BIG DATA ANALYTICS		Semester	VII
Course Code	**BIS701**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory/practical		

Course objectives:

1. To implement MapReduce programs for processing big data.
2. To realize storage and processing of big data using MongoDB, Pig, Hive and Spark.
3. To analyze big data using machine learning techniques.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
6. Use any of these methods: Chalk and board, Active Learning, Case Studies.

MODULE-1

Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment.

Big Data Analytics: What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools , NoSQL, Hadoop.

TB1: Ch 1: 1.1, Ch2: 2.1-2.5,2.7,2.9-2.11, Ch3: 3.2,3.5,3.8,3.12, Ch4: 4.1,4.2

MODULE-2

Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator).

Introduction to Map Reduce Programming: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

TB1: Ch 5: 5.1-,5.8, 5.10-5.12, Ch 8: 8.1 - 8.8

MODULE-3

Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.

TB1: Ch 6: 6.1-6.5

MODULE-4

Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF).

Introduction to Pig: What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.

TB1: Ch 9: 9.1-9.6,9.8, Ch 10: 10.1 - 10.15, 10.22

MODULE-5

Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark.

Text, Web Content and Link Analytics: Introduction, Text Mining, Web Mining, Web Content and Web

Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph. **TB2:** Ch5: 5.2,5.3, Ch 9: 9.1-9.4

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments (Java/Python/R)
1	Install Hadoop and Implement the following file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files and directories. **Hint:** A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
2	Develop a MapReduce program to implement Matrix Multiplication
3	Develop a Map Reduce program that mines weather data and displays appropriate messages indicating the weather conditions of the day.
4	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.
5	Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB
6	Write Pig Latin scripts to sort, group, join, project, and filter the data.
7	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
8	Implement a word count program in Hadoop and Spark.
9	Use CDH (Cloudera Distribution for Hadoop) and HUE (Hadoop User Interface) to analyze data and generate reports for sample datasets

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Identify and list various Big Data concepts, tools and applications.
- Develop programs using HADOOP framework.
- Use Hadoop Cluster to deploy Map Reduce jobs, PIG,HIVE and Spark programs.
- Analyze the given data set and identify deep insights from the data set.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books:

1. Seema Acharya and Subhashini Chellappan "Big data and Analytics" Wiley India Publishers, 2nd Edition, 2019.
2. Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning", McGraw Hill Publication, 2019.

Reference Books:

1. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012
2. Tom White, "Hadoop: The Definitive Guide" 4th Edition, O'reilly Media, 2015.
3. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016
4. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition

Web links and Video Lectures (e-Resources):

- https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset
- https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-g5W1mo37urJQOdCZ
- https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&index=4
- https://www.youtube.com/watch?v=GG-VRm6XnNk https://www.youtube.com/watch?v=JglO2Nv_92A

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Implement MongoDB based application to store big data for data processing and analyzing the results [10 marks]

PARALLEL COMPUTING		Semester	VII
Course Code	**BCS702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		

Course objectives:

This course will enable to,

- Explore the need for parallel programming
- Explain how to parallelize on MIMD systems
- To demonstrate how to apply MPI library and parallelize the suitable programs
- To demonstrate how to apply OpenMP pragma and directives to parallelize the suitable programs
- To demonstrate how to design CUDA program

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Programming assignment, which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE-1

Introduction to parallel programming, Parallel hardware and parallel software – Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory.

MODULE-2

GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance – Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance.

MODULE-3

Distributed memory programming with MPI – MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm.

MODULE-4

Shared-memory programming with OpenMP – openmp pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in openmp, tasking, tasking, thread safety.

MODULE-5

GPU programming with CUDA - GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Write a OpenMP program to sort an array on n elements using both sequential and parallel mergesort(using Section). Record the difference in execution time.
2	Write an OpenMP program that divides the Iterations into chunks containing 2 iterations, respectively (OMP_SCHEDULE=static,2). Its input should be the number of iterations, and its output should be which iterations of a parallelized for loop are executed by which thread. For example, if there are two threads and four iterations, the output might be the following: a. Thread 0 : Iterations 0 −− 1 b. Thread 1 : Iterations 2 −− 3
3	Write a OpenMP program to calculate n Fibonacci numbers using tasks.
4	Write a OpenMP program to find the prime numbers from 1 to n employing parallel for directive. Record both serial and parallel execution times.
5	Write a MPI Program to demonstration of MPI_Send and MPI_Recv.
6	Write a MPI program to demonstration of deadlock using point to point communication and avoidance of deadlock by altering the call sequence
7	Write a MPI Program to demonstration of Broadcast operation.
8	Write a MPI Program demonstration of MPI_Scatter and MPI_Gather
9	Write a MPI Program to demonstration of MPI_Reduce and MPI_Allreduce (MPI_MAX, MPI_MIN, MPI_SUM, MPI_PROD)

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Explain the need for parallel programming
- Demonstrate parallelism in MIMD system.
- Apply MPI library to parallelize the code to solve the given problem.
- Apply OpenMP pragma and directives to parallelize the code to solve the given problem
- Design a CUDA program for the given problem.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook:

1. Peter S Pacheco, Matthew Malensek – An Introduction to Parallel Programming, second

edition, Morgan Kauffman.
2. Michael J Quinn – Parallel Programming in C with MPI and OpenMp, McGrawHill.

Reference Books:

1. Calvin Lin, Lawrence Snyder – Principles of Parallel Programming, Pearson
2. Barbara Chapman – Using OpenMP: Portable Shared Memory Parallel Programming, Scientific and Engineering Computation
3. William Gropp, Ewing Lusk – Using MPI:Portable Parallel Programing, Third edition, Scientific and Engineering Computation

Web links and Video Lectures (e-Resources):

1. Introduction to parallel programming: https://nptel.ac.in/courses/106102163

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignment at higher bloom level (10 Marks)

	INFORMATION AND NETWORK SECURITY		Semester	7
	Course Code	**BIS703**	CIE Marks	50
	Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	50	Total Marks	100
	Credits	04	Exam Hours	3
	Examination type (SEE)	Theory		

Course objectives:

1. Understand the basics of, Security,its principle and Cryptography.
2. To study various cryptographic Algorithm.
3. Apply the knowledge of Cryptography to various fields.
4. Understand and apply various Hash functions
5. Discuss about various key management scenario.

Teaching-Learning Process

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

Module-1 10 hours

Introduction. How to Speak Crypto. Classic Crypto. Simple Substitution Cipher. Cryptanalysis of a Simple Substitution. Definition of Secure. Double Transposition Cipher. One-time Pad. Project VENONA. Codebook Cipher. Ciphers of the Election of 1876. Modern Crypto History. Taxonomy of Cryptography. Taxonomy of Cryptanalysis.

Textbook:1-Chapter 2

Module-2 10 hours

	What is a Hash Function? The Birthday Problem. Non-cryptographic Hashes. Tiger Hash. HMAC. Uses of Hash Functions. Online Bids. Spam Reduction. Other Crypto-Related Topics. Secret Sharing. Key Escrow. Random Numbers. Texas Hold 'em Poker. Generating Random Bits. Information Hiding. **Textbook:1-Chapter 5**
	Module-3 10 hours
	Random number generation, Providing Freshness, Fundamentals of entity authentication, Passwords, Dynamic password schemes, Zero-knowledge mechanisms, further reading. **Cryptographic Protocols**: Protocol Basics, From objectives to a protocol, Analysing a simple protocol, Authentication and key establishment protocols. **Textbook:2-Chapter 8, Chapter 9**
	Module-4 10 hours
	Key management fundamentals, Key lengths and lifetimes, Key generation, Key establishment, Key storage, Key usage, Governing key management. **Public-Key Management**: Certification of public keys, The certificate lifecycle, Public-key management models, Alternative approaches. **Textbook:2-Chapter 10, Chapter 11**
	Module-5 10 hours
	Cryptographic Applications: Cryptography for securing the Internet, Cryptography for wireless local area networks, Cryptography for mobile telecommunications, Cryptography for secure payment card transactions, Cryptography for video broadcasting, Cryptography for identity cards. **Textbook:2-Chapter 12 (12.1 to 12.6).**

Course outcome

At the end of the course, the student will be able to :

CO1: Understand the basic concepts of Security and Cryptography.

CO2: Apply different hash functions.

CO**3:** Describe the Random number generation and Cryptographic Protocols.

CO4: Explain key management scenario.

CO5: Apply the Concept of Cryptography for more security in different fields.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook

1. Information Security: Principles and Practice, 2nd Edition by Mark Stamp, Wiley
2. Everyday Cryptography: Fundamental Principles and Applications Keith M. Martin Oxford Scholarship Online: December 2013.

Reference Books:

1. Applied Cryptography Protocols, Algorithms, and Source Code in C by Bruce Schneier.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group assignments (TWO) to implement Cryptographic Algorithms (15 + 10 marks)

	Deep Learning		Semester	7
	Course Code	**BCS714A**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	40	Total Marks	100
	Credits	03	Exam Hours	03
	Examination type (SEE)	Theory		

Course objectives:

- Understand the basic concepts of deep learning.
- Know the basic working model of Convolutional Neural Networks and RNN in decision making.
- Illustrate the strength and weaknesses of many popular deep learning approaches.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation/Demonstration to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem/Practical Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills, and practical skill such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Use animations/videos to help the students to understand the concepts.
7. Demonstrate the concepts using PYTHON and its libraries wherever possible

Module-1

Introducing Deep Learning: **Biological and Machine Vision:** Biological Vision, Machine Vision: The Neocognitron, LeNet-5, The Traditional Machine Learning Approach, ImageNet and the ILSVRC, AlexNet, TensorFlow Playground. **Human and Machine Language:** Deep Learning for Natural Language Processing: Deep Learning Networks Learn Representations Automatically, Natural Language Processing, A Brief History of Deep Learning for NLP, Computational Representations of Language: One-Hot Representations of Words, Word Vectors, Word-Vector Arithmetic, word2viz, Localist Versus Distributed Representations, Elements of Natural Human Language.

Text book 2 : Chapter 1, 2

Module-2

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi- Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, **Optimization for Training Deep Models:** How Learning Differs from Pure Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.

Text book 1 : Chapter 7 (7.1 to 7.10), Chapter 8 (8.1,8.3,8.4,8.5)

Module-3

	Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning. **Text book 1 : Chapter 9 (9.1 to 9.8, 9.11)**
	Module-4
	Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory. **Text book 1 : Chapter 10 (10.1 to 10.6, 10.10)**
	Module-5
	Interactive Applications of Deep Learning: Natural Language Processing: Preprocessing Natural Language Data: Tokenization, Converting All Characters to Lowercase, Removing Stop Words and Punctuation, Stemming, Handling *n*-grams, Preprocessing the Full Corpus, Creating Word Embeddings with word2vec: The Essential Theory Behind word2vec, Evaluating Word Vectors, Running word2vec, Plotting Word Vectors, The Area under the ROC Curve: The Confusion Matrix, Calculating the ROC AUC Metric, Natural Language Classification with Familiar Networks: Loading the IMDb Film Reviews, Examining the IMDb Data, Standardizing the Length of the Reviews, Dense Network, Convolutional Networks, Networks Designed for Sequential Data: Recurrent Neural Networks, Long Short-Term Memory Units, Bidirectional LSTMs, Stacked Recurrent Models, Seq2seq and Attention, Transfer Learning in NLP. **Text book 2 : Chapter-8**

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Interpret the concepts of neural networks learning processes.
2. Illustrate deep learning methods using regularization and Optimization process
3. Design deep learning models using convolutional operations.
4. Analyze sequential data to build recurrent and recursive models.
5. Demonstrate the different interactive applications of deep learning.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016. https://www.deeplearningbook.org/lecture_slides.html
2. John Krohn, Grant Beyleveld, Aglae Bassens, Deep Learning Illustrated, A Visual, Interactive Guide to Artificial Intelligence, Pearson, 2022.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=VyWAvY2CF9c
https://www.youtube.com/watch?v=7sB052Pz0sQ
https://www.youtube.com/watch?v=Mubj_fqiAv8
https://www.coursera.org/learn/neural-networks-deep-learning

- **https://onlinecourses.nptel.ac.in/noc20_cs62/preview**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments, such as implementation of CNN and Recurrent neural network models - 10 Marks
- Group assignment (Group of two) on recent developments in Deep learning – Refer IEEE/ACM/Elsevier etc publications - 15 Marks