Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Permanent Affiliation by Andhra University & Approved by AICTE
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R20- IV YEAR

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING WITH DATA SCIENCE

ANITS-B Tech CSE (Data Science) CURRICULUM – REGULATIONS –R20

I Year Course structure – CSE(Data Science)

Semester – I

Course Code	Title of the course	Category	Periods						Sessional Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD111	Engineering Mathematics – I	BS	3	0	0	1	6	10	40	60	100	3
CSD112	Communicative English	HS	3	0	0	1	3	7	40	60	100	3
CSD113	BASIC ELECTRONICS	ES	3	0	0	1	3	7	40	60	100	3
CSD114	Digital Logic Design	ES	3	0	0	1	3	7	40	60	100	3
CSD115	PROBLEM SOLVING WITH C	ES	3	0	0	1	3	7	40	60	100	3
CSD116	English Language Lab	HS	0	0	3	0	3	6	50	50	100	1.5
CSD117	Problem solving with C – lab.	ES	0	0	3	0	3	6	50	50	100	1.5
CSD118	Environmental Science (Mandatory non-credit course)	BS	3	0	0	0	1	4	50	-	50	-
Total			**18**	**0**	**6**	**3**	**25**	**54**	**350**	**400**	**750**	**18**

II Year Course structure – (Data Science)

Semester - I

Course Code	Title of the course	Category	Periods						Sessional Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD121	Engineering Mathematics – II	BS	3	0	0	1	6	10	40	60	100	3
CSD122	Engineering Physics	BS	3	0	0	1	4	8	40	60	100	3
CSD123	Engineering Chemistry	BS	3	0	0	1	4	8	40	60	100	3
CSD124	ELEMENTS OF ELECTRICAL ENGINEERING	ES	3	0	0	1	4	8	40	60	100	3
CSD125	Engineering Drawing	ES	2	0	3	1	3	9	40	60	100	3.5
CSD126	Engineering Physics Lab.	BS	0	0	3	0	1	4	50	50	100	1.5
CSD127	Engineering Chemistry Lab.	BS	0	0	3	0	1	4	50	50	100	1.5
CSD128	Engineering Workshop	ES	0	0	3	0	1	4	50	50	100	1.5
CSD129	Human Values and Professional Ethics(Mandatory non-credit course)	HS	3	0	0	0	1	4	50	-	50	-
Total			**17**	**0**	**12**	**5**	**25**	**59**	**400**	**450**	**850**	**20**

II Year Course structure – CSE(Data Science)

Semester – I

CODE	SUBJECT NAME	Category	Periods						Sessional Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 211	DATA STRUCTURES&ALGORITHMS	PC	2	1	0	1	4	8	40	60	100	3
CSD 212	COMPUTER ORGANIZATION AND MICROPROCESSORS	PC	3	0	0	1	4	8	40	60	100	3
CSD 213	JAVA PROGRAMMING	PC	3	0	0	1	4	8	40	60	100	3
CSD 214	DATA COMMUNICATION AN D COMPUTER NETWORKS	PC	3	0	0	1	4	8	40	60	100	3
CSD 215	DISCRETE MATHEMATICAL STRUCTURES	BS	3	0	0	1	4	8	40	60	100	3
CSD 216	DESIGN THINKING & PRODUCT INNOVATION	ES	2	0	2	1	3	8	40	60	100	3
CSD 217	JAVA PROGRAMMING LAB	PC	0	0	3	0	2	5	50	50	100	1.5
CSD 218	DATA STRUCTURES LAB USING C	PC	0	0	3	0	2	5	50	50	100	1.5
CSD 219	Constitution of Indian & - Intellectual Property Rights	HS	2	0	0	0	1	3	50	-	50	-
Total			**18**	**1**	**8**	**6**	**28**	**61**	**390**	**460**	**850**	**21**

Semester - II — II Year Course structure – CSE(Data Science)

CODE	SUBJECT NAME	Category	Periods						Sessional Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 221	PROBABILITY , STATISTICS AND QUEUING THEORY	BS	3	0	0	1	6	10	40	60	100	3
CSD 222	BASICS OF DATA SCIENCE	PC	2	1	0	2	4	9	40	60	100	3
CSD 223	OPERATING SYSTEMS	PC	3	0	0	1	4	8	40	60	100	3
CSD 224	PYTHON PROGRAMMING	PC	3	0	0	1	4	8	40	60	100	3
CSD 225	THEORY OF COMPUTATION AND COMPILERS	PC	2	1	0	1	4	8	40	60	100	3
CSD 226	DESIGN ANALYSIS OF ALGORITHMS	PC	2	1	0	1	4	8	40	60	100	3
CSD 227	***PYTHON PROGRAMMING LAB***	PC	0	0	***3***	***0***	***1***	4	***50***	***50***	100	1.5
CSD 228	***CO & MICRO PROCESSOR INTERFACING LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSD 229	***OPERATING SYSTEM LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
Total			**15**	**3**	**9**	**7**	**29**	**63**	**390**	**510**	**900**	**22.5**

III Year Course structure – CSE(Data Science)

Semester – I

CODE	SUBJECT NAME	Category	Periods						Sessional Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 311	OPEN ELECTIVE -I* (Block Chain as EC)	OE	3	0	0	1	2	6	40	60	100	3
CSD 312	PROFESSIONAL ELECTIVE -I	PE	3	0	0	1	2	6	40	60	100	3
CSD 313	DATA ANALYSIS & VISUALIZATION	PC	3	0	0	1	2	6	40	60	100	3
CSD 314	COMPETITIVE PROGRAMMING	SOC	2	1	0	1	5	9	40	60	100	3
CSD 315	DATA BASE MANAGEMENT SYSTEMS	PC	3	0	0	1	4	8	40	60	100	3
CSD 316	***DATA SCIENCE WITH PYTHON LAB***	***PC***	0	0	***3***	***0***	1	4	***50***	***50***	100	1.5
CSD 317	***DATA BASE MANAGEMENT SYSTEMS LAB***	***PC***	0	0	***3***	***0***	1	4	***50***	***50***	100	1.5
CSD 318	***COMPETITIVE PROGRAMMING LAB***	***SOC***	0	0	3	0	1	4	***50***	***50***	100	1.5
CSD 319	**QA-I &SOFT SKILLS**	HS	0	0	3	0	1	4	***100***	***0***	100	1.5
CSD 31A	***SUMMER INTERNSHIP-INDUSTRY-1***	***PR***	0	0	***0***	***0***	***1***	1	***100***	***0***	***100***	2
Total			**14**	**1**	**9**	**5**	**18**	**47**	**300**	**400**	**700**	**23**

Semester - II

III Year Course structure – CSE(Data Science)

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 321	OPEN ELECTIVE -II*	OE	3	0	0	1	2	6	40	60	100	3
CSD 322	PROFESSIONAL ELECTIVE -II	PE	3	0	0	1	2	6	40	60	100	3
CSD 323	PROFESSIONAL ELECTIVE -III	PE	3	0	0	1	4	8	40	60	100	3
CSD 324	OBJECT ORIENTED SOFTWARE ENGINEERING	PC	3	0	0	1	4	8	40	60	100	3
CSD 325	WEB TECHNOLOGIES	PC	2	1	0	1	4	8	40	60	100	3
CSD 326	MACHINE LEARNING	PC	3	0	0	1	4	8	40	60	100	3
CSD 327	***WEB TECHNOLOGIES LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	100	1.5
CSD 328	***MACHINE LEARNING LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	100	1.5
CSD 329	**QA-II&VERBAL ABILITY**	HS	0	0	3	0	1	4	***100***	***0***	100	1.5
Total			**17**	**1**	**9**	**6**	**23**	**56**	**340**	**460**	**800**	**22.5**

IV Year Course structure – CSE(Data Science)

Semester - I (Tentative)

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 411	OPEN ELECTIVE -III*	OE	3	0	0	1	2	6	40	60	100	3
CSD 412	PROFESSIONAL ELECTIVE -IV	PE	3	0	0	1	2	6	40	60	100	3
CSD 413	PROFESSIONAL ELECTIVE -V	PE	3	0	0	1	3	7	40	60	100	3
CSD 414	BUSINESS INTELLIIGENCE	HS	3	0	0	0	2	5	40	60	100	3
CSD 415	DATA ANALYTICS	SOC	2	1	0	1	4	8	40	60	100	3
CSD 416	***OOSE LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSD 417	***DATA ANALYTICS LAB***	***SOC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSD 418	***PROJECT -PHASE 1***	***PR***	0	0	***3***	***0***	***1***	4	***100***	***0***	***100***	2
CSD 419	***SUMMER INTERNSHIP-INDUSTRY-2***	***PR***	0	0	***0***	***0***	***1***	1	***100***	***0***	***100***	2
Total			**14**	**1**	**9**	**4**	**17**	**45**	**500**	**400**	**900**	**22**

IV Year Course structure – CSE(Data Science)

Semester - II (Tentative)

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSD 421	OPEN ELECTIVE -IV*	OE	3	0	0	1	3	7	40	60	100	3
CSD 422	***PROJECT PHASE 2/INTERNSHIP IN INDUSTRY***	***PR***	0	0	9	0	2	11	***100***	***100***	***200***	8
Total			**3**	**0**	**9**	**1**	**5**	**18**	**140**	**160**	**300**	**11**

Total Credits **160**

*Open Elective can be Inter Department Disciplinary Course, Emerging Courses or MOOC. Final decision will be taken by the department.

PROFESSIONAL ELECTIVES	
PE1	•CSD 312(A)Smart Systems Design & Programming •CSD312(B)Advanced Data Structures •CSD312(C) No SQL Data Bases •CSD 312(D)Artificial Intelligence
PE2	•CSD322(A) Deep Learning •CSD 322(B) Mobile Computing • CSD322(C) Digital Image Processing • CSD322(D)Data warehousing and Data mining
PE3	• CSD323(A)Distributed Operating Systems • CSD323(B)Embedded Systems • CSD323(C)Human Computer Interaction • CSD323(D)Pattern Recognition
PE4	• CSD412(A)Computer vision • CSD412(B)Information Retrieval System • CSD 412(C)High Performance Computing • CSD415(D)Natural Language Processing
PE5	• CSD413(A)Internet Of Things • CSD413(B)Fuzzy Computing • CSD413(C)AI&ML in Cyber Security • CSD413(D) Cloud Computing

OPEN ELECTIVES	
OE 1 3rd Yr-Sem -1	Block Chain (as an emerging course)
OE2 3rd Yr-Sem -2	Introduction to Machine Learning
OE3 4th Yr-Sem -1	React JS (as an emerging course) Introduction to Data Analytics(non core)
OE4 4th Yr-Sem -2	MOOCS

REACT JS	
OE- CSD 411	**Credits: 3**
Instruction : 3 Periods/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre-requisites:

- Web Technologies (HTML, CSS Java Script)
- Database Management System

Course Objectives:

- To enable the students to make use of React Js Library.
- To build front end user interface using React Js
- To enable the students to build Server rendered applications.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Use and get familiar with installation, components, JSX, Developer Console, Babel, props, events and states.
2.	Utilize framework for developing a React app from scratch.
3.	Build Advanced component functionalities and creating server APIs for performing create, update and delete operations.
4.	Analyze the need for JSX and the Virtual DOM and create forms for accepting user input.
5.	Examine the need for routing and react router components along with dynamic routing.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2	-	3	-	-	-	2	-	1	2	-	-
2	2	2	2	-	3	-	-	-	2	-	1	2	-	-
3	2	2	2	-	3	-	-	-	2	-	1	2	-	-
4	2	2	2	-	3	-	-	-	2	-	1	2	-	-
5	2	2	2	-	3	-	-	-	2	-	1	2	-	-

SYLLABUS

UNIT- I **10 Periods**

Introduction to React JS

Case Study: Creating simple voting application.

Setting up your Development environment, Getting started , What is a component, Building product, Making product data driven, React the vote, Updating state and immutability, Refactoring with the Babel plugin transform-class-properties .

Learning Outcomes: At the end of this unit the student will be able to

1. Set up the executing environment for React Js.
2. Work with Developer Console and Apply basic React Js concepts.

UNIT-II: **10 Periods**

Components (Part – I)

Case Study: time-logging app

Getting started, Breaking the app into components , Build a static version of the app, Determine what should be stateful, Determine in which component each piece of state should live, Hard-code initial states, Add inverse data flow .

Learning Outcomes: At the end of this unit the student will be able to

1. Build a static version of the app
2. Determine the components state.

UNIT-III: **10 Periods**

Components and Servers

Components Part II

Case Study: Time-logging app

Updating timers, Deleting timers, Adding timing functionality, Add start and stop functionality.

Servers:

Introduction , server.js, The Server API, Playing with the API, Loading state from the server, client, Sending starts and stops to the server , Sending creates, updates, and deletes to the server .

Learning Outcomes: At the end of this unit the student will be able to

1. Add timing functionality to the components.
2. Work with Server API.

UNIT-IV: **10 Periods**

JSX and the Virtual DOM, Forms:
Case Study: Accepting Data from the user using Forms.
JSX and the Virtual DOM
React Uses a Virtual DOM, Why Not Modify the Actual DOM?, What is a Virtual DOM?, Virtual DOM Pieces, React Element, JSX.
Forms: Forms, Text Input, Remote Data, Async Persistence, Redux

Learning Outcomes: At the end of this unit the student will be able to

1. Use Virtual Dom
2. Implement Forms in React

UNIT-V: **10 Periods**

Routing
What's in a URL? , Building the components of react-router, Dynamic routing with React Router, Supporting authenticated routes.

Learning Outcomes: At the end of this unit the student will be able to

1. Construct routing with React Router.
2. Perform the authentication in Routing.

Text Books:

1. Anthony Accomazzo, "Fullstack React - The Complete Guide to ReactJS and Friends", 2017, Fullstack.io, San Francisco, California

Reference Books :

1. Alex Banks and Eve Porcello "Functional Web Development with React and ReduxLearning React",O'REILLY, 2017
2. Stoyan Stefanov "React Up and Running", O'REILLY, 2022
3. Robin Wieruch "The Road to Learn React", 2017.

Web Resources:
- https://reactjs.org/tutorial/tutorial.html
- https://www.simplilearn.com/tutorials/reactjs-tutorial/how-to-create-a-youtube-clone-using-react

Prepared By
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COMPUTER VISION	
CSD 412(A)	**Credits : 3**
Instruction **:** 3 Periods /Week	Sessional Marks : 40
End Exam : 3Hours	End Exam Marks : 60

Prerequisites:

Basic Knowledge of computer graphics and image processing.

Course Objectives:

- To understand light and shading effects
- To understand filtering and texture techniques
- To understand the use of clustering techniques & models for segmentation
- To understand fitting techniques

Course Outcomes:

Upon completion of the course, the students will be able to

By the end of the course, the student will be able to:	
1.	Discuss about measuring light, shadows and shading effects
2.	Apply Filtering techniques, edge detection methods, texture techniques
3.	Demonstrate segmentation using clustering techniques
4.	Illustrate segmentation using models
5.	Demonstrate fitting using classifiers

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	1	-	-	-	-	-	-	-	-	-	-	-
2	2	1	2	1	-	-	-	2	-	-	2	-	2	
3	1	1	2	2	-	-	-	2	-	-	2	-	2	2
4	1	1	2	2	-	-	-	2	-	-	1	-	2	2
5	1	1	-	-	-	-	-		-	-	2	-	2	2

SYLLABUS

UNIT-1 **10 Periods**

RADIOMETRY-MEASURING LIGHT: Light in Space, Light at Surfaces, Important Special Cases.

SOURCES, SHADOWS, AND SHADING: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Inter reflections: Global Shading
Models.

Learning Outcomes: At the end of this unit, Students are able to

1. Interpret behaviour of light and basic definitions of light
2. Describe the effects that result when surfaces reflect light onto one another.

UNIT-2 **10 Periods**

LINEAR FILTERS: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Technique: Normalized Correlation and Finding Patterns, Technique: Scale and Image Pyramids.

EDGE DETECTION: Noise, Estimating Derivatives, Detecting Edges.

TEXTURE: Representing Texture, Analysis using Oriented Pyramids,
Application: Synthesizing Textures for Rendering, Shape for Texture for Planes.

Learning Outcomes: At the end of this unit, Students are able to

1. Describe the Extraction of useful information from the images
2. Explain the edge detection techniques, representation of texture, analysis of pyramids and application of texture based manipulations.

UNIT-3 **10 Periods**

SEGMENTATION BY CLUSTERING: What is Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering.

Learning Outcomes: At the end of this unit, Students are able to

1. Describe the Image interpretation through segmentation techniques
2. Explain the Portioning and grouping based image clustering.

UNIT-4 **10 Periods**

SEGMENTATION BY FITTING A MODEL: The Hough Transform, Fitting Lines, Fitting
Curves, Fitting as Probabilistic Inference Problem, Robustness, Example: Using RANSAC to Fit
Fundamental Matrices, Missing Data Problems, the EM Algorithm.

Learning Outcomes: At the end of this unit, Students are able to

1. Differentiate the different image segmentations
2. Describe the need of segmentation in terms of missing data problems and outliers.

UNIT-5 **10 Periods**

FINDING TEMPLATES USING CLASSIFIERS: Method for Building Classifiers, Building
Classifiers from Class Histograms, Feature Selection, Neural Networks, the Support Vector Machine.

Learning Outcomes: At the end of this unit, Students are able to

1. Explain different types of image classification
2. Describe the proper selection of classification techniques.

TEXT BOOK:

1. David A.Forsyth, Jean Ponce, Computer Vision-A Modern Approach, PHI, 2003.

REFERENCES:

1. Geometric Computing With Clifford Algebras: Theoretical Foundations and Applications in Computer Vision and Robotics , Springer; 1/ e,2001 by Sommer.
2. Digital Image Processing and Computer Vision, 1/e, by Sonka.
3. Computer Vision and Applications: Concise Edition(With CD) by Jack, Academy Press,2000.

INFORMATION RETRIEVAL SYSTEMS	
CSD 412(B)	**Credits: 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

Data Structures, Relational Database Systems.

Course Objectives:

- Study fundamentals of DBMS, Data Warehouse and Digital Libraries.
- Learn various pre-processing techniques and indexing approaches in text mining
- Understand various clustering approaches and similarity measures
- Study various search techniques in information retrieval systems
- Explore various cognitive approaches used in text retrieval systems and evaluation approaches

Course Outcomes:

By the end of the course, the student will be able to:	
1	Demonstrate the functional overview and capabilities of the Information Retrieval System.
2	Apply indexing and various types of data structures for Information Retrieval.
3	Demonstrate and analyze the Automatic Indexing and Clustering.
4	Explain different user search techniques.
5	Describe the Text Searching Techniques and measures that can be used in evaluating Information Retrieval Systems

Mapping of course outcomes with program outcomes:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	-	-	-	-	-	-	1	1	-	1	-	-
2	2	2	2	2	1	1	-	-	1	1	-	1	2	2
3	2	2	2	2	1	1	-	-	1	1	-	1	2	2
4	2	1	1	1	1	1	-	-	1	1	-	1	2	2
5	2	2	2	2	1	1	-	-	1	1	-	1	2	2

SYLLABUS

UNIT-I: **10 Periods**

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management System, Digital Libraries and Data Warehouses.
Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities.

Learning Outcomes:

1. Focus on the functions available in an Information Retrieval System.
2. Demonstrate various information retrieval system capabilities.

UNIT-II: **10 Periods**

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction.
Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

Learning Outcomes:

1. Apply the indexing and cataloging for information System
2. Apply various types of data structures.

UNIT-III: **10 Periods**

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages.

Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

Learning Outcomes:

1. Demonstrate the various indexing techniques that stores the information.
2. Analyze the techniques that can be used to cluster the terms and documents

UNIT-IV: **10 Periods**

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, weighted searches of Boolean systems, Searching the Internet and hypertext.

Learning Outcomes:

1. Apply various searching techniques that map between the user search needs and the documents.
2. Explore the importance of ranking and relevance feedback in expanding the user's query.

UNIT-V: **10 Periods**

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems.

Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

Learning Outcomes:

1. Describes the hardware and software approaches to text search
2. Describes how to evaluate Information Retrieval Systems focusing on the theoretical and standard metrics used to evaluate information systems.

Text Books:

1. Kowalski, Gerald, Mark T May bury: Information Storage and Retrieval Systems: Theory and Implementation, Second Edition, Kluwer Academic Press, 2002.

Reference Books:

1. Finding Out About: Search Engine Technology from a cognitive Perspective, by Richard, K. Belew, Cambridge University Press, 2000. (for Case Studies)
2. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval data Structures and Algorithms, Prentice Hall, 1992.

Online Resources:

1. https://nlp.stanford.edu/IR-book/information-retrieval.html
2. https://resources.mpi-inf.mpg.de/d5/teaching/ss04/is04/links.htm
3. https://www.lisedunetwork.com/information-retrieval-syste/

HIGH PERFORMANCE COMPUTING	
CSD 412(C)	**Credits : 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Basic fundamentals of Data Structures
- Knowledge on Computer Organization, Computer Networks
- Exposure to Programming skills in C/C++

Course Objectives:

- Introducing different parallel machines
- Describe high performance computing in the context of scientific computing.
- Understand the concepts of parallel processing as it pertains to high-performance computing

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Explain the benefits of Parallel Computing and different parallel computing platforms.
2.	Design efficient Parallel Algorithms for scientific computations.
3.	Program computers with shared memory architecture
4.	Use GPU Computing efficiently for scientific computations.
5.	Apply High Performance Computing to solve real world Problems.

Mapping of course outcomes with program outcomes:

Mapping		**PO**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1	3	3	3	1	-	-	-	-	1	-	-	1	2	1
	2	3	2	2	2	-	-	-	-	1	-	-	1	1	3
	3	3	3	2	2	2	1	-	-	1	-	-	-	2	1
	4	3	3	3	2	2	2	-	-	1	-	-	-	2	3
	5	3	3	3	3	-	2	-	-	1	-	1	1	2	2

SYLLABUS

UNIT I: Introduction: 10 Periods

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms . (Text Book 1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the impact of Parallel Computing
2. Compare different Parallel Computing Platforms.

UNIT II: Principles of Parallel Algorithm Design: 10 Periods

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions. Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads Parallel Algorithm Models.

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs Performance Metrics for Parallel Systems, the Effect of Granularity on Performance, Scalability of Parallel Systems. (Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Design parallel algorithms
2. Compare different variety of overheads associated with parallelism.

UNIT III: Programming Shared Address Space Platforms: 10 Periods

Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads Controlling Thread and Synchronization Attributes, Thread Cancellation.

(Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Apply Shared address Space Programming
2. Develop programs using POSIX threads for high performance computing.

UNIT IV: GPU Computing: 10 Periods

Introduction: Heterogeneous Parallel Computing, Architecture of a Modern GPU, Why More Speed or Parallelism, SPEEDING UP REAL APPLICATIONS,

Data parallel computing: Data Parallelism, CUDA C Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Kernel Launch, CUDA Thread Organization, Mapping Threads to Multidimensional Data.

Learning Outcomes: At the end of this unit, the students will be able to (Text Book2)

1. Explain the impact of GPUs for achieving high performance
2. Develop programs using CUDA threads for high performance computing.

UNIT V: **10 Periods**

Case Studies
Dense Matrix Algorithms: Matrix-Vector Multiplication, Sorting, Quick sort, Bubble Sort and its Variants, Parallel Depth-First Search.
(Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Multiply dense matrices in parallel.
2. Compare different parallel sorting algorithms.

Text Book:

1. Ananth Grama, George Karypis , Vipin Kumar, Anshul Gupta, "Introduction to Parallel Computing", 2nd edition , Addison Wesley publishers,2003
2. David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors A Hands-on Approach, 3rd edition, MK Publishers,2016

Reference Book:

1. Gerassimos Barlas , " Multicore and GPU Programming An Integrated Approach " 1st Edition, MK Publishers,2015

Web Resources:

- http://nptel.ac.in/courses/106108055/#
- http://cs.nyu.edu/courses/fall10/G22.2945-001/lectures.html
- http://www.hpc.cam.ac.uk/
- http://www.hpc.cam.ac.uk/getting-help/introtohpc-course/view
- https://hpc.llnl.gov/training/tutorials
- https://www.wolfram.com/training/courses/hpc/
- https://www.epcc.ed.ac.uk/online-courses/courses/online-courses/practical-introduction-hpc

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Prepared By
Mr. S Ratan Kumar, Associate Prof, Dept of CSE
Dr. P.E.S.N. Krishna Prasad, Prof, Dept of CSE

NATURAL LANGUAGE PROCESSING	
CSD 412(D)	**Credits: 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Formal-language/automata theory, Artificial Intelligence, Machine learning

Course Objectives:

- Learn about the lexical, syntactic, and semantic analysis of natural language processing.
- Explore N-gram Language Models for language processing.
- Understand the statistical models for Natural language processing.
- Study the machine translation principles.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Demonstrate Parsing Techniques for Natural Language, Text preprocessing and Tokenization Techniques.
2	Evaluate Language Models through probability distribution and word sequence.
3	Apply word embedding's to find similarity and semantics of the language.
4	Apply Sequence labeling for POS Tagging and Select the appropriate method to evaluate the named entity recognition.
5	Examine Machine Translations and Encoder-Decoder Models for language processing.

Mapping of course outcomes with program outcomes:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	-	-	-	-	-	-	-	1	-	2	-	1
2	3	2	2	2	2	-	-	-	-	1	-	1	2	2
3	2	2	2	2	2	-	-	-	1	1	-	1	2	2
4	3	2	2	2	2	1	-	-	1	1	-	1	2	2
5	2	2	1	2	2	1	-	-	1	1	-	1	2	2

SYLLABUS

UNIT-I: Classical Approaches to NLP **12 periods**

Context, The Classical Toolkit-Text preprocessing, Lexical Analysis, Syntactic Parsing, Semantic Analysis, Natural Language Generation.
Text preprocessing-Introduction, Challenges of Text Preprocessing-Character-Set Dependency, Language Dependency, Corpus Dependency, Application Dependency.
Tokenization-Tokenization in space-Delimited Languages, Tokenization on unsegmented languages, Sentence Segmentation-Sentence Boundary Punctuation.

Learning Outcomes: At the end of this unit, the students will be able to

1. Interpret the steps of Natural Language Processing.
2. Summarize the challenges of Text preprocessing- Tokenization, Sentence Segmentation.

UNIT-II: N-gram Language Models **12 periods**

N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing Kneser-Ney Smoothing, Huge Language Models and Stupid Back off, Advanced: Perplexity's Relation to Entropy.

Learning Outcomes: At the end of this unit, the students will be able to

1. Find the probability distribution over word sequences.
2. Explore N- Gram Evaluating Language Models.

UNIT-III: Vector Semantics and Embedding's **12 periods**

Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.

Learning Outcomes: At the end of this unit, the students will be able to

1. Apply similarity measures for language processing
2. Illustrate word embedding techniques for semantic text processing

UNIT-IV: Sequence Labeling for Parts of Speech and Named Entities **12 periods**

English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.

Learning Outcomes: At the end of this unit, the students will be able to

1. Construct Sequence labeling for POS Tagging
2. Evaluate Named Entity Recognition for text classification.

UNIT-V: Machine Translation and Encoder-Decoder Models **12 periods**

Language Divergences and Typology, The Encoder-Decoder Model, Encoder-Decoder with RNNs, Attention Beam Search, Encoder-Decoder with Transformers, Some practical details on building MT systems, MT Evaluation, Bias, and Ethical Issues.

Learning Outcomes: At the end of this unit, the students will be able to

1. Identify the benefits of Encoder- Decoder.
2. Evaluate Machine Translation Models.

Textbooks:

1. Nitin Indurkhya and Fred J.Damerau,"Handbook of Natural Language Processing", Second Edition, CRC Press,2010.(UNIT-I)
2. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2020.(UNIT-II, UNIT-III, UNIT-IV, UNIT-V)

Reference Books:

1. Manning, Christopher D., and Hinrich Schütze, "Foundations of Statistical Natural Language Processing." Cambridge, MA: MIT Press, 1999. ISBN: 0262133601.

Web Resources:

- https://nptel.ac.in/courses/106105158
- https://www.mit.edu/~jda/teaching/6.864/sp21/

Prepared By
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Dr. M. Rama Krishna Murthy, Professor, Dept of CSE
Mr. P. Krishnanjaneyulu, Assistant Professor, Dept of CSE

INTERNET OF THINGS	
CSD 413(A)	**Credits: 3**
Instruction:3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Computer Networks

Course Objectives:

- Assess the genesis and impact of IoT applications, architectures in real world.
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT
- Identify sensor technologies for sensing real world entities and understand the role of IoT in variousdomains of Industry.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Discuss the foundations of IoT, challenges and issues, architectures and its functionality
2	Apply and use of Sensors, actuators and its connected components in designing models
3	Explain various protocols and configurations of IoT and discuss different layers and its protocols.
4	Discuss the need data analytics and cloud services in order to transform the data through IoT to Datastorage media.
5	Design and build the real-time applications(Smart applications).

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	1	2	2	2	-	-	-	-	1	1	-	-	2	-
	2	1	2	2	2	2	-	-	-	1	1	-	-	2	-
	3	1	2	2	2	2	-	-	-	1	1	-	-	2	-
	4	1	2	2	2	2	-	-	-	2	2	-	-	2	-
	5	1	2	3	3	3	-	-	-	2	2	-	-	2	-

SYLLABUS

UNIT I: **10 Periods**

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss what IoT is and how it works today
2. analyze the factors that contributed to the emergence of IoT

UNIT II: **10 Periods**

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting
Smart Objects, Communications Criteria, IoT Access Technologies.

Learning Outcome: At the end of this Unit the students will be able to

1. Analyze and discuss the deployment of sensors and its connected components and technologies to connect them to the network.
2. Build IoT models by connecting with IoT components and case study.

UNIT III **10 Periods**

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss the role of IoT protocols for efficient network communication.
2. Apply the Protocols for developing the applications.

UNIT IV: **10 Periods**

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Securing IoT.
IoT Cloud Platform: Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/Services, Everything as a service and Cloud Service Models.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss the need for Data Analytics and data streaming tools in IoT
2. Analyze and apply the Cloud platform in connection with IoT tools.

UNIT V: **10 Periods**

IoT Physical Devices –Micro Controllers
Arduino UNO: Introduction to Arduino, Installation, Fundamentals of Arduino Programming.
Raspberry Pi: Introduction, Hardware and Software Layout, Configuration, Basic Raspberry Pi Programming with Python.

Learning Outcome: At the end of this Unit the students will be able to

1. Explain different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.
2. Choose the sensors and actuators for designing IoT applications.

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill
   Education, 2017. (ISBN: 978-9352605224).

Reference Books:

1. Adrian McEwen,"Designing the Internet of Things", Wiley Publishers,2013,ISBN: 978-1-118-43062-0
2. Daniel Kellmereit, "The Silent Intelligence: The Internet of Things". 2013, ISBN 0989973700
3. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017

ONLINE WEB RESOURCES:

https://www.coursera.org/specializations/iot

FUZZY COMPUTING	
CSD 413(B)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Basic Knowledge of mathematical function and relation. Knowledge of set theory and logical Operations.

Course Objectives:

- To understand Fuzzy logic and inference system.
- To learn automated method of learning.
- To be able to apply decision making and classification techniques.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Differentiate between Fuzzy sets and crisp sets and their relational operations.
2.	Apply Fuzzification and de-Fuzzification with different member functions.
3.	Implement different automated methods of learning.
4.	Do decision making while solving problems for engineering applications.
5.	Classify and recognition patterns of discriminative classes.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	-	2	-	1	-	-	-	-	-	-	1	-	-	1
2	3	2	-	1	-	-	-	-	1	-	1	-	1	2
3	2	3	-	1	-	-	-	-	2	-	1	-	2	3
4	3	3	-	2	-	-	-	-	3	-	3	-	1	3
5	3	3	-	3	-	-	-	-	3	-	3	-	1	2

SYLLABUS

UNIT-I: **10 periods**

Fuzzy systems:

Introduction, History, Utility, Limitations, Uncertainty, accuracy and information, Fuzzy set, Fuzzy membership, Sets in hypercube.

Fuzzy sets:

Function and mapping in classical sets, Crisp versus Fuzzy set, Operations on Fuzzy sets, Properties.

UNIT-II: **10 periods**

Crisp and Fuzzy Relations:

Cardinality and properties of crisp relations, Operations on crisp relations, Cardinality and properties of Fuzzy relations, Operations on Fuzzy relations, Fuzzy Cartesian product and composition, Crisp tolerance and equivalence relations, Fuzzy tolerance and equivalence relations, Value assignments, Cosine amplitude, Max–Min method, Other similarity methods.

UNIT-III: **10 periods**

Logic and Fuzzy System:

Membership function and it's features, Fuzzification and its types, Defuzzification, λ-cuts for Fuzzy relations, Defuzzification to Scalars, Classical logic, Proof, Fuzzy logic, Approximate reasoning, Other forms of the implication operation, Rule-based systems, Graphical techniques of inferences, Membership value assignments through intuition, inference, and rank ordering.

UNIT-IV: **10 periods**

Automated Methods:

Batch least squares algorithm, Recursive least squares algorithm, Gradient method, Clustering method, Learning from examples, Modified learning from examples.

UNIT-V: **10 periods**

Decision Making:

Synthetic evaluation, Ordering, Non-transitive ranking, Preference and consensus, Multi- objective decision making.

Classification: Classifying by equivalence relations, Crisp relations and Fuzzy relations, Cluster analysis, Cluster validity, Hard c-Means (HCM) and Fuzzy c-Means (FCM), Fuzzy c-Means Algorithm.

Text Books:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley.

Reference Books :

1. S. Rajasekaran, G.A.V. Pai,"Neural Network, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications",PHI.

Web Resources:

- http://nptel.ac.in/courses/106105173/2
- http://nptel.ac.in/courses/108104049/16#

MACHINE LEARNING FOR CYBER SECURITY	
CSD 413(C)	**Credits: 3**
Instruction: 3 Periods /Week	**Sessional Marks: 40**
End Exam: 3 Hours	**End Exam Marks: 60**

Prerequisites:

- Proficiency in the Python programming language and Basic knowledge of cybersecurity concepts such as network security, cryptography, and malware detection.

Course Objectives:

- Understand the basic concepts and principles of machine learning, and how they can be applied to cybersecurity problems.
- Learn how to preprocess and prepare data for machine learning tasks in cybersecurity.
- Gain knowledge of various machine learning algorithms, such as supervised and unsupervised learning, clustering, classification, and anomaly detection, and how they can be used for cybersecurity tasks.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Explain the fundamentals of machine learning, including its different types, and the various machine learning algorithms and architecture used in the field.
2.	Apply heuristics and machine learning algorithms such as logistic regression, and multiclass classification to detect and classify malicious urls, as well as explain the types of abnormalities commonly found in urls and their relevance to cybersecurity.
3.	Identify and compare different types of email spoofing techniques and implement machine learning algorithm logistic regression for various spam detection.
4.	Analyze and detect malware using static and dynamic analysis techniques. They will also be able to use machine learning algorithms to detect the file type and similarity between files and develop a static malware detector to identify and classify malicious files.
5.	Capture and analyze network traffic and detect potential security threats such as network behavior anomalies, botnet traffic, insider threats, and ddos attacks.

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	1	2	1	1	-	-	-	-	-	-	-	-
2	3	3	3	3	3	1	-	2	-	2	-	1	-	2
3	2	3	3	3	3	1	-	2	-	2	-	1	-	2
4	3	3	3	3	3	1	-	2	-	2	-	1	-	2
5	2	3	3	3	3	1	-	2	-	2	-	1	-	2

SYLLABUS

UNIT- I **10 Periods**

Introduction:
What is machine learning? Problems that machine learning solves, Why use machine learning in cybersecurity? Current cybersecurity solutions, Data in machine learning, Different types of machine learning algorithms, Algorithms in machine learning, and the machine learning architecture**.**

Learning Outcomes:

1. Explain the importance of data in machine learning, the problems it solves, and the benefits it provides overcurrent cybersecurity solutions.
2. explain different machine learning algorithms and their use in cybersecurity.

UNIT-II: **10 Periods**

Segregating Legitimate and Lousy URLs: Introduction to the types of abnormalities in URLs, using heuristics to detect malicious pages, using machine learning to detect malicious URLs, Logistic regression to detect malicious URLs, SVM to detect malicious URLs, Multiclass classification for URL classification.

Learning Outcomes:

1. identify different types of abnormalities in URLs and understand how to use heuristics to detect malicious URLs.
2. apply multiclass classification techniques for URL classification.

UNIT-III: **10 Periods**

Catch Email Fraud and Spam:
Email spoofing: Bogus offers, Requests for help, and Types of spam emails.
Spam detection: Types of mail servers, Data collection from mail servers, Using the Naive Bayes theorem to detect spam, Laplace smoothing, Featurization techniques that convert text-based emails into numeric values, Logistic regression spam filters.

Learning Outcomes:

1. describe different types of email spoofing techniques and various types of spam emails**.**
2. describe featurization techniques that convert text-based emails into numeric values, which can be used for logistic regression spam filters.

UNIT-IV: **10 Periods**

Malware Detection: Malware static analysis, Malware dynamic analysis, using machine learning to detect the file type, Measuring the similarity between two strings, Measuring the similarity between two files, and building a static malware detector.

Learning Outcomes:

1. Perform both static and dynamic analysis of malware, including the ability to examine the code and file structure
2. Use machine learning algorithms to detect the file type of malware and measure the similarity between two strings or files.

UNIT-V: **10 Periods**

Automatic Intrusion Detection:
Capturing network traffic, Network behavior anomaly detection, Botnet traffic detection, Insider threat detection, Detecting DDoS.

Learning Outcomes:

1. Able to capture and analyze network traffic using appropriate tools and techniques.
2. Use machine learning algorithms to detect and prevent network security threats**.**

Text Books:

1. Soma Halder, Sinan Ozdemir "Hands-On Machine Learning for Cybersecurity: Safeguard your system by making your machines intelligent using the Python ecosystem" 1st Edition,2018, Packt Publishing, Birmingham, UK.

2. Emmanuel Tsukerman, "Machine Learning for Cybersecurity Cookbook: Over 80 recipes on how to implement machine learning algorithms for building security systems using Python ", 1st Edition,2019 , Packt Publishing, Birmingham, UK

Reference Books :

1. Brij B. Gupta , Quan Z. Sheng "Machine Learning for Computer and Cyber Security: Principle, Algorithms, and Practices (Cyber Ecosystem and Security" 1st Edition, CRC Press

Prepared By
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CLOUD COMPUTING	
CSD 413(D)	**Credits: 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Student Must have good back ground in Operating Systems Concepts and Networking Concepts will be very helpful.

Course Objectives:

- This course provides an insight into cloud computing
- To make a students to understand the different cloud service models, service oriented architectures.
- Student learn cloud programming environments, Concept of Virtualization.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Describe the principles of cloud computing and cloud Characteristics.
2.	Able to understand various service delivery models of a cloud computing architecture.
3.	Illustrate various service delivery models of a cloud computing architecture.
4.	Analyzing the ways in which the cloud can be programmed and deployed.
5.	Able to Understand how cloud computing leverages the virtualization for its different service models

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	1	1	1	1	-	1		-	1	1		
2	2	1	3	1	1	1	-	1		-	1	1	1	2
3	2	2	2	2	1	1	-	1		-	1	1	2	2
4	2	2	2	2	1	1	-	1		-	1	1	2	2
5	1	2	2	2	1	1	-	1		-	-	1	2	2

SYLLABUS

UNIT-1: **10 Periods**

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

Learning Outcomes:

1. Understand the basic ideas and motivation for cloud computing
2. Learn various Cloud Deployment Models.

UNIT-II: **10 Periods**

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications, on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure Managing the Cloud application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

Learning Outcomes:

- Provide an overview of the cloud architecture
- Learn Cloud Infrastructure and Various Migration approaches

UNIT-III: **10 Periods**

Cloud Service Models(Part 1): Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers.

Learning Outcomes:

- Understand how the Infrastructure as a Service (IaaS) changes computing
- Understand how the Platform as a Service (PaaS) changes the application developer

UNIT-IV: **10 Periods**

Cloud Service Models(Part II): Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.
Application Environment: Application Development Methodologies, Power of Cloud Computing in Application Development, Cloud Application Development Platforms, Cloud Computing APIs

Learning Outcomes:

- Understand how the Software as a Service (SaaS) changes the application delivery
- Implementation of service providers in application development.

UNIT-V: **10 Periods**

Virtualization: Introduction, Virtualization Opportunities, Approaches to Virtualization, Hypervisors, From Virtualization to Cloud Computing.

Learning Outcomes:

- Describe Importance of Virtualization approaches
- Understand the basics of hypervisor and its security issues

Text Books:

1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.

Reference Books :

1. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.

Prepared By

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BUSINESS INTELLIGENCE	
Code: CSD 414	**Credits: 3**
Instruction : 3 Periods/Week	**Sessional Marks: 40**
End Exam : 3 Hours	**End Exam Marks: 60**

Course Objectives:

- Develop solid understanding of the key concepts, principles and components of Business Intelligence, Business Analytics and Big Data Analytics
- Demonstrate comprehensive understanding of the decision making process.
- Familiarize with predictive modeling techniques
- Understand multi-criteria decision making systems
- Familiarize with automated decision systems.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Leverage knowledge of Business Intelligence framework, Business Analytics and Big Data analytics to analyze and interpret data for informed decision making. (Level 2)
2	Explore the phases, capabilities, classifications, and components of decision making.
3	Apply predictive modeling techniques and employ text analytics methods for sentiment analysis.
4	Apply prescriptive analytics techniques to optimize complex decision making scenarios.
5	Evaluate the impact of emerging trends on organizational decision making processes and demonstrate a comprehensive understanding of expert systems.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2	1	3	-	2	2	1	-	-	1	1	1
2	2	3	2	1	1	-	2	1	1	-	-	1	1	1
3	3	2	3	2	3	-	2	2	1	-	-	1	1	1
4	3	3	3	2	3	-	2	2	1	-	-	1	1	1
5	3	3	2	3	2	-	3	3	1	-	-	1	1	1

SYLLABUS

UNIT- I **10 Periods**

Decision Making and Analytics: An Overview: Information systems support for decision making, An early framework for computerized decision support, The concept of Decision Support System (DSS), A framework for Business Intelligence (BI), Business analytics overview, Brief Introduction to Big Data analytics.

Learning Outcomes:

1. Understands the importance, foundations, and applications of business analytics for managerial decision-making.
2. Learn the major framework of computerized decision support: analytics

UNIT-II **10 Periods**

Foundations and Technologies for Decision Making: Decision making: Introduction and definitions, Phases of the decision-making process, Decision making- The intelligent phase, Decision making-The design phase, Decision making- The choice phase, Decision making- The implementation phase.

Learning Outcomes:

1. Analyze the phases of the decision making process and apply appropriate decision making strategies and techniques at each phase.
2. Evaluate the capabilities and classifications of Decision Support Systems (DSS).

UNIT-III **10 Periods**

Techniques for Predictive Modeling: Basic concepts of neural networks, Developing neural-network-based systems, Illuminating the black box of ANN with sensitivity, Support vector machines, A process-based approach to the use of SVM.

Learning Outcomes:

1. Apply predictive modeling techniques to analyze and interpret complex datasets.
2. Employ text analytics techniques, including sentiment analysis and text mining to extract meaningful insights from data.

UNIT-IV **10 Periods**

Prescriptive Analytics: Decision support systems modeling, Structure of mathematical models for decision support, Certainty, uncertainty, and risk, Decision modeling with spreadsheets, Mathematical programming optimization, Multiple goals, sensitivity analysis, What-if analysis.

Learning Outcomes:

1. Apply modeling techniques to analyze and solve complex decision making problems, use sensitivity analysis and what-if analysis to evaluate the impact of different scenarios.
2. Evaluate and compare decision making approaches.

UNIT-V **10 Periods**

Automated Decision Systems and Expert Systems: The artificial intelligence field, Basic concepts of expert systems, Applications of expert systems, Structure of expert systems, Knowledge engineering, Problem areas suitable for expert systems, Development of expert systems.

Learning Outcomes:

1. Understand expert systems, and apply knowledge engineering techniques to develop effective expert systems
2. Analyze and evaluate emerging trends in business analytics.

Text Books:

1. Business Intelligence and Analytics: Systems for Decision Support, Ramesh Sharda, Efraim Turban, Dursun Delen, 10th Edition, Pearson Global Edition, 2015

References:

1. S. Christian Albright, Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, 6thEdition, CENGAGE INDIA , 2017
2. Dinabandhu Bag, Business Analytics, Routledge, 1st edition, 2016
3. Rick Sherman, Business Intelligence Guidebook: From Data Integration to Analytics, Morgan Kaufmann, 1st edition 2014

DATA ANALYTICS	
Course Code: CSD 415	**Credits: 3**
Instruction: 2 Periods and 1 Tutorial /Week	**Sessional Marks: 40**
End Exam: 3 Hours	**End Exam Marks: 60**

Prerequisites:

- Basics on Probability and statistics.
- Fundamentals of Python programming.

Course Objectives:

- To familiarize with basics data analytics and data analytics in Python.
- Equip the students with core statistical models and visualization techniques to perform exploratory data analysis using Python.
- Exploring the importance of analysis of variance and multivariate analysis of variance (MANOVA) and implementing them in Python with different kinds of data sets.

Course Outcomes:

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

1.	Understand the basic principles of data analytics for performing basic data analysis on given data.
2.	Apply the data visualization methods in Python for exploratory data analysis.
3.	Understand and apply Simple Statistical Techniques for Univariate and Bivariate Analyses
4.	Understand and apply the nature and logic of the analysis of variance.
5.	Understand and apply linear and multi linear regression models.

CO-PO Mapping:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
2	1	-	-	1	3	-	-	-	-	-	-	-	1	1
3	1	1	1	1	3	-	-	-	-	-	-	-	1	1
4	1	1	1	1	3	-	-	-	-	-	-	-	2	2
5	1	1	1	1	3	-	-	-	-	-	-	-	2	2

SYLLABUS

UNIT-1 **10 periods**

Introduction and Overview of Applied Statistics: How Statistical Inference Works, Statistics and Decision-Making, Data Analysis, Data Science, Machine Learning, Big Data. What Do the Numbers Tell Us? Clues to Substantive Theory, The Scatter plot, Correlograms, Histograms and Bar Graphs, Heatmaps, Line Charts.

Learning Outcome: At the end of this Unit the student will be able to

1. Understand basics of data analytics including its role in other sub domains.
2. Implement the few fundamental principles of data analytics using Python programming.

UNIT-2 **10 periods**

Simple Statistical Techniques for Univariate and Bivariate Analyses: Pearson Product-Moment Correlation, Computing Correlation in Python, T-Tests for Comparing Means, Paired-Samples t-Test in Python, Binomial Test, The Chi-Squared Distribution.

Learning Outcome: At the end of this Unit the student will be able to

1. Apply the statistical techniques to test the hypothesis.
2. Identify the relation between the significant attributes using correlation techniques.

UNIT-3 **10 periods**

Analysis of Variance (ANOVA): T-Tests for Means as a Special Case of ANOVA, Analysis of Variance (one-way classification), ANOVA in Python, Analysis of Variance (two-way classification), Evaluating Assumptions in ANOVA.

Learning Outcome: At the end of this Unit the student will be able to

1. Understand the purpose of conducting analytical comparisons.
2. Determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups using ANOVA.

UNIT-4 **10 periods**

Simple and Multiple Linear Regression: Regression, Regression in Python, The Least-Squares Principle, The Population Least-Squares Regression Line, **Multiple Linear Regression**, How to Assess Goodness of Fit.

Learning Outcome: At the end of this Unit the student will be able to

1. Learn and appreciate why regression analysis is so central to visually all statistical models and how multilinear regression is different from linear regression.
2. Implement linear regression and multi linear regression models in Python.

UNIT-5 **10 periods**

Multivariate Analysis of Variance (MANOVA): Why Technically Most Univariate Models are Actually Multivariate, Multivariate Model and Running a Multivariate Model, Multivariate Tests of Significance: Why They Are Different from the F-Ratio. Performing MANOVA in Python.

Learning Outcome: At the end of this Unit the student will be able to

1. Learn and appreciate multivariate regression analysis is so central to visually all statistical models and how multilinear regression is different from linear regression.
2. Implement MANOVA in Python and interpret results.

Text Book:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

1. https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

OBJECT ORIENTED SOFTWARE ENGINEERING LAB	
CSD 416	**Credits : 1.5**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites:

- Basic Mathematical Knowledge
- Basic knowledge on procedural and object-oriented programming
- Basic knowledge on problem solving.

Course Objectives:

The course should enable the students:

- To provide working knowledge of UML.
- To provide working knowledge of the technologies essentially for incorporating in the project.
- To expertise for testing and document software.
- To present the project in a professional manner.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Design DFD, UML Diagrams for the specified software project
2	Write the Software Requirements Document for a specified project
3	Design Test Suites
4	Discuss about the project implementation among the team members and improve their professional skills

Mapping of Course Outcomes with Program Outcomes & PSOs:

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	--	3	3	2	3	2	--	1	1	1	2	2	3	3
CO2	--	2	1	1	--	2	1	1	1	2	1	--	2	--
CO3	--	2	3	2	--	2	--	2	1	--	1	--	1	--
CO4	--	--	--	1	--	--	--	--	3	2	--	1	--	--

List of Experiments

Experiment -1

Familiarize students with the software development process in the IT industry and guide them in selecting appropriate project titles for each batch.

Experiment-2

System Modelling –DFD Diagram

Experiment-3

Introduction to UML and Use Case Scenario, Use Case Diagram

Experiment-4

Object Oriented Analysis: Discovering Classes , Class Diagram

Experiment-5

Interaction Diagrams: Sequence and Collaboration Diagrams

Experiment-6

State Chart Diagram

Experiment-7

Flow of Events and Activity Diagrams

Experiment-8

Component and Deployment Diagrams

Experiment-9

Software Requirements Specification Document

Experiment-10

Design Test Cases

Experiment-11

Test Report & Error Report

Experiment-12

PPT Presentation of their mini project

Text Books:

1. Roger S Pressman,Software Engineering: A Practitioner’s approach,Tata McGraw Hill Education,8th edition,2015
2. Pankaj Jalote, An integrated Approach to Software Engineering, Springer, 3rd edition,2005
3. Timothy C. Lethbridge, "Object Oriented Software Engineering” (Practical Software Development using UML and Java" Tata McGraw-Hill,2nd Edition,2019

Reference :

1. Ali Bahrami,Object Oriented Systems Development,Tata Mcgraw-Hill Education ,1st Edition,2008.

DATA ANALYTICS LAB	
Code: CSD 417	**Credits : 1.5**
Instruction **: 3 Periods/week**	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- Basic knowledge on Probability and statistics.
- Basics of Python Programming.

Course Objectives:

- To train the students to apply the principles of data analytics to analyze and effectively visualize the data.
- Train the students to gain the knowledge of computational statistical approaches and their application to a variety of datasets.
- Practical way of Understanding the nature of analysis of variance and Multivariate statistical models.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Work with different IDE and Python notebooks for mathematical, scientific applications and for data analysis.
2.	Explore Pandas, matplotlib and seaborn packages. Write example programs to visualize the data.
3.	Work with Linear Regression and Multiple Regression models in Python
4.	Understanding of the ANOVA that can used to test a given hypothesis and to verify the experimental results are significant.

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	-	-	-	-	3	-	-	-	-	-	-	-	-	-
2	1	-	-	-	3	-	-	-	-	-	-	-	1	1
3	1	2	2	-	3	-	-	-	-	-	-	-	1	1
4	1	2	2	-	3	-	-	-	-	-	-	-	2	2

List of Experiments

1. Getting familiarity with Python IDE and Notebooks.
2. Write a Program in Python to Read and write different types of Files (csv, json, txt etc).
3. Getting familiarity with Numpy-Comprehensive understating of the Numpy package.
4. Write a Program in Python to Manipulate, Aggregate and Analyze data using Numpy.
5. Getting familiarity with pandas-Visual understanding of pandas package.
6. Write a Program in Python to Handle and Analyze data using Pandas.
7. Write a Program in Python to perform statistical analysis on given Data set.
8. Apply basic statistical methods on Sample Datasets like Mushroom (Data sets from https://www.kaggle.com/datasets, https://archive.ics.uci.edu/ml/datasets.php etc.,)
9. Working with vectors and matrices in Python.
10. Working with matplotlib and seaborn packages in Python.
11. Write a Program in Python to add an indeed field, changing misleading data fields, Re-expressing categorical data as numerical data, standardizing numerical fields and identifying outliers for data preparation phase. for bank marketing data set. (https://www.kaggle.com/datasets/janiobachmann/bank-marketing-dataset)
12. Write a Program in Python to Classifying MNIST digits using Logistic Regression
13. Write a Program in Python to predict House rent using linear regression.
14. Write a Program in Python to implement Correlation.
15. Write a Program in Python to perform Multiple Regression.
16. Write a Program to apply Multiple Linear Regression Using Python and Scikit-learn.
17. Write a Program to apply Multivariate analysis of variance and co-variance (MANOVA).
18. Write a Program to apply Analysis of Variance (one-way classification) in Python.
19. Write a Program to apply Analysis of Variance (two-way classification) in Python.
20. Write a Program to apply Linear Discriminant analysis for multivariate data.
21. Write a Program to apply Principle component analysis for multivariate data.
22. Implement Factor Analysis for multivariate data in Python.
23. Implement Cluster analysis for multivariate data.

Text Books:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

- https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php