

VII Semester

BIG DATA ANALYTICS			
Course Code	21CS71	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
Course Learning Objectives: CLO 1. Understand fundamentals and applications of Big Data analytics CLO 2. Explore the Hadoop framework and Hadoop Distributed File system and essential Hadoop Tools CLO 3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data CLO 4. Employ MapReduce programming model to process the big data CLO 5. Understand various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.2. Show Video/animation films 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 thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.6. Topics will be introduced in a multiple representation.7. Show the different ways to solve the same problem 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.			
Module-1			
Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.			
Textbook 1: Chapter 1: 1.2 -1.7			
Teaching-Learning Process	Chalk and board https://www.youtube.com/watch?v=n_Krer6YWY4 https://onlinecourses.nptel.ac.in/noc20_cs92/preview		
Module-2			
Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.			
Hadoop Distributed File System Basics (T2): HDFS Design Features, Components, HDFS User Commands.			
Essential Hadoop Tools (T2): Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.			
Textbook 1: Chapter 2 :2.1-2.6 Textbook 2: Chapter 3			

Textbook 2: Chapter 7 (except walk throughs)	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Chalk and Board 2. Laboratory Demonstration
Module-3	
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	
Textbook 1: Chapter 3: 3.1-3.7	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Chalk and Board 2. Laboratory Demonstration https://www.youtube.com/watch?v=pWbMrx5rVBE
Module-4	
Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.	
Textbook 1: Chapter 4: 4.1-4.6	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Chalk and Board 2. Laboratory Demonstration
Module-5	
Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining.	
Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:	
Textbook 1: Chapter 6: 6.1 to 6.5	
Textbook 1: Chapter 9: 9.1 to 9.5	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Chalk and Board 2. Laboratory Demonstration
Course outcome (Course Skill Set) At the end of the course the student will be able to: <ol style="list-style-type: none"> CO 1. Understand fundamentals and applications of Big Data analytics. CO 2. Investigate Hadoop framework, Hadoop Distributed File system and essential Hadoop tools. CO 3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data. CO 4. Demonstrate the MapReduce programming model to process the big data along with Hadoop tools. CO 5. Apply Machine Learning algorithms for real world big data, web contents and Social Networks to provide analytics with relevant visualization tools. 	
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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and 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:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be 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 subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 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.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:**Textbooks**

1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education, 2016. ISBN13: 978-9332570351

Reference Books

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, 2015. ISBN-13: 978-9352130672
2. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1st Edition, Wrox Press, 2014 ISBN-13: 978-8126551071
3. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators", 1st Edition, O'Reilly Media, 2012. ISBN-13: 978-9350239261
4. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577

Weblinks and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=n_Krer6YWY4
2. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
3. <https://www.digimat.in/nptel/courses/video/106104189/L01.html>

4. https://web2.qatar.cmu.edu/~mhhammou/15440-f19/recitations/Project4_Handout.pdf

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

Mini Project Topics for Practical Based Learning :Search Engine Optimization, Social Media Reputation Monitoring, Equity Research, Detection of Global Suicide rate, Find the Percentage of Pollution in India, Analyze crime rate in India, Health Status Prediction, Anomaly Detection in cloud server, Tourist Behaviour Analysis, BusBest Not limited to above topics

VII Semester

CLOUD COMPUTING			
Course Code	21CS72	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	02	Exam Hours	03
Course Learning Objectives:			
CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers			
CLO 2. Introduce various models of cloud computing			
CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.			
CLO 4. Realize the importance of Cloud Virtualization, Abstraction's and Enabling Technologies and cloud security			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none">1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.2. Show Video/animation films 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 thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.6. Topics will be introduced in a multiple representation.7. Show the different ways to solve the same problem 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.			
Module-1			
Introduction:			
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka			
Textbook 1: Chapter 1: 1.1,1.2 and 1.3			
Teaching-Learning Process	Chalk and board, Active Learning		
Module-2			
Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples			
Textbook 1 : Chapter 3: 3.1 to 3.6			
Teaching-Learning Process	Chalk and board, Active Learning		
Module-3			
Cloud Computing Architecture: Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges			
Textbook 1: Chapter 4: 4.1 to 4.5			

Teaching-Learning Process	Chalk and board, Demonstration
Module-4	
Cloud Security: Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.	
Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9	
Teaching-Learning Process	Chalk and board
Module-5	
Cloud Platforms in Industry Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.	
Textbook 1: Chapter 9: 9.1 to 9.2	
Cloud Applications: Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.	
Textbook 1: Chapter 10: 10.1 to 10.2	
Teaching-Learning Process	Chalk and board
Course outcome (Course Skill Set) At the end of the course the student will be able to: CO 1. Understand and analyze various cloud computing platforms and service provider. CO 2. Illustrate various virtualization concepts. CO 3. Identify the architecture, infrastructure and delivery models of cloud computing. CO 4. Understand the Security aspects of CLOUD. CO 5. Define platforms for development of cloud applications	
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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and 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: Three Unit Tests each of 20 Marks (duration 01 hour) 1. First test at the end of 5 th week of the semester 2. Second test at the end of the 10 th week of the semester 3. Third test at the end of the 15 th week of the semester Two assignments each of 10 Marks 4. First assignment at the end of 4 th week of the semester 5. Second assignment at the end of 9 th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)	

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be 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 subject (**duration 03 hours**)

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

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013

Reference Books

1. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

Weblinks and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=1N3oqYhzHv4>
- <https://www.youtube.com/watch?v=RWgW-CgdIk0>

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

VII Semester

OPERATIONS RESEARCH			
Course Code	21ME753	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
Course objectives: <ul style="list-style-type: none">To enable the students to understand the scientific methods of providing various departments of an organization with a quantitative basis of decision making.To enable the students to understand the importance of various tools and techniques in finding optimal solutions to problems involving limited resources in the form of Men, Materials and machinery.			
Teaching-Learning Process (General Instructions) <p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none">Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.Chalk and Talk method for Problem Solving.Adopt flipped classroom teaching method.Adopt collaborative (Group Learning) learning in the class.Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.			
Module-1			
Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).			
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board		
Module-2			
LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and two-phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.			
Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board		
Module-3			
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems.			
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board		
Module-4			

<p>Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems.</p> <p>Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.</p>	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-5	
<p>Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.</p> <p>Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method.</p>	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Course outcome (Course Skill Set)	
<p>At the end of the course the student will be able to :</p> <ul style="list-style-type: none"> • Understand the meaning, definitions, scope, need, phases and techniques of operations research. • Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method. • Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems. • Solve problems on game theory for pure and mixed strategy under competitive environment. • Solve waiting line problems for M/M/1 and M/M/K queuing models. • Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks <p>Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3 machines, n jobs-m machines and 2 jobs-n machines using Johnson's algorithm.</p>	

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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and 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:

Three Unit Tests each of **20 Marks (duration 01 hour)**

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /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 subject (**duration 03 hours**)

39. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
40. 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.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:**Books**

Textbook/s

- 1 Operations Research P K Gupta and D S Hira S. Chand and Company LTD. Publications, New Delhi 2007
- 2 Operations Research, An Introduction Hamdy A. Taha PHI Private Limited Seventh Edition, 2006

Reference Books

- 1 Operations Research, Theory and Applications J K Sharma Trinity Press, Laxmi Publications Pvt.Ltd. Sixth Edition, 2016
- 2 Operations Research Paneerselvan PHI
- 3 Operations Research A M Natarajan, P Balasubramani Pearson Education, 2005
- 4 Introduction to Operations Research Hillier and Lieberman McGraw Hill 8thEd

Web links and Video Lectures (e-Resources):**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

VII Semester

INTERNET OF THINGS			
Course Code	21CS735	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
Course Learning Objectives			
CLO 1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.			
CLO 2. Understand the recent application domains of IoT in everyday life.			
CLO 3. Understand the protocols and standards designed for IoT and the current research on it.			
CLO 4. Understand the other associated technologies like cloud and fog computing in the domain of IoT.			
CLO 5. Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.			
CLO 6. Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.			
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 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.			
Module-1			
Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.			
Textbook 1: Chapter 4 – 4.1 to 4.5			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.			
Textbook 1: Chapter 5 – 5.1 to 5.9			
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration		
Module-3			
IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.			

Textbook 1: Chapter 6 – 6.1 to 6.5	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth	
Textbook 1: Chapter 7 – 7.1 to 7.16	
Teaching-Learning Process	Chalk & board, Problem based learning
Module-5	
IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols	
IoT Interoperability: Introduction, Taxonomy of interoperability, Standards, Frameworks	
Textbook 1: Chapter 8 – 8.1, 6.2, 8.3, 8.4, 8.5, 8.6, .7	
Textbook 1: Chapter 9 – 9.1, 9.2, 9.3	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes	
At the end of the course the student will be able to:	
CO 1. Understand the evolution of IoT, IoT networking components, and addressing strategies in IoT.	
CO 2. Analyze various sensing devices and actuator types.	
CO 3. Demonstrate the processing in IoT.	
CO 4. Apply different connectivity technologies.	
CO 5. Understand the communication technologies , protocols and interoperability in IoT.	
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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and 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:	
Three Unit Tests each of 20 Marks (duration 01 hour)	
1. First test at the end of 5 th week of the semester	
2. Second test at the end of the 10 th week of the semester	
3. Third test at the end of the 15 th week of the semester	
Two assignments each of 10 Marks	
4. First assignment at the end of 4 th week of the semester	
5. Second assignment at the end of 9 th week of the semester	
6. At the end of the 13 th week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
CIE methods /question paper has to be 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 subject (duration 03 hours)	

<ol style="list-style-type: none"> 1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 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. <p>The students have to answer 5 full questions, selecting one full question from each module</p>
Suggested Learning Resources:
<p>Textbooks</p> <ol style="list-style-type: none"> 1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021. <p>Reference:</p> <ol style="list-style-type: none"> 1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press. 2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. 3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
<p>Weblinks and Video Lectures (e-Resources):</p> <ol style="list-style-type: none"> 1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

VII Semester

DEEP LEARNING			
Course Code	21CS743	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	3	Exam Hours	3
Course Learning Objectives			
CLO 1. Understand the fundamentals of deep learning. CLO 2. Know the theory behind Convolutional Neural Networks, Autoencoders, RNN. CLO 3. Illustrate the strength and weaknesses of many popular deep learning approaches. CLO 4. Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems. CLO 5. Learn the open issues in deep learning, and have a grasp of the current research directions.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<div><div>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.</div><div>2. Use of Video/Animation to explain functioning of various concepts.</div><div>3. Encourage collaborative (Group Learning) Learning in the class.</div><div>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</div><div>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.</div><div>6. Introduce Topics in manifold representations.</div><div>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.</div><div>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</div></div>			
Module-1			
Introduction to Deep Learning: Introduction, Deep learning Model, Historical Trends in Deep Learning,			
Machine Learning Basics: Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.			
Textbook 1: Chapter1 – 1.1, 1.2, 5.1,5.7-5.8.			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
Feedforward Networks: Introduction to feedforward neural networks, Gradient-Based Learning, Back-Propagation and Other Differentiation Algorithms. Regularization for Deep Learning,			
Textbook 1: Chapter 6, 7			
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration		
Module-3			
Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies,			

Algorithms with Adaptive Learning Rates: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm.

Textbook 1: Chapter: 8.1-8.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
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Module-4

Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features- LeNet, AlexNet.

Textbook 1: Chapter: 9.1-9.9.

Teaching-Learning Process	Chalk& board, Problem based learning
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Module-5

Recurrent and Recursive Neural Networks: Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.

Applications: Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processing and Other Applications.

Textbook 1: Chapter: 10.1-10.3, 10.5, 10.6, 10.10, 12.

Teaching-Learning Process	Chalk and board, MOOC
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Course Outcomes

CO1: Understand the fundamental issues and challenges of deep learning data, model selection, model complexity etc.,
 CO2: Describe various knowledge on deep learning and algorithms
 CO3: Apply CNN and RNN model for real time applications
 CO4: Identify various challenges involved in designing and implementing deep learning algorithms.
 CO5: Relate the deep learning algorithms for the given types of learning tasks in varied domain

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). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and 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:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be 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 subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 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.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference:

1. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009.
2. N.D.Lewis, "Deep Learning Made Easy with R: A Gentle Introduction for Data Science", January 2016.
3. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications.

Weblinks and Video Lectures (e-Resources):

- <https://faculty.iitmandi.ac.in/~aditya/cs671/index.html>
- <https://nptel.ac.in/courses/106/106/106106184/>
- <https://www.youtube.com/watch?v=7x2YZhEj9Dw>

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