Detailed Syllabus of
Ph.D. Coursework Examination in
Computer Science and Application

Dept. of Computer Science and Application
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## 0.1 A model Scheme of Instruction and Examination

### Table 1: Details of lecture hours per week and marks distribution

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Term End</th>
<th>Sessional</th>
<th>Full Marks</th>
<th>Exam Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>Research Methodology</td>
<td>40</td>
<td>10</td>
<td>50</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Paper II</td>
<td>Mathematical Foundation</td>
<td>40</td>
<td>10</td>
<td>50</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Paper III</td>
<td>Programming and Data Structure</td>
<td>80</td>
<td>20</td>
<td>100</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

## 0.2 Syllabus of Core Subjects

### 0.2.1 Paper I: RESEARCH METHODOLOGY [F.M. 40+10]

**Group I**

**Introduction**— Meaning, purpose, objectives and characteristics of research, Types of research, Significance of Research, Motivation in Research, Research Approach and Process, Research Methods Vs Methodology, Criteria of good Research, Research Ethics

**The Research Problem**— Definition, finding a problem, stating the problem, identifying sub-problems - Necessity of Defining the Problem- Techniques involved in defining the Problem.

**Literature Review**— Importance of literature review in defining a problem, Including literature in research proposal, Critique, Survey & Peer review process, Identifying gap areas from literature review.

**Research Planning and Design**— Research plan and its components, Developing a research plan, Meaning and importance of Research Design, Different types of research design, Features of a Good research Design

**Sampling**— Steps in sampling, Characteristics of a good sample, Types of sample, Measurement and scaling techniques, Types of data-primary, secondary etc., Methods of data collection, Data collection instruments/tools.

**Development of working hypothesis**— Formulation of Hypotheses, Types of Hypotheses, Methods of testing Hypotheses, Correlation and Regression, Chi-square test, Analysis of variance and Covariance etc.

**Group II**
**Interpretation and Report Writing**—Techniques of interpretation, Types of research documents, Significance of documenting research, Technical reports and thesis, different steps in writing Report, Techniques and issues of writing project proposals, articles, technical reports, white papers, research papers, thesis etc., checklist/precautions for writing research documents, characteristics of a good research document, Writing abstracts, paper presentation, The Quantitative study, Final paper presentation, Soft skills

**Computer Applications and Research Tools**—Internet, e-mail, ICT, WWW, web as a source of data and information, searching the web, using open coursewire, online tutorials, eBooks, eJournals etc., Primary and secondary sources, Reviews, treatise, monographs patents, Library, Data analysis with Statistical Packages, MS-Office, MS-Publisher, LaTex etc., INFLIBNET, Shodhganga, ShodhGangotri, N-LIST, UGC-INFONET Digital Library Consortium etc.


**REFERENCES:**


6. Conducting Research Literature Reviews: From the Internet to Paper by Fink, A., Sage Publications.


9. Research Methodology by Dalip Kumar Bhattacharyya.
10. Research Methodology by C.H. Chaudhary, RBSA Publication

11. Statistical Techniques by S.P. Gupta, Sultan Chand & Sons


13. WWW (Web Sources)

0.2.2 Paper II: Mathematical Foundation [F.M. 40+10]

Mathematical Logic: Statements and notations, Connectives, Truth Tables, Well formed formulas, tautology, contradiction and satisfiable, equivalence implication, Quantifiers, Universal quantifiers, Normal forms, Theory of Inference for statement calculus, Predicate Calculus, Inference theory of the predicate calculus

Relation and Ordering: Function, Recursion, Generating Functions, Recurrence Relations, Solution of homogeneous and inhomogeneous recurrence relation.

Algebraic Structures: Groups, Applications of residue arithmetic to computers, Group Codes.

Graph Theory: Definition, Path, Reachibility, Connectedness, Representation of Graphs, Trees, Storage representation and manipulation of graphs, PERT/CPM and related techniques.

REFERENCES:

1. Graph Theory with Applications to Engineering and Computer Science by Deo Narsingh, PHI Learning Pvt. Ltd., 2004


9. Logic and Discrete Mathematics by Grass Man & Trembley, Pearson

0.2.3 Paper III: Programming and Data Structure [F.M. 80+20]

A programming language like C/C++/Java may be followed. The same language must be used for the laboratory.

**Group I**

**Programming Fundamentals:** Conditional statements, Control statements, Functions, Arrays, Preprocessor, Pointers, Variation in pointer declarations, Function Pointers, Function with Variable number of arguments

**Programming Advanced Features:** Structures and Unions, File handling concepts, File read, write, binary and Stdio, File Manipulations

**Object Oriented Programming Concepts:** Programming features, Data Abstraction, Encapsulation, class, object constructors, Polymorphism, Inheritance, static members, constant members, member functions, overloading and overriding, virtual functions, references, Role of this pointer, Storage classes, function as arguments, String Handling, dynamic memory allocation, Nested classes.

**Advanced Features:** Abstract class, Exception handling, Standard libraries, Generic Programming, templates, class template, function template, STL, containers, iterators, function adaptors, allocators, Parameterizing the class, File handling concepts.

**Group-II**

**Linear Data Structures List:** Abstract Data Types (ADTs), List ADT, array-based implementation, linked list implementation, singly, doubly, and circularly linked lists, applications of lists, Polynomial Manipulation, different operations on Lists

**Linear Data Structures Stacks, Queues:** Stack ADT, Evaluating arithmetic expressions, other applications, Queue ADT, circular queue implementation, double ended Queues, applications of queues

**Advanced Non-Linear Data Structures:** AVL trees, B-Trees, Red-Black trees, Splay trees,
Binomial Heaps, Fibonacci Heaps, Disjoint Sets, Amortized Analysis, accounting method, potential method, aggregate analysis.


**Sorting, Searching and Hash Techniques:** Different sorting and searching algorithms and their performance analysis, Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing

**REFERENCES:**

3. Programming in ANSI C by Balgurusamy, TMH
5. Programming with Java: A Primer by Balaguruswamy E, Tata McGraw Hill
7. Data Structure Using C AND C++ by Yedidyah, L., Moshe, J. M., M Aaron, Tenenbaum, 2/E (English) 2nd Edition