Haldia Institute of Technology

An Autonomous Institute (An Institution of ICARE)

NAAC Accredited Grade 'A' Institute

(Approved by All India Council for Technical Education (AICTE) and Affiliated to MAKAUT)

Curriculum for the

M.Tech in Computer Science and Engineering

(NBA Tire-I Accredited Department)

(For Academic year 2024-2025)

Department of Computer Science and Engineering

Haldia Institute of Technology

Syllabus for M. Tech in Computer Science and Engineering
For Academic Year 2024-2025

PROGRAM OUTCOME (POs):

Engineering Graduates will be able to:

PO-1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO-1: To provide students with a strong foundation in applied science and Computer Science & Engineering fundamentals necessary to analyze the requirements of the software, understand the technical specifications, design and create innovative computing products and solutions for real life problems.

PEO-2: To provide exposure to emerging technologies, adequate training and opportunities to work as teams on multidisciplinary projects with effective communication skills and leadership qualities.

PEO-3: To prepare the students for a successful professional career as engineer, scientist, teacher, technocrat, administrator or an entrepreneur and work with values & social concern bridging the digital divide and meeting the requirements of Indian and multinational companies.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO-1: Demonstration of Basic Knowledge: Ability to understand the principles & working of computer systems; demonstrate, analyze, apply management principles, mathematical foundations in the development of computational solutions.

PSO-2: Problem Solving Skills: Ability to design and develop computer programs and computer based systems of moderate complexity in the areas pertaining to database, networking, web-design, artificial intelligence and information security.

PSO-3: Professional Skills: Ability to apply standard practices and methods in software project management and software development using suitable programming environments to deliver quality product for the industry.

Department of Computer Science and Engineering

Haldia Institute of Technology

Syllabus for M. Tech (Computer Science & Engineering)
For Academic Year 2024-2025

Curriculum Structure
(First Year – First Semester)

Semester I						
Sl. No.	**Code**	**Course Title**	**Hours per week**			**Credits**
			L	**T**	**P**	
Theory						
1	MCS-PC-101	**Program Core I-** Mathematical foundations of Computer Science	3	0	0	3
2	MCS-PC-102	**Program Core II-**Advanced Data Structures	3	0	0	3
3	MCS-PC-103	**Program Core III** Operating System Design	3	0	0	3
4	MCS-PE-104 A/B/C/D/E	**Program Elective I** Machine Learning/ Wireless Sensor Networks/Introduction to Intelligent Systems/ Cluster and Grid Computing/ Advanced Computer Architecture	3	0	0	3
5	MCS-AC-105	Research Methodology and IPR	2	0	0	2
6	MCS-AC-106	Pedagogy Studies	1	0	0	1
Practical						
7	MCS-PCL-191	Advanced Data Structures Lab	0	0	4	2
8	MCS-PCL-192	Operating System Design Lab	0	0	4	2
Total credit of the Semester						**19**

Department of Computer Science and Engineering

Haldia Institute of Technology

Syllabus for M. Tech (Computer Science & Engineering)
For Academic Year 2024-2025

Curriculum Structure
(First Year - Second Semester)

Semester II						
Sl. No.	**Code**	**Course Title**	**Hours per week**			**Credits**
			L	**T**	**P**	
Theory						
1	MCS-PC-201	**Program Core IV** - Advanced Algorithms	3	0	0	3
2	MCS-PC-202	**Program Core V** - Soft Computing	3	0	0	3
3	MCS-PC-203	**Program Core VI**- Data Mining & Data Warehousing	3	0	0	3
4	MCS-PE-204 A/B/C/D/E/F	**Program Elective II –** Data Science/ Distributed Systems /Data Preparation and Analysis/ Computer Vision/ Computer Graphics/Software Engineering & case Tools	3	0	0	3
5	MCS-PE-205 A/B/C/D/E/F	**Program Elective III –** Human and Computer Interaction/ GPU Computing/ Digital Forensics/ Cloud Computing/ Quantum Computing/Advanced Web Technology	3	0	0	3
6	MCS-AC-206	English for Research Paper Writing	2	0	0	1
Practical/Sessional						
7	MCS-PCL-291	Advanced Algorithm Lab	0	0	4	2
8	MCS-P-281	Mini Project with Seminar	2	0	0	2
Total credit of the Semester						**20**

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Syllabus for M. Tech (Computer Science & Engineering)
For Academic Year 2024-2025

Curriculum Structure
(Second Year - Third Semester)

Semester III						
Sl. No.	**Code**	**Course Title**	**Hours per week**			**Credits**
			L	**T**	**P**	
Theory						
1	MCS-PE-301 A/B/C/D/E/F	**Program Elective IV –** Mobile Applications and Services/ Compiler for HPC/ Optimization Techniques/ Image Processing/ Pattern Recognition/Natural Language Processing	3	0	0	3
2	MCS-OE-302 A/B/C/D/E/F	**Open Elective** Business Analytics/ Industrial Safety/ Operations Research/ Cost Management of Engineering Projects/ Composite Materials/ Waste to Energy	3	0	0	3
Sessional						
3	MCS-P-381	Dissertation-I/ Industrial Project	0	0	20	10
Total credit of the Semester						**16**

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Detailed Syllabus for M. Tech (Computer Science & Engineering)
For Academic Year 2024-2025

Curriculum Structure
(Second Year - Fourth Semester)

Semester IV						
Sl. No.	**Code**	**Course Title**	**Hours per week**			**Credits**
			L	**T**	**P**	
Practical/Sessional						
3	MCS-P-481	Dissertation II	0	0	32	16
Total credit of the Semester						**16**

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Detailed Syllabus for M. Tech in Computer Science & Engineering
For Academic Year 2024-2025

CSE
First Year – Semester I

Program Core – I

Mathematical foundation of Computer Science
Code: MCS-PC-101
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	Explain and apply the basic principles of probability and statistics.
2.	Understand and use various probability distributions.
3.	Perform hypothesis testing and construct confidence intervals.
4.	Analyze relationships between variables using regression and correlation.

Pre-Requisite:	
1.	Concept of permutation and combination, Algebra.

Unit	Content	Hrs.
1.	Probability mass, density, cumulative distributionfunctions, expectation, variance, conditional expectation, applications of the univariate and multivariate central limit theorem, probabilistic inequalities, Markov chains	7
2.	Random samples, sampling distributions of estimators, methods of moments and maximum likelihoodestimator, Interval estimation	5
3.	Statistical inference:Testing of Hypotheses, UMP test, UMP unbiased test, Unbiased test for normal population,Likelihood Ratio test, Test for Goodness of fit, Introduction to univariate and multivariate statistical models: regression and classification problems.	8
4.	Graph Theory: isomorphism, planar graphs, graph colouring, Hamilton and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.	9
5.	Recent trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatic, soft computing and computer vision.	5

Text book and Reference books:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer ScienceApplications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley.
5. V.K. Rohatgi & A.K. Md. E. Saleh: An Introduction to Probability and Statistics by B.K. Kale: A First Course on Parametric Inference.
6. E.J. Dudewicz& S.N. Mishra: Modern Mathematical Statistics.

Program Core – II

Advanced Data Structure
Code: MCS-PC-102
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	To provide an in-depth understanding of advanced data structures and their efficient implementations.
2.	To equip students with the knowledge and skills to implement and analyze complex text processing algorithms and computational geometry techniques.
3.	To develop students' ability to perform probabilistic analysis and understand its applications in data structures.
4.	To prepare students for advanced research or professional roles by providing a strong foundation in both theoretical concepts and practical applications of data structures and algorithms.

Prerequisites:	
1.	Proficiency in at least one high-level programming language.
2.	Basic knowledge of fundamental data structures (arrays, linked lists, stacks, queues).
3.	Familiarity with discrete mathematics (sets, relations, functions, graphs, combinatorics).
4.	Understanding of basic algorithm design and complexity analysis (Big O notation, sorting, searching algorithms).

Unit	**Content**	**Hrs.**
1.	**Dictionaries**: Definition, Dictionary Abstract Data Type (1 hour) **Hashing**:Hash Function, Collision Resolution Techniques (SeparateChaining, Open Addressing), Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Advanced Hashing Techniques	6

2.	**Skip Lists:** Search and Update Operations (2 hours), Probabilistic Analysis	4
3.	**Trees:**Binary Search Trees: Basic Operations, Properties, Balanced Trees: AVL Trees, Red-Black Trees, B-Trees and Variants: 2-3 Trees, B-Trees, Self-Adjusting Trees: Splay Trees	10
4.	**Text Processing:** Pattern Matching: Brute-Force, Boyer-Moore, Knuth-Morris-Pratt, Tries: Standard Tries, Compressed Tries, Suffix Tries, Dynamic Programming Applications: Huffman Coding, Longest Common Subsequence (LCS)	10
5.	**Computational Geometry:**Range Searching: One and Two Dimensional, Spatial Data Structures: Quadtrees, k-D Trees, Advanced Topics: Priority Search Trees, Recent Innovations	6

Text book and Reference books:

1. Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
2. "Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss.
3. "Data Structures and Algorithms in Python" by Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser
4. "Handbook of Data Structures and Applications" edited by Dinesh P. Mehta and Sartaj Sahni
5. "Computational Geometry: Algorithms and Applications" by Mark de Berg, Otfried Cheong, Marc van Kreveld, and Mark Overmars

Program Core - III

Operating System Design
Code: MCS-PC-103
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	Be able to understand Functions, Services and structure of UNIX Operating Systems.
2.	Be able to understand and explanation of the UNIX schedulers, Process Scheduling mechanisms.
3.	Be able to comprehend the mechanisms used in Memory Management and Virtual Memory.
4.	Be able to understand issues related to Security in Operating Systems and System Security Issues.
5.	Be able to understand the concepts of Distributed systems, Embedded & Real Time systems.

Pre-Requisite:	
1.	Knowledge in basic computer organization.
2.	Knowledge in operating system structures, processes and threads.

Unit	Content	Hrs.
1.	General overview of the UNIX system from the user's perspective, General outline of the UNIX kernel architecture, System Buffer Cache mechanism, the foundation of the UNIX file system. System Calls used to provide user interface to the UNIX file system.	6
2.	System calls for controlling process context, UNIX Process Scheduling mechanism. Process Control, Context of a process, and Internal Kernel primitives for manipulating Process Context, including System Call Interface, Interrupt handling and Context Switch, Process Synchronization.	6
3.	Fundamentals of UNIX memory management, Memory Management and Virtual Memory, Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging. Demand Paging, Performance of Demanding Paging, Page Replacement, Page Replacement Algorithm, Allocation of Frames, Thrashing.	10
4.	Introduction to the topic of Security in Operating Systems, System Security Issues, Principles of Information Security, Access Control Fundamentals, and Generalized Security Architectures.	7
5.	Introduction to Distributed systems, Goals of distributed system, hardware and software Concepts, design issues. Elementary introduction to the terminologies within Modern Oss: Parallel, Distributed, Embedded & Real Time, Mobile, Cloud and Other Operating System Models.	7

Text book and Reference books:

1. Brian Kernighan, Rob Pike, "The UNIX Programming Environment", 1st Edition, Prentice Hall, 1983.
2. Michael Kerrisk, "The Linux Programming Interface: A Linux and UNIX System Programming Handbook", 1st Edition, No Starch Press, 2010.
3. UreshVahalia, ""Unix internals : The New Frontiers", 1st edition , prentice hall, 1996.
4. Daniel P. Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O"Reilly, 2005.
5. Jonathan Corbet, Alessandro Runini, Greg Kroah-Hartman, "Linux Device Drivers", 3rd Edition, O"Reilly, 2005.
6. SreekrishnanVenkateswaran, "Essential Linux Device Drivers",1st Edition, Prentice Hall, 2008.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Program Elective I

Machine Learning
MCS- PE-104A
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
2.	To design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3.	Explore supervised and unsupervised learning paradigms of machine learning.
4.	To explore Deep learning technique and various feature extraction strategies.

Pre-Requisite:	
1.	Basic understanding of Linear algebra, Trigonometry, Statistics, probability
2.	Python Programming

Unit	Content	Hrs.
1.	**Supervised Learning (Regression/Classification)** Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods	9
2.	**Unsupervised Learning** Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	6
3.	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
4.	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data.	5
5.	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning.	5
6.	Recent trends in various learning techniques of machine learning and classification methods for IOT applications.	4

Text book and Reference books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
5. 2. E. Alpaydin, "Introduction to Machine Learning", Second Edition, Prentice-Hall of India, 2010.

Wireless Sensor Network
MCS- PE-104B
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To review the architecture of WSN.
2.	To study the various protocols layers of WSN.
3.	To study the establishment of WSN infrastructure.

Pre-Requisite:	
1.	Computer networking concepts, Analysis of algorithms.

Unit	Content	Hrs.
1.	**Introduction to Wireless Sensor Networks:** Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors **Network Architecture:** Traditional layered stack, Cross-layer designs, Sensor Network Architecture **Hardware Platforms:** Motes, Hardware parameters	6
2.	**Introduction to ns-3:** Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.	4
3.	**Medium Access Control Protocol design:** Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled **Introduction to Markov Chain:** Discrete time Markov Chain definition, properties, classification and analysis **MAC Protocol Analysis:** Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)	8
4.	**Security:** Possible attacks, countermeasures, SPINS, Static and dynamic key distribution	8
5.	**Routing protocols:** Introduction, MANET protocols **Routing protocols for WSN:** Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast **Opportunistic Routing Analysis:** Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks.	6
6.	**ADVANCED TOPICS** Recent development in WSN standards, software applications	4

Text book and Reference books:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks – Theory and Practice", Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks - Technology, Protocols, and Applications", Wiley Interscience 2007
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology,
5. Protocols, and Applications", John Wiley & Sons, 2007. Holger Karl and Andreas Willig

Introduction to Intelligent System
MCS- PE-104C
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To study the most fundamental knowledge for understanding Artificial Intelligence.
2.	To introduce some basic search algorithms for problem solving; knowledge representation and reasoning; pattern recognition; fuzzy logic; and neural networks.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.	6
2.	Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.	4
3..	Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimisation and search such as stochastic annealing and genetic algorithm.	8
4.	Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as	8

	frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures	
5.	Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.	6
6.	Recent trends in Fuzzy logic, Knowledge Representation	4

Text book and Reference books:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.
3. D. Jurafsky and J. H. Martin, Speech and language Processing, Pearson Education, 2000.
4. E. Reiter and R. Dale, Building Natural Language Generation Systems, Cambridge University Press, 2000.
5. T. M. Mitchell, Machine learning, McGraw-Hill 1997.
6. J. Han and M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2000.

Cluster and Grid Computing
MCS- PE-104D
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To provide a sound foundation to the students on the concepts, percepts and practices in a field that is of immense concern to the industry and business.

Pre-Requisite:	
1.	Operating Systems, Computer Architecture, Computer Networks

Unit	Content	Hrs.
1.	A general introduction to the concept of cluster based distributed computing. Hardware technologies for cluster computing, including a survey of the possible node hardware and high-speed networking hardware and software.	6

2.	Software and software architectures for cluster computing, including both shared memory (OpenMP) and message passing (MPI/PVM) models. MPI-2 extension, dynamic process creation, one-sided communication, parallel I/O.	6
3.	Variants based on new low level protocols (MVAPICH), evaluation and tuning of system and software performance. Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf.	6
4.	Evolution of the Grid - Grids and Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques – Grid applications.	8
5.	The concept of virtual organizations – Grid architecture – Grid architecture and relationship to other Distributed Technologies – computational and data Grids, semantic grids.	6
6.	Case Study: Molecular Modeling for Drug Design and Brain Activity Analysis, Resource management and scheduling, Setting up Grid, deployment of Grid software and tools, and application execution.	4

Text book and Reference books:

1. Cluster Computing by Rajkumar Buyya, Clemens Szyperski
2. High Performance Cluster Computing: Architectures and systems by Rajkumar Buyya
3. Grid and Cluster Computing by C.S.R Prabhu
4. Fran Bermn, Geoffrey Fox, Anthony Hey J.G., "Grid Computing: Making the
5. Joshy Joseph, Craig Fallenstein "Grid Computing" Pearson Education, 2004
6. Ian Foster, Carl Kesselman "The Grid2: Blueprint of the New Computing Infrastructure" Morgan Kaufman, New Delhi, 2004
7. Ahmar Abbas, "Grid Computing: Practical Guide to Technology and Applications", Delmar Thomson Learning, USA, 2004

Advanced Computer Architecture

MCS- PE-104E
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To identify performance related parameters.
2.	To learn the different multiprocessor issues.
3.	To expose the different types of multicore architectures.

Pre-Requisite:	
1.	Principles of digital electronics. Microprocessor & Microcontroller.

Unit	Content	Hrs.
1.	The evolution of modern Computer systems – from DEC PDP-11, IBM 360/370 family, CDC Cyber 6600, Intel X86 architecture, Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. Introduction to high performance Computing – Overview, Flynn‟s classifications – SISD, SIMD, MISD,MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures, Performance measurement for parallel architectures – Flynn's measure, Fang's measure, Handler‟s measure, Amadahl‟s law of limitation for parallel processing, Gustafson‟s law.	6
2.	Performance Enhancement of Processor by Pipelining:, Basic idea to enhance the performance of a processor, Concept of Pipelining, Pipeline performance, various hazard in pipeline, methods to solve the hazards. Pipeline performance measurement parameters- speedup, efficiency, throughput, classification of pipeline processor, pipeline structure of CPU, examples from design of arithmetic pipeline- floating point adder, multiplier. Multifunction pipeline, reservation table, Dynamic pipeline, pipeline latency.	6
3.	Vector Processing: Characteristics of vector processing, vector instructions, special instruction, differences between scalar and vector processing with example, architecture of typical vector processor with multiple functional pipe., Pipeline chaining and vector loops.	3
4.	High performance Computing: Performance measurement parameters – MIPS, MFLOPS, SPEC rating, CPI etc., introduction to high performance computing – Overview, Flynn's classification – SISD, SIMD, MISD, MIMD. SIMD Array processors: SIMD computer organization, Masking and Data-Routing Mechanisms, Inter PE communication, SIMD Inter Connection Networks, SIMD Matrix Multiplication. Multiprocessor Architecture: Loosely Coupled and Tightly Coupled Multiprocessors.	5
5.	Embedded System and its Architecture: Why embedded system, Definition of Embedded system, Example of embedded systems, architecture of embedded systems with some example., Classification of Embedded system, Codesign of Embedded system, Embedded System Development cycle), Processor interfacing, Embedded System Design Issues: Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS)	4
6.	Reconfigurable Architecture and HDL(Hardware Description Languages): (6L), Introduction to Reconfigurable architecture, FPGA (Field Programmable Gate Array):Definition, Classification, Architecture, Synthesis on FPGA, Downloading bit on FPGA.(4L), Design and testing of circuit by HDL(Hardware Description	3

	Languages). (2L)	

Text book and Reference books:

1. Advanced Computer Architecture Hwang (TMH)
2. Computer Organization & design – Patterson & Hennessy (Morgan Kaufmann)
3. Computer Architecture & Organization – J P Hayes (McGraw Hill))
4. Computer organization and architecture, designing for performance – Stalling (PHI)
5. An Introduction to intel family of Microprocessors – Antonio's (Pearson)
6. Computer Architecture – Flynn (Narosa)
7. Structured Computer Organization – Tanenbaum (PHI)
8. Embedded Systems Architecture – a comprehensive guide for engineers and programmers –Tammy Noergaard (Elsevier)

Research methodology and IPR

Code: MCS-AC-105
Contacts: 2L
Theory: 2 hrs./week
Credit points: 2

Course Objectives:	
1.	Familiarization with research methodology research processes.
2.	Understand the scientific research process and the various steps involved in formulation of research problem.
3.	Understand the research design, design of experiments, thesis, proposals preparation, presentation, and publications.
4.	Understand the scope and rights of Intellectual property.

Pre-Requisite:	
1.	NA

Unit	Content	Hrs.
1	Research concepts, meaning, objectives, motivation, types of research, research process, criteria for good research, scientific methods and research design process.	5
2	Formulation of research task, literature review, methods, primary and secondary sources, problem solving approaches.	3
3	Effective technical writing, how to write report, paper developing a research proposal, format of research proposal, a presentation and assessment by a review committee	4
4	Research proposals, development and evaluation, research paper writing, layout of a research paper, journals in engineering, considerations in publishing, concept of impact factor–citations, open access publication, ethical issues, plagiarism.	8
5	Intellectual property rights, scope of patent rights. Licensing and	4

	transfer of technology. Patent information and databases. Geographical indications.	

Text book and Reference books:

1. C. R. Kothari, Research Methodology, New Age International, 2004.
2. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2012.
3. Deepak Chawla, MeenaSondhi, (2011) "Research Methodology – concepts & cases", Vikas Publishing House.
4. J.W Bames, "Statistical Analysis for Engineers and Scientists", McGraw Hill, New York.
5. Schank Fr.,(2008) "Theories of Engineering Experiments", Tata McGraw Hill Publication.
6. John W Best, James V Kahan, (2010) "Research in Education", PHI Learning.
7. Sinha, S.C. and Dhiman, A.K. (2002), "Research Methodology", ESS Publications.

Pedagogy Studies
Code: MCS-AC-106
Contacts: 2L
Theory: 2 hrs./week
Credit points: 1

Objective:	
1.	Introduce students to the advanced methods of understanding educational theories and models.
2.	The student should be able to choose appropriate developing curriculum and instructional strategies.
3.	To familiarize students with basic paradigms and integrating technology in education.
4.	Students should be able to understand different classes of problems concerning their research in computer science education.
5.	To introduce the students to recent developments in the area of diverse learning needs besides professional development and lifelong learning

Pre-Requisite:	
1.	Basic Educational Background, Interest in Teaching and Learning
2.	Communication Skills, Basic Psychology Knowledge, Interpersonal Skills,
3.	Critical Thinking Skills, Basic Research Skills, Technological Proficiency, Cultural Awareness

Unit	Content	Hrs.
1.	**Introduction and Methodology:** Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	5

2.	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	3
3.	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. Teacher education (curriculum and practicum) and school curriculum and guidance materials to support effective pedagogy. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	6
4.	Professional development: alignment with classroom practices and follow-up support. Peer support. Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.	6
5.	**Research gaps and future directions** Research design, Contexts Pedagogy, Curriculum and assessment Dissemination and research impact.	4

Text book and Reference books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Advanced Data Structures Lab

MCS-PCL-191
Contacts: 4P
Practical: 4 hrs./ Week
Credit points: 2

Course Objectives:	
1.	Implementation of Non-Linear Data Structures (Trees).
2.	Applying Effective Hashing Techniques.
3.	Design and implement a custom set data structure in C, supporting essential operations such as insertion, deletion, membership testing, size computation, and set operations like intersection, union, difference, and subset checks.

Prerequisites:	
1.	Pre-requisites as in MCS-PC-102(Assumed foundational knowledge in programming and basic data structures)

Laboratory Experiments:	
1.	Write a C program to demonstrate insert, delete and search operation in binary search tree. Also, perform in-order traversal of the tree. Print the in-order traversal of the tree before and after of insertion & deletion operation.
2.	Write a C program to demonstrate insert, delete operation in AVL tree. Also, perform in-order traversal of the tree.
3.	Understand and implement operations and applications of red-Black and splay Trees.
4.	To perform various operations i.e., insertion, deletion, searching using linear probing hash functions.
5.	To perform various operations i.e., insertion, deletion, searching using quadratic probing hash functions.
6.	To create ADT that implements the SET concept. a. Add (new Element) -Place a value into the set b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection e. Intersection of two sets, f. Union of two sets, g. Difference between two sets, h. Subset
7.	Implement Huffman Coding and decoding for text compression.
8.	To implement Pattern Matching Technique using Brute Force Algorithm.

Text book and Reference books:

1. "Data Structures Using C" by Aaron M. Tenenbaum, Moshe J. Augenstein, and YedidyahLangsam
2. "Data Structures and Algorithm Analysis in C" by Mark Allen Weiss
3. "Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Operating System Design Lab
MCS-PCL-192
Contacts: 4P
Practical: 4 hrs./Week
Credit points: 2

Course Objectives:	
1.	To familiarize students with the architecture of Unix OS.
2.	To provide necessary skills for developing and debugging programs in UNIX environment.

Prerequisites:	
1.	Knowledge of Basic programming knowledge.

Laboratory Experiments:	
1	**Preliminaries of Operating System:** managing users, managing systems, file managements, useful commands.
2	**Shell scripting:** shell syntax, executing shell scripts
3	**Process:** creating new process, counting maximum number of processes a system can handle at a time, handling system calls; inter process communication through pipes and message passing, zombie process, orphan process.
4	**Process Synchronization:** handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.
5	**Signal:** study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).

Text book and Reference books:

1. Richard Stevens, Stephen Rago, Advanced Programming in the UNIX Environment, Pearson
Education, 2/e.
2. UNIX : Concepts and Applications | 4th Edition by Sumitabha Das.
3. The C Odyssey: UNIX: v. 3 by Vijay Mukhi.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Detailed Syllabus for M. Tech in Computer Science & Engineering
For Academic Year 2024-2025

First Year – Semester II

Program Core IV

Advanced Algorithms
Code: MCS-PC-201
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	Introduce students to the advanced methods of designing and analysing algorithms.
2.	The student should be able to choose appropriate algorithms and use it for a specific problem.
3.	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4.	Students should be able to understand different classes of problems concerning their computation difficulties.
5.	To introduce the students to recent developments in the area of algorithmic design.

Pre-Requisite:	
1.	Design & Analysis of Algorithm.

Unit	Content	Hrs.
1.	**Sorting:** Review of various sorting algorithms, topological sorting **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	6
2.	**Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to Compute augmenting path.	8
3.	**Flow-Networks:** Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	7

4.	**Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT):** In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	7
5.	**Linear Programming:** Geometry of the feasibility region and Simplex algorithm **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	6
6.	Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	3

Text book and Reference books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. “Design & Analysis of Algorithms”, Gajendra Sharma, Khanna Publishing House, New Delhi.
5. “Introduction to Algorithms”, by T Cormen, C Leiserson And R Rivest, PHI.
6. “The Design and Analysis of Algorithms” by A.Aho, J.Hopcroft and J.Ullman PE.
7. "Fundamentals Of Computer Algorithms" by Horowitz Ellis, Sahani Sartaz, R. Sanguthevar University Press (INDIA) Pvt. Ltd.
8. “Design Analysis and Algorithms” by Hari Mohan Pandey.

Program Core V

Soft Computing
Code: MCS-PC-202
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To Know the concepts of fuzzy logic, crisp logic, fuzzy relation, and fuzzy implication rule.
2.	To Know the concepts of optimization theory genetic computing, and evolutionary computing.

3.	To Know the concepts of the neural network, Single Layer, Multilayer, classifications, Implementation, and training.
4.	To know the concepts of classifications, Implementation, and training.
5.	To know the concept of hybrid systems, like neuro-fuzzy systems, fuzzy genetic systems, and particle intelligence.

Pre-Requisite:	
1.	A Strong mathematical background, Proficiency with algorithms

Unit	Content	Hrs/Unit
1.	Introduction to Soft Computing, Concept of Soft Computing, Soft Computing vs. Hard Computing, Soft Computing paradigms, and applications of Soft Computing. Basics of Machine Learning	4
2.	introduction to Fuzzy Logic, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	6
3.	Introduction to Neural Networks, Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks	10
4.	Introduction to Genetic Algorithms, Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.	6
5.	Introduction to Evolutionary Computing, Genetic programming (GP), Ant colony optimization (ACO), Particle swarms optimization (PSO), Artificial Immune System (AIS).	6
6.	Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.	4

Text book and Reference books:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice Hall of India.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall.
3. S, Rajasekaran& G.A. VijayalakshmiPai, “Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications”, PHI Publication.
4. S.N. Sivanandam& S.N. Deepa, “Principles of Soft Computing”, Wiley Publications.
5. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India.
6. SAndries P Engelbrecht, Computational Intelligence: An Introduction, Wiley Publications.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Program Core VI

Data Mining and Data Ware housing
Code: MCS-PC-203
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	To introduce students to to the field of data mining.
2.	To study fundamental data mining concepts and techniques for discovering interesting patterns from data in various applications.
3.	To study techniques for developing effective, efficient, and scalable data mining tools.

Pre-Requisite:	
1.	Design and Analysis of Algorithms.
2.	Data Structure and Database Management Systems.
3.	Statistics, Artificial Intelligence.

Unit	Content	Hrs.
1.	Basics of Data Mining, Data Mining Functionalities, Classification of Data Mining Issues, Data Mining Goals. Stages of the Data Mining Process.	6
2.	Data Warehouse concepts, Data Warehouse Architecture, OLAP technology, DBMS, OLTP VS. Data Warehouse Environment, Multidimensional data model Data marts.	4
3.	Data Mining Techniques: Statistics, Similarity Measures, Decision Trees, Neural Networks, Genetic algorithms.	5
4.	Mining Association rules: Basic algorithm, parallel and distributed algorithm, comparative study, Incremental rules, Advanced, Association Rule Technique, Apriori Algorithm, partition algorithm, dynamic set counting algorithm, Item set Counting Algorithm, FP tree growth Algorithm, Boarder Algorithm.	7
5.	Clustering Technique: Partitioning Algorithms-K- means Algorithm, CLARA, CLARANS, Hierarchical Algorithms DBSCAN, ROCK.	7
6.	Classification Techniques: Statistical–based, Distance-based, Decision Tree- based Decision tree.	4
7	Application and trends in Data Mining: Applications, Advanced Techniques - Web Mining, Web Content mining, structure mining.	3

Text book and Reference books:

1. Roiger & Geatz, Data Mining, Pearson Education.
2. A.K.Pujari, Data Mining, University Press.
3. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
4. J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufman.
5. Parteek Bhatia, “Data Mining and Data Warehousing: Principles and Practical Techniques”, Cambridge University Press.

6. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", PearsonEducation.
7. Robert Layton, "Learning Data Miningwith Python", Packt Publishing.

Program Elective II

Data Science
MCS- PE-204A
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	Students will become proficient in the statistical analysis of data and the use of computation tools for data analysis.
2.	Students will apply statistical and computational tools to applied problems, and clearly communicate the results in both written reports and oral presentations.

Pre-Requisite:	
1.	knowledge of programming languages and artificial intelligence

Unit	Content	Hrs.
1.	Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	4
2.	Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources	6
3.	Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	8
4.	Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	8
5.	Applications of Data Science, Technologies for visualisation, Bokeh (Python)	5
6.	Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	5

Text book and Reference books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Distributed Systems
MCS- PE-204B
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	To provide hardware and software issues in modern distributed systems.
2.	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
3.	To analyze the current popular distributed systems such as peer-to-peer (P2P) systems.

Pre-Requisite:	
1.	Computer networking, operating systems. Database Management Systems.

Unit	Content	Hrs.
1.	**INTRODUCTION:** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE:** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues	5
2.	**DISTRIBUTED DATABASE DESIGN:** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation **SEMANTICS DATA CONTROL:** View management; Data security; Semantic Integrity Control **QUERY PROCESSING ISSUES:** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	9
3.	**DISTRIBUTED QUERY OPTIMIZATION:** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms **TRANSACTION MANAGEMENT:** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models **CONCURRENCY CONTROL:** Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	9
4.	**RELIABILITY:** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols	4
5.	**PARALLEL DATABASE SYSTEMS:** Parallel architectures; parallel	3

	query processing and optimization; load balancing	
6.	**ADVANCED TOPICS:** Mobile Databases, Distributed Object Management, Multi-databases	3

Text book and Reference books:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.
3. Distributed Database Systems, Chhanda Ray, 2008, Pearson.
4. Distributed Databases: Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, Indian Edition, 2017, Mc Grew Hill.

Data Preparation and Analysis

MCS- PE-204C
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	To Apply appropriate techniques for generating insights from data.
2.	Present actionable solutions with confidence to the business stakeholders.

Pre-Requisite:	
1.	Database Organization.

Unit	Content	Hrs.
1.	**Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues	7
2.	**Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	10
3.	**Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation	10
4.	**Visualization:** Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	9

Text book and Reference books:

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Computer Vision
MCS- PE-204D
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Be able to Learn fundamentals of computer vision and its applications.
2.	Be able to understand the basic image processing operations to enhance, segment the images.
3.	Be able to understand the analysing and extraction of relevant features of the concerned domain problem.
4.	Be able to understand and apply the motion concepts and its relevance in real time applications.
5.	Be able to apply the knowledge in solving high level vision problems like object recognition, image classification etc.

Pre-Requisite:	
1.	Calculus, Linear algebra, Probability, Programming knowledge.

Unit	Content	Hrs.
1.	Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	4
2.	Edge detection, Edge detection performance, Hough transform, corner detection	6
3.	Segmentation, Morphological filtering, Fourier transform	6
4.	Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data reprocessing	8
5.	Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.	8
6.	Recent trends in Activity Recognition, computational photography, Biometrics.	4

Text book and Reference books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski, Springer Nature Switzerland, 2022.
2. Deep Learning, by Goodfellow, Bengio, and Courville, Adaptive Computation and *Machine Learning* series, 2022.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al. Wiley-Blackwell, 2013.
4. Introductory Techniques for 3-D Computer Vision by EmanueleTrucco and AllessandroVerri, Prentice Hall, 1998.
5. Three-Dimensional Computer Vision by Olivier Faugeras, The MIT Press, 1993.

6. Emerging topics in computer vision by G_erardMedioni and Sing Bing Kang, Pearson, 2004.

Computer Graphics
MCS- PE-204E
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	The main objective of the course is to introduce students with fundamental concepts and theory of computer graphics
2.	It provides the basics of OpenGL application programming interface which allows students to develop programming skills in CG.

Pre-Requisite:	
1.	Calculus, Linear algebra, Probability, Programming knowledge.

Unit	Content	Hrs.
1.	**Introduction to computer graphics & graphics systems**: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	5
2.	**Scan conversion:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	5
3.	**2D transformation & viewing**: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	8
4.	**3D transformation & viewing:** 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.	7
5.	**Curves**: Curve representation, surfaces, designs, Bezier curves, B-spline	6

	curves, end conditions for periodic B-spline curves, rational B-spline curves. **Hidden surfaces**: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal – geometry.	
6.	**Color & shading models**: Light & color model; interpolative shading model; Texture	5

Text book and Reference books:

1. Hearn, Baker – " Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Ghosh – " Computer Graphics & Multimedia" Penram International.
3. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
4. D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
5. Foley, Vandam, Feiner, Hughes – "Computer Graphics principles (2nd Ed.) – Pearson Education.
6. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – TMH.
7. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI
8. Mukherjee Arup, Introduction to Computer Graphics, Vikas
9. Hill,Computer Graphics using open GL, Pearson Education

Software Engineering & Case Tools
MCS- PE-204F
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project
2.	Students will be able to decompose the given project in various phases of a lifecycle.
3.	Students will be able to choose appropriate process model depending on the user requirements.

Pre-Requisite:	
1.	Programming knowledge

Unit	Content	Hrs.
1	Introduction and over view, software development life-cycle models, software requirements analysis, identification and specification, formal requirements specification and verification - axiomatic and algebraic specifications.	6

2	Function-oriented software design, DFD, data dictionary, structure chart, transform and transaction analysis, object-oriented design, UML diagrams, design patterns, user interface design, coding standards.	10
3	Testing: Module, sub-system and system level testing, integration testing, stub, driver, test case and test suit design, system performance testing, verification & validation, debugging.	6
4	Software quality: SEI CMM, ISO-9001 and Six Sigma. Software reliability and fault-tolerance, software project planning, monitoring, and control, Cost Estimation Model, Metrics, software maintenance.	10
5	Computer-aided software engineering (CASE), software reuse, component-based software development, extreme programming.	4

Text book and Reference books:

1. Pressman, Software Engineering: A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. Rajib Mall, Software Engineering- (PHI)
4. N.S. Gill, Software Engineering – (Khanna Publishing House)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

Program Elective III

Human and Computer Interaction
MCS- PE-205A
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	Learn the foundations of Human Computer Interaction.
2.	Be familiar with the design technologies for individuals and persons with disabilities.
3.	Be aware of mobile Human Computer interaction.
4.	Learn the guidelines for user interface.

Pre-Requisite:	
1.	The course catalog lists "knowledge of C programming language/UNIX." In reality, the prerequisite is programming skill in some practical programming language such as Java, C#, HTML, or Processing.
2.	The course focuses on human-computer interaction and interface design and assumes that students will have the skills required to program prototypes of computer interfaces.

3.	Students without programming experience who wish to take this course should speak with the instructor before the second class.

Unit	Content	Hrs.
1.	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	6
2.	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules– principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	8
3.	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	6
4.	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8
5.	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	6
6.	Recent Trends: Speech Recognition and Translation, Multimodal System	2

Text book and Reference books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT 1 , 2 & 3).
2. Brian Fling, "Mobile Design and Development", First Edition , O Reilly Media Inc., 2009 (UNIT – 4).
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O Reilly, 2009.(UNIT-5) .
4. A Dix, Janet Finlay, G D Abowd, R Beale, Human-Computer Interaction, 3rd Edition, Pearson Publishers, 2008.
5. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.
6. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

GPU Computing
MCS- PE-205B
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	This course will introduce parallel computing paradigms with focus on GPU programming to harness the massively parallel GPU architecture in solving computationally demanding tasks.

Pre-Requisite:	
1.	Programming and Data Structure, Digital Logic, Computer architecture.

Unit	Content	Hrs/Unit
1.	**Introduction**: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs	8
2.	**Memory**: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories	6
3.	**Synchronization**: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU **Functions**: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.	8
4.	**Support**: Debugging GPU Programs. Profiling, Profile tools, Performance aspects **Streams**: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.	6
5.	**Case Studies**: Image Processing, Graph algorithms, Simulations, Deep Learning	4
6.	**Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	4

Text book and Reference books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722).
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334).

Digital Forensics
MCS- PE-205C
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Course Objectives:	
1.	To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
2.	To understand how to examine digital evidences such as the data acquisition, identification analysis.

Pre-Requisite:	
1.	Understanding of digital logic, operating system concepts, Computer hardware knowledge

Unit	Content	Hrs/Unit
1.	**Digital Forensics Science:** Forensics science, computer forensics, and digital forensics. **Computer Crime:** Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics	9
2.	**Cyber Crime Scene Analysis:** Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.	8
3.	**Evidence Management & Presentation:** Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.	9
4.	**Computer Forensics:** Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, **Network Forensics:** open-source security tools for network forensic analysis, requirements for preservation of network data.	10
5.	**Mobile Forensics:** mobile forensics techniques, mobile forensics	8

	tools. **Legal Aspects of Digital Forensics:** IT Act 2000, amendment of IT Act 2008.	
6.	Recent trends in mobile forensic technique and methods to search and seizure electronic evidence	4

Text book and Reference books:

1. John Sammons, The Basics of Digital Forensics, Elsevier.
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications.
3. The basics of digital Forensics (Latest Edition) – The primer for getting started in digital forensics by John Sammons – Elsevier Syngress Imprint
4. Cybersecurity – Understanding of cybercrimes, computer forensics and Legal perspectives by Nina Godbole and Sunit Belapure – Wiley India Publication
5. Practical Digital Forensics – Richard Boddington [PACKT] Publication, Open source community

Cloud Computing
MCS- PE-205D
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To understand the concepts of Cloud Computing.
2.	To learn Taxonomy of Virtualization Techniques.
3.	To learn Cloud Computing Architecture.
4.	To acquire knowledge on Aneka Cloud Application Platform.
5.	To learn Industry Cloud Platforms.

Pre-Requisite:	
1.	Prerequisites: Discrete Mathematics, Computer Networks
2.	Knowledge of Operating Systems
3.	Security Fundamentals

Unit	Content	Hrs.
1.	**Introduction to Cloud Computing:** Basic concepts - Benefits and Risks - Roles and Boundaries - Characteristics - XaaS based service offerings - Basic Deployment models.	3
2.	**Cloud Computing Architecture:** Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model, Cloud Deployment Models	5

3.	**Security Issues in Cloud Computing:** Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security **Identity and Access Management:** Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management	10
4.	**Security Management in the Cloud:** Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS **Privacy Issues:** Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing	8
5.	**Audit and Compliance:** Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance.	6
6.	**ADVANCED TOPICS:** Recent devlopments in hybrid cloud and cloud security.	4

Text book and Reference books:

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff,Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

Quantum Computing

MCS- PE-205E
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Students will learn about qubits and gating operations, construct quantum circuits and learn about quantum algorithms
2.	Students will also learn how to use Qiskit to construct and run quantum circuits on simulators and actual quantum hardware using Python.

Pre-Requisite:	
1.	Understanding of linear algebra.

Unit	Content	Hrs.
1.	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.	6
2.	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,	6
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.	4
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	8
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	4

Text book and Reference books:

1. Quantum Computing without Magic by Zdzislaw Meglicki
2. Quantum Computing Explained By DAVID Mc MAHON
3. Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann
4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.
5. Nielsen, Michael A., and Isaac L. Chuang. Quantum Computation and Quantum Information. Cambridge, UK: Cambridge University Press, September 2000.
6. Peres, Asher. Quantum Theory: Concepts and Methods. New York, NY: Springer, 1993. ISBN: 9780792325499.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Advanced Web Technology
MCS- PE-205F
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To introduce the students to advanced technologies which can help realization of complex Web applications.
2.	Students will be able to individually develop advanced Web projects.

Pre-Requisite:	
1.	Database Management Systems, Computer networks and security.

Unit	Content	Hrs.
1.	Internet & WWW, Introduction, Computer Network, Intranet, Extranet and Internet. Types of Networks (LAN, MAN, WAN), Network Topologies. Definition of Internet, Internet organization. Growth of Internet, Internet Application. Review of TCP/IP, OSI Reference model, TCP/IP Model, IP addressing, Classful and Classless Addressing, Subnetting, Features and services of TCP/IP, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram. Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail-POP3, SMTP. World Wide Web, Evolution of distributed computing. Core distributed computing technologies – Client/Server Architecture & its Characteristics, JAVA RMI. Challenges in Distributed Computing, role of J2EE and XML in distributed computing, emergence of Web Services and Service Oriented Architecture (SOA). Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services. Web Server Concept and Architecture. Definition of DNS (Domain Name System). Domain and Sub domain, Address Resolution, FTP & its usage, Telnet Concepts, Remote Logging, HTTP & HTTPs.	6
2.	Client Side Application Development, HTML & CSS, Introduction, Editors, Elements, Tags, Attributes, Heading, Paragraph. Formatting, Link, Image, Table, List, Block, Form, Frame Layout, DHTML, Basic Web Page Development, CSS- Create Class Styles, Create ID Styles ,Span, Colors.HTML5 in brief. Extensible Markup Language (XML), Brief Over View of XML – XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation, Tree, Syntax, Elements, Attributes, Validation, and	8

	Viewing. XHTML in brief. JavaScript, Introduction, JavaScript in Web Pages, The Advantages of JavaScript Writing JavaScript into HTML; Building Up JavaScript Syntax; Basic Programming Techniques ; Operators and Expressions in JavaScript; JavaScript Programming Constructs; Conditional Checking Functions in JavaScript, Dialog Boxes, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array. Function, Errors, Validation. The JavaScript Document Object Model-Introduction (Instance, Hierarchy); The JavaScript Assisted Style Sheets DOM; Understanding Objects in HTML (Properties of HTML objects, Methods of HTML objects); Browser Objects, Handling Events Using JavaScript	
3.	Server Side Programming with PHP & MySQL, Installing and Configuring, Current and Future Versions of MySQl and PHP, How to Get MySQL, Installing MySQL on Windows, Trouble Shooting your Installation, Basic Security Guidelines, Building PHP on Windows with Apache, Windows, php.ini.Basics, The Basics of PHP scripts. The Building blocks of PHP, Variables, Data Types, Operators and Expressions, Constants. Flow Control Functions in PHP: Switching Flow, Loops, Code Blocks and Browser.	8
4.	Functions, What is function? Calling functions, Defining Functions. Variable Scope, more about arguments. Working with Arrays and Some Array-Related Functions. Working with Objects, Creating Objects, Object Instance Working with Strings, Dates and Time, Formatting strings with PHP, Investigating Strings with PHP, Manipulating Strings with PHP, Using Date and Time Functions in PHP. Working with Forms, Creating Forms, Accessing Form Input with User defined Arrays, Combining HTML and PHP code on a single Page, Using Hidden Fields to save state, Redirecting the user, Sending Mail on Form Submission, and Working with File Uploads. Learning basic SQL Commands, Learning the MySQL Data types, Learning the Table Creation Syntax, Using Insert Command, Using SELECT Command, Using WHERE in your Queries,Selecting from Multiple Tables, Using the UPDATE command to modify records, Using the DELETE Command, Frequently used string functions in MySQL, Using Date and Time Functions in MySQL. Interacting with MySQL using PHP, MySQL Versus MySQLi Functions, Connecting to MySQL with PHP, Working with MySQL Data.	8
5.	Multimedia Application Development, Pixel, Image Resolution, Image Editing using Photoshop, 2D & 3D Animation, Logo Design, Banner. Animated Component Preparation using Flash & Action script. Multimedia Web Applications,Multimedia over IP: RTP, RTCP. Streaming media, Codec and Plugins, VoIP, Text and Voice Chat.	6

Text book and Reference books:

1. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.
2. Web Technology & Design, C.Xavier, New Age International Publication, Delhi
3. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.
4. Sams Teach Yourself PHP in 24 Hours, Third Edition
5. Wrox, Beginning PHP, Apache, MySQL Web Development
6. Wrox, Beginning PHP

English for Research Paper Writing
Code: MCS-AC-206
Contacts: 2L
Theory: 2 hrs./week
Credit points: 1

Objective:	
1.	Understand that how to improve your writing skills and level of readability.
2.	Learn about what to write in each section.
3.	Understand the skills needed when writing a Title.

Pre-Requisite:	
1.	All students must read five research papers of different reputed journals preferably SCI, SCOPUS Indexed of their discipline

Unit	Content	Hrs.
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6.	useful phrases, how to ensure paper is as good as it could possibly	4

	be the first- time submission	

Text book and Reference books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Advanced Algorithm Lab
MCS-PCL-291
Contacts: 4P
Practical: 4 hrs./ Week
Credit points: 2

Course Objectives:	
1.	Design and implement efficient algorithms for a specified application.
2.	Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.

Prerequisites:	
1.	Programming knowledge.
2.	Knowledge of Design and Analysis of Algorithm.

Laboratory Experiments:	
1.	Implement Quick sort and Merge sort using Divide and Conquer approach.
2.	Implement Single Source Shortest Path (Dijkstra, Bellman Ford Algorithm) for a Graph.
3.	Implement Inverse of a triangular matrix.
4.	Implement LU decomposition of a matrix.
5.	Implement Ford-Fulkerson algorithms to compute maximum flow of a network.
6.	Implement All Pair Shortest path for a graph. Implement Travelling Salesman Problem.
7.	Implement Clique Decision problem (CDP) problem.
8.	Implement Vertex Cover Problem.
9.	Compute Connected Components from a graph.
10.	Implement Topological sorting from agraph.
11.	Compute articulation point – if any from a graph.

Text book and Reference books:

1. "Data Structures Using C" by ReemaThareja.

2. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
3. "Data Structure Lab Experiment With C", by Girish Rao Salanke, Medtech.

Mini Project with Seminar
MCS-P-281
Contacts: 2P
Practical: 2 hrs./ Week
Credit points: 2

Objective:	
1.	To plan for various activities of the project and distribute the work amongst team members
2.	To develop student's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
3.	To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Mini Project with Seminar : Guidelines

The mini project work extends for a single semester and exposes the student to develop and present his/her work related to specific topic.

The topic of the seminar is substantial and relates to some area of computer science and/or its applications and has substantial theoretical or practical significance. However, it leads to a dissertation for the students in the 3rd and 4th semester. The student shall select the project topic in and thereafter would be assigned with a mentor/guide/supervisor based on his/her topic to work on it. Students will prepare a term paper outlining the objective of the project work, importance of the study, review of literature published in the relevant field and possible areas for further work. The student shall present seminar on this topic. The objective of mini project is to develop professional quality of synthesis among the students employing technical knowledge obtained in the field of Engineering & Technology through a project work involving design / analysis augmented with creativity, innovation and ingenuity.

The student shall take up investigative study on a topic in the broad relevant field of engineering, involving hardware or software or both hardware & software, to be assigned by the department on an individual basis, under the guidance of a supervisor from the department. This is expected to provide a good initiation for the students in R&D work.

The activities under mini project may normally include:
1. Literature survey on an assigned topic.
2. Working out a preliminary approach to the problem relating to the assigned topic.
3. Conducting preliminary analysis/modelling/simulation/experiment/design.
4. Compilation of the work and presenting it in a seminar talk during the semester, before a departmental committee.
5. Submit a written term paper based on the work.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Detailed Syllabus for M. Tech in Computer Science & Engineering
For Academic Year 2024-2025

CSE
Second Year – Semester III

Program Elective IV

Mobile Applications and Services
Code: MCS-PE-301A
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Identify various concepts of mobile programming that make it unique from programming for other platforms
2.	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.

Pre-Requisite:	
1.	Knowledge of programming and coding languages.

Unit	Content	Hrs.
1.	Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User	6
2.	More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider	6
3.	Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics	8
4.	Putting It All Together : Packaging and Deploying, Performance	6

	Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia	
5.	Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, More on Security, Hacking Android	8
6.	Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT	4

Text book and Reference books:

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons
2. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
3. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
4. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
5. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Compiler for HPC
Code: MCS-PE-301B
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	It covers optimizations and aspects of the compiler back-end and middle-end such as: instruction level parallelism, memory hierarchy optimizations, data level parallelism and thread level parallelism.
2.	

Pre-Requisite:	
1.	Computer Organization and Architecture, Basics of Compiler Design

Unit	Content	Hrs.
1.	**High Performance Systems,** Structure of a Compiler, Programming Language Features, Languages for High Performance.	4
2.	**Data Dependence:** Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. **Scalar Analysis with Factored Use-Def Chains:** Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables	4

	Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.	
3.	Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis. **Loop Restructuring:** Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. **Optimizing for Locality:** Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.	6
4.	**Concurrency Analysis:** Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. **Vector Analysis:** Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.	6
5.	**Message-Passing Machines:** SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. **Scalable Shared-Memory Machines:** Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.	6
6.	Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.	4

Text book and Reference books:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson.
2. Muchnick, Steven S, Advanced compiler design implementation, Morgan Kaufmann, cop. 1997. ISBN: 978-1558603202
3. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson
4. Aho, Alfred V, Compilers : Principles, Techniques, and Tools, Addison-Wesley, cop. 2007. ISBN:
5. 9780321486813
6. Allen, Randy; Kennedy, Ken, Optimizing Compilers for Modern Architectures : A Dependence-Based
7. Approach, Morgan Kaufmann Publishers, cop. 2002. ISBN: 1-55860-286-0

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Optimization Techniques

Code: MCS-PE-301C
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Import knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimization problems.

Pre-Requisite:	
1.	Back ground in differential calculus and basic maths.

Unit	Content	Hrs.
1.	Engineering application of Optimization, Formulation of design problems as mathematical programming problems.	6
2.	General Structure of Optimization Algorithms, Constraints, The Feasible Region.	6
3.	Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.	8
4.	Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	8
5.	Real life Problems and their mathematical formulation as standard programming problems.	6
6.	Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.	4

Text book and Reference books:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Image Processing
Code: MCS-PE-301D
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To learn the fundamental concepts of Digital Image Processing.
2.	To study basic image processing operations. To understand image analysis algorithms.
3.	To expose students to current applications in the field of digital image processing.

Pre-Requisite:	
1.	Concepts of Digital Signal Processing

Unit	Content	Hrs.
1.	Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	4
2.	Digital Image Formation: A Simple Image Model, Geometric Model-Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4
3.	Mathematical Preliminaries: Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.	7
4.	Image Enhancement: Spatial Domain Method, Frequency Domain Method, Contrast Enhancement –Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	7
5.	Image Restoration: Degradation Model, Discrete Formulation, Algebraic Approach to Restoration -Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.	7
6.	Image Segmentation: Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding -Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation – Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	7

Text book and Reference books:

1. Digital Image Processing, Gonzalves, Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing & Analysis, Chanda & Majumder, PHI
4. Fundamentals of Digital Image Processing, Jain, PHI
5. Image Processing, Analysis & Machine Vision, Sonka, VIKAS

Pattern Recognition
Code: MCS-PE-301E
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Study the fundamental algorithms for pattern recognition
2.	To instigate the various classification techniques
3.	To originate the various structural pattern recognition and feature extraction techniques.

Pre-Requisite:	
1.	Statistics and Probability Theory
2.	Differential Equations, ordinary and partial
3.	Analytical Geometry and Linear Algebra
4.	Differential and Integral Calculus

Unit	Content	Hrs.
1.	**Introduction** Revision of Probability Theory and Distributions, Brief Outline of Three Principal Paradigms: Statistical Pattern Neural Pattern Recognition, Syntactic Pattern Recognition	4
2.	**Data Set Representation:** Introducing Statistical Analysis, Principal Component Analysis, Feature Vector Representation, Normalization, Eigenvector-Eigen value Transformation (KLT), Singular Value Decomposition (SVD) and Applications	8
3.	**Important Paradigm:** Getting a Decision Boundary, Comparing two patterns, and Distance Measures, Comparing two patterns, Isolated Patterns, Patterns from a group of patterns, Distance Measures, Minkowski, Euclidean, Mahalanobis, Bayesian Decision Theory, Classifiers, Discriminant Functions, Decision Surfaces, Maximum Likelihood Estimation (MLE), Expectation Maximization (EM)	8

4.	**Unsupervised Learning and Clustering:** Statistical Approaches Bayes Decision Theory, K-Means Algorithm, Nearest Neighbour Classification, Hierarchical Methods Graph-Theoretic Methods, Simulated Annealing, Neural Approaches Kohonen's Net, and Self-Organizing Maps (Neural Equivalent of K-Means), Adaptive Resonance Theory (ART), Other Similar Approaches for Neural Networks	8
5.	**Syntactic Pattern Recognition:** A Brief Introduction	3
6.	**Miscellaneous Topics:** Hidden Markov Models (HMMs), Support Vector Machines (SVMs)	5

Text book and Reference books:

1. J.I. Tou & R.C. Gonzalez, Pattern Recognition Priciples, Addition-Wesley.
2. R. Schalkoff, Pattern Recognition - Statistiucal, Structural and Neural Approaches, John Wiley, 1992.
3. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.
4. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
5. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
6. Friedman and Kandel, Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches, World Scientific, 1999.

Natural Language Processing
Code: MCS-PE-301F
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	It gives a detailed look at the science of applying machine learning algorithms to process large amounts of natural language data.
2.	NLP is driving the growth of the AI market, and this course helps you develop the skills required to become an NLP Engineer.

Pre-Requisite:	
1.	Concepts of Automata Theory.

Unit	Content	Hrs.
1.	**Regular Expressions and Automata Recap**) - Introduction to NLP, Regular Expression, Finite State Automata. **Tokenization** - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance. **Morphology** - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State	9

	Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer.	
2.	**Language Modeling** Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. **Hidden Markov Models and POS Tagging** Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation.	9
3.	**Text Classification** Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. **Context Free Grammar** Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing.	9
4.	**Computational Lexical Semantics** Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity. **Information Retrieval** Boolean Retrieval, Termdocument incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback.	9

Text book and Reference books:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.
4. Jurafsky Dan and Martin James H. "Speech and Language Processing" ,3rd Edition, 2018.
5. Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
6. Goldberg Yoav "A Primer on Neural Network Models for Natural Language Processing".

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Open Elective

Business Analytics
MCS-OE-302A
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Investigate data to establish new relationships and patterns.
2.	Analyze the correlation between different variables.
3.	Use tools such as Excel and open source to interpret data.
4.	Use analytics to solve business problems.

Pre-Requisite:	
1.	Basics In Business Analytics.

Unit	Content	Hrs.
1.	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	6
2.	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	5
3.	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	6
4.	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model,	8

	Overbooking Model, Cash Budget Model.	
5.	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	6
6.	Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Text book and Reference books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
   Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, Pearson Education.
3. RN Prasad, Seema Acharaya - Fundamentals of Business Analytics – Wiley – Revised
4. Edition 2015.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar – Introduction to Data Mining – Pearson Education - Revised Edition 2015.

Industrial Safety
MCS-OE-302B
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To prevent accidents, eliminate work stoppages, achieve lower insurance rates, prevent injury and disability, and promote safety awareness.
2.	Common causes of industrial accidents include unsafe conditions, equipment, acts, and psychological factors.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	7
2.	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance,	6

	Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	
3.	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	8
4.	Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	6
5.	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	8

Text book and Reference books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Operations Research
MCS-OE-302C
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To gain a solid foundation in optimization principles, methodologies, and applications.
2.	To understand the Simplex method, revised Simplex method, and their applications.
3.	To understand the formulation and solution of Nonlinear Programming Problems (NLP) and learn the Kuhn-Tucker conditions for solving NLPs.
4.	To learn the principles of Critical Path Method (CPM) and Program Evaluation.
5.	To explore scheduling techniques and sequencing models, including single server and multiple server models.
6.	To understand deterministic inventory models and probabilistic inventory control models.
7.	To develop analytical skills to interpret and analyze results from different optimization models.

Pre-Requisite:	
1.	Linear Algebra, Calculus, Probability and Statistic.

Unit	Content	Hrs.
1.	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	8
2.	Formulation of a LPP - Graphical solution- revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	7
3.	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	10
4.	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	10
5.	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	8

Text book and Reference books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects
MCS-OE-302D
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To attain knowledge in Cost Management process and Costing System.
2.	Discuss about Various types of costs and its behaviour along with Quality Management.
3.	Identify various types of Budgets involved in Cost Management process.
4.	Broaden the career potential of available techniques and problems available in Cost Management.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	8
2.	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	10
3.	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets;	10

	Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	
4.	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	8

Text book and Reference books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials

MCS-OE-302E
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	Explain the behavior of constituents in the composite materials.
2.	Enlighten the students in different types of reinforcement.
3.	Develop the student's skills in understanding the different manufacturing methods available for composite material.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	6
2.	REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	6
3.	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties	8

	and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
4.	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	8
5.	Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8

Text book and Reference books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy
MCS-OE-302F
Contacts: 3L
Theory: 3 hrs./week
Credit points: 3

Objective:	
1.	To enable students to understand of the concept of Waste to Energy.
2.	To learn about the best available technologies for waste to energy.
3.	To analyze of case studies for understanding success and failures.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion	5

	devices – Incinerators, gasifiers, digestors	
2.	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	5
3.	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	8
4.	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	7
5.	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	10

Text book and Reference books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Dissertation-I/ Industrial Project
MCS-P-381
Practical Hours : 20 hrs./week
Credit points: 10

Objective:	
1.	To provide students with real-world work experience and broaden their knowledge in their chosen sector.
2.	Students will learn more about their chosen careers in the actual world.
3.	They will also discover what they must do to complete their assignments.

Dissertation-I/ Industrial Project : Guidelines

The objective of this course is to develop in students the capacity for analysis and the ability to carry out independent investigation in design/development through a dissertation work involving creativity, innovation and ingenuity. The work should start in the 2nd semester with comprehensive literature search and critical appreciation thereof so as to select a research problem and finalize the topic of dissertation.

Each student will carry out an independent dissertation under the supervision of a supervisor and in no case, more than two supervisors may be associated with one dissertation work. The first supervisor must be from the department, however, for interdisciplinary research work, the second supervisor may be from other department of the institute/outside university/industry. In the latter case, consent of the second supervisor with justification thereof needs to be submitted to the dissertation coordinator.

The activities under Dissertation -I may normally include:

1. The Dissertation (Phase-I) involves problem formulation along with data collection (if required) commencing in 3rd semester and would be concluded as Dissertation (Phase-II) in 4th semester.
2. Each student will be required to present a seminar talk, presenting the progress report containing literature survey, problem formulation and partial results (if any) of the work carried out by him/her in the semester.
3. The student will be required to submit one copy of spiral-bound progress report to the departmental committee.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Detailed Syllabus for M. Tech in Computer Science & Engineering
For Academic Year 2024-2025

CSE
Second Year – Semester IV

Dissertation-II/ Industrial Project
MCS-P-481
Practical Hours : 32 hrs./week
Credit points: 16

Objective:	
1.	To provide students with real-world work experience and broaden their knowledge in their chosen sector.
2.	Students will learn more about their chosen careers in the actual world.
3.	They will also discover what they must do to complete their assignments.

Dissertation-II/ Industrial Project

The Dissertation (Phase-II) in the 4th semester shall be the extension of Dissertation (Phase-I) carried out in 3rd semester.
There is a desirable requirement of one publication in an UGC-CARE listed journal.

The activities under Dissertation -II may normally include:

1. Each student will be required to present a seminar talk (post submission defense of dissertation towards the end of the semester, presenting the dissertation report of the work carried out.

2. Each student will be required to submit two copies of dissertation report (thesis). The committee constituted by the Head of the department will screen all the presentations so as to award the sessional marks.