 36-37]

4.2. Function (08hrs) [Ex. Ref 2: pg. 66-77] [Ex. Ref 3: pg. 109-110]
- 4.2.1. Function as a mapping from a set A to a set B [Ref 2: pg. 50-51]
- 4.2.2. Range of function; Function from a finite set A onto a set B [Ref 2: pg. 50-51]
- 4.2.3. One to one functions [Ref 2: pg. 52-54]
- 4.2.4. Bijections [Ref 3: pg. 107-109]
- 4.2.5. Inverse functions [Ref 2: pg. 52-54]
- 4.2.6. Composite functions [Ref 2: pg. 52]

5. Boolean Algebra (03hrs) [Ex. Ref 2: pg. 497-520]

Instructional Objectives
- Define a Boolean algebra
- Identify sets and prepositions as Boolean algebra
- Examine basic theorems in Boolean algebra

Sub Topics

5.1. Introduction [Ref 2: pg. 477]

5.2. Basic definitions [Ref 2: pg. 477-478]
5.3. Duality [Ref 2: pg. 478]
5.4. Basic theorems [Ref 2: pg. 478-479]

6. Techniques of Counting (08hrs) [Ex. Ref 4: pg. 42-58] [Ex. Ref 2: pg. 146-147]

Instructional Objectives

- Count the number of elements in certain mathematically defined sets where ordinary methods of counting are tedious.

Sub Topics

6.1. Permutations [Ref 4: pg. 36-38]
  6.1.1. Permutations [Ref 4: pg. 36-38]
  6.1.2. Permutations with repetitions [Ref 4: pg. 37-38]
6.2. Binomial theorem and the binomial coefficients [Ref 4: pg. 34-36]
6.3. Combinations [Ref 4: pg. 39-41]
6.4. Tree diagrams [Ref 4: pg. 41-42]
6.5. Pigeon hole principle [Ref 2: pg. 139]

7. Probability (10hrs) [Ref 4: pg. 970-84, 95-118]

Instructional Objectives

- Explain the basic summary measurements.
- Solve typical probabilistic problems.
- Explain the basic concept of probability.

Sub Topics

7.1. Sampling and Descriptive Statistics
  7.1.1. Measures of central tendencies
  7.1.2. Measures of dispersion
7.2. Sample space and events [Ref 4: pg. 59-63]
7.3. Axioms of probability and basic theorems [Ref 4: pg. 63-65]
7.4. Finite probability spaces [Ref 4: pg. 65-67]
7.5. Conditional probability and the multiplication rule [Ref 4: pg. 85-87]
7.6. Tree diagrams [Ref 4: pg. 87-89]
7.7. Bayes theorem [Ref 4: pg. 89-92]
7.8. Independent events [Ref 4: pg. 92-95]

PLATFORM

No practical required