ST ALOYSIUS COLLEGE (AUTONOMOUS)
MANGALURU

RE-ACCREDITED BY NAAC "A" GRADE

COURSE STRUCTURE AND SYLLABUS
OF

M.SC. SOFTWARE TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

(2021 –22 ONWARDS)

ಸಂತ ಅಲೋಶಿಯಸ್ ಕಾಲೇಜು
(ಸ್ವಾಯತ್ತ)
ಮಂಗಳೂರು– 575 003

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Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

Date: 12-08-2021

NOTIFICATION

Sub: Syllabus of **M.Sc. Software Technology** under Choice Based Credit Scheme.

Ref: Decision of the Academic Council meeting held on 19-06-2021.

Pursuant to the above, the Syllabus of **M.Sc. Software Technology** under Choice Based Credit Scheme which was approved by the Academic Council at its meeting held on 19-06-2021 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL **REGISTRAR**

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library
4. PG Office

M.Sc. Software Technology

Scheme of Teaching || New CBCS Syllabus from 2021

Programme Educational Objectives

PEO1	Communicate Software Technology concepts, designs, and solutions effectively and professionally with real life examples and experiences.
PEO2	Apply knowledge of computing to bring out effective designs and solutions for specific problems across various domains.
PEO3	Ability to use various software development tools, multiple software systems, and modern computing platforms, with priority on the emerging technologies.
PEO4	Comprehend the advances of technology in light of its impact on society and the social, legal, ethical and cultural ramifications of computer technology and their usage.

M.Sc. Software Technology

Scheme of Teaching || New CBCS Syllabus from 2021

Programme Outcomes

PO1	To prepare software professional with expertise in system design principals and development.
PO2	Identify, understand and analyze scientific problems to formulate substantiated conclusions using first principles of mathematics, natural sciences, and applied sciences.
PO3	Design solutions for complex problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Understand the impact of the professional software engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the scientific practice.
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO8	Communicate effectively on complex activities with the scientific community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO9	Demonstrate knowledge understanding of the scientific and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO10	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.

M.Sc. Software Technology

Scheme of Teaching || New CBCS Syllabus from 2021

I Semester

Sl No	Subject Code	Subject Title	Type	Credits	Total No of Hours	Lecture Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Self Study Hrs / week
1	PH 531.1	Data Structures and Analysis of Algorithms	HC	4	45	3	2	--	2
2	PH 532.1	Relational Database Management Systems	HC	4	45	3	2	--	2
3	PH 533.1	Object Oriented Programming with Java	HC	4	45	3	2	--	2
4	PH 534.1	Web Design with PHP and MySQL	HC	4	45	3	2	--	2
5	PH 535.1P	DBMS and Java Lab	HCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
6	PS 536.1P	Data Structures AOA & Web Design Lab	SCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
7	PS 537.1	Software Engineering with UML	SC	4	45	3	2	--	2
8	---	Technical Writing & Presentation	---	--	30	2	2	--	4
		Total		**26**		**17**	**16**	**12**	**14**

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

M.Sc. Software Technology - II Semester

Sl No	SubjectCode	Subjec.t Title	Type	Credits	Total No of Hours	Lecture Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Self Study Hrs / week
1	PH 531.2	Programming with Python	HC	4	45	3	2	--	2
2	PH 532.2	Mobile Application Development with Android	HC	4	45	3	2	--	2
3	PH 533.2P	Python and Android Lab	HCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
4	PS 534.2[E1]	Foundations of Data Science	SC	3	45	3	2	--	2
5	PS 534.2[E2]	Data Warehousing and Data Mining	SC	3	45	3	2	--	2
6	PS 535.2[E1]	Artificial Intelligence & Cognitive Computing	SC	3	45	3	2	--	2
7	PS 535.2[E2]	Machine Learning and Deep Learning	SC	3	45	3	2	--	2
8	PS 536.2P	Machine Learning and Data Science Lab	SCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
OPEN ELECTIVE – Offered to other Depts									
9	PO 537.2 (E1)	Enterprise Information System	SC	3 *	45	3	--	--	2
10	PO 537.2 (E2)	Marketing Analytics	SC	3 *	45	3	--	--	2
11	---	TechnicalWriting & Paper Presentation	---	--	30	--	4	--	4
		Total		**20+3***		**15**	**16**	**12**	**14**
	Add-On Course								
12	AON	Research Methodology and Ethics							

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

M.Sc. Software Technology - III Semester

M.Sc. Software Technology

III Semester

Sl No	Subject Code	Subject Title	Type	Credits	Total No of Hours	Lecture Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Self Study Hrs / week
1	PH 531.3	Cloud Computing with Amazon Web Services	HC	4	45	3	2	--	2
2	PH 532.3	Web Technologies and .NET Framework	HC	4	45	3	2	--	2
3	PH 533.3 P	AWS and .NET Lab	HCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
4	PS 534.3 [E1]	Internet of Things and Applications	SC	3	45	3	2	--	2
5	PS 534.3 [E2]	Natural Language Processing	SC	3	45	3	2	--	2
6	PS 535.3 [E1]	Big Data Analytics with Scala and Spark	SC	3	45	3	2	--	2
7	PS 535.3 [E2]	Big Data Analytics with MapReduce and Hadoop	SC	3	45	3	2	--	2
8	PS 536.3 P	Big Data Analytics and Research Lab	SCL	3	90	--	(1 x 2) 2	(3 x 2) 6	--
OPEN ELECTIVE – Offered to other Depts									
9	PO 537.3 (E1)	Social Media Analytics	SC	3 *	45	3	--	--	2
10	PO 537.3 (E2)	Streaming Analytics	SC	3 *	45	3	--	--	2
11	---	Technical Writing & Paper Presentation	---	--	30	--	4	--	4
		Total		**20+3***		**15**	**16**	**12**	**14**

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

M.Sc. Software Technology IV Semester

Sl No	Subject Code	Subject Title	Credits	Max. Marks for Dissertation /Valuation		External Evaluation		Total
				Dissertation I	Dissertation II	Dissertation III	Max. Marks for Viva-voce (Final)	
1	PH 531.4/ PH 532.4/ PH 533.4/ PH 534.4	Industry Internship / Project Work	16	SRS & SDD (100)	Mid Term Evaluation (100)	Record Reading (100)	200	500

Sl No	Subject Code	Subject Title	Credits	Internal Evaluation	External Evaluation	Total
2	PS 535.4	Domain Knowledge Project	04	Assignments / Paper Presentation (50)	Documentation | Viva Voce (100)	150
Grand Total			**20**	--		**650**

IV SEM – STRUCTURE FOR MARKS CARD PURPOSE ONLY						
Sl No	**Subject Code**	**Subject Title**	**Credits**			**Total**
	Industry Internship / Project Work					500
1	PH 531.4	Dissertation I	4	SRS & SDD (100)	**Internal Evaluation**	
2	PH 532.4	Dissertation II	4	Mid Term Evaluation (100)		
3	PH 533.4	Dissertation III	4	Record Reading (100)		
4	PH 534.4	Viva-voce	4	200	**External Evaluation**	
5	PS 535.4	Domain Knowledge Project	4	Assignments / Paper Presentation (50)	**Internal Evaluation**	150
				Documentation | Viva Voce (100)	**External Evaluation**	
	Total		**20**			**650**

Scheme of Examination || New CBCS Syllabus from 2021

M.Sc. Software Technology

I Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	PH 531.1	Data Structures and Analysis of Algorithms	HC	4	3	--	30	70	100
2	PH 532.1	Relational Database Management Systems	HC	4	3	--	30	70	100
3	PH 533.1	Object Oriented Programming with Java	HC	4	3	--	30	70	100
4	PH 534.1	Web Design with PHP and MySQL	HC	4	3	--	30	70	100
5	PH 535.1 P	DBMS and Java Lab	HCL	3	--	3	25	50	75
6	PS 536.1 P	Data Structures AOA & Web Design Lab	SC	3	--	3	25	50	75
7	PS 537.1 P	Software Engineering with UML	SCL	4	3	--	30	70	100
8	---	Technical Writing & Presentation	AON	--	--	--	--	-	--
		Total		**26**			**200**	**450**	**650**

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

AON – Add On

M.Sc. Software Technology

II Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	PH 531.2	Programming with Python	HC	4	3	--	30	70	100
2	PH 532.2	Mobile Application Development with Android	HC	4	3	--	30	70	100
3	PH 533.2 P	Python and Android Lab	HCL	3	--	3	25	50	75
4	PS 534.2 [E1]	Foundations of Data Science	SC	3	3	--	30	70	100
5	PS 534.2 [E2]	Data Warehousing and Data Mining	SC	3	3	--	30	70	100
6	PS 535.2 [E1]	Artificial Intelligence & Cognitive Computing	SC	3	3	--	30	70	100
7	PS 535.2 [E2]	Machine Learning and Deep Learning	SC	3	3	--	30	70	100
8	PS 536.2 P	Machine Learning and Data Science Lab	SCL	3	--	3	25	50	75
OPEN ELECTIVE – Offered to other Depts									
9	PO 537.2 (E1)	Enterprise Information System	SC	3 *	3	--	30	70	100
10	PO 537.2 (E2)	Marketing Analytics	SC	3 *	3	--	30	70	100
11	---	Technical Writing & Paper Presentation	AON	--	--	--	--	--	--
		Total		**20+3 ***			**200**	**450**	**650**
	Add-On Course								
	AON	Research Methodology and Ethics							

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

AON – Add On

M.Sc. Software Technology

III Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	PH 531.3	Cloud Computing with Amazon Web Services	HC	4	3	--	30	70	100
2	PH 532.3	Web Technologies and .NET Framework	HC	4	3	--	30	70	100
3	PH 533.3 P	AWS and .NET Lab	HCL	3	--	3	25	50	75
4	PS 534.3 [E1]	Internet of Things and Applications	SC	3	3	--	30	70	100
5	PS 534.3 [E2]	Natural Language Processing	SC	3	3	--	30	70	100
6	PS 535.3 [E1]	Big Data Analytics With Scala And Spark	SC	3	3	--	30	70	100
7	PS 535.3 [E2]	Big Data Analytics with MapReduce and Hadoop	SC	3	3	--	30	70	100
8	PS 536.3 P	Big Data Analytics and Research Lab	SCL	3	--	3	25	50	75
OPEN ELECTIVE – Offered to other Depts									
9	PO 537.3 (E1)	Social Media Analytics	SC	3 *	3	--	30	70	100
10	PO 537.3 (E2)	Streaming Analytics	SC	3 *	3	--	30	70	100
11	---	Technical Writing & Paper Presentation	AON	--	--	--	--	--	--
		Total		**20+3***			**200**	**450**	**650**

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab OE – Open Elective

AON – Add On

M.Sc. Software Technology

IV Semester

Sl No	Subject Code	Subject Title	Credits	Max. Marks for Dissertation / Valuation		External Evaluation		Total
				Dissertation I	Dissertation II	Dissertation III	Max. Marks for Viva-voce (Final)	
1	PH 531.4/ PH 532.4/ PH 533.4/ PH 534.4	Industry Internship / Project Work	16	SRS & SDD (100)	Mid Term Evaluation (100)	Record Reading (100)	200	500

Sl No	Subject Code	Subject Title	Credits	Internal Evaluation	External Evaluation	Total
2	PS 535.4	Domain Knowlege Project	04	Assignments / Paper Presentation (50)	Documentation/ Viva Voce (100)	150
Grand Total			**20**	--		**650**

IV SEM – STRUCTURE FOR MARKS CARD PURPOSE ONLY						
Sl No	**Subject Code**	**Subject Title**	**Credits**			**Total**
	Industry Internship / Project Work					500
1	PH 531.4	Dissertation I	4	SRS & SDD (100)	**Internal Evaluation**	
2	PH 532.4	Dissertation II	4	Mid Term Evaluation (100)		
3	PH 533.4	Dissertation III	4	Record Reading (100)		
4	PH 534.4	Viva-voce	4	200	**External Evaluation**	
5	PS 535.4	Domain Knowledge Project	4	Assignments / Paper Presentation (50)	**Internal Evaluation**	150
				Documentation | Viva Voce (100)	**External Evaluation**	
	Total		**20**			**650**

I Semester

PH 531.1 DATA STRUCTURES AND ANALYSIS OF ALGORITHMS

Total No. of Lectures : 48	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 4**	**[3 – 1 - 0 - 2]**

Course Objectives: This course helps the students:

- To understand and implement algorithms and are able to calculate the time and space complexities. Learn basic concepts such as structures, function pointers, classes and objects.
- To Learn the basic data structures, stack and queue and its variants using array and linked list
- To Learn creation of nodes, memory allocation and linked list concepts, Learn the tree data structure and its applications and traversals and expression representation.
- To Learn the important searching and sorting methods with the help of array
- To Learn the basic graph algorithms and different searching and traversal methods using array and linked list.

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

- To program using structures, function pointers, classes and objects.
- To implement and apply stack, queue and list data structures in different applications.
- To program binary tree, binary search tree, AVL tree and other tree data structures and traverse and represent expressions using tree data structure.
- To program different searching and sorting algorithms using c++ programming language, and also able to select suitable techniques based on the situation
- To create graph using array and using linked list. Ability to find shortest path in graph, able to traverse the graph

UNIT - I

Introduction: Notion of algorithm: - Properties of algorithm, Issues in writing algorithm, how to write an algorithm, what kinds of problem solved by algorithms. Designing algorithm. Analysis of algorithm – Space complexity, Time complexity, measuring an input Size, Measuring running time, Order of growth, Best, Worst and Average Case analysis. Growth of Functions – Big Oh, Omega, Theta Notation. Complexity Analysis Examples.

Structures, Functions, Pointers, new and delete operators, class and object, access specifiers , constructors and destructor. Single, two dimensional arrays, sparse matrices-array,

Introduction to Data structure types - Linear and Non Linear, Static and Dynamic data structures, primitive and Non primitive data structures.

(10 hours)

UNIT - II

Stack Data structure, Stack using array and linked list, Stack applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue - definition, array and linked Implementations, Circular queues-Insertion and deletion operations, Double Ended Queue using array, Priority Queue using array.

(10 hours)

UNIT - III

Singly Linked Lists- Operations-Insertion, Deletion, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion.

Trees – definition, terminology, Binary trees-definition, Properties of Binary Trees, representation of Binary Trees-array and linked representations, Binary Tree traversals, Representation of expressions using tree, Threaded binary trees – Right in threaded binary tree.

(10 hours)

UNIT - IV

Searching - Linear Search, Binary Search, Hashing-Introduction, hash tables, hash functions, Overflow Handling, Comparison of Searching methods.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Merge sort.

(9 hours)

UNIT - V

Graphs–Definitions, Graph Representations- Adjacency matrix, Adjacency lists, warshall's algorithm, shortest path algorithm, Graph traversal methods – Depth First Search and Breadth First Search, Graph spanning tree – prims algorithm and kruskal's algorithm.

(9 hours)

Text Books:

[1]. Yedidyah Langsam, Aaron M. Tenenbaum , "Data structures, using C and C++", 2nd Edition, 2018, Pearson Education.

[2]. A.A.Puntambekar , "Design and Analysis of Algorithms",2010 Technical Publications.

Reference Books:

[1].Michael Goodrich, Roberto Tamssia, "Data Structures and Algorithms", 6th Ed, 2013, Wiley International

[2].Nell Dale, Daniel T Joyce, Chip Weems, "Object Oriented Data Structures using Java", 3rd Edition, 2012, Jones & Bartlett International

[3].Jeoffrey McConnel, "Analysis of Algorithms", 2nd Edition, 2014, Jones & Bartlett Publishers.

[4]. Data structures with C++, J. Hubbard, Schaum's outlines, TMH.

[5]. Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

[6]. Data structures and Algorithm Analysis in C++, 3rd edition, M. A. Weiss, Pearson.

[7]. Classic Data Structures, D. Samanta, 2nd edition, PHI.

PH 532.1 RELATIONAL DATABASE MANAGEMENT SYSTEMS

Total No. of Lectures : 48 **Total Marks : 100** **[L – T – P – S]**
No. of Lectures / Week : 4 **Credits : 4** **[3 – 1 - 0 - 2]**

Course Objectives: This course helps the students.

- Introduction to the basic terminologies related to database management systems. Understanding various data models, relational models and relational algebra operations.
- Understanding the functional dependencies, schema refinement and Normalization for the design of Database.
- Knowledge on Transaction, concurrency control and Lock management for database design.
- Knowledge on Storage and Indexing.
- Preparing students for PL/SQL basic syntax, operators, functions and triggers.

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

- Have good understanding about data and database systems. Describe the fundamental elements of relational database management systems.
- Understand the design of relational databases through the use of Entity-Relationship Diagrams and Normalization procedures and Develop basic skills in the use of SQL in defining and creating a database, inserting and modifying entries in a table.
- Gain Knowledge about Transaction, concurrency control and Lock management for database design.
- Have awareness about how data is stored in different storage media and how data is indexed.
- Prepare the students to understand the power of Query languages and also write PL/SQL transactions and to create different data objects.

Unit - I

Database System Applications: Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, Data Models – The ER Model, Relational Model, Other Models; Database Languages – DDL, DML, Data Storage and Querying, Database Architecture, ER Diagrams.

Relational Model: Introduction to the Relational Model – Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying relational data, Logical data, Logical database design. Introduction to Views, Altering tables and views, Relational Algebra, Basic SQL Queries, Nested Queries, Complex Integrity Constraints in SQL, Triggers.

(10 hours)

Unit – II

Introduction to Schema Refinement: Problems caused by redundancy, Decompositions, Problem related to decomposition, Functional dependencies – Reasoning about FDS, Normal Forms – FIRST, SECOND, THIRD Normal Forms – BCNF – Properties of Decompositions – Lossless – Join decomposition, Dependency preserving Decomposition, Schema refinement in Database design – Multi valued Dependencies –FOURTH Normal Form, Join Dependencies, FIFTH Normal Form.

(10 hours)

Unit - III

Transaction Management: The ACID properties, Transactions and Schedules, Concurrent Execution of Transactions; Lock based concurrency control, Deadlocks – Performance of Locking, Transaction Support in SQL. **Concurrency Control:**Serializability and recoverability; Introduction to Lock Management – Lock Conversions, dealing with Deadlocks, Specialized Locking Techniques; Concurrency Control without Locking., Introduction to Crash recovery.

(10 hours)

Unit – IV

Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing – Clustered Indexes, Primary and Secondary Indexes, Index Data Structures – Hash Based Indexing, Tree Based Indexing. **Storing data:** Disks and Files – The Memory Hierarchy – Redundant arrays of Independent disks. Tree Structured indexing: Intuitions for Tree indexes, Indexed Sequential Access Methods (ISAM) B+ Trees: A Dynamic Index Structure, Search, Insert, and Delete.

(9 hours)

Unit - V

Introduction to PL/SQL: Overview, Environment, Basic Syntax, Data Types, Variables, Constants and Literals, Operators, Conditions, Loops, Strings, Arrays, Procedures, Functions, Cursors, Records, Exceptions, Triggers, Packages, Collections, Transactions, Date & Time, DBMS Output, PL/SQL.

(9 hours)

Text Book:

[1]. Abraham Silberschatz, Heny F Korth, S. Sudarshan, "Database System Concepts", 6th Edition,McGraw Hill Publishers, India.

[2]. Kevin Loney, "Oracle Database 11i The Complete Reference", 1st Edition, 2014, McGraw Hill International,India

Reference Books:

[1].RamezElmasri, ShamkantNavathe, "Database Systems – Models, Languages, Design and Application Programming', 6th Edition, 2011, Pearson Asia.

[2].Thomas Conolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation & Management", 5th Edition, 2012, Pearson Asia.

[3].Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, 2009, McGraw Hill Publishers International, India.

[4].Hector Garcia Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems : The complete book", 2nd Edition, 2011, Pearson Education Asia.

[5].Catherine M Ricardo, "Databases Illuminated", 2nd Ed, 2010, Jones &Bartlet Publishers.

[6].Jeffrey A Hoffer, V Ramesh, HeikkiTopi, "Modern Database Management", 11th Edition, 2013, Pearson Education, Asia.

[7].Jeffrey Ullman, Jennifer Widom, "First Course in Database Systems", 3rd Ed, 2009, Pearson Asia.

[8].David M Kroenke, David Auer, "Database Concepts", 6th Edition, 2009, Pearson Asia.

[9].Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T Snodgrass, V S Subramanian, Roberto Zicari, "Advanced Database Systems", 6th Edition, 2012, Morgan Kaufmann.

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PH 533.1 OBJECT ORIENTED PROGRAMMING WITH JAVA

Total No. of Lectures: 48 **Total Marks : 100** **[L – T – P – S]**

No. of Lectures / Week : 4 **Credits : 4** **[3 – 1 - 0 - 2]**

Course Objectives: The course objective is to:

- Introduce the principles and concepts of Object oriented programming followed the basic constructs of Java language.
- Explore the OOP concepts like constructors, method overloading, objects as parameters, nested classes and concept of Arrays in Java
- Understand String Handling in Java, concept of Inheritance and its importance and purpose of Interfaces
- Learn Exception Handling, File Handling and Collection Frameworks in Java
- Understand the concept of Multithreaded Programming and the importance of Generic programming

Course outcomes: After completing the course, the student should develop:

- An ability to understand the Object Oriented Concepts well and relate it with real world problems, develop solutions with programming constructs
- An understanding on classes, objects, methods, attributes, constructors and arrays and also write efficient programs using these concepts
- An ability to do string manipulation, understand and apply reusability using inheritance and also use Interfaces for efficient programming
- An understanding and clear knowledge about Exceptions and Exception handling, File I/O streams and also collection frameworks
- An ability to develop and understand multithreaded applications with synchronization and apply generic programming concepts wherever required

Unit-I

Principles of Object Oriented Programming: A look at procedure oriented programming – characteristics, Object Oriented programming paradigm, Basic concepts of OOP, Benefits and application of OOP.

Java Programming Fundamentals : The Java Language, The Java Development Kit, The Java Keywords, Identifies in Java, The Java Class Libraries, Java's Primitive Types, Literals, The Scope and Lifetime of Variables, operators, Type conversion, Expressions, Input characters from the Keyword, Control structures – if, if – else and nested ifs, The if-else-if Ladder, The Switch Statement, Looping structures - for Loop, while Loop, The do-while Loop, Use of break and continue statements, Nested Loops and labelled loops.

(10 hrs)

Unit-II

Classes, Objects and Methods: Class Fundamentals, Creating Objects – the new operator, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters – this Keyword.

Constructors – default, Parameterized Constructors, Garbage Collection and Finalize method. Controlling Access to Class Members, Passing Objects to Methods, Returning Objects, and Method Overloading, Overloaded Constructors, Static members, Introducing Nested and Inner Classes.

Arrays: Arrays in Java, Multidimensional Arrays, Using the Length Member, the For-Each Style for Loop.

(10 hrs)

Unit-III

String Handling: String class Fundamentals, The String Constructors, String class methods, StringBuffer and StringBuilder classes.

Inheritance: Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super under different contexts, Different types of inheritance, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final keyword.

Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Using Interface References, Implementing Multiple Interfaces.

(9 hrs)

Unit-IV

Exception Handling: Exception Handling Fundamentals, Try… throw…catch block, using Multiple catch clauses, Nested try blocks, Throwing an Exception, Throwable class, using finally, creating user defined exceptions and its use.

File Handling : Files and Streams, Operations using Reader and Writer classes

Collection Frameworks: Introduction to Java Collections Framework, Benefits of Java Collections Framework, Java Collections Interfaces – Iterator Interface, List Interface, Java Collection Classes – Hash Map Class

(10hrs)

Unit-V

Multithreaded Programming: Multithreading fundamentals, Thread life cycle, Creating a Thread - Thread Class and Runnable Interface, Creating Multiple Threads, Thread Priorities, Synchronization.

Generics: Introduction, Defining a Generic class – general form, Bounded types, Using wildcard arguments, creating generic method and constructors, generic interfaces and

Generic class hierarchies – use, generic subclass, casting and overriding methods in generic class.

(9 hrs)

Text Books:

[1]. Herbert Schildt, "Java :The Complete Reference", 8th Edition, 2014, McGraw- Hill.

[2]. Paul J Deitel, Harvey M Deitel, "Java for Programmers", 2nd Edition, 2013, Pearson.

Reference Books:

[1]. Cay S Horstmann, "Java Concepts Compatible with Java 5, 6, 7 th Edition", 2013, Wiley.

[2]. Julie Anderson, Harvey J, "Java Illuminated", 3rd Ed, 2013, Jones & Bartlett.

[3]. C Xavier, "Java Programming: A Practical Approach", 1st Edition, 2011, McGraw Hill.

[4]. Cay Horstman, Gary Cornel, "Core Java : Volume – 1 Fundamentals", 8th Edition, 2010, Pearson Asia.

[5]. Edward Currie, "Fundamentals of Programming using Java", 2nd Edition, 2009, Cengage.

[6]. Anthony J Dos Reis, "Introduction to Programming using Java", 1st Ed, 2012, J&B Int

[7]. Jana, Debashish, "Java and Object Oriented Programming Paradigm", 2nd Edition, 2010, PHI Learning,

[8]. Joyce Farrell, "Java Programming", 2nd Edition, 2008, Cengage Learning India

[9]. Steve Holzner, "Java 2 Black Book", 1st edition, 2009, Wiley India

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PH 534.1 : WEB DESIGN WITH PHP and MYSQL

Total No. of Lectures : 48	**Total Marks: 100**	**[L – T – P – S]**
No. of Lectures / Week: 4	**Credits : 4**	**[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students:

- Understand the principles of creating an effective web page, including an in-depth consideration of information architecture using HTML and CSS.
- To develop basic programming skills using JavaScript and jQuery
- To become familiar with jQuery and its use in efficiently building Ajax applications.
- To provide the necessary knowledge to design and develop dynamic, database-driven web applications using PHP.
- Will learn how to connect to any database, and to create database-driven HTML forms and reports.

Course Outcomes: The Candidate will be able

- To use knowledge of HTML and CSS code and an HTML editor to create personal and/or business websites following current professional and/or industry standards. Use critical thinking skills to design and create websites.
- To create effective scripts using JavaScript.
- To enhance the end user experience using JQuery.
- Students can be employed on entry-level jobs of PHP based web development in software industry
- To develop interactive and dynamic website using PHP and database connectivity.

Unit I

HTML 5: Difference between HTML 4 & 5, Page Structure of HTML5. Section Tag & Article Tag; HTML5 Forms Tags, search, tel, url and email; date/time input types, colornumber, range, min, max, and step attributes. Form Attributes, auto complete, no validate. Form Field Attributes, required, placeholder.**CSS:** Introduction to CSS, CSS Rules, Pseudo classes and pseudo elements, Selector Forms, The Box Model, Conflict Resolution; Cascading; Levels of Style Sheet, Style Specification Formats; Borders, and backgrounds. **(10 hrs)**

Unit II

JavaScript: The Basic of JavaScript, Primitives Operations and Expressions, Value, Data types , Variables, Control Statements, Arrays, Functions, Constructors,Object Creation and Object Model, Events and Listeners, Applications ,JavaScript Libraries.

(9 hrs)

Unit III

JQuery : Overview of jQuery; Structure of jQuery, Using jQuery and including .js file to HTML, Type of Selectors, Handling Events with jQuery, Filters;

AJAX: Introduction to AJAX, AJAX Load, Change AJAX data type, Status Codes, JSON, Accessing and consuming remote JSON Data.

JQuery UI: Introduction to JQuery UI; JQuery UI Interactions, JQuery UI Widgets, JQuery UI Effects. **(10 hrs)**

Unit IV

PHP Basics : Introduction to PHP; Embedding PHP code; Working with Types and operators; Integer division, Generating Random numbers; Comparing values with the Spaceship operator; Condition and Looping statements; Arrays, Numeric Associative and Multi-dimensional arrays; Strings and String functions; Regular Expressions; Date and Time function; Mathematical functions; User-Defined Functions; Return type declarations with compound Types; Scalar Type Hinting; Scalar Parameter and Return Type declarations; Working with web forms; PHP POST & GET form elements; Validating form data; Understanding magic quotes; Setting default values in forms; Handling Errors, Throwing and Catching Exceptions. Logging exceptions.

(9hrs)

Unit V

PHP Intermediate: Classes and Objects Constructors and Destructors Access Specifies, Static and final modifiers Inheritance and its types Polymorphism, Abstract and Final classes. Anonymous Classes, Generator Return expressions, Generator Delegation. Using MySQL; Database Basics, Configuring PHP for Database Support, Managing Database Connections, PHP's Database & SQL APIs, Performing Queries, Processing Result Sets, PDO. PHP cookie handling; PHP session handling; Reading & writing; files with PHP; Processing uploaded files; Retrieving uploaded files; Mail functions.

(10 hrs)

Text Books:

[1]. Robin Nixon, "Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5", 5th Ed, 2018, O'Reilly Publishers.

[2]. Christopher Murphey, R Clark, "Beginning HTML 5 and CSS 3", 1st Ed, 2015, Wiley Apress.

Reference Books:

[1].Steve Prettyman, "Learn PHP 7: Object Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL", 2016, Apress.

[2]. Simon Sarris,"HTML5 Unleashed", 2014, Pearson Education.

[3]. Piotr Sikora, "Professional CSS3", 2016, Packt Publishing.

[4]. Joel Murach, Ray Harris , "Murach's PHP and MySQL", 2nd Ed, 2014, Mike Murach& Associates

[5]. Mary Delamater, Zak Ruvalcaba, "Murach's JavaScript and JQuery", 3rd Ed, 2017,Mike Murach& Associates

[6]. Eric Sarrion, "jQuery UI", 2014, Oreilly Publishers.

[7]. Richard Blum, "PHP, MySQL & JavaScript", 2018, John Wiley & Sons.

[8]. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 5th Ed, 2018, Pearson Education.

PS 537.1 SOFTWARE ENGINEERING WITH UML

Total No. of Lectures : 42 **Total Marks : 100** **[L – T – P – S]**
No. of Lectures / Week : 4 **Credits : 4** **[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to

- To understand the fundamentals of software Engineering and various software process models such as waterfall and evolutionary models such as Agile.
- To discover the modeling concepts and learn using various UML diagrams in the software development process.
- To understand the role of Requirement Felicitation and Requirement Analysis in the overall software development process.
- To expose the various system design concepts such as Coupling and cohesion, Layers and Partitions, Architectural styles, System Design Activities.
- To understand about various pattern solutions and also the different object oriented software testing approaches.

Course outcomes: Upon Completion of this course, students should be able to:

- Plan and deliver an effective software engineering process, based on development lifecycle models.
- Make effective use of UML, along with design strategies such as defining a software architecture, separation of concerns and design patterns.
- Capture, document, analyze requirements and translate a requirements specification into an implementable design, a structured and organized process.
- Understanding the different system design concepts such as coupling, cohesion and architectural styles.
- Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.

Unit –I

Introduction: Software, Software Engineering: Definition; Phases in Software Engineering, Key Challenges in Software Engineering.

Software Process Life Cycle: Software Process, Project and Product; Process Assessment; Prescriptive Process Models; Specialized Process Models.

Agile Development : Introduction to Agility, Agility and the cost of change, Agile process, Extreme programming(XP), XP Process, Other Agile Process Models.

(9 hrs)

Unit –II

Modeling with UML: Introduction; Overview of UML: Use Case Diagrams, Class Diagrams, Interaction Diagrams, State chart Diagrams, Activity Diagrams.

Modeling Concepts: Systems, Models and views, Data Types, Abstract Data Types and Instances, Classes, Abstract Classes and objects, Event Classes, Events and Messages, Object-oriented Modeling, Falsification and prototyping.

A Deeper view into UML: Use Case Diagrams, Class Diagrams, Interaction Diagrams, State chart Diagrams, Activity Diagrams Case Studies

(9 hrs)

Unit –III

Requirement Elicitation : Introduction, An overview of Requirements Elicitation, Requirement Elicitation Concepts: Functional Requirements, Nonfunctional requirements, Completeness, consistency, Clarity and Correctness, Realism Verifiability, and Traceability, Greenfield Engineering, Reengineering and Interface Engineering, Requirement Elicitation Activities, Managing Requirements Elicitation, Case Study.

Analysis : Introduction, An overview of Analysis, Analysis Concepts, Analysis Activities: From Use cases to objects, Managing Analysis, Case.

(8hrs)

Unit –IV

System Design: Decomposing the System: Introduction, An overview of System Design, System Design Concepts: Subsystems and classes, Services and subsystem Interfaces, Coupling and cohesion, Layers and Partitions, Architectural styles, System Design Activities: From objects to subsystems**.**

System Design: Addressing Design Goals: Introduction, An overview of System Design Activities, UML Deployment Diagrams, System Design Activities, Concept: UML Deployment Diagrams, System Design Activities: Addressing Design Goals, Managing System Design, Case Study.

(8hrs)

Unit –V

Object Design: Reusing Pattern Solutions: Introduction, An overview of Object Design, Reuse Concepts, Reuse Activities, Managing Reuse, Interface Specification concepts, Interface Specification Activities, Managing Object Design.

Mapping Models to Code: An overview of Mapping, Mapping Concepts, Mapping Activities, Managing Implementation. Case study.

Testing : Overview of Testing, Testing Concepts: Faults, Erroneous States and Failures, Test Cases, Test Stubs and Drivers, Testing Activities: Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, Managing Testing: Planning Testing, Documenting Testing, Assigning Responsibilities, Regression Testing, Automation Testing.

(8hrs)

Text Books:

[1] R. S. Pressman, "Software Engineering – A practitioner's approach", 10th Ed, 2015, McGraw Hill Int. Ed.,.

[2] Bernd Bruegge, Allen H.Dutoit, "Object-oriented Software Engineering using UML, Patterns and Java", 2nd Edition, 2012, Pearson Education.

Reference Books:

[1] Rod Stephens, "Beginning Software Engineering" , 2015, Wiley and sons Inc.

[2] Pankaj Jalote, "Software Engineering: A precise approach", 2015, Wiley Precise Textbook series.

[3] I. Sommerville, "Software Engineering ", 10th Edition, 2016, Pearson.

[4] Frank Tsui, Orlando Karam, Barbara Bernal, "Essentials of Software Engineering", 2015, Jones and Bartlett Student Edition.

II Semester

PH 531.2 PROGRAMMING WITH PYTHON

Total No. of Lectures : 48	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 4**	**[3 – 0 - 2 - 2]**

Course Objectives: The objective of this course is to make the students:

- 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.
- Infer the Object-oriented Programming concepts in Python.

Course Outcomes: At the end of this course students would have learned

- To design and program Python applications, use lists, tuples, and dictionaries in Python programs.
- To identify Python object types, use indexing and slicing to access data in Python programs.
- To build and package Python modules for reusability and to read and write files in Python.
- Tto design object oriented programs with Python classes and use class inheritance in Python for reusability.
- To use exception handling in Python applications for error handling.

Unit I

Introduction to Python: Installation and Working with Python, Understanding Python variables, basic operators, blocks. Declaring and using Numeric data types: int, float, complex, using string data type and string operations, defining list and list slicing, Use of Tuple data type.

(10 hrs)

Unit II

Program Flow Control & Functions: Conditional blocks using if, else and elif, for loops in, for loop using ranges, use of while loops in python, Loop manipulation using pass, continue, break and else.Organizing python codes using functions, organizing python projects into modules, importing own module as well as external modules, Understanding Packages.

(10 hrs)

Unit III

String, List, Dictionary &File handling: Understanding in-built string methods, List manipulation, Dictionary manipulation. Programming using string, list and dictionary in-built

functions. Reading files in python, writing files in python, Understanding read and write functions, manipulating file pointer using seek, Programming using file operations.

(10 hrs)

Unit IV

OO Programming & Regular Expressions: Concept of class, object and instances, constructor, class attributes and destructors, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes. Pattern matching and searching, Power of pattern searching using regex in python, Pattern finding programs using regular expression.

(9 hrs)

Unit V

Exception Handling & Database Interaction: Avoiding code break using exception handling, Safe guarding file operation using exception handling, Handling and helping developer with error code. SQL Database connection using python, Creating and searching tables, Reading, storing and updating information on database.

(9 hrs)

Text Books:

[1]. R. Nageswara Rao, "Core Python Programming", 2nd Edition, 2018, Dreamtech Press.

[2]. Jason Rees, "Python Programming: A Practical Introduction To Python Programming For Total Beginners Paperback", 2019, Independent Publication.

Reference Books:

[1]. Eric Matthes, "Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming", 2019, No Starch Press.

[2]. Zed A. Shaw, "Learn Python 3 the Hard Way", 2017, Addison Wesley.

[3]. John M Zelle, "Python Programming: An Introduction to Computer Science", 2016, Ingram short title; Third edition.

[4]. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3, 2013, Oreilly 3rd Edition.

PH 532.2 MOBILE APPLICATION DEVELOPMENT WITH ANDROID

Total No. of Lectures : 48 **Total Marks: 100** **[L – T – P – S]**
No. of Lectures / Week: 4 **Credits : 4** **[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students:

- To understand the development environments, Architectures and programming paradigms of Android devices.
- To design and develop an Android App with various controls that provide interactivity and handle user inputs.
- To understand the various building blocks of Android and implement Broadcast Receiving, Services, Content Providers etc.
- To understand how various types of data is stored in an Android Based device and also perform read and write operations on the same.
- Implement and understand how various advanced features of Android such as Sensors, Accelerometer, GPS, etc.

Course Outcomes: Students must be able to

- Understand the architecture, working and environmental setup of Android
- Design and Implement simple GUI based Android Apps that handle user input and provide information
- Implement Android apps that are able to receive broadcasted messages, act as content provider or receiver and run background services.
- Create Android Apps that can manipulate data from various data stores such as internal, external memory and also SQLite as a Database.
- Design and Work with advanced sensors of the phone and manipulate Telephony and SMS in an Android Phone.

Unit - I

Introduction to Android - Architecture - Features of Android SDK - Introducing the Development Framework, Developing for Android- Android Development Tools- The Android Virtual Device Manager - Android SDK Manager - The Android Emulator - The Dalvik Debug Monitor Service - The Android Debug Bridge. Installing and Configuring Android SDK, ADT and AVD - Android Software Stack, Dalvik Virtual Machine.

(10hrs)

Unit – II

Creating Android Applications: Working of Android Application: Android Application Life Cycle; Building User Interfaces - Introducing Activities, Various Layouts, Fragments, and Adapters. Intents, Intent Filters, Controls, Dialogs, Toasts and Notifications: Displaying Pictures and Menus with Views; Adding Interactivity and Handling UI events.

(10 hrs)

Unit – III

Building Blocks of Android: Activities: Life Cycle and Working; Broadcast Receivers: Creating, Registering and unregistering a Broadcast Receiver. Content Providers: Concept of Content Resolver, Creating and using Content Providers. Services: Bound Services and Unbound Services, Life Cycle of services. **(9 hrs)**

Unit - IV

Data Access in Android: Creating, Saving and Retrieving Shared Preferences; Introducing the Preference Framework and the Preference Activity; Including Static Files as Resources; Working with the File System.Introducing Android Databases; Introducing SQLite; Content Values and Cursors; Working with SQLite Databases; Creating and Using Content Providers; Using Native Android Content Providers. **(10 hrs)**

Unit – V

Advanced Android:Introducing Services, Using Background Threads, Using Alarms; Controlling Device Vibration; Introducing Android Text-to-Speech; Using Sensors and the Sensor Manager; Using Accelerometer, Compass and GPS; Audio, Video and Using the Camera; Using Telephony and SMS.

(9 hrs)

Text Books:

[1]. Reto Meier, Ian Lake, "Professional Android", 4th edition, 2018,Wiley Wrox Publications.

[2]. Dawn Griffiths, David Griffiths, "Head First Android Development", 2nd Edition, 2017, O'Reilly Media.

Reference Books:

[1]. Bill Phillips, Chris Stewart, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", 3rd edition, 2017, Big Nerd Ranch Guides.

[2]. John Horton, "Android Programming for Beginners", 2nd edition, 2018, Ingram short title.

[3]. Paul Dietel, Harvey Dietel, "Android 6 for Programmers : An App Driven approach", 2016, Pearson

[4]. Reito Meier, "Professional Android Application Development", 1st Ed, 2012, Wiley Press.

[5]. Wei- Meng Lee, "Beginning Android 4 Application Development", 1st Ed, 2012, Wiley Press.

[6]. Mednieks, Laird Dornin, Blake Meike, "Programming Android", 2nd Ed,2012, O'Reilly Media.

PS 534.2 E1 FOUNDATIONS OF DATA SCIENCE

Total No. of Lectures : 42	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 3**	**[3 – 1 - 0 - 2]**

Course Objectives:

- To learn the basic of data presentation with appropriate visualization to have a better perspective of the data.
- To understand the process of finding the extreme values that deviate from other observations on data and give the right treatment which will enable to build a better model.
- To understand the purposes of measures of central tendency, how to calculate and interpret them. It also helps to determine the reliability of an average and comparethe variability of two or more series.
- To identify the strength and direction of a linear relationship between two variables and using regression to predict how much a dependent variable changes based on adjustments to an independent variable.
- To gain knowledge on the various methods of learning that will help to classify or cluster the data based on certain criteria.

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

- Select appropriate statistical techniques for summarizing and displaying of data.
- Identify outliers and use the right techniques to treat them in order to give a better understanding of the data.
- Analyze and draw inferences from data using appropriate statistical methods.
- Perform correlation and regression, and be able to make predictions and interpret the results
- Identify the types of learning and apply the appropriate tools to derive information from the data.

Unit I

Exploration of data: Data, types of data, measurement scales, variables, cleaning of data, missing values various types and the methods of imputation, univariate analysis and bivariate analysis.

(9 hrs)

Unit II

Outlier detection and treatment, visualization of data: basic graphical representations, their need and importance, exploring data distribution: boxplot, frequency table, histogram and density plot.

(9 hrs)

Unit III

Measures of central tendency: mean, median and mode, quartiles, deciles and percentiles & skewness, Measure of dispersion: range, Standard Deviation and Related Estimates.

(8 hrs)

Unit IV

Correlation: correlation coefficient, scatter plot, correlation matrix, drawing inferences, Introduction to linear regression: simple linear regression model, assumptions of the model, method of least squares, interpretation of the regression coefficients, prediction.

(8 hrs)

Unit V

Supervised and unsupervised learning, clustering: Distance measures for numerical and categorical data, hierarchical and non-hierarchical clustering, k- means & k –medoids algorithms Classification: need and importance, k-nn and Bayesian classification.

(8 hrs)

Text books

[1]. Peter Bruce and Andrew Bruce, "Practical Statistics for Data Scientists", 2017, Published by O'Reilly Media.

[2]. Lillian Pierson, "Data science for dummies", 2015, John Wiley and Sons.

Reference Books

[1]. Avrim Blum, John Hop Croft, Ravindran Kannan, "Foundations of Data Science", 2014, Cambridge University Press.

[2]. Thomas Mailund, "Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist", 2017, APress.

[3]. Jason W. Osborne, "Best Practices in Data Cleaning", 2012, Sage Publications..

[4]. Jesus Rogel-Salazar, "Data Science and Analytics with Python", 1st Edition, 2016, CRC Press

PS 534.2 E2 DATA WAREHOUSING AND DATA MINING

Total No. of Lectures : 42 **Total Marks : 100** **[L – T – P – S]**
No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students:

- Understand the different characteristics, models and algorithms in Data warehouses.
- Design data warehouse with dimensional modelling and apply OLAP operations.
- Discovering the usage of Data preprocessing, Algorithms related to Data Mining and Characterize the kinds of patterns that can be discovered by association rule mining.
- Characterize the kinds of patterns that can be discovered by classification and clustering.
- Master data mining techniques in various applications like social, scientific and environmental context.

Course Outcomes: By the end of the module, the student should

- Understand and implement classical models and algorithms in data warehouses.
- Display a comprehensive understanding of different data mining tasks and the algorithms most appropriate for addressing them.
- Evaluate models/algorithms related to Association rule mining with respect to their accuracy.
- Perform a self directed piece of practical work that requires the application of data mining techniques in classification and prediction.
- Conceptualize a data mining solution to a practical problem in clustering and outlier analysis.

Unit – I

Defining Data Warehouse Concepts and Terminology : Common data warehouse definitions, Data warehouse properties and characteristics, Warehouse development approaches, Components of data warehouse design and implementation, Components of a data warehouse, Data warehouse compared with data mart, Dependent and independent data marts .

Modeling the Data Warehouse : Data warehouse database design phases, Defining the business model, Choosing the architecture, Creating the dimensional model, Using time in the data warehouse, Using summary data, Query rewrite, Creating the physical model

(9 hrs)

Unit – II

Building the Warehouse: Extracting Data : Extracting, transforming, and loading data, Examining data sources, Extracting data, Extraction techniques Transforming Data : Transformation, Transforming data: problems and solutions, Resolving quality data issues, Transformation techniques, Transformation tools; Loading Warehouse Data : Loading data into the warehouse, Building the loading process, **Loading the data:** Post-processing of loaded data, Verifying data integrity; Refreshing Warehouse Data :

Capturing and applying changed data, Batch load requirements, Limitations of methods in applying change, Purging and archiving data.

(9 hrs)

Unit – III

Data Mining: Data, Types of Data, Data Mining functionalities – Data Mining Task Primitives; Issues - Integration of Data Mining system with a Data Warehouse.

Data Preprocessing: Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation

Association Rule Mining: Scalable Frequent Itemset Mining Methods, Improving efficiency, Mining various kinds of Association Rules, Association Mining to Correlation Analysis, Constraint based Association Mining. **(8 hrs)**

Unit – IV

Classification and Prediction: Issues; Classification by Decision Tree Introduction; Bayesian Classification; Rule Based Classification; Classification by Back propagation; Support Vector Machines; Associative Classification; Lazy Learners; Other Classification Methods; Prediction; Accuracy and Error Measures; Evaluating the Accuracy of a Classifier or Predictor; Ensemble Methods; Model Section.

(8hrs)

Unit – V

Cluster and Outlier Analysis: Types of Data in Cluster Analysis; Categorization of Major Clustering Methods; Partitioning Methods; Hierarchical methods; Density; Based Methods; Grid-Based Methods; Model-Based Clustering Methods; Constraint-Based Cluster Analysis; Outlier Analysis.

Data Mining Applications: Data mining applications; Social impacts of data mining: Ubiquitous and invisible data mining; data mining privacy and data security; Case Studies: Mining the WWW -Text mining. (**8hrs)**

Text Books:

[1] Jain Pei, Jiawei Han, Micheline Kamber, “Data Mining : Concepts and Techniques”, 3rd Ed, 2012, Elsevier.

[2] LuísTorgo, “Data Mining with R, Learning with Case Studies”, 2017, CRC Press, Taylor and Francis Group.

[3] Alex Berson, Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, 3rd Ed, 2011, McGraw Hill

Reference Books:

[1] PaulrajPonniah, “Data Warehousing: Fundamentals for IT Professionals”, 2nd Ed, 2012, Wiley India

[2] Prabhu C.S.R., “Data Warehousing Concepts, Techniques, Products andApplications”, 3rd Edition, 2011, PHI Learning Private Limited.

[3] MatthewA.Russell,"MiningtheSocialWeb:DataMiningFacebook,Twitter,LinkedIn, Google+, GitHub, and More", 2011, Shroff Publishers,2nd Edition .

[4] Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", 2014, Shroff Publishers.

[5] Witten, Frank, Hall, “Data Mining : Practical Machine Learning Tools & Techniques”, 3rd 2012, Elsevier.

PS 535.2 E1 ARTIFICIAL INTELLIGENCE AND COGNITIVE COMPUTING

Total No. of Lectures : 42	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 3**	**[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students:

- To understand the application of a given AI technique to a given concrete problem, usage of intelligent agent in AI problems, defining AI problem as a state space search
- To understand various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent, to learn the different search techniques for the design of AI problem
- To understand the concept of DFS & BFS and learn the application of statistical reasoning in AI, to provide the concept of Bayes rule in designing AI systems
- To understand the fundamental concepts of cognitive science and how it interacts with humans naturally with cognitive computing
- To understand the concept of computational neuroscience and its applications, Application of problem solving using cognitive psychology

Course Outcomes: By the end of the module, the student should be able

- To Design intelligent agents for problem solving, reasoning and planning.
- To implement AI systems with different approaches of knowledge representation, design AI systems with heuristic search techniques
- To implement AI systems using statistical and symbolic reasoning, designing AI models using Bayes rule
- Apply AI technique on current applicationswith cognitive psychology using connectionist approach
- To design applications using computational cognitive neuroscience by applying techniques of cognitive computing and neural network theory.

Unit - I

Artificial Intelligence: The AI Problems, The Underlying assumption, AI Technique, The Level of the model, Criteria for success, some general references, Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems.

Intelligent Agents: Agents and Environments, Nature of environments, Structure of agents.

(9hrs)

Unit - II

Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis.

Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem.

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction.

Logical Agents: Knowledge –based agents, the Wumpus world, Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic.

(9hrs)

Unit - III

Symbolic Reasoning Under Uncertainty: Introduction to non monotonic reasoning, Logic for non monotonic reasoning, Implementation Issues, Augmenting a problem-solver,

Implementation: Depth-first search, Implementation: Breadth-first search.

Statistical Reasoning: Probability and bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic.

Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Independence, Bayes' rule and its use, The Wumpus world revisited.

(8 hrs)

Unit - IV

Cognitive Science: Cognitive view, Fundamental concepts, Computers in Cognitive science, Applied Cognitive science, Interdisciplinary nature of Cognitive science

Cognitive Psychology: The Nature of Cognitive Psychology, The Notion of Cognitive Architecture, Propositional and Schematic representation, Cognitive processes, Working memory and Attention, Mental Images, Automatic and Controlled processes, The Acquisition of Skill Approach, The Connectionist approach to Cognitive Architecture.

(8 hrs)

Unit - V

Cognitive Psychology: Further Explorations: Concepts and Categories, Memory, Reasoning, Problem Solving.

Neuroscience: Brain and Cognition: Introduction to the study of the nervous system, Organization of the central nervous system, Neural Representation, Neuropsychology, Computational Neuroscience.

(8 hrs)

Text Books:

[1] Elaine Rich, Kevin Knight, Shivashanka B Nair:, "Artificial Intelligence", 3rd edition. 2013, Mc Graw Hill.

[2] Stuart Russel, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd edition 2013 Pearson.

[3] Neil A Stillings, Steven E. Weisler, Chrisopher H Chase, Mark H Feistein, Jay L Garfield and Edwina L Rissland, "Cognitive Science", Second Edition, MIT Press.

Reference Books :

[1] E. Charniak, "Introduction to Artificial Intelligence", 2nd Ed, 2014, Pearson Education.

[2] P. H. Winston, "Artificial Intelligence", 1st Edition, 2010, Pearson India.

[3] FU, Li-min, "Neural Networks in Computer Intelligence", 5th Ed, 2015, McGraw Hill.

[4] Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, "Cognitive Science: An Introduction", MIT Press.

PS 535.2 E2 MACHINE LEARNING AND DEEP LEARNING

Total No. of Lectures: 42 **Total Marks: 100** **[L –T – P – S]**
No. of Lectures / Week: 4 **Credits: 3** **[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students:

- To understand the theoretical and practical aspects of machine learning, learning the types of machine learning, application of bayes rule in machine learning, learning the imporatnace of dimensionality reduction
- To appreciate supervised and unsupervised learning algorithms and their applications, understand the method of clustering, Support Vector Machine and decision tree for developing machine learning models, importance of gradient descent in ML
- To learn the basic knowledge of HMM, MLP & reinforcement learning and their application in creating classification model, learning to evaluate the performance metric of a machine learning model
- To understand the concept of deep learning and importance of applied mathematics in machine learning, learn the basic idea of neural network, knowing the basic concept of CNN and RNN
- To gain knowledge of encoders and decoders, importance of transfer learning, understand the concept of structured probabilistic model

Course Outcomes: By the end of the module, the student should be able

- To implement Machine Learning with Bayes algorithm, to work out the concept of dimensionality reduction using PCA & LDA
- To implement Machine Learning with SVM, Decision tree and clustering methods
- To use MLP, HMM for classification and also to measure the performance of the classification algorithm, to design models using reinforcement learning
- To implement CNN and RNN for Deep Learning models by applying all the methods for creating optimal model
- To implement Transfer learning and Auto encoders for Deep Learning models

Unit - I

Introduction: Machine Learning Foundations, Overview, Applications, Types of Machine Learning,Basic Concepts in Machine Learning, Examples of Machine Learning, Applications.

Supervised Learning: Probably Approximately Correct (PAC) Learning, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm.

Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Linear Discriminant Analysis.

Bayesian Decision Theory: Introduction**,** Classification, Discriminant Functions, Bayesian Networks, Association Rules.

(9 hrs)

Unit - II

Decision Trees: Introduction, Univariate Trees, Pruning, Rule Extraction from Trees, Multivariate Trees.

Linear Discrimination: Introduction, Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Gradient Descent, Logistic Discrimination, Support Vector Machines.

Clustering: Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Hierarchical Clustering, Choosing the Number of Clusters.
Nonparametric Methods: Introduction, Nonparametric Density Estimation, Nonparametric Classification, Nonparametric Regression: Smoothing Models.

(9 hrs)

Unit - III

Multilayer Perceptrons: Introduction, Training a Perceptron, Back propagation Algorithm, Training Procedures, Tuning the Network Size.
Hidden Markov Models: Introduction, Discrete Markov Processes, Three Basic Problems of HMMs, Evaluation Problem, Learning Model Parameters, Model Selection in HMM.
Accessing and Comparing Classification Algorithms: Introduction, Cross-Validation and Resampling Methods, Measuring Error, Assessing a Classification Algorithm's Performance, Comparing Two Classification Algorithms, Comparing Multiple Classification Algorithms: Analysis of Variance.
Reinforcement Learning: Introduction, Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization.

(8hrs)

Unit - IV

Introduction: Historical trends in Deep learning, Deep learning: Overview of Methods.
Applied Math for Machine Learning: Linear Algebra, Probability and Information Theory, Numerical Computation.
Deep Networks: Deep Feedforward Networks – Feed Forward networks, Backpropogation; Regularization- Overview, Parameter Penalties, Data Augmentation, Multi Task learning, Bagging, Dropout; Optimization for Training Deep Models – Optimization vs training, Basic Algorithms, Adaptive learning Rates; Convolution Networks – The Convolution operation and CNNs, Convolution Networks, Pooling; Sequence Modeling: Recurrent and recursive Nets – Sequence Modeling, Unfolding Graphs, Recurrent Neural networks, Bidirectional RNNs, Deep Recurrent Networks.

(8hrs)

Unit - V

Deep Learning research: Linear Factor Models- PCA and factor Analysis, ICA; Autoencoders – Stochastic Encoders and Decoders, DenoisingAutoencoders, Applications; Representation Learning- Greedy Layer wise Unsupervised Pretraining, Transfer Learning and Domain Adaptation, Semi-supervised Distangling of causal factors, Distributed Representation; Structured Probabilistic Models for Deep Learning – Using Graphs to describe model structure, Boltzmann Machines, Deep Belief Networks, Directive Generative nets.

(8hrs)

Text Books:

[1] Ethem Alpaydin, "Introduction to Machine Learning", 1st Edition 2004, MIT press.
[2] Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", 1st Edition 2016, MIT press.

Reference Books:

[1] Christopher Bishop, "Pattern Recognition and Machine Learning", 1st Edition 2006, Springer.
[2] Kevin P. Murphy, " Machine Learning: A Probabilistic Perspective", 1st Edition2012, MIT press.
[3] Tom Mitchell, "Machine Learning", 1997, McGraw-Hill Publications.
[4] Michael Nielson, "Neural Networks and Deep Learning", 2nd Edition 2015, Determination Press.
[5] S.N Sivanandam, S.N Deepa, " Principles of Soft Computing", 3rd Edition, 2015, Wiley Press.

[OPEN ELECTIVE – OFFERED TO OTHER DEPTS]

PO 537.2 (E1): ENTERPRISE INFORMATION SYSTEMS

Total No. of Lectures : 45	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 3**	**[3 – 1 - 0 - 0]**

Course Objectives: This course is designed to provide an advanced introduction to the management of enterprise information systems with a specific focus on issues related to the interaction between organization design and the design of enterprise information systems. We will explore the relationship between the strategic intents of firms and their design of the enterprise information infrastructure. The course will be executed with an instructor guided self-learning philosophy, and by design, attempts to strike a balance between conceptual learning and exposure to practical issues through a case-based pedagogy.

Course Outcomes : Upon successful completion of this course, a student will be able to:

- Understand the enterprise need of integrating information assets, and be able to articulate
- the advantages and tradeoffs of different information integration designs of organizations.
- Understand the key components of Enterprise Information Systems such as Enterprise
- Resource Planning, Customer Relationship Management, Supplier Relationship
- Management and Business Intelligence. | Understand the key issues in implementing and managing EIS.
- Understand the emerging business models of enterprise system vendors

Unit - I

Management Information Systems – Advance in Management, MIS Organization, Purpose and Objectives - Contemporary Approaches to MIS - Information as a strategic resource - Use of information for competitive advantage - MIS as an instrument for the organizational change. Information Dynamics

Planning for MIS & System Life Cycle : Design and Implementation of MIS - IS Strategic Planning - MIS Design - Gross Design Concepts - Detail Design Concepts - MIS Implementation - Acquiring Information Systems: Contemporary Approaches; Information Flow - Entity Relationship Modeling - Data Modeling - Detailed Process Analysis - Data Flow Diagrams

9 hrs

Unit - II

Decision Making with MIS – System Concepts for MIS, Data, Information and Communication, Problem Solving and Decision Making; Models of Decision Making - Classical, Administrative and Herbert Simon's Models - Attributes of information and its relevance to Decision Making - Types of information

Decision Support Systems: Introduction, DSS Architecture, Decision Modeling and Analysis, Decision Support Developments, Executive Information Systems; Group Decision Support Systems, Types of Group DSS, Negotiation Support Systems; Intelligent Decision Support Systems - Knowledge-based Decision Support Systems

9 hrs

Unit - III

Enterprise Resource Planning : Introduction to ERP systems, Linkage with business processes and BPR, Modeling the core business processes with support tools from an ERP software (SAP), Mapping business processes in an organization and case for process improvement (BPR), Managerial issues in implementing ERP systems for organizations, Extending ERP systems to suppliers and customers. (SRM, CRM, SCM), Managing ERP systems benefits. Managing businesses processes using information from ERP systems.

9 hrs

Unit - IV

Business Intelligence : Technical and Business Meta Data, Meta Data Process, Data Warehouse Design, Star and Snowflake Schemas, Online Analytical Processing (OLAP) Architecture, Multidimensional Database (MDD), Data Cubes, ROLAP Data Model, MOLAP Data Model, Logical Models for Multidimensional Information, Conceptual Models for Multidimensional Information, Query and Reporting, Executive Information Systems (EIS), Data Warehouse and Business Strategy **9 hrs**

Unit - V

Knowledge Management : Scope and significance, techniques, , implementation, KM and sharing, types of KM, Principles, dynamics; Drivers of KM - Pillars of KM, Seven Layers, critical success factors; Essence of information technology - Knowledge Economy, context, customer relationship management, total quality management, benchmarking and reassurance of KM; KM implementation strategies -Digital dash board, Web storage system, wireless solutions, intelligent interface **9 hrs**

Reference Books:

[1] Kenneth C. Laudon, Jane Price Laudon, Mary Elizabeth Brabston "Management Information Systems: Managing the Digital Firm", 10th Edition, 2015, Pearson

[2] R. Kelly Rainer, Brad Prince, Hugh J. Watson, "Management Information Systems", 2015, Wiley

[3] Jawadekar, "Management Information Systems: Texts And Cases", 3rd Ed, 2009, McGraw Hill

[4] Giridhar Joshi, "Management Information Systems", 1st Ed, 2014, Oxford University Press

[5] Shubhalakshmi Joshi, Smita Vaze, "Management Information Systems", 1st Ed, 2013, Wiley Biztantra

[6] James OBrein, George Morakkas, Ramesh Behl, "Management Information Systems", 2013, McGraw Hill

[7] D P Goyal, "Management Information Systems : Managerial Perspectives", 2nd Ed, 2014, Vikas Publishers

[8] Nirmalaya Bagachi, "Management Information Systems", 1st Edition, 2014, Vikas Publishers

[9] Shashikala Parimi, "Management Information Systems", 2nd Edition, 2014, Wiley Dreamtech

[10] S Sadagopan, "Management Information Systems", 2nd Edition, 2013, PHI India Ltd

PO 537.2 (E2): MARKETING ANALYTICS

Total No. of Lectures : 45 **Total Marks : 100** **[L – T – P – S]**
No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 0]**

Course Objectives:

- To understand the terms and terminologies of predictive modeling.
- To study the various predictive models, their merits, demerits and application.
- To get exposure to various analytical tools available for predictive modeling.
- Introduces the principles and strategic concepts of marketing analytics.
- Understand cost concepts (Total Hours, fixed, variable); profit margins, and lifetime value of the customer.
- Get a overview to understand the benefits and objectives of quantitative marketing.

Course Outcomes: Students who complete this course will be able to

- Have a high- level understanding of the benefits and objectives of marketing analytics.
- Apply metrics -driven techniques to improve marketing decisions.
- Understand best practices through case studies.
- Learn by doing through hands-on computer spreadsheet models and metric
- Design and analyze appropriate predictive models.& apply statistical tools for analysis

Unit - I

Overview of Marketing Strategy - Relationship with Corporate Vision, Mission and Objectives. Market-led strategic management.
Strategic Marketing analysis – Identification of attractive markets, Industry business analysis and sustaining competitive advantage. **(9 hrs)**

Unit - II

Introduction to Marketing Analytics : Market Insight; Market sizing and trend analysis.
Market Segmentation: Market segmentation; Segment identification, analysis, and strategy, Competitive analysis- Competitor identification, analysis and strategy.
Business Strategy and Operations: Business Strategy; Analytics-based strategy selection; Business Operations; Forecasting, predictive analytics, and data mining.
(9 hrs)

Unit - III

Product, Service and Price Analytics: Product and Service Analytics; Conjoint analysis and product/service metrics, Price Analytics; Pricing techniques and assessment.
Distribution and Promotional Analytics: Distribution Analytics; Analytics-based channel evaluation and selection; Promotion Analytics; Promotion budget estimation and allocation.
(9 hrs)

Unit - IV

Introduction to Predictive Modeling: Core ideas in data mining; Supervised and unsupervised learning; Classification vs Prediction; Steps in data mining; Sampling -Pre-processing; Data cleaning; Data Partitioning; Building a model - Statistical models - Statistical models for predictive analytics.

Predictive Modeling Basics: Data splitting; Balancing; Overfitting; Oversampling; Multiple Regression; Artificial neural networks (MLP); Variable importance; Profit/loss/prior probabilities; Model specification; Model selection; Multivariate Analysis.

(9 hrs)

Unit - V

Predictive Models : Association Rules; Clustering Models; Decision Trees; Ruleset Models; KNearest Neighbors; Naive Bayes; Neural Network Model; Regression Models; Regression Trees; Classification & Regression Trees (CART); Logistic Regression; Mulitple Linear Regression Scorecards; Support Vector Machines; Time Series Models; Comparison between models; Lift chart Assessment of a single model.

(9 hrs)

Text Books:

[1]. Kattamuri S. Sarma, "Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications", 2nd Edition, 2007, SAS Publishing.

[2]. Stephan Sorger, "Marketing Analytics: Strategic Models and Metrics", 1st Edition, vCreate Space Independent Publishing Platform

Reference Books:

[1]. Stephan Sorger, "Marketing Planning: Where Strategy Meets Action", 1st Edition, Prentice Hall PTR,

[2]. Cesar A.Brea, "Pragmalytics : Practical approaches to the Marketing analytics in the Digital Age",1st Edition, iUniverse

[3]. Alex Guazzelli, Wen-Ching Lin, Tridivesh Jena, James Taylor, "PMML in Action Unleashing the Power of Open Standards for Data Mining and Predictive Analytics", 2nd Edition, 2012, Create Space Independent Publishing Platform,2012.

[4]. Ian H. Witten, Eibe Frank , "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann Series in Data Management Systems, 3rd Edition, 2011, Morgan Kaufmann.

[5]. Eric Siegel , "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", 1st Edition, 2013, Wiley.

[6]. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", 1st Edition, 2012, Que Publishing

Research Methodology and Ethics

Course Objectives:

- To have clear understanding of the meaning and purpose of Research in academics, research philosophy and strategies of Research.
- To acquaint with the knowledge of methodology involved in a scientific Research
- To know writing of a good Research Report.
- To understand the ethical issues and practices in research with an awareness of rights and obligations of research participants.
- Understand the process of Intellectual property Rights and its different forms and implications
- To know how to write research papers and publish research papers.

Course Outcomes:

- Research output with philosophical base and greater relevance to the society
- Quality research with scientific methodology
- Production of good Research Reports
- Original Research following ethical guidelines and practices in conducting the research and publication of papers.
- More awareness on Intellectual property Rights and Patents.

Pedagogy: Class room lecture, seminars, assignments, case studies, projects, workshops, dissecting research papers.

Unit 1: Foundation of Research: (6 Hours)

Research – meaning, characteristics, objectives, motivation in research, need and importance of research. Types of Research; Philosophy and Research Philosophy – Ontology, Epistemology, critical realism, interpretivism, post modernism, pragmatism – meaning, relevance and assumptions. Concept of Theory and Theory Building – deduction, induction and abduction. Research Strategies - meaning and types.

Unit 2: Research Methodology: (10 Hours)

Research Problem – selecting the problem, sources of problem, statement of a problem; Review of Literature – meaning and need for literature review, sources of literature review, reporting the review of literature, identification of research gap; Research Design – meaning, features of good research design, types of research design, significance and preparation of research design; Research Questions; Objectives of the study; Research Methodology: Analytical vs. Empirical Methods, Surveys, Case Studies, Controlled Experiments, Quantitative, Qualitative, and Mixed Methods, Choosing research methods, Validity threats; Introduction to Quantitative Research, Study Designs, Controlled Experiments, Elements and Methods, Data Collection – meaning, sources of data, Data Collection Techniques

Unit 3: Interpretation and Report Writing; (4 Hours)

Analysis of Data – Analysis and Interpretation of Quantitative Data, Descriptive Statistics; Research Report – meaning, features of a good Research Report, elements of Research Report, format of a Research Report, Appendices and References/ Bibliography – styles.

Unit 4: Research Ethics: (10 Hours)

Ethics – meaning and definition, Ethics Vs moral philosophy, nature of moral judgments and reactions. Rights and obligations of Research Participants. Scientific conduct – ethics with respect to science and research, intellectual honesty and research integrity. Scientific misconduct – falsification, fabrication and plagiarism. Publication ethics – meaning and importance, conflicts of interest, publication misconduct – meaning, problems that lead to unethical behaviors, types of publication misconduct, identification of publication misconduct, complaints and appeal. Redundant publication – duplicate and overlapping publications, salami slicing. Violation of public ethics, authorship and contributorship. Predatory publishers and journals – software to identify predatory publications – journal finder/journal suggestions tools by JANE, Elsevier journal finder, Springer journal suggestions etc,. Selective reporting and misinterpretation of data. Best practices/standard setting initiatives and guidelines. Self-plagiarism.

Unit 5: Intellectual Property Rights (IPR) and Publication of Scholarly Papers: (10 hrs)

IPR – Concept of IPR, nature and characteristics of IPR, IPR issues in physical and biological sciences, IPR issues in Social Sciences. Forms of IPR – copyrights, trademarks, patents, industrial designs,– meaning, features and application of different forms of IPRs. Filing and Registration process of IPRs.

Publication – Scholarly/research article – meaning and features of scholarly article. Successful scientific writing – process. Reference/ bibliography writing, Plagiarism and how to avoid it.

References:

- Indian National Science Academy (INSA). (2019). Ethics in Science Education, Research & Governance
- Barbara H Stanley J Joan E Sieber, Gary B Melton. Research Ethics: A Psychological Approach. University of Nebraska Press
- David I Bainbridge (2012), Intellectual Property Rights. Long man Publication
- Jayashree Watal. Intellectual Property Rights in the WTO and Developing Countries. Oxford University Press
- A K Singh. Tests, Measurements and Research Methods in Behavioral Sciences. Bharathi Bhawan (Publishers & Distributors), New Delhi
- Leedy P D. Practical Research: Planning & Design. Washington: Mc Millan Publishing Co., INC
- Singh Y K. Fundamentals of Research Methodology and Statistics. New International (P) Ltd., New Delhi.
- Wallinman N. Your Research Project: A Step by Step Guide for the first time Researcher. Sage Publications, London
- Kothari C R. Research methodology: Research & Techniques. New Age International Publishers, New Delhi
- Selecting Empirical Methods for Software Engineering Research, Easterbrook et al
- Pfleeger, S.L. Experimental design and analysis in software engineering. *Ann Software Eng* **1,** 219–253 (1995). https://doi.org/10.1007/BF02249052
- Research Design. Qualitative, Quantitative, and Mixed Methods Approaches. By John W. Creswell, Fourth Edition. SAGE Publication, 2014

III Semester

PH531.3 CLOUD COMPUTING WITH AMAZON WEB SERVICES

Total No. of Lectures : 48 **Total Marks : 100** **[L – T – P – S]**

No. of Lectures / Week : 4 **Credits : 4** **[3 – 1 - 0 - 2]**

Course Objectives:

- To introduce the broad perceptive of cloud architecture and model
- To understand the design of cloud Services and the trusted cloud Computing system
- To understand applications of cloud
- To know how to design cloud applications
- To know how to use AWS services in cloud applications

Course Outcomes: By the end of the module, the student should be able

- Describe the key technologies, architecture, strengths, limitations and applications of cloud computing
- Explain the types and service models of cloud and Understand security implications in cloud computing
- Design Cloud Services and Set a private cloud
- Create and automate infrastructure to design cost-effective, highly available applications
- Integrate AWS services with your application to meet and exceed non-functional requirements

Unit I

Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, ComputingPlatforms and Technologies. Virtualization : Introduction, Characteristics of Virtualized, Environments, Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization Technology.

(10 hrs)

Unit II

Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance, Security, Trust, and Privacy Organizational Aspects, Principles of Parallel and Distributed Computing- Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing.

(10 hrs)

Unit III

Energy efficiency in clouds . Energy-efficient and green cloud computing architecture, Market-based management of clouds, Market-oriented cloud computing, Reference model, A reference model for MOCC , Technologies and initiatives supporting MOCC , Federated clouds/Inter Cloud- Characterization, Cloud federation stack, Aspects of interest, Technologies for cloud federations, Third-party cloud services. Cloud Applications- Scientific applications (Healthcare, Biology, Geoscience) Business and consumer applications.

(10 hrs)

Unit IV

Designing Cloud Applications: Introducing cloud-based multitier architecture , Designing for multi-tenancy , Understanding cloud applications design principles Understanding emerging cloud-based application architectures , Estimating your cloud computing costs , A typical e-commerce web application, AWS Components, Managing costs on AWS Cloud, Application development environments

(9 hrs)

Unit V

Scalability: Objectives, Designing scalable application architecture, Leveraging AWS infrastructure services for scalability, architecture –increasing loads, Event handling at scale .High Availability: Objectives, Nature of failures, AWS High availability architecture, Security – Security objectives, Best practices in implementing AWS security.

(9 hrs)

Text Books:

[1]. Rajkumar Buyya, Christian Vecchiola, S ThamaraiSelvi, "Mastering Cloud Computing", 1st Edition, 2015, Tata Mcgraw Hill Publishing Co Ltd.

[2]. Aurobindo Sarkar, Amith Shah "Learning AWS" Second edition 2018,Packt Publishing Ltd.

Reference Books:

[1]. Atul V. Mistry ,"Expert AWS Development", First edition 2018, Packt Publishing Ltd.

[2]. Kris Jamsa, "Clooud Computing", 1st Edition, 2013, Jones & Bartlett Publishers.

[3]. Anthony T Velte, "Cloud Computing: A practical Approach", 1st Ed, 2010, Tata McGraw Hill.

[4]. Fern Halper, Kaufman, Bloor Robin, Hurwit, "Cloud Computing for Dummies", 1st Ed, 2010, Wiley Press.

[5]. Joshy Joseph , Craig Fellenstein, "Grid Computing", 4th Edition, 2013, Pearson Asia.

[6]. Ahmar Abbas, "Grid Computing: A Practical Guide to technology and Applications", 2010, CRC Press.

[7]. Kaittwang Geoffrey C.Fox, Jack J Dongrra,"Distributed and Cloud Computing",1st Ed, 2012 , Elsevier.

PH 532.3: WEB TECHNOLOGIES and .NET FRAMEWORK

Total No. of Lectures: 48 **Total Marks: 100** **[L –T–P– S]**
No. of Lectures / Week: 4 **Credits : 4** **[3 – 1 –0 –2]**

Course Objectives: The objective of this course is to make the students:

- To study the elements of the .NET Framework platform, features of ASP.NET IDE and to learn the features of C# language.
- To develop Dynamic Web Applications using ASP.NET and to implement web 2.0 features using AJAX.
- To understand the architecture and main classes of ADO.NET and to use LINQ and Entity Framework in Applications.
- To Develop ASP.NET MVC application and Create distributed applications by means of Web Services.
- To learn ASP.NET Core 3.0 architecture, principles and benefits.

Course Outcomes: By the end of the module, the student should be able

- Learn to develop correct, well documented programs using C# programming language.
- Create visually rich and attractive Web applications with ASP.NET controls and controls in the AJAX Control Toolkit
- Display dynamic data from a data source by using Microsoft ADO.NET, LINQ and EF.
- Create MVC Models and write code that implements business logic within Model methods, properties, and events.Dynamic web applications, create and consume web services,understand the Microsoft Web Technologies stack.
- Write an application that can create, edit, and view data from a database using ASP.Net Core, and create Single Page Applications (SPAs)and Navigation, Routing, State Management, Security.

Unit -I

.NET Framework and C#: Architecture of .NET Framework. -.NET Compliant Languages - The Common Language Runtime (CLR); Common Type System (CTS); Common Language Specification (CLS); Common Intermediate Language(CIL/MSIL);Types of JIT Compilers; Garbage Collection; Base Classes Framework; Assemblies and Modules.

C#: Data types – Operators and Expressions - Statements – Decision Making – Loops – Arrays and Collections – Strings ; Object Oriented Programming - Encapsulation, Polymorphism and Inheritance in C#.

(10 hrs)

Unit – II

ASP.NET: ASP.NET Architecture;Programming with ASP.NET Web pages, ASP.NET Controls, Web Parts; Master pages; Applying Themes and Styles to Controls; ASP.NET State Management; Caching;

ASP.NET AJAX Components of Microsoft's AJAX Support; Partial Page Update; Script Manager; Client-Side Page Lifecycle; Update Panel Control; Update Modes; Timer.

(10 hrs)

Unit – III

Data Access using ADO.NET, LINQ, Entity Framework: The ADO.NET Object Model; Managed Providers; Working with Connected and Disconnected Architectures.

LINQ; Using Standard 'LINQ to' Technologies namely: LINQ to Object, LINQ to Dataset, LINQ to SQL, and LINQ to XML.

+Entity Framework: Entity Data Model, Navigating the EF, Querying Data, CRUD Operations in EF. **(9hrs)**

Unit - IV

ASP.NET MVC: MVC Overview; Advantages of using MVC Model; ASP.NET MVC application Structure; Creating the Model; Creating a Controller; Adding a View; Razor View Engine; Razor Syntax, Variables, Loops and Logic; Specifying a Partial View; Models, Layout; Scaffolding , Databases; Custom Routing ASP.NET MVC and Security.

Web Services: Overview; Working of a Web Service; Creating a Web Service using ASP.NET; Consuming WebService. **(10hrs)**

Unit – V

ASP.NET Core 3.: Introduction; Routing; Controllers and Actions, API actions, Maintaining State; Views, Areas, Razor Pages; Forms and Models, Helpers, Model Binding, Minifications, Validations and Data Annotations; Security; Caching; Module Development, Filters.

(9hrs)

Text Books:

[1]. Andrew Trolesen, "Professional C# 6.0 and the .NET 4.6 Framework", 7th Editon, 2015, Wiley press.

[2]. Adam Freeman, "Pro ASP.Net MVC 5th Edition,2014, Wiley press.

[3]. Kenneth Yamikani Fukizi, Jason De Oliveira, "Learn ASP.NET Core 3",2nd Edition, 2019, Packt Publishing.

Reference Books:

[1]. John Sharp, "Microsoft Visual C# Step by Step", 9th Edition, 2018, Microsoft press.

[2]. Matthew MacDonald, "Asp.Net: The Complete Reference", 2016, Tata McGraw-Hill Education.

[3]. William Penberthy "Beginning ASP.NET for Visual Studio, 2016, Wiley Wrox press.

[4]. Adam Freeman, "Pro ASP.Net MVC 2", 2017, Wiley press.

[5]. Jon Galloway, Brad Wilson, K. Scott Allen, David Matson "Professional ASP.NET MVC 5", 2014, Wiley Wrox press.

[6]. Bruce Johnson, "Professional Visual Studio -AJAX", 2015, Wiley Wrox press.

[7]. Adam Freeman, "Pro ASP.NET Core 3", 2020, Apress.

PS 534.3 E1 INTERNET OF THINGS and APPLICATIONS

Total No. of Lectures: 42 **Total Marks: 100** **[L – T – P – S]**

No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 2]**

Course Objectives: As part of this course, students will study,

- Learn the basic concepts of internet of things, network and communication, security privacy trust
- Learn the concepts of IoT reference architecture, Identity Management Models, trust management in IoT
- Learn different IoT protocols in different layers of OSI Layers. Also learn IoT analytics for cloud
- Learn how IoT data is explored and how data is displayed using visualization techniques
- Learn how machine learning techniques are used to extract the useful data and how the data is organized for data analytics

Course Outcomes – upon successful completion of this course, the participant will be able to:

- Understand why IoT is used and how it is implemented and how networks and communication is used to implement IoT
- Understand how identity management models are used in IoT, also understand why trust management is important for IoT environment
- Understand the use of protocols which are used in different layers and how it is combined with other protocols down the layers to carry out the communication
- Understand how data is stored in cloud and how it is represented using different application to carry out or execute different data analytics tools
- Understand the concepts of data science for IoT analytics, how to organize data for analytics, and how to get benefits from IoT analytical tools.

Unit I

IoT Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardisation, Recommendations on Research Topics.

Internet of Things Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security,

Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

(9 hrs)

Unit II

Architectural Approach for IoT Empowerment : Introduction, Defining a Common Architectural Ground, IoT Standardisation, M2M Service Layer Standardisation, OGC Sensor Web for IoT, IEEE, IETF and ITU-T standardization activities, Interoperability Challenges, Physical vs Virtual, Solve the Basic First, Data Interoperability, Semantic Interoperability, Organizational Interoperability, Eternal Interoperability, Importance of Standardisation, Plan for validation and testing, Important Economic Dimension, Research Roadmap for IoT Testing Methodologies. Semantic as an Interoperability Enabler and related work.

Identity Management Models in IoT : Introduction, Vulnerabilities of IoT, Security requirements, Challenges for a secure Internet of Things, identity management, Identity portrayal, Different identity management model: Local identity, Network identity, Federated identity, Global web identity, Identity management in Internet of Things, User-centric identity management, Device-centric identity management, Hybrid identity management.

Trust Management in IoT: Introduction, Trust management life cycle, Identity and trust, Third party approach, Public key infrastructure, Attribute certificates, Web of trust models, Web services security, SAML approach, Fuzzy approach for Trust, Access control in IoT, Different access control schemes, Authentication and Access control policies modelling. **(9 hrs)**

Unit - III

Defining IOT Analytics and challenges: The situation; Defining IoT analytics; IoT analytics challenges

Business value concerns.

IoT Devices and Networking Protocols: IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics.

IoT Analytics for Cloud: Building elastic analytics; Elastic analytics concepts; Designing for scale Cloud security and analytics; The AWS overview; Microsoft Azure overview; The Thing Worx overview; **(8 hrs)**

Unit - IV

Exploring IoT Data: Exploring and visualizing data, attributes that might have predictive value R. Adding internal datasets; Adding external datasets

Visualizing and Dashboarding : Common mistakes when designing visuals; The Hierarchy of Questions method; Designing visual analysis for IoT data; Creating a dashboard with
Tableau; Creating and visualizing alerts. **(8 hrs)**

Unit -V

Data Science for IoT Analytics: Machine learning (ML); Anomaly detection using R; Forecasting using ARIMA; Deep learning

Strategies to Organize Data for Analytics: Linked Analytical Datasets; Managing data lakes; The data retention strategy.

Economics of IoT Analytics: The economics of cloud computing and open source, Cost considerations for IoT analytics, revenue opportunities, predictive maintenance example **(8 hrs)**

Text Books:

[1]. Andrew Minteer, "Analytics for the Internet of Things (IoT)", 2nd Ed, 2017, PACKT

[2]. Arsheep Bhaga, Vijay Madasetti, "Internet of Things : A Hands on Approach", 1st Edition, 2016, University Press India Ltd

[3]. Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", 1st Edition, 2015, McGraw Hill Publishers

Reference Books:

[1]. Hwaiyu Geng, "Internet of Things and Data Analytics Handbook", 1st Edition, 2016, Wiley

[2]. Peter Waher, "Mastering Internet of Things", 1st Edition, 2018, PACKT Publishers

[3]. Perry Lea, "Internet of Things for Architects", 2nd Edition, 2017, PACKT Publishers

[4]. Qusay F. Hassan, Atta ur Rehman Khan, Sajjad A. Madani, "Internet of Things: Challenges, Advances, and Applications", 2nd Edition, 2014, CRC Press

[5]. Pethuru Raj, Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", 2nd Edition, 2014, CRC Press.

[6]. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, 2015, Wiley International

[7]. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", 1st Ed, 2013, Wiley

[8]. Mile Lukodes, John Bruner, "What is the Internat of Things", 1st Ed, 2015, O'Reilly Publishers

[9]. Hakima Chaouchi, "The Internet of Things: Connecting Objects", 1st Edition, 2014, Wiley

[10]. Fawzi Behmann, Kwok Wu, "Collaborative Internet of Things (C-IoT): for Future Smart Connected Life and Business", 1st Edition, 2015, Wiley International

[11]. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms,", 2016, CRC Press

[12]. Weber, Rolph H, Romana, "Internet of Things : Legal Perspectives", 1st Ed, 2015, Springer

PS 534.3 E2 NATURAL LANGUAGE PROCESSING

Total No. of Lectures: 42	**Total Marks:100**	**[L – T – P – S]**
No. of Lectures / Week: 4	**Credits : 3**	**[3 – 1 - 0 - 2]**

Course Objectives: As part of this course, students will study,

- To understand about NLP. To know its origin. To know about different Indian languages and grammar of languages in general. Knowledge about regular expressions and finite state automata. Understand about morphology and parts-of-speech tagging
- To learn about Context-Free Grammar (CFG). Understand about syntactic and semantic analysis
- To understand Cohesion, Reference resolution, Discourse Coherence and structure.
- To understand the architectures of NLG systems, generation tasks and representations, applications of NLG
- To understand some of the NLP applications like MT, IR, automatic text summarization, question-answering system

Course Outcomes: upon successful completion of this course, the participant will be able to:

- Ability to create morphemes and perform morphological analysis. Construct simple DFA. Perform POS tagging
- Ability to construct parse trees for sentences when CFG is given. Perform leftmost and rightmost derivations. Perform top-down and bottom-up parsing. Perform ambiguity analysis and word sense disambiguation.
- Perform reference resolution on sentences. Differentiate Cohesion and Coherence.
- Differentiate pipelined, interleaved and integrated architecture of NLG.
- Compare direct MT system with transfer system. Implement a simple MT system.

Unit - I

Introduction: What is Natural Language Processing? Origins of NLP, Language and Knowledge, Language and Grammar, Processing Indian Languages, Early NLP systems.

Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological parsing, Words and Word Classes, Part-of-Speech Tagging

(9 hrs)

Unit - II

Syntactic Analysis: Context-Free Grammar, Phases of Syntactic Analysis, Constituency, Parsing – Top-down, Bottom-up parsing.

Semantic Analysis: Meaning representation, Lexical semantics, ambiguity, word sense disambiguation

(9 hrs)

Unit - III

Discourse and Reference Analysis: Reference Resolution, the structure of coherent discourse, types of reference phenomenon, Syntactic Constraints on Reference - Number agreement, Gender agreement, grammatical role etc.,

(8 hrs)

Unit - IV

Natural Language Generation: Introduction, Architectures of NLG systems, Generation tasks and representations, Applications of NLG.

(8hrs)

Unit - V

NLP Applications: Machine translation – characteristics of Indian languages, MT types, Information retrieval, automatic text summarization, question-answering system.

(8hrs)

Text Books:

[1]. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford Higher Education, 2008, Oxford University Press

[2]. Ela Kumar, "Natural Language Processing", 2013, I.K. International Publishing House Pvt. Ltd.

Reference Books:

[1].Daniel Jurafsky and James H. Martin, "Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2000, Pearson Education Publication.

[2].Michael W. Berry, "Survey of Text Mining: Clustering, Classification and Retrieval", 2007, Springer International Edition

[3]. Daniel M Bikel, ImedZitouni, "Multilingual Natural Language Processing Applications", 2013, Pearson Education Publication.

[4]. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python" 2009, O'Reilly Media.

PS535.3 E1 BIG DATA ANALYTICS WITH SCALA AND SPARK

Total No. of Lectures : 42 **Total Marks : 100** **[L – T – P – S]**

No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 2]**

Course Objectives: This course introduces students to the following objectives

- Understanding the concepts of Functional programming and introducing to Scala and object oriented Scala.
- Elaborating on the Spark's programming model in detail, being careful to understand how and when it differs from familiar programming models, like shared-memory parallel collections or sequential Scala collections.
- Understanding Spark SQL and exploring the use of Spark SQL for Data Exploration, Data Munging and Data streaming.
- Using Spark in Machine Learning for classification using Bayes and Naïve Bayes Algorithm.
- Learn to perform Testing in Spark and introducing PySparrk and Sparkr.

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Understand what Functional programming is and will know why classical data analysis techniques are no longer adequate
- Understand the benefits that Spark and Spark SQL offers for processing structured and unstructured data.
- Understand conceptually how Spark SQL is used for Data Exploration, Data Munging and Data Streaming.
- Understand how Spark can be used for Machine Learning.
- Understand the use of PySparrk and Sparkr

Unit- I

Scala: Purposes of Scala, Platforms and editors, Installing and setting up Scala, Scala: the scalable language, Scala for Java programmers, Scala for the beginners

Object Oriented Scala: Variables in Scala, Methods, classes, and objects in Scala, Packages and package objects, Java interoperability, Pattern matching, Implicit in Scala, Generic in Scala, SBT and other build systems.

Functional Programming Concepts: Introduction to functional programming, Functional Scala for the data scientists, FP and Scala for learning Spark; Pure functions and higher-order functions; Using higher-order functions; Error handling in functional Scala; Functional programming and data mutability

Collection of APIs : Scala collection APIs, Types and hierarchies, Performance characteristics, Java interoperability, Using Scala implicits

(9 hrs)

Unit- II

Spark : Introduction to data analytics, Introduction to big data, Distributed computing using Apache Hadoop, Apache Spark.

Spark – REPL & RDDS: Dig deeper into Apache Spark, Apache Spark installation, Introduction to RDDs, Using the Spark shell, Actions and Transformations, Caching, Loading and saving data.

Spark SQL: Introducing Spark Session, Understanding Spark SQL concepts, Using Spark SQL in streaming applications; Spark SQL and DataFrames, DataFrame API and SQL API, Aggregations, Joins.

Spark SQL for Processing Structured and Unstructured Data: data sources in Spark applications, Spark with relational databases, Spark with MongoDB (NoSQL database), Spark with JSON data, Spark with Avro files, Spark with Parquet files, Defining and using custom data sources in Spark

(9 hrs)

Unit- III

Spark SQL for Data Exploration: Exploratory Data Analysis (EDA), Spark SQL for basic data analysis, Visualizing data with Apache Zeppelin, Sampling data with Spark SQL APIs, Spark SQL for creating pivot tables

Spark SQL for Data Munging: Data munging, Exploring data munging techniques, Munging textual data, Munging time series data, Dealing with variable length records, Preparing data for machine learning

Spark Streaming: Spark Streaming, Discretized streams, Stateful /stateless transformations Check pointing, Interoperability with streaming platforms (Apache Kafka), Structured streaming.

(8 hrs)

Unit- IV

Spark MLLIB & ML: Introduction to machine learning, Spark machine learning APIs, Feature extraction and transformation, Creating a simple pipeline, Unsupervised machine learning, Binary and multiclass classification

Bayes and Nave Bayes: Multinomial classification, Bayesian inference, Naive Bayes, The decision trees

Text Analytics using Spark ML : Understanding text analytics, Transformers and Estimators, Tokenization, StopWordsRemover, NGrams, TF-IDF, Word2Vec, CountVectorizer, Topic modeling using LDA, Implementing text classification.

(8 hrs)

Unit- V

Spark Tuning: Monitoring Spark jobs, Spark configuration, Common mistakes in Spark app development, Optimization techniques;

Testing and Debugging in Spark: Testing in a distributed environment, Testing Spark applications, Debugging Spark applications.

PySparrk&Sparkr: Introduction to PySpark, Installation and configuration, Introducing SparkR, the SparkR architecture, SparkRDataFrames, SparkR for EDA and data munging tasks, SparkR for computing summary statistics, SparkR for data visualization, SparkR for machine learning. **(8 hrs)**

Text Book :

[1] Md. Rezaul Karim, Sridhar Alla, "Scala and Spark for Big Data Analytics - Harness the power of Scala to program Spark and analyze tonnes of data in the blink of an eye", 1st Ed, 2017, PACKT

[2] Romeo Kienzler, "Mastering Apache Spark 2.x", 2nd Edition, 2016, PACKT Publishers.

Reference Books :

[1] Ilya Ganelin, EmaOrhian, Kai Sasaki, Brennon York, "Spark: Big Data Cluster Computing in Production", 1st Edition, 2016,Wiley

[2] Rishi Yadav, "Apache Spark 2.x Cookbook", 2nd Edition, 2016, PACKT Publishers

[3] Dean Wampler, Alex Payne, "Programming Scala, Scalability = Functional Programming + Objects", 2nd Edition, 2016, O'Reilly Publishers

[4] Jason Swartz, "Learning Scala Practical Functional Programming for the JVM", 2016, O'Reilly

[5] Guller, Mohammed, "Big Data Analytics with Spark A Practitioner's Guide to Using Spark for Large Scale Data Analysis", 2nd Edition, 2016, Apress

[6] Luu, Hien, "Beginning Apache Spark 2 With Resilient Distributed Datasets, Spark SQL, Structured Streaming and Spark Machine Learning library", 2nd Ed, 2016, Apress Edition

[7] Nabi, Zubair, "Pro Spark Streaming The Zen of Real-Time Analytics Using Apache Spark", 2nd Edition, 2017, Apress Edition.

[8] MateiZaharia, Holden Karau, Andy Konwinski, Patrick Wendell, "Learning Spark Lightning-Fast Big Data Analysis", 2nd Edition, 2017, O'Reilly Publishers

[9] MateiZaharia, Bill Chambers, "Spark: The Definitive Guide Big Data Processing Made Simple", 3rd Edition, 2106, O'Reilly Publications

[10] Paul Chiusano, "Functional Programming in Scala", 2nd Edition, 2017, Wiley

[11] JanekBogucki, Alessandro Lacava, AliaksandrBedrytski, Matthew de Detrich, Benjamin Neil, "Professional Scala", 2nd Edition, 2016, Wiley Wrox

PS 535.3 E2: BIG DATA ANALYTICS with MAP REDUCE & HADOOP

Total No. of Lectures : 42 **Total Marks : 100** **[L – T – P – S]**

No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 2]**

Course Objectives: The course aims to cover the following objectives

- Understanding the Big Data Fundamentals, including the characteristics of Big Data, the sources Big Data (such as social media, sensor data, geospatial data etc) and Big Data Analytics.
- Introducing to No-SQL databases and different properties and characteristics associated with it.
- Learning about Hadoop, the need for it, Distributed processing, and using it for analyzing huge amount of data.
- Understanding Map Reduce programming and learning to write programs using mapper and reducer.
- Exploring Hadoop Eco system, familiarizing with Hive and Pig.

Course Outcomes : Upon Completion of the course, the students will be able to

- Identify and distinguish big data analytics applications from other applications and the use of Big Data.
- Describe No SQL databases and understanding different concepts related to No SQL and its applications using MongoDB.
- Understanding Hadoop and its advantage over the traditional database applications in solving practical problems
- Writing programs using mapper and reducer.
- Using Hive and Pig for analyzing and querying data and knowing the advantages over the traditional Data handling solutions.

Unit- I

Introduction to big data: Data, Characteristics of data and Types of digital data:, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data.

Big data analytics: Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.

(8 hrs)

Unit- II

NoSQL Data Management : Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models; relationships, graph databases, schemaless databases, materialized views, distribution models, sharding; master-slave replication; peer-peer replication; sharding and replication; consistency; relaxing consistency; version stamps; Case studies using MongoDB.

(8 hrs)

Unit –III

Introduction to Hadoop: Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop , Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System) , Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem **.**

(8 hrs)

UNIT –IV

Introduction to MAPREDUCE Programming: Introduction, Mapper, Reducer, Combiner, Partitioner , Searching, Sorting , Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats.

(8hrs)

UNIT –V

Introduction to Hive: Introduction to Hive, Hive Architecture , Hive Data Types, Hive File Format, Hive Query Language (HQL), User-Defined Function (UDF) in Hive.

Introduction to Pig: Introduction to Pig, The Anatomy of Pig , Pig on Hadoop , Pig Philosophy , Use Case for Pig: ETL Processing , Pig Latin Overview , Data Types in Pig , Running Pig , Execution Modes of Pig, HDFS Commands, Relational Operators, Piggy Bank , Word Count Example using Pig , Pig at Yahoo!, Pig versus Hive.

(9 hrs)

Text Book :

[1] Seema Acharya, SubhashiniChellappan "Big Data and Analytics", 1st Edition, 2015, Wiley International

[2] S. Mohanthy, MadhuJagadish, Harsh Srivatsa, "Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics", 1st Edition, 2015, Wiley Apress

Reference Books :

1. JeyLiebowitz, "Big Data and Business Analytics", 1st Edition, 2014, CRC Press
2. Tom White, "Hadoop – Definitive Guide", 1st Edition, 2015, O'Reilly Publishers
3. Boris Lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions",1st Edition, 2015, Wiley India Publications.
4. E Caprilo, Dean Wampler, "Hive Programming", 1st Edition, 2015, O'Reilly Publishers
5. SherifSakr, "Large Scale and Big Data: Processing and Management", 2014, CRC Press.

PO537.3 E1 SOCIAL MEDIA ANALYTICS

Total No. of Lectures : 42	**Total Marks : 100**	**[L – T – P – S]**
No. of Lectures / Week : 4	**Credits : 3**	**[3 – 1 - 0 - 2]**

Course Objective: The objective of this course is to make the students

- Develop skills for retrieving and analyzing social media data.
- Analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools
- Learn the concepts consumer reaction analytics on Youtube, Foursquare and social coding with Github
- Discuss social network analysis to identify important social actors, subgroups and network properties in social media.
- Understand the concepts social data analytics at Scale Spark and Amazon Services

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Apply multiple quantitative and qualitative methods
- Understand sources and limitations of web-based data
- Perform social network analysis to identify important social actors, subgroups and network properties in social media.
- Use appropriate information visualization technique to gain insights into large datasets
- Apply best practices in Search Engine Optimization

Unit - I

Social Media Analytics: Understanding social media, Social media analytics, Getting started with R, Data types, Data analytics, Machine learning, Text analytics

Social Graph: Delving into social data, Understanding the process, working environment, getting the data, Analyzing the data, visualizing the data, Getting started with the toolset.

(9 hrs)

Unit - II

Social Data – Connecting, Capturing, Cleaning: APIs in a nutshell, authentication techniques, Parsing API outputs, Basic cleaning techniques, MongoDB to store and access social data, MongoDB using Python

Uncovering Brand Activity, Popularity and Emotions on Facebook: Facebook brand page, Project planning, Analysis, Keywords, Noun phrases, Detecting trends in time series, Uncovering emotions.

Twitter Analytics: Understanding Twitter, Scope and process, Getting the data, Revisiting analytics, workflow, Sentiment analysis, Customized sentiment analysis, Trend analysis, Sentiment analysis, Follower graph analysis.

(9 hrs)

Unit - III

Campaign and Consumer Reaction Analytics on Youtube – Structured and Unstructured: Scope and process, Getting the data, Data pull, Data processing, Data analysis.

Foursquare: Foursquare – the app and data, Category trend analysis, Recommendation engine – let's open a restaurant, The sentimental rankings, Venue graph, Challenges for Foursquare data analysis

Analyzing Social Collaboration – Social Coding with Github: Scope and process, Getting the data Environment setup, Understanding GitHub, Accessing GitHub data, Data pull, Data processing, Data analysis, Analyzing repository activity, Analyzing repository trends, Analyzing language trends

(8hrs)

Unit - IV

Flickr Data Analysis: A Flickr-ing world, Accessing Flickr's data, Understanding Flickr data, Understanding interestingness – similarities, Challenges

Scrapping and Extracting Conventional Topics on Internet Forums: Scope and process, Getting the data, Data pull and pre-processing, Data analysis

Pintrest through Network Analysis of User Interest: Scope and process, Getting the data, Data pull and pre-processing, Data analysis.

(8hrs)

Unit - V

Social Data Analytics at Scale Spark and Amazon Services: Different scaling methods and platforms, Topic models at scale, Spark on the Cloud and Amazon Elastic MapReduce.

News – Collective Social media: News data – news is everywhere, Sentiment trend analysis, Topic modeling, Summarizing news articles, Challenges to news data analysis

(8hrs)

Text Books :

1. Siddhartha Chatterjee, Michal Krystyanczuk, "Python Social Media Analytics -Leverage the power of Python to collect, process, and mine deep insights from social media data ", 1st Ed, 2017, PACKT
2. Raghav Bali, Dipanjan Sarkar, Tushar Sharma, "Learning Social Media Analytics with R", 2017, PACKT

Reference Books:

[1]. Sharan Kumar Ravindran," Mastering Social Media Mining with R", 1st Edition, 2016, PACKT

[2]. Marshall Sponder, "Social Media Analytics", 2nd Edition, 2015, Wiley Publications

[3]. Alex Gonsalves, "Social Media Analytics Strategy: Using Data to Optimize Business Performance", 1st Edition, 2016, Elsevier Publishers

[4]. Chuck Hemann, Ken Burbary, "Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World", 1st Edition, Pearson

[5]. Marshall Sponder, "Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metric", 1st Edition, 2015, Pearson International

[6]. KohirkarGanis, "Social Media Analytics", 2nd Edition, 2015, Wiley International

PO537.3 E2 STREAMING ANALYTICS

Total No. of Lectures : 42 **Total Marks : 100** **[L – T – P – S]**
No. of Lectures / Week : 4 **Credits : 3** **[3 – 1 - 0 - 2]**

Course Objectives: The objective of this course is to make the students

- Understanding the use of Real-Time Data Analytics and getting to know the portion of Big Data that deals with streaming data.
- Introduce the basic concepts of Zoo keeper, kafka and Flume.
- Getting to know Storm DSL, Processing Data with Samza, Apache YARN, Getting Started with YARN and Samza, Integrating Samza into the Data Flow.
- Introducing the analysis, visualization and Delivering streaming analytics.
- Approximation of streaming data .

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Describe and use a wide variety of streaming analytics methods in a business or an industry.
- Understand how analytics can be used in business development using Kafka and Flume.
- Learn to use and to apply a selection of modern business analytics tools and software to solving real-world problems with real-world data
- Demonstrate hands-on skills using visualization in applying business analytics
- Demonstrate hands-on skills in applying analytics into real-world business using statistical approximation and sketching.

Unit - I

Introduction to Streaming Data: Sources of Streaming Data, Operational Monitoring, Web Analytics, Online Advertising, Social Media, Mobile Data and the Internet of Things, How Streaming Data Is Different, Always On, Always Flowing, Loosely Structured, High-Cardinality Storage, Infrastructures and Algorithms

Streaming Analytics Architecture: **Designing Real-Time Streaming Architectures:** Real-Time Architecture Components, Collection, Data Flow, Processing, Storage, Delivery, Features of a Real-Time Architecture - High Availability, Low Latency, Horizontal Scalability, Languages for Real-Time Programming. **(9 hrs)**

Unit - II

Service Configuration and Coordination: Motivation for Configuration and Coordination Systems; Maintaining Distributed State; Unreliable Network Connections, Clock Synchronization, Consensus in an Unreliable World,

Apache ZooKeeper, The znode, Watches and Notifications, Maintaining Consistency, Creating a ZooKeeper Cluster, ZooKeeper's Native Java Client, The Curator Client, Curator Recipes,

Data-Flow Management in Streaming Analysis: Distributed Data Flows, The "n+1" Problem,

Apache Kafka: High-Throughput Distributed Messaging, Design and Implementation, Configuring a Kafka Environment, Interacting with Kafka Brokers.

Apache Flume: Distributed Log Collection, The Flume Agent, Configuring the Agent, The Flume Data Model, Channel Selectors, Flume Sources, Flume Sinks, Sink Processors, Flume Channels, Flume Interceptors, Integrating Custom Flume Components, Running Flume Agents

(9 hrs)

Unit - III

Processing Streaming Data: Distributed Streaming Data Processing, Coordination, Partitions and Merges, Transactions, Processing Data with Storm, Components of a Storm Cluster, Configuring a Storm Cluster, Distributed Clusters, Local Clusters, Storm Topologies, Implementing Bolts, Implementing and Using Spouts, Distributed Remote Procedure

Trident: The Storm DSL, Processing Data with Samza, Apache YARN, Getting Started with YARN and Samza, Integrating Samza into the Data Flow

Storing Streaming Data : "NoSQL" Storage Systems, Redis, MongoDB, Cassandra, Other Storage Technologies, Relational Databases, Distributed In-Memory Data Grids, Choosing a Technology, Key-Value Stores, Document Stores, Distributed Hash Table Stores, In-Memory Grids, Relational Databases, Warehousing, Hadoop as ETL and Warehouse, Lambda Architectures

(8hrs)

Unit - IV

Analysis and Visualization: Delivering Streaming Metrics: Streaming Web Applications, Working with Node, Managing a Node Project with NPM, Developing Node Web Applications, A Basic Streaming Dashboard, Adding Streaming to Web Applications, Visualizing Data, HTML5 Canvas and Inline SVG, Data-Driven Documents: D3.js, High-Level Tools, Mobile Streaming Applications,

Exact Aggregation and Delivery: Timed Counting and Summation, Counting in Bolts, Counting with Trident, Counting in Samza, Multi-Resolution Time-Series Aggregation, Quantization Framework, Stochastic Optimization, Delivering Time-Series Data, Strip Charts with D3.js, High-Speed Canvas Charts, Horizon Charts

(8hrs)

Unit - V

Statistical Approximation of Streaming Data : Numerical Libraries, Probabilities and Distributions, Expectation and Variance, Statistical Distributions, Discrete Distributions, Continuous Distributions, Joint Distributions, Working with Distributions, Inferring Parameters,

The Delta Method, Distribution Inequalities, Random Number Generation, Generating Specific Distributions, Sampling Procedures, Sampling from a Fixed Population, Sampling from a Streaming Population, Biased Streaming Sampling

Approximating Streaming Data with Sketching: Registers and Hash Functions, Registers, Hash Functions, Working with Sets, The Bloom Filter, The Algorithm, Choosing a Filter Size, Unions and Intersections, Cardinality Estimation, Interesting Variations, Distinct Value Sketches, The Min-Count Algorithm, The HyperLogLog Algorithm, The Count-Min Sketch, Point Queries, Count-Min Sketch Implementation, Top-K and "Heavy Hitters", Range and Quantile Queries, Other Applications

(8hrs)

Text Books :

[1]. Byron Ellis, "Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data", 3rd Edition, 2016, Wiley International.

[2]. Sumit Gupta, Shilpi, "Real-Time Big Data Analytics - Design, process, and analyze large sets of complex data in real time", 1st Edition, 2016, PACKT Publishers

Reference Books:

[1]. ShilpiSaxena, "Practical Real Time Data Analytics", 2nd Edition, 2015, PACKT Publishers

[2]. Tomasz Lelek, "Advanced Analytics and Real-Time Data Processing in Apache Spark", 1st Edition, 2017, PACKT Publishers

[3]. AninditaBasak, "Real-time Data Processing with Azure Stream Analytics -Real-time data processing with Azure Stream Analytics", 2nd Edition, 2017, PACKT Publishers

[4]. Vinay Singh, "Real Time Analytics with SAP Hana", 3rd Edition, 2016, PACKT Publishers

[5]. ShilpiSaxena, "Real-time Analytics with Storm and Cassandra", 2nd Ed, 2015, PACKT

[6]. Krishna Sankar, Holden Karau, "Fast Data Processing with Spark - Perform real-time analytics using Spark in a fast, distributed, and scalable way", 2nd Edition, 2015, PACKT Publishers

[7]. Jacques Roy, "Streaming Analytics with IBM Streams: Analyze More, Act Faster, and Get Continuous Insights", 1st Edition, 2015, Wiley

[8]. AninditaBasak et al., "Stream Analytics with Microsoft Azure - Develop and manage effective real-time streaming solutions by leveraging the power of Microsoft Azure", 1st Ed, 2017, PACKT

[9]. Paul Zikopoulose, "Understanding Big Data: Analytics for Enterprise Class Hadoounderstanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data P and Streaming Data", 1st Edition, 2015, Wiley

SEMINAR AND TECHNICAL COMMUNICATION

Total No. of Demo hrs : 30	**Total Marks : ---**	**[L – T – P – S]**
No. of Hrs / Week : 2	**Credits : ---**	**[0 – 2 - 0 – 4]**

Introduction

Graduates of final year IT program are supposed to design and implement projects through knowledge and skills acquired in previous semesters. Students should identify complex engineering problems and find effective, efficient and innovative ways of solving them through their projects.

In a technical seminar, students should aim to review literature in a focused way for identifying a complex problem to be attempted in their final year project. Seminar should make the student attain skills like

a. gathering of literature in specific area in a focused manner
b. effectively summarizing the literature to find state-of-the-art in proposed area
c. identifying scope for future work
d. presenting (arguing) the case for the intended work to be done as project
e. reporting literature review and proposed work in scientific way using good English.

Course Objectives :

- To perform focused study of published or unpublished research literature relevant to a specific topic.
- To study, interpret and summarize literature scientifically.
- To build independent thinking on complex problems.
- To build collaborative work practices
- To communicate scientific information to a larger audience.
- To use presentation standards and guidelines effectively.
- To be ethical in presenting purpose, sources, conduct and use of the literature reviewed.
- To define future work or problem statement for projects.

Course Outcomes :

- Gather, organize, summarize and interpret literature with the purpose of formulating a proposal.
- Write a technical report summarizing state-of-the-art on an identified topic.
- Present the study using graphics and multimedia techniques.
- Define intended future work based on the technical review.

GUIDELINES FOR PROJECT BASED SEMINAR (PBS)

1. A group of 3-4 students shall identify problem(s) in Computer Engineering / Information Technology referring to recent trends and developments in consultation with institute guide.

2. The group must review sufficient literature (books, journal articles, conference papers, magazines, web resources etc.) in relevant area in parts (allocated to each student) decided by the SIG guide.
3. Research articles could be referred from IEEE, ACM, Science direct, Springer, Elsevier, IETE,CSI or from freely available digital libraries like Digital Library of India (dli.ernet.in), National Science Digital Library, JRD Tata Memorial Library, citeseerx.ist.psu.edu, getcited.org, arizona.openrepository.com, Open J-Gate, Research Gate, worldwidescience.org etc.
4. The group shall present the study as individual seminars in 20 – 25 minutes concluding with the solution to problem identified as their project statement.
5. Each student shall submit two copies of the seminar report in a prescribed format duly signed by the guide and Head of the department.
6. Internal guide shall define a project statement based on the study by student group.
7. Broad contents of review report (20-25 pages) shall be
    i. Introduction of specific topic
    ii. Motivation, purpose and scope of review
    iii. Related work with citations
    iv. Discussion (your own reflections and analysis)
    v. Conclusions
    vi. Project definition. (Short version of RUP's vision document if possible).
    vii. Bibliography

EVALUATION SCHEME (for add on certification)

a) A panel of staff members from the institute will assess the seminar internally during the presentation
b) Attendance for all seminars for all students is compulsory.
c) Criteria for evaluation

i.	Relevance of topic	- 05 Marks
ii.	Relevance + depth of literature reviewed	- 10 Marks
iii.	Seminar report (Technical Content)	- 10 Marks
iv.	Seminar report (Language)	- 05 Marks
v.	Presentation Slides	- 05 Marks
vi.	Communication Skills	- 05 Marks
vii.	Question and Answers	- 10 Marks

Reference Books

1. Gersen and Gersen, "Technical Writing: Process and Product" 6th Ed, 2012, Pearson Education Asia.
2. Rutherfoord, "Basic Communication Skills for Technology", 3rd Ed, 2009, Pearson Education Asia.
3. Lesikar, "Lesikar's Basic Business Communication", 2011; McGraw Hill Publishers

IV Semester
DOMAIN KNOWLEDGE PROJECT

Total Marks	**: 150**	**Final Viva**	**: 100**	**[L – T – P – S]**
Internal Assessment	**: 50**	**Credits**	**: 4**	**[0 – 2 - 4 – 4]**

The purpose of a thesis is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study. The thesis offers the opportunity to delve more deeply into and synthesise knowledge acquired in previous studies. A thesis for a Domain Knowledge should place emphasis on the technical/scientific/artistic aspects of the subject matter.

The overall goal of the thesis is for the student to display the knowledge and capability required for independent work as a Master of Science in Software Technology.

Learning objectives for a thesis are based on the objectives for Master of Science in Software Technology has Specific learning outcomes: for the student to demonstrate:

- Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
- Deeper knowledge of methods in the major subject/field of study.
- A capability to contribute to research and development work.
- The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.
- The capability to plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.
- The capability to create, analyse and critically evaluate different technical/architectural solutions.
- The capability to critically and systematically integrate knowledge.
- The capability to clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings in written and spoken English.
- The capability to identify the issues that must be addressed within the framework of the specific thesis in order to take into consideration all relevant dimensions of sustainable development.
- A consciousness of the ethical aspects of research and development work.

The same formulated learning objectives apply for theses encompassing 4 Credits (Hec). The course must be considerably more ambitious with respect to the scientific level or technical/architectural realisation. For example, the objective could be to author a scientific article as the result of the research or to further develop a technical solution for mass production and market introduction.

INDUSTRY INTERNSHIP / PROJECT WORK / DISSERTATION

Total Marks	**: 500**	**External**	**: 300**	**[L – T – P – S]**
Internal Assessment	**: 200**	**Credits**	**: 16**	**[0 – 2 - 0 – 10]**

Learning Objectives:

To provide students with an opportunity to gain work experience that will enhance and complement their academic learning. The course requirements are designed to provide a structure that will enable students to make connections between what they learn in the classroom and on the job, to further develop analytical and interpersonal skills, and to practice business writing skills.

Course Requirements

1. The Internship / Project work / Dissertation for credit requires students to spend the majority of their time in technical, analytical, or administrative work that will contribute to their learning as outlined in the course objectives.
2. Work of a clerical nature must be limited to a maximum of 15 percent of the time spent on the job.
3. Prior to beginning an internship for credit, students must receive an internship orientation at the Training and Placement Cell of AIMIT..
4. A meeting with the faculty advisor / Guide to cover the ground rules and requirements.
5. Submission of the Final Report within seven days of the completion of the internship

The body of the Final Report will cover the following:

- **Job description:** Describe in detail your internship position duties and responsibilities. Discuss what duties were performed on a daily basis, periodic (e.g.,weekly) basis, and one-time special projects.
- **Knowledge gained:** Describe the knowledge gained or enhanced as a result of your internship experience. Relate this knowledge to what you learned in specific courses at AIMIT. Did your courses prepare you to handle the responsibilities of your position?
- **Skills learned:** Describe the skills that you learned or sharpened on the job. Discuss any skills that you learned as part of a course at AIMIT that were useful on the job. Consider a skill as the ability to do something like problem solving, analyze a problem, work in a groups, etc.
- **Attitudes/values :** Describe the attitudes or values that you found to be important for success in your job. Think of attitudes as a way of thinking or behavior, e.g., stubborn, patient, confrontational, etc. Consider values as the things you regard as important in life, e.g., dependability, integrity, hard work, etc.
- **Learning outcomes:** Identify the outcomes or results from the knowledge, skills and attitudes or values that you have described above. For example, what can you

do for an organization today that you could not have done, or could not have done as well, before your internship

Guidelines to prepare the Project Document / Dissertation

The following format guidelines are intended to help you prepare your master's thesis or dissertation and should be used in conjunction with the specific style adopted by your IT program. It is your responsibility to conform to the following format requirements and ensure that your manuscript's presentation is of the highest quality. Because requirements may change over time, students should not use existing library or departmental copies of manuscripts as examples of proper format.

Format

All pages of your manuscript must be in 'Letter Size', 8 ½ X 11 inch, format.

Reproduction Quality

The copies of your manuscript must be clean, unshaded, and free of spots and smudges. Faint, streaked, or uneven copies are unacceptable.

Margins

The left margin of each page must be 1 1/2 inches, and the top, right, and bottom margins 1 inch.

Placement of Page Numbers

There are only two ways to paginate your manuscript; upper right hand corner and bottom center. If your page numbers are at the bottom, leave two blank line spaces between the last line of text and the line on which the page number is placed. Whether they are at the top or the bottom, page numbers should appear just outside the 1-inch margins (.5 to .8 inches from the top or bottom edge of the page. Whichever method of pagination is selected, it must be followed consistently. Use lower-case Roman numerals for the front matter (which is all pages before the body of research), create section break and continue (beginning again with page "1") with Arabic numerals for the remainder of the manuscript, including the text, illustrations, appendices and references.

Type and Font

Your manuscript should be double-spaced (one and a half spaces can be used if approved by the chair of your committee) and single-sided. References may be single-spaced with a double space between each reference. Indented quotations may also be single-spaced. Use a professional quality font (e.g., Arial, Times Roman, Courier or Helvetica). Font size for your text should be 12 point; headings may be up to 14 point. Fonts for tables, figures, and appendices may range from 8 to 12 point.

Style

The style of your thesis or dissertation may follow any one of many standard style guides, as preferred by your graduate unit, or the style considered standard in your particular discipline. You should consult your advisor for preferences or additional requirements your department may have. In any case, your manuscript must be internally consistent.

Format Guidelines

Thesis or dissertation manuscripts are generally divided into three sections – the Front Matter, the Body of Research, and the Reference Matter.

For a visual reference to format the Front Matter, utilize the Example of Completed Front Matter link at the Approval Template page. A Thesis Example and a Dissertation Example will help you format the Front Matter for pagination and the placement of the

proper order of the front matter pages which can be generated at the "MS Word Templates" page.

Approval (Signature) Page

The Approval Page is the first page of the Front Matter and the manuscript. Count this as page "i". Type the names of the committee members on the lines provided at the center of the page.

Title Page

The Title page contains the title of your manuscript, your name, your previous degrees (including your majors, institutions and years centered on the page). Count the title page as page "ii". The degree you will be receiving at SAC, and the month and year of your graduation should be listed toward the bottom of the page (check with Graduate Studies for the graduation date). When listing the degree to be awarded, please refer to the Master's Degree List included with these guidelines. Do not use abbreviations.

Dedication Page

This is an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The dedication itself may be single or double-spaced.

Acknowledgement Page

This is also an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The acknowledgment itself may be single or double-spaced.

Abstract Page

On the Abstract page first list the title of your manuscript, your name, all degrees you have already earned (in chronological order), and the degree to be awarded. These lines should be centered on the page, beginning just below the top margin. Then double-space, and on the following line, center the word ABSTRACT. Double-space again before beginning the text of your abstract. Use paragraph indentation as appropriate. The text itself should be either one and a half spaces or double-spaced.

Number the Abstract Page in appropriate sequence with a lower-case Roman numeral.

Table of Contents

The Table of Contents page is counted and numbered with a lower-case Roman numeral. If you have used a List of Figures (Optional) and/or a List of Tables (Optional) , they must be included in your Table of Contents. Tab leaders should be used between the heading levels and the page numbers. (DO NOT simply type dots across the page--the spacing will not work out. Instead, set a dot leader tab. If you have multiple appendices, they must each be listed (see section on Appendices).

List of Figures

Placed on separate page after the Table of Contents. This page is counted and numbered with a lower-case Roman numeral. It may be single or double-spaced. Tab leaders should be used between the title of the figures and page the numbers. This page should be listed at the beginning of the Table of Contents.

List of Tables

Placed on separate after the Table of Contents. This page is counted and numbered with a lower-case Roman numeral. It may be single or double-spaced. Tab leaders should be used between the title of the tables and the page numbers. This page should be listed after the List of Figures at the beginning of the Table of Contents.

Preface Page

This page is counted and numbered with a lower-case Roman numeral.

The Text

Beginning with the first page of the text (begin again with page "1"), pages are numbered with sequential Arabic numerals through the end of your manuscript. Each chapter/major division of the text must start on a new page. Each of these lead pages should be counted and numbered.

Figures

Figures may include diagrams, charts, drawings, schematics, photographs, etc. Each of the two required copies of your manuscript must contain its own original figures, with the exception of photographs, in which case both may be high-quality copies either in color or black and white. Figures should be inserted as near as reasonably possible to the text to which they relate. They should be numbered consecutively with Arabic numerals as part of the continuing text.

Figures and their captions must appear on the same page, within the required margins. If captions are more than one line long, they may be single-spaced. They should be placed on paper of the same size and weight as the rest of the manuscript. Colored materials are acceptable, but since color does not reproduce on microfilm, an alternate key should be provided if it will be needed for interpretation of the figure in black and white.

Oversized figures may be presented in one of two ways: A horizontal figure that is too wide to fit on a regular manuscript page may be mounted on another piece of paper at the left hand margin, and folded like a fan. The folds must be within the right hand margin.

A figure that is both too long and too wide may be folded and inserted into a 6 ½ x 9 ‘’ envelope that is mounted on another sheet of paper.

Tables

Tables that are a half-page or shorter in size may be placed at the top or the bottom of the page, or in the center, with text above and below. Tables may also be placed alone on the page immediately following the page that refers to them. The placement of tables should be consistent throughout the manuscript. Tables continuing for more than one page should be labeled [e.g., Table 1 (cont.)], and oversized tables should be treated in the same way as oversized figures.

Reference matter

It may include notes to the text, appendices, a glossary, a list of references, and an index. The appendices and the list of references are the two most commonly used categories, and are discussed in detail below.

Appendices

The appendix (or a series of appendices) usually follows the main text, and contains material that is useful for a detailed review of the study, but is not essential to an understanding of the text. For example, an appendix is the appropriate section in which to place material such as raw data, the results of individual laboratory analyses, or sample forms. This may be useful supporting data even though it is not specifically utilized in the text. Note, however, that some reference should be made in the text to the fact that these materials appear in the appendix. The pages of the appendices are numbered in sequence with those of the text. Although it is preferable, you do not have to meet margin requirements for the material in your appendix, except for the left-hand margin.

After the last page of text, include a list of Appendices on a separate page. Individual appendices should start on a separate page and should be clearly marked.

The List of Appendices should also be included in the Table of Contents. To list appendices in your Table of Contents, use "Appendices" as your major heading. On the next line, indent five spaces, and begin listing each appendix with its title (for example, "Appendix A. Survey Data") and page number.

List of References

No manuscript is complete without a full listing of the necessary bibliographic information about the sources upon which the study is based. In most cases, only those sources actually cited in the study are listed. This section will be called "List of References", "References Cited", or simply "References", and all pages are counted and numbered. The list is most often arranged alphabetically, although it may follow some other logical plan. It will follow the appendices.

Problems encountered :

Front Matter

Formatting on front material is very detailed. Make sure that formatting matches examples. Make sure that pages are numbered correctly.

Margins

Margins for the entire manuscript must be:

left – 1.5 inches; top, right, bottom – 1 inch

Exceptions: Top, right and bottom margins may vary in the Appendix pages, but the left margin must be 1.5 inches throughout the ENTIRE manuscript. Page numbers in the Appendices must also appear consistently as in the rest of the manuscript.

Landscape-oriented figures and tables

Margin requirements must be met, and page numbers must be placed consistently as in the rest of the manuscript.

Table of Contents/Headings & Subheadings within manuscripts

Your Table of Contents will be checked against the body of your manuscript.

Page numbers must be correct.

All headings/sub-headings that appear at the same level should have the same appearance in the body of the manuscript and be distinguished from other heading-levels by appearance or numbering.

All headings and subheadings (as many levels as you include in the Table of Contents) should appear in the Table of Contents. If you have some third-level headings in the Table of Contents, then ALL third-level subheadings should appear in the Table of Contents. The major section headings (usually Chapter headings) should each begin on a new page. Other levels should not be started on a new page.

Forms

Your manuscript must be accompanied by ALL the appropriate completed forms or it will not be accepted.

Please Note: The problems listed above are among the most common, but manuscripts can be returned for other problems as well.

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