Department of Computer Science
Meenakshi College for Women (Autonomous)

M.Phil. Computer Science

Curriculum 2019

Curriculum Overview

Programme Specific Objectives

- To provide a strong foundation in the Mathematics and Science of computing that is relevant for pursuing research in Computer Science.
- To power research in interesting, contemporary and high-impact research areas.
- To motivate research scholars towards inter-disciplinary research so that their research output may have a larger set of beneficiaries.

Eligibility

Candidates who have completed a Masters degree in Computer Science / Computer Applications / Information Technology or an equivalent degree are eligible to undertake this course, subject to rules of the University of Madras.

The M. Phil. (Computer Science) Course is offered in the following formats:

1. Full-time: 1 year
2. Part-time: 2 years

Candidates will be admitted to the course on the basis of their PG degree marks, an entrance test and an interview. Equal weightage will be given for the performance in the PG degree and that in the entrance test.

Credit System

Minimum credits required by a candidate to be eligible for the M.Phil. degree:

Part	**Minimum no. of credits**
Course Work (3 theory papers with 6 credits each)	18
Project Dissertation	10
Project Viva-voce	10

Requirements for the M.Phil. Degree

Course Work

The course work consists of three theory papers – two core and one elective. The grading pattern for this course work is given below:

Continuous Internal Assessment (CIA) 25 Marks

End-Semester Examination (ESE) 75 marks

To pass in a subject, the student would have to score a minimum of 50% in CIA, a minimum of 50% in ESE and a minimum aggregate of 55% in both put together according to the above weightage.

Thesis & Viva-Voce

M.Phil. thesis work (Project Dissertation) is to be submitted by the student and a viva-voce examination will be conducted.

Course Summary

Semester 1 (Full-time) / Year 1 (Part-time)

#	**Subject**
Paper 1	Mathematical Preliminaries for Research
Paper 2	Theoretical Foundations for Computer Science
Paper 3	Elective

Semester 2 (Full-time) / Year 2 (Part-time)

#	**Subject**
1	Project Work (Thesis)
2	Viva-Voce

Electives

Paper 3 (Elective) is connected with the thesis work done by the student. The following subjects are offered as Electives:

1. Pattern Recognition
2. Digital Image Processing
3. Natural Language Processing
4. Cryptography and Network Security
5. Data Mining and Data Warehousing
6. Artificial Neural Networks
7. Distributed Parallel Processing
8. Geographical Information Systems
9. Human-Computer Interaction

Course Syllabus

Semester I / Year I

MPhlCS1a: Research Methodology

OBJECTIVES:

1. To understand the basic concepts in research methodology.
2. To learn the different research design principles and methods.
3. To understand the concepts of measurement and scaling techniques in research.
4. To understand data collection and processing methods.
5. To create a research report.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Explain the importance, characteristics and types of research.
2. Understand how to select and define a research problem.
3. Explain the features of a good research design and the different methods involved in creating a good design.
4. Understand the concept of sampling and explain various types of sampling.
5. Explain the basic concepts of measurement and different measurement tools.
6. Explain the different methods involved in data collection and processing.
7. Describe the various ways by which analysed data is communicated/displayed.
8. Learn how to create a research report.

Unit	Course Content	L	P	T
1	**Research Methodology**: Research - Definition, Importance and Meaning of Research, Characteristics of Research, Types of research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of good research, Research problem and selection, techniques involved in defining a problem.	15	-	5
2	**Research Design**: Meaning, research design need, features of a good design, important concept relating to research design, different research design, basic principles of experimental designs. **Sampling:** Sampling meaning, sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design.	15	-	5
3	**Measurement and Scaling Techniques**: Measurement in research, Measurement scale, source of error in measurement, test of sound measurement, techniques of developing measurement tools, scaling, scale classification bases, Important Scaling techniques, scale construction techniques. **Data Collection Methods**: Interview, questionnaires, through schedules.	15	-	5
4	**Data Processing**: Processing Operations, Problem in processing, types of analysis, measure of central tendency, measure of dispersion, measure of asymmetry, measure of relationship, simple regression analysis, multiple correlation and regression, partial correlation. **Methods of communicating and displaying analysed Data**: Text-Tables-Graphs (Histogram, Bar Chart, Pie Chart, Frequency Polygon, Area Chart, Trend Curve, Scatter Diagram)-Statistical measure.	15	-	5
5	**Interpretation and Report Writing**: Research Reports- Types of	15	-	5

	reports, contents, Format & Styles of reporting, steps in drafting reports, Editing the final draft, Evaluating the final draft. Analysis and Interpretation of Data and Report Writing, References and Bibliography.			
Total		**75**	**-**	**25**

REFERENCE BOOKS

1. C. R. Kothari, *Research Methodology: Methods and Techniques*, Second Revised Edition, New Age International Publishers, 2004.
2. Ranjit Kumar, *Research Methodology*: *a step-by-step guide for beginners*, Third Edition, SAGE publications, 2011.

MPhlCS2: Theoretical Foundations for Computer Science

OBJECTIVES:

1. To simplify Boolean functions using Karnaugh Map.
2. To learn to design combinational circuits and sequential circuits.
3. To learn tree and graph data structures and sorting algorithms.
4. To learn various algorithmic design strategies and write algorithms for specific problems using one of the given design strategies.
5. To learn the different normal forms for normalizing a database and write basic SQL queries.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Simplify Boolean expressions using Karnaugh map.
2. Design combinational circuits.
3. Explain the basic types and circuitry of flip-flops.
4. Explain the design of asynchronous and synchronous counters.
5. Given a binary tree, traverse the tree using the traversal algorithms learnt.
6. Given a graph, traverse the graph using the traversal algorithms learnt.
7. Given a graph, generate the minimum cost spanning tree using the algorithms learnt.
8. Explain specific sorting algorithms.
9. Understand the algorithmic design strategies of Divide-and-Conquer, Greedy, back tracking, Dynamic Programming, branch and bound and know how these strategies are applied to solve the given specific problems.
10. Understand different normal forms and normalize simple databases.
11. Write simple SQL queries.

Unit	Course Content	L	P	T
1	**Digital Logic**: Boolean Algebra – Properties of Boolean algebra – Boolean functions – Canonical and Standard forms – Logic operations – Logic gates – Karnaugh Map up to 6 variables – Don't care condition – Sum of Products and Product of Sums simplification.	15	-	5
2	**Combinational Circuits:** Half Adder – Full Adder - Binary Parallel Adder – Decimal Adder – Half Subtractor – Full Subtractor - Code Converter –Magnitude Comparator-Decoders - Encoder– Multiplexer - Demultiplexer. **Sequential Circuits**: Flip Flops: RS Flip flop-D flip flop-JK flip flop-Master Slave Flip flop– Edge Triggered Flip flop – Excitation tables – Counters: Ripple counter (Binary, BCD)– Synchronous Counters (Binary, BCD).	15	-	5
3	**Data Structures**: Tree and graph traversals, Bi-Connected components, Spanning trees, Shortest paths, Sorting algorithms.	15	-	5
4	**Algorithm Designs**: Divide and Conquer Approach – Greedy Method with knapsack problem – Backtracking with 8-Queens problem – Dynamic Programming with Multistage Graph – Branch and Bound with Travelling Salesman problem.	15	-	5
5	**Database Management Systems**: Data Normalization: Introduction - Pitfalls in relational database design – Decomposition -Functional dependency – Normalization – 1NF, 2NF, 3NF and BCNF normal forms, Codd's Rules for relational database. **SQL:** Data definition - *not null* constraint – *unique* constraint – *check* clause - Basic structure of SQL queries – Use of set operations (union, intersect, except) – Null values - Nested subqueries	15	-	5
Total		**75**	**-**	**25**

REFERENCE BOOKS

1. M. M. Mano and C. R. Kime, *Digital Logic and Computer Design Fundamentals*, 2nd Edition, Pearson Education, New Delhi, 2001.
2. M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals*, 2nd Edition, Pearson Education, Delhi, 2001.
3. E. Horowitz, S. Sahni and Mehta, *Fundamentals of Data Structures in C++*, Galgotia, 1999.
4. E. Horowitz, S. Sahni and S. Rajasekaran, *Computer Algorithms*, Galgotia, New Delhi, 1999.
5. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, Fifth Edition, McGraw Hill International Edition

Elective 1 – MPhlCSPT: Pattern Recognition

OBJECTIVES:

1. To understand the concept of features and classifiers in pattern recognition.
2. To learn linear and non-linear classifiers.
3. To learn feature selection and generation techniques.
4. To learn the concept of clustering and different clustering algorithms.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Explain the concepts of feature, feature vector and classifiers.
2. Understand the different types of learning.
3. Understand Bayes decision theory and explain Bayes classifier.
4. Explain the concepts and algorithms of linear and non-linear classifiers.
5. Explain the concepts and algorithms used for context dependent classification.
6. Explain the concepts and methods used for feature selection and feature generation.
7. Understand learning methods with the given case-study.
8. Understand the concept of clustering and its types.
9. Explain sequential and Hierarchical clustering algorithms.
10. Explain how clustering done based on function optimization and graph theory.

Unit	Course Content	L	P	T
1	**Introduction:** Is Pattern Recognition Important? - Features, Feature Vectors and Classifiers – Supervised, Unsupervised and Semi-Supervised Learning **Classifiers Based on Bayes Decision Theory:** Introduction – Bayes Decision Theory – Discriminant Functions and Decision Surfaces – Bayesian Classification for Normal Distributions – Estimation of Unknown Probability Density Functions - The Nearest Neighbor Rule – Bayesian Networks	10	-	5
2	**Linear Classifiers:** Introduction – Linear Discriminant Functions and Decision Hyperplanes – The Perceptron Algorithm – Least Squares Methods – Mean Square Estimation Revisited – Logistic Discrimination - Support Vector Machines **Non Linear Classifiers:** Introduction – The XOR Problem – The two layer Perceptron - The three layer Perceptrons – Algorithms based on Exact Classification of the Training set – The Back Propogation Algorithm – Variations of the Back Propogation Theme – The Cost Function Choice – Choice of the Network Size – A simulation Example – Networks with Weight Sharing – Generalized Linear Classifiers – Capacity of the l – Dimensional Space in Linear Dichotomies – Polynomial Classifiers – Radial Basic Function Networks – Univelemrsal Approximators – Probabilistic Neural Networks – Support Vector Machines: The Non-Linear Case – Beyond the SVM Paradigm – Decision Trees – Combining Classifiers – The Boosting Approach to combine Classifiers – The Class Imbalance Problem	15	-	5
3	**Feature selection:** Introduction – Preprocessing – The Peaking Phenomenon – Feature Selection based on Statistical Hypothesis Testing – The ROC Curve – Class Seperability Measures – Feature Subset Selection – Optimal Feature Generation – Neural Networks and feature generation/selection – Generalization Theory – The Bayesian Information Criterion **Feature Generation I Data Transformation and Dimensionality Reduction :** Introduction – Basic Vectors and Images - The Karhunen-	15	-	5

Unit	Course Content	L	P	T
	Loeve Tranform – The Singular Value Decomposition – Independent Component Analysis – Non Negative Matrix Factorization – The DFT – The Discrete Cosine and Sine Tranforms – The Hadamard Tranform – The Haar Tranform – The Haar Expansion Revisited – DTWT – The multiresolution Interpretation – Wavelet Packets – 2D Generalizations - Applications			
4	**Feature Generation II :** Introduction – Regional Features – Features for Shape and Size Characterization – A Glimpse at Fractals – Typical Features for Speech and Audio Classification **Context Dependent Classification:** Introduction – The Bayes Classifier – Markov Chain Models – The Viterbi Algorithm – Channel Equalization - Hidden Markov Models – HMM with State Duration Modeling – Training Markov Models via Neural Networks – Markov Random Fields **Supervised Learning: The Epilogue:** Introduction – Error Counting Approach – Exploiting the Finite Size of the Data Set – A case study from Medical Imaging – Semi Supervised Learning	10	-	5
5	**Clustering:** Introduction – Proximity Measures **Clustering Algorithms I: Sequential Algorithms:** Introduction – Categories of Clustering Algorithms – Sequential Clustering Algorithms - A modification of BSAS – A two threshold Sequential Scheme – Refinement Stages – Neural Network Implementation **Clustering Algorithms II: Hierarchical Algorithms:** Introduction – Agglomerative Algorithms – The Cophenetic Matrix – Divisive Algorithms – Hierarchical Algorithms for large data sets – Choice of the best number of clusters **Clustering Algorithms III: Schemes based on Function Optimization:** Introduction – Mixture Decomposition Schemes – Fuzzy Clustering Algorithms – Possibilistic Clustering – Hard Clustering Algorithms – Vector Quantization **Clustering Algorithms IV:** Introduction – Clustering Algorithms based on Graph Theory – Competitive Learning Algorithms- Binary Morphology Clustering Algorithms – Boundary Detection Algorithms – Valley-Seeking Clustering Algorithms – Clustering via Cost Optimization – Kernel Clustering Methods – Density based Algorithms for Large data Sets – Clustering algorithms for High Dimensional Data Sets – other Clustering algorithms – combinationof clusterings **Cluster Validity:** Introduction – Hypothesis testing revisited - Hypothesis testing in cluster validity – Relative Criteria – Validity of Individual Clusters – Clustering Tendency	25	-	5
Total		**75**	**-**	**25**

TEXT BOOKS

1. S. Theodoridis, K. Koutroumbas, *Pattern Recognition*, 4th Edition, Elsevier Inc. 2009

REFERENCE BOOKS

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, *Pattern Recognition and Image Analysis*, PHI Learning Private Ltd, 2012.
2. Robert Schalkoff, *Pattern Recognition – Statistical, Structural and Neural Approaches*, Wiley India, 2010.
3. R.O.Duda, P.E.Hart and D.G.Stork, *Pattern Classification*, John Wiley, 2001
4. C.M.Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006
5. Christopher M. Bishop, *Neural Networks for Pattern Recognition*, Clarendon Press – Oxford, 1995.

Elective 2 - MPhlCSIP: Digital Image Processing

OBJECTIVES:

1. To gain knowledge of the various characteristics and aspects of digital images.
2. To learn to apply spatial and frequency filters for intensity and image enhancements.
3. To learn the methods of image compression and restoration.
4. To learn the basics of colour image processing.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
2. Explain the basics of colour image processing.
3. Understand simple image enhancement techniques in spatial and frequency domains.
4. Understand the concept of filters.
5. Explain image compression and restoration techniques.

Unit	Course Content	L	P	T
1	**Introduction:** Steps in Image Processing – Image Acquisition, representation, sampling and quantization, relationship between pixels – colour models, basics of colour image processing.	15	-	5
2	**Image Enhancement in spatial domain:** Some basic gray level transformations – Histogram processing – Enhancement using Arithmetic and logic operations – basics of spatial filtering and smoothing.	15	-	5
3	**Image Enhancement in frequency domain:** Introduction to fourier transform – 1D, 2D, DFT and its inverse transform, smoothing and sharpening filters.	15	-	5
4	**Image Restoration:** Model of degradation and restoration process – noise models – restoration in the presence of noise – periodic noise reduction – image segmentation – thresholding and region based segmentation.	15	-	5
5	**Image Compression:** Models – Information Theory – Error free compression – Lossy compression – predictive and transform coding, JPEG Standard.	15	-	5
Total		**75**	**-**	**25**

REFERENCE BOOKS

1. R.C. Gonzalez, R.E. Woods, *Digital Image Processing*, 2nd Edition, Pearson Education, 2002.
1. Pratt W.K., *Digital Image Processing*, John Wiley and Sons, 3rd Edition.
2. Rosenfled A. and Kak A. C., *Digital Picture Processing*, Vol. I and II, Academic Press, 1982.
3. Anil K. Jain, *Fundamental of Digital Image Processing*, 2nd Edition, Prentice Hall of India, New Delhi, 1994.

Elective 3 – MPhlCSLP: Natural Language Processing

OBJECTIVES:

1. To learn the basic concepts of natural language processing and the associated mathematical concepts.
2. To learn the concept of parsing of context-free grammars with respect to English.
3. To learn lexical, syntactic and semantic processing concepts for English language processing.
4. To understand the complexities and methods of word sense disambiguation.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand language models and algorithms.
2. Understand the use of automata in English language parsing.
3. Learn the various classes of words and parts of speech in English and to understand the method of tagging PoS.
4. Learn to represent English as a context-free grammar.
5. Understand how to parse sentences in the lexical, morphological, syntactic and semantic levels.
6. Understand the challenges and solutions in word sense disambiguation.
7. Understand the techniques used for machine translation.

Unit	Course Content	L	P	T
1	**Introduction:** Knowledge in speech and language processing – Ambiguity – Models and Algorithms – Language, Thought and Understanding. Regular Expressions and automata: Regular expressions – Finite-State automata. Morphology and Finite - State Transducers: Survey of English morphology – Finite-State Morphological parsing – Combining FST lexicon and rules – Lexicon – Free FSTs: The porter stammer – Human morphological processing.	15	-	5
2	**Word classes and part-of-speech tagging:** English word classes – Tagsets for English – Part-of- speech tagging – Rule-based part-of-speech tagging – Stochastic part-of-speech tagging – Transformation-based tagging – Other issues. Context-Free Grammars for English: Constituency – Context-Free rules and trees – Sentence-level constructions – The noun phrase – Coordination – Agreement – The verb phrase and sub categorization – Auxillaries – Spoken language syntax – Grammars and human processing. **Parsing with Context-Free Grammars:** Parsing as search – A Basic Top-Down parser – Problems with the basic Top-Down parser – The early algorithm – Finite-State parsing methods.	15	-	5
3	**Features and Unification:** Features structures – Unification of feature structures – Features structures in the grammar – Implementing unification – Parsing with unification constraints – Types and Inheritance. **Lexicalized and Probabilistic Parsing:** Probabilistic context-free grammar – problems with PCFGs – Probabilistic lexicalized CFGs – Dependency Grammars – Human parsing.	15	-	5
4	**Representing Meaning:** Computational desiderata for representations – Meaning structure of language – First order predicate calculus – Some linguistically relavant concepts – Related representational approaches – Alternative approaches to meaning. Semantic Analysis:	15	-	5

	Syntax-Driven semantic analysis – Attachments for a fragment of English – Integrating semantic analysis into the early parser – Idioms and compositionality – Robust semantic analysis. **Lexical semantics:** relational among lexemes and their senses – WordNet: A database of lexical relations – The Internal structure of words – Creativity and the lexicon.			
5	**Word Sense Disambiguation and Information Retrieval:** Selectional restriction – based disambiguation – Robust word sense disambiguation – Information retrieval – other information retrieval tasks. Natural language Generation: Introduction to language generation – Architecture for generation – Surface realization – Discourse planning – Other issues. **Machine Translation:** Language similarities and differences – The transfer metaphor – The interlingua idea: Using meaning – Direct translation – Using statistical techniques – Usability and system development.	15	-	5
Total		**75**	**-**	**15**

REFERENCE BOOKS

1. Daniel Jurafsky and James H.Martin, *Speech and Language Processing*, Pearson Education, 2002.
2. James Allen, *Natural Language Understanding*, Pearson Education, 2003.

Elective 4 – MPhlCSCN: Cryptography and Network Security

OBJECTIVES:

1. To learn the evolution of cryptographic systems.
2. To understand public key encryption standards, algorithms and protocols.
3. To learn the concepts of message authentication and intrusion detection methods.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the important role of cryptography in network security.
2. Learn various encryption techniques from classical to modern.
3. Understand the important aspects of number theory used in cryptography.
4. Understand the RSA algorithm and connected protocols.
5. Learn the importance of message authentication and understand the secure hash algorithm.
6. Explain the various authentication protocols.
7. Explain the various intrusion detection mechanisms.

Unit	Course Content	L	P	T
1	**Introduction:** OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality	15	-	5
2	**Key Management:** Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.	15	-	5
3	**Authentication:** Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard	15	-	5
4	**Authentication Applications:** Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.	15	-	5
5	**Intrusion Detection:** – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.	15	-	5
Total		**75**	**-**	**15**

REFERENCE BOOKS

1. William Stallings, *Cryptography and Network Security – Principles and Practices*, Prentice Hall of India, Third Edition, 2003.
2. Atul Kahate, *Cryptography and Network Security*, Tata McGraw-Hill, 2003.
3. Bruce Schneier, *Applied Cryptography*, John Wiley & Sons Inc, 2001.
4. Charles B. Pfleeger, Shari Lawrence Pfleeger, *Security in Computing*, Third Edition, Pearson Education, 2003.

Elective 5 – MPhlCSDM: Data Mining and Data Warehousing

OBJECTIVES:

1. To appreciate the types of problems for which Data Mining is used.
2. To learn how data mining is done, the various issues involved in Data Mining, and how to handle them.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the concept of data discovery in various types of databases, and the need for data mining.
2. Understanding the various methods of data preprocessing.
3. Understand how to perform data reduction and discretization.
4. Learn the rules and algorithms involved in association rule mining.
5. Understand the issues involved and methods used for classification and prediction.
6. To understand the different methods used for clustering.
7. To understand the concepts of web, spatial and temporal data mining.

Unit	Course Content	L	P	T
1	**Introduction:** Data Mining tasks – Data Mining versus Knowledge Discovery in Data bases – Relational databases – Data warehouses – Transactional databases – Object oriented databases – Spatial databases – Temporal databases – Text and Multimedia databases – Heterogeneous databases - Mining Issues – Metrics – Social implications of Data mining.	15	-	5
2	**Data Preprocessing:** Why preprocess the data – Data cleaning – Data Integration – Data Transformation – Data Reduction – Data Discretization.	15	-	5
3	**Data Mining Techniques:** Association Rule Mining – The Apriori Algorithm – Multilevel Association Rules – Multidimensional Association Rules – Constraint Based Association Mining.	15	-	5
4	**Classification and Prediction:** Issues regarding Classification and Prediction – Decision Tree induction – Bayesian Classification – Back Propagation – Classification Methods – Prediction – Classifiers accuracy.	15	-	5
5	**Clustering Techniques:** Cluster Analysis – Clustering Methods – Hierarchical Methods – Density Based Methods – Outlier Analysis – **Advanced Topics:** Web Mining, Spatial Mining and Temporal Mining.	15	-	5
Total		**75**	**-**	**15**

REFERENCE BOOKS

1. J. Han and M. Kamber, *Data Mining: Concepts and Techniques*, Morgan Kaufmann, New Delhi, 2001.
2. M. H.Dunham, *Data Mining: Introductory and Advanced Topics*, Pearson Education, Delhi, 2003.
3. Paulraj Ponnaiah, *Data Warehousing Fundamentals*, Wiley Publishers, 2001.

Elective 6 – MPhlCSNN: Artificial Neural Networks

OBJECTIVES:

1. To learn the fundamental theory and concepts of neural networks for creating computationally intelligent systems.
2. To understand the architecture, learning algorithms and issues of various feed forward and feed backward neural networks.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the need and basic concepts of neural networks.
2. Describe the various neural computational models.
3. Understand supervised and unsupervised learning methods.
4. Understand how to train a neural nework.
5. Explain the architecture of feed-forward and feed-backward neural networks.
6. Find the output of a neural network using various methods, given the inputs, input weights and learning rule.
7. Describe the different neural network models.
8. Understand the basic concepts of pattern recognition using neural networks.

Unit	Course Content	L	P	T
1	**Introduction to Neural Networks:** Basic Concepts of Neural Networks – Interface and Learning – Classification Models – Association Models – Optimization Models – Self –Organisation Models.	15	-	5
2	**Supervised and Unsupervised Learning:** Statistical Learning – All Learning – Neural Network Learning – Rule Based Neural Networks - Network Traning – Network Revision – Issues – Theory of Revision – Decision Tree Based NN – Constraint Based NN.	15	-	5
3	**Incremental Learning:** Mathematical Modeling – Application of NN – Knowledge based Applications.	15	-	5
4	**Heuristics:** Hierarchical Models – Hybrid Models – Parallel Models – Differentiation Models – Control Networks – Symbolic Methods – NN Methods.	15	-	5
5	**Structures and Sequences:** Spatio-temporal NN – Learning Procedures – Knowledge based Applications.	15	-	5
Total		**75**	**-**	**15**

REFERENCE BOOKS

1. Limin Fu, *Neural Networks in Computer Intelligence*, McGraw Hill International Edition, 1994.
2. Robert J Schakof, *Artifical Neural Networks*, McGraw Hill, 1997.
3. Anderson, *An Introduction to Neural Networks*, PHI, 2001.
4. Christopher M. Bishop, *Neural Networks for Pattern Recognition*, Clarendon Press – Oxford, 1995.

Elective 7 - MPhlCSPP: Distributed Parallel Processing

OBJECTIVES:

1. To understand the different parallel processor architectures and interconnecting networks.
2. To understand how to design parallel algorithms and languages.
3. To understand the concepts of distributed systems.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Explain the various parallel processor architectures.
2. Explain the different types of interconnection networks.
3. Understand the design of parallel algorithms.
4. Explain the features and constructs of parallel languages.
5. Explain the various concepts and models of distributed systems with specific case study.
6. Understand the design and implementation of distributed file system.

Unit	Course Content	L	P	T
1	**Parallel Architecture:** Pipelining, vector processors, array processors, multiprocessor architectures, data flow architectures, systolic architectures – Basis concepts – examples.	15	-	5
2	**Interconnecting Networks:** Single stage, Multistage interconnection networks, cube, mesh shuffle exchange, pyramid, butterfly networks.	17	-	5
3	**Parallel Algorithms and Languages:** Design of parallel algorithms, sorting, FFT, dictionary operation, graph algorithms, parallel languages – features, constructs.	18	-	5
4	**Distributed Systems:** Models, Hardware concepts, communication, synchronization mechanism. Case Study: MPI and PVM.	15	-	5
5	**Distributed File Systems:** Design, implementation, trends in distributed file systems.	10	-	5
	Total	**75**	**-**	**25**

REFERENCE BOOKS:

1. Hwang. K., *Advanced Computer architecture: Parallelism, scalability, Programmability*, Tata McGraw Hill, 1993.
2. Joel M. Crichlow, *An Introduction to Distributed and Parallel Computing*, Prentice Hall of India, New Delhi, 1997
3. Hwang. K, Briggs. F.A., *Computer Architecture and Parallel processing* , Tata McGraw Hill , 1995
4. Quinn, M.J., *Designing efficient algorithms for parallel computers*, McGraw Hill, 1995.
5. Tanenbaum A.S, *Modern Operating Systems*, Prentice Hall, N.J., 1999.
6. Culler, D.E., *Parallel Computer Architecture: A Hardware – Software approach*, Harcourt Asia Pte. Ltd., 1999.

Elective 8 - MPhlCSGI: Geographic Information Systems

OBJECTIVES:

1. To understand the basic principles and techniques of geographic information systems.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the basic concepts and applications of geographic information systems.
2. Explain the important principles of geographic information systems.
3. Understand geographic data modeling.
4. Explain the methods used for analysis of GIS.
5. Understand the policies and management aspects involved with GIS.

Unit	Course Content	L	P	T
1	**Introduction**: System, Science and Study – A gallery of applications – Science, Geography and Applications, Representative application areas and their foundation	8	-	5
2	**Principles**: Representing geography – The nature of geographic data - Georeferencing – Uncertainty	10	-	5
3	**Techniques**: GIS Software - Geographic data modeling - GIS data collection - Creating and maintaining geographic databases – Distributed GIS	20	-	5
4	**Analysis**: Cartography and map production – Geovisualization - Query, measurement, and transformation - Descriptive summary, design, and inference - Spatial modeling with GIS	20	-	5
5	**Management and Policy**: Managing GIS - GIS and management, the Knowledge Economy, and information - Exploiting GIS assets and navigating constraints - GIS partnerships	17	-	5
	Total	**75**	**-**	**25**

REFERENCE BOOKS

1. Longley, P.A., Goodchild, M.F., Maguire, D.J., and Rhind, D.W., *Geographic Information Systems and Science*, John Wiley & Sons, Inc. 2011.
2. Ormsby, T., Napoleon, E., Burke, R., Groessl, C., and Feaster, L., *Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo*. ESRI Press, 2010.
3. Chang, K., *Introduction to GIS*.6th, McGraw-Hill, NY, 2011
4. DeMers, M.N., *Fundamentals of Geographic Information Systems*, John Wiley & Sons, Incorporated, 2009
5. Heywood, I. Cornelius, S., and Carver, S., *Introductory Geographic Information Systems*, 4th Edition, 2012

Elective 9 - MPhlCSCI: Human Computer Interaction

OBJECTIVES:

1. To gain an understanding of the concepts relating to the design of human-computer interfaces.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand how the field of HCI evolved.
2. Learn the software engineering concepts required for interactive system design.
3. Understand the different types of models & laws required for design and evaluation.
4. Learn the various rules and principles, which serve as guidelines for HCI.
5. Explain the empirical research methods and task models used for HCI.
6. Understand dialog design using FSMs, State charts and Petri Nets.
7. Understand the design of HCI using specific case studies.

Unit	Course Content	L	P	T
1	**Introduction**: Historical evolution of the field **Interactive system design (theory and practice)**: Concept of usability - definition and elaboration - HCI and software engineering - GUI design and aesthetics - Prototyping techniques **Model-based Design and evaluation**: Basic idea, introduction to different types of models	15	-	5
2	**Model-based Design and evaluation** : GOMS family of models (KLM and CMN-GOMS) - Fitts' law and Hick-Hyman's law - Model-based design case studies **Guidelines in HCI**: Shneiderman's eight golden rules - Norman's seven principles - Norman's model of interaction - Nielsen's ten heuristics with example of its use - Heuristic evaluation - Contextual inquiry - Cognitive walkthrough	15	-	5
3	**Empirical research methods in HCI**: Introduction (motivation, issues, research question formulation techniques) - Experiment design and data analysis (with explanation of one-way ANOVA) **Task modeling and analysis**: Hierarchical task analysis (HTA) - Engineering task models and Concur Task Tree (CTT)	15	-	5
4	**Dialog Design**: Introduction to formalism in dialog design, design using FSM (finite state machines) - State charts and (classical) Petri Nets in dialog design **Cognitive architecture**: Introduction to CA, CA types, relevance of CA in IS design - Model Human Processor (MHP)	15	-	5
5	**Object Oriented Programming**: OOP- Introduction - OOM- Object Oriented Modeling of User Interface Design **Design - Case Studies**: Case Study 1- Multi-Key press Hindi Text Input Method on a Mobile Phone - Case Study 2 -Interface on mobile device for Doctors during emergency - Mobile Application for employment of construction workers	15	-	5
	Total	**75**	**-**	**25**

BOOKS FOR REFERENCE

1. Dix A., Finlay J., Abowd G. D. and Beale R., *Human Computer Interaction*, 3rd Edition, Pearson Education, 2005.
2. Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T., *Human Computer Interaction*, Addison-Wesley, 1994.
3. B. Shneiderman, *Designing the User Interface*, Addison Wesley 2000 (Indian Reprint).

4. Jacob Nieilsen, *Usability Engineering*, Morgan Kaufmann - Academic Press, London, 1993.

Semester II / Year II

MPhlCSPR: Project Dissertation

OBJECTIVES:

1. To gain real-time experience in software project development in a production environment.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand how to execute a software project from scratch to delivery and deployment.
2. Understand the various processes involved in the engineering of software through practical implementation.
3. Understand how to develop a software solution for the given large problem.
4. Write a project report that incorporates all the stages of software engineering and processes involved in the project.

MPhlCSPV: Project Viva-Voce

OBJECTIVES:

1. To learn to present project work done.

OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand how to make an effective presentation of the project work.
2. Explain the project work and answer technical questions on the work done.