Centre for Distance and Online Education (CDOE)
Open and Distance Learning Programmes

Programme Structure

(2025-26)

Programme Name – M.Sc. Computer Science **Programme Code - ODLMSCS**

SEMESTER- I

S. No.	Course Code	Course Title	Type of Course	Credits
1	6.0 ODLCSC01	Advanced Algorithms	CC	4
2	6.0 ODLCSC02	Machine Learning	CC	4
3	6.0 ODLCSC03	Big Data Analytics	CC	4
4	6.0 ODLCSC04	Data Mining and Warehousing	CC	4
5		Elective*	OE	4
			Total Credits	**20**

SEMESTER- II

S.No	Course Code	Course Title	Type of Course	Credits
1	6.0 ODLCSC05	Natural Language Processing	CC	4
2	6.0 ODLCSC06	Neural Networks & Deep Learning	CC	4
3	6.0 ODLCSC07	Major Project	SEC	12*
			Total Credits	**20**

SEMESTER- III

S.NO	Course Code	Course Title	Type of Course	Credits
1	6.5 ODLCSC01	Image Processing & Computer Vision	CC	4
2	6.5 ODLCSC02	Software Agent and Swarm Intelligence	CC	4
3		Elective*	DE	4
4		Elective*	DE	4
5		Elective*	OE	4
			Total Credits	**20**

SEMESTER- IV

S.No	Course Code	Course Title	Type of Course	Credits
1	6.5 ODLCSC03	Project Work in Industry or Institution	CC	20
			Total Credits	**20**

Total Programme Credits : 80

Detailed Syllabus

Semester-I

Total Credits: 20

Course Title: Advanced Algorithms (6.0 ODLCSC01) **Credits :04**	
UNIT I	Design Paradigms Overview: Overview of complexity notations, Divide and Conquer method, Greedy and Dynamic Programming.
UNIT II	Backtracking, Branch and Bound, Max Flow Problem, String Matching etc.
UNIT III	Brief overview of Notations and Recurrence analysis, Amortized analysis, B- Trees, AVL trees
UNIT IV	Dictionaries and tries, Binomial Heaps, Fibonacci Heaps, Disjoint Sets, Union by Rank and Path Compression
UNIT V	Randomized Algorithms and Parallel Algorithms: Randomized Algorithms: Las Vegas and Monte Carlo algorithms, Applications on graph problems, Finger Printing, Pattern Matching, Primality testing algorithm
UNIT VI	Introduction, Combinatorial optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, subset-sum problem etc., Analysis of the expected time complexity of the algorithms

Reference Books:

1. Introduction to Algorithms: T.H. Cormen, C.E.Leiserson and R.L. Rivest
2. Fundamentals of Algorithmics : G.Brassard and P.Bratley
3. Approximation Algorithms: Vijay V.Vazirani
4. Randomized Algorithms: R. Motwani and P.Raghavan
5. Parallel Computing: Theory and Practice: M. J. Quinn
6. Introduction to Parallel Computing: T. G. Lewis and H. El-Rewini

Course Title: Machine Learning (6.0 ODLCSC02) **Credits :04**	
UNIT I	Basics: Introduction to Machine Learning - Different Forms of Learning, Basics of Probability Theory, Linear Algebra and Optimization. Regression Analysis: Linear Regression, Ridge Regression, Lasso, Bayesian Regression, Regression with Basis Functions.
UNIT II	Classification Methods: Instance-Based Classification, Linear Discriminant Analysis, Logistic Regression, Large Margin Classification, Kernel Methods, Support Vector Machines, Multi-class Classification, Classification and Regression Trees.
UNIT III	Neural Networks: Non-linear Hypotheses, Neurons and the Brain, Model Representation, Multi-layer Networks, Back-propagation, Multi-class Discrimination, Training Procedures, Localized Network Structure, Deep Learning.

UNIT IV	Graphical Models: Hidden Markov Models, Bayesian Networks, Markov Random Fields, Conditional Random Fields. Ensemble Methods:Boosting - Adaboost, Gradient Boosting, Bagging - Simple Methods, Random Forest.
UNIT V	Clustering:Partitional Clustering - K-Means, K-Medoids, Hierarchical Clustering - Agglomerative, Divisive, Distance Measures, Density Based Clustering – DBscan, Spectral Clustering.
UNIT VI	Dimensionality Reduction: Principal Component Analysis, Independent Component Analysis, Multidimensional Scaling, and Manifold Learning. Reinforcement Learning: Q-Learning, Temporal Difference Learning

Reference Books:

1. Pattern Recognition and Machine Learning: Christopher Bishop
2. Machine Learning: Tom Mitchell
3. Pattern Classification: R.O. Duda, P.E. Hart and D.G. Stork
4. Data Mining: Tools and Techniques: Jiawei Han and Michelline Kamber

Course Title: Big Data Analytics (6.0 ODLCSC03) **Credits :04**	
UNIT I	Introduction to Big Data, Types of Digital Data, Characteristics of Data, Evolution of Big Data, Data Storage and Analysis, Characteristics of Big Data, Big Data Architecture, Requirement for new analytical architecture, Challenges in Big Data analytics, Need of big data frameworks.
UNIT II	Requirement of Hadoop Framework, Design principle of Hadoop, Comparison with other system, Hadoop Components, Hadoop versions, HDFS, Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, secondary sorting, Pipelining MapReduce jobs.
UNIT III	Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm.
UNIT IV	MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.
UNIT V	Spark Framework, Writing Spark Application, Spark Programming in Scala, Python, R, Java, Application Execution.
UNIT VI	SQL Context, Importing and Saving data, Data frames using SQL, GraphX overview, Creating Graph, Graph Algorithms.

Reference Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytics Trends for Today's Businesses, John Wiley & Sons, 2013.
2. Mike Framton, "Mastering Apache Spark", Packt Publishing, 2015.
3. TomWhite,"Hadoop:The Definitive Guide",O'Reilly,4thEdition,2015.

4. NickPentreath,Machine Learning with Spark,Packt Publishing,2015.
5. Mohammed Guller, Big Data Analytics with Spark, Apress,2015.
6. Donald Miner, Adam Shook, “Map Reduce Design Pattern”, O’Reilly, 2012.

Course Title: Data Mining and Warehousing (6.0 ODLCSC04) **Credits :04**	
UNIT I	Fundamentals of Data Mining: Data Mining, History of Data Mining, Data Mining Strategies, Data Mining Techniques, KDD process, Applications of Data Mining, Challenges and Future of data mining. Data Preprocessing and Data Warehousing: Data, information, knowledge, and intelligence, Types of data, Data warehouses, Data cleaning, Data de-normalization, Data transformation, Data quality measures, OLAP technology, OLAP vs OLTP. Data Sampling.
UNIT II	The Classification Task: Introduction to classification, Decision trees, Random forests, Naïve Bayes’, K-NN, SVM, ANNs, applications of classification. Model evaluation techniques- ROC, Lift Charts, cost and utility, Parsimony, Bagging and Boosting, The model ranking approach.
UNIT III	The Clustering Task: Introduction to clustering, Distance measures, types of clustering-hierarchical: agglomerative and divisive, Non-hierarchical: Partition based, Density based, Probability based, K-means clustering, Self-organizing concept, self-organizing maps, SOM algorithm, cluster validation, strength and weaknesses of clustering algorithms, applications of clustering.
UNIT IV	Association Rule Mining: Concepts of association rules, relevance and functions of association rules, the problem of large data set, Apriori algorithm, scalable association rule mining-FP-Growth algorithm, Applications of ARM, strength and weaknesses of ARM.
UNIT V	Information Retrieval: Boolean Retrieval, The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms. Dictionaries and tolerant retrieval: Search structures for dictionaries, spelling correction. Scoring, term weighting and vector space model, the vector space model for scoring, variant tf-idf functions.
UNIT VI	Computing scores in a complete search system: Efficient scoring and ranking, components of an information retrieval system. Evaluation in information retrieval. Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, global methods for query reformulation.

Reference Books:

1. Data Mining Concepts & techniques: Jai wei Han and Micheline Kamber, Morgan Kaufman.
2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press.
3. Data Mining Techniques : Arun K. Pujari, Universities Press, Fourth Edition, ck and ps2016.
4. Mastering Data Mining: M. Berry and G. Linoff, John Wiley & Sons., 2000.
5. Data Mining: Methods and Techniques: A B M Shawkat Ali, Saleh A. Wasimi, 2009, Cengage Learning.

Semester-II

Course Title: Natural Language Processing (6.0 ODLCSC05) **Credits :04**	
UNIT I	Introduction to Natural Language Understanding: The study of Language, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems.
UNIT II	Linguistic Background: An outline of English syntax.
UNIT III	Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing, Morphological Analysis and the Lexicon.
UNIT IV	Parsing with Features, Augmented Transition Networks, Various Lexicon Resource & Knowledge Source, Study of Word Net and Indo Net.
UNIT V	Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars, Hold mechanisms in ATNs. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser, Study of POS Tagger, Stemmer
UNIT VI	Ambiguity Resolution: Statistical Methods, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form: Word senses and Ambiguity, Encoding Ambiguity in Logical Form. Discourse Analysis and Pragmatic Analysis.

Reference Books:

1. JAMES ALLEN, Natural Language Understanding, 2/e, Pearson Education, 2003.
2. D. JURAFSKY, J. H. MARTIN, Speech and Language Processing, Pearson Education, 2002.
3. CHRISTOPHER D. MANNING, HINRICH SCHÜTZE, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts.1999.
4. U. S. TIWARY, TANVEER SIDDIQUI, Natural Language Processing and Information Retrieval, Oxford University Press (2008).
5. AKSHAR BHARATI, VINEET CHAITANYA, RAJEEV SANGAL, Natural Language Processing: A Paninian Perspective.

Course Title: Neural Networks & Deep Learning (6.0 ODLCSC06) **Credits :04**	
UNIT I	Overview of biological neurons: Structure of biological neurons relevant to ANNs. Fundamental concepts of Artificial Neural Networks: Models of ANNs; Feed-forward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all learning rule, etc.
UNIT II	Single layer Perception Classifier: Classification model, Features & Decision regions; training & classification using discrete perceptron algorithm, single layer continuous perceptron networks for linearly separable classifications.

UNIT III	Multi-layer Feed forward Networks: linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, generalized delta learning rule, Error back-propagation training, learning factors, Examples. Single layer feedback Networks: Basic Concepts, Hopfield networks, Training & Examples
UNIT IV	Self-Organizing Networks: Introduction, Self-organizing concept, self-organizing maps, SOM algorithm, adaptive resonance theory (ART), ART algorithm, and variations of ART algorithm. Adaptive pattern classification.
UNIT V	Associative memories: Linear Association, Basic Concepts of recurrent. Auto associative memory: retrieval algorithm, storage algorithm; Bi-directional associative memory, Architecture, Association encoding & decoding, and Stability.
UNIT VI	Introduction to Deep Learning: Deep learning vs. machine learning, significance of deep learning, deep neural networks vs. traditional neural networks. Convolutional neural networks (CNNs): convolution, pooling, padding, and stride. Image classification using CNNs.

Reference Books:

1. Neural networks a comprehensive foundation, Simon Haykin, Pearson Education 2nd Edition 2004.
2. Artificial neural networks - B.Vegnanarayana Prentice Halll of India P Ltd 2005
3. Neural networks in Computer intelligence, Li Min Fu TMH 2003
4. “Neural Networks, Fuzzy Logic and Genetic Algorithms”, S. Rajasekaran and G. A. V. Pai, PHI, 2003.
5. Introduction to artificial neural systems”, Jacek M. Zurada, 1994, Jaico Publ. House.

Semester-III

Course Title: Image Processing & Computer Vision (6.5 ODLCSC01) **Credits :04**	
UNIT I	Overview of image processing systems, Image formation and perception, Continuous and digital image representation, Image quantization: uniform and non-uniform, visual quantization (dithering).
UNIT II	Image contrast enhancement: linear and non-linear stretching, histogram equalization, Continuous and discrete-time Fourier Transforms in 2D; and linear convolution in 2D.
UNIT III	Image smoothing and image sharpening by spatial domain linear filtering; Edge detection, Discrete Fourier transform in 1D and 2D, and image filtering in the DFT domain.
UNIT IV	Median filtering and Morphological filtering, Color representation and display; true and pseudo color image processing, Image sampling and sampling rate conversion (resize).
UNIT V	Image segmentation and Feature Extraction Various methods of image segmentation, edge detection, object proposals, SIFT features. Multi-view Geometry (2 weeks) Shape from stereo and motion, feature matching, surface fitting, Active ranging Object Recognition: Traditional Methods HoG/SIFT features, Bayes classifiers, SVM classifier.
UNIT VI	Object Recognition: Deep Learning Methods : Image classification, object detection and semantic segmentation, adversarial attacks. Various neural network architectures, visualization techniques. Motion analysis and Activity Recognition: Motion detection and tracking, Inference of human activity from image sequences.

Reference Books:

1. Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall, 2011.
2. Emanuele Trucco and Alessandro Verri, “Introductory Techniques for 3-D Computer Vision”, Prentice Hall, 1998.
3. Olivier Faugeras, “Three Dimensional Computer Vision”, MIT Press, 1993.
4. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011
5. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, CL Engineering, 2013.

Course Name: Software Agent and Swarm Intelligence (6.5 ODLCSC02) **Credits :04**	
UNIT I	Introduction to Software Agents: Software agents in business and private area, Economic potential, Definition, Characteristics, Classification.
UNIT II	Areas of Influence of software agents

	Architecture – BDI architecture, Deliberative agent architecture, Architecture of Reactive agent, A few existing architectures. Mobile architecture – Remote programming, Remote procedure call, Advantages and disadvantages, Technical implementations, Layers of base software, Migration, A few existing architectures – Rao-Georgeff BDI architecture, Brooks Subsumption architecture, Muller Interrap architecture.
UNIT III	Communication – Distributed problem solving, Communication methods: Blackboard, Messege passing, KQML. Cooperation Protocols - Contract net systems, Partial Global Planning, Negotiations, Matching and brokering. Learning and Planning, Security.
UNIT IV	Honey Bee Colony – Introduction, Decentralized decision making, Where to forage?, Exploration, Exploitation method, Waggle dance, Where to live?, House hunting, Ant Colony Optimization – Introduction, ACO modelling, Solving travelling salesman problem using ACO.
UNIT V	Particle Swarm Optimization – PSO modelling, Variants of PSO, Applications, Introduction to Swarm Robotics.
UNIT VI	Monopolistic competition — general and Chamberlin approaches to equilibrium, equilibrium of the firm and the group with product differentiation and selling costs, excess capacity under monopolistic and imperfect competition,

Reference Books:

1. Intelligent software agents: foundations and applications by Walter Brenner, Rudiger Zarnekow, Hartmut Witting Springer, 1998.
2. Swarm intelligence: introduction and applications By Christian Blum, Daniel Merkle., Springer 2008.