PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018
(AUTONOMOUS)
REGULATIONS 2023

Ph.D – Course Work Elective

S.No.	Course Code	Course Title	L	T	P	C
1	PCR2301	Machine Learning Techniques	3	0	0	3
2	PCR2302	Deep Learning Techniques	3	1	0	4
3	PCR2303	Data Analytics	3	0	0	3
4	PCR2304	Block Chain Technologies	3	0	0	3
5	PCR2305	Randomized Algorithms	3	0	0	3

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Computer Science & Engineering
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PCR2301	MACHINE LEARNING TECHNIQUES	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn the various regression methods.
2	acquire the knowledge in supervised learning techniques
3	gain the knowledge of ANN and Genetic algorithm techniques
4	impart the unsupervised learning techniques
5	design appropriate ensemble learning algorithms for problem solving

UNIT I	STATISTICAL THEORY AND REGRESSION	9

Linear methods for Regression - Gauss-Markov theorem, Multiple regression; Subset selection; Ridge regression; Principal components regression; Partial least squares; Linear discriminant analysis; Logistic regression.

UNIT II	SUPERVISED LEARNING	9

Decision Tree Learning - Issues in Decision tree Learning; Bayes Theorem - Concept Learning; Maximum Likelihood; Minimum Description Length Principle; Bayes Optimal Classifier; Gibbs Algorithm; Naive Bayes Classifier; Bayesian Belief Network; EM Algorithm.

UNIT III	ARTIFICIAL NEURAL NETWORKS AND GENETIC ALGORITHM	9

Introduction – Perceptron; Multilayer Networks and Back Propagation Algorithm; Remarks on the Back - Propagation Algorithm; Alternative Error Function, Alternative Error Minimization Procedures - Recurrent Networks, Instance Based Learning; Genetic Algorithm.

UNIT IV	UNSUPERVISED LEARNING	9

Association rules; Cluster analysis; Self organizing maps; Principal components, curves and surfaces; Non-negative matrix factorization; Independent component analysis; Multidimensional scaling.

UNIT V	RANDOM FORESTS AND ENSEMBLE LEARNING	9

Introduction -Details of Random Forests; Analysis of Random Forests; Ensemble Learning Introduction; Boosting and Regularization Paths; Learning Ensembles.

	TOTAL PERIODS	**45**

COURSE OUTCOMES

At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	compare and contrast about various regression methods.	Understanding (K2)
CO2	illustrate various supervised learning algorithms.	Apply (K3)
CO3	create and deploy deep neural network applications.	Analyze (K4)
CO4	synthesize the usage of unsupervised learning algorithms.	Apply (K3)
CO5	apply the appropriate ensemble learning strategy for any given problem	Understanding (K2)

REFERENCES

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer; Second Edition, 2009.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Second Edition, 2010.
4. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer; First Edition 2013.
5. Stephen Marsland, Machine Learning An Algorithmic Perspective, CRC Press Taylor &Francis Group, United States, Second Edition, 2015.

CO-PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes(POs)							
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	2	2	0	1	3	2
CO2	2	2	2	3	0	1	2	3
CO3	3	2	3	3	1	2	3	3
CO4	2	1	2	2	0	1	2	2
CO5	3	2	2	3	0	1	2	2

PCR2302	DEEP LEARNING TECHNIQUES	3	1	0	4

COURSE OBJECTIVES

To enable the students to

1	learn various parameters of deep learning model.
2	study about functional components of deep learning.
3	acquire knowledge of deep learning algorithms.
4	predict the uses of CNN and RNN.
5	apply deep learning Concepts

UNIT I	FOUNDATIONS OF DEEP LEARNING	12

Introduction - Math behind machine learning: Linear Algebra; Statistics, Machine Learning works; Logistic regression; Evaluating Models; Neural Networks; Training Neural Networks; Activation functions; Loss functions; Hyper parameters.

UNIT II	ARCHITECTURAL DESIGN	12

Defining Deep Learning — Common Architectural Principles of Deep Networks: Parameters, Layers, Activation functions, Loss functions, Optimization Algorithms, Hyper parameters; Building blocks of Deep Networks - RBMs, Autoencoders, Variational Autoencoders.

UNIT III	TYPES OF DEEP NETWORKS	12

Unsupervised pretrained Networks; Convolutional Neural Networks (CNNs); Recurrent Neural Networks; Recursive Neural Networks; Applications.

UNIT IV	CNN AND RNN	12

Convolutional Neural Networks: Applying Pooling layers; Optimizing with Batch Normalization; Understanding padding and strides; Experimenting with Different types of initialization; Implementing a convolutional auto encoder; Applying a 1D CNN to text; Recurrent Neural Networks: Implementing a simple RNN; Adding LSTM; Using GRUs; Implementing Bidirectional RNNs; Character-level text generation.

UNIT V	APPLICATIONS OF DEEP LEARNING	12

Large scale deep learning — Computer vision: Introduction —Augmenting images with computer Vision Techniques; Classifying objects in images; Speech recognition; Natural language processing: Analyzing sentiment; Translating Sentences.

	TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	experiment with the various parameters of deep learning model	Understanding (K2)
CO2	know the functional components of deep learning.	Apply (K3)
CO3	know the categories of deep learning algorithms	Analyze (K4)
CO4	understood the uses of CNN and RNN	Apply (K3)
CO5	develop the simple deep learning applications	Understanding (K2)

REFERENCES

1. Josh Patterson and Adam Gibson, "Deep Learning — A Practitioner's Approach", Ist Edition, O* Reilly Series, August 2017.
2. Indra den Bakker, "Python Deep Learning Cookbook", 1st Edition, Packt Publishing, October 2017.

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CO2	2	2	2	3	0	1	2	2
CO3	2	1	2	2	1	1	2	2
CO4	3	1	3	3	1	1	3	3
CO5	3	2	3	3	1	2	3	3

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PCR2303	DATA ANALYTICS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce data analytics and preparing the data.
2	impart knowledge on data summarization and visualization.
3	familiar with the types of machine learning and data streams.
4	learn big data frameworks.
5	learn the design of data analytics.

UNIT I	OVERVIEW OF DATA ANALYTICS	9

Data Analytics Life Cycle; Different types of Data; Different types of Data Analytics; Data Analytics Challenges; Application areas of Data Analytics; Introduction to Big Data, Characteristics of Big Data, Big data ecosystem.

UNIT II	DATA PREPARATION	9

Data Cleaning - Handle Missing Values, Handle Noise and Outliers, Remove Unwanted data; Data Transformation - Aggregation, Normalization, Discretization, Concept hierarchy generation; Generalization: Data Reduction, Dimensionality Reduction, Numerosity Reduction, Data Compression.

UNIT III	DATA SUMMARIZATION	9

Statistical data elaboration, Numerical Descriptive Measures - Central Tendency - Variation and Shape - Exploring Numerical Data - Numerical Descriptive Measures for a Population - Covariance and the Coefficient of Correlation - Summarizing Data through graphs.

UNIT IV	MINING DATA STREAMS	9

Introduction to Streams Concepts; Stream data model and architecture; Stream Computing, Sampling data in a stream; Filtering streams; Counting distinct elements in a stream; Estimating moments; Counting oneness in a window; Decaying window; Real-time Analytics Platform (RTAP)applications; case studies-real time sentiment analysis, stock market predictions.

UNIT V	BIG DATA TOOLS	9

Need of Big data tools - understanding distributed systems - Overview of Hadoop comparing SQL databases and Hadoop Eco System - Distributed File System: HDFS, Design of HDFS-writing files to HDFS, Reading files from HDFS.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	prepare the data for further use.	Understanding (K2)
CO2	apply the statistical analysis in big data.	Apply (K3)
CO3	understand and apply Supervised and Unsupervised learning approaches.	Analyze (K4)
CO4	understand Data stream mining concepts.	Apply (K3)
CO5	understand big data frameworks.	Understanding (K2)

REFERENCES

1. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets,2019,3rd edition,Cambridge University Press, New York.
2. Anderson D.R, Sweeney D.J, Williams T.A, (2019), Statistics for Business and Economics, 13th edition, Cengage Learning.
3. Bill Franks, Tamingthe Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, 2012, 1st edition, John Wiley and sons, Hoboken, New Jersey.
4. Glenn J.Myatt, Making Sense of Data, 2011,2nd edition, John Wiley and Sons, Hoboken, New Jersey.
5. Jiawei Han, MichelineKamber, Data Mining Concepts and Techniques, 2008, 2nd edition, Elsevier, India

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CO2	2	2	3	3	0	2	2	2
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CO4	2	1	2	2	1	1	2	2
CO5	2	1	2	3	1	1	3	2

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PCR2304	BLOCKCHAIN TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	study the basics of block chain technology.
2	understand about bitcoin and cryptocurrency.
3	learn the mechanisms of ethereum.
4	know the basics of hyperledger and solidity programming.
5	know about the applications of blockchain.

UNIT I	INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN	9

Introduction to Blockchain, Blockchain. Technology Mechanisms & Networks, Blockchain. Origins Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II	BITCOIN AND CRYPTOCURRENCY	9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III	INTRODUCTION TO ETHEREUM	9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT IV	INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING	9

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT V	BLOCKCHAIN APPLICATIONS	9

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	understand and explore the working of blockchain technology	Understanding (K2)
CO2	analyze the working of smart contracts	Apply (K3)
CO3	understand and analyze the working of Hyperledger	Analyze (K4)
CO4	apply the teaming of solidity to build de-centralized apps on Ethereum	Apply (K3)
CO5	develop applications on blockchain.	Understanding (K2)

REFERENCES

1. linran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Fclten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University.
3. Antonopoulos, Mastering Bitcoin, O'Rei1Iy Publishing, 2014.
4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017

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CO3	3	2	3	3	1	2	3	3
CO4	2	2	3	3	1	2	3	3
CO5	3	2	3	3	1	2	3	3

PCR2305	RANDOMIZED ALGORITHMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the mathematical foundations needed for understanding and designing algorithms
2	expose the inequalities and probabilistic methods
3	understand the concept of random walk and Algebraic techniques
4	expose the Data Structures and Graph algorithms
5	implement the Approximate counting and Parallel and distributed algorithms

UNIT I	INTRODUCTION, GAME-THEORETIC TECHNIQUES AND MOMENTS AND DEVIATIONS	9

Introduction-Min-Cut Algorithm, Binary Planar Partitions; Game-Theoretic Techniques-Game Tree Evaluation, The Minimax principle, Randomness and Non-uniformity; Moments And Deviations-Occupancy Problems, Markov and Chebyshev Inequalities, Randomized Selection, Two-point Sampling, Stable Marriage Problem and Coupon Collector's Problem.

UNIT II	TAIL INEQUALITIES AND THE PROBABILISTIC METHOD	9

Tail Inequalities-Chernoff Bound, Routing in a parallel Computer, A wiring Problem, Martingales; The Probabilistic Method- Overview, Maximum Satisfiability, Expanding Graphs, Lovasz Local Lemma and Method of Conditional Probabilities.

UNIT III	MARKOV CHAINS AND RANDOM WALKS AND ALGEBRAIC TECHNIQUES	9

Markov Chains and Random Walks-A 2-SAT Example, Markov Chains, Random Walks on Graphs, Electrical Networks, Cover Times, Graph Connectivity, Expanders and Rapidly Mixing Random Walks; Algebraic techniques-Fingerprinting and Freivalds Technique, verifying polynomial identities, perfect matchings in graphs, verifying equality of strings, pattern matching, Interactive proof systems.

UNIT IV	DATA STRUCTURES AND GRAPH ALGORITHMS	9

Data Structures-Fundamental Data-structuring problem, Random Treaps, Skip Lists, HashTables and Hashing; Graph algorithms-All-pairs Shortest Paths, Min-cut Problem, Minimum Spanning Trees.

UNIT V	APPROXIMATE COUNTING AND PARALLEL AND DISTRIBUTED ALGORITHMS	9

Approximate Counting-Randomized Approximation Schemes, DNF Counting Problem, Volume Estimation; Parallel and distributed algorithms-PRAM model and its sorting, Maximal Independent Sets, Perfect Matching, Choice Coordination Problem, Byzantine Agreement.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	identify the need for randomized algorithms	Understanding (K2)
CO2	discuss the different probabilistic method used for designing randomized algorithms	Analyzing (K4)
CO3	present the various paradigms for designing randomized algorithms	Understanding (K2)
CO4	design with data structures and graph algorithms	Creating (K6)
CO5	apply the techniques studied to design algorithms for different parallel	Applying (K3)

	and distributed algorithms	

REFERENCES

1. Rajeev Motwani and PrabhakarRaghavan, "Randomized Algorithms", 1st Edition, Cambridge University Press, Reprint 2010.
2. Michael Mitzenmacher and Eli Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis", 2007
3. Grimmett and Stirzaker, "Probability and Random Processes", Oxford, 2001.

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CO3	3	2	3	2	1	2	1	2
CO4	3	2	3	2	1	2	1	2
CO5	3	2	3	2	1	2	1	2