SCHEME & SYLLABI
OF
M.TECH.
COMPUTER SCIENCE & ENGINEERING
w.e.f.
2018 -2019
(as per AICTE Model Curriculum)

CH. BANSI LAL UNIVERSITY, BHIWANI

First Semester:

Subject Code	Subject Name	L-T-P	Credits	Mark Weightage		Course Type
				Internal	External	
18MCSE-501	Mathematical Foundation of Computer Science	3-0-0	3	25	75	Core-I
18MCSE-503	Advanced Data Structures	3-0-0	3	25	75	Core-II
	Discipline Specific Elective - I	3-0-0	3	25	75	Programme Elective I
	Discipline Specific Elective - II	3-0-0	3	25	75	Programme Elective II
18MCSE-505	Advanced Data Structures Lab – I	0-0-4	2	25	25	Core
	Discipline Specific Elective Lab - II	0-0-4	2	25	25	Core
18MCSE-507	Research Methodology and IPR	3-0-0	2	25	75	Core
	Audit Course- 1	2-0-0	0	25	75	Audit
	Total	**17-0-8**	**18**	**200**	**500**	

Discipline Specific Elective-I

18MCSE-509 Machine Learning
18MCSE-511 Wireless Sensor Networks
18MCSE-513 Introduction to Intelligent Systems

Discipline Specific Elective-II

18MCSE-515 Data Science
18MCSE-517 Distributed Systems
18MCSE-519 Advanced Wireless and Mobile Networks

Discipline Specific Elective Lab

18MCSE-521 Machine Learning
18MCSE-523 Wireless Sensor Networks
18MCSE-525 Introduction to Intelligent Systems

Audit course 1 & 2

18 AUD- 101 Research Paper Writing
18 AUD -102 Disaster Management
18 AUD -103 Sanskrit and Technology
18 AUD -104 Value Education
18 AUD -105 Constitution of India
18 AUD -106 Pedagogy Studies
18 AUD -107 Stress Management
18 AUD -108 Personality Development through Life Enlightenment Skills

Second Semester

Subject Code	Subject Name	L-T-P	Credits	Mark Weightage		Course Type
				Internal	External	
18MCSE-502	Advance Algorithm	3-0-0	3	25	75	Core-III
18MCSE-504	Soft Computing	3-0-0	3	25	75	Core-IV
	Discipline Specific Elective-III	3-0-0	3	25	75	Programme Elective III
	Discipline Specific Elective-IV	3-0-0	3	25	75	Programme Elective IV
18MCSE-506	Soft Computing Lab - III	0-0-4	2	25	25	Core
	Discipline Specific Elective Lab- IV	0-0-4	2	25	25	Core
	Audit Course- 2	2-0-0	0	25	75	Audit
18MCSE-508	Mini-Project	0-0-4	2	25	75	Core
	Total	**14-0-12**	**18**	**200**	**500**	

Discipline Specific Elective-III

18**MCSE-510** Data Preparation and Analysis
18**MCSE-512** Secure Software Design & Enterprise Computing
18**MCSE-514** Sensor Networks and IoT

Discipline Specific Elective-IV

18**MCSE-516** GPU Computing
18**MCSE-518** Human and Computer Interaction
18**MCSE-520** Architecture of High Performance Computer Systems

Discipline Specific Elective Lab

18**MCSE-522** Data Preparation and Analysis Lab
18**MCSE-524** Secure Software Design & Enterprise Computing Lab
18**MCSE-526** Sensor Networks and IoT Lab

Third Semester:

Subject Code	Subject Name	L-T-P	Credits	Mark Weightage		Course Type
				Internal	External	
	Discipline Specific Elective-V	3-0-0	3	25	75	Programme Elective V
	Open Elective	3-0-0	3	25	75	Open Elective
18MCSE-533	Dissertation Phase-I	0-0-20	10	50	150	Dissertation
	Total	**6-0-20**	**16**	**100**	**300**	

Discipline Specific Elective-V

18MCSE-527 Mobile Applications and Services
18MCSE-529 Optimization Techniques
18MCSE-531 Digital Forensics

Open Elective

18 OEC- 531 Business Analytics
18 OEC -533 Industrial Safety
18 OEC -535 Operations Research
18 OEC -537 Cost Management of Engineering Projects
18 OEC -539 Composite Materials
18 OEC -541 Waste to Energy

Fourth Semester:

Subject Code	Subject Name	L-T-P	Credits	Mark Weightage		Course Type
				Internal	External	
18MCSE-528	Dissertation Phase-II	0-0-32	16	150	350	Dissertation
	Total	**0-0-32**	**16**	**150**	**350**	

Total Credits for the programme = 18 + 18 +16 +16 = 68 Credits

Course code	**18MCSE-501**
Course title	**MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course Objective

1. To understand the mathematical fundamentals that are prerequisites for a variety of courses like Data mining, Computer Networks, Computer security etc.
2. To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
3. To study various sampling and classification problems.

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

Unit 2

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Unit 3

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Unit 4

Graph Theory: Isomorphism, Planar Graphs, Graph colouring, Hamilton circuits and Euler cycles. Permutations and combinations with and without repetition.

Course outcomes

After completion of course, students would be able to:

1. To understand the basic notions of discrete and continuous probability.
2. To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
3. To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

REFERENCES

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Course code	**18MCSE-503**
Course title	**ADVANCED DATA STRUCTURES**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course Objectives:

1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary mathematical abstraction to solve problems.
3. To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4. Student should be able to come up with analysis of efficiency and proofs of correctness.

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

UNIT-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 Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

UNIT-3

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, SplayTrees

UNIT-4

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad-trees, k-D Trees.

Course Outcomes:

After completion of course, students would be able to:

1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.

REFERENCES

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

Course code	**18MCSE-507**
Course title	**RESEARCH METHODOLOGY AND IPR**
Scheme (L-T-P)	**3-0-0**
Credits	**2**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course Objectives:
The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

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.

Unit -2
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit -3
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.

Unit-4
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases, Geographical Indications.

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.

Course Outcomes: At the end of the course, students will demonstrate their ability to:
1. Understanding and formulation of research problem.
2. Analyze research related information.
3. Understand plagiarism and follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

5. Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

References:

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.

Course code	**18MCSE-509**
Course title	**MACHINE LEARNING**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyze 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.

Unit 1

Supervised Learning: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unit 2

Unsupervised Learning: Clustering: K-means/Kernel K-means DimensionalityReduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Unit 3

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests), Introduction to scalable machine learning, Recent trends in various learning techniques of machine learning.

Unit 4

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Course outcomes

After completion of course, students would be able to:

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyse various machine learning approaches and paradigms.

References:

Course code	**18MCSE-511**
Course title	**Wireless Sensor Network**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. Architect sensor networks for various application setups.
2. Devise appropriate data dissemination protocols and model links cost.
3. Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.

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 Recent development in WSN standards

Unit 2

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)

Unit 3

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key Distribution

Unit 4

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.

Course outcomes

After completion of course, students would be able to:

1. Describe and explain radio standards and communication protocols for wireless sensor networks.
2. Explain the function of the node architecture and use of sensors for various applications.
3. Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms

References:

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.

Course code	**18MCSE-513**
Course title	**Introduction to Intelligent Systems**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.
Pre Requisite: Computer Networks

Course objective

1. The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
2. To design and analysis various artificial intelligence algorithms on recent advances.

Unit 1

Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks. Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks, Recent trends in Fuzzy logic.

Unit 2

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, hillclimbing search. Optimization and search such as stochastic annealing and genetic algorithm.

Unit 3

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, Knowledge Representation.

Unit 4

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.

Course outcomes

After completion of course, students would be:

1. Able to demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyze and compare the relative merits of a variety of AI problem solving techniques.

References:

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.

Course code	**18MCSE-515**
Course title	**Data Science**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. Provide with the knowledge and expertise to become a proficient data scientist.
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
3. Produce Python code to statistically analyze a dataset.
4. Critically evaluate data visualizations based on their design and use for communicating stories from data.

Unit 1

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 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

Unit 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.

Unit 4

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Course outcomes

On completion of the course the student should be able to

1. Explain how data is collected, managed and stored for data science.
2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;

References:

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

Course code	**18MCSE-517**
Course title	**Distributed Systems**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.
2. To provide with the knowledge and expertise to become a database administrator.

Unit 1

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

Unit 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

Unit 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

Unit 4

Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols, Mobile Databases, Distributed Object Management, Multi-databases

Course outcomes

After completion of course, students would be:

1. Design trends in distributed systems.
2. Apply network virtualization.
3. Apply remote method invocation and objects.

References:

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.

Course code	**18MCSE-519**
Course title	**Advanced Wireless and Mobile Networks**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. The students should get familiar with the wireless/mobile market and the future needs and challenges.
2. To get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
3. To learn how to design and analyse various medium access.
4. To learn how to evaluate MAC and network protocols using network simulation software tools.
5. The students should get familiar with the wireless/mobile market and the future needs and challenges.

Unit 1

Introduction: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple, Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Challenges in Mobile Computing IEEE 802.11 standards, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues, VANETs

Unit 2

Wireless cellular networks: 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP variants for Wireless Networks, Cellular architecture, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

Unit 3

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Sensor Networks: Introduction, Application, Physical, MAC layer and Network Layer, Power Management.

Unit 4

Bluetooth AND Zigbee, Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in Wireless Communication, EAPTLS, EAPTTLS, EAP- -Peap Security, DoS in wireless communication

Course outcomes

After completion of course, students would be:

1. Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
2. Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
3. Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
4. Design wireless networks exploring trade-offs between wire line and wireless links.

Course code	**18MCSE-505**
Course title	**Advanced Data Structures Lab –I**
Scheme (L-T-P)	**0-0-4**
Credits	**2**
Internal Assessment	**25**
External Assessment	**25**
Total	**50**

The students will be required to carry out 10 to 12 experiments covering the theory course

Course code	**18MCSE-521/ 18MCSE-523/18MCSE-525**
Course title	**Lab on Electives -II**
Scheme (L-T-P)	**0-0-4**
Credits	**2**
Internal Assessment	**25**
External Assessment	**25**
Total	**50**

The students will be required to carry out 10 to 12 experiments covering the theory course

Course code	**18MCSE-502**
Course title	**Advance Algorithm**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. Introduce students to the advanced methods of designing and analyzing 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.

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

Unit 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.

Unit 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.

Unit 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

Course outcomes

After completion of course, students would be able to:

1. Analyze the complexity/performance of different algorithms.
2. Determine the appropriate data structure for solving a particular set of problems.

3. Categorize the different problems in various classes according to their complexity.
4. Students should have an insight of recent activities in the field of the advanced data structure

References:

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.

Course code	**18MCSE-504**
Course title	**Soft Computing**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide student an hand-on experience on MATLAB to implement various strategies.

Unit 1

Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics, Introduction to Deep Learning

Unit 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.

Unit 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

Unit 4

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Course outcomes

After completion of course, students would be able to:

1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

References:

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

Course code	**18MCSE-510**
Course title	**Data Preparation and Analysis**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To prepare the data for analysis and develop meaningful Data Visualizations
2. To provide with the knowledge and expertise to become a data analyst.

Unit 1

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues

Unit 2

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit 3

Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Unit 4

Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

Course outcomes

After completion of course, students would be:

1. Able to extract the data for performing the Analysis.

References:

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

Course code	**18MCSE-512**
Course title	**Secure Software Design & Enterprise Computing**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To fix software flaws and bugs in various software.
2. To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
3. Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
4. Methodologies and tools to design and develop secure software containing minimum vulnerabilities

Unit 1

Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts

Unit 2

Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Unit 3

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit 4

Software containing minimum vulnerabilities and flaws, Perform security testing and quality assurance Managing software quality in an organization, software configuration management, software measurement and metrics,

Course outcomes

After completion of course, students would be able to:

1. Differentiate between various software vulnerabilities.
2. Software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.

References:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett

2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

3. Nina S. Godbole, Software Quality Assurance: Principles and Practices, Narosa Publication.

Course code	**18MCSE-514**

Course title	Sensor Networks and IoT
Scheme (L-T-P)	3-0-0
Credits	3
Internal Assessment	25
External Assessment	75
Total	100
Duration of Exam	3 HRS

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. The course gives an overview of various topics related to wireless sensor networks, which are expected to be the basis for the emerging internet-of-things.
2. The course covers topics with relation to various sub-disciplines of computer science such as hardware, operating systems, distributed systems, networking, security and databases.
3. Able to understand wireless sensor network (WSN) specific issues such as localization, time synchronization, and topology control are addressed as well.

Unit 1

Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security

Unit 2

IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints: Introduction, Technical Design constraints: hardware, Data representation and visualization, Interaction and remote control.

Unit 3

Industrial Automation: Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry , Interface and Programming & IOT Device

Unit 4

Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases 10

Course outcomes

On completion of the course the student should be able to

1. identify requirements from emerging WSN applications on WSN platforms, communication systems, protocols and middleware
2. understand, compare and evaluate communication and network protocols used in WSNs
3. discuss and evaluate mechanisms and algorithms for time synchronization and localization in WSNs
4. understand and discuss requirements for the design of security mechanisms and middleware systems to be used in WSNs

References:

1. Mandler, B., Barja, J., Mitre Campista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing

Course code	**18MCSE-516**
Course title	**GPU Computing**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To learn parallel programming with Graphics Processing Units (GPUs).
2. To evaluate the performance of GPU using case studies.

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

Unit 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

Unit 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 Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

Unit 4

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

Course outcomes

After completion of course, students would be:

1. Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

References:

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)

Course code	**18MCSE-518**
Course title	**Human and Computer Interaction**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

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. Learn the guidelines for user interface.

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.

Unit 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.

Unit 3

Web Interfaces – Drag & Drop, Direct Selection, Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit 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.

Course outcomes After completion of course, students would be:

1. Understand the structure of models and theories of human computer interaction and vision.
2. Design an interactive web interface on the basis of models studied.

References:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)

2. Brian Fling, “Mobile Design and Development”, First Edition , O Reilly Media Inc., 2009 (UNIT – IV)

3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, OReilly, 2009.(UNIT-V)

Course code	**18MCSE-520**
Course title	**Architecture of High Performance Computer Systems**
Scheme (L-T-P)	**3-0-0**
Credits	**3**
Internal Assessment	**25**
External Assessment	**75**
Total	**100**
Duration of Exam	**3 HRS**

Note: Nine questions are to be set by the examiner. Question No. 1 will be compulsory and based on the entire syllabus. It will contain ten short answer type questions. Two questions are to be set from each unit. The student is required to attempt five questions in all by selecting one question from each unit and question no. 1, which is compulsory. All question carry equal marks.

Course objective

1. To provide students with a broad understanding of current and emerging trends in computer architecture
2. To study architecture exploiting instruction level parallelism and muti processors and multi computers
3. To inculcate knowledge about the latest commercial processors

Unit 1

Introduction: review of basic computer architecture, quantitative techniques in computer design, measuring and reporting performance. CISC and RISC processors.

Unit 2

Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards, and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques. Compiler techniques for improving performance.

Unit 3

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies. Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super-pipelined and VLIW processor architectures. Array and vector processors.

Unit 4

Multiprocessor architecture: taxonomy of parallel architectures. Centralized shared-memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

Course outcomes

After completion of course, students would be able to:

1. Demonstrate the advanced concepts of computer architecture
2. Investigate modern design structures of Pipelined and Multiprocessor Systems
3. Understand the interaction amongst architecture, applications and technology

References:

1. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
2. John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill.

3. M. J. Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House.
4. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill.

Course code	**18MCSE-506**
Course title	**Soft Computing Lab -III**
Scheme (L-T-P)	**0-0-4**
Credits	**2**
Internal Assessment	**25**
External Assessment	**25**
Total	**50**

The students will be required to carry out 10 to 12 experiments covering the theory course

Course code	**18MCSE-522/ 18MCSE-524/18MCSE-526**
Course title	**Lab on Electives -II**
Scheme (L-T-P)	**0-0-4**
Credits	**2**
Internal Assessment	**25**
External Assessment	**25**
Total	**50**

The students will be required to carry out 10 to 12 experiments covering the theory course