



RAJALAKSHMI ENGINEERING COLLEGE CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM

M.E. COMPUTER SCIENCE AND ENGINEERING REGULATION 2023

Vision

To promote highly ethical and innovative computer professionals through excellence in teaching, training and research.

Mission

- To produce globally competent professionals, motivated to learn the emerging technologies and to be innovative in solving real world problems.
- To promote research activities amongst the students and the members of faculty that could benefit the society.
- To impart moral and ethical values in their profession.

PROGRAMME OUTCOMES (POs)

The Post Graduate Degree Program in Computer Science and Engineering will prepare students to be able to:

PO1: Independently carry out research /investigation and development work to solve practical problems.

PO2: Write and present a substantial technical report/document.

PO3: Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Analyze existing complex problems in an area of specialization; develop innovative and research-oriented methodology to provide ICT based solutions.

PO5: Apply algorithmic principles, computer science theory to design a system that meet the specified needs with appropriate consideration on health and safety, environmental, societal, ethical and sustainable factors.

CURRICULUM

M.E. COMPUTER SCIENCE AND ENGINEERING Regulation 2023 | Total Credits: 70

SEMESTER I								
SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	MH23113	Advanced Statistical Methods	FC	4	3	1	0	4
2.	CP23111	Networking Technologies	PC	3	3	0	0	3
3.	PG23111	Research Methodology and IPR	MC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	CP23131	Advanced Data Structures and Algorithms	PC	5	3	0	2	4
5.	CP23132	Advanced Database Technology	PC	5	3	0	2	4
NON CREDIT COURSES								
6.	AC23111	English for Research Writing	MC	3	3	0	0	0
TOTAL				23	18	1	4	18

SEMESTER II								
SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	CP23211	Advanced Software Engineering	PC	3	3	0	0	3
2.		Program Elective – I	PE	3	3	0	0	3
3.		Program Elective – II	PE	3	3	0	0	3
4.		Program Elective – III	PE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
5.	CP23231	Applied Machine Learning	PC	5	3	0	2	4
LABORATORY COURSES								
6.	CP23221	Advanced Software Engineering Laboratory	PC	4	0	0	4	2
7.	CP23222	Mini Project with Seminar	EEC	4	0	0	4	2
NON CREDIT COURSES								
7.	AC23211	Constitution of India	MC	3	3	0	0	0
TOTAL				28	18	0	10	20

SEMESTER III								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.		Program Elective –IV	PE	3	3	0	0	3
2.		Program Elective – V	PE	3	3	0	0	3
3.		Program Elective – VI	PE	3	3	0	0	3
4.		Open Elective	OE	3	3	0	0	3
LABORATORY COURSES								
5.	CP23321	Project Phase – I	EEC	12	0	0	12	6
TOTAL				24	12	0	12	18

SEMESTER IV								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
LABORATORY COURSES								
1.	CP23421	Project Phase – II	EEC	28	0	0	28	14
TOTAL				28	0	0	28	14

Total Credits: 70

PROGRAM ELECTIVES (PE)						
S.No	Course Code	Course Title	L	T	P	C
Data Science						
1.	DS23112	Data Science Foundation	3	0	0	3
2.	CP23A11	Applied Deep Learning	3	0	0	3
3.	CP23A12	Data and Information Visualization	3	0	0	3
4.	CP23A13	Data Analytics	3	0	0	3
5.	DS23A11	AI for Computer Vision	3	0	0	3
6.	DS23B12	Health Care Data Analytics	3	0	0	3
7.	DS23A13	Natural Language Processing and Applications	3	0	0	3
Business Analytics						
1.	CP23B11	Time Series Analysis	3	0	0	3
2.	CP23B12	Statistics for Data Science	3	0	0	3
3.	CP23B13	Database Foundation for Business Analytics	3	0	0	3
4.	DS23B13	Applied Business Analytics	3	0	0	3
5.	CP23B14	Predictive Modelling	3	0	0	3
6.	CP23B15	Prescriptive Analytics	3	0	0	3
7.	CP23B16	Web Analytics	3	0	0	3

OPEN ELECTIVE COURSES OFFERED BY CSE

S.No	Course Code	Course Title	L	T	P	C
1	CP23O11	Cyber Security	2	0	2	3

Credit Distribution

Category	AICTE 2018	R2019	R2023
Mathematical courses FC	3	4	4
Professional core courses PC	19	21	20
Professional Elective courses PE	15	17	18
Open Electives from other technical and /or emerging subjects OE	3	3	3
Project work, seminar and internship in industry or elsewhere EEC	26	22	22
Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition] MC	2	3	3
Total	68	70	70

SUMMARY OF ALL COURSES

S.NO	Course Category	Credits per Semester				Total Credits
		1	2	3	4	
1	FC	4				4
2	PC	11	9			20
3	PE		9	9		18
4	OE			3		3
5	EEC		2	6	14	22
6	MC	3				3
	Total	18	20	18	14	70

Subject Code	Course Title	Category	L	T	P	C
MH23113	ADVANCED STATISTICAL METHODS	FC	3	1	0	4

Objectives:
<ul style="list-style-type: none"> To provide basic estimation and detection background for engineering applications.
<ul style="list-style-type: none"> To explain data, and synthesis of the information to provide valid conclusions using design of experiments.
<ul style="list-style-type: none"> To apply the multivariate methods in the framework of the multivariate analysis.
<ul style="list-style-type: none"> To distinguish nonparametric methods in estimation, testing, model fitting, and in analyses.
<ul style="list-style-type: none"> To analyse the underlying structure(s) and to forecast the trend pattern exhibited by the given data by using various methods.

UNIT-I	ESTIMATION THEORY	12
Unbiased Estimators – method of moments – maximum likelihood estimation - curve fitting by principle of leastsquares – regression lines		
UNIT-II	LINEAR STATISTICAL MODELS	12
Scatter diagram, Linear regression and correlation. Least squares method. Rank correlation. Multiple regression and multiple correlation, Analysis of variance (one way, two way with and without interaction).		
UNIT-III	MULTIVARIATE ANALYSIS	12
Random vectors and matrices - mean vectors and covariance matrices –multivariate normal density and its properties - principle components population principal components- principle components from standardized variables.		
UNIT-IV	NON PARAMETRIC TESTS	12
Sign test, Wilcoxon signed rank test, Mann Whitney test, Run test, Kolmogorov Smirnov test, Spearman and Kendall’s test , Tolerance region.		
UNIT-V	BASICS OF TIME SERIES	12
Stationary, ARIMA models: Identification, estimation and Forecasting		
		Total Contact Hours:60

Course Outcomes: On completion of the course, students will be able to
<ul style="list-style-type: none"> Use the main concepts and algorithms of detection and estimation theory for practical applications as well as for their research.
<ul style="list-style-type: none"> Interpret data, and synthesis of the information to provide valid conclusions using design of experiments.
<ul style="list-style-type: none"> Apply the multivariate methods in the framework of the multivariate analysis.
<ul style="list-style-type: none"> Distinguish nonparametric methods in estimation, testing, model fitting, and in analyses.
<ul style="list-style-type: none"> Forecast the trend pattern exhibited by the given data by using various methods.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Activity Based Learning

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

Text Book(s):	
1.	Gupta S.C. and Kapoor V.K, “Fundamentals of Mathematical Statistics”,10 th edition, Sultan and Sons.
2.	Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, 6 th Edition.
3.	Douglas C. Montgomery George, C. Runger “Applied Statistics and Probability for Engineers”, 7 th Edition, (2016), John Wiley & Sons.
4.	Veerarajan T, “Probability, statistics and random process with queueing theory and queueing networks”, 4 th Edition, McGraw - Hill Publishing Company Limited.
5.	Chris Chatfield, “The analysis of Time series: An Introduction”.

Reference Books(s):	
1.	R. Johnson, “Miller & Freund’s Probability and Statistics for Engineers”, (9 th Edition), PHI.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
MH23113.1	1	2	3	-	-
MH23113.2	3	-	2	2	-
MH23113.3	-	-	1	-	3
MH23113.4	2	1	3	2	2
MH23113.5	2	2	1	-	1
AVERAGE	2	1.67	2	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
CP23111	NETWORKING TECHNOLOGIES	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand the principles required for network design. To explore various technologies in the wireless domain. To study about 3G and 4G cellular networks. To understand the paradigm of Software defined networks.

UNIT-I	NETWORK DESIGN	9
Advanced multiplexing – CDM, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, QoS – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches –Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.		
UNIT-II	WIRELESS NETWORKS	9
IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX -802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security– IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles		
UNIT-III	CELLULAR NETWORKS	9
GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface –UTRAN –Core and Radio Network Mobility Management – UMTS Security		
UNIT-IV	4G NETWORKS	9
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture –Interconnection with UMTS and GSM – LTE Advanced (3GPP Release 10) – 4G Networks– Protocol Boosters – Hybrid 4G Wireless Networks Protocols –Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G		
UNIT-V	SOFTWARE DEFINED NETWORKS	9
Introduction to SDN – Control and Data Planes – Open Flow –SDN Controllers – General Concepts –VMWare – VLANs – NVGRE –Data Center – Multi Tenant Data Centre – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework		
Total Contact Hours		: 45

Course Outcomes:
On completion of the course, the students will be able to
<ul style="list-style-type: none"> Identify the components required for designing a network. Design a network at a high-level using different networking technology. Analyze the various protocols of wireless and cellular networks. Discuss the features of 4G and 5G networks. Experiment with software defined networks.

Text Book(s):
1. Erik Dahlman, Stefan, Johan Skold, “4G: LTE/LTE-Advanced for Mobile Broadband”, Academic Press, 2013.
2. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.

Reference Books(s):
1 Larry Peterson and B Davie, “Computer Networks: A Systems Approach”, 5 th edition, Morgan Kauffman, 2011
2 Paul Goransson, C. Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kauffman, 2014.
3 Thomas D. Nadeau and Ken Gray, “SDN Software Defined Networks”, O’Reilly, 2013.
4 Ying Dar Lin, Ren Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2011.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23111.1	2	-	2	1	-
CP23111.2	2	-	2	1	1
CP23111.3	2	-	2	2	1
CP23111.4	2	-	2	2	1
CP23111.5	2	-	2	2	1
AVERAGE	2	-	2	1.6	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
PG23111	RESEARCH METHODOLOGY AND IPR	MC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To inculcate the importance of research methodology and Intellectual Property Rights. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
<ul style="list-style-type: none"> To get registration of patents in our country and foreign countries of invention, designs and thesis or theory written. To get knowledge of patents, copy right, trademarks and designs

UNIT-I	FUNDAMENTALS OF RESEARCH METHODOLOGY	9
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations		
UNIT-II	REVIEW OF LITERATURE AND TECHNICAL WRITING	9
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal.		
UNIT-III	INTELLECTUAL PROPERTY RIGHTS	9
Nature of Intellectual Property: Patents, Designs, Trade and Copyright, copyright registration in India Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under Patent Cooperation Treaty.		
UNIT-IV	PATENT RIGHTS AND RECENT DEVELOPMENTS IN IPR	9
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.		
UNIT-V	INDUSTRIAL DESIGNS AND GEOGRAPHICAL INDICATIONS	9
Industrial designs and IC Layout design, Registrations of designs, conditions and procedures of industrial designs- Cancellation of Registration, International convention of design- types and functions. Semiconductor Integrated circuits and layout design Act- Geographical indications-potential benefits of Geographical Indications		
Total Contact Hours		: 45

Course Outcomes:
On completion of the course, the students will be able to
<ul style="list-style-type: none"> Apply knowledge on research problem formulation and analyze research related information Apply IPR concept to important place in growth of individuals & nation. Describe the importance of copyright and industrial designs. Apply patent right to new products developed. Describe the procedure and the tools to get patent copy right for their innovative work.

Text Books(s):	
1	Neeraj Pandey and Khushdeep D, "Intellectual Property Rights", 1 st edition, PHI learning Pvt. Ltd., Delhi, 2014.
2	Uma Sekaran and Roger Bougie, "Research methods for Business", 5 th Edition, Wiley India, New Delhi, 2012.

Reference Books(s):	
1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", 2 nd edition, Juta Academic, 2001.
2	Ramakrishna B & Anilkumar H S, "Fundamentals of Intellectual Property Rights", 1 st Ed. Notion Press, 2017.
3	William G Zikmund, Barry J Babin, Jon C. Carr, Atanu Adhikari, Mitch Griffin, "Business Research methods, A South Asian Perspective", 8 th Edition, Cengage Learning, New Delhi, 2012.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
PG23111.1	3	1	1	3	2
PG23111.2	1	-	1	2	3
PG23111.3	2	2	2	2	3
PG23111.4	2	1	2	3	3
PG23111.5	2	2	3	3	2
AVERAGE	2.0	1.5	1.8	2.6	2.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
CP23131	ADVANCED DATA STRUCTURES AND ALGORITHMS	PC	3	0	2	4

Objectives:
● To understand the usage of algorithms in computing.
● To learn and use hierarchical data structures and its operations.
● To learn the usage of graphs and its applications.
● To select and design data structures and algorithms that is appropriate for problems.
● To study about NP Completeness of problems.

UNIT-I	ROLE OF ALGORITHMS IN COMPUTING	9
Algorithms –Introduction: Classical Algorithms–Analyzing Algorithms – Designing Algorithms– Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions– Solving Recurrences: The Substitution Method – Master theorem method– The Recursion–Tree Method.		
UNIT-II	HIERARCHICAL DATA STRUCTURES	9
Binary Search Trees: Basics –Insertion, Deletion and Search– Red-Black Trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion –B-Trees: Definition– Basic operations on B-Trees – Deleting a key from a B-Tree– Fibonacci Heaps: structure – Merge able-heap operations– Decreasing a key and deleting a Node–Bounding the maximum degree.		
UNIT-III	GRAPHS	9
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components– Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim– Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra’s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd, Warshall Algorithm, Johnson’s algorithm for sparse graphs.		
UNIT-IV	ALGORITHM DESIGN TECHNIQUES	9
Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming –Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy– Huffman Codes.		
UNIT-V	NP COMPLETE AND NP HARD	9
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems		
Contact Hours		: 45

List of Experiments			
1	Implementation of graph search algorithms.		
2	Implementation and application of network flow and linear programming problems.		
3	Implementation of algorithms using dynamic programming techniques.		
4	Implementation of recursive backtracking algorithms.		
5	Implementation of randomized algorithms.		
6	Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues and concurrent stacks.		
7	Developing applications involving concurrency.		
		Contact Hours	: 30
		Total Contact Hours	: 75

Platform Needed: Linux	
HARDWARE :	Personal Computer with Dual Core Processor with 4 GB RAM.
SOFTWARE :	Gcc Compiler

Course Outcomes: On completion of the course, the students will be able to	
●	Design data structures and algorithms to solve computing problems.
●	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
●	Understand the importance of Graphs and its applications.
●	Apply suitable design strategy for problem solving.
●	Differentiate NP complete and NP hard.

Text Books(s):	
1	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2013.
2	Robert Sedgewick and Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education.

Reference Books(s):	
1	S. Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23131.1	3	-	1	2	-
CP23131.2	2	-	1	1	1
CP23131.3	3	-	2	1	-
CP23131.4	2	-	1	2	1
CP23131.5	2	-	2	1	1
AVERAGE	2.4	-	1.4	1.4	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
CP23132	ADVANCED DATABASE TECHNOLOGY	PC	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To acquire knowledge on parallel and distributed databases and its applications. To study the usage and applications of Object-Oriented database. To understand the principles of intelligent databases. To learn emerging databases such as XML, Cloud and Big Data. To acquire inquisitive attitude towards research topics in databases.

UNIT-I	PARALLEL AND DISTRIBUTED DATABASES	9
Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems– Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems– Distributed Database Concepts – Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies		
UNIT-II	OBJECT AND OBJECT RELATIONAL DATABASES	9
Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.		
UNIT-III	EMERGING TECHNOLOGIES	9
XML Databases: XML–Related Technologies–XML Schema– XML Query Languages– Storing XML in Databases– XML and SQL– Native XML Databases– Web Databases– Cloud Based Databases: Data Storage Systems on theCloud– Cloud Storage Architectures–Cloud Data Models– Query Languages		
UNIT-IV	BIG DATA STORAGE ANALYSIS	9
Big Data introduction: The Hadoop ecosystem– Querying big data with Hive: Introduction, From SQL to HiveQL– Introduction to HIVE e HIVEQL – Using Hive to query Hadoop files.		
UNIT-V	INTELLIGENT DATABASES	9
Active databases – Deductive Databases – Knowledge bases – Multimedia Databases– Multidimensional Data Structures– Image Databases – Text/Document Databases– Video Databases – Audio Databases – Multimedia Database Design.		
Contact Hours		: 45

List of Experiments	
A	<p>Data Definition Language</p> <ul style="list-style-type: none"> Create, Alter and Drop Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints Creating Views <p>Data Manipulation Language</p> <ul style="list-style-type: none"> Insert, Delete, Update Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join Aggregate Functions Set Operations Nested Queries <p>Transaction Control Language</p> <ul style="list-style-type: none"> Commit, Rollback and Save Points
B	<ul style="list-style-type: none"> Distributed Database Design and Implementation Row Level and Statement Level Triggers Accessing a Relational Database using PHP, Python and R

C	<ul style="list-style-type: none"> • Creating XML Documents, Document Type Definition and XML Schema • Using a Relational Database to store the XML documents as text • Using a Relational Database to store the XML documents as data elements • Creating or publishing customized XML documents from pre-existing relational databases • Extracting XML Documents from Relational Databases • XML Querying 			
D	<ul style="list-style-type: none"> • Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j. • Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j 			
E	<ul style="list-style-type: none"> • Implementing Access Control in Relational Databases 			
F	Documenting the project			
		Contact Hours	:	30
		Total Contact Hours	:	75

Platform Needed: Linux	
HARDWARE :	Personal Computer with Dual Core Processor with 8 GB RAM.
SOFTWARE :	AGRO UML/STAR UML for Design
	Selenium/Junit (any automated testing software) for testing
	Jile Software/Jeera (any Agile planning Software) to do agile planning

Course Outcomes: On completion of the course, the students will be able to	
•	Model and represent the real-world data using object-oriented database.
•	Design a semantic based database to meaningful data access.
•	Embed the rule set in the database to implement intelligent databases.
•	Represent the data using XML database for better interoperability.
•	Handle Big data and manipulate using HIVE.

Text Books(s):	
1	R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 5 th Edition, Pearson Education, 2007
2	Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3 rd Edition, Pearson Education, 2007.

Reference Books(s):	
1	Henry F Korth, A. Silberschatz, S. Sudharshan, "Database System Concepts", 5 th Edition, McGraw Hill, 2006.
2	Simon St. Laurent and Michael Fitzgerald, "XML Pocket Reference", 3 rd Edition, O'Reilly, 2012.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23132.1	-	3	-	-	-
CP23132.2	2	-	3	2	-
CP23132.3	2	3	-	2	-
CP23132.4	3	-	-	2	1
CP23132.5	-	-	-	3	2
AVERAGE	2.3	3.0	3.0	2.3	1.5

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : "-"

Subject Code	Course Title	Category	L	T	P	C
AC23111	ENGLISH FOR RESEARCH WRITING	MC	3	0	0	0

Objectives:
<ul style="list-style-type: none"> To express technical ideas in writing.
<ul style="list-style-type: none"> To plan and organize the research paper.
<ul style="list-style-type: none"> To understand the structure and familiarize the mechanics of organized writing.
<ul style="list-style-type: none"> To improvise academic English and acquire research writing skills.

UNIT-I	INTRODUCTION TO RESEARCH WRITING	9
Research – Types of Research – Selecting the Primary resources – Categorizing secondary sources – Discovering a researchable area and topic – Need Analysis – Research Question–Focusing on the Research Problem–Developing Research Design – Framing the Hypothesis – Identifying the Scope of the Research – Writing – General and Academic Writing.		
UNIT-II	LANGUAGE OF WRITING	9
Active reading – text mining – use of academic words – jargons – ambiguities – use of expression – use of tense -proper voices – third person narration – phraseology – use of foreign words – use of quotes – interpreting quotes.		
UNIT-III	THE FORMAT OF WRITING	9
Types of Journals – different formats and styles – IEEE format – Structure – Margins – Text Formatting – Heading and Title – Running Head with Page Numbers – Tables and illustrations – Paper and Printing – Paragraphs – Highlighting – Quotation – Footnotes.		
UNIT-IV	ORGANISING A RESEARCH PAPER	9
Title- Abstract – Introduction – Literature review – Methodology – Results –Discussion –Conclusion – Appendices – Summarizing– Citation and Bibliography.		
UNIT-V	PUBLISHING PAPER	9
Finding the Prospective publication or Journal –analyzing the credits – Reviewing – Revising – Plagiarism Check –Proof reading – Preparing the Manuscript– Submitting – Resubmitting – Follow up – Publishing.		
		Total Contact Hours : 45

Course Outcomes:	On completion of the course, the students will be able to
<ul style="list-style-type: none"> Understand the basic structure of research work. 	
<ul style="list-style-type: none"> Apply proper use of language in writing paper. 	
<ul style="list-style-type: none"> Comprehend different formats of journal paper. 	
<ul style="list-style-type: none"> Learn the process of writing a research paper. 	
<ul style="list-style-type: none"> Know the process of publishing journal paper. 	

Text Books(s):	
1	Adrian Wallwork, “English for Writing Research Papers”, Springer Science Business Media, 2 nd Edition, 2011.
2	Stephen Howe and Kristina Henriksson, “Phrasebook for Writing Papers and Research in English”, The Whole World Company Press, Cambridge, 4 th Edition 2007
3	The Modern Language Association of America, “MLA Handbook for Writers of Research Papers” 8 th Edition, The Modern Language Association of America, 2016

Reference Books(s):	
1	Rowena Murray, “The Handbook of Academic Writing: A Fresh Approach”, Sarah Moore Open University Press, 2006.
2	Stephen Bailey: “Academic Writing: A Practical Guide for Students”, Routledge Falmer, 2003
3	Joseph M. Moxley, “Publish, Don't Perish: The Scholar's Guide to Academic Writing and Publishing”, Praeger Publishers, 1992

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
AC23101.1	1	1	1	1	1
AC23101.2	2	2	2	2	2
AC23101.3	3	3	3	3	3
AC23101.4	3	3	3	3	3
AC23101.5	3	3	3	3	3
AVERAGE	2.4	2.4	2.4	2.4	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
CP23211	ADVANCED SOFTWARE ENGINEERING	PC	3	0	0	3

Objectives:
● To understand basic concepts of software engineering and agile methodology.
● To analyze and design a software project with Unified Process.
● To do project management and cost estimation.
● To understand software testing approaches.
● To be familiar with advance software engineering concepts.

UNIT-I	INTRODUCTION	9
Software engineering concepts – Development activities – Software lifecycle models – Rational unified process–Agile methods– Project Management– Project Planning		
UNIT-II	REQUIREMENTS ENGINEERING	9
Software Requirements: Functional and Non-Functional requirements– User Requirements– System Requirements – Requirements elicitation and analysis–Requirement Discovery– Requirements Validation and Management		
UNIT-III	ARCHITECTURE AND DESIGN	9
Architectural patterns – Design patterns – Modeling Data – Object-oriented design using the UML Data FlowDiagrams– Software Implementation Techniques–Coding Practices–Refactoring.		
UNIT-IV	TESTING	9
Software Testing – Software testing strategies – Testing Conventional applications – OO Testing – Developmenttesting– Test-driven development– Release testing– User testing – Software maintenance Quality Management		
UNIT-V	ADVANCE SOFTWARE ENGINEERING	9
Software Reuse–Component based software engineering–Distributed software engineering – Distributed software Engineering		
Total Contact Hours		: 45

Course Outcomes:
On completion of the course, the students will be able to
● Gain knowledge on project management approaches as well as cost and schedule estimation strategies.
● Use UML diagrams for analysis and design.
● Architect and design using architectural styles and design patterns.
● Understand software testing approaches.
● Understand the concepts to design advance software engineering concepts.

Text Books(s):
1. Ian Sommerville, “Software Engineering”, 9th edition, 2017, Pearson Education.
2. Roger S, Pressman“Software Engineering – A Practitioner’s Approach”, 7th Edition, 2010.

Reference Books(s):
1. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, Third Edition, Pearson Education, 2005.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP19103.1	1	-	-	-	2
CP19103.2	2	3	3	3	2
CP19103.3	1	3	3	3	2
CP19103.4	2	-	3	3	2
CP19103.5	-	-	3	2	2
AVERAGE	1.5	3	3.0	2.8	2.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Course Title	Category	L	T	P	C
CP23231	APPLIED MACHINE LEARNING	PC	3	0	2	4

Objectives:
<ul style="list-style-type: none"> To introduce students to the basic concepts and techniques of Machine Learning. To have a thorough understanding of the Supervised learning techniques To have a thorough understanding of the Unsupervised learning techniques To study the various probability-based learning techniques To understand graphical models of machine learning algorithms

UNIT-I	INTRODUCTION	9
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Regression.		
UNIT-II	LINEAR MODELS	9
Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi- layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back- Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.		
UNIT-III	TREE AND PROBABILISTIC MODELS	9
Learning with Trees – Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.		
UNIT-IV	DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS	9
Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms –Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.		
UNIT-V	GRAPHICAL MODELS	9
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods		
Contact Hours		: 45

List of Experiments			
1	Demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples..		
2	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.		
3	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.		
4	Apply k-Means algorithm to cluster a set of data stored in a .CSV file and comment on the quality of clustering.		
5	Interpret the results of PCA analysis .		
6	Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.		
		Contact Hours	: 30
		Total Contact Hours	: 75

Platform Needed: Linux	
HARDWARE :	Personal Computer with Dual Core Processor with 4 GB RAM.
SOFTWARE :	Tools : SAS / NumPy, Software: Weka, TensorFlow, RapidMiner.

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> ● Understand the concept of machine learning fundamentals ● Apply the appropriate machine learning strategy for linear and graphical model ● Apply the tree and probabilistic approach in learning ● Analyze the evolutionary model in machine learning ● Design and develop machine learning applications using the following Tools : SAS / NumPy, Software: Weka, Tensor Flow, Rapid Miner.

Text Books(s):	
1	Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014
2	Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014

Reference Books(s):	
1	Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
2	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

CO - PO matrices of course

PO \ CO	PO1	PO2	PO3	PO4	PO5
CP23231.1	3	-	1	2	-
CP23231.2	2	-	1	1	1
CP23231.3	3	-	2	1	-
CP23231.4	2	-	1	2	1
CP23231.5	2	-	2	1	1
AVERAGE	2.4	-	1.4	1.4	1

Correlation levels 1, 2 or 3 are as defined below:
 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
 No correlation : "-"

Course Code	Course Title	Category	L	T	P	C
CP23221	ADVANCED SOFTWARE ENGINEERING LABORATORY	PC	0	0	4	2

Objectives:

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

List of Experiments

1	Write a Problem Statement to define a title of the project with bounded scope of project
2	Select relevant process model to define activities and related task set for assigned project
3	Prepare broad SRS (Software Requirement Specification) for the above selected projects
4	Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5	Develop the activity diagram to represent flow from one activity to another for software development
6	Develop data Designs using DFD Decision Table & ER Diagram
7	Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project
8	Write Test Cases to Validate requirements of assigned project from SRS Document
9	Evaluate Size of the project using function point metric for the assigned project.
10	Estimate cost of the project using COCOMO and COCOMO II for the assigned project.
11	Use CPM/PERT for scheduling the assigned project.
12	Use timeline Charts or Gantt Charts to track progress of the assigned project.
Contact Hours : 30	
Total Contact Hours : 75	

Course Outcomes: On completion of the course students will be able to

- Can produce the requirements and use cases the client wants for the software being Produced.
- Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture
- Create and specify such a software design based on the requirement specification that the software can be implemented based on the design.
- Can assess the extent and costs of a project with the help of several different assessment methods.
- Understand the scheduling and tracking of project using techniques.

CO - PO matrices of course

PO \ CO	PO 1	PO 2	PO 3	PO 4	PO 5
CP23221.1	3	3	3	3	3
CP23221.2	2	3	3	3	2
CP23221.3	3	1	2	2	-
CP23221.4	2	3	1	2	-
CP23221.5	1	1	2	2	2
Average	2.2	2.2	2.2	2.4	2.3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-“

Subject Code	Subject Name (Non-Credit course)	Category	L	T	P	C
AC23211	CONSTITUTION OF INDIA	MC	3	0	0	0

Objectives:
<ul style="list-style-type: none"> To inculcate the values enshrined in the Indian constitution. To create a sense of responsible and active citizenship. To know about Constitutional and Non-Constitutional bodies To understand sacrifices made by the freedom fighters.

UNIT-I	Introduction	9
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution –Features – Basic Structure – Preamble.		
UNIT-II	Union Government	9
Union and its territory – Citizenship – Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties. Union Government: Executive, Legislature and Judiciary: President – Vice President – Prime Minister – Central Council of Ministers – Cabinet Committees – Parliament: Committees, Forums and Groups – Supreme Court.		
UNIT-III	State Government & Union Territories	9
State Government: Executive, Legislature and Judiciary–Governor - Chief Minister – State Council of Ministers – State Legislature – High Court – Subordinate Courts –Panchayat Raj – Municipalities–Union Territories –Scheduled and Tribal Areas.		
UNIT-IV	Relations Between Union and States	9
Relations between Union and States – Services under Union and States. Cooperative Societies – Scheduled and Tribal Areas – Finance, Property, Contracts and Suits – Trade and Commerce within Indian Territory – Tribunals.		
UNIT-V	Constitutional Bodies and Amendments	9
Introduction to Constitutional & Non-Constitutional Bodies–Elections – Special Provisions relating to certain classes – Languages - Emergency Provisions – Miscellaneous – Amendment of the Constitution – Temporary, Transitional and Special Provisions – Short title, date of commencement, Authoritative text in Hindi and Repeals. Schedules of the Constitution of India – Appendices in the Constitution of India.		
Total Contact Hours		: 45

Course Outcomes:
On completion of the course, the students will be able to:
<ul style="list-style-type: none"> Appreciate the philosophical foundations of the Indian Constitution. Understand the functions of the Indian government. Understand and abide the rules of the Indian constitution. Gain knowledge on functions of state Government and Local bodies. Gain Knowledge on constitution functions and role of constitutional bodies and amendments of constitution.

Text Books(s):	
1	M Lakshmikanth “Indian Polity”, McGraw Hill Education, 5 th edition 2017.
2	Durga Das Basu, “Introduction to the Constitution of India “, Lexis Nexis, New Delhi., 21 st edition, 2013.

Reference Books(s):	
1	Sharma, Brij Kishore, “Introduction to the Constitution of India”, PHI, New Delhi, 7 th edition, 2015.
2	Subhash Kashyap, “Our Constitution: An Introduction to India’s Constitution and Constitutional Law”, National Book Trust India, 1994.
3	Mahendra Prasad Singh and Himanshu Roy, “Indian Political System”, Pearson India, 4 th edition, 2017.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
AC19201.1	-	-	1	-	2
AC19201.2	-	-	1	-	2
AC19201.3	-	-	1	-	2
AC19201.4	-	-	1	-	2
AC19201.5	-	-	1	-	2
AVERAGE	-	-	1	-	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial

(High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23112	DATA SCIENCE FOUNDATION	PE	3	0	0	3

Objectives:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyse a dataset.
- Critically evaluate data visualisations based on their design and use for communicating stories from data.
- To understand the application and recent trends in Data Science process.

UNIT I	INTRODUCTION	9
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.		
UNIT II	DATA COLLECTION AND MANAGEMEMNT	9
Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.		
UNIT-III	DATA ANALYSIS	9
Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.		
UNIT IV	DATA VISUALISATION	9
Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.		
UNIT-V	APPLICATIONS	9
Applications of Data Science, Technologies for visualization, Bokeh(Python). Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.		
		Total Contact Hours : 45
Course Outcomes: On completion of course you will be able to		
<ul style="list-style-type: none"> ● Explain how data is collected, managed and stored for data science ● Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists. ● Implement data collection and management scripts using MongoDB ● To understand the concepts of data visualization ● To understand the application and recent trends in Data Science process 		

Text Books:

1.	Cathy O’Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O’Reilly.
2.	Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Reference Books(s) :

1.	Y. S. Abu-Mostafa, M. Magdon-Ismael, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2.	P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3.	S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Prentice Hall, 2009.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
DS23113.1	2	2	2	2	-
DS23113.2	1	1	2	2	1
DS23113.3	1	-	1	2	2
DS23113.4	-	2	1	1	-
DS23113.5	1	-	2	2	2
AVERAGE	1.25	1.67	1.6	1.8	1.67

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23A11	APPLIED DEEP LEARNING	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand the fundamental principles, theory and approaches for learning with deep neural networks
<ul style="list-style-type: none"> To learn the main variants of deep learning (such convolutional and recurrent architectures), and their typical applications
<ul style="list-style-type: none"> To understand the key concepts, issues and practices when training and modelling with deep architectures
<ul style="list-style-type: none"> To understand how deep learning fits within the context of other ML approaches
<ul style="list-style-type: none"> To learn deep learning algorithms in application of choice using tensor flow.

UNIT I	INTRODUCTION TO DEEP LEARNING	9
Introduction to Neural Network, Activation Functions, Multilayer Perceptron, Back Propagation Learning		
UNIT II	CONVOLUTIONAL NEURAL NETWORKS (CNN)	9
CNN History- Understanding CNN Layers -CNN Models – ALEXNET-VGG-Google Net-RESNET - CNN Application on image processing and text processing.		
UNIT III	RECURRENT NEURAL NETWORKS (RNN)	9
Introduction to RNN Model Long Short-Term memory (LSTM) Recursive Neural Tensor Network Theory Recurrent Neural Network Model.		
UNIT IV	UNSUPERVISED LEARNING	9
Applications of Unsupervised Learning-Restricted Boltzmann Machine-Collaborative Filtering with RBM		
UNIT V	AUTO ENCODERS	9
Introduction to Auto encoders- Types of Auto encoders- and Applications- Auto encoders- Deep Belief Network		
Total Contact Hours		: 45

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Understand the fundamental principles, theory and approaches for learning with deep neural networks
<ul style="list-style-type: none"> Implement the main variants of deep learning (such convolutional and recurrent architectures), and their typical applications
<ul style="list-style-type: none"> Understand the key concepts, issues and practices when training and modeling with deep architectures
<ul style="list-style-type: none"> Understand how deep learning fits within the context of other ML approaches.
<ul style="list-style-type: none"> Apply deep learning algorithms in application of choice using tensor flow.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini Projects

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

Text Book(s):	
1.	Ian Good fellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, The MIT Press,2016.
2.	Rajiv Chopra, Deep Learning: A Practical Approach, Khanna publication,2018.

Reference Books(s)/Web links:	
1.	MOOC, Deep Learning By Google, https://in.udacity.com/course/deep-learning--ud730
2.	MOOC, Deep Learning https://www.coursera.org/specializations/deep-learning

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23A11.1	2	-	-	-	-
CP23A11.2	1	2	2	2	1
CP23A11.3	1	-	2	2	1
CP23A11.4	1	1	2	2	-
CP23A11.5	1	1	2	2	2
AVERAGE	1.2	1.3	2	2	1.3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial

(High)No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23A12	DATA AND INFORMATION VISUALIZATION	PC	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To develop skills to both design and critique visualizations. To introduce visual perception and core skills for visual analysis. To understand technological advancements of data visualization To understand various data visualization techniques. To understand the methodologies used to visualize large data sets.

UNIT I	INTRODUCTION AND DATA FOUNDATION	9
Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets		
UNIT II	FOUNDATIONS FOR VISUALIZATION	9
Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson’s Affordance theory – A Model of Perceptual Processing.		
UNIT III	VISUALIZATION TECHNIQUES	9
Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.		
UNIT IV	INTERACTION CONCEPTS AND TECHNIQUES	9
Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.		
UNIT V	RESEARCH DIRECTIONS IN VISUALIZATIONS	9
Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications		
		Total Contact Hours : 45

Course Outcomes: On completion of course students will be able to
<ul style="list-style-type: none"> Visualize the objects in different dimensions Design and process the data for Visualization. Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences Apply the virtualization techniques for research projects Identify appropriate data visualization techniques given particular requirements imposed by the data.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini Projects

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.

Reference Books(s) / Web links:

- 1 Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007
- 2 Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23A12.1	-	-	1	2	3
CP23A12.2	1	-	2	1	-
CP23A12.3	-	-	1	2	3
CP23A12.4	1	1	1	2	3
CP23A12.5	-	-	1	2	3
AVERAGE	1	1	1.2	1.8	

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23A13	DATA ANALYTICS	PE	3	0	0	3

Objectives:

- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I	INTRODUCTION TO BIG DATA	9
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis –Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.		
UNIT II	SEARCH METHODS AND VISUALIZATION	9
Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies – Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types –Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques		
UNIT III	MINING DATA STREAMS	9
Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.		
UNIT IV	FRAMEWORKS	9
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation .		
UNIT V	R LANGUAGE	9
Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues - Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations.		
Total Contact Hours		: 45

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

- Understand the basics of big data analytics
- Ability to use Hadoop, Map Reduce Framework.
- Ability to identify the areas for applying big data analytics for increasing the business outcome
- Gain knowledge on R language
- Contextually integrate and correlate large amounts of information to gain faster insights.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Mini Projects

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion.

Text Book(s):	
1.	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020
2.	Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011

Reference Books(s)/Web links:	
1.	Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012
2.	Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23A13.1	2	-	-	-	-
CP23A13.2	1	2	1	1	-
CP23A13.3	-	-	2	1	1
CP23A13.4	2	2	1	-	-
CP23A13.5	1	-	-	1	1
AVERAGE	1.5	2	1.3	1	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23A11	AI FOR COMPUTER VISION	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand ML models to read the images, train, evaluate, and predict. To explore the use of computer vision for object detection and image segmentation problems. To understanding concept of preprocessing, training and evaluation of data set. To design the model for containerized pipeline and no-code image classification system To demonstrate the model prediction and to solve a variety of problems

UNIT-I	AI Models for Vision	9
A Dataset for Machine Perception - A Linear Model Using Keras - A Neural Network Using Keras. Image Vision : Pretrained Embeddings - Convolutional Networks - Modular Architectures - Neural Architecture Search Designs. Beyond Convolution: The Transformer Architecture – Choosing a Model.		
UNIT-II	Object Detection, Segmentation and Creating Vision Datasets	9
Object Detection – Segmentation. Creating Vision Datasets : Collecting Images – Data types – Manual Labeling – Labeling at Scale – Automated Labeling – Bias – Creating a Dataset		
UNIT-III	Preprocessing , Training and Continuous Evaluation	9
Preprocessing : Reasons for Preprocessing – Size and Resolution – Data Augmentation – Forming Input Images. Training Pipeline : Efficient Ingestion – Saving Model State – Distribution Strategy – Serverless ML . Model Quality and Continuous Evaluation : Monitoring – Model Quality Metrics – Quality Evaluation		
UNIT-IV	Model Predictions and Trends in Production ML	9
Model Predictions : Making Predictions – Online Prediction – Batch and Stream Prediction – Edge ML. Trends in Production ML : Machine Learning Pipelines – Explainability – No-Code Computer Vision		
UNIT-V	Advanced Vision Problems	9
Object Measurement – Counting – Pose Estimation – Image Search. Image and Text Generations: Image Understanding – Image Generation –Image Captioning .		
Total Contact Hours: 45		

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Design and select the AI Model for Computer Vision tasks Create an end-to-end model pipeline to train, evaluate and deploy. Pre-processes images to data augmentation and support learnability Deploy image models as web services or on-edge device. Implementations to image generation, counting and pose detection problems

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini Projects

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation / Discussion

Text Book(s):	
1.	Valliappa Lakshmanan, Martin Gorner, and Ryan Gillard, “Practical Machine Learning for Computer Vision“, O’Reilly Media, First Edition, 2021.
2.	David A. Forsyth and Jean Ponce, “Computer Vision a Modern approach“, Pearson Education, Second Edition, 2015.

Reference Books(s)/Web links:	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
3.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
4.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
DS23A11.1	-	3	2	-	2
DS23A11.2	2	3	-	-	2
DS23A11.3	3	2	1	-	1
DS23A11.4	-	1	1	2	3
DS23A11.5	2	3	3	2	-
AVERAGE	2.33	2.4	1.75	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23B12	HEALTH CARE DATA ANALYTICS	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To explore the various forms of electronic health care information.
<ul style="list-style-type: none"> To learn the techniques adopted to analyse health care data.
<ul style="list-style-type: none"> To understand the predictive models for clinical data

UNIT-I INTRODUCTION	9
Introduction to Healthcare Data Analytics – Healthcare Data Sources and Basic Analytics – Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare – Resources for Healthcare Data Analytics – Electronics Health Records – Benefits of EHR – Barriers of Adopting EHR.	
UNIT-II BIOMEDICAL IMAGE ANALYSIS	9
Biomedical Image Analysis - Biomedical Imaging Modalities -Object Detection -Image Segmentation - Image Registration-Feature Extraction-Mining of Sensor Data in Healthcare -Challenges in Healthcare Data Analysis - Sensor Data Mining Applications- Nonclinical Healthcare Applications	
UNIT-III NATURAL LANGUAGE PROCESSING	9
Natural Language Processing and Data Mining for Clinical Text- Natural Language Processing - Mining Information from Clinical Text - Challenges of Processing Clinical Reports - Mining the Biomedical Literature - Information Extraction . - Text Mining Environments – Applications - Integration with Clinical Text Mining	
UNIT-IV ADVANCED DATA ANALYTICS	9
Advanced Data Analytics for Healthcare - Basic Statistical Prediction Models - Alternative Clinical Prediction Models – Temporal Data Mining for Healthcare-Data - Association Analysis - Temporal Pattern Mining - Sensor Data Analysis - Other Temporal Modeling Methods	
UNIT-V PREDICTIVE MODELS	9
Predictive Models for Integrating Clinical and Genomic Data - Issues and Challenges in Integrating Clinical and Genomic Data - Different Types of Integration - Different Goals of Integrative Studies - Validation - Information Retrieval for Healthcare - Knowledge-Based Information in Healthcare - Content of Knowledge-Based Information Resources – Indexing – Retrieval	
Total Contact Hours:45	

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Analyze health care data using appropriate analytical techniques.
<ul style="list-style-type: none"> Apply analytics for decision making in healthcare services.
<ul style="list-style-type: none"> Apply NLP for generating clinical reports
<ul style="list-style-type: none"> Apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems.
<ul style="list-style-type: none"> Apply Predictive modeling in healthcare services

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic
<ul style="list-style-type: none"> Problem solving sessions Flipped classroom - Comparing SOA with Client-Server and Distributed architectures Survey on various storage technologies Activity Based Learning Implementation of small module

<p>SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic</p> <ul style="list-style-type: none"> ● Tutorial problems ● Assignment problems ● Quizzes ● Class Presentation/Discussion
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Text Book(s):	
1.	Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, Taylor & Francis, 2015
2.	Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.

Reference Books(s)/Web links:	
1.	Trevor L. Strome (2013). Healthcare Analytics for Quality and Performance Improvement. John Wiley & Sons, Inc
2.	Principles of Health Interoperability HL7 and SNOMED (Health Information Technology Standards), Springer Publication by Tim Benson
3.	Wellness Management A Lifestyle Approach for Health, Fitness and Energy - Rajasekhar Kali Venkata – Notion press

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
DS23B12.1	1	3	1	2	2
DS23B12.2	2	3	1	2	2
DS23B12.3	2	3	1	1	3
DS23B12.4	2	3	1	1	3
DS23B12.5	2	3	1	1	3
AVERAGE	1.8	3	1	1.4	2.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23A13	NATURAL LANGUAGE PROCESSING AND APPLICATIONS	PE	3	0	0	3

Objectives:

<ul style="list-style-type: none"> To understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
<ul style="list-style-type: none"> To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.
<ul style="list-style-type: none"> To familiarize various NLP software libraries and data sets publicly available
<ul style="list-style-type: none"> To develop systems for various NLP problems with moderate complexity.
<ul style="list-style-type: none"> To learn various strategies for NLP system evaluation and error analysis.

UNIT-I	INTRODUCTION	9
<p>Introductions: Regular Expressions, Text Normalization, Edit Distance, N-Grams, Evaluating Language Models , Sampling sentences from a language model , Generalization and Zeros, Naive Bayes Classifiers and Training , Naive Bayes as a Language Model , Precision, Recall, F-measure , Test sets and Cross- validation, Classification with Logistic Regression, Multinomial logistic regression, Learning in Logistic Regression, Lexical Semantics, Vector Semantics, Words and Vectors.</p>		
UNIT-II	NEURAL NETWORKS AND NEURAL LANGUAGE MODEL	9
<p>Neural Networks and Neural Language Models : Feedforward Neural Networks, Classification, Language Modelling, Training Neural Nets, Training the neural language model, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs) ,RNNs as Language Models, RNNs for other NLP tasks, Stacked and Bidirectional RNN architectures, LSTM, Evaluation of Named Entity</p>		
UNIT-III	MACHINE TRANSLATION AND INFORMATION RETRIEVAL	
<p>Machine Translation and Information Retrieval : Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model ,Translating in low-resource situations, Information Retrieval, IR-based Factoid Question Answering, Entity Linking , Knowledge- based Question Answering, Using Language Models to do QA , Classic QA Models, Simple Frame-based Dialogue Systems, The Dialogue-State Architecture , Evaluating Dialogue Systems , Dialogue System Design, The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture.</p>		
UNIT-IV	CONTEXT FREE GRAMMAR	9
<p>Context-Free Grammars , Parsing and Semantics : Context-Free Grammars, Treebanks ,Grammar Equivalence and Normal Form , Ambiguity , CKY Parsing: A Dynamic Programming Approach, Span- Based Neural Constituency Parsing, Evaluating Parsers, Dependency Relations, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing, Model-Theoretic Semantics, First-Order Logic , Event and State Representations , Description Logics .</p>		
UNIT V	SEMANTICS AND SENTIMENTS	9
<p>Semantic ,Sentiment and Coreference : Semantic Roles, Problems with Thematic Roles , The Proposition Bank and FrameNet, Semantic Role Labeling , Selectional Restrictions, Emotion, Creating Affect Lexicons by Human Labeling, Semi-supervised Induction of Affect Lexicons, Supervised Learning of Word Sentiment , Using Lexicons for Sentiment and affect Recognition , Lexicon-based methods for Entity- Centric Affect, Coreference Linguistic Background, Tasks and Datasets, Mention Detection, Architectures for Coreference Algorithms, Classifiers using hand-built features, A neural mention-ranking algorithm, Evaluation of Coreference Resolution , Winograd Schema problems Gender Bias in Coreference .</p>		
Total Contact Hours:		45

Course Outcomes: On completion of the course, the students will be able to
<ul style="list-style-type: none"> Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
<ul style="list-style-type: none"> Demonstrate understanding of the relationship between NLP and statistics & machine learning.
<ul style="list-style-type: none"> Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis.
<ul style="list-style-type: none"> Develop systems for various NLP problems with moderate complexity.
<ul style="list-style-type: none"> Evaluate NLP systems, identify shortcomings and suggest solutions for these shortcomings.

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic
<ul style="list-style-type: none"> Research problem literature study. Comparison on various algorithms. Case study discussion. Develop the small applications.

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

Text Book(s):
1. Jurafsky Dan and Martin James H. “Speech and Language Processing” ,3rd Edition, 2018.
2. Jurafsky D. and Martin J. H., “Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
3. Rajesh Arumugam, Rajalingappa Shanmugamani “Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application”.PACKT publisher, 2018.

Reference Books(s)/Web links:
1. James Allen “Natural Language Understanding”, Pearson Publication 8th Edition. 2012.
2. Christopher D. Manning and Hinrich Schütze, “ Foundations of Natural Language Processing”, 6 th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
3. Alexander Clark, Chris Fox, Shalom Lappin, “The Handbook of Computational Linguistics and Natural Language Processing”,Wiley-Blackwell,2012
4. Chris Manning and Hinrich Schütze, “Foundations of Statistical Natural Language Processing ”,MIT Press 1999.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
DS23A13.1	3	2	-	-	-
DS23A13.2	2	3	2	3	2
DS23A13.3	2	3	-	2	2
DS23A13.4	2	3	2	-	3
DS23A13.5	2	2	1	3	3
AVERAGE	2.2	2.6	1.66	2.67	2.5

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23B11	TIME SERIES ANALYSIS	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> Present time series in an informative way, both graphically and with summary Statistics. Model time series to analyses the underlying structure(s) in both the time and frequency domains.

UNIT I	Time Series Analysis	9
Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data - resampling time series data.		
UNIT II	INTRODUCTION TO TREND	9
Introduction to times series data, application of time series from various fields, Components of a time series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.		
UNIT III	TREND AND SEASONAL COMPONENT	9
Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend, Ratio to moving average and Link relatives.		
UNIT IV	FORECASTING	9
Variate component method: Stationary Time series: Weak stationary, autocorrelation function and correlogram of moving average .Forecasting: Exponential smoothing methods, Short term forecasting methods: Brown’s discounted regression, Box-Jenkins Method.		
UNIT V	CYCLIC COMPONENT	9
Introduction to Auto encoders- Types of Auto encoders- and Applications- Auto encoders- Deep Belief Network		
Total Contact Hours		: 45

Course Outcomes: On completion of course you will be able to
<ul style="list-style-type: none"> Forecast the trend pattern exhibited by the given data by using various methods Run and interpret time series models and regression models for time series Use the Box-Jenkins approach to model and forecast time series data empirically. Analyze and estimate the cyclic components using special processes. Understand Autoencoders and its applications

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Activity Based Learning

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

Text Book(s):	
1.	Kendall M.G: Time Series, Charles Griffin, 3 rd Edition 1976.
2.	Chatfield C: The Analysis of Time Series –An Introduction, Chapman & Hall,6 th Edition 2003

Reference Books(s):	
1.	Mukhopadhyay P: Applied Statistics, 2nd ed. Revised reprint, Books and Allied,2011.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B11.1	1	-	-	2	-
CP23B11.2	2	2	2	1	-
CP23B11.3	2	2	3	1	-
CP23B11.4	1	1	-	2	1
CP23B11.5	-	-	2	2	2
AVERAGE	1.5	1.67	2.33	1.6	1.5

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : “-”

Subject Code	Subject Name	Category	L	T	P	C
CP23B12	STATISTICS FOR DATA SCIENCE	PE	3	0	0	3

Objectives:

- To learn the fundamentals of data science.
- To learn the fundamentals of descriptive data analytics.
- To gain knowledge to make predictive analytic using different models
- To gain in-depth knowledge on descriptive data analytical techniques.
- To learn data analytical frameworks.

UNIT I	INTRODUCTION TO DATA SCIENCE	9
Introduction to data science – Overview of data – Sources of data – Types of data – Small data and Big data – Data collection methods – Surveys – Interviews – Log and Diary data – User studies in Lab and Field – Web scrapping – Public datasets – Data cleaning – Tools for data science.		
UNIT II	DESCRIPTIVE DATA ANALYSIS	9
Dataset construction – Sampling of data – Stem and Leaf plots – Frequency table – Time series data – Central Tendency Measures of the location of data – Dispersion measures – Correlation analysis.		
UNIT-III	PREDICTIVE ANALYTICS AND EVALUATION	9
Overview of Machine learning concepts – Model construction using regression and Classification models – Linear regression and multiple regression models –KNN classification models – Comparison models – Training data construction – Normalization – Cross – Validation techniques – Accuracy metrics for evaluation of models – Contingency table, ROC curve, Precision – Recall curves – A/B testing.		
UNIT IV	DATA ANALYTICS USING STATISTICS	9
Types of Data – Mean, Median and Mode – Standard Deviation and Variance – Probability – Probability Density Function - Types of Data Distribution – Percentiles and Moments – Correlation and Covariance – Conditional Probability - Bayes' Theorem – Introduction to Univariate, Bivariate and multivariate Analysis – Dimensionality Reduction using Principal Component Analysis and LDA – Principal Component Analysis (PCA) example with Iris Dataset from UCI repository.		
UNIT-V	DATA ANALYTICAL FRAMEWORK	9
Introducing Hadoop – Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Introduction to NoSQL: Cap theorem – MongoDB: RDBMS vs MongoDB – MongoDB Database Model – Data types and Sharding – Introduction to Hive – Hive Architecture – Hive Query Language (HQL).		
		Total Contact Hours
		: 45

Course Outcomes: On completion of course you will be able to

- Apply the skills of data inspecting and cleansing.
- Determine the relationship between data dependencies using statistics.
- Can handle data using primary tools used for data science in Python.
- Solve analytical problem with relevant mathematics background knowledge
- Write and demonstrate simple applications involving analytics using Hadoop and MapReduce.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

TEXT BOOKS:	
1.	Frank Pane, “Hands on Data Science and Python Machine Learning”, Packt Publishers, 2017.
2.	Seema Acharya, Subhashini Chellapan , “Big Data and Analytics”, Wiley, 2015.
3.	Grus, Joel, “Data science from scratch: first principles with python”, O’Reilly Media, 2019.
4.	Chirag Shah, “A Hands-on Introduction to Data Science”, Cambridge University Press, UK, 2020.

REFERENCE BOOKS:	
1.	Alberto Boschetti, Luca Massaron, “Python Data Science Essentials”, Packt Publications, 2ndEdition, 2016.
2.	DT Editorial Services, Big Data, Black Book, Dream Tech Press, 2015.
3.	Yuxi (Hayden) Liu, “Python Machine Learning”, Packt Publication, 2017.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B12.1	2	1	1	-	-
CP23B12.2	-	-	2	2	-
CP23B12.3	1	1	1	1	1
CP23B12.4	2	1	2	1	2
CP23B12.5	-	-	1	2	2
AVERAGE	1.67	1	1.4	1.5	1.67

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23B13	DATABASE FOUNDATION FOR BUSINESS ANALYTICS	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> Understand the role of databases in business analytics and decision-making. Learn the principles of database design and normalization. Acquire skills in SQL (Structured Query Language) for querying and manipulating data. Explore techniques for managing and maintaining databases efficiently. Learn analytical techniques, statistical methods, and data visualization tools to analyze data, identify patterns, and make data-driven recommendations for improving business performance.

UNIT I INTRODUCTION TO DATABASES AND DESIGN	9
Definition of databases and their significance in business analytics- Overview of database management systems (DBMS) and types of databases- Database architecture and components- Database Design and Modeling: Entity- Relationship (ER) modeling- Normalization techniques- Data modeling tools and techniques.	
UNIT II SQL FUNDAMENTALS AND ADVANCED SQL	9
Introduction to Structured Query Language (SQL)- Basic SQL commands: SELECT, INSERT, UPDATE, DELETE- Filtering and sorting data using SQL queries- Join operations and data aggregation- Advanced SQL: Subqueries and nested queries Data manipulation language (DML) and data definition language (DDL) statements-Views, stored procedures, and triggers- Indexing and optimization techniques.	
UNIT III DATABASE ADMINISTRATION AND BUSINESS INTELLIGENCE	9
Database security and access control- Backup and recovery strategies- Performance tuning and optimization- Data integrity and consistency- Introduction to data warehousing concepts- Extract, Transform, Load (ETL) processes- Online Analytical Processing (OLAP) and data cubes- Reporting and visualization tools for business analytics.	
UNIT IV INTRODUCTION TO BUSINESS ANALYTICS AND DATA COLLECTION	9
Overview of business analytics and its applications in different industries- Role of analytics in decision-making processes- Introduction to analytical software tools and platforms- Data sources and types of business data- Data collection methods- Data cleaning, transformation, and preprocessing techniques.	
UNIT V DESCRIPTIVE AND PREDICTIVE ANALYTICS	9
Exploratory data analysis (EDA) techniques- Data visualization tools and techniques- Case studies- Introduction to predictive modeling techniques: regression analysis, time series forecasting- Classification and clustering algorithms- Model evaluation and validation methods.	
Total Contact Hours : 45	

Course Outcomes: On completion of course you will be able to
<ul style="list-style-type: none"> Understand the fundamental principles and components of database management systems (DBMS). Develop proficiency in using Structured Query Language (SQL) and utilize advanced SQL techniques for complex data retrieval, manipulation, and optimization. Implement database management strategies and Analyze business requirements and design database solutions to support decision-making processes and business intelligence. Understand the role and importance of business analytics in modern organizations and apply statistical techniques and data analysis methods to interpret and draw insights from business data. Utilize data visualization tools to communicate findings and present actionable insights and explore predictive modeling techniques for forecasting and decision support.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini Projects

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

TEXT BOOKS:	
1.	Database Systems: Design, Implementation, and Management" , Carlos Coronel, Steven Morris, and Peter Rob,9 th Edition, 2009
2.	Business Analytics: Data Analysis & Decision Making" , S. Christian Albright, Wayne L. Winston, and Christopher Zappe,4 th Edition,2010

REFERENCE BOOKS:	
1	SQL Ultimate Beginner's Guide: Programming Basics for Absolute Beginners,2016

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B13.1	2	-	-	-	-
CP23B13.2	1	-	2	-	-
CP23B13.3	2	1	1	-	1
CP23B13.4	2	1	2	-	-
CP23B13.5	1	1	1	-	1
AVERAGE	1.6	1	1.5	-	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High)No correlation : "-"

Subject Code	Subject Name	Category	L	T	P	C
DS23B13	APPLIED BUSINESS ANALYTICS		3	0	0	3

Objectives:

<ul style="list-style-type: none"> To understand the Analytics Life cycle.
<ul style="list-style-type: none"> To comprehend the process of acquiring Business Intelligence.
<ul style="list-style-type: none"> To understand various types of analytics for Business Forecasting.
<ul style="list-style-type: none"> To model the supply chain management for Analytics.
<ul style="list-style-type: none"> To apply analytics for Enterprise Reporting.

UNIT I	Introduction	9
What is Business Analytics?- Evolution of Business Analytics-Scope of Business Analytics-Data for Business Analytics-Models in Business Analytics-Problem Solving with Analytics.		
UNIT II	Business Intelligence	9
BI Component Framework-Who is BI for?-BI users-BI Applications-BI roles and Responsibilities-Types of Decisions-Decision Support Systems-OLAP-Analytic functions.		
UNIT III	Business Forecasting	9
Qualitative and Judgmental Forecasting-Statistical Forecasting Models-Forecasting Models for stationary time series-Models for Time series with linear trend, seasonality and Selecting Appropriate Time-Series-Based Forecasting Models.		
UNIT IV	HR and Supply Chain Analytics	9
Human Resources-Planning and Recruitment-Training and development-Supply chain network-Planning Demand, Inventory and Supply-Logistics-Analytics applications in HR and Supply chain-Appling HR Analytics to make a prediction of the demand for hourly employees for a year.		
UNIT V	Enterprise Reporting	9
Reporting perspectives common to all levels of enterprise-Report standardization and Presentation Practices-Enterprise Reporting Characteristics in OLAP world-Balanced Scorecard-Dashboards-How to create Dashboard?-Scorecard vs. Dashboard.		
Total Contact Hours: 45		

Course Outcomes: On completion of course you will be able to
<ul style="list-style-type: none"> Explain the real world business problems and model with analytical solutions.
<ul style="list-style-type: none"> Identify the business processes for extracting Business Intelligence.
<ul style="list-style-type: none"> Apply Predictive analytics for business forecasting.
<ul style="list-style-type: none"> Apply analytics for supply chain and logistics management.
<ul style="list-style-type: none"> Use Analytics for Enterprise Reporting.

SUGGESTED ACTIVITIES

<ul style="list-style-type: none"> Case study Discussion Flipped classroom – Comparing of Forecasting Models. Activity Based Learning <ul style="list-style-type: none"> Mind Mapping- Supply Chain network, Gallery Walk- HR Planning and Recruitment, Role Play- Decision Support Systems
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SUGGESTED EVALUATION METHODS

- Mini Projects
- Assignment problems
- Quizzes

Text Book(s):

- | | |
|----|--|
| 1. | R. Evans James, Business Analytics, 2 nd Edition, Pearson, 2017. |
| 2. | R.N. Prasad, Semma Archarya, Fundamentals of Business Analytics, 2 nd Edition, Wiley, 2016. |

Reference Books(s) / Web links:

- | | |
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| 1.. | Philip Kotler and Kevin Keller, Marketing Management, 15 th Edition, PHI, 2016. |
| 2. | VSP RAO, Human Resource Management, 3 rd Edition, Excel Books, 2010. |

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
DS23B13.1	2	1	2	3	3
DS23B13.2	2	3	2	2	-
DS23B13.3	2	2	2	2	3
DS23B13.4	2	3	1	2	2
DS23B13.5	2	3	-	2	1
AVERAGE	2	2.4	1.75	2.2	2.3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23B14	PREDICTIVE MODELLING	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand the terms and terminologies of predictive modeling. To study the various predictive models, their merits, demerits and application. To get exposure to various analytical tools available for predictive modeling. To learn the predictive modeling markup language. To get familiar with the technologies in predictive modeling.

UNIT I	INTRODUCTION TO PREDICTIVE MODELING	9
Core ideas in data mining - Supervised and unsupervised learning - Classification vs. Prediction - Steps in data mining- SEMMA Approach - Sampling -Pre-processing - Data cleaning - Data Partitioning - Building a model - Statistical models - Statistical models for predictive analytics.		
UNIT II	PREDICTIVE MODELING BASICS	9
Data splitting – Balancing- Over fitting –Oversampling –Multiple Regression Artificial neural networks (MLP) - Variable importance- Profit/loss/prior probabilities - Model specification - Model selection - Multivariate Analysis.		
UNIT III	PREDICTIVE MODELS	9
Association Rules-Clustering Models –Decision Trees- Ruleset Models- KNearest Neighbors – Naive Bayes - Neural Network Model – Regression Models – Regression Trees – Classification & Regression Trees (CART) – Logistic Regression – Multiple Linear Regression Scorecards – Support Vector Machines – Time Series Models - Comparison between models - Lift chart Assessment of a single model.		
UNIT IV	PREDICTIVE MODELING MARKUP LANGUAGE	9
Introduction to PMML – PMML Converter - PMML Structure – Data Manipulation in PMML – PMML Modeling Techniques - Multiple Model Support – Model Verification.		
UNIT V	TECHNOLOGIES AND CASE STUDIES	9
Weka – RapidMiner – IBM SPSS Statistics- IBM SPSS Modeler – SAS Enterprise Miner – Apache Mahout –R Programming Language.-Real time case study with modeling and analysis.		
Total Contact Hours		45

Course Outcomes: On completion of course students will be able to
<ul style="list-style-type: none"> Design and analyze appropriate predictive models. Define the predictive models using PMML. Apply statistical tools for analysis. Use various analytical tools available for predictive modeling. Apply predictive modeling markup language in data manipulation.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini Projects

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems Quizzes Class Presentation/Discussion

TEXT BOOKS:	
1.	Kattamuri S. Sarma, “Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications”, 3rd Edition, SAS Publishing, 2017
2.	Alex Guazzelli, Wen-Ching Lin, Tridivesh Jena, James Taylor, “PMML in Action Unleashing the Power of Open Standards for Data Mining and Predictive Analytics”, 2nd Edition, Create Space Independent Publishing Platform, 2012.

Reference Books (s)/Web links:	
1.	Ian H. Witten, Eibe Frank , “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, 3rd Edition, 2011.
2.	Eric Siegel , “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, 2nd Edition, Wiley, 2016.
3.	Conrad Carlberg, “Predictive Analytics: Microsoft Excel”, 1st Edition, Que Publishing, 2012.
4.	Jeremy Howard, Margit Zwemer, Mike Loukides, “Designing Great Data Products- Inside the Drivetrain Approach, a Four-Step Process for Building Data Products – Ebook”, 1st Edition, O'Reilly Media, March 2012.
5.	https://nptel.ac.in/courses/108108111/
6.	https://www.coursera.org/learn/predictive-modeling-analytics
7.	https://bookdown.org/egarpor/PM-UC3M/
8.	https://cics.nd.edu/research/applications/materials/

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B14.1	1	1	-	-	-
CP23B14.2	2	-	-	-	-
CP23B14.3	2	1	1	1	2
CP23B14.4	2	1	1	1	2
CP23B14.5	1	-	-	1	1
AVERAGE	1.6	1	1	1	1.67

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23B15	PRESCRIPTIVE ANALYTICS	PE	3	0	0	3

Objectives:
<ul style="list-style-type: none"> To understand specific statistical and predictive analysis methods applicable to real life scenario.
<ul style="list-style-type: none"> To learn the regression types and apply in predictive analysis.
<ul style="list-style-type: none"> To Understand the impact of each independent variable on the dependent variable, while controlling for other variables.
<ul style="list-style-type: none"> To assess the prediction using decision tree algorithm categorization and validated data.
<ul style="list-style-type: none"> To address specific questions or problems within a system by creating a virtual representation that allows for experimentation and analysis

UNIT I	INTRODUCTION	9
Overview-Definition- Need-Analytics in decision making-Types and - Application- Visualization- Predicting Analytics Examples- Digital Analytics.		
UNIT II	SIMPLE LINEAR REGRESSION	9
Introduction-Types-Model Building, OLS Estimation-Model interpretation- Data Collection and Cleaning.		
UNIT-III	MULTIPLE LINEAR REGRESSION	9
Overview, Estimation of Regression Parameters, Model Diagnostics, Introduction to Dummy, Derived & Interaction Variables.		
UNIT IV	DECISION TREES	9
Overview, Application, Terminologies, And Model validation, Chi-Square Automatic Interaction Detectors (CHAID), Classification and Regression Tree (CART).		
UNIT-V	SIMULATION MODELING	9
Simulation Development Process- Types of Simulation - Monte Carlo Simulation- Monte Carlo Simulation- Discrete Event Simulation- Simulation Software.		
		Total Contact Hours : 45

Course Outcomes: On completion of course you will be able to
<ul style="list-style-type: none"> Assess understanding and application of analytics concepts.
<ul style="list-style-type: none"> Assess knowledge of OLS estimation, model interpretation, and data preparation.
<ul style="list-style-type: none"> Assess knowledge of estimation techniques, model diagnostics, and variable types.
<ul style="list-style-type: none"> Develop the skills to build, interpret, and validate decision tree models using popular algorithms like CHAID and CART
<ul style="list-style-type: none"> Understand different types of simulations, with an emphasis on Monte Carlo simulation and discrete event simulation.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> Problem solving sessions Mini projects

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> Tutorial problems Assignment problems. Quizzes Class presentation/Discussion

TEXT BOOKS:	
1.	Eric Siegel: Predictive Analytics: The power to Predict Who Click, Buy, Lie, or Die, Wiley,2 nd Edition, 2016.
2.	Bari: Predictive Analytics for Dummies, Wiley,2014

Reference Books (s)/Web links:	
1.	NamakumR N Prasad, Seema Acharya: Fundamentals of Business Analytics, Wiley,2011.
2.	Prescriptive Analytics : The Final Frontier for Evidence-Based Management and Optimal Decision Making, 1 st edition, Published by Pearson FT press,2019.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B15.1	2	1	-	-	-
CP23B15.2	2	2	1	-	-
CP23B15.3	2	2	1	-	-
CP23B15.4	2	1	2	2	2
CP23B15.5	1	-	-	2	2
AVERAGE	1.8	1.5	1.33	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23B16	WEB ANALYTICS	PE	3	0	0	3

Objectives:

- To Assess that how website visitors view and interact with a site's pages and features, and business intelligence, which would allow using data on customer purchasing patterns, demographics, and demanding trends to make effective strategic decisions.

UNIT I	INTRODUCTION	9
Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, On site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations. Data Collection: Clickstream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.		
UNIT II	QUALITATIVE ANALYSIS	9
Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, Creating and running a survey, Benefits of surveys. Web Analytic fundamentals: Capturing data: Web logs or JavaScripts tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding clickstream data quality, Identifying unique page definition, Using cookies, Link coding issues.		
UNIT-III	WEB METRICS	9
Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization(e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI.		
UNIT IV	WEB ANALYTICS 2.0	9
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.		
UNIT-V	SEARCH ANALYTICS	9
Internal Search, SEO, and PPC Performing Internal Site Search Analytics, Beginning Search Engine Optimization, Measuring SEO Efforts, Analyzing Pay per Click Effectiveness. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.		
Total Contact Hours		: 45

Course Outcomes: On completion of course you will be able to

- Understand the Web analytics.
- Identify Different Data Collection and Web Analytics Strategies.
- Apply Different Web Analytics Tools.
- Understand Web Analytics 2.0.
- Summarize Various Google Analytics and testing.

TEXT BOOKS:

1.	Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc. (2010), 2nd ed.
2.	Kaushik A., Web Analytics 2.0 The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. (2010), 1st ed.

Reference Books (s)/Web links:

- Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons(2002), 1st ed.

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B16.1	2	-	-	-	-
CP23B16.2	3	2	-	-	-
CP23B16.3	2	2	2	2	-
CP23B16.4	1	1	2	2	1
CP23B16.5	1	1	2	-	2
AVERAGE	1.8	1.5	2	2	1.5

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation : “-”

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23O11	CYBER SECURITY	OE	2	0	2	3

Objectives:
<ul style="list-style-type: none"> To learn cybercrime and cyber law.
<ul style="list-style-type: none"> To understand the cyber attacks and tools for mitigating them.
<ul style="list-style-type: none"> To understand information gathering.
<ul style="list-style-type: none"> To learn how to detect a cyber attack.
<ul style="list-style-type: none"> To learn how to prevent a cyber attack.

UNIT I INTRODUCTION	6
Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.	
UNIT II ATTACKS AND COUNTERMEASURES	6
OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.	
UNIT III RECONNAISSANCE	5
Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.	
UNIT IV INTRUSION DETECTION	5
Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.	
UNIT V INTRUSION PREVENTION	5
Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.	
	Total Contact Hours : 27

List of Experiments			
1.	Install Kali Linux on Virtual box.		
2.	Explore Kali Linux and bash scripting		
3.	Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego.		
4.	Understand the nmap command d and scan a target using nmap.		
5.	Install metasploitable on the virtual box and search for unpatched vulnerabilities.		
6.	Use Metasploit to exploit an unpatched vulnerability.		
7.	Install Linus server on the virtual box and install ssh.		
8.	Use Fail2banto scan log files and ban Ips that show the malicious signs.		
9.	Launch brute-force attacks on the Linux server using Hydra.		
10.	Perform real-time network traffic analysis and data pocket logging using Snort.		
		Contact Hours	: 30
		Total Hours	: 60
Course Outcomes: On completion of course you will be able to			
	<ul style="list-style-type: none"> Explain the basics of cyber security, cyber crime and cyber law 		
	<ul style="list-style-type: none"> Classify various types of attacks and learn the tools to launch the attacks 		
	<ul style="list-style-type: none"> Apply various tools to perform information gathering 		
	<ul style="list-style-type: none"> Apply intrusion techniques to detect intrusion 		
	<ul style="list-style-type: none"> Apply intrusion prevention techniques to prevent intrusion 		

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1.	Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021
2.	Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011
3.	https://owasp.org/www-project-top-ten/

Reference Books(s):

1.	David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013
2.	Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011
3.	Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007 (Unit 3)
4.	William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 (Units 4 and 5)
5.	Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2014 (Lab)

CO - PO matrices of course

PO CO	PO1	PO2	PO3	PO4	PO5
CP23B11.1	2	1	1	1	2
CP23B11.2	-	-	2	1	2
CP23B11.3	-	1	2	2	1
CP23B11.4	-	-	2	2	2
CP23B11.5	-	-	1	2	3
AVERAGE	2	1	1.6	1.6	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : "-"