SYLLABUS
B. Tech. Seventh Semester- Computer Science & Engineering
(Big Data Analytics (BDA))

SYLLABUS

B.TECH. (BIG DATA ANALYTICS)

SEVENTH SEMESTER

		July 2023	1.00	Applicable for AY 2023-24 Onwards
Chairman (AC)	Chairman (BoS)	Date of release	Version	

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B. Tech. Seventh Semester- Computer Science & Engineering

(Big Data Analytics (BDA))

Sl. No.	Board of Studies (BOS)	Courses (Subject)	Category	Course Code	Period per Week			Scheme of Examination Theory/Lab			Total Marks	Credit
					L	T	P	ESE	CT	TA		
1	Computer Science & Engineering	Cryptography and Network Security	PCC	**CS102701**	2	1	-	100	20	30	150	3
2	Computer Science & Engineering	Data Analytics with R- Programming	PCC	**CS111702**	2	1	-	100	20	30	150	3
3	Computer Science & Engineering	Data Warehousing & Mining with Hive	PCC	**CS111703**	3	-	-	100	20	30	150	3
4	Computer Science & Engineering	Professional Elective III	PEC	Refer Table I	3	-	-	100	20	30	150	3
5	Computer Science & Engineering	Open Elective II	OEC	Refer Table II	3	-	-	100	20	30	150	3
6	Computer Science & Engineering	R-Programming Lab	LC	**CS111791**	-	-	2	25	-	25	50	1
7	Computer Science & Engineering	HQL Lab(Data Warehousing & Mining Lab)	LC	**CS111792**	-	-	2	25	-	25	50	1
8	Computer Science & Engineering	Capstone Project Phase I	Proj	**CS102793**	-	-	4	50	-	50	100	2
9	Computer Science & Engineering	Internship assessment/Industrial training (Report and Seminar)	MC	**CS100794**	-	-	2	-	-	25	25	1
10	Computer Science & Engineering	Universal Human Values and Professional Ethics	NC	**CS100795**	-	-	-	-	-	25	25	-
Total					**13**	**2**	**10**	**600**	**100**	**300**	**1000**	**20**

L : Lecture, T: Tutorial, P : Practical, ESE : End Semester Exam CT : Class test TA: Teacher's assessment

PCC :Program Core Courses, PEC: Professional Elective Courses, OEC : Open Elective Courses, LC : Laboratory Courses PROJ : Project WorkMC: Mandatory Courses, NC : Non Credit

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Table-I: Professional Elective – III [7th Sem]

Sl. No.	Board of Studies (BOS)	Courses (Subject)	Course Code
1	Computer Science and Engg.	Internet and Web Technology	CS102721
2	Computer Science and Engg.	Natural Language Processing	CS110722
3	Computer Science and Engg.	Object Oriented Database Management System	CS111723
4	Computer Science and Engg.	Industrial IOT	CS115724
5	Computer Science and Engg.	AI in Gaming	CS114725

Table-II: Open Elective – II [7th Sem]

Sl. No.	Board of Studies (BOS)	Courses (Subject)	Course Code
1	Computer Science and Engg.	Advance Statistical Methods	CS100741
2	Computer Science and Engg.	Enterprise Resource Planning	CS100742

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Subject Code CS102701	Cryptography & Network Security	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.** To understand the principles and practices of cryptography and network security **2.** To understand the practical applications that have been implemented and are in use to provide network Security	**Students will be able to:** **CO1** Understand the Conventional encryption algorithms for confidentiality and their design principles **CO2** Understand the Public key encryption algorithms and their design principles **CO3** Understand the Use of message authentication codes, hash functions, digital signature and public key certificates **CO4** Understand the Network security tools and applications **CO5** Understand the System-level security issues like threat of and countermeasures for intruders and viruses, and the use of firewalls and trusted systems.

UNIT 1 Overview: Security trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. **Symmetric (Private Key) Ciphers:Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. **Block Ciphers and the Data Encryption Standard:** Block Cipher Principles, The Data Encryption Standard (DES), The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles.	**CO1** **7 Hrs**
UNIT 2Symmetric Ciphers (continued): **Basic Concepts in Number Theory and Finite Fields:** Groups, Rings, and Fields, Modular Arithmetic, the Euclidian algorithm, Finite Fields of the Form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2n). **Advanced Encryption Standard:** The Origins AES, Evaluation criteria for AES, the AES Cipher. **Stream cipher:** Stream ciphers and RC4. **Confidentiality using symmetric encryption:** Placement of encryption function, traffic confidentiality, key distribution.	**CO2** **8 Hrs**
UNIT 3 Asymmetric (Public Key) Ciphers: Introduction to Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms. **Public-Key Cryptography and RSA:** Principles of Public-Key Cryptosystems. **Key Management-Other Public-Key Cryptosystems:** Key management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	**CO3** **7Hrs**

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UNIT 4 Asymmetric Ciphers (continued): Message Authentication and Hash functions: Message authentication requirements, authentication functions, Message authentication codes, Hash functions, Security of Hash functions and MAC, SHA, HMAC, CMAC. **Digital Signatures and Authentication protocols**: Digital signature, Authentication protocols, Digital signature standards.	**CO4** **7 Hrs**
UNIT 5 Network Security applications: Authentication applications: Kerberos, X.509 Authentication services, public key infrastructure. **Electronic mail security**: PGP, S/MIME. Overview of IP Security. **Web Security**: Web security considerations, SSL and TLS, Secure electronic transaction. **System Security:** Intruders, Intrusion detection, password management, viruses and related threats, virus counter measures, Firewall design principles, and trusted systems.	**CO5** **7Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Cryptography and Network Security, Principles and Practices	William Stallings	Pearson Education,Prentice Hall, 4th Edition.
2	Cryptography and Network Security	AtulKahate	McGraw Hill Education (India) Private Limited; Thirdedition.

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Applied Cryptography: Protocols & Algorithms	Schneier& Bruce,	MGH International
2	Cryptography and Security	Dr T R Padmanabhan N Harini	Wiley India Pvt Ltd, 2011

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Subject Code CS111702	Data Analytics Using R Programming	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.** Learn Fundamentals of R. **2.** Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions. **3.** Cover the Basics of statistical data analysis with examples. **4.** The whole syllabus will give an idea to collect, compile and visualize data using statistical functions.	**Students will be able to:** **CO1** Understand the basics of Fundamentals of R. **CO2** Understands the loading, retrieval techniques of data. **CO3** Understand how data is analyzed and visualized using statistic functions. **CO4** Understand the R – programming functions and data frames for data analysis. **CO5** Understand the descriptive statistics methods.

UNIT 1 Introduction to R: What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and –inf.	**CO1** **7 Hrs**
UNIT 2 R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - R Decision Making: if statement, if – else statement, if – else if statement, switch statement – R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.	**CO2** **7 Hrs**
UNIT 3 R-Function: function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - R Vectors – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - R List - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array	**CO3** **8Hrs**

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Elements - R Factors –creating factors, generating factor levels gl().	
UNIT 4 Data Frames: Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – R -Excel File – Reading the Excel file.	**CO4** **7Hrs**
UNIT 5 Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode - Standard Deviation – Correlation - Spotting Problems in Data with Visualization: visually Checking Distributions for a single Variable - R –Pie Charts: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – R Histograms – Density Plot - R – Bar Charts: Bar Chart Labels, Title and Colors.	**CO5** **7Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	R Programming for Beginners	SandipRakshit	McGraw Hill Education (India), 2017, ISBN : 978-93-5260-455-5.
2	Data Analytics using R	SeemaAcharya,	McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.

Reference Books:

S. No.	Title	Author(s)	Publisher
1	R for Data Science	Hadley Wickham and Garrett Grolemund	O'Reilly Media, Inc. 2016, ISBN : 9781491910344
2	Beginner's Guide for Data Analysis using R Programming	Dr. Jeeva Jose	Khanna Book Publishing, 2018, ISBN : 978-9386173454
3	R for Dummies A Wiley Brand, 2nd Edition	Andrie de Vries, JorisMeys,	John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8
4	R Programming	Tutorials Point (I)	Retrieved simply easy learning, Online Tutorial Library (2018) from https://www.tutorialspoint.com/r/r_tutorial.pdf

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SYLLABUS

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Subject Code CS111703	Data Warehousing and Data Mining	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. To understand the basics of data warehousing and its components. 2. To introduce the concept of data mining and its functionalities.. 3. To learn about association analysis and its techniques. 4. To explore classification and prediction techniques in data mining. 5. To understand the concept of clustering and its methods.	Students will be able to: **CO1:** Gain knowledge of the data warehousing concept, its schemas (data warehouse architecture, and back-end tools and utilities. **CO2:** Understand the definition and purpose of data mining, types of databases, and data preprocessing techniques **CO3:** Understand the problem definition of association analysis, frequent item set generation and evaluation of association patterns. **CO4:** Students will gain the ability to apply classification techniques, evaluate classifier accuracy, and make informed predictions based on data patterns. **CO5:**Students will acquire the skills to utilize various clustering methods and employ data mining techniques to analyze complex types of data.

UNIT 1: Introduction to Data warehouse, Differences between OLAP and OLTP, A Multi-dimensional data model- Star, Snow flake and Fact constellation schemas, Measures, Concept hierarchy, OLAP Operations in the Multidimensional Data Model, Data warehouse architecture- A three tier Data warehouse architecture, Data warehouse Back-End Tools and Utilities, Metadata Repository, types of OLAP servers, Data warehouse Implementation, Data Warehouse models- Enterprise warehouse, Data warehouse implementation.	**CO 1** **8 Hrs**
UNIT 2: Data mining: Introduction, what is Data Mining, Definition, Knowledge Discovery in Data (KDD), Kinds of data bases, Data mining functionalities, Classification of data mining systems, Data mining task primitives, Data Preprocessing: Data cleaning, Data integration and transformation, Data reduction, Data discretization and Concept hierarchy.	**CO 2** **7 Hrs**

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UNIT 3: Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm, Evaluation of Association Patterns.	**CO 3** **7 Hrs**
UNIT 4: Classification and PredictionIssues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.	**CO4** **7 Hrs**
UNIT 5: Clustering: Types of data, categorization of major clustering methods, K-means partitioning methods, hierarchical methods, density based methods, grid based methods, model based clustering methods, outlier analysis. Mining Complex Types of Data: Multi-dimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.	**CO 5** **7 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Data warehousing Data mining and OLAP	Alex Berson, Stephen J.Smith,	Tata McGraw
2	Data Mining-Concepts and techniques	Jiawei Han, Michelin Kamber	Elsevier, 2nd Edition,

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Data Mining Techniques	Arum K Pujari,	3rd Edition, Universities Press
2	Data Warehousing Fundamentals	PualrajPonnaiah, Wiley	Student Edition

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Subject Code CS100741	Advanced Statistical Method	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.** Ability to summarize and present data numerically and visually. **2.** Knowledge of which statistical methods to use in which situations **3.** Ability to think critically about data-based claims and quantitative arguments **4.** Ability to learn new statistical analysis techniques on your own	**Students will be able to:** **CO1** Apply statistical methods and hypothesis testing to business problems **CO2** Learn the details and complexities of Analysis of Variance (ANOVA) **CO3** Learn some of the details and complexities of Multiple Regression (MR)

UNIT 1 Sampling Techniques: Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement). Sampling distribution of sample mean, stratified random sampling.	**CO 1** **7Hrs**
UNIT 2 Linear Statistical Models: Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Multiple regression& multiple correlation. Analysis of variance (one way, two ways with as well as without interaction).	**CO 2** **7 Hrs**
UNIT 3 Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation. **Sufficient Statistic:** Concept & examples, complete sufficiency, their application in estimation. **Test of hypothesis:** Concept & formulation. Type 1 and Type II errors, Neyman Pearson lemma, Procedures of testing.	**CO3** **8Hrs**
UNIT 4 Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test. Kolmogorov-Smirnov test. Spearman s and Kendall's test Tolerance region**.**	**CO 4** **7Hrs**
UNIT 5 Basics of Time Series Analysis & Forecasting: Stationary. ARIMA Models: Identification, Estimation and Forecasting.	**CO 5** **7Hrs**

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Text Books:

S. No.	Title	Author(s)	Publisher
1	Probability and Statistics for Engineers (Fourth Edition)	LR. Miller, J.E. Freund and R.Johnson	Prentice Hall India Learning PrivateLimited
2	Fundamentals of Statistics (vol. 1 & vol. II)	A. Goon. M. Gupta and B. Dasgupta.	World Press

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Discovering Statistics Using R.	Field, A., Miles, J., & Field, Z. (2012).	Thousand Oaks, CA: Sage

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Subject Code CS100723	Object oriented DBMS (OODBMS)	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.**This course discusses the requirements for advanced database features in database applications. **1.** Introduce Parallel and Distributed databases. **2.** Understand the enhanced data models for advanced applications. **4.** Examines the concepts of various emerging database technologies.	**Students will be able to:** **CO1**.Able to understand the needs and concepts of object-oriented database, spatial database, web database, data warehousing and data mining. **CO2**.Able to analyze, design and evaluate the construct of various advanced databases such as object-oriented, object-relational, semi-structured, unstructured and distributed databases. **CO3**.Be able to implement practical solutions to GIS database problems using OO/OR database, spatial database, data warehousing and data mining approaches. **CO4.** Be able to understand the architecture and design of client server,parallel and distributed database. **CO5.** Be able to understand the concept of web and structured data like XML.

UNIT 1: : The extended Entity- Relationship Model and Object model: The ER model revisited, Motivation for complex data types, User defined abstract data types and structured types, Subclasses, Super classes, Inheritance, Specialization and Generalization, Constraints and characteristics of specialization and Generalization, Relationship types of degree higher than two.	**CO 1** **7 Hrs**
UNIT 2: Object oriented databases: Overview of Object-Oriented concepts, Object identity, Object structure, and type constructors, Encapsulation of operations, Methods, and Persistence, Type hierarchies and Inheritance, Type extents and queries, Complex objects; Database schema design for OODBMS;	**CO 2** **8Hrs**

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OQL, Persistent programming languages; OODBMS architecture and storage issues; Transactions and Concurrency control, Example of ODBMS.	
UNIT 3: Object relational and extended relational databases: Database design for an ORDBMS - Nested relations and collections; Storage and access methods, Query processing and Optimization; An overview of SQL3, Implementation issues for extended type; Systems comparison of RDBMS, OODBMS, ORDBMS	**CO 3** **7 Hrs**
UNIT 4: Parallel and distributed database and Client server architecture: Architectures for parallel databases, Parallel query evaluation; Parallelizing individual operations, Sorting, Joins; Distributed database concepts, Data fragmentation, Replication, and allocation techniques for distributed database design; Query processing in distributed databases; Concurrency control and Recovery in distributed databases. An overview of Client-Server architecture.	**CO 4** **7 Hrs**
UNIT 5: Databases on the web and semi structured data: Web interfaces to the Web, Overview of XML; Structure of XML data, Document schema, Querying XML data; Storage of XML data, XML applications; The semi structured data model, Implementation issues, Indexes for text data. Enhanced Data Models for Advanced Applications: Active database concepts. Temporal database concepts. Spatial databases, Concepts and architecture; Deductive databases and Query processing; Mobile databases, Geographic information systems.	**CO 5** **7Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Object Oriented Interfaces and Databases	Rajesh Narang	Prentice Hall of India
2	Database Management Systems, Raghu Ramakrishnan	Johannes Gehrke	McGraw-Hil

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education
2	Database System Concepts	Korth, Silberchatz, Sudarshan	McGraw-Hill

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Subject Code CS111791	R- Programming Lab	L=0	T=0	P = 2	Credits = 1
Evaluation Scheme	ESE		TA	Total	ESE Duration
	25		25	50	3 Hours

Course Objectives	Course Outcomes
Course Objectives: • Demonstrate use of basic functions • Create their own customized functions • Construct tables and figures for descriptive statistics • Learn to understand new data sets and functions by yourself • Work on built-in real-time cases for analysis and visualization	Students will be able to: **CO1:** Enable to build programming logic and thereby developing skills in programming **CO2:** Clear understanding on how to organize data analyse data using real time example. **CO3:** Understanding the I/O interface programming **CO4:** Study and Analyzes Data Visualizations. **CO5:** Implement any application-level simulation using R.

List of Experiments12 Hours

1. Write a program to check whether a year(integer)entered by the user is a leap year or not?
2. Write an R program to find the sum of natural without formula using the if-else statement and while loop.
3. Write a program that prints the grades of the students according to the marks obtained. The grading of the marks should be as follows. Marks Grades 800-1000 A+, 700 – 800 A, 500 – 700 B+, 400-500 B, 150 – 400 C, Less than 150 D.
4. Write an R program to make a simple calculator that can add, subtract, multiply and divide using switch cases and functions.
5. Write a program to perform searching within a list (1 to 50). If the number is found in the list, print that the search is successful otherwise print that the number is not in the list. Program:
6. Create a list and data frame that stores the marks of any three subjects for 10 students. Find out the total marks, average, maximum marks and minimum marks of every subject.
7. Write the steps to import data from Excel to CSV files and apply data viewer functions like rm(),dim(),head(), tail(), sorting, filtering, searching to view few set of rows.
8. Write a program to create two 3 X 3 matrices A and B and perform the following operations:

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a. Transpose of the matrix.
b. Addition.
c. Subtraction

9. Write an R program to create a list containing strings, numbers, vectors and logical values and dothe following manipulations over the list:
    a. Access the first element in the list
    b. Give the names to the elements in the list
    c. Add element at some position in the list
    d. Remove the element
    e. Print the fourth element
    f. Update the third element
10. Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Create a histogram by suing appropriate arguments for the following statements:
    a. Assigning names, using the air quality data set
    b. Change colours of the Histogram
    c. Remove Axis and Add Labels to Histogram
    d. Change Axis limits of a Histogram
    e. Create a Histogram with density and Add Density curve to the Histogram
11. Design a data frame in R for storing about 20 employee details. Create a CSV file named“input.csv” that defines all the required information about the employee such as id, name, salary,start_date, dept. Import into R and do the following analysis.
    a. Find the total number rows & columns
    b. Find the maximum salary
    c. Retrieve the details of the employee with maximum salary
    d. Retrieve all the employees working in the IT Department
    e. Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”.
12. Create a dataset or table [‘Smart Phone”] in an excel sheet that stores the mobile information [price, company name, model, Sale Percent] of five different companies. Store at least 20 rows. Write the scripts and find out the output for the following information.
    a. Maximum price of the mobile of each company
    b. Minimum price of mobile of each company
    c. Average price of mobile of each company
    d. Total Price of mobile of each company

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Subject Code CS111792	Data Warehousing & Mining Lab	L=0	T=0	P = 2	Credits = 1
Evaluation Scheme	ESE		TA	Total	ESE Duration
	25		25	50	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **3.** Data mining is primarily used by the companies with a strong consumer focus. It enables these companies to determine the factors such as price, product positioning, or staff skills, and economic indicators, competition, and customer demographics	Students will be able to: CO1 Provide efficient distribution of information and easy access to data CO2 Create user friendly reporting environment. CO3 Find the unseen pattern in large volume of historical data that helps to manage an organization efficiently. CO4 Understand the concepts of various data mining Techniques. CO5 Understand the concepts of Preprocessing.

List of Experiments12 Hours

1. Exploring Weka mining tool.
2.To study the file formats for the data mining.
3. Demonstration of preprocessing on dataset.
4. To convert ARFF (Attribute-Relation File Format) into text file and vice Versa.
5. To apply the concept of Linear Regression for training the given dataset.
6. Demonstration of Association rule process on dataset using apriorialgorithm.
7. Demonstration of classification rule process on dataset using j48 algorithm.
8. Demonstration of classification rule process on dataset using id3 algorithm.
9. Demonstration of classification rule process on dataset using naïve bayesalgorithm.
10.Demonstration of clustering rule process on dataset using simple k-means algorithm.

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Subject Code CS102793	Capstone Project Phase I	L=0	T=0	P = 4	Credits = 2
Evaluation Scheme	ESE		TA	Total	ESE Duration
	50		50	100	3 Hours

Guideline for Allocation of project24 Hours

1. Information regarding broad area must be made available to the students well in advance (may be during previoussemester).
2. Information must cover following parameters. I. Broad area: Subject or expertise/application area. II. Required skills: Knowledge of subject(s), software, tools & other characteristics. III. Type of project: Hardware, software, design, survey, study based etc. IV. Guide available: Name of Guide (S) from Department & Institute. V. Other related information depending upon specific branch & institute.
3. It is also recommended to give proper counseling to pick up suitable project.
4. Students must get chance to select projects as per their choice or decided mutually between students anddepartment faculty (HoD) concern.
5. One project group must contain maximum four students, however students can do project individually but it shouldbe approved by department.
6. Compiled list of projects must be submitted to the University within 25 days of start of semester.
7. Compiled list may contain following parameters.

Monitoring of project:

1. It is recommended to give projects as per the specializations of existing faculty of the department instead of outsideperson/agency.
2. Project must be allocated, developed and monitored by department / institution itself, but not by outside agencies.
3. Regular review by guide is recommended to ensure development & contribution of students. Internal

Evaluation & Submission of project:

1. Evaluation of project would be as per the examination scheme of the University, which is based on internal as well as external evaluation.
2. Internal assessment requires submission of project report for getting approved by the concern authority. However printing and binding would be as per the conventional format.
3. Evaluation will be based on live demonstration / presentation and Viva.
4. Final submission of project is expected as, Submission of a copy to the University,• One copy to the Institution central library,• One copy to the department.•

External Evaluation:

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External assessment of project would be like conduction of practical exams of University, and must be executed asper the norms of practical exams.
NOTE: Completion of Project outside the department/Institution should not be encouraged

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Professional Elective-III

Subject Code CS102701	Internet and Web Technology	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
1. Describe the important features of the Web and Web browser software 2. Evaluate e-mail software and Web-based e-mail services 3. Use FTP and other services to transfer and store data 4. Demonstrate the use of real-time chat and briefly describe the history of the wireless Internet 5. Create HTML documents and enhance them with browser extensions	**Students will be able to:** **CO1** Understand, analyze and apply the role of languages like HTML, DHTML, CSS, XML, Javascript, and web applications **CO2** Analyze a web page and identify its elements and attributes. **CO3** Create XML documents and XML Schema. **CO4** Learn about various security issues. **CO5** Will be able to plan and host websites.

UNIT-I INTRODUCTION TO INTERNET: Introduction, Evolution of Internet, Internet Applications, Internet Protocol -TCP/IP, UDP, HTTP, Secure Http(Shttp) Internet Addressing – Addressing Scheme – Ipv4 & IPv6, Network Byte Order, Domain Name Server and IP Addresses, Mapping . Internet Service Providers, Types Of Connectivity Such As Dial-Up Leaded Vsat Etc. Web Technologies: ThreeTier Web Based Architecture; Jsp, Asp, J2ee, .Net Systems	**CO1** **8Hrs**
UNIT-II HTML CSS AND SCRIPTING: HTML - Introduction, Sgml, Dtd(Document Type Definition, Basic Html Elements, Tags and usages, HTML Standards , Issues in HTML Dhtml: Introduction Cascading Style Sheets: Syntax ,Class Selector, Id Selector Dom (Document	**CO2**

ObjectModel) &DSO (Data Source Object) Approaches To Dynamic Pages: Cgi, Java Applets, Plug Ins, Active X, Java Script –Java Script Object Model, Variables-Constant – Expressions, ConditionsRelational Operators- Data Types – FlowControl – Functions & Objects-events and event handlers – Data type Conversion & Equality – Accessing HTML form elements	**8Hrs**
UNIT-III XML: What is XML – Basic Standards, Schema Standards, Linking & Presentation Standards, Standards thatbuild on XML, Generating XML data, Writing a simple XML File, Creating a Document type definition, Documents&Data ,DefiningAttributes & Entities in the DTD ,Defining Parameter Entities & conditional Sections, Resolving a namingconflict, UsingNamespaces, Designing an XML data structure, Normalizing Data, NormalizingDTDS	**CO3** **8 Hrs**
UNIT-IV INTERNET SECURITY & FIREWALLS: Security Threats From Mobile Codes, Types Of Viruses, ClientServer Security Threats, Data & Message Security, Various electronic payment systems, Introduction to EDI, Challenges–Response System, Encrypted Documents And Emails,Firewalls: Hardened Firewall Hosts, Ip- Packet Screening, ProxyApplication Gateways, Aaa (Authentication, AuthorizationAnd Accounting).	**CO4** **8Hrs**
UNIT-V WEBSITE PLANNING & HOSTING: Introduction, Web Page Lay-Outing, Where To Host Site, MaintenanceOf Site, Registration Of Site On Search Engines And Indexes, Introduction To File Transfer Protocol, Public DomainSoftware, Types Of Ftp Servers (Including Anonymous),Ftp Clients Common Command. Telnet Protocol, Server Domain,Telnet Client, Terminal Emulation. Usenet And Internet Relay Chat.	**CO5** **8 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Internet & Intranet Engineering	Daniel Minoli	TMH
2	Internet for Every One	Alexis Leon and Mathews Leon	Tech World

Reference Books:

S. No.	Title	Author(s)	Publisher

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1	Using HTML 4, XML and JAVA	Eric Ladd, Jim O'Donnel	Prentice Hall of India -1999
2	Beginning Java Script	Paul Wilton	SPD Publications
3	Frontiers of Electronics of Commerce	Ravi kalakota& Andrew B. Whinston	Addison Wesley

Subject Code CS110722	Natural Language Processing	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**30**	**150**	**3 Hours**

Course Objectives	Course Outcomes
The objective of the course to: **1.** To understand the concepts of morphology, syntax, semantics and pragmatics of the language. **2.** To recognize the significance of pragmatics for natural language understanding. **3.** To describe the simple system based on logic and demonstrate the difference between the semantic presentation and interpretation of that presentation. **4.** To describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.	**Students will be able to:** **CO1** Understand language and the tools that are available to efficiently study and analyze large collections of text. **CO2** Analyze and discuss the effects of electronic communication on our language. **CO3** Learn natural language processing with manual and automated approaches. **CO4** Learn computational frameworks for natural language processing.

UNIT 1 Introduction:A computational framework for natural language, description of English or an Indian language inthe frame work, lexicon, algorithms and data structures for implementation of the framework, Finitestate automata, the different analysis levels used for NLP (morphological, syntactic, semantic,pragmatic, Recursive and augmented transition networks. Applications like machine translations.	**CO1** **7 Hrs**
UNIT 2 WordLevel& Syntactic Analysis:Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and correction, Words and	**CO2** **8 Hrs**

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Word classes, Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar, Constituency, Parsing-Probabilistic Parsing. Machine readable dictionaries and lexical databases, RTN, ATN.	
UNIT 3 SemanticAnalysis:Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. Discourse Processing: cohesion, Reference Resolution, Discourse Coherence and Structure. Knowledge Representation, reasoning.	**CO3 7 Hrs**
UNIT 4 Natural Language Generation:Natural Language Generation (NLG): Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG. Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Translation involving Indian Languages.	**CO4 7 Hrs**
UNIT 5 Information Retrieval & Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems, Classical, Non-classical, Alternative Models of Information Retrieval, valuation Lexical Resources: World Net, Frame Net, Stemmers, POS Tagger.	**CO5 7 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Natural Language Understanding	James Allen	Pearson Education, 2002
2	NLP: A Paninian Perspective	AksharBharati, VineetChaitanya, and Rajeev Sangal	Prentice Hall, 2016
3	Meaning and Grammar	G. Chirchia and S. McConnell Ginet	MIT Press, 1990

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Reference Books:

S. No.	Title	Author(s)	Publisher
1	An Introduction to NLP, CL&SR	Daniel Jurafsky and James H. Martin	Pearson Education, 2006.
2	Natural language processing in Prolog	Gazdar, &Mellish	Addison-Wesley

Alternative NPTEL/SWAYAM Course (if any):

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Natural Language Processing	Prof. PawanGoyal	IIT Kharagpur
2	Natural Language Processing	Prof. Pushpak Bhattacharya	IIT Bombay

Web Reference:https://www.coursera.org/specializations/natural-language-processing

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Subject Code CS111723	Object Oriented DBMS (OODBMS)	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. This course discusses the requirements for advanced database features in database applications. 2. Introduce Parallel and Distributed databases. 3. Understand the enhanced data models for advanced applications. 4. Examines the concepts of various emerging database technologies.	**Students will be able to:** **CO1**.Able to understand the needs and concepts of object-oriented database, spatial database, web database, data warehousing and data mining. **CO2**.Able to analyze, design and evaluate the construct of various advanced databases such as object-oriented, object-relational, semi-structured, unstructured and distributed databases. **CO3**.Be able to implement practical solutions to GIS database problems using OO/OR database, spatial database, data warehousing and data mining approaches. **CO4.** Be able to understand the architecture and design of client server, parallel and distributed database. **CO5.** Be able to understand the concept of web and structured data like XML.

UNIT 1: : The extended Entity- Relationship Model and Object model: The ER model revisited, Motivation for complex data types, User defined abstract data types and structured types, Subclasses, Super classes, Inheritance, Specialization and Generalization, Constraints and characteristics of specialization and Generalization, Relationship types of degree higher than two.	**CO 1** **7Hrs**

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UNIT 2: Object oriented databases: Overview of Object-Oriented concepts, Object identity, Object structure, and type constructors, Encapsulation of operations, Methods, and Persistence, Type hierarchies and Inheritance, Type extents and queries, Complex objects; Database schema design for OODBMS; OQL, Persistent programming languages; OODBMS architecture and storage issues; Transactions and Concurrency control, Example of ODBMS.	**CO 2** **8 Hrs**
UNIT 3: Object relational and extended relational databases: Database design for an ORDBMS - Nested relations and collections; Storage and access methods, Query processing and Optimization; An overview of SQL3, Implementation issues for extended type; Systems comparison of RDBMS, OODBMS, ORDBMS	**CO 3** **7 Hrs**
UNIT 4: Parallel and distributed database and Client server architecture: Architectures for parallel databases, Parallel query evaluation; Parallelizing individual operations, Sorting, Joins; Distributed database concepts, Data fragmentation, Replication, and allocation techniques for distributed database design; Query processing in distributed databases; Concurrency control and Recovery in distributed databases. An overview of Client-Server architecture.	**CO 4** **7 Hrs**
UNIT 5: Databases on the web and semi structured data: Web interfaces to the Web, Overview of XML; Structure of XML data, Document schema, Querying XML data; Storage of XML data, XML applications; The semi structured data model, Implementation issues, Indexes for text data. Enhanced Data Models for Advanced Applications: Active database concepts. Temporal database concepts. Spatial databases, Concepts and architecture; Deductive databases and Query processing; Mobile databases, Geographic information systems.	**CO 5** **7 Hrs**

Text Books:

S.No.	Title	Author(s)	Publisher
1	Object Oriented Interfaces and Databases	Rajesh Narang	Prentice Hall of India
2	Database Management Systems, Raghu Ramakrishnan	Johannes Gehrke	McGraw-Hil

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Reference Books:

S.No.	Title	Author(s)	Publisher
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education
2	Database System Concepts	Korth, Silberchatz, Sudarshan	McGraw-Hill

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Subject Code CS114724	AI in Gaming	L = 3	T = 0	P = 0	Credits = 3
Examination Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The students should be able to understand and use AI techniques for generating efficient, intelligent behaviour in games. Additional attention is to be given to AI algorithms for improving game play experience.	**After completion of course, students would be able to:** **CO1** Understand identify tasks that can be tackled using AI techniques. **CO2** Apply appropriate AI technique for the problem under investigation. **CO3** Create efficient and robust AI algorithms for game tasks. **CO4** Apply learning mechanisms to gaming problems. **CO5** Apply AI algorithms for improving game play experience.

Unit 1: Introduction

Introduction to Game AI, kind of AI used in game development, model of game AI, AI engine structure.

Unit 2: Movement Algorithms and Steering Behavior

kinematic movement algorithms, problems related to the steering behaviour of objects and Solutions. Coordinated Movement and Motor Control This unit discusses the concepts related to coordinated movements and motor control.

Unit 3: Pathfinding

Basic Path finding Algorithms in game development, Path finding for complex solutions

Unit 4:

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Decision-Making and Uncertainty decision trees and state machines for game development, models for implementing knowledge uncertainty, such as fuzzy logic and Markov systems.

Unit 5:

Introduction to Learning Mechanisms Board game theory and discusses the implementation of some key algorithms, such as minimax and negamax, Random Number Generation and Minimaxing, algorithms for implementing action prediction, decision learning and reinforcement learning.

Text Books:

S.No.	Title	Author(s)	Publisher
1	Artificial Intelligence and Games,	Georgios N. Yannakakis and Julian Togelius,	Springer International Publishing, 2018.
2	Artificial Intelligence for Games,	Ian Millington and John Funge,	CRC Press; 2nd edition, 2009.

Reference Books:

S. No.	Title	Author(s)	Publisher
1	https://www.athabascau.ca/syllabi/comp/comp452.php		
2	https://www.udemy.com/course/artificial-intelligence-for-simple-games/		

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Subject Code CS115725	Industrial IOT	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application. 2. Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students	**Students will be able to:** **CO1**Analyze and discuss the effects of electronic communication on our language. **CO2** Ability to identify, formulate and solve engineering problems by using Industrial IoT. **CO3**Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability. **CO4**Analyze and discuss next generation sensors and AR,VR concepts. **CO5** Understand industrial applications and analyse the case studies of IIOT.

UNIT 1: Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factorie	**CO 1** **7 Hrs**
UNIT 2: Implementation systems for IIoT: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.	**CO2** **8 Hrs**
UNIT 3:IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's	**CO3**

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Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology	**7 Hrs**
UNIT 4: Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis	**CO4** **7 Hrs**
UNIT 5: Industrial IoT- Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management **Case Studies of IIoT Systems:** IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board	**CO5** **7 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Publications: Apress
2	The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics	Bartodziej, Christoph Jan Springer	Publication in the field of economic science.

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Reference Books:

S. No.	Title	Author(s)	Publisher
1	Embedded System: Architecture, Programming and Design	Rajkamal	TMH3
2	Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Dr.OvidiuVermesan, Dr. Peter Friess	River Publishers

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Open Elective-II

Subject Code CS100741	Advanced Statistical Method	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**30**	**150**	**3 Hours**

Course Objectives	Course Outcomes
The objective of the course to: **5.** Ability to summarize and present data numerically and visually. **6.** Knowledge of which statistical methods to use in which situations **7.** Ability to think critically about data-based claims and quantitative arguments **8.** Ability to learn new statistical analysis techniques on your own	**Students will be able to:** **CO4** Apply statistical methods and hypothesis testing to business problems **CO5** Learn the details and complexities of Analysis of Variance (ANOVA) **CO6** Learn some of the details and complexities of Multiple Regression (MR) **CO7** Communicate statistical ideas to a diverse audience. **CO8** Formulate a statistical solution to real-data research problems

UNIT 1 Sampling Techniques: Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement). Sampling distribution of sample mean, stratified random sampling.	**CO1** **7 Hrs**
UNIT 2 Linear Statistical Models: Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Multiple regression& multiple correlation. Analysis of variance (one way, two ways with as well as without interaction).	**CO2** **7 Hrs**
UNIT 3 Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.	**CO3** **8 Hrs**

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Sufficient Statistic: Concept & examples, complete sufficiency, their application in estimation. **Test of hypothesis:** Concept & formulation. Type 1 and Type II errors, Neyman Pearson lemma, Procedures of testing.	
UNIT 4 Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test. Kolmogorov-Smirnov test. Spearmans and Kendall's test Tolerance region**.**	**CO4** **7 Hrs**
UNIT 5 Basics of Time Series Analysis & Forecasting: Stationary. ARIMA Models: Identification, Estimation and Forecasting.	**CO5** **7 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Probability and Statistics for Engineers (Fourth Edition)	LR. Miller, J.E. Freund and R.Johnson	Prentice Hall India Learning PrivateLimited
2	Fundamentals of Statistics (vol. 1 & vol. II)	A. Goon. M. Gupta and B. Dasgupta.	World Press

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Discovering Statistics Using R.	Field, A., Miles, J., & Field, Z. (2012).	Thousand Oaks, CA: Sage

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Subject Code CS100742	Enterprise Resource Planning	L = 3	T = 0	P = 0	Credits = 3
Examination Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours
	Minimum number of class tests to be conducted=02			Minimum Assignments=02	

Course Objectives	Course Outcomes
• To know the basics of ERP and business modules of ERP. • To understand the key implementation issues of ERP. • To be aware of some popular products in the area of ERP. • To appreciate the current and future trends in ERP	**CO1** To know the basics of ERP **CO2** To understand the key implementation issues of ERP **CO3** To know the business modules of ERP **CO4** To be aware of some popular products in the area of ERP **CO5** To appreciate the current and future trends in ERP

Unit-I Introduction: Overview of enterprise systems ñ Evolution - Risks and benefits – Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems. Introduction to SAP

Unit- II ERP Solutions and Functional Modules: Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR and best business practices - Business process Management, Functional modules.

Unit-III ERP Implementation: Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training ñ Data Migration – People Organization in implementation-Consultants, Vendors and Employees.

Unit-IV Post Implementation: Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation. Emerging Trends on ERP: Extended ERP systems and ERP add-ons -CRM,

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SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing.

Unit V ERP and Related Technologies. ERP and Related Technologies. Business Process Reengineering (BPR). Management Information System (MIS). Executive Information System. Decision support System (DSS). Supply Chain Management (SCM) Other Related Technologies of SCM E-Procurement; E-Logistics; Internet Auctions; E-markets; Electronic Business Process Optimization; Business Objects in SCM; E commerce

Text Books:

S. No.	Title	Author(s)	Publisher
1	ERP demystified	Alexis Leon	Tata McGraw-Hill,2008
2	Essentials of Business Process and Information System	Sinha P. Magal and Jeffery Word	Wiley India,2012

Reference Books:

S. No.	Title	Author(s)	Publisher
1	ERP and Supply Chain Management	Christian N. Madu	CHI4
2	Implementing SAP ERP Sales & Distribution	Glynn C. Williams	McGraw-Hill

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