Department of Computer Science and Engineering

Haldia Institute of Technology

An Autonomous Institution (An Institution of ICARE)

Curriculum Structure for M. Tech (Computer Science & Engineering)

First Year

Semester- I			
Course Code	**Course Name**	**Credits**	**Scheme Of Studies Per Week (L-T-P)**
MCS-PC-101	**Program Core I-** Mathematical foundations of Computer Science	3	3-0-0
MCS-PC-102	**Program Core II-**Advanced Data Structures	3	3-0-0
MCS-PC-103	**Program Core III** Operating System Design	3	3-0-0
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	3-0-0
MCS-AC-105	Research Methodology and IPR	2	2-0-0
MCS-AC-106	Pedagogy Studies	1	2-0-0
MCS-PCL-191	Advanced Data Structures Lab	2	0-0-4
MCS-PCL-192	Operating System Design Lab	2	0-0-4
Total Credits		19	

Semester-II			
Course Code	**Course Name**	**Credits**	**Scheme Of Studies Per Week (L-T-P)**
MCS-PC-201	**Program Core IV** - Advanced Algorithms	3	3-0-0
MCS-PC-202	**Program Core V** - Soft Computing	3	3-0-0
MCS-PC-203	**Program Core VI**- Data Mining & Data Warehousing	3	
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	3-0-0

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	3-0-0
MCS-AC-206	English for Research Paper Writing	1	2-0-0
MCS-PCL-291	Advanced Algorithm Lab	2	0-0-4
MCS-P-281	Mini Project with Seminar	2	2-0-0
Total Credits		20	

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Curriculum Structure for M. Tech (Computer Science & Engineering)

Second Year

Semester-III			
Course Code	**Course Name**	**Credits**	**Scheme Of Studies Per Week (L-T-P)**
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	3-0-0
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	3-0-0
MCS-P-381	Dissertation-I/ Industrial Project	10	0-0-20
Total Credits		16	

Semester-IV			
Course Code	**Course Name**	**Credits**	**Scheme Of Studies Per Week (L-T-P)**
MCS-P-481	Dissertation II	16	0-0-32
Total Credits		16	

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Detailed Syllabus for M. Tech in Computer Science & Engineering

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

Unit	Content	Hrs/Unit
1	Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, 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 Likelihood,	7
3	Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.	8
4	Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.	11
5	**Computer science and engineering applications** Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.	10
6	Recent Trands in various distribution functions in mathmatical 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 Sciencem Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

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Program Core - II

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

Unit	Content	Hrs/Unit
1	**Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.	7
2	**Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	5
3	**Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9
4	**Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	12
5	**Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.	10
6	Recent Trands in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem	5

Text book and Reference books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Program Core - III

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

Unit	Content	Hrs/Unit
1	General overview of the UNIX system from the users perspective , General outline of the UNIX kernel architecture, System Buffer Cache mechanism, the foundation of the UNIX file system.	12
2	Data structures and Algorithms used internally by the UNIX File system , System Calls used to provide user interface to the UNIX file system (6L), Process Control: Context of a process, internal kernel primitives for manipulating process context, including system call interface, interrupt handling and context switch (6L)	17
3	System calls for controlling process context , UNIX Process Scheduling mechanism	5
4	fundamentals of UNIX memory management, including swapping and paging systems, Basics of UNIX device driver interfaces	10

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. Robert Love, "Linus kernel development" 3rd edition, Addision-wesley Professional, 2010
4. Uresh Vahalia, ""Unix internals : The New Frontiers", 1st edition , prentice hall, 1996.
5. Daniel P. Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O"Reilly, 2005
6. Jonathan Corbet, Alessandro Runini, Greg Kroah-Hartman, "Linux Device Drivers", 3rd Edition, O"Reilly, 2005

Sreekrishnan Venkateswaran, "Essential Linux Device Drivers",1st Edition, Prentice Hall, 2008

Program Elective I

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

Unit	Content	Hrs/Unit
1	**Supervised Learning (Regression/Classification)** • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes	10

	• Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	
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)	7
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, Deep Learning and Feature Representation Learning	9
5	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9
6	Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.	5

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.

Wireless Sensor Network

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

Unit	Content	Hrs/Unit
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	9
2	**Introduction to ns-3:** Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.	9
3	**Medium Access Control Protocol design:** Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled **Introduction to Markov Chain:** Discrete time Markov Chain	8

	definition, properties, classification and analysis **MAC Protocol Analysis:** Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)	
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.	10
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

Introduction to Intelligent System

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

Unit	Content	Hrs/Unit
1	Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.	9
2	Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.	6
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.	7
4	Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures	9
5	Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A	7

	study of different learning and evolutionary algorithms, such as statistical learning and induction learning.	
6	Recent trends in Fuzzy logic, Knowledge Representation	5

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.

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

Unit	Content	Hrs/Unit
1	**Cluster Computing**: 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. 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. Variants based on new low level protocols (MVAPICH), evaluation and tuning of system and software performance. Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf.	18
2	**Grid Computing**: Evolution of the Grid - Grids and Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques – Grid applications. The concept of virtual organizations – Grid architecture – Grid architecture and relationship to other Distributed Technologies – computational and data Grids, semantic grids. 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	22

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

Unit	Content	Hrs/Unit
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. (4L) 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.(8L)	12
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. (4L), Pipeline performence measurement parameters- speedup, effiency, throughput, classification of pipeline processor, pipeline structure of CPU, examples from design of arithmetic pipeline- floating point adder, multiplier. (6L), Multifunction pipeline, reservation table, Dynamic pipeline, pipeline latency. (2L)	12
3	Vector Processing: (6L), 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. (4L), Pipeline chaining and vector loops. (2L)	5
4	High performance Computing:(10L), Performance measurement parameters – MIPS, MFLOPS, SPEC rating, CPI etc., introduction to high performance computing – Overview, Flynn's classification – SISD, SIMD, MISD, MIMD. (2L), SIMD Array processors: SIMD computer organization, Masking and Data-Routing Mechanisms, Inter PE communication, SIMD Inter Connection Networks, SIMD Matrix Multiplication.(6L), Multiprocessor Architecture: Loosely Coupled and Tightly Coupled Multiprocessors.(2L)	10
5	Embedded System and its Architecture:(6L), Why embedded system, Defination 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	6

	Languages, Time Criticality, RTOS)	
6	Reconfigurable Architecture and HDL(Hardware Describption Languages): (6L), Introduction to Reconfigurable architecture, FPGA (Field Programmable Gate Array):Defination, Classification, Architecture, Synthesis on FPGA, Downloading bit on FPGA.(4L), Design and testing of circuit by HDL(Hardware Describption Languages). (2L)	6

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

Unit	Content	Hrs/Unit
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research Problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	5
2	Effective literature studies approaches, analysis Plagiarism, Research ethics,	2
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	3
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, Patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	6
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	2
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	4

Text book and Reference books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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

Unit	Content	Hrs/Unit
1	**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.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	2
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best 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.	4
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	4
5	• **Research gaps and future directions** • Research design	2

	• Contexts Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact.	

Suggested Reading:

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

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.

Operating System Design Lab

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

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).

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Syllabus for M. Tech in Computer Science & Engineering

First Year – Semester II

Program Core IV

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

Unit	Content	Hrs/Unit
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.	9
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	10

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	10
6	Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5

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.

Program Core V

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

Unit	Content	Hrs/Unit
1	**INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics	7
2	**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.	8
3	**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	**GENETIC ALGORITHMS:** Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.	5

5	**Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic	13
6	Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.	5

Text book and Reference books:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Program Core VI

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

Unit	Content	Hrs/Unit
1	Basics of Data Mining . Data Mining Functionalities, Classification of Data Mining Issues, Data Mining Goals. Stages of the Data Mining Process	14
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.	6
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.	10
5	Clustering Technique: Partitioning Algorithms-K- means Algorithm, CLARA, CLARANS, Hierarchical Algorithms DBSCAN, ROCK.	6
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	6

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.

Program Elective II

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

Unit	Content	Hrs/Unit
1	Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	6
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	7
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.	10
4	Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	11
5	Applications of Data Science, Technologies for visualisation, Bokeh (Python)	7
6	Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	7

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.

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

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

Unit	Content	Hrs/Unit
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	8
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	11
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	11
4	**RELIABILITY** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols	8
5	**PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing and optimization; load balancing	6
6	**ADVANCED TOPICS** Mobile Databases, Distributed Object Management, Multi-databases	4

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.

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

Unit	Content	Hrs/Unit
1	**Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues	9
2	**Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	11
3	**Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation	13
4	**Visualization:** Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	15

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

Unit	Content	Hrs/Unit
1	Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	8
2	Edge detection, Edge detection performance, Hough transform, corner detection	9
3	Segmentation, Morphological filtering, Fourier transform	9
4	Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data reprocessing	9
5	Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of	9

	Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.	
6	Recent trends in Activity Recognition, computational photography, Biometrics.	4

Text book and Reference books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
1. Deep Learning, by Goodfellow, Bengio, and Courville.
2. Dictionary of Computer Vision and Image Processing, by Fisher et al.

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

Unit	Content	Hrs/Unit
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.	6
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.	6
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	7

	transformation; clipping, viewport clipping, 3D viewing.	
5	**Curves**: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.	6
6	**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
7	**Color & shading models**: Light & color model; interpolative shading model; Texture;	4

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

Unit	Content	Hrs/Unit
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.	9
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.	11
3	Testing: Module, sub-system and system level testing, integration testing, stub, driver, test case and test suit design, system	6

	performance testing, verification & validation, debugging.	
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. Software Engineering: A Practitioner's Approach Paperback, Roger S Pressman
2. Software Engineering, Pearson Education, Ian Sommerville
3. Fundamentals of Software Engineering, Carlo Ghezzi , Mehdi Jazayeri , Dino Mandrioli

Software Engineering Theory and Practice, Paperback, Shari Lawrence Pfleeger

Program Elective III

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

Unit	Content	Hrs/Unit
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.	9
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.	12
3	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	8
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	8

	Flow. Case Studies.	
6	Recent Trends: Speech Recognition and Translation, Multimodal System	3

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)

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

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	13
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	7
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.	10
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.	8

5	**Case Studies**: Image Processing, Graph algorithms, Simulations, Deep Learning	5
6	**Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	5

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

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 tools. **Legal Aspects of Digital Forensics:** IT Act 2000, amendment of IT Act 2008.	8

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.

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

Unit	Content	Hrs/Unit
1	**Introduction to Cloud Computing** Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing	4
2	**Cloud Computing Architecture** Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, 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** Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise	11
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**	11

	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, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	
5	**Audit and Compliance** Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud	8
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

Unit	Content	Hrs/Unit
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.	8
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,	8

3	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.	7
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.	12
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.	5

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.

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

Unit	Content	Hrs/Unit
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,	8

	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.	
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 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	10
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	9

	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.	
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

Unit	Content	Hrs/Unit
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	4

	and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
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 be the first- time submission	4

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

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.

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

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
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Syllabus for M. Tech in Computer Science & Engineering

CSE
Second Year – Semester III

Program Elective V

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

Unit	Content	Hrs/Unit
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	8
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	8
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	10
4	Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia	9
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	5

	IOT	

Text book and Reference books:

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

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

Unit	Content	Hrs/Unit
1	**High Performance Systems,** Structure of a Compiler, Programming Language Features, Languages for High Performance.	7
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 Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.	7
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.	10
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.	10
5	**Message-Passing Machines:** SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments,	10

	Other Topics. **Scalable Shared-Memory Machines:** Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.	
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

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

Unit	Content	Hrs/Unit
1	Engineering application of Optimization, Formulation of design problems as mathematical programming problems.	7
2	General Structure of Optimization Algorithms, Constraints, The Feasible Region.	7
3	Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.	11
4	Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	12
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.	5

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.

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

Unit	Content	Hrs/Unit
1	Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	5
2	Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	6
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.	8
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	7

	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.	

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

Unit	Content	Hrs/Unit
1	Basic concepts – Definition, Data sets for pattern recognition, structure of a typical pattern recognition system. Different paradigms of pattern recognition. Representations of patterns and classes. Metric and non- metric proximity measures	8
2	Feature vectors - Feature spaces - Different approaches to Feature Selection-Branch and Bound Schemes. Sequential Feature Selection.	7
3	Principal Component Analysis (PCA), Kernel PCA	5
4	Pattern classification using Statistical classifiers – Bayes' classifier - Classification performance measures – Risk and error probabilities. Linear discriminant function, Mahalanobis distance, K-NN Classifier, Fisher's LDA, Single layer perception, Multi-layer perception. Training set, test set: standardization and normalization.	10
5	Basics of Clustering: Similarity/ dissimilarity measures, clustering criteria, Different distance functions and similarity measures, K-means algorithm, K-medoids, DBSCAN	10
6	Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy techniques, and real life examples.	8

Text book and Reference books:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.

3. Statistical pattern Recognition; K. Fukunaga; Academic Press, 2000.
4. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

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

Unit	Content	Hrs/Unit
1	**Regular Expressions and Automata Recap**) - Introduction to NLP, Regular Expression, Finite State Automata [2L] **Tokenization** - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance [5L] **Morphology** - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer [4L]	11
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. [5L] **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. [5L]	10
3	**Text Classification** Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. [5L] **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 [6L]	11
4	**Computational Lexical Semantics** Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity [4L] **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 [5L]	9

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press 3.
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson

Open Elective

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

Unit	Content	Hrs/Unit
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.	9
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.	8
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.	9
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, Overbooking Model, Cash Budget Model.	10

5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
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.

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

Unit	Content	Hrs/Unit
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.	9
2	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	8
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.	9
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	10

	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.	
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	9

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.

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

Unit	Content	Hrs/Unit
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

Unit	Content	Hrs/Unit
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; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer	10

	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

Unit	Content	Hrs/Unit
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.	8
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.	7
3	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	10
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	8

	criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	

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

Unit	Content	Hrs/Unit
1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	7
2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	6
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.	9
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.	10
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 –	10

	Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	

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

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)

Syllabus for M. Tech in Computer Science & Engineering

CSE
Second Year – Semester IV

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

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.