**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

## AD-601Deep Learning

Course Outcomes: After completion of the course students will be able to

**CO1: Understanding the basics concepts of deep learning.**
**CO2: Emphasizing knowledge of various deep learning algorithms.**
**CO3: Understanding of CNN and RNN to model real world applications.**
**CO4: Understanding of Deep Generative Models to model real world applications**
**CO5: Understanding the various challenges involved in designing deep learning algorithms for varied applications**

### Unit-I: Introduction to Deep Learning

Introduction to Deep Learning: Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts Neural Model, Linear Perceptron, Perceptron Learning, Feed Forward and Back Propagation Networks.

### Unit-II: Feedforward Networks

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.

### Unit-III: Convolutional Networks

Convolutional Networks: The Convolution Operation, Variants of the Basic Convolution Function, Structured Outputs, Efficient Convolution Algorithms, Random or Unsupervised Features, LeNet, AlexNet

### Unit-IV: Recurrent Neural Networks

Recurrent Neural Networks: Bidirectional RNNs, Deep Recurrent Networks Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs

### Unit-V: Deep Generative Models

Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Introduction to MCMC and Gibbs Sampling, Gradient computations in RBMs, Deep Belief Networks, Deep Boltzmann Machines

### APPLICATIONS

Image Processing, Speech Recognition, Natural Language Processing

REFERENCES


1. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Manning; Second Edition, 2021.

3. Navin Kumar Manaswi “Deep Learning with Applications Using Python”, Apress,2018.
4. Nikhil Buduma, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O’Reilly publications,2017.

LAB Experiments-

1. Write a Program to implement Linear Perceptron.
2. Write a Program to implement Multi-Layer Perceptron.
3. Write a Program to implementAutoencoders.
4. Write a Program to implement basic Convolutional Neural Network for Image Classification.
5. Write a Program to implement LeNet for image classification
6. Write a Program to implement AlexNet for image classification
7. Write a Program to implement RNN for text classification
8. Write a Program to implement LSTM for text prediction.
9. Write a Program to implementBoltzmann Machines for any real world classification problem.
10. Write a Program to implement restricted Boltzmann Machines for any real world classification problem.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

## AD-602 Computer Networks

Course Outcomes: After completion of the course students will be able to

1. Characterize and appreciate computer networks from the view point of components and from the view point of services (Knowledge & design of networks)
2. Understand the Concepts of Data link layerand its protocols and also about the working of MAC sublayer.

CO-3: Describe the essential principles of Network Layers and use IP addressing to createsubnets for any specific requirements.

CO-4. Design a Reliable Data Transfer Protocol and incrementally develop solutions for therequirements of Transport Layer.

CO-5: Select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS,Bit torrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols.

Unit –I:

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison withTCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations.

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data LinkLayer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat,

Hybrid ARQ.

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, DistributedRandom Access Schemes/Contention Schemes: for Data Services (ALOHA and SlottedALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA). IEEE Standards 802 series & their variant.

Unit-III

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least Cost-Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6.

Unit-IV

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement.

Unit-V

Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP),DNS, Network Management (SNMP).

Network Security: Introduction to security, Traditional Ciphers, Modern Ciphers, Message Integrity and Authentication.

References:

1.Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks” Pearson Education.
2 Douglas E Comer, “Internetworking WithTcp/Ip Principles, Protocols, And Architecture - Volume I”6th Edition, Pearson Education
3. DimitriBertsekas, Robert Gallager, “Data Networks”, PHI Publication, Second Edition.
4. Behrouz A. Forouzan, “TCP/IP protocol Suite” Fourth Edition, Tata Mc Graw Hill
5.Uyless Black, “Computer Networks”, PHI Publication, Second Edition.

List of Experiments:

1. Study of Different Type of LAN& Network Equipment.
2. Study and Verification of standard Network topologies i.e. Star, Bus, Ring etc.
3. LAN installations and Configurations.
4. Write a program to implement various types of error correcting techniques.
5. Write a program to implement various types of framing methods.
6. Study of Tool Command Language (TCL).
7. Study and Installation of Standard Network Simulator: N.S-2, N.S3.OpNet, QualNetetc .
8. Study & Installation of ONE (Opportunistic Network Environment) Simulator for High Mobility Networks.
9. Configure 802.11 WLAN.
10. Implement &Simulate various types of routing algorithm.
11. Study & Simulation of MAC Protocols like Aloha, CSMA, CSMA/CD and CSMA/CA usingStandard Network Simulators.
12. Study of Application layer protocols-DNS, HTTP, HTTPS, FTP and TelNet.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

## Departmental Elective – AD 603 (A) Data Mining and Warehousing

COURSE OBJECTIVES

1. Student should understand the value of Historical data and data mining in solving real-worldproblems.
2. Student should become affluent with the basic Supervised and unsupervised learning algorithmscommonly used in data mining.
3. Student develops the skill in using data mining for solving real-world problems.

Unit-I: Data Warehousing: Introduction, Delivery Process, Data warehouse Architecture, DataPre-processing: Data cleaning, Data Integration and transformation, Data reduction. Data warehouseDesign: Data warehouse schema, Partitioning strategy Data warehouse Implementation, Data Marts,Meta Data, Example of a Multidimensional Data model. Introduction to Pattern Warehousing.

Unit-II: OLAP Systems: Basic concepts, OLAP queries, Types of OLAP servers, OLAP operations etc.Data Warehouse Hardware and Operational Design: Security, Backup And Recovery.

Unit-III: Introduction to Data& Data Mining :Data Types, Quality of data, Data Pre-processing, Similaritymeasures, Summary statistics, Data distributions, Basic data mining tasks, Data Mining V/sknowledge discovery in databases. Issues in Data mining. Introduction to Fuzzy sets and fuzzylogic.

Unit-IV: Supervised Learning: Classification: Statistical-based algorithms, Distance-based algorithms,Decision tree-based algorithms, Neural network-based algorithms, Rule-based algorithms,Probabilistic Classifiers

Unit-V: Clustering & Association Rule mining: Hierarchical algorithms, Partitional algorithms, Clusteringlarge databases – BIRCH, DBSCAN, CURE algorithms. Associationrules: Parallel and distributedalgorithms such as Apriori and FP growth algorithms.

Books Recommended:

Text Books:

1. Pang – ningTan , Steinbach & Kumar, “Introduction to Data Mining”, Pearson Edu, 2019.
2. Jaiwei Han, MichelineKamber, “Data Mining : Concepts and Techniques”, Morgan KaufmannPublishers.

Reference Books:

1. Margaret H. Dunham, “Data Mining : Introductory and Advanced topics”, Pearson Edu., 2009.

2. Anahory& Murray, “Data Warehousing in the Real World”, Pearson Edu., 2009.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. Understand the need of designing Enterprise data warehouses and will be enabled to approachbusiness problems analytically by identifying opportunities to derive business.

CO2. Compare and contrast, various methods for storing & retrieving data from different data Sources/repository.

CO3. Ascertain the application of data mining in various areas and Pre-process the given data andvisualize it for a given application or data exploration/mining task

CO4. Apply supervised learning methods to given data sets such as classification and its various types.

CO5. Apply Unsupervised learning methods to given data sets such as clustering and its various types.

CO6 Apply Association rule Mining to various domains

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

## Departmental Elective – AD 603 (B) Digital Image Processing

Course Outcomes: After completion of the course students will be able to

CO1: Develop a theoretical foundation of fundamental Digital Image Processing concepts.
CO2: Apply transformation techniques for digital manipulation of images.
CO3: Understand and Apply Enhancement techniques on Digital Image.
CO4: Able to understand Segmentation & Compression Techniques on Digital Image.
CO5: Able to elaborate morphological techniques and advance techniques applicable for DIP

Unit-I Digital Image fundamentals, A simple image model, Sampling and Quantization. Relationship between pixels. Imaging geometry. Image acquisition systems, Different types of digital images

Unit-II Image transformations, Introduction to Fourier transforms, Discrete Fourier transforms, Fast Fourier transform, Walsh transformation, Hadmord transformation, Discrete Cosine Transformation.

Unit-III Image enhancement, Filters in spatial and frequency domains, Histogram based processing. Image subtraction, Averaging, Image smoothing, Nedion filtering, Low pass filtering, Image sharpening by High pass filtering.

Unit-IV Image encoding and segmentation, Encoding: Mapping, Quantizer, Coder. Error free compression, Lossy Compression schemes. JPEG Compression standard. Detection of discontinuation by point detection, Line detection, edge detection, Edge linking and boundary detection, Local analysis, Global processing via Hough transforms and graph theoretic techniques

Unit-V Mathematical morphology- Binary, Dilation, crosses, Opening and closing, Simple methods of representation, Signatures, Boundary segments, Skeleton of a region, Polynomial approximation, Recent advancement in DIP, Machine learning for image processing application

References:

1. Rafael C Gonzalez, Richard E Woods 3rd Edition, Digital Image Processing Pearson.
2. Rafael C Gonzalez, Richard E Woods 3rd Edition, Digital Image Processing using Matlab – TMH.
3. Sonka, Digital Image Processing & Computer Vision , Cengage Learning
4 Jayaraman, Digital Image Processing, TMH.
5. Pratt, Digital Image Processing, Wiley India
6 Annadurai, Fundamentals of Digital ImageProcessing , Pearson Education .

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

**Departmental Elective – AD 603 (C) Information Retrieval**

Course Outcomes: After completion of the course students will be able to

CO1: Understand the role of Information Retrieval on Web and Artificial Intelligence.
CO2: Comprehend the different space retrieval models in IR and pre-processing.
CO3: Able to understand the web architectures and crawling techniques.
CO4: Able to understand Link Analysis for Information Retrieval.
CO5: Able to elaborate text mining, Classification and clustering algorithms

Unit-I

Introduction - History of IR- Components of IR - Issues -Open source Search engine. Frameworks - The Impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a search engine, characterizing the web.

Unit -II

Boolean and Vector space retrieval models- Term weighting - TF-IDF weighting-cosinesimilarity - Pre-processing - Inverted indices - efficient processing with sparse vectors LanguageModel based IR - Probabilistic IR -Latent Semantic indexing - Relevance feedback and queryexpansion.

Unit- III

Web search overview, web structure the user paid placement search engine optimization, Web
Search Architectures - crawling - meta-crawlers, Focused Crawling - web indexes - Near duplicate detection - Index Compression - XML retrieval.

Unit -IV

Link Analysis -hubs and authorities - Page Rank and HITS algorithms -Searching and Ranking
Relevance Scoring and ranking for Web - Similarity - Hadoop & Map Reduce - Evaluation - Personalized search - Collaborative filtering and content-based recommendation of documents
And products - handling invisible Web - Snippet generation, Summarization. QuestionAnswering, Cross-Lingual Retrieval.

Unit -V

Information filtering: organization and relevance feedback - Text Mining- Text classification andclustering - Categorization algorithms, naive Bayes, decision trees and nearest neighbor - Clustering algorithms: agglomerative clustering, k-means, expectation maximization (EM).

References:

1. C. Manning, P. Raghvan and H Schutze: Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Ricardo Baeza -Yates and Berthier Ribeiro –Neto, Modern Information Retrieval The Concepts and Technology behind Search 2nd Edition, ACM Press Books 2011.
3. Bruce Croft, Donald Metzler and Trevor Strohman Search Engines Information Retrieval in Practice 1st Edition Addison Wesley, 2009
4. MarkLevene, An Introduction to Search Engines and Web Navigation, 2nd Edition Wiley 2010.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

## Open Elective AD 604 (A) Internet of Things

Course Objective:
The objective of this course is to provide an understanding of the technologies and the standardsrelating to the Internet of Things and to develop skills on IoT technical planning.

Unit I
IoT definition, Characteristics, IoT conceptual and architectural framework, Componentsof IoT ecosystems, Physical and logical design of IoT, IoT enablers, Modern day IoTapplications, M2M communications, IoT vs M2M, IoT vs WoT, IoT reference architecture, IoTNetwork configurations, IoT LAN, IoT WAN, IoT Node, IoT Gateway, IoT Proxy, Review ofBasic Microcontrollers and interfacing.

Unit II
Define Sensor, Basic components and challenges of a sensor node, Sensor features,Sensor resolution; Sensor classes: Analog, Digital, Scalar, Vector Sensors; Sensor Types, bias,drift, Hysteresis error, quantization error; Actuator; Actuator types: Hydraulic, Pneumatic,electrical, thermal/magnetic, mechanical actuators, soft actuators.

Unit III
Basics of IoT Networking, IoT Components, Functional components of IoT, IoT serviceoriented architecture, IoT challenges, 6LowPAN, IEEE 802.15.4, ZigBee and its types, RFIDFeatures, RFID working principle and applications, NFC (Near Field communication),Bluetooth, Wireless Sensor Networks and its ApplicationsUnit IV MQTT, MQTT methods and components, MQTT communication, topics andapplications, SMQTT, CoAP, CoAP message types, CoAP Request-Response model, XMPP,AMQP features and components, AMQP frame types.

Unit V
IoT Platforms, Arduino, Raspberry Pi Board, Other IoT Platforms; Data Analytics forIoT, Cloud for IoT, Cloud storage models & communication APIs, Attacks in IoT system,vulnerability analysis in IoT, IoT case studies: Smart Home, Smart framing etc.

References:
1. Vijay Madisetti, ArshdeepBahga, “İnternet of Things, A Hands on Approach”, University Press
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
5. Adrian McEwen, “Designing the Internet of Things”, Wiley

6. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
7. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media

**Course Outcomes:**

After the completion of this course, the students will be able to:

1. Understand Internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Analyze data from various sources in real-time and take necessary actions in anintelligent fashion
4. Remotely monitor data and control devices
5. Develop real life IoT based projects

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

**Open Elective AD 604 (B) Block Chain Technologies**

Unit-I

Introduction: Overview of Block chain, Public Ledgers, Bit coin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain,Understanding Crypto currency to Block chain, Permissioned Model of Block chain,Overview of Security aspects of Block chain; Basic Crypto Primitives: Cryptographic HashFunction, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature,Public Key Cryptography, A basic crypto currency

Unit-II

Understanding Block chain with Crypto currency: Bit coin and Block chain: Creation ofcoins, Payments and double spending, Bit coin Scripts, Bit coin P2P Network, Transaction inBit coin Network, Block Mining, Block propagation and block relay. Working withConsensus in Bit coin: Distributed consensus in open environments, Consensus in a Bitcoinnetwork, Proof of Work (PoW) – basic introduction, Hash Cash PoW, Bit coin PoW, Attackson PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of ElapsedTime, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit-III

Understanding Block chain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machinereplication, Overview of Consensus models for permissioned block chain-Distributedconsensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem,Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT overAsynchronous systems.

Unit-IV

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, and Identity on Block chain

Unit-V

Block chain application development: Hyperledger Fabric- Architecture, Identities andPolicies, Membership and Access Control, Channels, Transaction Validation, Writing smartcontract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview ofRipple and Corda

References:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015

2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to BlockchainTechnology and Leveraging Block Chain Programming”
3. Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017
4. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
5.Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization andSmart Contracts Explained”, Packt Publishing
6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build SmartContractsfor Ethereum and Block Chain”, Packt Publishing
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd,VenkatramanRamakrishna, “Hands-On Block Chain with Hyperledger: BuildingDecentralized Applications with Hyperledger Fabric and Composer”, Import, 2018

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Artificial Intelligence and Data Science, VI-Semester**

**Open Elective AD 604 (C) Compiler Design**

**Unit-I: Introduction to compiling & Lexical Analysis**

Introduction of Compiler, Major data Structure in compiler, types of Compiler, Front-end and Back-endof compiler, Compiler structure: analysis-synthesis model of compilation, various phases of a compiler,Lexical analysis: Input buffering , Specification & Recognition of Tokens,Design of a Lexical AnalyzerGenerator, LEX.

**Unit-II Syntax Analysis &Syntax Directed Translation**

Syntax analysis: CFGs, Top down parsing, Brute force approach, recursive descent parsing,transformation on the grammars, predictive parsing, bottom up parsing, operator precedence parsing, LRparsers (SLR, LALR, LR),Parser generation. Syntax directed definitions: Construction of Syntax trees,Bottom up evaluation of S-attributed definition, L-attribute definition, Top down translation, Bottom Upevaluation of inherited attributes Recursive Evaluation, Analysis of Syntax directed definition.

Unit-III Type Checking & Run Time Environment

Type checking: type system, specification of simple type checker, equivalence of expression, types, typeconversion, overloading of functions and operations, polymorphic functions. Run time Environment:storage organization, Storage allocation strategies, parameter passing, dynamic storage allocation, Symbol table, Error Detection & Recovery, Ad-Hoc and Systematic Methods.

Unit –IV Code Generation

Intermediate code generation: Declarations, Assignment statements, Boolean expressions, Casestatements, Back patching, Procedure calls Code Generation: Issues in the design of code generator, Basicblock and flow graphs, Register allocation and assignment, DAG representation of basic blocks, peepholeoptimization, generating code from DAG.

Unit –V Code Optimization

Introduction to Code optimization: sources of optimization of basic blocks, loops in flow graphs, deadcode elimination, loop optimization, Introduction to global data flow analysis, Code Improvingtransformations ,Data flow analysis of structure flow graph Symbolic debugging of optimized code.

References:s

1. A. V. Aho, R. Sethi, and J. D. Ullman. Compilers: Principles, Techniques and Tools , Pearson Education
2 Raghavan, Compiler Design, TMH Pub.
3. Louden. Compiler Construction: Principles and Practice, Cengage Learning
4. A. C. Holub. Compiler Design in C , Prentice-Hall Inc., 1993.
5. Mak, writing compiler & Interpreters, Willey Pub.