



Progressive Education Society's
Modern College of Engineering, Shivajinagar, Pune-05.
Department of Artificial Intelligence and Data Science

Curriculum Booklet

2019 Pattern

Semester: II

Class: TE (Artificial Intelligence and Data Science)

Vision of the Institute

- Creation of a collaborative academic environment to foster professional excellence and ethical values.

Mission of the Institute

- To develop outstanding professionals with high ethical standards capable of creating and managing global enterprises.
- To foster innovation and research by providing a stimulating learning environment.
- To ensure equitable development of students of all ability levels and backgrounds.
- To be responsive to changes in technology, socio-economic and environmental conditions.
- To foster and maintain mutually beneficial partnerships with alumni and industry.

Objectives of the Institute

- To develop infrastructure appropriate for delivering quality education
- To develop the overall personality of students who will be innovators and future leaders capable of prospering in their work environment.
- To inculcate ethical standards and make students aware of their social responsibilities.
- Promote close interaction among industry, faculty and students to enrich the learning process and enhance career opportunities.
- Encourage faculty in continuous professional growth through quality enhancement programs and research and development activities.
- Foster a healthy work environment which allows for freedom of expression and protection of the rights of all stakeholders through open channels of communication



Vision of the Department

To create a collaborative academic environment in the field of Artificial Intelligence and Data Science by imparting required skill sets and interactive industry interface for students and inculcate into them social and ethical values

Mission of the Department

M1: To nurture students with latest technologies in the field of Artificial Intelligence and Data Science.

M2: To build industry academia interface to update the recent trends in field of Artificial Intelligence and Data Science.

M3: To prepare students with professional approach, strong ethical values and research spirit along with leadership skills.

M4: To mentor students in the field of Artificial Intelligence and Data Science research to serve the needs of the society.

Program Educational Objectives (PEOs)

Program Educational Objectives (PEO's)	
A graduate of the Artificial Intelligence and Data Science Program will able to-	
PEO1	Work in the area of Artificial Intelligence and Data Science to design ability of a computer system.
PEO2	Apply analytical skills ,decision making skills, leadership skills and critical thinking skills to solve multidisciplinary problems for the betterment of the society
PEO3	Demonstrate professionalism as a means of lifelong learning in the area of Artificial Intelligence and Data Science with emerging tools and technologies like IoT , Big Data, Cloud Services , Artificial Neural Network.

Program Specific Outcomes (PSOs)

Program Specific Outcomes (PSO's)	
A graduate of the Artificial Intelligence and Data Science Program will demonstrate	
PSO1	Professional Skills- The ability to understand, analyze and develop computer programs in the areas of Artificial Intelligence and Data Science for efficient design of computer based systems.
PSO2	Problem-Solving Skills- The ability to apply the knowledge of Artificial Intelligence and Data Science to cater the need of industry, academia and society.
PSO3	Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments and platforms to become an entrepreneur and to have a zest for higher studies.



Program Outcomes (POs)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
- 7. Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- 9. Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
- 10. Communication Skills :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation make effective presentations and give and receive clear instructions.
- 11. Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Structure

Curriculum for Third Year of Artificial Intelligence and Data Science (2019 Course), Savitribai Phule Pune University

Savitribai Phule Pune University														
Third Year of Artificial Intelligence and Data Science (2019 Course)														
(With effect from Academic Year 2022-23)														
Semester-VI														
Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks						Credit Scheme			
		##(Hours/Week)			Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
		#Lecture	Practical	Tutorial										
317529	Data Science	04	-	-	30	70	-	-	-	100	03	-	-	03
317530	Cyber security	04	-	-	30	70	-	-	-	100	03	-	-	03
317531	Artificial Neural Network	04	-	-	30	70	-	-	-	100	03	-	-	03
**	Elective II	04	-	-	30	70	-	-	-	100	03	-	-	03
317533	Software Laboratory II	-	04	-	-	-	25	25	-	50	-	02	-	02
317534	Software Laboratory III	-	04	-	-	-	50	25	-	75	-	02	-	02
317535	Internship**	-	-	-	-	-	50	-	50	100	-	04	-	04
317536	Mini Project (CS and Elective-II)	-	02	-	-	-	50	-	25	75	-	01	-	01
Total		16	10	-	120	280	175	50	75	700	12	09	-	21
317537	Audit Course 6										Grade			
Total											12	09	-	21
Elective-II Options		Audit Course 6 Options												
317532(A) Robotics and Automation		317537(A) Digital and Social Media Marketing												
317532(B) Natural Language Processing		317537(B) Sustainable Energy Systems												
310254(C) Cloud Computing		317537(C) Leadership and Personality Development												
310254(D) Software Modeling and Architecture		317537(D) Foreign Language												
		317537(E) MOOC- Learn New Skills												
Software Laboratory II (Assignments from)		Artificial Neural Network												
Software Laboratory III (Assignments from)		Data Science												
Mini Project (Assignments from)		Cyber Security and Elective II												
Internship**		Internship guidelines are provided in course curriculum sheet.												



Subject 1: Data Science

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	04	-	-

Online/ In-sem	Theory	Practical	Oral	Term- work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives

- To understand the need of Data Science
- To understand computational statistics in Data Science
- To study and understand the different technologies used for Data processing
- To understand and apply data modeling strategies
- To learn Data Analytics using Python programming
- To be conversant with advances in analytics

Course Outcomes

At the end of the Course, Students will be able to,

- Analyze needs and challenges for Data Science
- Apply statistics for Data Analytics
- Apply the lifecycle of Data analytics to real world problems
- Implement Data Analytics using Python programming
- Implement data visualization using visualization tools in Python programming
- Design and implement Big Databases using the Hadoop ecosystem

Syllabus

Unit	Topic	Hours
I	Introduction to Data Science	07
	Basics and need of Data Science, Applications of Data Science, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data: Data Types, Data Collection. Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Data Discretization.	
II	Statistical Inference	06
	Need of statistics in Data Science, Measures of Central Tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.	
III	Data Analytics Life Cycle	06
	Introduction, Data Analytic Lifecycle: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operationalize.	
IV	Predictive Data Analytics with Python	06
	Introduction, Essential Python Libraries, Basic examples. Data Preprocessing: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data. Analytics Types: Predictive, Descriptive and Prescriptive. Association Rules: Apriori Algorithm, FP growth. Regression: Linear Regression, Logistic Regression. Classification: Naïve Bayes, Decision Trees. Introduction to Scikit-learn, Installations, Dataset, matplotlib, filling missing values, Regression and Classification using Scikit-learn.	
V	Data Analytics and Model Evaluation	06
	Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis. Introduction to Text Analysis: Text-preprocessing, Bag of words, TF-IDF and topics. Need and Introduction to social network analysis, Introduction to business analysis. Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Clustering and Time-series analysis using Scikit-learn, sklearn. metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.	
VI	Data Visualization and Hadoop	05

Introduction to Data Visualization, Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization, Hadoop ecosystem, Map Reduce, Pig, Hive,. Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box- plot.

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Basics and need of Data Science, Applications of Data Science, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data: Data Types, Data Collection. Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Data Discretization	1.1,1.2, 2.1,2.2	7
2	II	Need of statistics in Data Science, Measures of Central Tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.	1.1,1.2 2.1,2.2,2.5	6
3	III	Introduction, Data Analytic Lifecycle: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operationalize.	1.1,1.2,2.1 ,2.2,2.4,2. 5	6
4	IV	Introduction, Essential Python Libraries, Basic examples. Data Preprocessing: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data. Analytics Types: Predictive, Descriptive and Prescriptive. Association Rules: Apriori Algorithm, FP growth. Regression: Linear Regression, Logistic Regression.	1.1, 1.2, 2.1,2.2,2.3 ,2.4	6

		Classification: Naïve Bayes, Decision Trees. Introduction to Scikit-learn, Installations, Dataset, matplotlib, filling missing values, Regression and Classification using Scikit-learn.		
5	V	Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis. Introduction to Text Analysis: Text-preprocessing, Bag of words, TF-IDF and topics. Need and Introduction to social network analysis, Introduction to business analysis. Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Clustering and Time-series analysis using Scikit-learn, sklearn. metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.	1.1,1.2,1.2.1, 2.2,2.3,2.4,2.5	6
6	VI	Introduction to Data Visualization, Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization, Hadoop ecosystem, Map Reduce, Pig, Hive,. Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box- plot.	1.2,2.1, 2.2,2.3,2.4	5

1. Text Books:

1. David Dietrich, Barry Hiller, “Data Science and Big Data Analytics”, EMC educationservices, Wiley publication, 2012, ISBN0-07-120413-X.
2. Jiawei Han, Micheline Kamber, and Jian Pie, “Data Mining: Concepts and Techniques” Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807.

2. Reference Books:

1. EMC Education Services, “Data Science and Big Data Analytics- Discovering,analyzing Visualizing and Presenting Data” Ist Edition.
2. DT Editorial Services, “Big Data, Black Book”, DT Editorial Services,ISBN: 9789351197577, 2016 Edition.
3. Chirag Shah, “A Hands-On Introduction To Data Science”, Cambridge

University Press, (2020), ISBN : ISBN 978-1-108-47244-9.

4. Wes McKinney, "Python for Data Analysis", O' Reilly media, ISBN: 978-1-449-31979-3.
5. Trent Hawk, "Scikit-learn Cookbook", Packt Publishing, ISBN: 9781787286382.
6. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", O'Reilly Media, Inc., ISBN:9781491913703
7. Venkat Ankam, "Big Data Analytics", Packt Publishing, ISBN: 9781785884696.
8. Seema Acharya, Subhashini Chellappan, "Big Data And Analytics", Wiley publication, ISBN: 9788126579518

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- *e-Books:*

1. An Introduction to Statistical Learning by Gareth James
<https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf>
2. Python Data Science Handbook by Jake VanderPlas
<https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf>
3. Hadoop Tutorial :
https://www.tutorialspoint.com/hadoop/hadoop_tutorial.pdf?utm_source=7_&utm_medium=af_filiate&utm_content=5f34cd37cdf1050001b09537&utm_campaign=Admitad&utm_term=761c_575424fc4a6b48d02f72157eb578
4. Learning with Python; How to think like a computer scientist:
<http://openbookproject.net/thinkcs/python/english3e/>
5. Scikit Learn Tutorial <https://scikit-learn.org/stable/>
6. Python for everybody:http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
7. An introduction to data Science :
<https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1>

- *MOOC/ Video Lectures available at:*

- Computer Science and Engineering - NOC:Data Science for Engineers
- Computer Science and Engineering - NOC:Python for Data Science
- Computer Science and Engineering - NOC:Data Mining
- Computer Science and Engineering - NOC:Big Data Computing
- Big Data Computing - Course

Unit No.-I-

Name of the Unit : Introduction to Data Science

Lecture No.	Details of the Topic to be covered	References
1	Basics and need of Data Science, Applications of Data Science .	1.1,1.2
2	Relationship between Data Science and Information Science.	1.1,1.2,1.3
3	Business intelligence versus Data Science	1.1,1.2,1.3
4	Data: Data Types, Data Collection	1.1,1.2,2.1
5	Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction	1.1,1.2,2.2
6	Data Transformation, and Data Discretization.	1.1,1.2,1.3, 2.1

Question Bank: Theory & Numericals Mapped to Course Outcome:

- Q. 1** Define Data Science and its core components.
- Q. 2** List and describe various industries that benefit from data science applications.
- Q. 3** Compare and contrast data science and information science.
- Q. 4** Define Business Intelligence (BI) and its primary objectives.
- Q. 5** Explain different data types (e.g., numerical, categorical, ordinal) with examples.

Unit No.-II-

Name of the Unit : Statistical Inference

Lecture No.	Details of the Topic to be covered	References
1	Need of statistics in Data Science, Measures of Central Tendency: Mean, Median, Mode, Mid-range.	1.1,2.1
2	Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation	1.1,2.1
3	Bayes theorem	1.1,2.1
4	Basics and need of hypothesis and hypothesis testing	1.1,2.1
5	Pearson Correlation	1.1,2.1
6	Sample Hypothesis testing, Chi-Square Tests, t-test	1.1,2.1

Question Bank: Theory & Numericals Mapped to Course Outcome:

Q. 1 Discuss the role of statistics in data science and its importance in the data analysis process.

Q. 2 Define measures of central tendency (mean, median, mode, mid-range) and their respective use cases

Q. 3 Define measures of dispersion (range, variance, mean deviation, standard deviation) and their significance.

Q. 4 Explain Bayes' theorem and its application in probability and statistical inference.

Q. 5 Define a hypothesis and explain its role in the scientific method.

Unit No.-III

Name of the Unit: Data Analytics Life Cycle

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Data Analytic Lifecycle: Introduction	1.1,1.2,2.1,2.5
2	Phase 1: Discovery, Phase 2: Data Preparation	1.1,1.2,2.5,2.1
3	Phase 3: Model Planning, Phase 4: Model Building	1.1,1.2, 2.1,2.5
4	Phase 5: Communication results, Phase 6: Operationalize.	1.1,1.2, 2.1,2.5

Question Bank: Theory & Programs Mapped to Course Outcome:

Q. 1	What is the primary objective of the discovery phase in the data analytic lifecycle?
Q. 2	Why is data cleaning an essential step in the data preparation phase?
Q. 3	What factors should be considered when selecting data analysis techniques for a specific problem?
Q. 4	Describe the process of model building and training in the data analytic lifecycle.
Q. 5	Why is effective communication of data analysis results crucial for decision-making?

Unit No.-IV

Name of the Unit: Predictive Data Analytics with Python

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Essential Python Libraries, Basic examples	1.1, 1.2, 2.1,2.2,2.3,2.5
2	Data Preprocessing: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data.	1.1, 1.2, 2.1,2.2,2.2,2.3,2.5
3	Analytics Types: Predictive, Descriptive and Prescriptive.	1.1, 1.2, 2.1,2.2,2.2,2.3,2.5
4	Association Rules: Apriori Algorithm, FP growth.	1.1, 1.2, 2.1,2.2,2.2,2.3,2.5
5	Regression: Linear Regression, Logistic Regression. Classification: Naïve Bayes, Decision Trees.	1.1, 1.2,2.1,2.2,2.2,2.3,2.5
6	Introduction to Scikit-learn, Installations, Dataset, mat plotlib, filling missing values, Regression and Classification using Scikit-learn.	1.1, 1.2, 2.1,2.2,2.2,2.3,2.5

Question Bank: Theory & Programs Mapped to Course Outcome:

Q. 1 Define predictive data analytics and its role in making data-driven decisions.

Q. 2 Name some popular Python libraries used for predictive data analytics.

Q. 3 Explain the process of handling missing data in a dataset using Python.

Q. 4 Define regression analysis and its use in predictive modeling.

Q. 5 What is classification, and how does it differ from regression?

Unit No.-V

Name of the Unit: Data Analytics and Model Evaluation

Lecture No.	Details of the Topic to be covered	References
1	Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis	2.1, 2.2,2.3,2.4,2.5
2	Introduction to Text Analysis: Text-preprocessing, Bag of words, TF-IDF and topics	2.1, 2.2 ,2.3,2.4,2.5
3	Need and Introduction to social network analysis, Introduction to business analysis.	2.1, 2.2, ,2.3,2.4,2.5
4	Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation	2.1, 2.2, ,2.3,2.4,2.5
5	Clustering and Time-series analysis using Scikit- learn, sklearn.	2.1, 2.2, ,2.3,2.4,2.5
6	metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.	2.1, 2.2,2.3,2.4,2.5

Question Bank: Theory & Programs Mapped to Course Outcome:

Q. 1	Explain the working principle of the K-Means clustering algorithm.
Q. 2	Define time-series analysis and its significance in data analysis.
Q. 3	Describe the process of text preprocessing and its importance in text analysis.
Q. 4	Define social network analysis and its applications in various fields.
Q. 5	List and describe metrics used for evaluating classifier performance (e.g., accuracy, precision, recall, F1-score).

Unit No. VI

Name of the Unit: Data Visualization and Hadoop

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Data Visualization, Types of data visualization	2.1, 2.2
2	Data Visualization Techniques, Tools used in Data Visualization	2.1, 2.2
3	Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization	2.1, 2.2
4	Hadoop ecosystem, Map Reduce, Pig, Hive	2.1, 2.2
5	Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box- plot.	2.1, 2.2

Question Bank: Theory & Numericals Mapped to Course Outcome:

Q. 1	Define data visualization and explain its importance in data analysis.
Q. 2	List and describe the different types of data visualization (e.g., bar charts, pie charts, heatmaps, etc.).
Q. 3	Explain the principles of effective data visualization design (e.g., color choice, data labeling, chart layout).
Q. 4	What are the main challenges in visualizing big data?



Subject 2: Cyber Security

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	04	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:

- To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
- To know the basics of cryptography.
- To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
- To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics.

Course Outcomes:

On completion of the course, learner will be able to–

- Gauge the security protections and limitations provided by today's technology.
- Identify cyber security threats.
- Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
- Build appropriate security solutions against cyber-attacks

Syllabus

Unit	Topic	Hours
I	Introduction	06
	Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.	
II	Data Encryption Techniques And Standards	08
	Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistel Cipher, Data Encryption Standard (DES), Triple DES, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).	
III	Public Key And Management	08
	Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.	
IV	Security Requirements	08
	IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).	
V	Firewall And Intrusion	08
	Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.	
VI	Cyber Forensic, Hacking& its countermeasures	08
	Personally Identifiable Information (PII), Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective. Hacking: Remote connectivity and VoIP hacking, Wireless Hacking, Mobile Hacking, countermeasures	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.	Nina Godbole, Sunit Belapure, Cyber Security	06
2	II	Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistel Cipher, Data Encryption Standard (DES), Triple DES, Weak Keys in DES Algorithms, Advance Encryption Standard (AES)	Dr.V.K. Pachghare, Cryptography and Information Security	08
3	III	Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol	William Stallings, "Cryptography and Network Security	08
4	IV	IP Security: Introduction, Architecture, IPV6, IPV4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET)	Principles and Practice", 7/e, Pearson,	08
5	V	Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.	Atul Kahate, "Cryptography and Network Security",	08



6	VI	Personally Identifiable Information (PII), Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective. Hacking: Remote connectivity and VoIP hacking, Wireless Hacking, Mobile Hacking, countermeasures	Hacking Exposed Network Security Secrets and Solutions, McGrowHill,	08
---	----	---	---	----

Text Books:

1. Dr. V.K. Pachghare, Cryptography and Information Security, PHI, ISBN 978-81-303- 5082-3
2. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, ISBN:978-81-345-2179-1

Reference Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 7/e, Pearson, ISBN:9789332585225.
2. . Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- <https://www.simplilearn.com/introduction-to-cyber-security-beginners-guide-pdf>
- https://pearsoned.co.in/web/books/9789332585225_Cryptography-and-NetworkSecurity_William-Stallings.aspx
- <http://84.209.254.175/linux-pdf/Hacking-Exposed-7-Network-SecuritySecrets.pdf>

Unit No.-I- Introduction

Lecture No.	Details of the Topic to be covered	References
1	Introduction	Pearson -Cryptography and Network Security
2	Elements of Information Security	Mc Graw Hill Publication Cryptography and Network Security
3	security Policy, Techniques, Steps, Categories	Pearson -Cryptography and Network Security
4	Operational Model of Network Security	Mc Graw Hill Publication Cryptography and Network Security
5	Basic Terminologies in Network Security.	Pearson -Cryptography and Network Security
6	Threats and Vulnerability, Difference between Security and Privacy.	McGrawHill -Hacking Exposed Network Security Secrets and Solutions,

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1	List and explain element of information security.
Q. 2	What are security approaches to used to implement security policies
Q. 3	Describe 1) Distributed Denial-of-Service (DDoS) 2) Phishing.
Q. 4	Draw and explain operational model of Network Security.
Q. 5	What is passive and active attacks in information security explain with suitable diagram

Unit No.-II- Data Encryption Techniques and Standards

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography	Dr. V.K. Pachghare, Cryptography and Information Security
2	Substitution Ciphers. Transposition Ciphers	Dr. V.K. Pachghare, Cryptography and Information Security
3	Stenography applications and limitations, Block Ciphers and methods of operations	Dr. V.K. Pachghare, Cryptography and Information Security
4	Feistel Cipher	Dr. V.K. Pachghare, Cryptography
5	Data Encryption Standard (DES), Triple DES	Cyber Security, Wiley India
6	Weak Keys in DES Algorithms	Cyber Security, Wiley India
7	Advance Encryption Standard (AES)	Cyber Security, Wiley India
8	Advance Encryption Standard (AES)	Cyber Security, Wiley India

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1	Describe a) Symmetric Encryption Method b) Asymmetric Encryption Method c) Cryptography d) Weak Key in DES
Q. 2	Explain different types of cryptography
Q. 3	Use Play fair cipher to encrypt the following message "This is a columnar transposition" use key - APPLE

Q. 4 Explain the operation of DES algorithm in detail

Q. 5 Explain operation of AES algorithm and state its application

Unit No.-III- Public Key and Management

Lecture No.	Details of the Topic to be covered	References
1	Public Key Cryptography, RSA Algorithm	Dr.V.K.Pachghare, Cryptography and Information Security
2	RSA Algorithm Key length, Security, Key Distribution,	Mc Graw Hill Publication Cryptography and Network Security
3	Deffie-Hellman Key Exchange	Mc Graw Hill Publication Cryptography and Network Security
4	Elliptic Curve: Arithmetic, Cryptography, Security,	Dr. V.K. Pachghare, Cryptography and Information Security
5	Authentication methods, Message Digest	Mc Graw Hill Publication Cryptography and Network Security
6	Kerberos, X.509 Authentication service	Mc Graw Hill Publication Cryptography and Network Security
7	Digital Signatures: Implementation, Algorithms, Standards (DSS)	Dr. V.K. Pachghare, Cryptography and Information Security
8	Authentication Protocol.	Mc Graw Hill Publication Cryptography and Network Security

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 Explain various public key distribution approaches.

Q. 2 What is authentication? Explain various methods for authentication

Q. 3 What is Kerberos? Explain its operation

Q. 4 Explain A) Message Digest
B) X.509 Authentication service

Q. 5 Describe elliptic curve cryptography.

Unit No.-IV- Security Requirements

Lecture No.	Details of the Topic to be covered	References
1	IP Security: Introduction, Architecture, IPV6, IPv4,	William Stallings, "Cryptography and Network Security
2	IPsec protocols, and Operations, AH Protocol,	William Stallings, "Cryptography and Network Security
3	AH Protocol, ESP Protocol, ISAKMP Protocol VPN. WEB Security	William Stallings, "Cryptography and Network Security
4	Secure Socket Layer (SSL) ,SSL Session and Connection,	William Stallings, "Cryptography and Network Security
5	SSL Record Protocol, Change Cipher Spec Protocol	William Stallings, "Cryptography and Network Security
6	Alert Protocol, Handshake Protocol.	William Stallings, "Cryptography and Network Security
7	Electronic Mail Security: Introduction, Pretty Good Privacy	William Stallings, "Cryptography and Network Security
8	MIME, S/MIME, Comparison. Secure Electronic Transaction SET	William Stallings, "Cryptography and Network Security

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 Define IP security. Draw and explain the architecture of IP security.

Q. 2 What are different protocols used in IP security. Explain each protocol briefly.

Q. 3 Define Secure socket layer (SSL). Explain SSL record protocol briefly.

Q. 4 What is Electronic mail security? Explain the concept of pretty good privacy.

Q. 5 Explain the concept of virtual private network used for IP security.

Unit No.-V- Firewall and Intrusion

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Computer Intrusions.	William Stallings, "Cryptography and Network Security:
2	Firewall Introduction, Characteristics and types	William Stallings, "Cryptography and Network Security:
3	Benefits and limitations. Firewall architecture	William Stallings, "Cryptography and Network Security:
4	Trusted Systems, Access Control.	William Stallings, "Cryptography and Network Security:
5	Intrusion detection, IDS: Need of IDS	William Stallings, "Cryptography and Network Security:
6	Methods, Types of IDS	William Stallings, "Cryptography and Network Security:
7	Intrusion detection, IDS	William Stallings, "Cryptography and Network Security:
8	Password Management, Limitations and Challenges	William Stallings, "Cryptography and Network Security:

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 What are the challenges of Intrusion Detection

Q. 2 What are various characteristic of firewall

Q. 3 Explain Anomaly-based Intrusion Detection system

Q. 4 What is Access control security service?

Q. 5 Explain Architecture of Firewall

Unit No.-VI- Cyber Forensic, Hacking& its countermeasures

Lecture No.	Details of the Topic to be covered	References
1	Personally Identifiable Information (PII)	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
2	Personally Identifiable Information (PII)	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
3	Cyber Stalking, Cybercrime	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
4	PII Confidentiality Safeguards	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
5	Information Protection Law: Indian Perspective	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
6	Hacking: Remote connectivity and VoIP hacking	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
7	Wireless Hacking, Mobile Hacking	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,
8	Mobile Hacking, countermeasures	George Kurtz, Hacking Exposed Network Security Secrets and Solutions,



Question Bank: Theory & Numerical Mapped to Course Outcome:

- | | |
|-------------|--|
| Q. 1 | Explain the concept of confidentiality and cyber forensic |
| Q. 2 | What do you mean by personally identifiable information? Explain the use of PII in terms of confidentiality and cyber forensic |
| Q. 3 | What is cyber stalking? Describe back levels of cyber stalking |
| Q. 4 | What is information Protection law? Explain the IPL law in terms of Indian perspective |
| Q. 5 | What is SIP scanning in VoIP attack? State its counter measure |



Subject 3: Artificial Neural Network

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	04	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:

- To provide students with a basic understanding of the fundamentals and applications of artificial neural networks
- To identify the learning algorithms and to know the issues of various feed forward and feedback neural networks.
- To Understand the basic concepts of Associative Learning and pattern classification.
- To solve real world problems using the concept of Artificial Neural Networks.

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the basic features of neural systems and be able to build the neural model.
- Perform the training of neural networks using various learning rules.
- Grasping the use of Associative learning Neural Network
- Describe the concept of Competitive Neural Networks
- Implement the concept of Convolutional Neural Networks and its models CO6: Use a new tool /tools to solve a wide variety of real-world problems

Syllabus

Unit	Topic	Hours
I	Introduction to ANN	07
	Introduction to ANN, History of Neural Network, Structure and working of Biological Neural Network, Neural net architecture, Topology of neural network architecture, Features, Characteristics, Types, Activation functions, Models of neuron-Mc Culloch & Pitts model, Perceptron, Adaline model, Basic learning laws, Applications of neural networks, Comparison of BNN and ANN.	
II	Learning Algorithms	07
	Learning and Memory, Learning Algorithms, Numbers of hidden nodes, Error Correction and Gradient Decent Rules, Perceptron Learning Algorithms, Supervised Learning Backpropagation, Multilayered Network Architectures, Back propagation Learning Algorithm, Feed forward and feedback neural networks, example and applications.	
III	Associative Learning	07
	Introduction, Associative Learning, Hopfield network, Error Performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, State transition diagram and false minima problem, stochastic update, simulated annealing. Basic functional units of ANN for pattern recognition tasks: Pattern association, pattern classification and pattern mapping tasks.	
IV	Competitive learning Neural Network	07
	Components of CL network, Pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network. Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification	
V	Convolution Neural Network	07
	Building blocks of CNNs, Architectures, convolution / pooling layers, Padding, Strided convolutions, Convolutions over volumes, SoftMax regression, Deep Learning frameworks, Training and testing on different distributions, Bias and Variance with mismatched data distributions, Transfer learning, multi-task learning, end-to-end deep learning, Introduction to CNN models: LeNet – 5, AlexNet, VGG – 16, Residual Networks	
VI	Applications of ANN	06
	Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction to ANN, History of Neural Network, Structure and working of Biological Neural Network, Neural net architecture, Topology of neural network architecture, Features, Characteristics, Types, Activation functions, Models of neuron-Mc Culloch & Pitts model, Perceptron, Adaline model, Basic learning laws, Applications of neural networks, Comparison of BNN and ANN.	T1, T2 ,R1	7
2	II	Learning and Memory, Learning Algorithms, Numbers of hidden nodes, Error Correction and Gradient Decent Rules, Perceptron Learning Algorithms, Supervised Learning Backpropagation, Multilayered Network Architectures, Back propagation Learning Algorithm, Feed forward and feedback neural networks, example and applications.	T1, T2 ,R1	7
3	III	Introduction, Associative Learning, Hopfield network, Error Performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, State transition diagram and false minima problem, stochastic update, simulated annealing. Basic functional units of ANN for pattern recognition tasks: Pattern association, pattern classification and pattern mapping tasks.	T1, T2 ,R1	7
4	IV	Components of CL network, Pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network. Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification	T1, T2 ,R1	7

5	V	Building blocks of CNNs, Architectures, convolution / pooling layers, Padding, Strided convolutions, Convolutions over volumes, SoftMax regression, Deep Learning frameworks, Training and testing on different distributions, Bias and Variance with mismatched data distributions, Transfer learning, multi-task learning, end-to-end deep learning, Introduction to CNN models: LeNet – 5, AlexNet, VGG – 16, Residual Networks	T1, T2 ,R1	7
6	VI	Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation .	T1, T2 ,R1	6

1. Text Books:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Laurene Fausett: Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.
3. An introduction to neural networks, Gurney, Kevin, CRC press.

2. Reference Books:

1. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd ,2005
2. Neural Networks in Computer Inteligance- Li Min Fu, MC GRAW HILL EDUCATION, 2003
3. Neural Networks -James A Freeman David M S Kapura, Pearson Education, 2004.
4. Introduction to Artificial Neural Systems- Jacek M. Zurada, JAICO Publishing House Ed.,2006.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

e-Books:

- <https://www.pdfdrive.com/neural-networks-a-comprehensive-foundationpdf-e18774300.html>



- <https://www.pdfdrive.com/elements-of-artificial-neural-networks-e17103719.html> 3
- <https://www.pdfdrive.com/neural-networks-methodology-and-applications-e38107895.html>

MOOC/ Video Lectures available at:

- <https://nptel.ac.in/courses/17105084>
- <https://www.coursera.org/projects/predicting-weather-artificial-neural-networks>

Unit No.-I-

Name of the Unit: Introduction to ANN

Lecture No.	Details of the Topic to be covered	References
1	Introduction to ANN,History of Neural Network.	Text Book no. 1
2	Structure and working of Biological Neural Network,Neural net architecture	Text Book no. 1
3	Topology of neural network architecture, Features,Characteristics,Types	Text Book no. 1
4	Activation functions,Models of neuron-Mc Culloch & Pitts model	Text Book no. 1
5	Perceptron, Adaline model,	Text Book no. 1
6	Basic learning laws, Applications of neural networks	Text Book no. 1
7	Comparison of BNN andANN.	Text Book no. 1

Question Bank: Theory & Numericals Mapped to Course Outcome:

Q. 1 What is an Artificial Neural Network (ANN) and how does it differ from a Biological Neural Network (BNN)?

Q. 2 What are the different components of a neural network architecture?

Q. 3 What is a perceptron? How does it function and what are its limitations?

Unit No.-II-

Name of the Unit: Learning Algorithms

Lecture No.	Details of the Topic to be covered	References
1	Learning and Memory	Text Book no. 1, 2
2	Learning Algorithms, Numbers of hidden nodes	Text Book no. 1, 2
3	Error Correction and Gradient Decent Rules	Text Book no. 1, 2
4	Perceptron Learning Algorithms, Supervised Learning Backpropagation	Text Book no. 1, 2
5	Multilayered Network Architectures	Text Book no. 1, 2
6	Back propagation Learning Algorithm	Text Book no. 1, 2
7	Feed forward and feedback neural networks, example and applications.	Text Book no. 1, 2

Question Bank: Theory & Numericals Mapped to Course Outcome:

- Q. 1** Discuss the relationship between learning and memory in neural networks. How does the network's ability to learn affect its memory capacity?
- Q. 2** Describe the Perceptron learning algorithm and its significance in training neural networks.
- Q. 3** Discuss the differences between feedforward and feedback neural networks. Provide examples of each and their applications in real-world problems.

Unit No.-III

Name of the Unit: Associative Learning

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Associative Learning	Text Book no. 1, 2
2	Hopfield network, Error Performance in Hopfield networks	Text Book no. 1, 2
3	Simulated annealing	Text Book no. 1, 2
4	Boltzmann machine and Boltzmann learning	Text Book no. 1, 2
5	State transition diagram and false minima problem, stochastic update, simulated annealing.	Text Book no. 1, 2
6	Basic functional units of ANN for pattern recognition tasks	Text Book no. 1, 2
7	Pattern association, pattern classification and pattern mapping tasks.	Text Book no. 1, 2

Question Bank: Theory & Programs Mapped to Course Outcome:

- Q. 1** What is a Boltzmann machine and how does it differ from other neural network models? Explain the Boltzmann learning algorithm.
- Q. 2** Discuss the issue of false minima in optimization problems and how it relates to Boltzmann machines. How can stochastic update techniques help overcome this problem?
- Q. 3** Compare and contrast the applications and limitations of different neural network models, such as Hopfield networks, Boltzmann machines, and traditional feedforward networks, in pattern recognition tasks.

Unit No.-IV

Name of the Unit: Competitive learning Neural Network

Lecture No.	Details of the Topic to be covered	References
1	Components of CL network, Pattern clustering and feature mapping network	T1, R1
2	ART networks, Features of ART models	T1, R1
3	Character recognition using ART network.	T1, R1
4	Self-Organization Maps (SOM): Two Basic Feature Mapping Models	T1, R1
5	Self-Organization Map, SOM Algorithm	T1, R1
6	Properties of Feature Map, Computer Simulations	T1, R1
7	Learning Vector Quantization, Adaptive Pattern Classification	T1, R1

Question Bank: Theory & Programs Mapped to Course Outcome:

- Q. 1** Explain the concepts of pattern clustering and feature mapping in neural networks. How are these processes used to organize and classify input patterns?
- Q. 2** Provide an example of character recognition using an ART network. How does the network learn and classify different characters?
- Q. 3** Discuss the properties of feature maps generated by SOM. What are some typical characteristics of these maps?

Unit No.-V

Name of the Unit: Convolution Neural Network

Lecture No.	Details of the Topic to be covered	References
1	Building blocks of CNNs	T1, R1
2	Architectures, convolution / pooling layers	T1, R1
3	Padding, Strided convolutions	T1, R1
4	Convolutions over volumes, SoftMax regression,	T1, R1
5	Deep Learning frameworks, Training and testing on different distributions,	T1, R1
6	Bias and Variance with mismatched data distributions, Transfer learning, multi-task learning, end-to-end deep learning,	T1, R1
7	Introduction to CNN models: LeNet – 5, AlexNet, VGG – 16, Residual Networks	T1, R1

Question Bank: Theory & Programs Mapped to Course Outcome:

Q. 1 Explain the building blocks of Convolutional Neural Networks (CNNs). What are convolutional layers, pooling layers, and fully connected layers, and how do they contribute to the network's functionality?

Q. 2 What is padding in the context of convolutional layers? How does it affect the spatial dimensions of the output feature maps?

Q. 3 Explain SoftMax regression in the context of CNNs. How is it used to produce probability distributions over multiple classes?

Unit No. VI

Name of the Unit: Applications of ANN

Lecture No.	Details of the Topic to be covered	References
1	Pattern classification – Recognition of Olympic games symbols	T1, R1
2	Recognition of printed Characters. Neocognitron – Recognition of handwritten characters.	T1, R1
3	NET Talk: to convert English text to speech.	T1, R1
4	Recognition of consonant vowel (CV) segments	T1, R1
5	texture classification and segmentation	T1, R1

Question Bank: Theory & Numericals Mapped to Course Outcome:

- Q. 1** Explain how pattern classification is applied in the recognition of printed characters. What are some common methods and algorithms used in this task?
- Q. 2** Describe the Neocognitron model and its application in the recognition of handwritten characters. How does it differ from other neural network architectures?
- Q. 3** Describe how pattern classification is used in texture classification and segmentation tasks. What are some common features and algorithms used to characterize and segment textures?



Subject 4: Cloud Computing

Weekly Work Loads(in Hrs)	Lecture	Tutorial	Practical
	04	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	0	100	03

Course Objectives:

- To study fundamental concepts of cloud computing
- To learn various data storage methods on cloud
- To understand the implementation of Virtualization in Cloud Computing
- To learn the application and security on cloud computing
- To study risk management in cloud computing
- To understand the advanced technologies in cloud computing

Course Outcomes:

On completion of the course, learners should be able to

- Understand the different Cloud Computing environment
- Use appropriate data storage technique on Cloud, based on Cloud application
- Analyze virtualization technology and install virtualization software
- Develop and deploy applications on Cloud
- Apply security in cloud applications
- Use advance techniques in Cloud Computing

Syllabus

Unit	Topic	Hours
I	Introduction to Cloud Computing	07
	Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models: SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.	
II	Data Storage and Cloud Computing	07
	Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage.	
III	Virtualization in Cloud Computing	07
	Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Grid, Cloud and Virtualization: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.	
IV	Cloud Platforms and Cloud Applications	07
	Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.	
V	Security in Cloud Computing	07
	Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.	



VI	Advanced Techniques in Cloud Computing	07
	<p>Future Trends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.</p>	

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	<p>Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models: SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.</p>	T1,R1	07
2	II	<p>Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage.</p>	T1,R1	07
3	III	<p>Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Grid, Cloud and Virtualization: Virtualization in Grid,</p>	T1,R1	07



		Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.		
4	IV	Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.	T1,R1	07
5	V	Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.	T1,R1	07
6	VI	Future Trends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.	T1,R1	07

Text Books:

1. A. Srinivasan, J. Suresh, “Cloud Computing: A Practical Approach for Learning and Implementation”, Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, ISBN-13:978-1-25-902995-0

Reference Books:

1. James Bond ,“The Enterprise Cloud”, O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more”, Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
4. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications”, Cambridge University Press, ISBN: 9780511778476
5. Tim Mather, Subra K, Shahid L.,”Cloud Security and Privacy”, Oreilly, ISBN-13 978-81- 8404-815-
6. Dr. Kumar Saurabh, “Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms”, Wiley publication, ISBN: 9788126570966
7. Rishabh Sharma, “Cloud Computing: Fundamentals, Industry Approach and Trends”, Wiley publication, ISBN:

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

<https://sjceodisha.in/wp-content/uploads/2019/09/CLOUD-COMPUTING-Principles-andParadigms.pdf>

<https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf>

<https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf>

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf>

Unit No.-I- Introduction to Cloud Computing

Lecture No.	Details of the Topic to be covered	References
1	Importance of Cloud Computing, Characteristics,	T1,R1
2	Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing.	T1,R1
3	Cloud Service Models: SaaS, PaaS, IaaS, Storage.	T1,R1
4	Cloud Architecture: Cloud Computing Logical Architecture,	T1,R1
5	Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models	T1,R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 How to improve performance in cloud through load balancing?

Q. 2 How Grid Computing Technologies plays important role in cloud computing.

Q. 3 Differentiate between public cloud & private cloud

Q. 4 Explain involvement of cloud computing in an organization. Explain its types

Q. 5 Explain primary cloud deployment models as per the NIST guidelines

Unit No.-II- Data Storage and Cloud Computing

Lecture No.	Details of the Topic to be covered	References
1	Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage	T1,R1
2	Storage Area Network, Network Attached Storage, Data Storage Management,	T1,R1
3	File System, Cloud Data Stores, Using Grids for Data Storage. C	T1,R1
4	Cloud Storage: Data Management, Provisioning Cloud storage,	T1,R1
5	Data Intensive Technologies for Cloud Computing.	T1,R1
6	Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage	T1,R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1	What is PaaS? Explain in details
Q. 2	What is SaaS? Explain in details
Q. 3	What is IaaS? Explain in details
Q. 4	Data Intensive Technologies for Cloud Computing
Q. 5	Explain Data Management in cloud

Unit No.-III- Virtualization in Cloud Computing

Lecture No.	Details of the Topic to be covered	References
1	Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software	T1,R1
2	Virtual Clustering, Virtualization Application, Pitfalls of Virtualization.	T1,R1
3	Grid, Cloud and Virtualization: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security	T1,R1
4	Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization	T1,R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 State the types of hardware virtualization?

Q. 2 State the limitations of virtualization.

Q. 3 What is the goal of encrypted cloud storage?

Q. 4 What is Grid computing

Q. 5 What are the applications of virtualization



Unit No.-IV- Cloud Platforms and Cloud Applications

Lecture No.	Details of the Topic to be covered	References
1	Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).	T1,R1
2	Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance.	T1,R1
3	Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing	T1,R1
4	Business and Consumer Applications: CRM and ERP, Social Networking	T1,R1
5	Google Cloud Application: Google App Engine. Overview of OpenStack architecture.	T1,R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 Explain Amazon web services

Q. 2 Explain cloud in health care

Q. 3 Explain cloud in e commerce

Q. 4 Explain cloud in CRM

Q. 5 Explain Google App Engine

Unit No.-V- Security in Cloud Computing

Lecture No.	Details of the Topic to be covered	References
1	Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing	T1,R1
2	Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages	T1,R1
3	Cloud Digital persona and Data security, Content Level Security.	T1,R1
4	Cloud Security Services: Confidentiality, Integrity and Availability	T1,R1
5	Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing	T1,R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 Explain Risks in Cloud Computing

Q. 2 Explain Security Issues in cloud

Q. 3 Explain Cloud Digital persona and Data security

Q. 4 What is integrity in cloud

Q. 5 What are the requirements of secure cloud

Unit No.-VI- Advanced Techniques in Cloud Computing

Lecture No.	Details of the Topic to be covered	References
1	Future Trends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud	T1R1
2	Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing	T1R1
3	Containers, Docker, and Kubernetes, Introduction to DevOps.	T1R1
4	IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.	T1R1

Question Bank: Theory & Numerical Mapped to Course Outcome:

Q. 1 What are the future trends in cloud

Q. 2 Explain multimedia cloud

Q. 3 Explain Kubernetes

Q. 4 Explain DevOps

Q. 5 Explain application of cloud in automobile