UNIVERSITY OF PUNE, PUNE 411007.

BOARD OF STUDIES IN MATHEMATICS

SYLLABUS

F.Y.BSc (Computer Science)
Paper-I
Discrete Mathematics
First Term

1) **Finite Induction** **(4 lectures)**

1.1) First principle of induction.
1.2) Second Principle of finite induction.

2) **Elementary counting principles** **(7 lectures)**

2.1) Functions and counting.
2.1.1) Cardinality of finite sets.
2.1.2) Cardinality of the union of sets (Addition Principle)
2.1.3) Principle of Inclusion and Exclusion.
2.1.4) Multiplication Principle.
2.1.5) Listing of functions from one set to another.
2.1.6) Number of functions from one set to another
2.2 Combinatorial arguments.
2.3) Pigeonhole Principle (Without proof).
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3) **Recurrence Relations.** **(7 lectures)**

3.1) Homogenous and Non-Homogenous solutions.

4) **Logic.** **(7 lectures)**

4.1) Predicates
4.2) Valid arguments and proofs.
4.3) Proofs in mathematics.

5) **Algorithms** **(11 lectures)**

5.1) Definition
5.2) Pseudocode conventions.
5.3) Examples.
5.4) Characteristics of an algorithm.

5.5) Time complexity.
Types of Examples:-
Iterative.
Recursion e.g. Fibonacci sequence.
Evaluation e.g. Horner's Method.
Searching Methods.
Sorting Methods (Insertion Sort, Merge Sort, Bubble Sort).
Time Complexity-(Big 'O', Big 'Omega'). Brief introduction only.
Growth rates of functions with their comparisions.

Second Term

6) **Graphs** **(6 lectures)**

6.1) Definition & elementary results.
6.2) Types of graphs.
6.3) Isomorphism.
6.4) Adjacency and incidence matrix- Definition, Examples.

7) **Operations on Graphs** **(4 Lectures)**

7.1) Subgraphs and induced graphs.
7.2) Complement of a graph. Self-complementary graphs.
7.3) Union, intersection of graphs.

8) **Connected graphs-** **(10 Lectures)**

8.1) Definition of connected and disconnected group.
8.2) Definition and elementary results of edge sequence, trail, path and circuit.
8.3) Isthmus, cut-vertex.
8.4) Definition Examples and Non-Examples.
8.5) Dijkstra's shortest path algorithm.
(Breadth-First Search approach).

9) **Trees** **(6 Lectures)**

9.1) Definition and equivalent characterizations, elementary results.
9.2) Centre of a tree.
9.3) Spanning trees and fundamental circuits.
9.4) Binary trees and elementary results.
9.5) Kruskal's Algorithm for weighted spanning trees.

10) **Directed graphs** **(10 Lectures)**

10.1) Definition, different types, examples.
10.2) Directed trees, arborescence and polish notation.

10.3) Network and Flows: Definition, examples and construction of flows, Max flow Min cut theorem.
10.4) Ford and Fulkerson's Algorithm (BFS approach).

Text Books:

1) Kenneth Rosen- Discrete Mathematics; Tata McGraw Hill**.**
2) Narsing Deo- Graph Theory with Applications to Computer Science and Engineering ; Prentice Hall, India
3) Ron Clark and Derek Holton- Graph Theory, Narosa.

Paper-II

Algebra and Calculus

First Term : Algebra

1) Relations (12 Lectures)

1.1) Ordered pairs, Cartesian product of sets.
1.2) Relations, types of relations, equivalence relations, partial orderings.
1.3) Digraphs of relations, matrix representation and composition of relations.
1.4) Transitive closure and Warshall's Algorithm.
1.5) Equivalence class, properties and partition of a set.
1.6) Definition of function as relation.

2) Divisibility in integers (12 Lectures)

2.1) Well ordering principle.
2.2) Division algorithm (With Proof).
2.3) Divisibility and its properties, prime numbers.
2.4) Greatest Common Division (G.C.D). (With Proof)
2.5) Euclidean Algorithm.
2.6) Relatively prime integers, Euclid's Lemma & its generalisation.
2.7) Congruence relations & its properties.
2.8) Fermat's Theorem.
2.9) Residue Classes: Definition, Examples, addition & multiplication modulo n and their composition tables

3) **Boolean Algebra** **(12 Lectures)**

3.1) Hasse diagram.
3.2) Lattice.
3.3) Boolean Algebra Definition as a lattice, Properties of Boolean algebra.
3.4) Finite Boolean Algebra.
3.5) Boolean Expressions and Boolean functions.
3.6) Disjunctive Normal form and Simplification.

Second Term: Calculus

4) Sequences of real numbers **(8 Lectures)**

4.1) Definition, notation and examples .
4.2) Convergent , divergent and oscillatory sequences, definition and examples.
4.3) Bounded Sets, Bounded sequences , Definition and Examples.
4.4) Monotonic sequences, theorems on monotonic and bounded sequences (without proof).
4.5) Lim $(1+1/n)^n$=e. With Proof
$n \to \infty$.
4.6) Convergence of $\langle x^n \rangle$, $x \in R$ $x > 0$.(with proof)

5) Series of real numbers **(8 Lectures)**

5.1) Sequence of partial sums.
5.2) Convergence of series .If $\sum u_n$ is convergent
then $u_n \to 0$ as $n \to \infty$.(with proof)
5.3) Convergence of geometric series.(with proof)
5.4) Series of positive terms, comparision test and its limit form (without proof).
5.5) Convergence of $\sum 1/n^p$, $p \in R$.(with proof)
5.6) D'Alembert's ratio test (without proof).
5.7) Root test. (without proof).

6) Continuity and mean value theorems **(10 Lectures)**

6.1) Continuity and properties of continuous functions defined on [a,b] (without proof) and examples.
6.2) Differentiability.
6.3) Theorem – Differentiability implies continuity but not conversely. Left hand derivative & Right hand derivative.

6.4) Rolle's theorem (with proof and geometric interpretation).
6.5) Lagrange's Mean Value Theorem. (with proof and geometric interpretation).
6.6) Cauchy's mean value theorem(with proof), Verification and Applications.

7) Successive differentiation (6 Lectures)

7.1) n^{th} derivatives of standard functions.
7.2) Leibnitz's Theorem.(with proof).
7.2) L'Hospital's Rule(without proof)

8) Taylor's and Maclaurin's Theorems (4Lectures)

8.1) Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders (without proof).
8.2) Taylor's and Mclaurin's Series.

Text Books:

1) Real Analysis- R.G. Bartle, D. Sherbert, 3rd Edn, John Wiley & Sons, Indian Edn..
2) Differential Calculus- Shanti Narayan, S.Chand & Co.
3) Elementary Number Theory- D. Burton, Tata McGraw Hill, Indian Edn.
4) Discrete Mathematics- Bernard Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, Pearson Education, 5th Edition.

PAPER – III
PRACTICAL PAPER

Modalities For Conducting The Practical and The Practical Examination

1) There will be four Practical slots lectures of 45 minutes per week, two slots for Paper I and two for Paper II. (24 Practical slots for Paper I and 24 practical slots for Paper II per term in any one term) **OR** one 3 hour Practical session for each batch of 20 students per week

2) A question bank consisting of 100 problems in all for the whole year, distributed in four Sections: 50 questions for each term (25 questions on Paper I and 25 on Paper II) will be the course work for this paper. Question Bank will be prepared by a Sub-Committee to be appointed by the Board of Studies in Mathematics. Question Bank shall be ready by first week of June, 2008.

3) The College will conduct the written Practical Examination of 80 marks at least 15 days before the commencement of the Main Theory Examination. There will be no external examiner. The written practical exam will be of the duration of 3 hours and the question paper will be as follows:
   Q1. (a) Any 1 out of 2 of 10 marks on Paper I(first term).
   (b) Any 1 out of 2 of 10 marks on Paper II.(first term).

   Q2. Any 4 out of 5 each of 5 marks on Paper I.

   Q3. Any 4 out of 5 each of 5 marks on Paper II.

   Q4. (a) Any 1 out of 2 of 10 marks on Paper I(second term).
   (b) Any 1 out of 2 of 10 marks on Paper II(second term).

In Q2 and Q3, there will be either 2 questions from first term and 3 questions from the second term or viceversa.

4) Each student will maintain a journal to be provided by the College at cost. Certified journal will be submitted by the student at the time of the Practical Examination. There will be 20 marks for internal assessment which will include marks for journal and attendance.

5) 60 percent of the questions for the written practical examination will be exclusively set from the Question Bank provided. **Questions from the Question Bank (meant for practical course) should NOT be asked in the University Theory Examinations.**

6) The Question Bank shall be changed once every three years.

7) In each term 12 practicals will be held including 2 revision practicals. Each practical can either be conducted in one session of 3 hours or it can be spread out over 4 slots of 45 mins each per week. Hence the total number of slots per term for the practicals is 48.

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