IT2103: Mathematics for Computing I

(Compulsory)

1. OUTLINE OF SYLLABUS

Topic	Minimum number of hours
• Indices and logarithms	03
• Sets	07
• Logic	17
• Relations and Functions	12
• Boolean Algebra	03
• Techniques of Counting	08
• Probability	10
Total for the subject	**60**

Learning Outcome :
After successfully completing this course students should be able to:
Acquire the skills of discrete mathematics needed to analyze, model and solve problems in Information and communication technology.

2. 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.

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.

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

- Grasp the language of mathematical logic starting from the language of sets.
- Construct Propositions and to evaluate truth values.
- Use quantifiers.
- Identify appropriate methods and applying them in the proof of mathematical statements.

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 => lq). 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

4. Relations and Function (12hrs)

Instructional Objectives

- Define and work with functions and relations

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
- Work with Boolean expressions.

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]
5.5. Sum of products form of Boolean algebras [Ref 2: pg. 481-483]
5.6. Minimal Boolean expression, prime implications [Ref 2: pg. 483-486]

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.

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

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

3. BOOKS RECOMMENDED FOR READING AND REFERENCE

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 (OPTIONAL)

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

4. PLATFORM

No practical required

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