PhD Course Work: Structure/Syllabus as per UGC regulations

As per University Grants Commission (Minimum Standards and Procedure for Award of PhD Degree) Regulations 2022.

9.1. The Credit requirement for the Ph.D. coursework is a minimum of 12 credits, including a "Research and Publication Ethics" course as notified by UGC vide D.O. No. F.1- /2018(Journal/CARE) in 2019 and a research methodology course. The Research Advisory Committee can also recommend UGC recognized online courses as part of the credit requirements for the Ph.D. programme.

Proposal for Course Structure is placed below

PhD Course Work (2 Semesters)			
S. No.	Course Title	Credits	Type
SEMESTER – I			
1	Algorithms	4	HC
2	Data Structures and Programming Lab	2	P
SEMESTER – I or SEMESTER – II			
3	Research Methods in Computer Science†	4	AECC
4	Research Publication Ethics†	2	AECC
5	Elective†	4	DSE

† These courses can be taken in either of semesters, subject to their availability.

Note: Minimum number of credits required to pass the PhD course work is 16.

Course Type Codes	
HC	Hard Core
SC	Soft Core
DSE	Discipline Specific Elective
GE	Generic Elective (Non-discipline)
AECC	Ability Enhancing Compulsory Course
P	Practical
SE	Skill Enhancement Course
PD	Project/Dissertation
(*)	Offered to other Schools/Depts

Syllabus for the PhD Course Work

Syllabus for Algorithms

The syllabus for algorithms will be identical to that of the M. Tech course by the same name, but may require extra work if the university decides that all PhD courses MUST be different from M. Tech courses.

Syllabus for DSP Lab

The syllabus for DSP Lab (Data Structures & Programming Lab) will be identical to that of the M. Tech course by the same name and will include a mini project-based evaluation accounting for 40% of the grade.

Syllabus for Elective

An elective that is being offered to M. Tech/IMTech students in the ongoing semester can be taken by the Research Scholar and the choice of the elective shall be based on the supervisor's recommendation aligned with the research area.

- The syllabi for the Courses are given below.

Syllabus for Research Methodology in Computer Science

Module-A: What is research? what is not research? why? Types of research? Stages of research, Approaches, Qualities desirable, Design thinking, Research Mind, Research Attitude, openness for discussion and criticism. Creations of Mind and Intellectual Property. Creativity, Innovation and problem solving. Good habits and Best practices for a good research output.

Module-B: Planning the research, Study of existing literature, survey of top journals, top conferences, top experts, top websites, top tools and techniques, top problems, top applications and top x. Problem statement and scope of work.Carrying out research, experimental plans, test data, parameters, measurements to be done,programs to be written, literature to be seen - focused, literature analysis and critiques.Data Processing: Facility with UNIX commands, awk, sed, Shell Scripting, GNUPLOT, MATLAB/ SCILAB / R.

Module-C: Research Ideas and implementation methodology, experimental setup, standard and non standard data sets, performance metrics, comparison of performance, evaluation of results.Benchmark Data sets, Performance Metrics: Precision, Recall, F-measure, AUROC, AUPR etc.Statistical Analysis:Testing for statistical significance using P-value. Statistical hypothesis tests like T-test, Friedman Test, Posthoc Test, Wilcoxon Test etc. Statistical software such as R/Scilab/Scala and languages with powerful data handling capabilities such as Python/Java.

Module-D: To publish or not publish. Types of Publications - conference paper and presentations,Journal Paper, High impact and reputed journals, and Patents. Publishing your work, how to read a paper, how to write a paper. Research without any reference.where to publish your work, whether to patent or to publish, criteria for patent filing. Impact of Research, contributions, prototypes, tools, plug ins, and Writing a thesis. Research Ethics: Plagiarism issues, Social implications LINUX software for Document Preparation and presentation: Drawing packages, LATEX and BEAMER.

References:

1. Kothari C R, “Research Methodology - Methods and Techniques,” Willey Eastern Ltd., New Delhi 1992.
2. Donald H. McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
3. Alan M Johnson, Charting a course for a successful research career, Elsevier 2011
4. Lowry, Richard. Concepts & Applications of Inferential Statistics. March 2015.
5. Statistics: An Introduction using R, Michael J. Crawley, Wiley 2011.
6. Statistical Design for Research, Leslie Kisch, Journal of Educational Statistics, 1990
7. LaTex and Beamer tutorials : Tex Users Group : https://www.tug.org/

School of Computer & Information Sciences

Name of the Academic Program: Ph.D. (Computer Science) (PhD-I)

Course Code: CPE- RPE Title of the Course: **Research and Publication Ethics**

L-T-P: 2-0-0 Credits: 2

Prerequisite Course / Knowledge (If any): None

Course Outcomes (COs)

After completion of this course successfully, the students will be able to……

CO1: Understanding ethics in general

CO2: Ethics in conducting research work

CO3: Ethics in publication of the research work

CO4: Identification of good journals and conferences

CO5: Using software tools

Detailed Syllabus
The course comprises of six modules listed below.

THEORY
Module 01: PHILOSOPHY AND ETHICS (3 hrs.)
1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

Module 02: SCIENTIFIC CONDUCT (5hrs.)
1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Module 03: PUBLICATION ETHICS (7 hrs.)
1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types

5. Violation of publication ethics, authorship and contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

Module 04: OPEN ACCESS PUBLISHING (4 hrs.)

1. Open access publications and initiatives
2. SHERPA/ RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Module 05: PUBLICATION MISCONDUCT (7hrs.)

A. Group Discussions (5 hrs.)

1. Subject specific ethical issues (AI and ethics), FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open-source software tools

Module 06: DATABASES AND RESEARCH METRICS (3hrs.)

A. Databases (3 hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

Resources

1. Research Methodology for Natural Sciences, Soumitro Banerjee, IISc Press, 2022
2. Manual for Research and Publication Ethics in Science and Engineering, Eun Seong Hwang, Eun Hee Cho, Young-Mog Kim, Kibeom Park, Wha-Chul Son, Tae-Woong Yoon, Jeong Mook Lim, https://www.kcse.org/books/index.php?SCBK1000141
3. Academic Integrity and research Quality by UGC, https://www.ugc.gov.in/e-book/Academic%20and%20Research%20Book_WEB.pdf

School of Computer and Information Sciences

Name of the Academic Program: M.Tech((Computer Science) (M.Tech-I)

Course Code: CS402 Title of the Course: Algorithms
L-T-P: 4-0-0 Credits : 4

Prerequisite Course / Knowledge (If any): Data Structures in under graduate level, discrete mathematical structures, knowledge of sorting algorithms and basic search strategies

Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

- CO-1: Assess the inherent structure/hardness of a problem (Evaluate)
- CO-2: Select an appropriate strategy to solve a problem (Understand)
- CO-3 Design an algorithm that suits the time complexity requirements of the problem. (Create)
- CO-4: Estimate the time and space complexities of an algorithm along with the necessary mathematical proofs when necessary. (Evaluate)
- CO-5: Devise algorithms by choosing appropriate data structures (Create)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2			3			1		
CO2				3		1		2	
CO3			3				2		
CO4		3			2		1		
CO5				3		2			

Detailed Syllabus

UNIT-I: Analysis of Algorithms: Asymptotic Notation; Best, worst and average case analysis of algorithms; Solving recurrence relations using substitution method, generating functions, Master's theorem etc. Warm-up to complexity analysis: Heap data structure, priority queue application, Best, worst and average case analysis of a few sorting algorithms like heap sort, insertion, bubble, selection, counting and radix sort algorithms. Strategies for problem solving

UNIT-II: Divide and Conquer strategy: Time complexity analysis for Merge Sort and Quick Sort Algorithms

UNIT-III: Greedy strategy: Theoretical foundation of greedy strategy: Matroids Algorithms for solving problems like Knapsack Problem (Fractional), Minimum Spanning Tree problem; Shortest Paths, Job Scheduling, Huffman's code etc along with proofs of corrections and complexity analysis

UNIT-IV: Dynamic Programming strategy: Identify situations in which greedy and divide and conquer strategies may not work. Understanding of optimality principle. Technique of memorization. Applications to problems like Coin change, 0/1 and 0/n- Knapsack, Shortest Paths, Optimal Binary Search Tree (OBST), Chained Matrix Multiplication, Traveling Salesperson Problem (TSP) etc.

UNIT-V: Backtracking and Branch & Bound strategies: State space tree construction, traversal techniques and solving problems like 0/1 and 0/n knapsack, TSP, Applications of Depth First Search: Topological sorting, Finding strongly connected components and game problems.

UNIT-VI: Theory of NP-Completeness: Complexity classes of P, NP, NP-Hard, NP-Complete, Polynomial reductions, Cook's theorem. Discussion of problems: Satisfiability(SAT), CNF-SAT, Min-Vertex Cover, Max-Clique, Graph Coloring, NP-Completeness proofs.

Reference Books:

1. Introduction to Algorithms-T.Cormen, C.E.Leiserson, R.L.Rivest, PHI, 3rdEdition 2009.
2. Algorithms- R.Johnsonbaugh and M.Schaefer, Pearson, 2004.
3. Fundamentals of Algorithmics - G.Brassard and P.Bratley, PH, 1996
4. The Algorithm Design Manual- Steven S. Skiena, Springer, 2009

School of Computer and Information Sciences

Name of the Academic Program: M.Tech (Computer Science) (MTECH-I)

Course Code: CS404 Title of the Course: Data Structures & Programming Lab

L-T-P: 0-0-3 Credits : 2

Prerequisite Course / Knowledge (If any): Programming and Data Structures at under graduate level

Course Outcomes (COs)

After completion of this course successfully, the students will be able to

- CO-1: Solve a problem by choosing appropriate data structures in C programming language (Apply)
- CO-2: Select suitable data structure for an idea and propose solution using C Programming Language (Analyze)
- CO-3: Analyze the time taken to solve the problem by using C programming language (Analyze)
- CO-4: Assess the solution in terms of efficiency, modularity and well-documented programs in C under Linux environment (Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3		1						
CO2			1	3					
CO3		2							
CO4			2		1		3		

Detailed Syllabus:

UNIT-I: Implementing Stacks and types of Queues as dynamic data structures using linked lists and their applications

UNIT-II: Binary Tree, Binary search trees & Traversals of BST, balanced trees - AVL Trees and their applications

UNIT-III: Sorting Techniques, Basic Searching Techniques, Hashing-Collision Resolution and closed hashing.

UNIT-IV: Graphs: Representations (Matrix and Adjacency List), basic traversal techniques: Depth First Search , Breadth First Search, Implementation of Kruskal Algorithm, Dijkstra Algorithm, Spanning and Minimal Spanning Trees.

UNIT-V: Multi link Structures, B Trees and B+ Trees and their applications.

Reference Books:

1. Horowitz, E., and Sahni.S: Fundamentals of Data structures. Computer Science Press, 1978.
2. Tanenbaum, A.M., and Augenstein, M.J.: Data Structures with Pascal, Prentice - Hall International, 1985.
3. Stubbas, D.: Data Structures with Abstract Data Types and Modula2, Brooks & Cole Pub. Co. 1987.
4. Trembley & Sorenson: An Introduction to Data Structures with Applications; Tata McGraw Hill
5. Kruse, R.L., Leung, B.P., and tondo, C.L.: Data Structures and Program Design in C; Prentice-Hall of India 1999.