CD321	Operations Research	L	T	P	C
		2	1	0	3

Course Objectives:

1. Grasp the methodology of OR problem solving and formulate linear programming problem
2. Develop formulation skills in transportation models and assignment problems.
3. Understand the basics in the field of queuing theory and game theory
4. Be able to know how project management techniques help in planning and scheduling a project and to provide basics of simulation and its application to queuing and inventory problems.

Course Outcomes:

On completion of the course, the students will be able to:

1. Recognize the importance and value of Operations Research and linear programming in solving practical problems in industry.
2. Interpret the transportation models' solutions and infer solutions to the real-world problems.
3. Recognize and solve queuing and game theory problems
4. Gain knowledge of drawing project networks for quantitative analysis of projects and know when simulation can be applied in real world problems

Course Content:

UNIT – I **(CO1) (12 Periods)**

Linear Programming : Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, dual Simplex method, Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT – II **(CO2) (12 Periods)**

Transportation Problem: Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model.

Assignment Problem: One to one assignment problem, optimal solutions, unbalanced assignment matrix, travelling sales man problem, maximization in A.P.

UNIT – III **(CO3) (12 Periods)**

Queuing Theory: Queuing systems and their characteristics. Classification, Models - (M/M/1:∞/FCFS), (M/M/1: N /FCFS).

Theory of Games: Introduction, rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, concept of dominance to reduce the given matrix, Graphical method for 2xn and nx2 games.

UNIT – IV **(CO4) (12 Periods)**

Project Planning through Networks: Introduction, Basic steps in PERT/CPM techniques, Network diagram presentation, Rules of drawing network diagram, Fulkerson's rule, Time estimates and Critical path in network analysis, floats, Project evaluation and review technique, Application areas of PERT/CPM techniques.

Simulation: Introduction, Monte-Carlo Simulation, Application to Inventory Control, Application to Queuing Problems.

Learning Resources:

Text Books:

1. S.D. Sharma, 'Operations Research' Kedarnath, Ramnath & Co.,Meerut , 11/e , 2002.
2. Gupta and Hira, 'Operations Research' , S.Chand Publishers, 2011.
3. H.A. Taha, 'Operations Research', Pearson, 7th Edition, June 2002.

Reference Books:

1. S.S. Rao, 'Optimization Theory and Applications,, John Wiley & Sons , 1996
2. Phillips,Ravindran, James Soldberg, 'Introduction to Operations Research', Wiley 1976.
3. Hiller and Liberman ,'Introduction to Operations Research' , MGH, 7th Edition, 2002.

CD322	Cryptography & Network Security	L	T	P	C
		2	1	0	3

Course Objectives:

1. Describe the architecture of network security.
2. Explain design principles of symmetric and asymmetric encryption techniques.
3. Discuss various authentication protocols.
4. Describe the web security and network security applications.

Course Outcomes:

On completion of the course, the students will be able to:

1. Identify common network security vulnerabilities/ attacks, classical and symmetric encryption schemes.
2. Analyze the concepts of public key encryption and key management schemes.
3. Design MAC and Hashing techniques needed for authentication.
4. Discuss the authentication applications, Web and E-Mail security mechanisms.

Course Content:

UNIT – I **(CO1) (13 Periods)**

Introduction: Computer Security Concepts, The OSI security architecture, Security Attacks, Security Services, Security Mechanisms, A model for Network Security .

Number Theory: Prime Numbers, Fermat's and Euler's theorem, testing for primality, The Chinese remainder theorem, Discrete logarithms.

Classical Encryption techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Steganography.

UNIT – II **(CO1,2) (13 Periods)**

Block Ciphers & Data Encryption Standard: Traditional Block Cipher Structure, Data Encryption Standard, Strength of DES, Block Cipher Design Principles.

Advanced Encryption Standard (AES): AES structure, AES Transformation functions, AES key expansion.

Block Cipher operations:

Public key cryptography and RSA: Principles of public key crypto-systems, The RSA Algorithm.

Other Public Key Crypto Systems: Diffie Hellman Key exchange, Elgamal Cryptographic System

UNIT – III **(CO2,3) (12 Periods)**

Cryptographic Hash Functions: Applications of cryptographic hash functions, Hash function based on cipher block chaining, SHA 512, SHA-3.

Message Authentication codes: Message Authentication requirements, Message Authentication functions, MAC Based on Hash functions: HMAC

Digital signatures: Digital Signatures, Elgamal Digital Signature Scheme.

Key management and Distribution: Symmetric key distribution using Symmetric Encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates.

UNIT – IV **(CO4) (12 Periods)**

User authentication: Kerberos.

Transport Level Security: Web security Considerations, Transport Layer Security (TLS), Secure Shell (SSH).

E-Mail Security: S/MIME, Pretty Good Privacy (PGP).

IP Security: Overview, IP Security Policy, Encapsulating Security Payload.

Learning Resources:

Text Books:

1. Cryptography and Network Security Principles and Practice William Stallings, 7th Edition, Pearson Education.

Reference Books:

1. BehrouzA.Ferouzan,"Cryptography&NetworkSecurity",TataMcGrawHill,2007.
2. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
3. Charles P fleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.

CD323	Deep Learning	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the fundamental Principles and Techniques of Neural Computation
2. To impart the knowledge on concepts of Convolution Neural Networks, Auto encoders and Recurrent Neural Networks

Course Outcomes:

On completion of the course, the students will be able to:

1. Explain the basic concepts of Neural Networks
2. Explain the various Auto encoders
3. Explain the concepts of Convolution Neural Network
4. Explain the concepts of Recurrent Neural Network
5. Design appropriate DNN model for real time applications

Course Content:

UNIT I **(CO1) (12 Periods)**

Introduction: Biological Neural Network, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch-Pitts Neuron, Linear Separability, Non-Linear Seperability, Hebb Network.

Supervised Learning Network: Perceptron Network, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons.

UNIT-II

Auto Encoders: Unsupervised Learning **(CO2) (12 Periods)**

Introduction, Under complete Auto encoder, Regularized Auto encoders, Denoising Auto encoders, Sparse Auto encoders, Contractive Auto encoders

UNIT-III

Convolutional Neural Networks (CNN): **(CO3) (12 Periods)**

Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function

Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture.

UNIT-IV **(CO4&CO5)(12 periods)**

Recurrent Neural Networks (RNN)

Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT.

Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit.

Text Books:

1. J M Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press Ltd,2016
3. Satish Kumar "Neural Networks A Classroom Approach", Tata Mc Graw-Hill.

Reference Books:

1. Buduma, N.and Locascio, N, Fundamentals of deep learning :Designing next-generation Machine intelligence algorithms", 2017, O'Reilly Media, Inc."..
2. François Chollet Deep learning with Python,(Vol. 361), 2018 New York: Manning
3. Douwe Osinga–Deep LearningvCookvbook, O'REILLY, SPD Publishers, Delhi
4. Simon Haykin, Neural Network-A Comprehensive Foundation-Prentice Hall International, Inc.
5. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India

Useful Links

1. https://nptel.ac.https://deeplearning.cs.cmu.edu/S21/index.html 2
2. http://www.cse.iitm.ac.in/~miteshk/CS6910.html
3. https://nptel.ac.in/courses/106/106/106106184/
4. https://www.deeplearningbook.org/

CD324	Big Data Processing	L	T	P	C
		3	0	0	3

Course Objectives:

3. Optimize business decisions and create competitive advantage with Big Data Processing
4. Introducing Java concepts required for developing map reduce programs
5. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
6. To introduce programming tools PIG
7. HIVE in Hadoop echo system

Course Outcomes:

On completion of the course, the students will be able to:

6. Preparing for Java collections to implement Map Reduce Programs and able to understand Big data.
7. Implement Map-Reduce Programs using Hadoop API.
8. Create applications for Big Data Processing using PIG.
9. Build a complete business data analytic solution using Hive.

Course Content:

UNIT-I **(CO1) 12 Periods**

Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization.

Introduction to Bigdata: Data, Characteristics of data and Types of digital data: Unstructured, Semi-structured and Structured, Evolution and Definition of big data, Sources of big data, Characteristics and Need of big data, Challenges of big data.

UNIT-II **(CO2) 12 Periods**

Working with Bigdata: Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

Writing MapReduce Programs: Understanding Hadoop API for MapReduce Framework, Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner

UNIT-III **(CO3) 12 Periods**

Hadoop I/O: The Writable Interface, WritableComparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, BytesWritable, NullWritable, ObjectWritable and GenericWritable, Writable collections.

Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

UNIT-IV **(CO4) 10 Periods**

Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data.

Text Books:

4. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
5. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
6. Hadoop in Action by Chuck Lam, MANNING Publ.
7. Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt. Ltd., 2016.
8. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk, Bruce Brown, Rafael Coss.

Reference Books:

6. Hadoop in Practice by Alex Holmes, MANNING Publ.
7. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne

Software Links:

1. Hadoop:http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

CD325	GPU Programming (Open/Job Oriented Elective-II)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To equip students with parallel algorithm analysis techniques
2. To introduce parallel programming concepts with OpenMP & CUDA

Course Outcomes:

On completion of the course, the students will be able to:

1. Explain the concepts of parallel programming
2. Analyze Parallel algorithms
3. Explain CUDA programming concepts
4. Explain memory & data locality
5. Explain performance enhancement considerations in CUDA
6. Explain OpenMP concepts

Course Content:

UNIT – I **[CO1, CO2]** **(10 Periods)**

Introduction: GPUs as Parallel Computers, Architecture of a Modern GPU, Why More Speed or Parallelism?, Parallel Programming Languages and Models. (T1)

Multi-threaded Algorithms: Masters Theorem, Analysis of Parallel Matrix Multiplication, Analysis of Parallel Merge Sort, Analysis of Parallel Longest common subsequence problem. (T2)

UNIT – II **[CO3]** **(14 Periods)**

Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix–Matrix Multiplication Example, Device Memories and Data Transfer, Kernel Functions and Threading. (T1)

CUDA Threads: CUDA Thread Organization, 2 Using blockIdx and threadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. (T1)

UNIT – III **[CO4, CO5]** **(10 Periods)**

CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, Memory as a Limiting Factor to Parallelism.

Performance considerations: More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Prefetching, Instruction Mix, Thread Granularity, Measured Performance and Summary.

UNIT – IV **[CO6]** **(10 Periods)**

OpenMP Basics: The OpenMP model, Your first OpenMp program, Thread Data, Creating parallelism.

Parallel Regions: Creating parallelism with parallel regions, Nested parallelism, Cancel parallelism construct.

Loop parallelism: Loop parallelism, Loop schedules, Reductions, Nested Loops, ordered iterations, nowait, While loops.

Work sharing: Sections, Single/master.

Synchronization: Barrier, Mutual exclusion, Locks.

Learning Resources:

Text Books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010.
2. Introduction to Algorithms, Third Edition, Cormen, Leiserson, Rivest, and Stein.

REFERENCE BOOKS:

1. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012.

Web Resources:

1. https://www.openmp.org/
2. https://www.openacc.org/
3. https://www.nvidia.com/en-in/data-center/resources/
4. https://gpuopen.com/

CD361	Deep Learning Lab	L	T	P	C
		0	0	3	1.5

List of Experiments

1. Implementation of OR operation using McCulloch Pitts Network.
2. Implementation of character recognization using Hebb Neural Network
3. Implementation of And operation using perceptron.
4. Implementation of OR operation using Adaline
5. Implementation of XOR using Multiple Adaptive Linear Neurons.
6. Implementation of Autoencoder.
7. Implement the image denoising using Convolutional Autoencoder.
8. Implement the following architectures for classification of digits.
   (i) LeNet (ii) AlexNet
9. Implement the Simple RNN architecture.
10. Implement the LSTM architecture.

CD362	Big Data Processing Lab (Professional Elective Lab – II)	L	T	P	C
		0	0	3	1.5

Course Objectives:

At the end of this lab, the learner will be able to:

1. Illustrate Java Data Structures like List, Sets, Stacks, Queues and Maps.
2. Familiarize the queries to add/delete and move/copy file from local OS to HDFS & vice-versa.
3. Understand the Map-Reduce programs.
4. Demonstrate queries to perform various Pig Transformations.
5. Analyze data using Hive DDL and DML queries.

Course Outcomes:

1. Develop Java programs for data structures such as List, stack, queue, set, map.
2. Demonstrate to Store, Retrieve and Delete local OS files and directories into HDFS and Vice-versa.
3. Implement Map-Reduce Program for various problems.
4. Develop various Pig transformations.
5. Describe about implement HQL queries.

Week 1 - 3

Implement the following Data structures in Java

a) Linked Lists
b) Stacks
c) Queues

Week 4, 5

Implement the following Data structures in Java

a) Set
b) Map

Week 6

Implement the following file management tasks in Hadoop:

- Adding files and directories
- Retrieving files
- Deleting files

Week 7, 8

Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

Week 9, 10

Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Week 11, 12

Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and Indexes.

CDSL4	Natural Language Processing (Skill Oriented Course-IV)	L	T	P	C
		1	0	2	2

Course Objectives:

1. To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

Course Outcomes:

On completion of the course, the students will be able to:

1. Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.
2. Perform POS tagging for a given natural language.
3. Select a suitable language modelling technique based on the structure of the language.
4. Check the syntactic and semantic correctness of sentences using grammars and labelling.

Course Content:

UNIT-I **(CO1) 12 Periods**

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, question answering, and machine translation Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

UNIT-II **(CO2) 12 Periods**

Introduction to word types, word2Vec, Word Embedding, POS Tagging, Count Vectorizer, Multiword Expressions the role of language models. Simple N-gram models. Bag of words, estimating parameters and smoothing. Evaluating language models.

UNIT-III **(CO3) 12 Periods**

Introduction to phrases, cleaning text data, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense Disambiguation, WordNet.

UNIT-IV **(CO4) 12 Periods**

Hidden Markov Models- Viterbi Algorithm examples, Applications of NLP: NL Interfaces, Text Summarization, Sentiment Analysis,. Recent Trends in NLP.

Text Books:

1. Daniel Jurafsky and James H. Martin “Speech and Language Processing”, 3rd edition, Prentice Hall, 2009.

Reference Books:

1. Chris Manning and HinrichSchütze, “Foundations of Statistical Natural Language Processing”, 2nd edition, MITPress Cambridge, MA, 2003.
2. NitinIndurkhya, Fred J. Damerau “Handbook of Natural Language Processing”, Second Edition, CRC Press, 2010. James Allen “Natural Language Understanding”, Pearson Publication 8th Edition. 2012.