APPENDIX A
Courses of Study and Scheme of Evaluation
M.Sc. (Information Technology)

S. No	Course Code	Title of the paper		T/P	Credits	Hours/ Week	Marks		
		I Semester					**I**	**E**	**Total**
1	546101	Core 1	Mathematics for Computing	T	5	5	25	75	100
2	546102	Core 2	Distributed Operating System	T	5	5	25	75	100
3	546103	Core 3	Web Technology	T	5	5	25	75	100
4	546104	Core 4	Python Programming	T	5	5	25	75	100
5	546105	Core 5	Lab-I : Web Technology and Python Lab	P	3	6	25	75	100
6		**Elective-I**		T	4	4	25	75	100
					27	**30**	**150**	**450**	**600**
		II Semester							
7	546201	Core 6	Database Systems	T	5	5	25	75	100
8	546202	Core 7	Data Mining	T	5	5	25	75	100
9	546203	Core 8	Digital Image Processing	T	4	4	25	75	100
10	546204	Core 9	Lab II: Data Mining Lab	P	2	4	25	75	100
11	546205	Core 10	Lab III: Digital Image Processing Lab	P	2	4	25	75	100
12		**Elective-II**		T	4	4	25	75	100
13		Non-Major Elective-I		T	2	3	25	75	100
14		Library, Yoga & Career Guidance				1			
15	MOOC'S	Self-learning course (SLC)			Extra credit				
					24	**30**	**175**	**525**	**700**
		III Semester							
16	546301	Core 11	Internet of Things	T	5	5	25	75	100
17	546302	Core 12	Big Data Analytics and R Programming	T	5	5	25	75	100
18	546303	Core 13	Machine Learning	T	4	4	25	75	100
19	546304	Core 14	Lab III – Data Analytics Lab	P	2	4	25	75	100
20	546305	Core 15	Lab IV – Machine Learning Lab	P	2	4	25	75	100
21		Elective-III		T	4	4	25	75	100
22		Non-Major Elective-II		T	2	3	25	75	100
23		Library, Yoga & Career Guidance				1			
24		Self-learning course (SLC) –MOOCs**			Extra credit				
					24	**30**	**175**	**525**	**700**
		IV Semester							
23	546999	Core 16	***Dissertation Work or Internship programme		15	30	50	150	200
					15	**30**	**50**	**150**	**200**
			Total		**90** +Extra Credits		**550**	**1650**	**2200**

*DSE – Student Choice and it may be conducted by parallel sections.
SLC- Voluntary basis * Dissertation / internship report –Marks -Vivo-voce (50) + thesis (100) + internal (50) =200
T-Theory P-Practical

ELECTIVE COURSES

	Elective Group I
546501	Object Oriented Software Engineering
546502	Software Project Management
546503	Object Oriented Analysis and Design

	Elective Group II
546504	Virtualization & Cloud Computing
546505	Embedded Systems
546506	Soft Computing

	Elective Group III
546507	Mobile Computing
546508	Mobile Application Development
546509	Wireless Ad hoc and Sensor Networks

Semester - I				
CC		**Core**	**Credits**	**H/W**
Course code:	**546101**	**Mathematics for Computing**	**5**	**5**

Objectives	• To develop problem-solving techniques. • To explore topics in fundamental mathematics required for Information Technology field. • To express statements in the language of formal logic and draw conclusions, model situations in terms of graph and set theory. • To find and interpret recursive definitions for mathematical sequences. • Use combinatorial methods to approach counting problems and find solutions for decision making problems using fundamental statistics and probability.
Unit -I	**Mathematical Logic:** Statements and Notations, Connectives, Well formed formulas – Truth Tables – Tautology - Equivalence Implication -Normal Forms. **Predicate Calculus:** Predicates, Statement Function - Variables – Quantifiers - Free and Bound Variables – The Universe of Discourse, Inference Theory of Predicate Calculus.
Unit-II	**Set Theory:** Basic Concepts and Notations – Ordered Pairs and Cartesian Product – **Set Operations Relations:** Properties of Binary Relations, Equivalence, Transitive Closure, Compatibility and Partial Ordering Relations, Lattices, Hasse Diagram. **Functions:** Composition of Functions, Inverse Function, Hashing Functions, Natural Numbers, Recursive Functions.
Unit-III	**Elementary Combinatorics:** Basics of Counting, Combinations & Permutations, with Repetitions, Constrained Repetitions, Binomial Coefficients, Binomial and Multinomial Theorems, The Principles of Inclusion – Exclusion, Pigeon Hole Principles and Its Application - Mathematical Induction –Recurrence Relations – Particular Solutions – Solution of Recurrence Relations by Using Generating Functions.
Unit-IV	**Probability and Statistics:** Introduction to Statistics – Frequency Distribution – Measures of Central Tendancy – Covariance – Correlation and Linear Regression - Introduction to Probability – Terminologies – Event – Sample Space – Rules of Probability – Conditional Probability – Bayes Theorem – Distributions : Binomial – Poisson – Other Type of Distribution – Multinomial and Hypergeometric Probabilities – Testing of Hypothesis - Sampling Distributions - Estimation of Parameters - Statistical Hypothesis - Large Sample Tests Based on Normal Distribution For Single Mean and Difference of Means -Tests Based on t, Chi-square and F distributions for Mean, Variance And Proportion - Contingency Table (Test For Independent) – Goodness of

	Fit.
Unit-V	**Graphs:** Basic Concepts – Representation of Graphs - Isomorphism and Sub graphs, Trees and Their Properties, Spanning – Trees - Directed Trees - Binary Trees - Planar Graphs -Multi Graphs and Euler Circuits -Hamiltonian Graphs, Chromatic Numbers.

Reference and Textbooks:

- Trembley, J. P., Manohar, R. (2008). *Discrete Mathematics with Applications to Computer Science.* TMH.
- Mott, J.L., Kandel A., Baker T.P. (2008) *Discrete Mathematics for Computer Scientists and Mathematicians (2nd ed.)* PHI.
- Gupta. S.C, Kapoor. V.K. (2009). *Fundamentals of Mathematical Statistics*. Sultan Chand and Sons.
- Mallik, Sen. *Discrete Mathematical Structures.* Cengage Learning.
- Bernand Kolman., Robert C.Busby, Sharon. *Discrete Mathematical Structures.* Cutler Ross. PHI.
- Rosen, K.H. *Discrete Mathematics and its Applications (6th ed.)*. TMH.
- Chakraborthy, S. K., Sarkar, B. K. (2011). *Discrete Mathematics Oxford.*
- Milton, J. S., Arnold, J.C. (2007). *Introduction to Probability and Statistics (4th ed.).* Tata McGraw Hill.
- Devore. J.L., (2014). *Probability and Statistics for Engineering and the Sciences*‖. Cengage Learning. (*8th ed.*) New Delhi.

Outcomes	• Ability to illustrate by examples the basic terminology of functions, relations, and sets and demonstrate knowledge of their associated operations. • Ability to get a problem solving knowledge for mathematical sequences. • Ability to demonstrate in practical applications the use of basic counting principles of permutations, combinations, inclusion/exclusion principle and the pigeonhole methodology. • Ability to represent and Apply Graph theory in solving Information Technology application problems. • Ability to apply the statistical techniques in solving decision making problems.

CC		Core	Credits	H/W
Course code:	**546102**	**Distributed Operating System**	**5**	**5**

Objectives	• This subject provides students with an in-depth knowledge about the operating system. • This subject covers distributed operating system in detail, including communication process file system and memory management synchronization. • To learn the mechanisms of OS to handle processes and threads and their communication • To illustrate principles and importance of distributed operating system • Implement distributed client server applications using remote method invocation and Distinguish between centralized systems and distributed systems.
Unit -I	**Distributed Systems:** Introduction- Goals Hardware and Software Concepts - Design Issues- **Communication in Distributed Systems: Layered Protocol**: ATM Networks Client Server Model- Remote Procedure Call – Group Communication – Implementation Issues. **Case Studies:** SUN RPC, DEC RPC
Unit-II	**Synchronization:** Clock Synchronization – Mutual Exclusion – Election Algorithm - Atomic Transactions – Dead Lock in Distributed Systems. **Process and Processors:** Threads – System Models - Processor Allocation – **Scheduling in Distributed Systems:** Load Balancing and Sharing Approach, Fault Tolerance, Real Time Distributed Systems, Process Migration and Related Issues.
Unit III	**Distributed File Systems:** Introduction, Features – Goal – **System Design:** File Service Interface – Directory Service Interface – Naming Transparency – Two Level Naming - File Models - File Accessing Models - File Sharing Semantics, File Caching Scheme, File Replication, Fault Tolerance, Trends In Distributed File System. **Case Study:** Distributed File System.
Unit IV	**Distributed Shared Memory (DSM):** Introduction - Architecture - Design And Implementation Issues – Granularity - Structure of Shared Memory Space - Replacement Strategy – Thrashing. Bus Based Multi Processors, Ring Based Multiprocessors, Switched Multiprocessors – Consistency Models – Page Based Distributed Shared Memory – Shared Variable Distributed Shared Memory – Object Based Distributed Shared Memory. **Case Studies:** MACH and CHORUS
Unit V	**Distributed Web-Based Systems :** Architecture, Processes, Communication, Naming, Synchronization, **Consistency and Replication:** Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications **Security:** Introduction of Security in Distributed OS - Overview of Security Techniques, Features, Need, Access Control,

	Security Management. **Case Study:** Java RMI, Sun Network File System, Google.

Reference and Textbooks:

- Andrew S Tannebaum. (2002*). Distributed Operating Systems*. Pearson Education.
- Pradeep K. Sinha. (1997). *Distributed Operating Systems Concepts and Design.* PHI .
- George Coulouris., Jean Dollimore., Tim Kindberg. (2011). *Distributed Systems: Concepts and Design (5th ed.).* Addison Wesley.
- Sunita Mahajan, Seema., Shah. (2013). *Distributed Computing*. OXFORD Press.
- Randy Chow, Theodore Johnson, Distributed Operating systems and Algorithms, 1997

Outcomes	• Knowledge and understanding of potential benefits of Distributed OS. • Apply standard design principles in the construction of these systems. • Analyze the various device and resource management techniques for timesharing and distributed systems. • Distinguish between centralized systems and distributed systems. • Ability to get the knowledge in mechanisms of OS and to handle processes and its communications.

CC		Core	Credits	H/W
Course code:	**546103**	**Web Technology**	**5**	**5**

Objectives	• To comprehend the basics of the internet and web terminologies. • To develop the knowledge & skill in Advanced web Technology. • Enrich knowledge about HTML5 control and XML control classes. • Understand the need of usability, evaluation methods for web services. • To introduce scripting language concepts for developing client-side applications. • To practice server-side programming features like PHP. • To be familiar with database applications • To know the usefulness of web services.
Unit -I	**Introduction to HTML5:** Overview - New Elements - Canvas - Video and Audio - Web Storage – Geolocation - Offline Web Pages - Microdata - HTML5 APIs - Migrating From HTML4 to HTML5 - **Advanced CSS:** Introduction to CSS3 - Selectors - Designing and Implementing CSS3. **Advanced Client Side Programming:** Document Object Model (DOM) - Overview of DOM – Jquery.
Unit-II	**Basics of PHP:** Introduction to PHP – Working of PHP with Web Server-Hardware and Software requirements - Basic PHP Development- PHP scripts –syntax – variables - data types- Operators- Variable and String manipulation.
Unit III	**Control Structures**: The if statement-if else statement, multiple if, nested if - The switch statement. Loops-The while, do while and for statements - Break & continue statements - Nesting loops.
Unit IV	**PHP Arrays:** Single, Multidimensional, Casting and Associative Arrays-Associative arrays - Accessing arrays - Looping through an array - Sorting arrays- Sorting associative arrays. **PHP Functions and File Handling :** Functions-Introduction - Library Function-Array functions-String functions-Date and time functions- User Defined Function-Defining with and without parameters - Returning value from function- Function calls with the static statement- Passing arguments to a function by value and by reference.
Unit V	**Working With the File System:** File Operations - Working with directories - Working With Forms-Forms-Super global variables-The server array-A script to acquire user input-Importing user input -Accessing user input-Combine HTML and PHP code-Using hidden fields -Redirecting the user - File upload and scripts.

Reference and Textbooks:

- Kogent Learning Solutions Inc. (2011). *HTML 5 in Simple Steps.* Dreamtech Press.
- Fritz Schneider, Thomas Powell. (2013). *JavaScript: The Complete Reference(3rd ed.*). Tata McGraw - Hill Education.
- David Sklar, Nathan Torkington. *Learning PHP 5* (2004). O'Reilly.
- Steven Holzner. (2009*). PHP: The Complete Reference (2nd ed.).* Tata McGraw-Hill Publishing Company Limited.
- Ivan Bayross. (2010). *Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML(4th ed.)*. BPB Publication.
- Jason Gilmore, W. (2006). *Beginning PHP and MySQL 5(2nd ed.).* Apress.
- Kevin Yank. (2011). *Build Your Own Database Driven Web Site Using PHP & MySQL (4th ed.).* Sitepoint.
- Ahsanul Bari. (2008). *Cake Php Application Development (1st ed.).* Packet Publishing Ltd.

Outcomes	• Design a web page with Web form fundamentals and web control classes. • Understand client and server-side scripting and their applicability • Analyze a web page and identify its elements and attributes. • Create XML documents and Schemas. • Students will be able to connect a php program to a DBMS and perform insert, update and delete operations on DBMS table.

CC		Core	Credits	H/W
Course code:	**546104**	**Python Programming**	**5**	**5**

Objectives	• To understand the fundamentals of python programming. • Describe the core syntax and semantics of Python programming language. • Discover the need for working with the strings and functions. • Illustrate the process of structuring the data using lists, dictionaries, tuples and sets. • Indicate the use of regular expressions and built-in functions to navigate the file system. • Describe the various operators and control flow statements, analyze various data structures, make use of functions, modules, packages in python. • Object oriented concepts, exception handling, illustrate advanced concepts like multithreading, graphics and generate various test cases.
Unit -I	**Introduction:** History of Python – Basics of Python Programming -Characteristics-Features-Applications of Python-**Variables:** Variable Names, Assigning Multiple Values, Global and Local Variables- Identifiers - Reserved Words - Lines and Indentation-Quotation in Python-Comments- **Built-in Data Types:** Numeric, Sequence, Mapping, Set, Boolean-Binary- Python Keywords-Python Literals-Operators**. Python OOPs:** OOPs Concept- Class and Objects-Constructor-Destructor-**Inheritance:** Types-Abstraction.
Unit-II	**Strings:** Creating a String, Accessing Characters in String, Reversing a String, String Slicing, Deleting/ Updating from a String, Escape Sequencing, Formatting Strings, Inbuilt Python Functions for String, String operators and operations- **Functions:** Basics of a Function, Calling a Function, Pass by Reference Vs Value, Function Arguments, Anonymous Function, The Return Statement, Scope of Variable, Local and Global Variables.
Unit-III	**Lists:** Characteristics of List, Creating a List, List Indexing and Splitting, Updating List Values, List Operations, Adding Elements to the List, Removing Element From The List, Access Elements From List, List Built-in Functions. **Tuples:** Creating a Tuple, Nested Tuples, Accessing of Tuples, Different Tuple Operations: Adding Elements to the Tuple, Deleting Elements from a Tuple, Check for the Element Existing in the Tuple, Length of the Tuple, Concatenation, Selection of Tuple Methods, Slicing of Tuples, Built-in Methods, and Built-in Functions. **Sets:** Creating a Set, Adding Elements to the Set, Accessing a Set, Removing Elements from the Set, and Set Methods. **Dictionaries:** Creating the Dictionary, Accessing the Dictionary Values, Adding Dictionary Values, Deleting Elements Using del Keyword, iterating Dictionary, Properties of Dictionary Keys, Built-in Dictionary Functions and Methods.

Unit-IV	**Conditional Statements:** If Statement, If-Else Statement, Nested If Statement, If-Elif-Else Statement. **Python Loops:** Introduction-**While Loop:** Definition-Break Statement in While Loop, Continue Statement in While Loop, and While Loop with Else- **For Loops**: Definition- Break Statement in For Loop, Continue Statement in For Loop, and The Range of Function, Else in For Loop- Nested Loops. **Control Statements:** Break, Continue and Pass Statements.
Unit-V	**Files and Input / Output:** File Objects, File Built-in Function, File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules. **Errors and Exceptions:** Definition- Exceptions in Python-Exceptions Vs Syntax Errors-Detecting and Handling Exceptions, Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions.

Reference and Textbooks:

- Chun, J Wesley. (2012). *Core Python Programming(3rd ed.).* Pearson.
- Reema Thareja. (2016). *PYTHON Programming Using Problem Solving Approach.* Oxford University Press.
- Ashok Namdev Kamthane, Amit Ashok Kamthane. (2018). *Programming and Problem Solving with PYTHON.* McGraw Hill Education.
- Barry, Paul. (2010). *Head First Python (2nd ed.).* O Rielly.
- Lutz, Mark. *Learning Python (4th ed.).* O Rielly.

Outcomes	• Understand the basics of python programming languages • Illustrate simple programs with control structures • Apply advanced concepts like data structures and make use of functions. • Develop simple applications by using modules, packages and exception handling mechanisms. • Demonstrate projects that make use of libraries and generate test cases for the projects • Understand the object-oriented program design and development. • Understand and begin to implement code

CC		Core	Credits	H/W
Course code:	**546105**	**Web Technology And Python Lab**	**5**	**6**

Objectives	• To develop an ability to design and implement static and dynamic website. • Be familiar with Web page design using HTML5 and style sheets. • Understand, analyze and build web applications using PHP. • To write, test, and debug simple Python programs. • To implement Python programs with conditionals and loops.
S. No.	**Web Technology Lab Exercises**
1.	Write a HTML Program for Login Form using External CSS.
2.	Write a HTML Program to Show Particular Student Mark Statement by using JavaScript Switch Statement
3.	Write a HTML Program to Create a Valediction Form using Javascript.
4.	Write a PHP program to check palindrome number.
5.	Write a PHP program to print Fibonacci series without using recursion and using recursion.
6.	Write a PHP program to reverse given number.
7.	Write a PHP program to swap two numbers with and without using third variable.
8.	Write a PHP program to demonstrate insert update delete operations using mySQL DB,
9.	Write a PHP program to calculate the EB Bill amount as following conditions 0-100 units Free 101-200 Rs 3/Unit 201-300 Rs 5/Unit 301-500 Rs 10/Unit 501 and above Rs 20/Unit
10.	Write a PHP Program to Display the Student Result from Mysql DB by the following conditions Find Pass or Fail Calculate the Percentage Calculate the Grade
S.No	**Python Lab Exercises**
1.	Write python programs to understand Expressions, Variables, Quotes, Basic Math operations, Strings: Basic String Operations & String Methods, List, Tuples, Dictionaries, Arrays.
2.	Write python programs to understand GUI designing and database operations (Minimum Three programs based on GUI designing using Tkinter, Mysql database creation & Database connectivity with DML operations using python.
3.	Programs that take command line arguments (word count)
4.	Simulate elliptical orbits in Pygame.

5.	Simulate bouncing ball using Pygame.
6.	Create Comma Separate Files (CSV), Load CSV files into internal Data Structure.
7.	Demonstrate use of advanced regular expressions for data validation.
8.	Write python programs to understand different File handling operations.
9.	Demonstrate Exceptions in Python.
10.	Write python programs to understand TCP and UDP Sockets in Python

Software Requirements	• Windows or Linux Desktop OS • Python 3.6 or higher • Notepad ++ • Python IDEs like Pydev, Netbeans or Eclipse • Mysql • Xamp Server			
Outcomes	• Understand, analyze and apply the role of languages like HTML5, CSS3, XML, JavaScript, PHP and • protocols in the workings of the web and web applications. • Design and Implement database applications. • Develop Python programs step-wise by defining functions and calling them. • Read and write data from/to files in Python.			
CC		**Core**	**Credits**	**H/W**
Course code:	**546201**	**Database Systems**	**5**	**5**
Objectives	• To study the physical and logical database designs, database modeling, relational, hierarchical, and network models. • To understand and use data manipulation language to query, update, and manage a database. • Understand the role of a database management system in an organization. • Familiarize the students with a good formal foundation on the relational model. • Describe the concepts of transactions and transaction processing and the issues, techniques related to concurrency and recovery manager.			
Unit -I	**Database System:** Introduction-Data Independence-Database System Architecture- The External Level – The Conceptual Level – The Internal Level – Mappings – The Database Administrator – Data Dictionary – Data Models – Record-based Data Models – Object based Data Models – Physical Data Models - Hierarchical Data Models – Network Data Models-Relational Data Model-Entity-Relationship Models – Object Oriented Data Model-			

	Comparison Between Data Models.
Unit-II	**Distributed Databases:** Introduction-Preliminaries-The Twelve Objectives - Problems – Client/Server Systems – DBMS Independence-SQL Facilities – Decision Support-Data Preparation-Data Warehouses and Data Marts – Online Analytical Processing – **Object Oriented Databases:** Introduction-Object Oriented Data Models-Object Oriented DBMS – Object Oriented Languages.
Unit- III	**Temporal Databases:** Introduction-Intervals-Packing and Unpacking relations-Generalizing the relational operators – Database Design – Integrity Constraints – **Multimedia Databases:** Multimedia Sources – Multimedia Database Queries – Multimedia Database Applications.
Unit -IV	**Spatial Databases:** Spatial Data- Spatial Database Characteristics – Spatial Data Model-Spatial Database Queries – Techniques of Special Database Query.
Unit -V	**Emerging Database Technologies:** Introduction – **Internet Databases:** Internet Technology – The World Wide Web-Web Technology – Web Databases – Advantages-**Mobile Databases:** Architecture of Mobile Databases – Characteristics of Mobile Computing – Mobile DBMS.

Reference and Textbooks:

- Date, C. J., Kannan, ., Swamynathan, S. (2006). *An Introduction to Database Systems(8th ed.)*. Pearson Education.
- Singh, S. K., (2008). *Databse Systems: Concepts, Design and Applications(2nd ed.)*. Person Education.
- Abraham Silberschatz., HentryF.Korth, Sudarshan, S. (2010). *Database Management System Concepts (6th ed.)*. McGraw Hill International.

Outcomes	• Upon successful completion of this course, students should be able to, improve the database design. • Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods. • Analyze and design a real database application. • Describe the fundamental elements of relational database management systems. • Explain the basic concepts of relational data model, entity-relationship model,

	relational database design, relational algebra and SQL.

CC		Core	Credits	H/W
Course code:	**546202**	**Data Mining**	**5**	**5**
Objectives	• To introduce students to the basic concepts and techniques of Data Mining. • To develop the abilities of critical analysis to data mining systems and applications. • Develop a general framework for decision support within organizations. • Analyze and design a real database application. • To develop skills of using recent data mining software for solving practical problems. • To gain experience of doing independent study and research.			
Unit -I	**Data Mining and Data Preprocessing:** Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.			
Unit-II	**Data Warehousing, Business Analysis And On-Line Analytical Processing (OLAP):** Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures - Multidimensional Data Model - Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.			
Unit- III	**Frequent Patterns, Associations and Classification:** Mining Frequent Patterns, Associations and Correlations-The Apriori Algorithm –Classification and Prediction – Classification by Decision Tree Induction - Bayesian Classification – Rule Based Classification-Lazy Learners.			
Unit -IV	**Cluster Analysis:** Clustering Techniques - Partitioning Methods - Hierarchical Methods - Density Based Methods - Grid Based Methods - Model based clustering - Outlier analysis-Outlier Detection Methods.			
Unit- V	**Spatial, Multimedia, Text and Web Data:** Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web – Data Mining Applications – Trends in Data			

	Mining.

Reference and Textbooks:

- Jiawei Han, Micheline Kamber. (2011). *Data Mining: Concepts and Techniques (3rd ed.).* (The Morgan Kaufmann Series in Data Management Systems.
- Ian H. Witten., Eibe Frank, Mark A. Hall.(2014). *Data Mining: Practical Machine Learning Tools and Techniques(3rd ed.).* Elsevier.
- Margret H. Dunham. (2003). *Data Mining: Introductory and Advanced Topics*. Pearson Education.
- Awad, M., Latifur Khan., Bhavani Thuraisingham, Lei Wang. (2015). *Design and Implementation of Data Mining Tools*. CRC Press-Taylor & Francis Group.
- Pang-Ning Tan., Michael Steinbach, Vipin Kumar. (2016). *Introduction to Data Mining-Instructor's Solution Manual*. Pearson Education.
- Mohammed J.Zaki., Wagner Meira JR. (2016). *Data Mining and Analysis: Fundamental Concepts and Algorithms*. Cambridge India.
- Ebook: https://repo.palkeo.com/algo/information-retrieval/Data mining and analysis.pdf

Outcomes	• Demonstrate advanced knowledge of data mining concepts and techniques. • Analyze and evaluate performance of algorithms for Association Rules. • Deploy Classification and Clustering algorithms. And, determine whether a real world problem has a data mining solution. • Apply data mining algorithms and techniques adaptively to real world problem solving. • Know recent developments and active research topics in knowledge discovery and data mining.

CC		Core	Credits	H/W
Course code:	**546203**	**Digital Image Processing**	**4**	**4**

Objectives	• Learn digital image fundamentals. • Be exposed to simple image processing techniques. • To know the image restoration processing • Be familiar with image compression and segmentation techniques. • Learn to represent image in form of features.
Unit -I	**DIGITAL IMAGE FUNDAMENTALS:** Element of Digital Image Processing Elements of Visual Perception - Psychovisual Model Brightness-Contrast-Hue Saturation, Machband Effect, Color Image Fundamentals – RBG - His Models, Image Sampling, Quantization, Dither, Matrix Theory Result, Block Matrices and Kronecker Products.
Unit-II	**IMAGE TRANSFORMS:** Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filter, Sharpening Spatial Filters, Combining Spatial Enhancement methods. 2-D Orthogonal and Unitary Transforms, 1-D and 2-D Discrete Fourier Transformation techniques.
Unit- III	**IMAGE ENHANCEMENT:** Point Operation-Contrast Stretching, Clipping and Thresholding Density Slicing, Histogram Equalization, Modification and Specification, Spatial Operation-Spatial Averaging, Low Pass, Highpass Band Pass Filtering, Direction Smoothing, Medium Filtering and Homomorphic Filtering.
Unit- IV	**IMAGE RESTORATION:** Image Observation Model, Sources of Degradation, Inverse and Wiener Filtering, Geometric Mean Filter, Non Linear Filter, Smoothing Splines and Interpolation, Constrained Least Squares Restoration.
Unit- V	**IMAGE DATA COMPRESSION:** Image Data Rates, Pixel Coding, Need For Data Compression. Error Free Compression: Variable Length Coding, Bit Plane Coding, LZW Coding, **Lossy Compression:** Transform Coding, Wavelet Coding, **Compression Standards:** Binary Image Compression Standard, Still Image Compression Standards, Video Compression Standards. **Dynamic Content:** Latest Techniques in Compression.

Reference and Textbooks:

- Chandra, B., Dutta Majumder, D. (2006). *Digital Image Processing and Analysis*. Prentice-Hall of India private limited.
- Rafael C. Gonzalez., Richard E. Woods. (2008). *Digital Image Processing(3rd ed.).* Pearson Education.
- Jain, A. (2001). *Fundamentals of Digital Image Processing.* Prentice Hall of India.

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- Jayaraman, S., Veerakumar, T., Esakkirajan, S. (2009). *Digital Image Processing(1st ed.).* McGraw Hill Education.
- Khalid Sayood. (2018). *Introduction to Data Compression(5th ed.).* Morgan Kaufmann.

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<tr><td>Outcomes</td><td>

- Discuss digital image fundamentals.
- Apply image enhancement and restoration techniques.
- Use image compression and segmentation Techniques and represent features of images.
- Be expertise in image restoration processing.
- Finding the solution for image transformations.

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CC		Core	Credits	H/W
Course code:	**546204**	**Lab-II Data Mining Lab**	**2**	**4**

Objectives

- To learn the libraries and know where it is used.
- To obtain practical experience using data mining techniques on real world data sets.
- Expertise to resolve the noisy data removal.
- Emphasize hands-on experience working with all real data sets.
- To learn classification and clustering problems and solve as it is.

1.

MATRIX OPERATIONS

Introduction to Python libraries for Data Mining:

NumPy, SciPy, Pandas, Matplotlib, Scikit-Learn

Write a Python program to do the following operations:

Library: NumPy

i. Create multi-dimensional arrays and find its shape and dimension
ii. Create a matrix full of zeros and ones
iii. Reshape and flatten data in the array
iv. Append data vertically and horizontally
v. Apply indexing and slicing on array
vi. Use statistical functions on array - Min, Max, Mean, Median and Standard Deviation

2.

LINEAR ALGEBRA ON MATRICES

Write a Python program to do the following operations:

Library: NumPy

i. Dot and matrix product of two arrays
ii. Compute the Eigen values of a matrix
iii. Solve a linear matrix equation such as 3 * x0 + x1 = 9, x0 + 2 * x1 = 8
iv. Compute the multiplicative inverse of a matrix
v. Compute the rank of a matrix
vi. Compute the determinant of an array

3.

UNDERSTANDING DATA

Write a Python program to do the following operations: Data set: brain_size.csv

Library: Pandas

i. Loading data from CSV file
ii. Compute the basic statistics of given data - shape, no. of columns, mean
iii. Splitting a data frame on values of categorical variables
iv. Visualize data using Scatter plot

4.

CORRELATION MATRIX

Write a python program to load the dataset and understand the input data

Dataset : Pima Indians Diabetes Dataset

Library: Scipy

i. Load data, describe the given data and identify missing, outlier data items
ii. Find correlation among all attributes
iii. Visualize correlation matrix

5.	**DATA PREPROCESSING – HANDLING MISSING VALUES** **Write a python program to impute missing values with various techniques on given dataset.** **i.** Remove rows/ attributes **ii.** Replace with mean or mode **iii.** Write a python program to perform transformation of data using Discretization (Binning) and normalization (MinMaxScaler or MaxAbsScaler) on given dataset.
6.	**ASSOCIATION RULE MINING- APRIORI** **Write a python program to find rules that describe associations by using Apriori algorithm between different products given as 7500 transactions at a French retail store.** **Libraries:** NumPy, SciPy, Matplotlib, Pandas **Dataset:** https://drive.google.com/file/d/1y5DYn0dGoSbC22xowBq2d4po6h1JxcTQ/view?usp=sharing **i.** Display top 5 rows of data **ii.** Find the rules with min_confidence : .2, min_support= 0.0045, min_lift=3, min_length=2
7.	**CLASSIFICATION – LOGISTIC REGRESSION** **Classification of Bank Marketing Data:** The data is related with direct marketing campaigns of a Portuguese banking institution. The marketing campaigns were based on phone calls. Often, more than one contact to the same client was required, in order to access if the product (bank term deposit) would be ('yes') or not ('no') subscribed. The dataset provides the bank customers‟ information. It includes 41,188 records and 21 fields. The classification goal is to predict whether the client will subscribe (1/0) to a term deposit (variable y). **Libraries:** Pandas, NumPy, Sklearn, Seaborn **Write a python program to** **i.** Explore data and visualize each attribute **ii.** Predict the test set results and find the accuracy of the model **iii.** Visualize the confusion matrix **iv.** d) Compute precision, recall, F-measure and support
8.	**CLASSIFICATION - KNN** **Dataset:** The data set consists of 50 samples from each of three species of Iris: Iris setosa, Iris virginica and Iris versicolor. Four features were measured from each sample: the length and the width of the sepals and petals, in centimetres. **Libraries:** numpy **Write a python program to** **i.** Calculate Euclidean Distance. **ii.** Get Nearest Neighbors **iii.** Make Predictions.

9.	**CLASSIFICATION – SUPPORT VECTOR MACHINES (SVM)** A wide dataset is one with a large number of predictors, such as might be encountered in the field of bioinformatics (the application of information technology to biochemical and biological data). A medical researcher has obtained a dataset containing characteristics of a number of human cell samples extracted from patients who were believed to be at risk of developing cancer. Analysis of the original data showed that many of the characteristics differed significantly between benign and malignant samples. **Dataset:** The stream named svm_cancer.str, available in the Demos folder under the streams subfolder. The data file is cell_samples.data. The dataset consists of several hundred human cell sample records, each of which contains the values of a set of cell characteristics. **i.** Develop an SVM model that can use the values of these cell characteristics in samples from other patients to give an early indication of whether their samples might be benign or malignant. Hint: Refer UCI Machine Learning Repository for data set.
10.	**CLUSTERING – K-MEANS** Predicting the titanic survive groups: The sinking of the RMS Titanic is one of the most infamous shipwrecks in history. On April 15, 1912, during her maiden voyage, the Titanic sank after colliding with an iceberg, killing 1502 out of 2224 passengers and crew. This sensational tragedy shocked the international community and led to better safety regulations for ships. One of the reasons that the shipwreck led to such loss of life was that there were not enough lifeboats for the passengers and crew. Although there was some element of luck involved in surviving the sinking, some groups of people were more likely to survive than others, such as women, children, and the upper-class. **Libraries:** Pandas, NumPy, Sklearn, Seaborn, Matplotlib **Write a python program** i. To perform preprocessing **ii.** To perform clustering using k-means algorithm to cluster the records into two i.e. the ones who survived and the ones who did not.
Outcomes	• Learn the fundamental concepts from library. • Generate the rules like association. • Find the solution for confusion and correlation matrix. • Deploy association rules for any kind of databases. • Develop clustering and classification rules for applications.

CC		Core	Credits	H/W
Course code:	**546205**	**Lab-III- Digital Image Processing**	**2**	**4**

Objectives	• To learn the fundamental concepts of Digital Image Processing • To develop and enhance the image using latest tools. • To introduce basic analytical methods to be used in image processing. • To do the image transformation processing. • To familiarize students with image enhancement and restoration techniques.
1.	Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale)
2.	Implementation of Relationships between Pixels
3.	Implementation of Transformations of an Image
4.	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5.	Display of bit planes of an Image
6.	Display of FFT (1-D & 2-D) of an image
7.	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
8.	Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
9.	Implementation of image sharpening filters and Edge Detection using Gradient Filter
10.	Image Compression by DCT, DPCM, HUFFMAN coding
11.	Implementation of image restoring techniques
12.	Implementation of Image Intensity slicing technique for image enhancement
13.	Canny edge detection Algorithm
Outcomes	• Make use of this DIP lab as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books. • Learn different techniques employed for the enhancement of images. • Understanding the image transformation and do the process. • Experiments image segmentation. • Understand the concept of image restoration.

CC		Core	Credits	H/W
Course code:	**546301**	**Internet of Things**	**5**	**5**
Objectives	• To understand the basic concept of Internet of Things. • To learn IoT protocols and implementation in the real world scenario. • To provide hands on training in constructing systems using Raspberry PI and Arduino. • Analyze different protocols for IoT. • Explain the web services related to IoT device access controls.			
Unit -I	**Introduction to Internet of Things**: Definition – Characteristics - Design Concepts – Physical – Things in IoT - IoT Protocols – **Logical Design:** IoT Functional Blocks – Communication Models - IoT Enabling Technologies - IoT Levels - Deployment Templates - Domain Specific IoTs - IoT and M2M – Difference between IoT and M2M – Software Defined Network (SDN) and Network Function Virtualization (NFV) for IoT - IoT System Management – Need – SNMP – Network Operator Requirements – System Management with NETCONF-YANG.			
Unit-II	**Developing IoT and IoT Architecture:** IoT Platforms Design Methodology - M2M High-Level ETSI Architecture - IETF Architecture for IoT - OGC Architecture - IoT Reference Model - Domain Model - Information Model - Functional Model - Communication Model - IoT Reference Architecture.			
Unit III	**IoT Protocols:** Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.			
Unit IV	**Building IoT With Raspberry Pi & Arduino:** Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device - Building Blocks -Raspberry Pi -Board - Linux on Raspberry Pi – Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.			
Unit V	**Case Studies:** Real World Design Constraints - Applications - Asset Management, Industrial Automation, Smart Grid, Commercial Building Automation, Smart Cities - Participatory Sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.			

Reference and Textbooks:

- Arshdeep Bahga, Vijay Madisetti. (2015). *Internet of Things – A hands-on approach.* Universities Press.
- By Jan Holler., Vlasios Tsiatsis., Catherine Mulligan., Stefan Avesand, Stamatis Karnouskos, David Boyle. *(2014). From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence(1st ed.).* Academic Press.
- Francis daCosta. (2013). *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything(1st ed.)*. Apress Publications.
- Cuno Pfister. (2011). *Getting started with Internet of Things*. O'Reilly Media.
- Dieter Uckelmann., Mark Harrison., Michahelles, Florian (Eds). (2011). *Architecting the Internet of Things*. Springer.
- Jan Ho¨ ller., Vlasios Tsiatsis., Catherine Mulligan., Stamatis., Karnouskos., Stefan Avesand, David Boyle. (2014). *From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence.* Elsevier.
- Honbo Zhou. (2012). *The Internet of Things in the Cloud: A Middleware Perspective*. CRC Press.
- Olivier Hersent., David Boswarthick, Omar Elloumi. (2012). *The Internet of Things – Key applications and Protocols.* Wiley.

Outcomes	• Under the fundamental concept of IoT. And learn the function of IoT systems. • Understand web services which are related to IoT device access controls. • Design a portable IoT using Rasperry Pi. • Deploy an IoT application and connect to the cloud. • Analyze applications of IoT in real time scenario.

CC		Core	Credits	H/W
Course code:	**546302**	**Big Data Analytics And R Programming**	**5**	**5**

Objectives	• Gives an overview of Big Data, i.e. storage, retrieval and processing of big data. • Learning basic and advanced methods to big data technology and tools, including MapReduce and Hadoop and its ecosystem. • Understanding the Concept of R programming and its implementation in Data Analysis. • It also focuses tools/algorithms that are available for storage, processing of Big Data. • It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.
Unit -I	**Introduction to Big Data Analytics:** Big Data Overview – Data Structures – Analyst Perspective on Data Repositories - State of the Practice in Analytics – BI Versus Data Science - Current Analytical Architecture – Drivers of Big Data – Big Data Ecosystem - Data Analytics Lifecycle – Data Discovery – Data Preparation – Model Planning – Model Building – Communicate Results – Operationalize.
Unit-II	**Basic Data Analytic Methods Using R:** Introduction to R programming – R Graphical User Interfaces – Data Import and Export – Attribute and Data Types – **Descriptive Statistics Exploratory Data Analysis :** Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables Data Exploration Versus Presentation- **Statistical Methods of Evaluation:** Hypothesis Testing – Difference of Means – Wilcoxon Rank - Sum Test – Type I and Type II Errors – Power and Sample Size – ANOVA..
Unit- III	**Advanced Analytical Theory and Methods:** Clustering – K Means – Use Cases – Overview – Determining Number of Clusters – Diagnostics – Reasons to Choose and Cautions – Additional Algorithms - **Association Rules :** Apriori Algorithm – Evaluation of Candidate Rules – Applications of Association Rules – Validation and Testing – Diagnostics. **Regression :** Linear Regression and Logistic Regression – Use Cases – Model Description – Diagnostics - Additional Regression Models.
Unit -IV	**Classification :** Decision Trees – Overview – Genetic Algorithm – Decision Tree Algorithms – Evaluating Decision Tree – Decision Trees in R – Naïve Bayes – Bayes Theorem – Naïve Bayes Classifier – Smoothing – Diagnostics – Naïve Bayes in R. **Text Analysis:** Text Analysis Steps – Example – Collecting – Representing Term Frequency – Categorizing – Determining Sentiments – Gaining Insights.
Unit -V	**Advanced Analytics Technology and Tools:** MapReduce and Hadoop - Analytics for Unstructured Data - UseCases - MapReduce - Apache Hadoop – The Hadoop Ecosystem – Pig – Hive – Hbase – Manout – NoSQL - **Tools in Database Analytics:** SQL Essentials –

	Joins – Set operations – Grouping Extensions.

Reference and Textbooks:

- John Wiley & Sons. (2015). *Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data***.** EMC Education Services Published.
- Noreen Burlingame. (2012). *The little book on Big Data*. New Street publishers.
- Anil Maheshwari. (2017). *Data Analytics*. McGraw Hill Education.
- Norman Matloff. (2011). *The Art of R Programming: A Tour of Statistical Software Design (1st ed.)*. No Starch Press.
- Sandip Rakshit. (2017). *R for Beginners*. McGraw Hill Education.

Outcomes	• Able to understand the key concepts of Data Analytics. • Able to participate in big data analytics projects. • Understand Big Data and its analytics in the real world. • Analyze the Big Data framework like Hadoop and NoSQL to efficiently store and process Big Data to generate analytics. • Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.

CC		Core	Credits	H/W
Course code:	**546303**	**Machine Learning**	**4**	**4**

Objectives	• To understand the basic theory underlying machine learning. • To be able to formulate machine learning problems corresponding to different applications. • To understand a range of machine learning algorithms along with their strengths and weaknesses. • To be able to apply machine learning algorithms to solve problems of moderate complexity. • To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
Unit -I	**Introduction:** Machine Learning–**Types of Machine Learning:** Supervised, Unsupervised, Semi-Supervised, Reinforcement Learning –Perspectives and Issues in Machine Learning-Pattern Recognition- Classification – Regression – Feature Selection-Machine Learning Algorithms, Turning Data Into Probabilities, and Statistics for Machine Learning. Probability Theory – Probability Distributions – Decision Theory.
Unit-II	**Linear Discrimination:** Introduction-Generalizing the Linear Model- Geometry of the Linear Discriminant: Two Classes and Multiple Classes- Pairwise Separation- Parametric Discrimination Revisited- Gradient Descent- Logistic Discrimination. **Instance-based Learning:** K-Nearest Neighbor – Self-Organizing Map (SOM)-Learning Vector Quantization (LVQ) - Locally Weighted Learning (LWL).
Unit- III	**From Theory to Algorithms:** Linear Predictors**:** Linear Regression, Logistic Regression-Polynomial Regression. **Learning Decision Trees:** Inference model - General Domains – Symbolic Decision Trees - ID3 Algorithm-Random Forest. **Advanced Learning:** Neural Networks – Active Learning -Ensemble Learning: Bagging: - Bootstrap, Aggregation - Boosting: - Weak Learnability- Adaboost- Stacking
Unit -IV	**Deep Learning:** Introduction- History of Deep Learning-A Probabilistic Theory of Deep Learning- Basic Concept of Neurons- **Feed Forward Networks:** Multilayer Perceptron-Backpropagation -Empirical Risk Minimization-Regularization- Batch Normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks-Generative Adversarial Networks (GAN), Semi-supervised Learning-Auto Encoders-Convolutional Neural Network-Recurrent Neural Network.

Unit -V	**Applications of Deep Learning**: Images Segmentation – Object Detection – Automatic Image Captioning – Image Generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision.

Reference and Textbooks:

- Alpaydin, E. (2014). *Introduction to Machine Learning*. Prentice Hall of India.
- Mitchell, T. M. (2017). *Machine Learning(1st ed.)*. McGraw-Hill.
- Bishop, C. M. (2011). *Pattern Recognition and Machine Learning*. Springer.
- Duda, R. O., Hart, P. E., Stork, D.G. (2001). *Pattern Classification*. John Wiley and Sons.
- Vladimir N. Vapnik. (1998). *Statistical Learning Theory*. John Wiley and Sons.
- Shawe-Taylor, J., Cristianini, N. (2000). *Introduction to Support Vector Machines*. University Press. Cambridge.

Outcomes	• Appreciate the importance of visualization in the data analytics solution • Apply structured thinking to unstructured problems • Understand a very broad collection of machine learning algorithms and problems • Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory • Develop an appreciation for what is involved in learning from data.

CC		Core	Credits	H/W
Course code:	**546304**	**Lab-IV-Data Analytics Lab**	**2**	**4**
Objectives	• Imparting the architectural concepts of Hadoop and introducing map reduce paradigm. • Introduce programming tools PIG & HIVE in Hadoop echo system. • Understand the basics of R programming including objects, classes, vectors etc. • Become proficient in writing a fundamental program and perform analytics with R. • Learn image restoration process.			
1.	i. Perform setting up and Installing Hadoop in its two operating modes: Pseudo distributed, Fully distributed. ii. Use web based tools to monitor your Hadoop setup.			
2.	i. Implement the following file management tasks in Hadoop: ii. Adding files and directories, Retrieving files, Deleting files. iii. Benchmark and stress test an Apache Hadoop cluster.			
3.	Assignments on Basic Concepts of R			
4.	Assignments on Data Structures in R			
5.	Assignments on R packages, R Data Reshaping			
6.	Assignments on Working with files, R object and Class			
7.	Assignments on Data visualization in R and Data Management			
8.	Assignments on Statistical modelling and Databases in R			
9.	Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all. **Find average, max and min temperature for each year in NCDC data set?** • Filter the readings of a set based on value of the measurement, Output the line• of input files associated with a temperature value greater than 30.0 and store it in a separate file.			
10.	Purchases.txt Dataset Instead of breaking the sales down by store, give us a sales breakdown by product category across all of our stores.			

	What is the value of total sales for the following categories? a)Toys b)Consumer Electronics
11.	Implement a Map Reduce Program That Processes A Weather Dataset.
12.	Implement Linear And Logistic Regression
13.	Visualize Data Using Any Plotting Framework
14.	Implement An Application That Stores Big Data In Hbase / Mongodb / Pig Using Hadoop / R.
15.	Develop Pig Latin scripts for big data processing.
Outcomes	• Prepare and equip students for opportunities in ever changing technology with hands-on industrial training. • Transform the students to become globally competent professionals through internship. • Process big data using Hadoop framework • Build and apply linear and logistic regression models • Perform data analysis with machine learning methods and graphical data analysis

CC		Core	Credits	H/W
Course code:	**546305**	**Lab-V: Machine Learning**	**2**	**4**
Objectives	• To understand the basic concepts and techniques of Machine Learning through python programming. • To develop skills of using recent machine learning packages for solving practical problems. • To gain experience of doing independent study and research. • To apply common Machine Learning algorithms in practice and implementing their own.			
1.	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.			
2.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.			
3.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.			
4.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.			
5.	Write a program to 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.			
6.	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set			
7.	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.			
8.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.			
9.	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for			

	this problem.
10.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
Outcomes	• Understand complexity of Machine Learning algorithms and their limitations • be capable of confidently applying common Machine Learning algorithms in practice and implementing their own. • Be capable of performing experiments in Machine Learning using real-world data. • Understand modern notions in data analysis-oriented computing. • Able to generate, analyze and interpret data using Python.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546501**	**Object Oriented Software Engineering**	**4**	**4**
Objectives	• To learn essential and fundamental concepts of object oriented along with their applications. • To understand analyze, design and implement object oriented software systems by means of a mid-sized projects. • To learn and understand various O-O concepts along with their applicability contexts. • Develop design solutions for problems on various O-O concepts. • To learn various modeling techniques to model different perspectives of object-oriented software design (UML).			
Unit -I	**Introduction to Software Engineering:** Software Engineering Concepts, Software Engineering Development Activities, Managing Software Development, Object Oriented Paradigm. **Modeling with Unified Modeling Languages**: Introduction, An overview of UML, Modeling Concepts And Deeper View into UML. **Project Organization and Communication**: Introduction, A Rocket Example, An Overview of Projects, Project Organization Concepts, Project Communication Concepts, Organizational Activities.			
Unit-II	**Requirements Elicitation-Introduction:** Usability Examples, An Overview of Requirements Elicitation, Requirements Elicitation Concepts, Requirements Elicitation Activities, Managing Requirements Elicitation. **Analysis**-Introduction: An Optical Illusion, An Overview of Analysis, Analysis Concepts, Analysis Activities: From Use Cases to Objects, Managing Analysis.			
Unit- III	**System Design:** Decomposing the System-**Introduction:** A Floor Plan Example, an Overview of System Design, System Design Concepts, System Design Activities. **System Design**: Addressing Design Goals, Introduction, A Redundancy Example, an Overview of System Design Activities, **Concepts:** UML Deployment Diagrams, System Design Activities: Addressing Design Goals, Managing System Design.			
Unit -IV	**Object Design Reusing Pattern Solutions:** Introduction- Bloopers, An Overview of Object Design, **Reuse Concepts:** Solution Objects, Inheritance and Design Patterns. **Reuse Activities**: Selecting Design Patterns and Components, Managing Reuse. **Object Design Specifying Interfaces**: Introduction, A Relational Example, An Overview of Interface Specification, Interface Specification Concepts, Interface Specification Activities, Managing Object Design.			

Unit -V	**Mapping Models to Code:** An Overview of Mapping, Mapping Concepts, Mapping Activities and Managing Implementation, Mapping Object Model to Database Schema. **Testing**: **Introduction:** Testing the Space Shuttle, Overview of Testing - Testing Concepts, Testing Activities, Managing Testing.

Reference and Textbooks:

- Bernd Bruegge, Allen H.Dutoit. (2010). *Object Oriented Software Engineering Using UML, Patterns and Java(3rd ed.).* Pearson Education.
- Stephen R Schach. (2005). *Object Oriented & Classical Software Engineering(6th ed.).* TMH.
- Timothy C.Lethbridge, Robert Laganiere. (2004). *Object Oriented Software Engineering Practical Software Development using UML & Java.* TMH Edition.
- Grady Booch, James Rambaugh, Ivar Jacobson. (2006). *The Unified Modeling Language User Guide*. Pearson Education.

Outcomes	• Apply various software architectures, including frameworks and design patterns, when developing software projects. • Extract an Object Model and Dynamic Model of system functionality and performance from the requirements. • Analyze the requirements of a given software projects and produce requirement specifications (SRS). • Design the usecase diagrams, sequence diagrams, class diagrams, state diagrams and deployment diagrams by applying the UML standards. • Apply knowledge of object oriented modeling concepts and design methods with a clear emphasis on Unified Modeling Language for a moderately realistic object oriented system.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546502**	**Software Project Management**	**4**	**4**
Objectives	• Define roles and responsibilities of process group include initiating, planning, executing controlling, and closing of the process model. • Conduct project planning activities that accurately forecast project costs, timelines, and quality. • Implement processes for successful resource, communication, and risk and change management. • Be familiar with the different methods and techniques used for project management. • Understand and maintain projects at each stage of the software development life cycle (SDLC).			
Unit -I	**Introduction:** Project - Definition - Software projects vs other types of project- Project Management Activities - plans, methods and methodologies-categorizing software projects - Management definition-problems with software projects-setting objectives-stakeholders-Requirement specification-Management control- Project Planning : Overview - Step wise project planning- project selection -identifying project scope, objectives and project infrastructure-Identify project products and activities-estimate effort-Identify activity risks-Allocate resources-review/publicize plan-Execute plan and lower levels of planning.			
Unit-II	**Project Evaluation**: Strategic assessment-technical assessment – Cost-benefit analysis-cash flow forecasting-cast-benefit evaluation techniques-Risk evaluation - Selection of an appropriate project approach: Technologies-Technical plan contents list- Process models-Waterfall model- V-process model- spiral model-software prototyping-categorizing prototypes-controlling changes during prototyping-incremental delivery-Dynamic system Development method-Extreme programming-Managing iterative processes-selecting the most appropriate process model.			
Unit- III	**Software Effort Estimation:** Stages of estimation-problems with over-and under-estimates-software effort estimation techniques-function point analysis-function points mark II-Objects points- code-oriented approach-COCOMO - Activity planning : objectives-project schedules-projects and activities-sequencing and scheduling activities-network planning models-formulating a network model- forward pass- backward pass-Identifying the critical path-Activity float-shortening the project duration-Identifying critical activities.			

Unit -IV	**Risks management :** Risks – Nature – Types – Managing Risks - Hazard identification-Hazard analysis-Risk planning and control-Evaluating risks to the schedule - Resource allocation: Nature of resources-Identifying resource requirements-Scheduling resources-creating critical paths-counting the cost- Publishing the resource schedule-cost schedules-Scheduling sequence - Monitoring and control : creating the framework-collecting the data-visualizing progress-cost monitoring-Earned value-prioritizing monitoring- change control.
Unit -V	**Managing contracts :** Types of contract- stages in contract placement-contract management-acceptance-managing people and organizing teams: Understanding behavior-organizational behavior : Selecting persons and methods -Motivation- job characteristics model-working in groups- Decision making-Leadership-Organizational structures – stress-Health and safety- Software quality in project planning - importance -ISO 9126-practical software quality measures-product versus process quality management-External standards-techniques to help enhance software quality-Quality plans.

Reference and Textbooks:

- Bob Hughes, Mike Cotterll. (2011). *Software Project Management*(*5th ed.*). TMH.
- Walker Royce. (2012). *Software Project Management.* Pearson Edition.
- Joel Henry. (2004). *Software Project Management*. Pearson Edition .
- PankjJalote. (2005). *Software Project Management in Practice*. Pearson Edition.

Outcomes	• Plan and manage projects at each stage of the software development life cycle (SDLC). • Apply estimating and risk management techniques to projects. • Work in groups to analyze a project and implement a solution. • Understand and conduct project planning activities that accurately forecast project costs, timelines, and quality. • Implement processes for successful resource, communication, and risk and change management.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546503**	**Object Oriented Analysis And Design**	**4**	**4**
Objectives	• To understand the basics of object oriented analysis and design concepts. • To learn the UML design diagram and map to code. Be expose to various testing techniques. • To understand the Object-based view of Systems • To develop robust object-based models for Systems • To inculcate necessary skills to handle complexity in software design.			
Unit -I	**Object Oriented System Development:** Introduction – Object Basics **- The Object Model:** Evolution – Elements **-** Classes and Objects: Object Nature – Relationship Among Objects – Class Nature – Relationships Among Classes – Building Quality Classes and Objects – System Development Life Cycle.			
Unit-II	**Object Oriented Methodologies:** Rumbaugh Object Modeling Technique – Booch – Jacobson – Shaler / Mellor – Coad / Yardon – Patterns – Frame Works – The Unified Approach – UML – Static and Dynamic Model – UML diagrams.			
Unit- III	**Object Oriented Analysis:** Identifying Use Cases – Use Case Model – Documentation – Classification: Identifying Classes – Noun Phrases Approach – Common Class Pattern Approach – Use Case Driven Approach – Identifying Object Relationship Attributes and Methods**.**			
Unit -IV	**Object Oriented Design:** Introduction – Design Process – Design Axioms – Designing Classes – Visibility – Refining Attributes – Designing Methods **-** Access Layer Design – View Layer Design.			
Unit -V	**Managing Analysis and Design**: Evaluation Testing – Impact of Object Oriented Testing **-** Coding – Maintenance – Metrics – Case Study Foundation Class Library – Client/Server Computing.			

Reference and Textbooks:

- Ali Bahrami. (2008). *Object Oriented System Development.* Tata McGraw Hill Edition.
- Grady Booch, Robert A.Maksimchuk. (2009). *Object Oriented Analysis And Design With Applications*(*3rd ed.*). Pearson Education.
- James Rumbaugh. (2002). *Object Oriented Modeling and Design*. PHI.
- Larman. (2003). Applying Uml & Patterns, An Introduction To Object Oriented Analysis And Design(*2nd ed.)*. Pearson Education.

Outcomes	• Design and implement projects using OO concepts.

	• Use the UML analysis and design diagrams and apply appropriate design pattern. • Create code from design and be familiar with various testing techniques. • Ability to analyze and model software specifications. • Ability to abstract object-based views for generic software systems. • Ability to deliver robust software components.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546504**	**Virtualization And Cloud Computing**	**4**	**4**

Objectives	• In-depth knowledge of Cloud Computing concepts, technologies, architecture and applications. • To expose the students to frontier areas of Cloud Computing and information systems and to implement Virtualization and build Private Cloud. • The fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges. • The basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations. • Different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS).
Unit -I	**INTRODUCTION**: Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Cloud Services – Cloud models – Elasticity in Cloud – On-demand Provisioning.
Unit-II	**VIRTUALIZATION:** Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization.
Unit- III	**CLOUD ENABLING TECHNOLOGIES AND INFRASTRUCTURE**: Service Oriented Architecture – RESTful Web Services – NIST Cloud Computing Reference Architecture – IaaS – PaaS – SaaS – Public, Private and Hybrid Clouds – Cloud Storage –Design Challenges in Cloud – Peer-to-Peer Architecture.
Unit -IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD** : Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security.
Unit -V	**PROGRAMMING MODELS**: Parallel and Distributed Programming Paradigms – MapReduce – Hadoop – Mapping Applications – Google App Engine – Amazon AWS – Cloud Software Environments –Eucalyptus – Open Nebula – Open Stack.
Reference and Textbooks:	

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Kai Hwang, Geoffrey C Fox, Jack G Dongarra. (2012). Distributed and Cloud Computing, From Parallel Processing to the Internet of Things. Morgan Kaufmann Publishers.
James E. Smith, Ravi Nair. (2005). Virtual Machines: Versatile Platforms for Systems and Processes. Elsevier/Morgan Kaufmann.
GautamShroff. (2011). Enterprise Cloud Computing. Cambridge University Press.
Kumar Saurabh. (2011). Cloud Computing – Insights Into New-Era Infrastructure. Wiley India.
John W.Rittinghouse, James F.Ransome,. (2010). Cloud Computing: Implementation Management, and Security. CRC Press.
Anthony T.Velte, Toby J.Velte, Robert Elsenpeter. (2010). Cloud Computing – A Practical Approach. McGraw Hill Education.
George Reese. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice). O'Reilly.
Michael Miller, Rajkumar Buyya, Christian Vecchiola, ThamaraiSelvi, S. (2008). Mastering Cloud Computing. Que Publishing. TMGH.

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<tr><td>Outcomes</td><td>

Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications that are resilient, elastic and cost-efficient.
Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.

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DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546505**	**Cyber Security**	**4**	**4**

Objectives	• To learn the principles of cyber security and to identify threats and risks. • To learn how to secure physical assets and develop system security controls. • To understand how to apply security for Business applications and Network Communications. • To learn the technical means to achieve security. • To learn to monitor and audit security measures.
Unit -I	**PLANNING FOR CYBER SECURITY:** Best Practices - Standards and a Plan of Action-Security Governance Principles, Components And Approach - Information Risk Management - Asset Identification - Threat Identification Vulnerability Identification - Risk Assessment Approaches - Likelihood and Impact Assessment - Risk Determination, Evaluation and Treatment - Security Management Function Security Policy - Acceptable Use Policy -Security Management Best Practices.
Unit-II	**SECURITY CONTROLS:** People Management - Human Resource Security-Security Awareness and Education Information Management - Information Classification and Handling -Privacy - Documents and Record Management - Physical Asset Management - Office Equipment-Industrial Control Systems-Mobile Device Security - System Development-Incorporating Security into SDLC Case Study on Information Security Policies.
Unit- III	**CYBER SECURITY FOR BUSINESS APPLICATIONS AND NETWORKS:** Business Application Management - Corporate Business Application Security - End User Developed Applications-System Access - Authentication Mechanisms - Access Control System Management-Virtual Servers - Network Storage Systems-Network Management Concepts - Firewall-IP Security - Electronic Communications – Case Study on OWASP Vulnerabilities using OWASP ZAP tool.
Unit -IV	**TECHNICAL SECURITY**: Supply Chain Management - Cloud Security-Security Architecture-Malware Protection Intrusion Detection - Digital Rights Management-Cryptographic Techniques - Threat and Incident Management - Vulnerability Management-Security Event Management - Forensic Investigations - Local Environment Management-Business Continuity – Case Study on Cloud and Cryptographic Vulnerabilities.

Unit -V	**SECURITY ASSESSMENT:** Security Monitoring and Improvement-Security Audit-Security Performance-Information Risk Reporting-Information Security Compliance Monitoring-Security Monitoring and Improvement Best Practices.

Reference and Textbooks:

- William Stallings. (2018). *Effective Cyber Security- A guide to using Best Practices and Standards(1st ed.)*. Addison-Wesley Professional.
- Adam Shostack. (2014). *Threat Modelling- Designing for Security(1st ed.)*. Wiley Publications.
- Gregory J. Touhill, Joseph Touhill, C. (2014). Cyber Security For Executives- A Practical Guide (*1st ed.*). Wiley Publications.
- RaefMeeuwisse. (2017). *Cyber Security for Beginners*(*2nd ed.*). Cyber Simplicity Ltd.
- Patrick Engebretson. (2013). *The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy(2nd ed.)*. Syngress.

Outcomes	• Develop a set of risk and security requirements to ensure that there are no gaps in an organization's security practices. • Achieve management, operational and technical means for effective cyber security. • Audit and monitor the performance of cyber security controls. • To spot gaps in the system and devise improvements. • Identify and report vulnerabilities in the system.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546506**	**Soft Computing**	**4**	**4**
Objectives	• Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory. • Introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications. • Provide the mathematical background for carrying out the optimization associated with neural network learning. • Artificial Intelligence, Various types of production systems, characteristics of production systems. • Neural Networks, architecture, functions and various algorithms involved.			
Unit -I	**Introduction:** Soft Computing Constituents – Soft Computing Vs Hard Computing – Characteristics - Applications - **Artificial Neural Network**: Fundamental Concept – Application Scope - Basic Terminologies – Neural Network Architecture – Learning Process – Basic Models of ANN: McCulloch-Pitts Model – Hebb Network – Linear Separability.			
Unit-II	**Supervised Learning Networks:** Perceptron Networks – Adaline and Madaline Networks – Back Propagation Network – Radial Basis Function Network. Associative Memory Networks – BAM - Hopfield Network - Boltzmann Machine. Unsupervised Learning Networks: Kohonen Self Organizing Network – Counter Propagation Network – ART Network.			
Unit- III	**Fuzzy Sets:** Basic Concept – Crisp Set Vs Fuzzy Set - Operations on Fuzzy Set – Properties of Fuzzy Sets – Fuzzy Relations: Concept – Fuzzy Composition – Fuzzy Equivalence and Tolerance Relation - Membership Functions: Features – Fuzzification – Methods of Membership value assignments – Defuzzification – Methods.			
Unit -IV	**Fuzzy Arithmetic:** Extension Principle – Fuzzy Measures – Fuzzy Rules and Fuzzy Reasoning: Fuzzy Propositions – Formation of Rules – Decomposition of Rules – Aggregation of Rules – Approximate Reasoning – Fuzzy Inference and Expert Systems – Fuzzy Decision Making – Fuzzy Logic Control Systems.			
Unit -V	**Genetic Algorithm:** Fundamental Concept – Basic Terminologies – Traditional Vs Genetic Algorithm - Elements of GA - Encoding - Fitness Function – Genetic Operators: Selection – Cross Over - Inversion and Deletion - Mutation – Simple and General GA -			

	The Schema Theorem - Classification of Genetic Algorithm – Genetic Programming – Applications of GA.
Reference and Textbooks: • Sivanandam, S. N., Deepa, S.N., (2011). *Principles of Soft Computing(2nd ed.).* Wiley India. • Rajasekaran, S., Pai, G.A.V., *Neural Networks, Fuzzy Logic, Genetic Algorithms*. Prentice Hall India.	
Outcomes	• Understand soft computing techniques and their role in problem solving. • Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory. • Analyze the genetic algorithms and their applications. • . Learn about soft computing techniques and their applications • Analyze various neural network architectures • Understand perceptrons and counter propagation networks.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546507**	**Mobile Computing**	**4**	**4**
Objectives	• Evaluate the architecture and principles of operation of computer systems and networks. • To learn about the concepts and principles of mobile computing. • To explore both theoretical and practical issues of mobile computing. • To develop skills of finding solutions and building software for mobile computing applications. • To be familiar with the network layer protocols and Ad-Hoc networks. And to know the basis of transport and application layer protocols.			
Unit -I	**Introduction:** Wireless Concept - Dialogue Control, Networks, Middleware and Gateways, Applications and Services, Developing Mobile Computing Applications, Security in Mobile Computing, Standards - **Mobile Computing Architecture:** History of Computers, History of Internet, Internet - Ubiquitous Network, Architecture of Mobile Computing, Three Tier Architecture, Design Considerations For Mobile Computing, Mobile Computing Through Internet, Making Existing Applications Mobile – Enabled. **Mobile Computing Through Telephony:** Evolution of Telephony, Multiple Access Procedure, Mobile Computing through Telephone, Developing An IVR Application, Voice XML, Telephony Application Programming Interface (TAPI)			
Unit-II	**Emerging Technologies:** Introduction, Bluetooth, Radio Frequency Identification (RFid), Wireless Broadband (WiMAX), Mobile IP, Internet Protocol Version 6 (Pv6), Java Card. **Global System For Mobile Communications (GSM):** Global System For Mobile Communications, GSM Architecture, GSM Entities, Call Routing in GSM, PLMN Interfaces, GSM Addresses and Identifiers, Network Aspects in GSM, GSM Frequency Allocation, Authentication and Security Short message service (SMS): Mobile Computing Over SMS, Short Message Services (SMS), Value Added Services Through SMS, Accessing SMS Bearer.			
Unit- III	**General Packet Radio Service (GPRS):** Introduction, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Limitations of GPRS, Billing And Charging in GPRS			
Unit -IV	**Wireless Application Protocol (WAP):** Introduction, WAP, MMS, GPRS Applications - **CDMA and 3G:** Introduction, Spread - Spectrum Technology, Is - 95, CDMA Vs GSM, Wireless Data, Third Generation Networks, Applications on 3G. **Wireless LAN:**			

	Introduction, Wireless LAN Advantages, IEEE 802.11 Standards, Wireless LAN Architecture, Mobility in Wireless LAN, Deploying Wireless LAN, Mobile Ad Hoc Networks and Sensor Networks, Wireless LAN Security, Wi- Fi vs 3G
Unit -V	**Voice Over Internet Protocol And Convergence:** Voice Over IP, H.323 Frame Work for Voice Over IP, Session Initiation Protocol (SIP),Comparison Between H.323 and SIP, Real Time Protocols, Convergence Technologies, Call Routing, Voice Over IP Applications, IP Multimedia Subsystem (IMS), Mobile VoIP Security Issues In Mobile Computing: Introduction, Information Security, Security Techniques And Algorithms, Security Protocols, Public Key Infrastructure, Trust, Security Models, Security Frameworks For Mobile Environment.
Reference and Textbooks: • Asoke K Talukder, Roopa R Yavagal. (2008). *Mobile Computing*. TMH publications. • Rajkamal. (2008). *Mobile Computing*. Oxford press.	
Outcomes	• Grasp the concepts and features of mobile computing technologies and applications. • Identify the important issues of developing mobile computing systems and applications. • Organize the functionalities and components of mobile computing systems into different layers and apply various techniques for realizing the functionalities. • To analyze next generation Mobile Communication System. • To understand network and transport layers of Mobile Communication. And analyze various protocols of all layers for mobile and ad hoc wireless communication networks. Also, understand IP and TCP layers of Mobile Communication.

DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546508**	**Mobile Application Development**	**4**	**4**

Objectives	• Fundamental design paradigms and technologies to mobile computing applications. • Describe different mobile application models/architectures and patterns. • Characteristics of mobile applications. • User-interface design for mobile applications. • Describe those aspects of mobile programming that make it unique from programming for other platforms and critique mobile applications on their design pros and cons.
Unit -I	**INTRODUCTION:** Mobile Applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Software Engineering – Frameworks and Tools – Mobile devices Profiles.
Unit-II	**USER INTERFACE**: Generic UI Development – VUIs and Mobile Applications – Text to Speech Techniques – Designing the Right UI – Multimodal and Multichannel UI – Gesture Based UIs – Screen Elements and Layouts – Voice XML – Java API.
Unit- III	**APPLICATION DESIGN:** Memory Management – Design Patterns For Limited Memory – Work Flow For Application Development – Techniques for Composing Applications – Dynamic Linking – Plug-ins and Rules of Thumb for Using DLLs – Concurrency and Resource Management – Look and Feel.
Unit -IV	**APPLICATION DEVELOPMENT**: Intents and Services – Storing and Retrieving Data – Communication via the Web – Notification and Alarms – Graphics and Multimedia – Telephony – Location Based Services – Packaging and Deployment – Security and Hacking.
Unit -V	**TOOLS GOOGLE ANDROID PLATFORM**: Eclipse Simulator – Android Application Architecture – Android Application Life Cycle - Event Based Programming – Apple iPhone Platform – UI Toolkit Interfaces – Event Handling and Graphics Services – Layer Animation.

Reference and Textbooks:

- Share Conder, Lauren Darcey. (2014). *Android Wireless Application Development(4th ed.)*. Pearson.
- Zigurd Mednieks, Laird Dornin, G., Blake Meike, Masumi Nakamura. (2012). *Programming Android*. Reilly.

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- Jeff Mcherter, Scott Gowell. (2012). *Professional mobile Application Development*. Wiley India Private Limited.
- Barry A. Burd. (2015). *Android Application Development For Dummies All in One*. Wiley.
- Reto Meier, Wrox Wiley, “Professional Android 2 Application Development”, 2010.
- Ed Burnette, Hello. (2012). *Android: Introducing Google Mobile Development Platform* (*3rd ed.*). Pragmatic Programmers.
- Jerome(J.F) DiMarzio. (2010). *Android A Programmers Guide*. Tata McGraw-Hill.
- Maritn Sauter. (2011). *From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband.* John Wiley and Sons.
- Alasdair Allan. (2010). *IPhone Programming*. Reilly.
- Paula Beer, Carl Simmons. (2015). *Android App Development for Young Adults.* The Rest of US Paperback.

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<tr><td>Outcomes</td><td>

- Be competent with the characterization and architecture of mobile applications.
- Be competent with designing and developing mobile applications using one application development framework.
- Evaluate the role of mobile applications in software intensive systems.
- Program mobile applications for the Android operating system that use basic and advanced phone features.
- Deploy applications to the Android marketplace for distribution.

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DSE		ELECTIVE SUBJECTS	Credits	H/W
Course code:	**546509**	**Advanced Network Security**	**4**	**4**

Objectives	• To understand the Advanced Network security. • To understand Cryptography Theories, Algorithms and Systems. • To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks. • To understand various Authentication schemes to simulate different applications. • To understand various Security practices and System security standards.
Unit -I	**INTRODUCTION:** Security Trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of Network Security – Security Attacks, Services and Mechanisms – OSI Security Architecture – Classical Encryption Techniques: Substitution Techniques, Transposition Techniques, Steganography - **Foundations of Modern Cryptography**: Perfect Security – Information Theory – Product Cryptosystem – Cryptanalysis.
Unit-II	**SYMMETRIC CRYPTOGRAPHY**: Mathematics of Symmetric Key Cryptography: Algebraic Structures - Modular Arithmetic-Euclid'S Algorithm- Congruence and Matrices - Groups, Rings, Fields- Finite fields - **SYMMETRIC KEY CIPHERS**: SDES – Block Cipher Principles of DES – Strength of DES – Differential and Linear Cryptanalysis - Block Cipher Design Principles – Block Cipher Mode of Operation – Evaluation Criteria for AES – Advanced Encryption Standard - RC4 – Key Distribution.
Unit- III	**PUBLIC KEY CRYPTOGRAPHY**: Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's Totient Function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and Logarithm - **ASYMMETRIC KEY CIPHERS**: RSA Cryptosystem – Key Distribution – Key Management – Diffie Hellman Key Exchange - ElGamal Cryptosystem – Elliptic Curve Arithmetic-Elliptic Curve Cryptography.
Unit -IV	**MESSAGE AUTHENTICATION AND INTEGRITY**: Authentication Requirement – Authentication Function – MAC – Hash Function – Security of Hash Function and MAC – SHA –Digital Signature And Authentication Protocols – DSS - **Entity Authentication**: Biometrics, Passwords, Challenge Response Protocols - Authentication Applications - Kerberos, X.509
Unit -V	**SECURITY PRACTICE AND SYSTEM SECURITY**: Electronic Mail Security – PGP, S/MIME – IP Security – Web Security - **SYSTEM SECURITY**: Intruders – Malicious

	Software – Viruses – Firewalls.
Reference and Textbooks: • William Stallings. (2006). *Cryptography and Network Security: Principles and Practice(3rd ed.).* PHI. • Shyamala, C K., Harini, N., Padmanabhan, T. R. *Cryptography and Network Security.* Wiley India Pvt.Ltd. • BehrouzA.Foruzan. (2007). *Cryptography and Network Security*. Tata McGraw Hill.	
Outcomes	• Understand the fundamentals of networks security, security architecture, threats and vulnerabilities • Apply the different cryptographic operations of symmetric cryptographic algorithms • Apply the different cryptographic operations of public key cryptography • Apply the various Authentication schemes to simulate different applications. • Understand various Security practices and System security standards.

NME		NON – MAJOR ELECTIVE COURSES	Credits	H/W
Course code:	**546703**	**OBJECT ORIENTED PROGRAMMING WITH C++**	**2**	**3**

Objectives	• To impart adequate knowledge on the need of programming languages and problem solving techniques. • To develop programming skills using the fundamentals and basics of C++ Language. • To enable effective usage of arrays, functions, constructor, destructor. • To develop program using class and objects.
Unit -I	Principles Of Object Oriented Programming. Procedure Oriented Programming – Object Oriented Programming – Basic Concepts And benefits Of OOP – Object Oriented Language – Applications Of OOP – Structure Of C++ – Applications of C++.
Unit-II	Tokens, Expression And Control Structure – Operators – Manipulators – Functions In C++: Function Prototyping – Call By Reference – Return By Reference – Inline Functions – Default Const Arguments – Function Overloading– Friend And Virtual Functions.
Unit- III	Objects And Classes – Member Functions – Nesting Of Member Functions –Private Member Functions – Memory Allocation Of Objects – Static Data Member Functions – Arrays Of Objects – Objects As Functions – Arguments –Pointers To Be Members.
Unit -IV	Constructors: Parameterized Constructors – Multiple Constructors – Constructor With Default Parameters – Copy And Dynamic Constructors – Destructors –Operator Overloading –Overloading Unary And Binary Operators – Overloading-Binary Operators Using Friend Functions.
Unit -V	Inheritance: Defining Derived Classes – Single Inheritance – Making Private Member Inheritable – Multiple Inheritance – Hybrid Inheritance – Virtual Base Classes – Abstract Classes – Constructors In Derived Class – Member Classes –Nesting Of Classes.

Reference and Textbooks:

- Balagurusamy , E. (2013). Object Oriented Programming with C++: 6e . Tata McGraw Hill Education Private Limited.
- Barakati, N. Object Oriented Programming in C++ . SAMS PHI Pvt. Ltd.
- Lafore, R. (2001). Object Oriented Programming in C++, (4 th ed.). Sams Publishing.
- Lippman, S. B., Lajoie, J., & Moo, B. E. (2011). C++ Primer, (5th ed.).
- Shukla, R. K. (2008). Object-Oriented Programming in C++. Wiley India Pvt Ltd.

Outcomes	• To obtain the knowledge about the number systems this will be very useful for bitwise operations. • To develop programs using the basic elements like control statements, Arrays and Strings. • To understand about the code reusability with the help of user defined functions.

NME		NON – MAJOR ELECTIVE COURSES	Credits	H/W
Course code:	**546704**	**INTERNET AND WEB DESIGN**	**2**	**3**
Objectives	• Describe network types, topologies and structural arrangements. • Compare features of different Internet communication tools. • Describe categories of individual and organisational Internet users and their values and goals. • Describe Internet providers and compare ways individuals and organisations obtain connections to the Internet. • Describe Internet-related careers and professions and the roles taken by members of a large web development team.			
Unit -I	Introduction to Internet - Anatomy – Terminology – History – Connecting and Accessing Internet - Internet Services : Protocols, Email, Newsgroup, Net Meeting, Chatting – Applications – Impact – Internet Technology and Protocols : TCP/IP, SLIP, PPP, SMTP, POP3 – FTP – HTTP – Addressing on Internet –Domain Name System. Hazards on the Internet (viruses, spam, worms, hoaxes, and scams).			
Unit-II	Introduction to World Wide Web and Web Design: WWW – History – Basic Features – Browsers – Servers – Search Engines and their categories – Functions – Search Criterion – Hypertext. Basic Web Design principles -Planning process - Rules of web designing - Designing navigation bar – Page design - Home Page Layout - Web Design concept – Web site's purpose, specification, creating user profiles and website prototypes - Web Standards – Web Development Models- Website classifications. Different website structures and web design approaches.			
Unit- III	HTML : Definition - HTML Documents - Basic structure of an HTML document - Creating an HTML document - Mark up Tags - Heading- Paragraphs - Line Breaks - HTML Tags.Elements of HTML : Introduction - Working with Text- Working with Lists, Tables and Frames - Working with Hyperlinks, Images and Multimedia – Working with Forms and controls.			
Unit -IV	Introduction to Cascading Style Sheets - Concept of CSS - Creating Style Sheet - CSS Properties - CSS Styling(Background, Text Format, Controlling Fonts) - Working with block elements and objects - Working with Lists and Tables - CSS Id and Class – Box Model(Introduction, Border properties, Padding - Properties, Margin properties) - CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align,Pseudo class,			

	Navigation Bar, Image Sprites, Attribute sector) - CSS Color - Creating page Layout and Site Designs.
Unit -V	Web Publishing or Hosting: Creating the Web Site - Saving the site – Working on the web site - Creating web site structure - Creating Titles for web pages - Themes-Publishing web sites. Interactive Tools (Fundamental only) : ASP, Javascript, Microsoft Front Page, Dreamweaver.

Reference and Textbooks:

- Deitel, & Nieto. (2000). Internet & World Wide Web – How to program. Pearson Education Publishers.
- Kogent learning solutions.pdf. (2005). HTML 5 in Simple Steps Dreamtech Press. Kogent Learning Solutions Inc.
- Bangia, R. (2005). Internet & Web Design, (2nd ed.). Firewall Media Publications.
- Duckett, J. (2004). Beginning HTML, XHTML, CSS, & JavaScript. India: Wiley.
- Krishnamoorthy, R., & Prabhu, S. (2004). Internet & Java Programming. New Age International Publishers.
- Powell, T. A. (2003). The Complete Reference HTML & XHTML, (4th ed.). Tata McGraw Hill.
- Steven, M. Web Designing & Architecture-Educational Technology Centre University of
- Buffalo Schafer HTML, XHTML, & CSS Bible, (5th ed.). India:Wiley.

Outcomes	• Review the current topics in Web & Internet technologies. • Describe the basic concepts for network implementation. • Learn the basic working scheme of the Internet and World Wide Web. • Understand fundamental tools and technologies for web design. • Comprehend the technologies for Hypertext Mark-up Language (HTML). • Specify design rules in constructing web pages and sites.