SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur, Chengalpattu Dt.-603203, Tamil Nadu.

DEPARTMENT OF

COMPUTER SCIENCE AND ENGINEERING

POST GRADUATE

CURRICULA AND SYLLABI

(REGULATIONS 2019)

Programme: M.E. - Computer Science and Engineering

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To mould students to exhibit top performance in the higher education and research and to become the State-of-the-art technocrat.

PEO2: To impart the necessary background in Computer Science and Engineering by providing solid foundation in Mathematical, Science and Engineering fundamentals.

PEO3: To equip the students with the breadth of Computer Science and Engineering innovate novel solutions for the benefit of common man.

PEO4: To groom the students to be multifaceted entrepreneurs with professional ethical attitude in broader social perspective.

PEO5: To provide an ambience learning environment that is conducive for the growth of successful professional career of students.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Computer Science and

Engineering Graduates will exhibit ability to:

Sl.No	PO #	Programme Outcome
1	**PO 1**	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering Problems.
2	**PO 2**	**Problem analysis:** Identify, formulate, research literature, and analyse Complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3	**PO 3**	**Design/development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and Cultural, societal, and environmental considerations.
4	**PO 4**	**Conduct investigations of complex problems**: 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

5	**PO 5**	**Modern tool usage** :Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the Limitations.
6	**PO 6**	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, And cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**PO 7**	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and Need for sustainable development.
8	**PO 8**	**Ethics** : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**PO 9**	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**PO 10**	**Communication**: Communicate effectively on complex engineering activities with the engineering 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.
11	**PO 11**	**Project management and finance** : Demonstrate knowledge and understanding of the engineering 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.
12	**PO 12**	**Life-long learning** :Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Exhibit proficiency in planning, implementing and evaluating team oriented-software Programming solutions to specific business problems and society needs.

PSO2: Demonstrate professional skills in applying programming skills, competency and decision making capability through hands-on experiences.

PSO3: Apply logical thinking in analyzing complex real world problems, and use professional and ethical behaviors to provide proper solutions to those problems.

PSO4: Demonstrate the ability to work effectively as part of a team in applying technology to business and personal situations.

4. PEOs / POs and PSOs Mapping:

The given below is the relational table between the programme educational objective mapped along with program outcome and program specific outcome.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
I	2	3	2		2	-	-	-	-	-	-	2	1	2	-	3
II	-	-	1	2	2	2	2	2	-	2	-	-	-	3	2	-
III	2	-	2		2	-	-	-	2	2	2	-	1	-	2	1
IV	2	2	3	2	3	3	-	-	-	-	-	1	-	2	-	1
V	-	-	-	-	-	1	2	2	-	2	-	-	-	1	2	-

Contribution 1: Reasonable 2: Significant 3: Strong

M.E. COMPUTER SCIENCE AND ENGINEERING SEMESTER COURSE WISE PO MAPPING

		Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
YEAR I	SEMESTER I	Applied Probability and Statistics	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
		Advanced Data Structures and Algorithms	2	3	2	3	2	-	1	2	-	1	2	1	1	2	3	2
		Advanced Computer Architecture	3	2	2	2	1	2	1	-	1	-	-	1	2	2	3	3
		Operating System Internals	2	2	2	2	2	2	1	2	-	3	2	-	2	2	2	2
		Advanced Software Engineering	3	2	3	3	3	2	3	-	-	3	-	3	3	3	3	3
		Machine learning Techniques	3	2	2	2	2	-	3	-	-	-	-	2	3	2	2	1
		Data Structures Laboratory	2	2	3	-	2	-	-	-	-	1	-	-	2	3	2	1
	SEMESTER II	Network Design and Technologies	2	2	2	2	2	2	2	3	-	-	2	2	2	2	2	2
		Security Practices	2	2	3	-	2	-	3	-	3	2	2	2	3	2	2	2
		Internet of Things	3	3	-	3	3	3	-	-	-	3	-	-	3	3	3	3
		Big Data Analytics	3	2	3	2	2	2	-	3	1	1	2	1	2	2	2	2
		Professional Elective - I																
		Advanced Databases	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	
		Principles of Programming Languages	3	3	3	2	2	-	-	-	-	-	2	3	3	2	2	2
		Image Processing and Analysis	3	2	-	2	2	-	-	3	1	-	2	-	2	2	2	2
		Web Engineering	3	1	2	2	2	3	-	-	3	-	3	3	3	3	3	2
		Cloud Computing Technologies	2	3	3	2	-	2	2	3	-	-	-	-	2	3	2	2
		Professional Elective - II																
		Real Time Systems	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2
		Mobile and Pervasive Computing	2	-	-	2	2	-	2	-	-	-	2	2	2	2	2	1
		Parallel Programming Paradigms	2	2	2	3	3	3	3	3	-	-	-	-	2	2	2	-
		Information Retrieval Techniques	3	2	2	-	2	2	2	1	3	3	-	3	2	2	2	2
		Software Architectures and Design	3	2	3	2	2	1	-	-	-	1	-	-	2	3	3	3
		Data Analytics Laboratory	3	-	-	2	2	-	-	-	1	-	2	-	2	2	2	2
		Term Paper Writing and seminar	3	2	3	2	2	2	-	3	1	1	2	1	2	2	2	2

2YEAR II	SEMESTER III	**Professional Elective –III**															
		Performance Analysis of Computer Systems	2	2	2	3	3	3	3	3	-	-	-	-	2	2	2	-
		Language Technologies	3	2	2	-	2	2	2	1	3	3	-	3	2	2	-	2
		Computer Vision	2	2	2	-	-	2	1	2	-	3	2	-	2	2	2	2
		Speech Processing and Synthesis	3	2	2	2	-	2	1	-	1	-	-	1	2	2	3	3
		Software Quality Assurance and Testing	2	2	2	-	-	2	1	2	-	3	2	-	2	2	2	2
		Professional Elective – IV																
		Formal Models of Software Systems	2	2	3	3	2	1	3	-	-	2	1	2	2	2	3	
		Embedded Software Development		2	3	3	-	3	3	-	-	3	-	3	2	1	2	2
		Social Network Analysis	2	2	-	3	2	-	3	-	-	-	-	1	2	2	2	2
		Bio-inspired Computing	2	2	3	3	3	3	3	-	-	2	-	2	3	2	2	-
		Compiler Optimization Techniques	2	-	3	2	2	2	2	-	1	1	-	-	1	1	-	-
		Professional Elective – V																
		Data Visualization Techniques	2	2	2	3	2	3	1	1	2	-	2	1	2	2	2	1
		Reconfigurable Computing	2	2	3	1	2	3	2	2	3	2	1	1	1	2	2	2
		Mobile Application Development	2	3	3	1	2	3	2	2	3	2	-	1	1	2	2	1
		Bio Informatics	2	1	-	-	3	1	2	-	-	3	3	1	1	2	2	2
		Information Storage Management	1	2	2	3	2	2	2	2	2	2	1	1	2	2	3	3
		Project Work Phase - I	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	SEMESTER IV	Project Work Phase - II	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

SRM VALLIAMMAI ENGINEERING COLLEGE

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Approved by AICTE & Affiliated to Anna University, Chennai, 'A' Grade Accreditation by NAAC, NBA Accredited, ISO 9001:2015 Certified

REGULATIONS -2019
M.E. COMPUTER SCIENCE AND ENGINEERING
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918104	Applied Probability and Statistics	FC	4	4	0	0	4
2.	1912101	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
3.	1912102	Advanced Computer Architecture	PC	3	3	0	0	3
4.	1912103	Operating System Internals	PC	3	3	0	0	3
5.	1912104	Advanced Software Engineering	PC	3	3	0	0	3
6.	1912105	Machine Learning Techniques	PC	3	3	0	0	3
PRACTICALS								
7.	1912106	Data Structures Laboratory	PC	4	0	0	4	2
			TOTAL	**24**	**20**	**0**	**4**	**22**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1912201	Network Design and Technologies	PC	3	3	0	0	3
2.	1912202	Security Practices	PC	3	3	0	0	3
3.	1912203	Internet of Things	PC	3	3	0	0	3
4.	1912204	Big Data Analytics	PC	3	3	0	0	3
5.	19122XX	Professional Elective – I	PE	3	3	0	0	3
6.	19122XX	Professional Elective – II	PE	3	3	0	0	3
PRACTICALS								
7.	1912215	Data Analytics Laboratory	PC	4	0	0	4	2
8.	1912216	Term Paper Writing and Seminar	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	19123XX	Professional Elective –III	PE	3	3	0	0	3
2.	19123XX	Professional Elective –IV	PE	3	3	0	0	3
3.	19123XX	Professional Elective –V	PE	3	3	0	0	3
PRACTICAL								
4.	1912316	Project Work Phase - I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	1912401	Project Work Phase - II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

SUMMARY

SL. NO.	Subject Criteria	Credits Per Semester				Credits Total	Percentage
		I	II	III	IV		
1.	FC	4				4	5.79
2.	PC	18	14			32	45.71
3.	PE		6	9		15	21.73
4.	EEC		1	6	12	19	27.53
	Total	**22**	**21**	**15**	**12**	**70**	**100%**
5.	**Non-Credit / Mandatory**						

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918104	Applied Probability and Statistics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1912101	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
2.	1912102	Advanced Computer Architecture	PC	3	3	0	0	3
3.	1912103	Operating System Internals	PC	3	3	0	0	3

4.	1912104	Advanced Software Engineering	PC	3	3	0	0	3
5.	1912105	Machine Learning Techniques	PC	3	3	0	0	3
6.	1912106	Data Structures Laboratory	PC	4	0	0	4	2
7.	1912201	Network Design and Technologies	PC	3	3	0	0	3
8	1912202	Security Practices	PC	3	3	0	0	3
9.	1912203	Internet of Things	PC	3	3	0	0	3
10.	1912204	Big Data Analytics	PC	3	3	0	0	3
11.	1912215	Data Analytics Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

1.	1912216	Term Paper Writing and Seminar	EEC	2	0	0	2	1
2.	1912316	Project Work Phase - I	EEC	12	0	0	12	6
3.	1912401	Project Work Phase - II	EEC	24	0	0	24	12

LIST OF ELECTIVES

II SEMESTER PROFESSIONAL ELECTIVE (PE) - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1912205	Advanced Databases	PE	3	3	0	0	3
2.	1912206	Principles of Programming Languages	PE	3	3	0	0	3
3.	1912207	Image Processing and Analysis	PE	3	3	0	0	3
4.	1912208	Web Engineering	PE	3	3	0	0	3
5.	1912209	Cloud Computing Technologies	PE	3	3	0	0	3

II SEMESTER PROFESSIONAL ELECTIVE (PE) - II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1912210	Real Time Systems	PE	3	3	0	0	3
2.	1912211	Mobile and Pervasive Computing	PE	3	3	0	0	3
3.	1912212	Parallel Programming Paradigms	PE	3	3	0	0	3
4.	1912213	Information Retrieval Techniques	PE	3	3	0	0	3
5.	1912214	Software Architectures and Design	PE	3	3	0	0	3

III SEMESTER PROFESSIONAL ELECTIVE (PE) - III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1912301	Performance Analysis of Computer Systems	PE	3	3	0	0	3
2.	1912302	Language Technologies	PE	3	3	0	0	3
3.	1912303	Computer Vision	PE	3	3	0	0	3
4.	1912304	Speech Processing and Synthesis	PE	3	3	0	0	3
5.	1912305	Software Quality Assurance and Testing	PE	3	3	0	0	3

III SEMESTER PROFESSIONAL ELECTIVE (PE) - IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1912306	Formal Models of Software Systems	PE	3	3	0	0	3
2.	1912307	Embedded Software Development	PE	3	3	0	0	3
3.	1912308	Social Network Analysis	PE	3	3	0	0	3
4.	1912309	Bio-inspired Computing	PE	3	3	0	0	3
5.	1912310	Compiler Optimization Techniques	PE	3	3	0	0	3

III SEMESTER PROFESSIONAL ELECTIVE (PE) - V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1912311	Data Visualization Techniques	PE	3	3	0	0	3
2.	1912312	Reconfigurable Computing	PE	3	3	0	0	3
3.	1912313	Mobile Application Development	PE	3	3	0	0	3
4.	1912314	Bio Informatics	PE	3	3	0	0	3
5.	1912315	Information Storage Management	PE	3	3	0	0	3

SEMESTER - I

1918104 APPLIED PROBABILITY AND STATISTICS

L	T	P	C
4	0	0	4

OBJECTIVES:

- This course is designed to provide the solid foundation on topics in applied probability and its distributions.
- The course gives us the idea of One and Two dimensional Random variables.
- Study of various statistical methods which is the basis for mathematical sciences including statistics, and estimation Theory.
- The modern optimization methods are used in testing of hypothesis and risk modeling.
- It is framed to address the issues and the principles of multivariate analysis.

UNIT- I : PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma – Function of a random variable.

UNIT - II :TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT - III : ESTIMATION THEORY 12

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT-IV : TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT - V : MULTIVARIATE ANALYSIS 12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

- Basic probability axioms and rules and the moments of discrete and continuous random Variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood Estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, Calculating descriptive statistics, testing for multivariate normality.
- The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCE BOOKS:

1. Devore, J. L., ―Probability and Statistics for Engineering and the Sciences‖, 8th Edition, Cengage Learning, 2014.

2. Dallas E. Johnson, ―Applied Multivariate Methods for Data Analysis‖, Thomson and Duxbury press, 1998.

3. Gupta S.C. and Kapoor V.K.,‖ Fundamentals of Mathematical Statistics‖, Sultan and Sons, New Delhi, 2001.

4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.

5. Richard A. Johnson and Dean W. Wichern, ―Applied Multivariate Statistical Analysis‖, 5th Edition, Pearson Education, Asia, 2002.

CO – PO and PSO MAPPING:

Course Outcomes	Program Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

1912101 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C

4 0 0 4

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To learn and use data structures for set manipulation problem..
- To study about design techniques of algorithms.
- To learn and use hierarchical tree data structures and its operations
- To learn the usage of graphs and its applications.

UNIT - I: DESIGN OF EFFICIENT ALGORITHMS 12

Data structures: lists, queues, and stacks - Set representations - Graphs-Trees -Recursion -Divide-and-conquer - Balancing -Dynamic programming -Sorting and Order Statistics - The sorting problem - Radix sorting -Sorting by comparisons – Heap sort- an O(n log n) comparison sort – Quick sort-an O(n log n) expected time sort.

UNIT - II: DATA STRUCTURES FOR SET MANIPULATION PROBLEMS 12

Fundamental operations on sets - Hashing - Binary search - Binary search trees - Optimal binary search trees - A simple disjoint-set union algorithm. - Tree structures for the UNION-FIND problem - Balanced tree schemes - Dictionaries and priority queues - Mergeable heaps - Concatenable queues. –Partitioning.

UNIT - III: ALGORITHM DESIGN TECHNIQUES 12

Divide-and-Conquer Algorithms - The Problem of Multiplying Long Integers-Balancing Sub problems- Dynamic Programming-The Triangulation Problem -Greedy Algorithms-Backtracking-Implementing Backtrack Search-Branch-and-Bound Search-Local Search Algorithms – Introduction to String Algorithms – Introduction to Randomized and approximation algorithms-Introduction to Parallel Algorithms.

UNIT - IV: ALGORITHMS ON TREES 12

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B- trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable - heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT - V: ALGORITHMS ON GRAPHS 12

Minimum-cost spanning trees- Depth-first search - Biconnectivity-Depth-first search of a directed

graph - Strong connectivity- Path-finding problems -A transitive closure algorithm - A shortest-path algorithm - Path problems and matrix multiplication - Single-source problems - Dominators in a directed acyclic graph: putting the concepts together

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Design data structures and algorithms to solve computing problems.
- Design data structures for set manipulation problems
- Understand algorithm design techniques.
- Design tree data structures and perform its operation
- Design algorithms using graph structure to solve real-life problems.

REFERENCES:

1. Alfred V.Aho, John E. Hopcroft, Jeffrey D. Ullman,-Data Structures and Algorithms, Pearson Education, Reprint2006.
2. Robert Sedgewickand Kevin Wayne,-ALGORITHMS, Fourth Edition,Pearson Education.
3. S. Sridhar, Design and Analysis of Algorithms, First Edition, Oxford UniversityPress.2014
4. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein,-Introduction to Algorithms, Third Edition, Prentice-Hall,2011.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 3	-	-	2	-	-	-	-	2	-	1	-	-	-	2	-	-
CO 4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	-	-
CO 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2

1912102 ADVANCED COMPUTER ARCHITECTURE L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To understand the design of the memory hierarchy
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the Vector, SIMD and GPU architectures

UNIT - I: FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Mother Board architecture – CPU socket–Fan and Heat Sink mounting point-Power connector–DRAM- PCI slot–CMOS–Connectors and Integrator–Computer Design – Measuring and Reporting Performance –Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP -Advanced Branch Prediction -Dynamic Scheduling - Exploiting ILP -Instruction Delivery and Speculation -Limitations of ILP.

UNIT - II: MEMORY HIERARCHY DESIGN 9

Introduction –Optimizations of Cache Performance –Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines –Design of Memory Hierarchies.

UNIT - III: MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues –Performance Issues –Synchronization –Models of Memory Consistency - Interconnection Networks –Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT - IV: MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures –Intel Multicore Architectures –SUN CMP architecture –IBM Cell Architecture. Introduction to Warehouse - scale computers-Architectures-Physical Infrastructure and Costs - Cloud Computing.

UNIT - V: VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture –SIMD Extensions for Multimedia –Graphics Processing Units – GPGPU Computing –Detecting and Enhancing Loop Level Parallelism- Case Studies- porting scientific applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the limitations of ILP.
- Discuss the various techniques used for optimizing the memory performance.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit Parallelism.
- To Design vector , SIMD and GPU system.

REFERENCES:

1. John L. Hennessey and David A. Patterson, —Computer Architecture –A Quantitative Approach, Morgan Kaufmann / Elsevier, 5th edition, 2012.
2. David B. Kirk, Wen-mei W. Hwu, —Programming Massively Parallel Processors, Morgan Kauffman, 2010.
3. Darryl Gove, —Multicore Application Programming: For Windows,Linux, and Oracle Solari, Pearson, 2011
4. David E. Culler, Jaswinder Pal Singh, - Parallel computing Architecture:A hardware/software approach, Morgan Kaufmann /Elsevier Publishers, 1999
5. Kai Hwang and Zhi.WeiXu, - Scalable Parallel Computing, Tata McGraw Hill, New Delhi, 2003.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2	-	2	1	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	-	2	-	-	-	-	-	-	-	1	-	2	-	-
CO 3	-	2	-	2	-	-	1	-	1	-	-	-	-	-	3	-
CO 4	-	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO 5	-	-	2	-	-	2	-	-	1	-	-	-	-	-	-	3

1912103 **OPERATING SYSTEM INTERNALS** **L T P C**

3 0 0 3

OBJECTIVES:

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in Linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.

UNIT - I: INTRODUCTION **9**

Basic Operating System Concepts - Overview of Unix File System – Files - Links - Types - Inodes -Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization and Critical region- Inter process Communication – Process Management - Memory Management - Device Drivers.

UNIT - II: PROCESSES **9**

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes -Termination – Removal- Interruption and Exceptions.

UNIT - III: FILE SYSTEM **9**

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - File system Types - Special File systems – File system Type Registration – File system Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

UNIT - IV: DISTRIBUTED SYSTEM **9**

Advantages of Distributed system – Types of network based operating system – Network structure – Communication structure – Communication protocols – An Example: TCP/IP – Robustness – Design Issues.

UNIT - V: PROTECTION AND SECURITY **9**

Goals of protection – Principles of protection – Domain of protection – Access matrix – Implementation of access matrix. The Security problem – Program threats – System and network threats – Cryptography as a security tool – User authentication – Implementing security defenses - Firewalling to protect systems and networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the Linux kernel for a different software system.
- To understand about the distributed system, protection and security of the operating system.

REFERENCES:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Concepts” ninth edition, 2013 Wiley Publication**.**
2. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O’Reilly Publications, 2005.
3. Harold Abelson, Gerald Jay Sussman and Julie Sussman, “Structure and Interpretation of Computer Programs”, Second Edition, Universities Press, 2013.
4. Maurice J. Bach, “The Design of the Unix Operating System” 1st Edition Pearson Education, 2003.
5. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, “Linux Kernel Internals”, 2nd Edition, Addison-Wesley, 1998.
6. Robert Love**,** “Linux Kernel Development”, 3rd Edition, Addison-Wesley, 2010

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	3	-	-	2	3	-	-
CO 3	-	2	2	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 4	-	-	2	-	-	-	1	-	-	-	-	-	-	2	2	-
CO 5	-	2	-	2	2	-	-	2	-	-	-	-	-	-	-	2

1912104 **ADVANCED SOFTWARE ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand Software Engineering Lifecycle Models.
- To Understand Software Requirement.
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches.
- To be familiar with Maintenance practices.

UNIT - I: INTRODUCTION **9**

Software engineering concepts – Development activities – Software lifecycle models - Software Process-Generic process- Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral –Agile Development.

UNIT - II: SOFTWARE REQUIREMENT **9**

Representation of Requirement –Data flow, ER Diagram, View point , Controlled Requirement Expression, Structured Analysis and Design Technique, View point Oriented Requirements Definitio**n-** Case Study : Requirement Engineering Tools.

UNIT - III: ARCHITECTURE AND DESIGN **9**

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design modeling – static and Dynamic modeling-Architectures for network, mobile, and embedded system.

UNIT - IV: TESTING **9**

Testing – Unit testing – Cyclomatic Complexity -Black box testing– White box testing – Integration and System testing– Regression testing.

UNIT - V: MAINTENANCE **9**

Software maintenance framework- Enhancing maintenance productivity, maintenance teams, potential solutions to maintenance problem - Reverse Engineering- Maintenance tools: Criteria for selecting tools, taxonomy of tools

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand clearly about the different Software Engineering Lifecycle Models.
- Design Software Requirement for any given project.
- Gain knowledge of the architectural System Analysis and Design concepts..

- Understand software testing approaches and develop test cases for the project.
- Familiarize with the Maintenance practices.

REFERENCES:

1. Roger S Pressman, “Software Engineering – A Practitioner’s Approach”, 7th edition, Tata McGraw Hill Education, 2014
2. Ian Somerville “Software Engineering”, 9th edition, Pearson Education, 2010.
3. Elizabeth Hull, Ken Jackson and Jeremy Dick, “*Requirements Engineering”,* third edition, Springer, 2010*.*
4. Carlos Otero, "Software Engineering Design: Theory and Practice", CRC Press, 2012
5. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006.
6. Armstrong a Takang and Penny A.Grubb, “Software Maintenance: concepts and Practice”, International Thomson Computer press, London, 2015.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 2	3	3	-	3	-	2	-	-	-	3	-	3	-	-	3	-
CO 3	3	-	3	3	3	-	-	-	-	-	-	-	-	3	-	3
CO 4	3	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1912105 **MACHINE LEARNING TECHNIQUES** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce various types of machine learning and its basics.
- To provide an insight to neural network techniques, merits and demerits.
- To enable the students to understand to real world problems
- To study the various learning techniques.
- To study and evaluate graphical model for the given data.

UNIT - I: INTRODUCTION **9**

Machine learning: What and why? - Examples of Machine Learning Applications - Types Of Machine Learning Supervised Learning - Machine Learning Process- The Curse of Dimensionality, Over fitting - Training, Testing, and Validation Sets-The Confusion Matrix & Basic Statistics-Bias-Variance Tradeoff.

UNIT - II: NEURONS, NEURAL NETWORKS, AND LINEAR DISCRIMINANTS **9**

Hebb's Rule - Neural Networks - The Perceptron - Linear Separability& Linear Regression. The Multi-layer Perceptron: Biases, Algorithm - Local minima and Stochastic gradient Descent Examples Of Using The MLP : Regression Problem & Classification Example - Deriving Back-Propagation

UNIT - III: DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS **9**

Linear Discriminant Analysis (LDA) - PRINCIPAL COMPONENTS ANALYSIS (PCA), Factor Analysis - Independent Components Analysis - **PROBABILISTIC MODEL -** Gaussian Mixture Models : EM Algorithm - Nearest Neighbour Methods - Support Vector Machines

UNIT - IV: LEARNING **9**

Evolutionary Learning **-** The Genetic Algorithms (GA)-Reinforcement Learning -Decision Trees - CLASSIFICATION AND REGRESSION TREES (CART) - Ensemble Learning : Boosting, Bagging, Random Forests - Unsupervised Learning : K-Means – Algorithm - Vector Quantisation.

UNIT - V: GRAPHICAL MODEL **9**

Bayesian Networks - Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand various types of machine learning and its basics.
- Apply appropriate neural network strategy for any given problem
- Suggest dimension reduction algorithms for any given problem
- Understand the various learning techniques.
- Understand and evaluate dimensionality reduction for the given data.

REFERENCES:

1. Stephen Marsland, - Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

2. Ethem Alpaydin, - Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2	-	-	-	-	-	-	-	-	-	2	3	-	-	-
CO 2	3	3	2	2	2	-	3	-	-	-	-	2	-	3	-	-
CO 3	3	2	2	2	-	-	3	-	-	-	-	2	-	2	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	2	-	-	2	2
CO 5	3	2	2	2	2	-	3	-	-	-	-	2	-	-	-	1

1912106 **DATA STRUCTURES LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- To understand sorting algorithms
- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures
- To understand the usage of spanning trees.

List of Experiments:

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for Concurrency.

Exercises should be designed to cover the following topics:

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Design and implement sorting algorithms.
- Design and implement basic and advanced tree data structures
- Design algorithms using graph structures
- Design algorithms using heap structures
- Design and develop efficient algorithms with minimum spanning tree.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-
CO 2	-	2	-	-	2	-	-	-	-	-	-	-	-	3	-	1
CO 3	-	-	3	-	3	-	-	-	-	-	-	-	-	-	2	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SEMESTER - II

1912201 NETWORK DESIGN AND TECHNOLOGIES L T P C

3 0 0 3

OBJECTIVES:

- To understand the principles required for network design.
- To explore various technologies in the wireless domain.
- To study about cellular networks.
- To study about 3G and 4G cellular networks.
- To understand the paradigm of Software defined networks.

UNIT - I: NETWORK DESIGN FUNDAMENTALS 9

OFDM – Basic Principles of OFDM – OFDM Demodulation – OFDM implementation using IFFT/FFT processing – Cyclic-Prefix Insertion - Frequency-Domain Model Of OFDM Transmission- Channel Estimation And Reference Symbols-Frequency Diversity With OFDM: Importance Of Channel Coding- Selection Of Basic OFDM Parameters- Multi-Cell Broadcast/Multicast Transmission And OFDM.

UNIT - II: WIRELESS NETWORKS 9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security– IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS.

UNIT - III: CELLULAR NETWORKS 9

Global System for Mobile Communications(GSM)- The GSM Subsystems-The Network Subsystem Mobility Management and Call Control-General Packet Radio Service(GPRS) and EDGEGSM – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – Introduction to Universal Mobile Telecommunications Systems (UMTS) and High-Speed Packet Access (HSPA)

UNIT - IV: 4G NETWORKS 9

Evolution of Mobile Systems before LTE- Drivers for LTE-Standardization of LTE-The 3GPP Process-The 3G Evolution to 4G-LTE Introduction-Network Architecture- Air Interface and Radio Networks-Basic Procedure-Summary and Comparison with HSPA-LTE-Advanced-Channel Modeling for 4G – Introduction to 5G.

UNIT - V: SOFTWARE DEFINED NETWORKS 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types– Virtualization – Data Plane – I/O – Design of SDN Framework.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to

- Identify the components required for designing a network
- Design a wireless network at a high-level using different networking technologies
- Analyze the various protocols of cellular networks
- Discuss the features of 3G and 4G networks
- Experiment with software defined networks.

REFERENCES:

1. Erik Dahlman, Stefan Parkva, Johan Skold,-4G:LTE/LTE-Advancedfor Mobile Broadband‖, Academic Press, 2013.
2. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks andMobile Broadband", Wiley,2014.
3. Martin Sauter, -Beyond 3G-BringingNetworks, Terminals and theWebTogether:LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0‖, Wiley,2009.
4. Thomas D.Nadeauand Ken Gray,-SDN–Software Defined Networks,O'Reilly Publishers,2013.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	3	-	2	-	2	-	-	-	-	2	-	3	-	-	-
CO 2	-	2	3	-	-	2	-	-	-	-	2	2	-	2	-	-
CO 3	-	3	2	2	2	-	2	-	-	-	2	2	2	-	2	-
CO 4	-	2	2	2	3	2	2	-	-	-	2	-	-	3	-	2
CO 5	2	-	2	2	-	-	2	3	-	-	2	2	2	-	2	-

1912202 **SECURITY PRACTICES** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the core fundamentals of system security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts
- To perform a detailed study of Privacy and Storage security and related Issues.

UNIT - I: SYSTEM SECURITY **9**

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Guarding against network intrusions.

UNIT - II: NETWORK SECURITY **9**

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security.

UNIT - III: SECURITY MANAGEMENT **9**

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

UNIT - IV: CYBER SECURITY AND CRYPTOGRAPHY **9**

Computer Forensics- Computer Forensics and Incidence Response - Security e-Discovery – Network Forensics-Data Encryption-Satellite Encryption -Password based authenticated Key establishment Protocols.

UNIT - V: PRIVACY AND STORAGE SECURITY **9**

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course the students should be able to

- Understand the core fundamentals of system security
- Apply the security concepts related to networks in wired and wireless scenario
- Implement and Manage the security essentials in IT Sector
- Able to explain the concepts of Cyber Security and encryption Concepts.
- Able to attain a thorough knowledge in the area of Privacy and Storage.

REFERENCES:

1. John R.Vacca, Computer and Information Security Handbook, Second Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, Fourth Edition, Cengage Learning, 2012.
3. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	2	-	-	-	3	-	-	-	3	-	-	-
CO 2	2	-	-	-	3	-	3	-	-	-	-	-	-	2	-	-
CO 3	-	-	3	-	3	-	-	-	3	2	-	2	-	3	2	-
CO 4	3	2	-	-	-	-	-	-	-	-	2	-	-	-	3	1
CO 5	-	3	-	-	2	-	-	-	-	-	-	-	3	-	-	3

1912203 **INTERNET OF THINGS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To understand the challenges in IOT and IOT applications
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT - I: INTRODUCTION TO IOT **9**

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models- Machine to Machine, Difference between IoT and M2M, Software define Network.

UNIT - II: CHALLENGES AND DOMAIN SPECIFIC APPLICATIONS IN IOT **9**

Design challenges, Development challenges, Security challenges, Other challenges- Home automation, Industry applications, Surveillance applications.

UNIT - III: IOT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – CoAP – Security.

UNIT - IV: BUILDING IOT PRODUCTS **9**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces.

UNIT - V: DEVELOPING IOT PROGRAMS **9**

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Analyze the various fundamentals for IoT
- Develop solution for challenges in IoT devices and applications
- Analyze the basics of IoT protocols..
- Design a portable IoT using Raspberry Pi
- Analyze applications of IoT in real time scenario

REFERENCES:

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012.
5. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	3	-	3	3	-	-	-	-	3	-	-	3	3	3	-
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CO 3	3	3	-	-	3	-	-	-	-	3	-	-	3	3	-	-
CO 4	3	3	-	-	3	-	-	-	-	3	-	-	3	-	3	-
CO 5	3	3	-	-	3	3	-	-	-	3	-	-	3	3	-	3

1912204 **BIG DATA ANALYTICS** **L T P C**

3 0 0 3

OBJECTIVES:

- Understand the Big Data Platform and its Use cases
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System
- Apply analytics on Structured, Unstructured Data and exposure to Data Analytics with R.

UNIT - I: INTRODUCTION TO BIG DATA AND HADOOP **9**

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets..

UNIT - II: HADOOP FRAMEWORK **9**

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures

UNIT - III: MAP REDUCE **9**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT - IV: HADOOP ECO SYSTEM **9**

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction.

UNIT - V: DATA ANALYTICS WITH R **9**

Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand how to leverage the insights from big data analytics.
- Analyze data in HADOOP framework .
- Analyze data by utilizing map reduce techniques.
- Develop Big Data Solutions using Hadoop Eco System
- Apply Machine Learning Techniques using R.

REFERENCE BOOKS:

1.Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.

2.Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	-	-	-	2	-	-	-	-	1	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	-	2	-	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	3	-	-	-	1	2	-	-	-

1912215 **DATA ANALYTICS LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- To implement Map Reduce programs for processing big data.
- To realize storage of big data using H base, MongoDB.
- To analyze big data using linear models.
- To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering.
- To visualize data using plotting methods.

LIST OF EXPERIMENTS:

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset
4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application to store big data in Hbase / MongoDB / Pig using Hadoop /R.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Process big data using Hadoop framework.
- Build and apply linear and logistic regression models.
- Perform data analysis with machine learning methods.
- Perform graphical data analysis.
- Understand application using Hbase/MongoDB

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:

Hadoop YARN

R Package

Hbase

MongoDB

REFERENCES:

1. Alan Gates and Daniel Dai, "Programming Pig – Dataflow scripting with Hadoop", O'Reilley, 2nd Edition, 2016.
2. Gareth James, Daniela Witten,Trevor Hastie and Robert Tibshirani,-An Introduction to Statistical Learning with Applications in R, Springer Publications, 2015(Corrected 6th

Printing)

3. Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data Storage", O'Reilley, 2nd Edition, 2013.
4. Lars George, "HBase: The Definitive Guide", O'Reilley, 2015.
5. Tom White, -Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale‖, O'Reilley, 4th Edition, 2015.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1912216 **TERM PAPER WRITING AND SEMINAR** **L T P C**

0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into atopic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP)	3rd week	**3%** (the selected information must be area specific and of international and national standard)

	from your area.		
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - tryto: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour-first-or-foundational papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain another view, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion?	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about eachpaper)

	• What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)

Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation &Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th& 15th week	**10%** (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	-	-	-	2	-	-	-	-	1	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	1	2	-	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	3	-	-	-	1	2	-	-	-

SEMESTER – III

1912316	**PROJECT WORK PHASE - I**	**L T P C**
		0 0 12 6

OBJECTIVES:

- To identify and analyze the solution to the particular problem that serves or benefits the society and the mankind.
- To develop a systematic approach and a step by step methodology for the problem identified.
- To equip the students in developing project, generating reports and to train them in a way such that they present their proposals in a proper way such that the progress in the project is represented clearly in the reviews.
- To formalize a well narrated project report by attaining a solution to the problem.
- To make enable the project developed to be recognized by various national/international organizations.

SYLLABUS:

The student's proposal for developing a project is focused based on the benefit of the mankind authorized by the reputed journals (IEEE, ACM, Springer, Elsevier, etc.,) within the two years from the start of the project. The student can develop the solution which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. The topic is validated by the faculty member whose area of interest is related to the topic. Their project can be an extension of a research work guided by the faculty member. The size of the report should not be less than 25 pages with 20% plagiarism. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through various reviews and will be the word is rewarded by the viva-voice through the panel of members with external faculty members.

TOTAL: 90 PERIODS

OUTCOMES:

- Students have the ability to continue the research for the project which they have developed.
- Students are able to face the delegates during their questionnaires.
- Students have knowledge to identify problems and obtaining solution to various scenarios in the project proposed area.
- Students are able to develop a working model which can be related to their area which simplifies their proposed work.
- Equipped to publish their work and get recognized by the national or international journals.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	3	3	3	1	2	1	2	3	1	2	2	2	2	1	1
CO 2	1	-	1	2	-	1	1	2	-	1	1	2	1	-	2	1
CO 3	2	2	2	1	-	-	1	-	-	1	-	-	2	-	2	-
CO 4	-	2	2	2	3	2	2	-	-	-	2	-	-	3	-	2
CO 5	2	-	2	2	-	-	2	3	-	-	2	2	2	-	2	-

SEMESTER – IV

1912401 **PROJECT WORK PHASE - II** **L T P C**

0 0 24 12

OBJECTIVES:

- To identify and analyze the solution to the particular existing problem or it can be the extension work of the phase-I.
- To develop the solution in such a way that is recognized by international standards.
- To train the students to develop their working model in the recent updated model or software in the current trend.
- To formalize and prepare report which has a précised writing method which acts as the reference for the future work.
- To make enable the project developed to file their own patents and book chapter.

SYLLABUS:

The student's proposal can be related to the development of the phase-I work or it can be the research extension. The student can develop the solution which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. The topic is validated by the faculty member whose area of interest is related to the topic. Their project can be an extension of a research work guided by the faculty member. The size of the report should not be less than 40 pages with 10% plagiarism. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through various reviews and will be the word is rewarded by the viva-voice through the panel of members with external faculty members.

TOTAL: 180 PERIODS

OUTCOMES:

- Students are equipped with their own patents and book chapters recognizing their works.
- Students are eligible to publish their works in International / Scopus indexed journals.
- Students will be trained to initialize their research work on the proposed project
- Students will have knowledge in modularizing a new technology related to the recent trend.
- Able to lead their work in various research areas where there is an opportunity.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	3	-	2	-	3	3	2	-	-	2	-	3	-	-	-
CO 2	-	2	1	-	-	2	-	-	-	1	2	2	-	2	-	-
CO 3	1	2	2	2	2	-	2	-	3	2	-	2	2	-	2	-
CO 4	-	2	-	2	3	2	2	-	2	2	2	-	-	3	-	2
CO 5	2	-	2	2	-	-	2	3	-	-	2	2	2	-	2	-

PROFESSIONAL ELECTIVE - I

1912205 ADVANCED DATABASES L T P C

3 0 0 3

OBJECTIVES:

- To understand the design of parallel and distributed databases.
- To study the usage and applications of Intelligent databases.
- To understand the emerging databases like XML
- To understand the MOBILE databases.
- To understand multimedia databases like XML

UNIT - I: PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism– Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing.

UNIT - II: INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases- Spatial Data Types - Spatial Data Structures-Spatial Access Methods.

UNIT - III: XML DATABASES 9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT - IV: MOBILE DATABASES 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols.

UNIT - V: MULTIMEDIA DATABASES 9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Develop skills on parallel and distributed databases to optimize their performance in practice.
- Analyze each type of intelligent databases and its necessity

- Design faster algorithms in solving practical database problems.
- Understand about mobile databases.
- Understand the design of multimedia databases.

REFERENCES:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, —Database System Concepts, Sixth Edition, McGraw Hill, 2011.

2. C.J.Date, A. Kannan, S. Swamynathan, - An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.

3. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, - Advanced Database Systems, Morgan Kaufmann publishers,2006.

4. R. Elmasri, S.B. Navathe,-Fundamentals of Database Systems, Sixth Edition, Pearson Education/Addison Wesley, 2010.

5. Vijay Kumar, —Mobile Database Systems, John Wiley & Sons, 2006.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	2	-	-	-	2	-
CO 3	-	-	-	2	-	2	-	-	-	-	-	-	2	-	-	-
CO 4	-	-	-	-	-	-	2	-	2	-	-	2	-	-	2	-
CO 5	-	-	-	-	2	-	-	1	-	2	-	-	2	1	-	-

1912206 PRINCIPLES OF PROGRAMMING LANGUAGES L T P C

3 0 0 3

OBJECTIVES:

- To understand and describe syntax and semantics of programming languages.
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs with functional and logic programming paradigms

UNIT - I: INTRODUCTION 9

Reasons for Studying, Concepts of Programming Languages - Programming Domains - Languages Evaluation Criteria - Influences on Languages Design - Language Categories, - Implementation Methods - Evolution of Major Programming Languages - Overview of Compilation.

UNIT - II: SYNTAX, DATA TYPES, AND BASIC STATEMENTS 9

Programming Language Syntax - Describing Syntax and Semantics - Lexical Analysis - Recursive Descent Parser - Bottom Up Parsing - Names, Scopes, and Bindings - Control Flow - Expression Evaluation - Structured and Unstructured Flow, Sequencing and Selection - Iteration and Recursion - Data Types.

UNIT - III: SUBROUTINES AND CONTROL ABSTRACTION 9

Introduction, Fundamentals of Subprogram - Design Issues for Subprograms & Local - Referencing Environments - Parameter-Passing Methods - Overloaded Subprograms, Generic Subprograms - Design Issues for Functions & User Defined Operators - Implementing Subprograms - Abstract Data Types - Encapsulation Constructs.

UNIT - IV: OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING 9

Object-Oriented Programming - Design Issues for Object-Oriented Languages, Support for Object Oriented Programming - Implementation of Object-Oriented Constructs - Introduction to Subprogram-Level Concurrency - Semaphores - Monitors , Message Passing - Threads, Statement-Level Concurrency - Introduction to Exception Handling, Exception Handling in Ada, C++, Java.

UNIT - V: FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Functional Programming Languages - Logic Programming Concepts – Prolog - Theoretical Foundations - Logic Programming in Perspective – Concurrency.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Describe syntax and semantics of programming languages
- Explain data, data types, and basic statements of programming languages
- Design and implement subprogram constructs
- Apply object-oriented, concurrency, and event handling programming constructs
- Develop programs in logical concepts and Prolog

REFERENCES:

1. Robert W. Sebesta, "Concepts of Programming Languages", Tenth Edition, Addison Wesley, 2012.
2. Michael L. Scott, "Programming Language Pragmatics", Third Edition, Morgan Kaufmann, 2009
3. Ghezzi,-Programming Languages‖, 3rdEdition,JohnWiley, 2008.
4. John C. Mitchell, -Concepts in Programming Languages‖, Cambridge University Press, 2004.
5. Louden,-Programming Languages, 3rdEdition,2012.
6. Ravi Sethi, -Programming Languages: Concepts and Constructs, 2nd Edition, Addison Wesley, 1996.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	3	-	3	2	-	-	-	-	-	3	3	3	3	2	2
CO 2	3	3	3	1	-	-	-	-	-	-	3	3	3	3	2	2
CO 3	3	1	2	3	-	-	-	-	-	-	2	2	3	3	2	2
CO 4	3	3	3	1	-	-	-	-	-	-	1	3	3	2	-	2
CO 5	3	3	3	2	1	-	-	-	-	-	1	3	3	2	3	2

1912207 **IMAGE PROCESSING AND ANALYSIS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image restoration techniques and their applications,
- To appreciate the use of color image processing in various applications.
- To understand image processing and segmentation techniques.

UNIT - I: IMAGE PROCESSING FUNDAMENTALS **9**

Introduction – Origins of Digital Image Processing - Examples of Fields that Use Digital Image Processing - Fundamental Steps in Digital Image Processing - Components of an Image Processing System -Elements of visual perception– Light and the Electromagnetic Spectrum – Image Sensing and Acquisition - Image Sampling and Quantization - Basic Relationships between Pixels- Mathematical Tools Used in Digital Image Processing.

UNIT - II: INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING **9**

Background- Intensity Transformation Functions- Histogram Processing- Fundamentals of Spatial Filtering- Smoothing Spatial Filters- Sharpening Spatial Filters- Combining Spatial Enhancement Methods- Fuzzy Techniques for Intensity Transformations and Spatial Filtering- Sampling and the Fourier Transform of Sampled Functions- Discrete Fourier Transform (DFT) of One Variable- Extension to Functions of Two Variables- Filtering in the Frequency Domain- Smoothing and Sharpening filters.

UNIT - III: IMAGE RESTORATION AND RECONSTRUCTION **9**

Model of the Image Degradation/Restoration Process- Noise Models- Restoration in the Presence of Noise Only-Spatial Filtering- Periodic Noise Reduction by Frequency Domain Filtering- Linear, Position-Invariant Degradations- Estimating the Degradation Function- Inverse Filtering- Minimum Mean Square Error (Wiener) Filtering- Constrained Least Squares Filtering- Geometric Mean Filter

UNIT - IV: COLOR IMAGE PROCESSING AND WAVELETS **9**

Color Fundamentals - Color Models- Pseudo color Image Processing- Basics of Full-Color Image Processing- Color Transformations- Smoothing and Sharpening- Image Segmentation Based on Color- Noise in Color Images- Color Image Compression- Wavelets Background- Multi resolution Expansions- Wavelet Transforms in One Dimension- Wavelet Transforms in Two Dimensions.

UNIT - V: IMAGE PROCESSING AND SEGMENTATION 9

Erosion and Dilation - The Hit-or-Miss Transformation - Some Basic Morphological Algorithms - Gray-Scale Morphology - Image Segmentation Fundamentals- thresholding - Region-Based Segmentation - Segmentation Using Morphological Watersheds - Use of Motion in Segmentation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Design and implement algorithms for image processing applications.
- Familiar with the use image processing techniques.
- Familiarize the image restoration techniques and their applications
- Critically analyze different approaches to color image processing applications
- Explore the possibility of applying Image processing concepts and segmentation techniques.

REFERENCES:

1. Rafael C.Gonzalez and Richard E.Woods, -Digital Image Processingǁ, Third Edition, Pearson Education, 2008, New Delhi.
2. Alasdair McAndrew, -Introduction to Digital Image Processing with Matlab, Cengage Learning 2011, India.
3. Anil J Jain, - Fundamentals of Digital Image Processing, PHI, 2006.
4. Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing,CRC - Taylor and Francis, New York,2000.
5. S.Sridhar, -Digital Image Processing, Oxford University Press, 2011.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-
CO 5	-	2	-	-	-	-	-	3	-	-	-	-	2	-	-	-

1912208 **WEB ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the fundamental concepts of web engineering.
- To understand the web application architectures and its application
- To familiarize the web application design..
- To appreciate the use of web application various applications.
- To implement web project management.

UNIT - I: INTRODUCTION TO WEB ENGINEERING **9**

Motivation, Categories of Web Applications, Characteristics of Web Applications, - Requirements Engineering Activities RE Specifics in Web Engineering, Principles for RE of Web Applications, Adapting RE Methods to Web Application Development.

UNIT - II: WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS **9**

Introduction- Categorizing Architectures, Specifics of Web Application Architectures, Components of a Generic Web Application Architecture, Layered Architectures, Data-aspect Architectures, Modeling Specifics in Web Engineering, Modeling Requirements, Hypertext Modeling, Presentation Modeling, Customization Modeling.

UNIT - III: WEB APPLICATION DESIGN **9**

Introduction, Web Design from an Evolutionary Perspective, Presentation Design, Interaction Design, Functional Design.

UNIT - IV: TESTING WEB APPLICATIONS **9**

Introduction, Fundamentals, Terminology, Test Specifics in Web Engineering, Test Approaches, Test Scheme, Test Methods and Techniques, Test Automation.

UNIT - V: WEB PROJECT MANAGEMENT **9**

From Software Project Management to Web Project Management, Challenges in Web Project Management, Managing Web Teams, Managing the Development Process of a Web Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Apply the characteristics of web engineering and its applications.
- Modelling web applications.
- Design web applications.

- Test web applications.
- Implement web project management.

REFERENCES:

1. Gerti Kappel, Birgit Proll, “Web Engineering”, John Wiley and Sons Ltd, 2006.
2. Roger S. Pressman, David Lowe, “Web Engineering”, Tata McGraw Hill Publication, 2007.
3. Guy W. Lecky-Thompson, “Web Programming”, Cengage Learning, 2008.
4. Chris Bates, “Web Programming: Building Internet Applications”, Third Edition, Wiley India Edition, 2007
5. John Paul Mueller, “Web Development with Microsoft Visual Studio 2005”, Wiley Dream tech, 2006.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	1	2	1	1	-	-	-	3	-	3	3	3	3	3	1
CO 2	3	1	2	1	1	-	-	-	3	-	3	3	3	3	3	1
CO 3	3	1	2	1	1	-	-	-	3	-	3	3	3	3	3	1
CO 4	3	2	-	3	3	3	-	-	3	-	3	-	-	-	-	3
CO 5	3	2	2	3	3	3	-	-	3	-	3	3	3	3	2	2

1912209 CLOUD COMPUTING TECHNOLOGIES L T P C

3 0 0 3

OBJECTIVES:

- To learn about the concept of cloud computing.
- To have knowledge on the virtualization in cloud computing.
- To be familiar with cloud architecture, services and storage.
- To appreciate the resource management and security in cloud environment.
- To familiarize with AWS and open nebula.

UNIT - I: INTRODUCTION TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT - II: VIRTUALIZATION 9

Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT - III: CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS –SaaS – Architectural Design Challenges – Cloud Storage.

UNIT - IV: RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Software-as-a-Service Security-Data Security –Application Security – Virtual Machine Security.

UNIT - V: CASE STUDIES 9

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula –Open Stack.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling virtualization technologies that help in the development of cloud.
- Develop the ability to understand and use of cloud architecture services and storage .

- Explain the core issues in resource management and security of cloud.
- Be able to install and use current cloud technologies AWS open nebula.

REFERENCES:

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.

2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

3. Ritting house, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

4. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.

5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.

6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	2	-	-	2	-	-	-	-	-	2	-	-	-
CO 2	-	3	3	-	-	-	-	3	-	-	-	-	2	3	-	-
CO 3	2	-	3	-	-	-	2	-	-	-	-	-	-	-	2	-
CO 4	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	2
CO 5	-	3	-	2	-	-	-	3	-	-	-	-	-	-	2	-

PROFESSIONAL ELECTIVE - II

1912210 REAL TIME SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To learn real time operating system concepts, the associated issues &Techniques.
- To understand software requirement design and problems in Real Time System.
- To understand inter task Communication.
- To explore the concepts of real time databases.
- To understand the evaluation techniques and clock synchronization present in Real Time System.

UNIT - I: REAL TIME SYSTEM AND SCHEDULING 9

Introduction - Structure of a Real Time System - Applications –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Case Study : Internet Of Things.

UNIT - II: SOFTWARE REQUIREMENTS ENGINEERING 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – organizing the requirements document – organizing and writing documents – requirements validation and revision – Case Study : Application Specific Software Product for Requirement Engineering.

UNIT - III: INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – deadlock – priority inversion– process stack management – memory management in task control block - swapping – overlays –replacement algorithms – memory locking – working sets –contiguous file systems – Case Study : Memory Management in Windows 10.

UNIT - IV: REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Case Study: In Memory Database.

UNIT - V: EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy– Clock, A Non fault–Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software-Case Study: performance evaluation in Distributed Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Explain the fundamental principles for programming of real time systems with time and resource limitation and how it plays a crucial role in today's Internet of Things.
- Identify how Real Time System has to be designed with the help of requirements engineering and the important role it plays in upgrading the system to meet the future demands.
- To perform a proper communication in between the task in order to make the real Time systems in this scenario to work in a more organized and efficient manner.
- To explore the concepts of real time database.
- To check the performance of the real time systems using the concept of clock synchronization in order to make it work in a time-bound fashion and to fix a time frame for the execution of different tasks.

REFERENCES:

1. C.M. Krishna, Kang G. Shin, Real-Time Systems, McGraw-Hill International Editions, 1997.
2. Philip. A. Laplante, Real Time System Design and Analysis ,Prentice Hall ofIndia,3rd Edition, 2004
3. Rajib Mall, Real-time systems: theory and practice ,Pearson Education, 2009.
4. R.J.A Buhur, D.L Bailey, -An Introduction to Real-Time Systems, Prentice Hall International, 1999.
5. Stuart Bennett,-Real Time Computer Control-An Introduction, Prentice Hall of India,1998.
6. Allen Burns, Andy Wellings, -Real Time Systems and Programming Languages , Pearson Education, 2003.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	2	-	-	-	-	2	-	-	2	-	-	-
CO 2	-	1	-	-	-	-	2	-	2	-	-	2	-	-	2	-
CO 3	-	-	2	-	-	2	-	2	-	-	-	-	-	2	-	-
CO 4	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	2
CO 5	-	-	3	-	-	-	-	-	1	-	2	-	-	2	-	2

1912211 MOBILE AND PERVASIVE COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems.
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management
- To explore the HCI in Pervasive environment.
- To apply the pervasive concepts in mobile environment.

UNIT - I: INTRODUCTION 9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture- Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT - II: OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM 9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA.

UNIT - III: PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview - Pervasive Computing - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management - Service Management - Data Management - Security Management – Pervasive Computing Environments.

UNIT - IV: HCI IN PERVASIVE COMPUTING 9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context- Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

UNIT - V: PERVASIVE MOBILE TRANSACTIONS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Obtain a thorough understanding of Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Incorporate the pervasive concepts.
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment

REFERENCES:

1. J.Schiller, - Mobile Communication, Addison Wesley, 2000.
2. M. Bala Krishna, Jaime LloretMauri, - Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks, CRC 2016.
3. Alan Colman, Jun Han, and Muhammad AshadKabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
4. JuhaKorhonen, - Introduction to 4G Mobile Communications , Artech House Publishers, 2014
5. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
6. MinyiGuo, Jingyu Zhou, Feilong Tang, Yao Shen, - Pervasive Computing: Concepts, Technologies and Applications CRC Press, 2016.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-
CO 2	-	-	-	-	-	-	2	-	-	-	-	2	2	-	-	1
CO 3	2	-	-	-	2	-	-	-	-	-	-	2	-	2	-	1
CO 4	2	-	-	2	-	-	1	-	-	-	-	-	-	-	1	-
CO 5	3	-	-	-	2	-	2	-	-	-	-	2	-	-	-	2

1912212 **PARALLEL PROGRAMMING PARADIGMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and
- To understand shared memory paradigm with OpenMP.
- To learn the Graphical processing based parallel programming using OpenCL.

UNIT - I: FUNDAMENTALS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Parallel hardware and software- Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware- Parallel Software- I/O parallel program design.

UNIT - II: DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD- programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types –A Parallel Sorting Algorithm

UNIT - III: SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads, Pthreads – thread synchronization – busy waiting – mutex – Producer-consumer synchronization and semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety

UNIT - IV: SHARED MEMORY PARADIGM: OPENMP 9

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers

UNIT - V: GRAPHICAL PROCESSING PARADIGMS: OPENCL 9

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Event model – Command-Queue - Event Object - case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and
- Design and develop shared memory parallel programs using OpenMP.
- Implement Graphical Processing OpenCL programs.

REFERENCES:

1. Peter S. Pacheco, - An introduction to parallel programming, Morgan Kaufmann, 2011.
2. M. J. Quinn, - Parallel programming in C with MPI and OpenMP, Tata McGraw Hill, 2003.
3. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, - OpenCL programming guide, Addison Wesley, 2011
4. Rob Farber, - CUDA application design and development, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, - Using MPI: Portable parallel programming with the message passing interface, Second Edition, MIT Press, 1999.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO 2	-	-	2	-	3	-	3	-	-	-	-	-	-	-	3	-
CO 3	-	2	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	1	2	-		-	-	-	3	-	-	-	-	2	-	2	-
CO 5	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	-

1912213 **INFORMATION RETRIEVAL TECHNIQUES** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the basics of information retrieval
- To understand the various models of information retrieval .
- To understand the various applications of information retrieval giving emphasis to indexing and searching
- To understand the information retrieval in Parallel and Distributed IR.
- To understand the search challenges of information retrieval .

UNIT - I: INTRODUCTION: MOTIVATION **9**

Basic Concepts – Past, Present, Future- Retrieval Process - Web Characteristics–Search engines-Architectures-Browsing- Web directories –Combine Searching and Browsing –Meta Searchers.

UNIT - II: MODELING **9**

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT - III: INDEXING AND SEARCHING **9**

Inverted files-Searching, Construction, Boolean queries, Sequential searching –Brute Force, Knuth-Morris-Pratt, Boyer-Moore, Pattern Matching, Structural queries, Compression Compressed indices.

UNIT - IV: PARALLEL AND DISTRIBUTED IR **9**

Parallel IR-MIMD, SIMD, Distributed IR-Collection Partitioning, Source selection, Query Processing, Web issues, Multimedia IR-Indexing and searching-Spatial Access methods-Time Series-Color images

UNIT - V: SEARCHING THE WEB **9**

Searching the Web, Challenges, Characterizing the Web–Search Engines-Ranking, Web Crawling and Indices –Searching using Hyperlinks , Online IR systems, Digital Libraries

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Build a basis in an Information Retrieval system.
- Identify and design the various models of an Information Retrieval system.
- Identify indexing and searching for IR models.

- Identify the Parallel and Distributed concepts used in IR
- Design an efficient search engine and analyze the Web content structure.

REFERENCES:

1. Ricardo Baeza- Yates, Berthier Ribeiro- Neto, Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.

2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, - Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.

3. Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2010

4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, - Information Retrieval

5. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009.

6.Mark Levene, an Introduction to Search Engines and Web Navigation, 2nd Edition Wiley,2010.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	3	-	2	-	1	1	2	-	-	3	-	-	-	2	-	-
CO 2	2	-	-	-	2	1	-	-	-	3	-	3	-	-	2	-
CO 3	3	2	-	-	3	2	-	-	-	-	-	-	2	-	-	-
CO 4	-	3	-	-	2	2	-	1	2	-	-	-	-	-	-	2
CO 5	-	2	-	-	1	2	-	1	3	3	-	-	-	-	2	-

1912214 SOFTWARE ARCHITECTURES AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the Software quality attributes for large scale systems
- To design Middleware Architectures
- To build design knowledge on Software Architecture Process.
- To understand ICDE architecture.

UNIT - I: UNDERSTANDING SOFTWARE ARCHITECTURE 9

Software Architecture-Definitions of Software Architecture -Architecture Defines Structure - Architecture Specifies Component- Communication -Architecture Addresses Non-functional Requirements -Architecture is an Abstraction -Architecture Views -What Does a Software Architect Do-Architectures and Technologies.

UNIT - II: SOFTWARE QUALITY ATTRIBUTES 9

Quality Attributes -Performance – Throughput-Response Time Deadlines-Performance for the ICDE System –Scalability- Request Load -Simultaneous Connections-Data Size-Deployment - Some Thoughts on Scalability-Scalability for the ICDE Application Modifiability -Modifiability for the ICDE Application -Security Security for the ICDE Application Availability-Availability for the ICDE Application –Integration-Integration for the ICDE Application Other Quality Attributes.

UNIT - III: A GUIDE TO MIDDLEWARE ARCHITECTURES AND TECHNOLOGIES 9

Introduction- Technology Classification- Distributed Objects- Message-Oriented Middleware- Application Servers- Message Brokers- Business Process Orchestration- Integration Architecture Issues.

UNIT - IV: SOFTWARE ARCHITECTURE PROCESS. 9

Process Outline- Architecture Design- Validation- UML 2.0 - Architecture Views- More on Component Diagrams- Architecture Documentation Template.

UNIT - V: CASE STUDY DESIGN 9

Overview- ICDE Technical Issues- ICDE Architecture Requirements- ICDE Solution- Architecture Analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand the need of software architecture for sustainable dynamic systems.
- Have a sound knowledge on design principles and to apply for large scale systems
- Design architectures for distributed heterogeneous systems
- Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Have a working knowledge to develop appropriate architectures through various ICDE case studies.

REFERENCES:

1. Essentials of software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011.
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010.
3. Software Architecture in Practice (3rd Edition) (SEI Series in Software Engineering) 3rd Edition, by Len Bass, Paul Clements ,Rick Kazman.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	2	-	-	-	-	-	1	-	-	2	-	-	-
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	3	-	1	-	-	-	-	1	-	-	-	3	-	-
CO 4	-	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 5	-	-	3	-	2	1	-	-	-	-	-	-	-	-	-	3

PROFESSIONAL ELECTIVE - III

1912301 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the discrete-time and continuous-time Markov chains models
- To understand the multi-server and multi queue of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies.

UNIT - I: OVERVIEW OF PERFORMANCE EVALUATION 9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws – Modification for Closed Systems.

UNIT - II: MARKOV CHAINS AND SIMPLE QUEUES 9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT - III: MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT - IV: REAL-WORLD WORKLOADS 9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Analytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT - V: SMART SCHEDULING IN THE M /G /1 9

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies-

. Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the need for performance evaluation and the metrics used for it
- Use discrete-time and continuous-time Markov chains to model real world systems
- Distinguish between open and closed queuing networks
- Apply the operational laws to open and closed systems
- Develop analytical techniques for evaluating scheduling policies.

REFERENCES:

1. K. S. Trivedi, -Probability and Statistics with Reliability, Queuing and Computer Science Applications, John Wiley and Sons, Second Edition 2016.
2. Lieven Eeckhout,-Computer Architecture Performance Evaluation Methods, Morgan and Claypool Publishers, 2010.
3. Mor Harchol -Balter,-Performance Modeling and Design of Computer Systems– Queueing Theory in Action ‖,Cambridge University Press, 2013.
4. Paul J.Fortier and Howard E.Michel,-Computer Systems Performance Evaluation and Prediction‖, Elsevier,2003.
5. Raj Jain, -The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling,Wiley-Interscience,1991.
6. Krishna Kant, -Introduction to Computer System Performance Evaluation‖, McGraw-Hill, 1992.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO 2	-	-	2	-	3	-	3	-	-	-	-	-	-	-	3	-
CO 3	-	2	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	1	2	-	-	-	-	-	3	-	-	-	-	2	-	2	-
CO 5	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	-

1912302 **LANGUAGE TECHNOLOGIES** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the fundamentals of natural language processing.
- To appreciate the use of CFG and PCFG in NLP.
- To know about computational phonology.
- To understand the role of semantics and pragmatics.
- To explore the application of language technologies.

UNIT - I: INTRODUCTION **9**

Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of-Speech – Tagging - Hidden Markov and Maximum Entropy Models.

UNIT - II: SPEECH **9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.

UNIT - III: SYNTAX **9**

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.

UNIT - IV: SEMANTICS AND PRAGMATICS **9**

The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse.

UNIT - V: APPLICATIONS **9**

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To explore the application of language technologies.

REFERENCES:

1. Breck Baldwin, "Language Processing with Java and Ling Pipe Cookbook", Atlantic Publisher, 2015.
2. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
4. Richard MReese ,"Natural Language Processing with Java", O_ReillyMedia,2015.
5. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	2	-	1	1	2	-	-	3	-	-	-	2	-	-
CO 2	2	-	-	-	2	1	-	-	-	3	-	3	2	-	-	-
CO 3	3	2	-	-	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	2	2	-	1	2	-	-	-	-	-	-	2
CO 5	-	2	-	-	1	2	-	1	3	3	-	-	-	2	-	-

1912303 **COMPUTER VISION** **L T P C**

3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To study some applications of computer vision algorithms.

UNIT - I: IMAGE PROCESSING FOUNDATIONS **9**

Review of image processing techniques – classical filtering operations – thresholding techniques edge detection techniques – corner and interest point detection – mathematical morphology – texture

UNIT - II: SHAPES AND REGIONS **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT - III: HOUGH TRANSFORM **9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection - accurate center location – speed problem – ellipse detection – Case study: Human Iris location - hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT - IV: 3D VISION AND MOTION **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT - V: APPLICATIONS **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Implement fundamental image processing techniques required for computer vision.
- Implement boundary tracking techniques, chain codes and other region descriptors
- Apply Hough Transform for line, circle, ellipse detections and Apply 3D vision techniques.
- Develop applications using computer vision techniques and motion related techniques
- Implement the different image processing applications in the real world problems

REFERENCES:

1. D. L.Baggio et al.,-Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing,2012.
2. E.R.Davies,-Computer &Machine Vision‖, Fourth Edition, Academic Press,2012.
3. Jan Erik Solem, -Programming Computer Vision with Python: Tools and algorithms for analyzing images, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S.Aquado,-Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
5. R. Szeliski,-Computer Vision: Algorithms and Applications, Springer 2011.
6. Simon J. D. Prince, -Computer Vision: Models, Learning, and Inference, Cambridge University Press,2012

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
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CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	3	-	-	2	3	-	-
CO 3	-	2	2	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 4	-	-	2	-	-	-	1	-	-	-	-	-	-	2	2	-
CO 5	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	2

1912304 SPEECH PROCESSING AND SYNTHESIS L T P C

3 0 0 3

OBJECTIVES:

- To understand the mathematical foundations needed for speech processing.
- To understand the basic concepts and algorithms of speech processing and synthesis.
- To familiarize the students with the various speech signal representation.
- To know about coding and recognition techniques.
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

UNIT - I: FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT - II: SPEECH SIGNAL REPRESENTATIONS AND CODING 9

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT - III: SPEECH RECOGNITION 9

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT - IV: TEXT ANALYSIS 9

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT - V: SPEECH SYNTHESIS 9

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the various features required for identifying speech units – phoneme, syllable and word.
- Determine and apply different speech signal representation for the complex problems
- Justify the use of different speech recognition and its limitations.
- Identify the apt approach of text analysis depending on the language to be processed.
- Determine the use of formant and concatenative speech synthesis.

REFERENCES:

1. Joseph Mariani,-Language and Speech Processing,Wiley,2013.
2. Lawrence Rabiner and Biing-Hwang Juang, -Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
3. Sadaoki Furui,-Digital Speech Processing: Synthesis, and Recognition, Second Edition,(Signal Processing and Communications),Marcel Dekker, 2000.
4. Thomas F.Quatieri,-Discrete-Time Speech Signal Processing‖, Pearson Education,2002.
5. Xuedong Huang ,AlexAcero, Hsiao-Wuen Hon,-Spoken Language Processing– A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2	-	2	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	-	2	-	-	-	-	-	-	-	1	-	2	-	-
CO 3	-	2	-	2	-	-	1	-	1	-	-	-	-	-	3	-
CO 4	-	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO 5	-	-	2	-	-	2	-	-	1	-	-	-	-	-	-	3

1912305 SOFTWARE QUALITY ASSURANCE AND TESTING L T P C

3 0 0 3

OBJECTIVES:

- To understand the basics of testing, test planning &design and test team organization
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution
- To learn the software quality metrics and defect prevention techniques
- To learn the techniques for quality assurance and applying for applications**.**

UNIT - I: SOFTWARE TESTING - CONCEPTS, ISSUES,ANDTECHNIQUES **9**

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black ,test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management**-**Test Groups, Software Quality Assurance Group ,System Test Team
Hierarchy, Team Building.

UNIT - II: SYSTEM TESTING **9**

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables.

UNIT - III: SYSTEM TEST CATEGORIES **9**

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests.

UNIT - IV: SOFTWARE QUALITY **9**

Software quality - People‘s Quality Expectations**,** Frameworks and ISO-9126, McCall‘s Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models**-** Test Process Improvement Testing Maturity Model.

UNIT - V: SOFTWARE QUALITY ASSURANCE **9**

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Comparing Quality Assurance Techniques and Activities**.** QA Monitoring and Measurement, Risk

Identification for Quantifiable Quality Improvement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Perform functional and nonfunctional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques.
- To know about software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

REFERENCES:

1. Software Testing and Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2010.
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
3. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004.
4. Software Quality Assurance, Milind Limaye, TMH,New Delhi, 2011.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	3	-	-	2	3	-	-
CO 3	-	2	2	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 4	-	-	2	-	-	-	1	-	-	-	-	-	-	2	2	-
CO 5	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	2

PROFESSIONAL ELECTIVE -IV

1912306 FORMAL MODELS OF SOFTWARE SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Z, Object Z and B Specification languages with case studies.

UNIT - I: SPECIFICATION FUNDAMENTALS 9

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities-Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT - II: FORMAL METHODS 9

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

UNIT - III: LOGIC 9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT - IV: SPECIFICATION MODELS 9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study - A

Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

UNIT - V: FORMAL LANGUAGES 9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language- Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, and composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method - Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
- Gain knowledge on fundamentals of abstraction and formal systems
- Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
- Have working knowledge on Z, Object Z and B Specification languages with case studies.

REFERENCES:

1. Mathematical Logic for computer science, second edition, M.Ben-Ari, Springer, 2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.
3. Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011.
4. The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press, 1996.
5. Using Z-Specification Refinement & Proof,Jim Woodcock & Jim Devies Prentice Hall, 1996
6. Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	-	-	3	-	2	-	-	-	-	-	-	1	-	2	-	-
CO 2	-	2	3	-	-	1	-	-	-	-	1	-	-	-	-	-
CO 3	-	-	-	3	1	-	-	-	-	2	-	2	-	2	3	-
CO 4	-	2	3	3	-	1	-	-	-	-	-	-	2	-	3	-
CO 5	2	-	3	3	-	-	3	-	-	-	1	-	-	1	-	-

1912307 EMBEDDED SOFTWARE DEVELOPMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyze and design applications on embedded systems.

UNIT - I: EMBEDDED PROCESSORS 9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.

UNIT - II: EMBEDDED COMPUTING PLATFORM 9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT - III: EMBEDDED NETWORK ENIVIRONMENT 9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT - IV: REAL-TIME CHARACTERISTICS 9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT - V: SYSTEM DESIGN TECHNIQUES 9

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand different architectures of embedded processor and its characteristics
- Identity the interfaces of embedded computing platform.
- Analyze the embedded network architecture, design and its scheduling.
- Understand the challenges in Real time characteristics of embedded system.
- Design and analyze applications on embedded systems.

REFERENCES:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition,2013
2. Andrew N Sloss, D. Symes, C. Wright, Arm system developers guide, Morgan Kauffman/Elsevier,2006.
3. Arshdeep Bahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach**"** VPT First Edition,2014.
4. C.M.Krishna and K.G. Shin,-Real-TimeSystems,McGraw-Hill,1997
5. Frank Vahid and Tony Givargis, -Embedded System Design: A Unified Hardware/Software Introduction, John Wiley &Sons.
6. Jane. W.S. Liu,-Real-Time systems, Pearson Education Asia.
7. Michael J.Pont,-Embedded C, Pearson Education , 2007.
8. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, " The AVR Microcontroller and Embedded Systems: Using Assembly and C" Pearson Education, First edition,2014
9. Steve Heath, -Embedded SystemDesign, Elsevier, 2005
10. Wayne Wolf,-Computers as Components: Principles of Embedded Computer System Design, Elsevier,2006.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	-	-	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	3	3	-	-	-	-	-	2	-	-	-	1	-	-
CO 3	-	-	-	-	-	3	3	-	-	-	-	-	-	-	2	2
CO 4	-	-	-	3	-	3	3	-	-	-	-	-	-	-	1	2
CO 5	-	2	3	-	-	-	-	-	-	3	-	3	-	1	-	-

1912308 **SOCIAL NETWORK ANALYSIS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To know the applications in real time systems.

UNIT - I: INTRODUCTION **9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT - II: MODELING AND VISUALIZATION **9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data **–** Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT - III: MINING COMMUNITIES **9**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT - IV: EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints- with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT - V: APPLICATIONS **9**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Work on the internals components of the social network.
- Model and visualize the social network.
- Mine the behaviour of the users in the social network.
- Predict the possible next outcome of the social network.
- Apply social network in real time applications.

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, -Computational Social Network Analysis:Trends, Tools and Research Advances,Springer,2012.
2. Borko Furht, -Handbook of Social Network Technologies and Applications, Springer, 1st edition, 2011.
3. Charu C. Aggarwal,-Social Network Data Analytics, Springer;2014.
4. Giles, Mark Smith, John Yen, -Advances in Social Network Mining and Analysis, Springer, 2010.
5. Guandong Xu, Yanchun Zhangand LinLi,-Web Mining and Social Networking–Techniques and applications, Springer, 1st edition, 2012.
6. Peter Mika,-Social Networks and the Semantic Web, Springer, 1st edition,2007.
7. Przemyslaw Kazienko, Nitesh Chawla,l Applications of Social Media and Social Network Analysis, Springer,2015

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	2	-	2	2	-	-	-	-	-	-	-	-	2	-	-
CO 2	-	-	-	3	3	-	-	-	-	-	-	-	2	-	-	-
CO 3	-	-	-	3	2	-	3	-	-	-	-	1	-	2	-	-
CO 4	2	-	-	2	2	-	2	-	-	-	-	1	-	-	2	-
CO 5	-	-	-	-	-	-	3	-	-	-	-	2	-	-	-	2

1912309	BIO-INSPIRED COMPUTING	L T P C
		3 0 0 3

OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for features election
- To understand bio-inspired application in image processing

UNIT - I: INTRODUCTION 9

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

UNIT - II: RANDOM WALK AND ANEALING 9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT - III: GENETIC ALGORITHMS AND DIFFERENTIAL EVOLUTION 9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - Introduction to differential evolution- varients - choice of parameters - convergence analysis – Implementation.

UNIT - IV: SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients-Ant colony optimization toward feature selection.

UNIT - V: APPLICATION IN IMAGE PROCESSING 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted ThresholdedHistogramEqualizationAlgorithmforDigitalImageContrastEnhancementUsing Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Implement and apply bio-inspired algorithms
- Apply random walk and simulated annealing in real time applications
- Implement and apply genetic algorithms
- Understand the swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in image processing.

REFERENCES:

1. Eiben, A.E., Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang ,Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016.
4. Xin-She Yang, "Nature Ispired Optimization Algorithm, Elsevier First Edition 2014.
5. Yang ,Cui,XIao, Gandomi, Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	3	2	-	-	-	-	-	-	-	2	-	-	-	-
CO 2	-	2	-	3	-	-	-	-	-	2	-	-	3	-	-	-
CO 3	-	-	-	3	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	2	-	-	-	-	3	3	-	-	-	-	2	-	-	-	-

1912310 COMPILER OPTIMIZATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To be aware of different forms of intermediate languages and analyzing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn the inter procedural analysis and optimizations.
- To explore the knowledge about resource utilization.

UNIT - I: INTERMEDIATE REPRESENTATIONS AND ANALYSIS 9

Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic
Block Dependence DAGs – Alias Analysis.

UNIT - II: EARLY AND LOOP OPTIMIZATIONS 9

Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common – Sub expression Elimination - Loop-Invariant Code Motion - Partial- Redundancy Elimination - Redundancy Elimination and Re association - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT - III: PROCEDURE OPTIMIZATION AND SCHEDULING 9

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching – Branch Optimizations Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

UNIT - IV: INTERPROCEDURAL OPTIMIZATION 9

Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis- Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References.

UNIT - V: REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY 9

Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the different optimization techniques for simple program blocks.
- Apply the optimization techniques in the real time applications .
- Understand and apply the various optimization on procedures.
- Apply the inter procedural optimization to improve the efficiency
- Ensure better allocation and utilization of resources.

REFERENCES:

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition,2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation inJava", Cambridge University Press, Second Edition, 2002.
3. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.
4. Randy Allen and Ken Kennedy,-Optimizing Compilers for Modern Architectures :A Dependence based Approach, Morgan Kaufman, 2001.
5. Robert Morgan,BuildinganOptimizingCompiler,DigitalPress,1998
6. Steven Muchnick,-Advanced Compiler Design and Implementation, Morgan Kaufman Publishers,1997.

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CO 3	-	-	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-
CO 5	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-

PROFESSIONAL ELECTIVE - V

1912311 DATA VISUALIZATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis, ranking analysis and deviation analysis.
- To understand visualization for distribution analysis, correlation analysis and multivariate analysis.
- To understand the design and best practices in information dashboard design.
- To understand the graphical design and best practices in information dash board design.

UNIT - I: CORE SKILLS FOR VISUAL ANALYSIS 9

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT - II: TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT - III: DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT - IV: INFORMATION DASHBOARD DESIGN 9

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT - V: GRAPHICAL DASHBOARD DESIGN 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Spark lines – Dashboard Display Media –Critical Design Practices – Putting it all together-
Unveiling the dashboard.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Apply core skills for visual analysis
- Implement the visualization for time-series analysis, ranking analysis and deviation analysis.
- Apply visualization techniques for various data analysis tasks
- Design and implement the information dashboard
- Apply the Graphical design information dash board for the real world problems.

REFERENCES:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. .Gert H. N. Laursen and JesperThorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	2	-	2	-	-	-	1	-	-	-	3	-	1	-
CO 2	-	2	2	-	2	3	-	-	-	-	-	-	-	2	-	1
CO 3	-	-	3	-	2	-	-	-	3	-	-	-	2	3	2	-
CO 4	-	-	-	-	3	-	-	-	-	-	-	1	-	-	3	1
CO 5	-	-	-	3	-	-	1	1	-	-	2	-	1	1	-	1

1912312 **RECONFIGURABLE COMPUTING** **L T P C**

3 0 0 3

OBJECTIVES:

- To expose the students to various device architectures.
- To understand the different types of compute models for programming reconfigurable architectures
- To examine the various reconfigurable computing systems.
- To expose the students to the various placement and routing protocols
- To develop applications with FPGAs

UNIT - I: DEVICE ARCHITECTURE **9**

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture – Case Studies.

UNIT - II: RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS **9**

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT - III: PROGRAMMING RECONFIGURABLE SYSTEMS **9**

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing Operating System Support for Reconfigurable Computing.

UNIT - IV: MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS **9**

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

UNIT - V: APPLICATION DEVELOPMENT WITH FPGmAS **9**

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the need for reconfigurable architectures.
- Point out the salient features of different reconfigurable architectures.
- Develop applications using any HDL and appropriate tools.
- Discuss the architecture and mapping of FPGAs.

- Design and build anSoPC for a particular application.

REFERENCES:

1. Christophe Bobda,-Introduction to Reconfigurable Computing– Architectures, Algorithms and Applications, Springer,2010.
2. Maya B.Gokhale and Paul S.Graham,-Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays, Springer,2005.
3. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform**.**
4. Reconfigurable Computing: From FPGAs to Hardware/Software Code sign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer.
5. Scott Hauck and Andre Dehon (Eds.),-Reconfigurable Computing–The theory and Practice of FPGA-Based Computation, Elsevier/MorganKaufmann,2008.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	2	-	2	1	-	-	1	-	-	-	-	1	1	-	1	-
CO 2	-	2	-	-	2	-	-	-	3	-	-	-	-	2	-	3
CO 3	-	-	3	-	-	3	-	2	-	-	-	-	-	-	3	-
CO 4	-	-	-	-	-	-	-	-	-	2	1	-	1	-	-	3
CO 5	2	-	-	-	1	-	2	-	-	-	-	-	-	1	-	1

1912313 **MOBILE APPLICATION DEVELOPMENT** **L T P C**

3 0 0 3

OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT - I: INTRODUCTION **9**

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT - II: BASIC DESIGN **9**

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT - III: ADVANCED DESIGN **9**

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT - IV: ANDROID **9**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT - V: IOS **9**

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

- Describe the requirements for mobile applications.
- Develop design for mobile applications for specific requirements.
- Explain the challenges in mobile application design and development.
- Implement the design using Android SDK.
- Implement the design using Objective C and iOS.

REFERENCES:

1. Charlie Collins, Michael Galpin and Matthias Kappler, -Android in Practice, DreamTech, 2012.
2. David Mark,Jack Nutting, Jeff LaMarche and Frederic Olsson,-BeginningiOS6 Development: Exploring the iOSSDK, Apress,2013.
3. http://developer.android.com/develop/index.html.
4. James Dovey and Ash Furrow,-Beginning Objective C,Apress,2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
6. RetoMeier,-Professional android Development,Wiley-IndiaEdition,2012.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	-	2	1	-	-	1	-	-	-	-	-	2	-	2	1
CO 2	-	3	3	-	2	-	-	-	3	-	-	-	-	2	-	-
CO 3	-	3	3	-	-	3	-	2	-	-	-	1	1	-	3	-
CO 4	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	1
CO 5	2	-	-	-	1	-	2	-	-	-	-	-	-	1	2	-

1912314	BIO INFORMATICS	L T P C
		3 0 0 3

OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks.
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of human genomics.

UNIT - I: INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of genes , genomics , molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrival systems – genome browsers.

UNIT - II: BIOINFORMATICS ALGORITHM AND ANALYSIS 9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT - III: DNA REPLICATION AND MOLECULAR CLOCKS 9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array-converting patterns- solving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.

UNIT - IV: ASSEMBLE GENOMES AND SEQUENCES 9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler‘s theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences-Case Study –Manhattan tourist Problem.

UNIT - V: HUMAN GENOME 9

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and breakpointgenomes-breakpointgraps-syntenyblockconstruction-openproblemsand Technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students should be able to:

- Deploy the genomics technologies in Bioinformatics.
- Able to distinct efficient algorithm and issues.
- Deploy the replication and molecular clocks in bioinformatics.
- Work on assemble genomes and sequences.
- Use the Microarray technologies for genome expression.

REFERENCES:

1. Ion Mandoiu and Alexander Zelikovsky**, "**Computational Methods for Next Generation Sequencing Data Analysis – Wiley series 2016.
2. Istvan Miklos, Renyi Institute, -Introduction to algorithms in bioinformatics, Springer 2016.
3. Philip Compeau and Pavel pevzner, -Bioinformatics Algorithms: An Active Learning Approach‖ Second edition volumeI, Cousera, 2015.
4. Supratim Choudhuri,-Bioinformatics For Beginners,Elsevier,2014.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	1	-	-	2	-	3	-	-	-	-	-	1	2	-	-
CO 2	1	-	-	-	3	1	2	-	-	-	-	-	-	-	2	-
CO 3	-	-	-	-	-	-	2	-	-	3	-	1	-	2	-	-
CO 4	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-	2
CO 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

1912315 INFORMATION STORAGE MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To learn about the Core elements of a data center infrastructure
- To understand the storage architecture and available technologies.
- To understand the different network storage options for different applications.
- To learn to establish & manage datacenter.
- To learn security aspects of storage & datacenter.

UNIT - I: STORAGE TECHNOLOGY 9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT - II: STORAGE SYSTEMS ARCHITECTURE 9

Hardware and software components of the host environment, Key protocols and concepts usedbyeachcomponent,Physicalandlogicalcomponentsofaconnectivityenvironment, Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0,RAID 6,Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

UNIT - III: INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT - IV: INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT - V: SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students should be able to:

- Analyzed various storage architectures.
- Select from various storage technologies to suit for required application.
- Apply network storage options in the real time applications.
- Analyzed key management task in data center.
- Understand the different security levels of storage and its visualization.

REFERENCES:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley,-Building Storage Networks, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, -Storage Networks: The Complete Reference-, Tata McGraw Hill, Osborne, 2003.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	-	-	-	-	2	-	-	-	-	-	-	2	-	2	-
CO 2	-	2	2	-	-	-	-	-	-	-	-	-	-	2	-	3
CO 3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	3	-
CO 4	-	-	-	-	2	-	2	-	2	-	1	1	2	-	-	3
CO 5	1	2	2	2	-	-	-	2	-	2	-	-	-	2	-	2