ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. COMPUTER SCIENCE AND ENGINEERING
(SPECIALIZATION IN BIG DATA ANALYTICS)
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

VISION AND MISSION

VISION OF THE DEPARTMENT

The Department of Computer Science and Engineering strives to create computing professionals, researchers, and entrepreneurs, with high technical knowledge, communication skills, values and ethics. It collaborates with academia, industry and community to set high standards in academic excellence and in fulfilling societal responsibilities.

MISSION OF THE DEPARTMENT

The mission of the Department of Computer Science and Engineering is to

- Provide motivated faculty and state of the art facilities for education and research, both in foundational aspects and of relevance to emerging computing trends.
- Develop knowledgeable, industry-ready students with pertinent competencies.
- Inculcate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- Engage in collaborative research with academia and industry for seamless transfer of knowledge resulting in patentable solutions.
- Generate adequate resources for research activities from sponsored projects and consultancy.

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PROGRAM EDUCATIONAL OBJECTIVES:

1. Prepare students to understand the foundational concepts in Computer Science and Engineering.
2. Enable students to integrate theory and practice for problem solving.
3. Empower students to critically analyze current trends and future issues from a system perspective at multiple levels of detail and abstraction.
4. Prepare students to critically analyze existing literature, identify the gaps and propose innovative and research oriented solutions for Big Data.
5. Enable students to pursue lifelong multidisciplinary learning as professional engineers and scientists.
6. Enable students to effectively communicate technical information, function effectively on teams, and apply computer engineering solutions within a global, societal, and environmental context by following ethical practices.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

PO #	Graduate Attribute	Programme Outcomes
1.	Research Aptitude	An ability to independently carry out research / Investigations, identify problems and develop solutions to solve practical problems.
2.	Technical documentation	An ability to write and present a substantial technical report/ document.
3.	Technical competence	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Handle complex problems	Use research based knowledge, methods, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations.
5	Environmental Sustainability and societal Ethics	Ensure development of socially relevant and eco friendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices
6	Life-long learning	Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

1. In-depth understanding of the concepts and intricacies of Big Data Analytics
2. Perform Critical Analysis of Big Data Applications using Special purpose tools and software
3. Consolidate ideas, develop and apply innovative solutions through research to the real world problems involving Big Data

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme educational objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PO1	PO2	PO3	PO4	PO5	PO6
1			√			√
2	√		√	√		√
3	√		√	√		√
4	√		√	√		√
5						√
6	√	√		√	√	√

YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	SEM1	Advanced Mathematics for Scientific Computing	√		√	√		√
		Data Structures and Algorithms	√		√	√		√
		Multi Core Architectures	√		√	√		√
		Big Data Mining and Analytics	√		√	√		√
		Research Methodology and IPR	√	√			√	√
		Audit Course – I						
		Data Structures and Algorithms Laboratory	√		√	√		√
		Big Data Computing Laboratory	√		√	√		√
	SEM2	Advances Operating Systems	√		√	√		√
		Big Data Query Languages	√		√	√		√

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YEAR	SEMESTER	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
		Machine Learning	√		√	√		√
		Program Elective I						
		Program Elective II						
		Audit Course –II						
		Machine Learning Techniques Laboratory	√		√	√		√
		Big Data Query Languages Laboratory	√		√	√		√
		Professional Practices	√	√	√	√		√
YEAR 2	SEM3	Program Elective III						
		Program Elective IV						
		Program Elective V						
		Open Elective						
		Dissertation I	√	√	√	√	√	√
	SEM4	Dissertation I	√	√	√	√	√	√

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I - IV SEMESTER CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODSPERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5153	Advanced Mathematics for Scientific Computing	FC	3	1	0	4	4
2.	CP5151	Data Structures and Algorithms	PCC	3	0	0	3	3
3.	CP5152	Multi Core Architectures	PCC	3	0	0	3	3
4.	BD5151	Big Data Mining and Analytics	PCC	3	0	0	3	3
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Audit Course – I *	AC	2	0	0	2	0
PRACTICALS								
7.	CP5161	Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
8.	BD5111	Big Data Computing Laboratory	PCC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**19**

* Audit Course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODSPER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CP5251	Advanced Operating Systems	PCC	3	3	0	3	3
2.	BD5201	Big Data Query Languages	PCC	3	0	0	3	3
3.	CP5253	Machine Learning	PCC	3	0	0	3	3
4.		Program Elective I	PEC	3	0	2	3	4
5.		Program Elective II	PEC	3	0	0	3	3
6.		Audit Course –II *	AC	2	0	0	2	
PRACTICALS								
7.	BD5211	Big Data Query Languages Laboratory	PCC	0	0	4	4	2
8.	CP5261	Machine Learning Techniques Laboratory	PCC	0	0	4	4	2
9.	CP5262	Professional Practices	EEC	0	0	2	2	1
			TOTAL	**17**	**3**	**12**	**27**	**21**

* Audit Course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective III	PEC	3	0	2	5	4
2.		Program Elective IV	PEC	3	0	0	3	3
3.		Program Elective V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	BD5311	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	BD5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 71

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OPEN ELECTIVE COURSES (OEC)

*(out of 6 courses one course must be selected)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0
			Total Credits			**0**

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA5153	Advanced Mathematics for Scientific Computing	FC	3	1	0	4	4

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PROGRAM CORE COURSES (PCC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	CP5151	Data Structures and Algorithms	PCC	3	0	0	3	3
2.	CP5152	Multi Core Architectures	PCC	3	0	0	3	3
3.	BD5151	Big Data Mining and Analytics	PCC	3	0	0	3	3
4.	CP5161	Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
5.	BD5111	Big Data Computing Laboratory	PCC	0	0	4	4	2
6.	CP5251	Advanced Operating Systems	PCC	3	0	0	3	3
7.	BD5201	Big Data Query Languages	PCC	3	0	0	3	3
8.	CP5253	Machine Learning	PCC	3	0	0	3	3
9.	BD5211	Big Data Query Languages Laboratory	PCC	0	0	4	4	2
10.	CP5261	Machine Learning Techniques Laboratory	PCC	0	0	4	4	2

PROGRAM ELECTIVES COURSE (PEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.	CP5090	Advanced Database Technology and Design	PEC	3	0	2	5	4
2.	CP5073	Cloud Computing Technologies	PEC	3	0	2	5	4
3.	CP5080	Ethical Hacking	PEC	3	0	2	5	4
4.	CP5079	Digital Image and Video Processing	PEC	3	0	2	5	4
5.	CP5085	Principles of Cryptography	PEC	3	0	2	5	4
6.	CP5083	Internet of Things	PEC	3	0	2	5	4
7.	IF5076	Deep Learning	PEC	3	0	2	5	4
8.	CP5089	Web Content Design and Management	PEC	3	0	2	5	4
9.	IF8090	Semantic Web	PEC	3	0	2	5	4
10.	IF5088	Mobile Application Development	PEC	3	0	2	5	4
11.	CP5075	Cryptocurrency and Blockchain Technologies	PEC	3	0	2	5	4
12.	SE5071	Multimedia Systems and Applications	PEC	3	0	2	5	4

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13.	SE5076	Software Testing and Quality Assurance	PEC	3	0	2	5	4
14.	CP5082	Information Retrieval Techniques	PEC	3	0	0	3	3
15.	CP5086	Social Network Analysis	PEC	3	0	2	5	4
16.	CP5084	Parallel Algorithms	PEC	3	0	0	3	3
17.	CP5076	Cyber Security	PEC	3	0	0	3	3
18.	CP5087	Soft Computing	PEC	3	0	0	3	3
19.	CP5088	User Interface Design	PEC	3	0	0	3	3
20.	SE5074	Software Reliability Metrics and Models	PEC	3	0	0	3	3

BIG DATA ANALYTICS ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
21.	BD5001	Statistical Natural Language Processing	PEC	3	0	2	5	4
22.	BD5002	Linked Open Data and Its Applications	PEC	3	0	0	3	3
23.	BD5003	Data Intensive Computing	PEC	3	0	0	3	3
24.	CP5074	Cognitive Science	PEC	3	0	0	3	3
25.	BD5004	Data Visualization	PEC	3	0	0	3	3
26.	BD5005	Real Time Data Streaming	PEC	3	0	0	3	3
27.	BD5006	Big Data Acquisition	PEC	3	0	0	3	3
28.	BD5007	Text Processing and Mining	PEC	3	0	0	3	3
29.	BD5008	Big Data Security	PEC	3	0	0	3	3
29.	SE5073	Sentiment Analysis	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	CP5262	Professional Practices	EEC	0	0	2	2	1
2.	BD5311	Dissertation I	EEC	0	0	12	12	6
3.	BD5411	Dissertation II	EEC	0	0	24	24	12

MA5153 **ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING** **L T P C**

3 1 0 4

OBJECTIVES:

- To apply mathematical linear programming techniques to solve constrained problems.
- To appreciate the use of simulation techniques.
- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions .
- To impart knowledge of handling random vectors which represent random variables in multi dimensional space.

UNIT I LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method –Transportation and Assignment Problems.

UNIT II SIMULATION 12

Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems.

UNIT III ESTIMATION THEORY 12

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Estimation of parameters – Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion, 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

OUTCOMES:

At the end of the course, students will be able to

- Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.
- Simulate appropriate application/distribution problems.
- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:

1. Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, 9th Edition, Boston, 2016.
2. Johnson, R.A, Irwin Miller and John Freund., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, 9th Edition, New York, 2016.
3. Johnson, R.A., and Wichern, D.W., “Applied Multivariate Statistical Analysis”, Pearson Education, Sixth Edition, New Delhi, 2013.
4. Ross. S.M., “Probability Models for Computer Science”, Academic Press, SanDiego, 2002.
5. Taha H.A.,, “Operations Research: An Introduction”, Prentice Hall of India Pvt. Ltd. 10th Edition, New Delhi, 2017.
6. Winston, W.L., “Operations Research”, Thomson – Brooks/Cole, Fourth Edition, Belmont, 2003.

CP5151 DATA STRUCTURES AND ALGORITHMS L T P C

3 0 0 3

OBJECTIVES:

- To extend the students' knowledge of algorithms and data structures.
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To understand various types of search and heap structures.
- To study various types of geometric, randomized and approximation algorithms.
- To extrapolate from them in order to apply those algorithms and techniques to solve problems.

UNIT I FUNDAMENTALS 9

Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff.

UNIT II SEARCH STRUCTURES 9

Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT III HEAP STRUCTURES 9

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps

UNIT IV GEOMETRIC ALGORITHMS 9

Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram

UNIT V ADDITIONAL TOPICS 9

Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem – Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees – Online Algorithm: Euclidean Spanning Tree.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the Course, the Student will be able to

- Analyze algorithms.
- Determine algorithm correctness.
- Choose appropriate data structures for the problems to be solved.
- Design algorithms for problems from different domains.
- Identify various research strategies on algorithmic design.

REFERENCES:

1. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C",Second Edition, University Press, 2008.
2. Gilles Brassard, Paul Bratley, "Algorithmics: Theory and Practice", Prentice Hall, 1988.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, "Computational GeometryAlgorithms and Applications", Third Edition, Springer, 2008.
4. R.C.T Lee, S.S Tseng, R.C Chang and Y.T Tsai, "Introduction to the Design and Analysis of Algorithms", Tata McGraw-Hill Edition, 2012.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 2009.

CO	PO	PSO

	1	2	3	4	5	6	1	2	3
1.			√	√		√	√		
2.		√		√		√	√		
3.	√		√	√		√	√		
4.	√		√	√		√	√	√	√
5.	√		√	√		√	√	√	√

CP5152 **MULTICORE ARCHITECTURES** **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 different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.
- To understand how the various forms of parallelism are exploited by the architecture.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP **9**

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Limitations of ILP – Multithreading – SMT and CMP Architectures – The Multicore era.

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 – Case Studies.

UNIT III MULTIPROCESSOR ISSUES **9**

Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – 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, Cloud Computing – Architectures and Issues – Case Studies.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES **9**

Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism – Introduction to Domain Specific Architectures.

TOTAL : 45 PERIODS

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OUTCOMES:

Upon Completion of the Course, the Student will be able to

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- Identify the limitations of ILP and the need for multicore architectures.
- Discuss the issues related to multiprocessing and suggest solutions.
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Point out the various optimizations that can be performed to improve the memory hierarchy design.
- Point out the salient features of vector, GPU and domain specific architectures.

REFERENCES:

1. John L. Hennessey and David A. Patterson, “Computer Architecture – A Quantitative Approach”, Morgan Kaufmann, Elsevier, 5th edition, 2012.
2. Darryl Gove, “Multicore Application Programming: For Windows, Linux, and Oracle Solaris”, Pearson, 2011.
3. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors”, Morgan Kauffman, 2010.
4. Wen– mei W. Hwu, “GPU Computing Gems”, Morgan Kaufmann, Elsevier, 2011.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√			√		√	√		√
2.	√		√	√		√	√		
3.	√			√					√
4.	√			√					√
5.	√			√			√		

BD5151 **BIG DATA MINING AND ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the computational approaches to Modeling, Feature Extraction.
- To understand the need and application of Map Reduce.
- To understand the various search algorithms applicable to Big Data.
- To analyze and interpret streaming data.
- To learn how to handle large data sets in main memory.
- To learn the various clustering techniques applicable to Big Data.

UNIT I DATA MINING AND LARGE SCALE FILES 9

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems– Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS 9

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS 9

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS 9

Page Rank –Efficient Computation – Topic Sensitive Page Rank – Link Spam – Market Basket Model – Apriori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING 9

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – **Case Study:** Advertising on the Web – Recommendation Systems

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the Course, the Student will be able to

- Design algorithms by employing Map Reduce technique for solving Big Data problems.
- Identify similarities using appropriate measures.
- Point out problems associated with streaming data and handle them.
- Discuss algorithms for link analysis and frequent itemset mining.
- Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

REFERENCES:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT Press,2001.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√			√	√	√
2.			√	√		√	√		
3.	√		√	√			√	√	√
4.	√		√	√			√	√	√
5.	√		√	√			√	√	√

RM5151 RESEARCH METHODOLOGY AND IPR LT P C
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.

Traditional knowledge Case Studies, IPR and IITs.

Attested

TOTAL: 30 PERIODS

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OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

CP5161 DATA STRUCTURES AND ALGORITHMS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To familiarize various data structure implementations.
- To implement heap and various tree structures like AVL, Red-black, B- Tree and segment trees.
- To understand efficient implementation of line segment intersection.
- To understand various search structures.
- To get understanding of problem to program mapping.

LIST OF EXPERIMENTS:

1. Binary Search Trees
2. Min/Max Heaps
3. Leftist Heaps
4. AVL Trees
5. Red-Black Trees
6. B-Trees
7. Segment Trees
8. Line segment intersection

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Achieve programming skill to convert a problem to a programming logic.
- Apply suitable data structure for the problem in hand.
- Implement heap and various tree structures like AVL, Red-black, B- Tree and segment trees.
- Understand the usage of data structures for geometric problems.
- Understand the importance of height balancing in search structures.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√		√	√	√	√
2.	√			√		√		√	√
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4.			√	√		√		√	
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BD5111 **BIG DATA COMPUTING LABORATORY** **LT P C**
0 0 4 2

OBJECTIVES:

- To set up single and multi-node Hadoop Clusters.
- To solve Big Data problems using Map Reduce Technique.
- To design algorithms that uses Map Reduce Technique to apply on Unstructured and structured data.
- To learn NoSQL query.
- To learn Scalable machine learning using Mahout.

LIST OF EXERCISES:

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
4. K-means clustering using map reduce
5. Page Rank Computation
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Set up single and multi-node Hadoop Clusters.
- Apply Map Reduce technique for various algorithms.
- Design new algorithms that uses Map Reduce to apply on Unstructured and structured data.
- Develop Scalable machine learning algorithms for various Big data applications using Mahout.
- Represent NoSQL data.

Attested

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CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.			√	√	√	√			
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3.	√		√	√	√	√	√	√	√
4.	√		√	√	√	√	√	√	√
5.			√	√					

CP5251 ADVANCED OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of distributed systems.
- To get an insight into the various issues and solutions in distributed operating systems.
- To learn about real-time operating systems.
- To gain knowledge on the design concepts of mobile operating systems.
- To understand cloud operating systems.

UNIT I INTRODUCTION 9

Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages

UNIT II DISTRIBUTED OPERATING SYSTEMS 9

Distributed Mutual Exclusion Algorithms – Classification – Preliminaries –Simple Solution – Lamport's Algorithm – Ricart-Agrawala Algorithm – Suzuki-Kasami's Broadcast Algorithm – Raymond's Tree-Based Algorithm – Distributed Deadlock Detection – Preliminaries – Centralized Deadlock Detection Algorithms – Distributed Deadlock Detection Algorithms – Path Pushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms – Agreement Protocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak-Pease Algorithm

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System – Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory – Load Distributing Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol

UNIT IV REAL TIME OPERATING SYSTEMS 9

Basic Model of Real - Time Systems – Characteristics – Application of Real Time Systems – Real - Time Task Scheduling – Handling Resource Sharing

UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

Android – Overall Architecture – Linux Kernel –Hardware Support – Native User-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the features of distributed operating systems.
- Demonstrate the various protocols of distributed operating systems.
- Identify the different features of real time operating systems.
- Discuss the features of mobile operating systems.
- Discuss the features of cloud operating systems.

REFERENCES:

1. MukeshSinghal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems", Tata MC Graw-Hill, 2001.
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
3. KarimYaghmour, "Embedded Android", O'Reilly, First Edition, 2013.
4. NikolayElenkov, "Android Security Internals: An In-Depth Guide to Android's Security Architecture", No Starch Press, 2014.

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1.	√		√	√			√	√	
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3.	√		√	√	√		√	√	√
4.	√		√	√			√	√	
5.	√		√	√			√	√	

BD5201 BIG DATA QUERY LANGUAGES L T P C
3 0 0 3

OBJECTIVES:

- To familiarize with R Programming.
- To understand data analysis using R and HADOOP Integrated Programming Environment.
- To Understand Analytics for Big data 'at Rest' and Real-Time Analytical Processing for Big data 'in Motion'.
- To understand the Pig Data model and Pig scripts.
- To learn way of Querying Big Data using Hive.

Attested

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UNIT I INTRODUCTION TO R PROGRAMMING 9

Introduction to R – Vectors – Filtering – Matrices – Creating Matrices – Applying Functions to Matrix Rows and Columns – Lists – Creating List – General List Operations – Data Frames – Creating Data Frames – Matrix like Operations in Frames – Applying Functions to Data Frames – Factors and Tables – Math and Simulations in R – Input/Output – Reading and Writing Files – Graphics – Creating Three-Dimensional Plots – Linear Models – Non-linear models – Clustering

UNIT II DATA ANALYSIS USING R AND HADOOP 9

Features of R Language - HADOOP Features – HDFS and Map Reduce architecture – R and Hadoop Integrated Programming Environment- RHIPE Introduction – Architecture of RHIPE – RHIPE function reference. RHADOOP Introduction – Architecture of RHADOOP – RHADOOP function reference, SQL on HADOOP.

UNIT III ANALYTICS FOR BIG DATA STREAMS 9

IBM Pure Data Systems – Netezza‟s Design Principles – The Netezza Appliance – Extending the Netezza Analytics – Real-Time Analytical Processing – Info Sphere Streams Basics – InfoSphere Streams Working – enterprise class – industry use cases – Indexing Data from Multiple Sources – Creating Information Dashboards

UNIT IV PROGRAMMING WITH PIG 9

Introduction – installation and execution – PIG Data Model – PIG Latin – Input, Output- Relational Operators – User Defined Functions – Join Implementations – Integrating Pig with Legacy Code and Map Reduce –Developing and Testing Pig Latin Scripts – Embedding Pig Latin in Python – Evaluation Function in Java- Load Functions – Store Functions.

UNIT V PROGRAMMING WITH HIVE 9

Introduction – Data Types and File Formats – Databases in Hive – HiveQL: Data Definition – Data Manipulation – Queries – Views – Indexes – Schema Design

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Design applications using R, HADOOP.
- Design applications using RHADOOP& RHIPE.
- Develop analytic applications for data Streams.
- Develop Pig scripts for Big data applications.
- Design Big data applications schema and use HIVE QL.

REFERENCES:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Tom White “ Hadoop: The Definitive Guide” Third Edition, O‟reilly Media, 2011.
3. Zikopoulos, P., Parasuraman, K., Deutsch, T., Giles, J., & Corrigan, D.V Harness the Power of Big Data The IBM Big Data Platform. McGraw Hill Professional, 2012.
4. Prajapati, V, “Big Data Analytics with R and Hadoop”, Packt Publishing Ltd, 2013.
5. Gates, A. Programming Pig.” O’Reilly Media, Inc.”, 2011.
6. Capriolo, E., Wampler, D., &Rutherglen, J., “Programming Hive”, O’Reilly Media, Inc.”,2012
7. Norman Matloff , “The Art of R Programming: A Tour of Statistical Software Design”, NoStarch Press, 2011.
8. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

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2.	√		√	√		√	√	√	√
3.	√		√	√		√	√	√	√
4.	√		√	√		√	√	√	√
5.	√		√	√		√	√	√	√

CP5253 **MACHINE LEARNING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the theoretical and practical aspects of Probabilistic Graphical Models.
- To appreciate the concepts and algorithms of advanced learning.

UNIT I INTRODUCTION **8**

Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

UNIT II SUPERVISED LEARNING **10**

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks , Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.

UNIT III UNSUPERVISED LEARNING **9**

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

Attested

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UNIT IV PROBABILISTIC GRAPHICAL MODELS 9

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields-Hidden Markov Models – Conditional Random Fields(CRFs).

UNIT V ADVANCED LEARNING 9

Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

TOTAL : 45+30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Design a learning model appropriate to the application.
- Design a Neural Network for an application of your choice.
- Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Design and implement an HMM for a Sequence Model type of application.
- Identify applications suitable for different types of Machine Learning with suitable justification.

REFERENCES:

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRC Press, Second Edition, 2014.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. EthemAlpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
5. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.

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1.	√		√	√			√	√	√
2.	√		√	√			√	√	√
3.	√		√	√			√	√	√
4.	√		√	√			√	√	√
5.	√		√	√			√	√	√
6.	√		√	√		√	√	√	√

BD5211 **BIG DATA QUERY LANGUAGES LABORATORY** **LT P C**
0 0 4 2

OBJECTIVES:

- To understand the basic programming constructs of R and understand the use of R in Big Data analytics.
- To solve Big data problems using Map Reduce Technique in R, HADOOP.
- To develop Pig scripts for analyzing large un-structured and semi-structured data.
- To develop program for Query processing using Hive.
- To perform analytics on Big data streams using Hadoop Streaming API.
- To learn to work on Sqoop.

LIST OF EXPERIMENTS:

1. Perform descriptive and predictive analytics using "**R programming**"
2. MapReduce application for word counting on **R HADOOP** after successful installation of three R packages(**rhdfs, rmr, and rhbase**)
3. Understand data pipeline using Pig Interactive Shell Commands after successful "**Pig**" installation
4. **Develop Pig Scripts** and call **UDF's** to accomplish functionalities to meet the problem objectives
5. Embedding PIG Latin in Python
6. Log analysis using **"Pig"** on semi structured data
7. Perform query processing on data warehousing after successful installation of "**Hive**"
8. Perform adhoc query on HDFS data using Hive Query Language (HQL)
9. Accomplish MapReduce Job by using **Hadoop Streaming API**
10. Perform various **HDFS** commands
11. Loading data into HDFS using **Sqoop**

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Set up R packages and develop a program using R Programming constructs.
- Solve Big Data problems using RHADOOP.
- Understand setting up of Pig and solve Big Data problems.
- Understand setting up of Hive and perform query processing.
- Apply Hadoop Streaming API for Big Data problems.
- Apply Sqoop for data loading into HDFS.

CO	PO						PSO		
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3.	√		√	√	√	√	√	√	√
4.	√		√	√			√	√	
5.	√		√	√	√	√	√		√
6.	√			√				√	

Attested

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CP5261 MACHINE LEARNING TECHNIQUES LABORATORY LT P C
0 0 4 2

OBJECTIVES:

- To apply the concepts of Machine Learning to solve real-world problems
- To implement basic algorithms in clustering & classification applied to text & numeric data
- To implement algorithms emphasizing the importance of bagging & boosting in classification & regression
- To implement algorithms related to dimensionality reduction
- To apply machine learning algorithms for Natural Language Processing applications

EXERCISES RECOMMENDED

1. Solving Regression & Classification using Decision Trees
2. Root Node Attribute Selection for Decision Trees using Information Gain
3. Bayesian Inference in Gene Expression Analysis
4. Pattern Recognition Application using Bayesian Inference
5. Bagging in Classification
6. Bagging, Boosting applications using Regression Trees
7. Data & Text Classification using Neural Networks
8. Using Weka tool for SVM classification for chosen domain application
9. Data & Text Clustering using K-means algorithm
10. Data & Text Clustering using Gaussian Mixture Models
11. Dimensionality Reduction Algorithms in Image Processing applications
12. Application of CRFs in Natural Language Processing

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- To learn to use Weka tool for implementing machine learning algorithms related to numeric data
- To learn the application of machine learning algorithms for text data
- To use dimensionality reduction algorithms for image processing applications
- To apply CRFs in text processing applications
- To use fundamental and advanced neural network algorithms for solving real-world data

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√	√		√	√	√	√
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3.	√		√	√			√	√	√
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CP5262 **PROFESSIONAL PRACTICES** **L T P C**
0 0 2 1

OBJECTIVES:

- To facilitate analysis, design and problem solving skills.
- To have a thorough domain knowledge.
- To understand the best Industry practices by reading case studies.
- To kindle innovative and professional thinking.
- To explore possible alternative solutions.
- To estimate feasibility, cost, risk and ROI.

SESSIONS BASED ON:

Identify an Application/Projects (may be of social relevance) – Understand Customer Requirements – Analyze and Understand Customers and Stakeholders – Value Additions – Innovations and Research Component – Preparing Plan / SRS Document Indicating Feasibility, Cost, Risk, ROI and Related Design – Suggest Implementation Methodology – Perform Risk Assessment and Management

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify and formulate the problem
- Describe the background of the problem.
- Assess the needs of stakeholders.
- Make estimates like cost, risk, ROI etc., to justify the business opportunity.
- Describe the industry standards and procedures.
- Predict the business opportunity.
- Suggest system implications.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
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4.			√	√			√		
5.			√	√			√		√
6					√		√		
7					√	√			√

Attested

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CP5090 ADVANCED DATABASE TECHNOLOGY AND DESIGN L T P C
3 0 2 4

OBJECTIVES:

- To comprehend the underlying principles of Relational Database Management System.
- To develop database models using parallel and distributed databases.
- To understand the concepts of XML and Web databases.
- To apprehend the design and implementation of active temporal and deductive databases.
- To develop applications based on NoSQL database.

UNITI RELATIONAL MODEL 9+6

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language-Database Normalization – Transaction Management-Recovery

UNIT II PARALLEL AND DISTRIBUTED DATABASES 9+6

Parallel Databases– I/O Parallelism– Inter-Query and Intra-Query Parallelism– Inter-Operation and Intra-operation Parallelism – Performance evaluation for Parallel DB Systems – Distributed Database Architecture-Distributed Data Storage – Distributed Transactions – Distributed Query Processing –Distributed Transaction Management – Load balancing tools for DDB – DDB Security.

UNIT III XML AND WEB DATABASES 9+6

XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity-Java Database Connectivity–Accessing Relational database using PHP – User Driven Querying – Writing to Web Databases – Session Management.

UNIT IV ACTIVE TEMPORAL AND DEDUCTIVE DATABASES 9+6

Event Condition Action Model – Design and Implementation Issues for Active Databases – Termination, Confluence, Determination and Modularization – Temporal Databases –Interpreting Time in Relational Databases – Deductive Databases – Data log Queries

UNIT V NoSQL DATABASES 9+6

NoSQL database vs traditional RDBMS database – Migrating from RDBMS to NoSQL– CRUD operations – Querying NoSQL stores – Indexing and Ordering Datasets – MongoDB-Database creation and Querying– Web Application development using MongoDB

TOTAL : 45+30:75 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Design and implement relational databases.
- Design and implement parallel and distributed databases.
- Design and implement XML databases, Active, Temporal and Deductive databases.
- Implement the concept of database connectivity with the applications.
- Design and implement No SQL database.

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Addison-Wesley, 2011.
2. Han, Jiawei, Jian Pei, and MichelineKamber. Data mining: Concepts and Techniques. 2011.
3. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
4. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Fifth Edition, McGraw Hill, 2006.
5. C.J.Date, A.KannanandS.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
6. V.S.Subramanian, “Principles of Multimedia Database Systems”, Harcourt India Pvt. Ltd.,2001.

7. ShashankTiwari, ”Professional NoSQL”, Wiley, 2011.
8. David Lane, Hugh.E.Williums, Web Database Applications with PHP and MySQL, O’Reilly Media; 2nd edition, 2004

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2.	√		√	√		√	√	√	√
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5.	√		√	√		√	√	√	√

CP5073 CLOUD COMPUTING TECHNOLOGIES LT P C
3 0 2 4

OBJECTIVES:

- To understand the concept of cloud and utility computing.
- To understand the various issues in cloud computing.
- To familiarize themselves with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.
- To be able to set up a private cloud.

UNIT I INTRODUCTION 9+6

Introduction- Historical Development – Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS – Open Source Private Cloud Software: Eucalyptus, Open Nebula, Open Stack.

UNIT II VIRTUALIZATION 9+6

Data Center Technology – Virtualization – Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing –Pros and Cons of Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V, KVM, Virtual Box

UNIT III CLOUD COMPUTING MECHANISM 9+6

Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System

UNIT IV HADOOP AND MAP REDUCE 9+6

Apache Hadoop – HadoopMap Reduce –Hadoop Distributed File System- Hadoop I/O- Developing a MapReduce Application – MapReduce Types and Formats – MapReduce Features– Hadoop Cluster Setup –Administering Hadoop.

UNIT V SECURITY IN THE CLOUD 9+6

Basic Terms and Concepts – Threat Agents – Cloud Security Threats –Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images.

TOTAL: 45 +30 : 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Identify the architecture, infrastructure and delivery models of cloud computing.
- Explain the core issues of cloud computing such as security, privacy and interoperability.
- Choose the appropriate technologies, algorithms and approaches for the related issues.
- Facilitate Service Level Agreements (SLA).

REFERENCES:

1. Thomas Erl, ZaighamMahood, Ricardo Puttini, “Cloud Computing, Concept, Technology & Architecture”, Prentice Hall, 2013.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata McGraw-Hill, 2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, “Cloud Computing, A Practical Approach”,Tata McGraw-Hill Edition, 2010.
4. ArshdeepBahga, Vijay Madisetti, “Cloud Computing: A Hands-On Approach”, Universities Press(India) Private Limited, 2014.
5. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Media, 4th Edition, 2015.
6. James E Smith and Ravi Nair, “Virtual Machines”, Elsevier, 2005.
7. John Rittinghouse& James Ransome, “Cloud Computing, Implementation,Management and Strategy”, CRC Press, 2010.

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4.	√		√	√		√	√	√	
5.	√		√	√		√	√	√	√

Attested

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CP5080 **ETHICAL HACKING** **L T P C**
3 0 2 4

OBJECTIVES:

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing.

UNIT I INTRODUCTION TO HACKING 9+6

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines

UNIT II SCANNING AND ENUMERATION 9+6

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools

UNIT III SYSTEM HACKING 9+6

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Countermeasures – Escalating Privileges – Executing Applications – Keyloggers and Spyware

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9+6

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures

UNIT V PENETRATION TESTING 9+6

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing– Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL: 45+30:75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify threats to computers.
- Defend hacking attacks.
- Protect data assets .
- Defend a computer against a variety of security attacks using various tools.
- Practice and use safe techniques on the World Wide Web.

REFERENCES:

1. EC-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Cengage Learning, 2010.
2. Jon Erickson, “Hacking, 2nd Edition: The Art of Exploitation”, No Starch Press Inc., 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, 2013.
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Second Edition, Elsevier, 2013.
5. RafayBoloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

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CP5079 **DIGITAL IMAGE AND VIDEO PROCESSING** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand broad range of image processing techniques and their applications.
- To learn about video processing techniques and understand the video content.
- To appreciate various techniques used for acquisition, preprocessing, enhancement and analysis of Image and Video data.
- To appreciate the use of image& video processing in current technologies.
- To expose the students to real-world applications and case studies of the image& video processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING **9+6**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System – Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models – Image Operations

UNIT II IMAGE ENHANCEMENT AND RESTORATION **9+6**

Image Transforms – Enhancement in the Spatial Domain –enhancement in the Frequency Domain– Image restoration.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY **9+6**

Detection of Discontinuities – Edge operators- Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation- Binary and Gray level morphology operations – Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms.Features – Textures – Boundary representations and Descriptions- Component Labeling – Regional Descriptors and Feature Selection Techniques.

UNIT IV BASICS OF VIDEO PROCESSING **9+6**

Introduction – Video Sampling and Interpolation- Motion Detection and Estimation – Video Enhancement and Restoration

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UNIT V VIDEO SEGMENTATION, TRACKING &APPLICATIONS 9+6

Video Segmentation- Motion Segmentation- Motion Tracking in Video-Video Quality Assessment-Case Studies –Image processing in Biometrics, Image Security, Steganography and Watermarking, Stereo vision, Object Segmentation and Tracking in the Presence of Complex Background in video , Forensic video analysis.

TOTAL: 45+30:75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
- Critically analyze the role of video in modern technologies.
- Implement basic image and video processing algorithms.
- Design and develop various applications that incorporates different techniques of Image and Video processing.
- Apply and explore new techniques in the areas of Image and video Processing.

REFERENCES:

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008, New Delhi.
2. S.Sridhar, “Digital Image Processing”, Oxford University Press, 2011, New Delhi.
3. A I Bovik (Alan C Bovik), “The Essential Guide to Video Processing”, Academic Press, Second Edition, 2009.
4. A. Murat Tekalp “Digital Video Processing”, Prentice Hall, 1995
5. Oges Marques, “Practical Image and Video Processing Using MATLAB”, Wiley-IEEE Press, 2011.

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CP5085 **PRINCIPLES OF CRYPTOGRAPHY** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the mathematical foundations of security principles.
- To appreciate the different aspects of encryption techniques.
- To understand various attacks present over encryption and authentications techniques.
- To understand the role played by authentication in security.
- To appreciate the current trends of security practices.

UNIT I CLASSICAL ENCRYPTION AND BLOCKCIPHERS 9+6

Classical Encryption – Substitution Cipher – One-time-pad Encryption – Block Ciphers – DES – Key Recovery Attacks on Block Ciphers – Iterated-DES and DESX – AES – Limitations of Key-recovery based Security.

UNIT II PSEUDO-RANDOM FUNCTIONS AND SYMMETRIC ENCRYPTION 9+6

Random Functions – Permutations – Pseudo Functions – Pseudo-random Permutations – ModellingBlockciphers – Security Against Key Recovery – The Birthday Attack – Symmetric Encryption Schemes – Chosen Plaintext Attacks – Semantic Security – Security of CTR and CBC – Chosen Ciphertext Attack.

UNIT III HASH FUNCTIONS AND MESSAGE AUTHENTICATION 9+6

Hash Function SHA1 – Collision resistant Hash Functions – Collision Finding Attacks – Onewayness of Collision resistant Hash Functions – MD Transform – Syntax for message Authentication – PRF as a MAC Paradigm – CBC MAC – Universal-hashing Approach – Authenticated Encryption.

UNIT IV NUMBER THEORY AND ASYMMETRIC ENCRYPTION 9+6

Computational Number Theory – Number Theoretic Primitives – Diffie Hellman Problem – Asymmetric Encryption Schemes – Hybrid Encryption – ElGamal Scheme and its Variants – Homomorphic Encryption – Digital Signatures

UNIT V SECURITY PRACTICES AND ADVANCED TOPICS 9+6

Electronic Mail Security – IP Security – Digital cash – Schnorr's Identification protocol and Signature – Blind Signature – Distributed Ledger and bitcoin — Secret Sharing – Shamir threshold scheme – Security in routing – Mixnet

TOTAL : 45 +30:75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Demonstrate the various classical encryption techniques and the adversary capabilities.
- Apply computational secrecy and semantic security to find out the probability of how strong are the security schemes.
- Illustrate the various MAC and HASH functions and apply the Birthday attack over Hash.
- Apply number theory in public key encryption techniques.
- Analyze the application of cryptography for secure E-Commerce and other secret transactions.

REFERENCES:

1. MihirBellare and Phillip Rogaway, "Introduction to Modern Cryptography", 2005.
2. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", Chapman and Hall, CRC Press Second Edition,2015.
3. Hans Delfts and Helmut Knebl, "Introduction to Cryptography – Principles and Applications", Springer, Third Edition, 2015.

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CP5083 **INTERNET OF THINGS** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the different architectures for IoT.
- To learn various protocols at the different layers for IoT.
- To develop prototype systems using Arduino / Rasberry Pi.
- To apply the use of data analytics in IoT.
- To develop applications of IoT in Industrial contexts.

UNIT I ARCHITECTURES AND MODELS **9+6**

Introduction to IoT – IoT Architectures – Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer – IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing – Sensors, Actuators, Smart Objects, Sensor networks.

UNIT II CONNECTIVITY **9+6**

Communications Criteria – Access Technologies – IP as IoT Network Layer – Business case – Optimization – Profiles and compliances – Application Protocols – Transport Layer – Application Transport Methods.

UNIT III SYSTEM DEVELOPMENT **9+6**

Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV DATA ANALYTICS ANDIoT SECURITY **9+6**

Data Analytics for IoT – Big Data Analytics Tools and Technology – Edge Streaming Analytics – Network Analytics.Applications.Security history, challenges, variations – Risk Analysis Structures – Application in Operational Environment.

UNIT V IoT IN INDUSTRY **9+6**

Manufacturing, Architecture, Protocols – Utilities, Grid Blocks - Smart Cities, Architecture, Use cases – Transportation, Architecture, Use cases.

TOTAL : 45+30:75 PERIODS

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OUTCOMES:
Upon completion of the course, the students will be able to

- Explain the underlying architectures and models in IoT.
- Analyse different connectivity technologies for IoT.
- Develop simple applications using Arduino / Raspberry Pi.
- Apply data analytics techniques to IoT.
- Study the needs and suggest appropriate solutions for Industrial applications.

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017
2. Olivier Hersent, David Boswarthick, Omar Elloum, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3. Michael Miller, “The Internet of Things”, Pearson Education, 2015.
4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
5. Jan Ho¨ ller, VlasiosTsiatsis, 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.
6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

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IF5076 **DEEP LEARNING** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks
- To understand the basic concepts of Big Data and Statistical Data Analysis
- To familiarize the student with The Image Processing facilities like Tensorflow and Keras
- To appreciate the use of Deep Learning Applications
- To understand and implement Deep Learning Architectures

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UNIT I BASICS OF NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

Suggested Activities:

- Discussion of role of Neural Networks.
- External learning – Boltzmann Machine and Perceptron.
- Practical – Installation of TensorFlow and Keras.

Suggested Evaluation Methods:

- Tutorial – Perceptron.
- Assignment problems on backpropagation networks.
- Quizzes on Neural Networks.

UNIT II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

Suggested Activities:

- Discussion of role of Gradient Descent in Deep Learning.
- External learning – Feature extraction and feature learning.
- Survey of Deep Learning Development Frameworks.
- Discussion of Gradient Descent Problem.

Suggested Evaluation Methods

- Tutorial – Gradient descent in deep learning.
- Assignment problems in optimization.
- Quizzes on deep learning regularization and optimization.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning

Suggested Activities:

- Discussion of role of Convolutional Networks in Machine Learning.
- External learning – Concept of convolution and need for Pooling.

Suggested Evaluation Methods:

- Tutorial – Image classification and recurrent nets.
- Assignment problems in image classification performances.
- Quizzes on Convolutional Neural Networks.

UNIT IV MORE DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM

Suggested Activities:

- Discussion of role of Deep Learning architectures.
- External learning – Compression of features using Autoencoders.

Suggested Evaluation Methods:

- Tutorial – LSTM and Autoencoders.
- Assignment problems in deep generative models, Deep Belief Networks.
- Quizzes on deep learning architectures.

UNIT V APPLICATIONS OF DEEP LEARNING 9

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

Suggested Activities:

- Discussion of role of Deep Learning in Image and NLP applications.
- External learning – NLP concepts.

Suggested Evaluation Methods:

- Tutorial – Image segmentation.
- Assignment problems in parsing and sentiment analysis.
- Quizzes on deep learning architectures.

PRACTICAL EXERCISES:

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement a SimpleLSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN.
11. Mini Project

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Understand the role of Deep learning in Machine Learning Applications.
2. To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
3. To design and implement Deep Learning Applications.
4. Critically Analyse Different Deep Learning Models in Image Related Projects.
5. To design and implement Convolutional Neural Networks.
6. To know about applications of Deep Learning in NLP and Image Processing.

REFERENCES:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
4. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
6. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

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CP5089 WEB CONTENT DESIGN AND MANAGEMENT L T P C
3 0 2 4

OBJECTIVES :

- Understand the design principles and interaction.
- To explore the detailed design practices, standards.
- To gain an insight into Content Management System for content design.
- To use any Content Management System tool for better content management.
- To get familiarized with Web Analytics for better management.

UNIT I PRINCIPLES OF WEB DESIGN 9+6

User Centered Design, Web Medium, Information Architectures, Site types and Architectures, Page Structure, Site Maps, Navigation, Search, Web Design Process, Designing for multiple screen resolutions, creating a unified site design, Evaluating Web Sites.

UNIT II ELEMENTS OF PAGE DESIGN 9+6

Elements of Page Design, Adding styles with CSS, Pages and Layout, Typography, Color, Images, GUI Widgets and Forms, responsive web designs, User input forms, Working with data tables, Web standards and styles.

UNIT III WEB CONTENT DESIGN 9+6

Features – Automated templates – Template processor –Front Controller pattern – content modeling – content aggregation – plug-ins – Search Engine Optimization – recommended usage of tools – WORDPRESS

UNIT IV WEB CONTENT MANAGEMENT 9+6

Work flow management – document management – collaboration – versioning – recommended usage of tools – WORDPRESS

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UNIT V WEB ANALYTICS 9+6

Web Analytics process – Data collection – qualitative analysis – log file analysis – Page Tagging – hybrid methods – click analytics – onsite and offsite analytics – web analytics methods

TOTAL : 45+60 : 75 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Design web pages that follow standards and are usable.
- Design web sites that are appealing.
- To be able to appreciate the usage of Content management System for designing web Content.
- To take advantage of Content Management System tools for managing content for large web sites.
- To be able to use analytics tools for better management.

REFERENCES:

1. Patrich J. Lynch, Sarah Horton, "Web Style Guide-Foundations of User ExperienceDesign", Yale University Press, 4th Edition, 2016.
2. Thomas A. Powell, "The Complete Reference– Web Design", Tata McGraw Hill,Second Edition, 2003.
3. Joel Sklar, — Principles of Web Design, Cengage Learning –Web Warrior Series, 6th Edition,2015.
4. Deane Barker, "Web Content management-Systems, Features and Best Practices", O'reilly Media, 1st Edition, 2016.
5. Brian Clifton, "Advanced web Metrics with Google Analytics", Third Edition, Sybex Publishers, 2012.
6. AvinashKaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, 1st edition, Sybex publishers, 2009.

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IF8090	SEMANTIC WEB	L T P C 3 0 2 4

OBJECTIVES:

- To learn the fundamentals of semantic web and to conceptualize and depict Ontology for semantic web.
- To understand the languages for semantic web.
- To learn about the ontology learning algorithms and to utilize in the development of an application.
- To know the fundamental concepts of ontology management.
- To learn the applications related to semantic web.

UNIT I THE QUEST FOR SEMANTICS 9

Building Models – Calculating with Knowledge – Exchanging Information – Semantic Web Technologies – Layers – Architecture – Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background – Sample Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation.

Suggested Activities:

- Flipped classroom on semantic web background and tutorial activity in class.
- Brainstorming session on various knowledge representation formats in class.

Suggested Evaluation Methods:

- Tutorial – Semantic web basics.
- Quizzes on knowledge representation formats.

UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 9

Web Documents in XML – RDF – Schema – Web Resource Description using RDF – RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics – Traditional Ontology Languages – LOOM – OKBC – OCML – Flogic Ontology Markup Languages – SHOE – OIL – DAML+OIL – OWL.

Suggested Activities:

- Flipped classroom on comparison of various semantic web related languages and tutorial activity in class.

Suggested Evaluation Methods:

- Quizzes on various ontology related languages.

UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB 9

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning –Importing and Processing Ontologies and Documents – Ontology Learning Algorithms –Methods for evaluating Ontologies.

Suggested Activities:

- Flipped classroom on natural language processing techniques like statistical text analysis, term extraction, Word sense disambiguation, concept extraction and tutorial activity in class.
- External reading – https://nlp.stanford.edu/fsnlp/

Suggested Evaluation Methods

- Tutorials – Language processing techniques.

UNIT IV ONTOLOGY MANAGEMENT AND TOOLS 9

Overview – Need for management – Development process – Target Ontology – Ontology mapping – Skills management system – Ontological class – Constraints – Issues – Evolution –Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

Suggested Activities:

- Flipped classroom on study of various ontology related tools.

Suggested Evaluation Methods

- Tutorials – Ontology related tools like Protege, Ontolingua, Webonto.

UNIT V APPLICATIONS 9

Web Services – Semantic Web Services – Case Study for specific domain – Security issues – Web Data Exchange and Syndication – Semantic Wikis – Semantic Portals – Semantic Metadata in Data Formats – Semantic Web in Life Sciences – Ontologies for Standardizations – Rule Interchange Format.

Suggested Activities:

- Flipped classroom on other applications of semantic web.

Suggested Evaluation Methods

- Quizzes on semantic web applications.

PRACTICAL EXERCISES: 30

1. Design of simple ontology on their domain of interest using Protege like tool.
2. Create RDF document using PHP library EasyRdf.
3. Use OWL language to represent relationships, properties and to provide inferences from created ontology.
4. Term extraction and Term disambiguation from corpus using Alchemy like API.
5. Use of any tool to apply SAPRQL queries and implement reasoning for avoiding inconsistencies.
6. Exercises on Merging two ontologies, Applying association rules and Applying clustering algorithms.
7. Development of Simple application like chat bot, semantic search engine creation using Topic map data models extracted from Ontopia/Mappa.
8. Creating intelligent expert systems using semantic Wikis like SMW+.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Create ontology for a given domain.
2. Develop an application using ontology languages and tools.
3. Understand the concepts of semantic Web.
4. Use ontology related tools and technologies for application creation.
5. Design and develop applications using semantic web.
6. Understand the standards related to semantic web.

REFERENCES:

1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, “Foundations of Semantic Web Technologies”, Chapman & Hall/CRC, 2009.
2. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez, “Ontological Engineering: with Examples from the Areas of Knowledge Management, e-Commerce and the Semantic Web”, Springer, 2004.
3. Grigoris Antoniou, Frank van Harmelen, “A Semantic Web Primer (Cooperative Information Systems)”, MIT Press, 2004.
4. Alexander Maedche, “Ontology Learning for the Semantic Web”, First Edition, Springer. 2002.

5. John Davies, Dieter Fensel, Frank Van Harmelen, “Towards the Semantic Web: Ontology Driven Knowledge Management”, John Wiley, 2003.
6. John Davies, Rudi Studer, Paul Warren, (Editor), “Semantic Web Technologies: Trends and Research in Ontology-Based Systems”, Wiley, 2006.

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IF5088 MOBILE APPLICATION DEVELOPMENT L T P C
3 0 2 4

OBJECTIVES:
- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile application.
- To understand the design issues in the development of mobile applications.
- To understand the development procedures for mobile application.
- To develop mobile applications using various tools and platforms.

UNIT I INTRODUCTION 9
Mobile applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools.

Suggested Activities:
- Flipped classroom on survey on mobile application models.
- External learning – mobile application design using frameworks and tools.

Suggested Evaluation Methods:
- Quiz – questionnaire related to mobile application models.
- Assignment – evaluate using learning content management system like Moodle.

UNIT II USER INTERFACE 9
Generic UI development – Designing the right UI – Multimodal and Multichannel UI – Gesture based UI – Screen Elements and Layouts – Voice XML.

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Suggested Activities:

- Flipped classroom on discussion on UI for mobile application like voice and gestures.
- External learning – survey on different view elements for mobile application.

Suggested Evaluation Methods:

- Quiz – questionnaire related to user interface design for mobile applications.
- Assignment – evaluate using learning content management system like Moodle.

UNIT III APPLICATION DESIGN 9

Memory Management – Design Patterns for Limited Memory – Work Flow for Application Development – Java API – Dynamic Linking – Plug-ins and Rule of Thumb for using DLLs – Concurrency and Resource Management.

Suggested Activities:

- Flipped classroom on discussion on memory constraints for mobile application design.
- External learning – survey on resource management and concurrent operations.

Suggested Evaluation Methods:

- Quiz – questionnaire related to memory constraints in design for mobile applications.
- Assignment – evaluate using learning content management system like Moodle.

UNIT IV APPLICATION DEVELOPMENT I 9

Mobile OS: Android, Ios – Android Application Architecture – Android basic Components – Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking.

Suggested Activities:

- Simple Android application development like user account creation.
- Android application accessing the mobile database to view user data.

Suggested Evaluation Methods:

- Evaluation based on the demonstrated application functionality using emulators.

UNIT V APPLICATION DEVELOPMENT II 9

Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer Animation, Event Handling and Graphics Services – Telephony – Location Based Services.

Suggested Activities:

- Application accessing Internet for communication like web application.
- Android application accessing GPS for location based service.

Suggested Evaluation Methods:

- Evaluation based on the demonstrated application functionality using emulators.

PRACTICAL EXERCISES: 30

1. Develop an application that uses GUI components, Font and Colours.
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write an application that draws basic graphical primitives on the screen.
5. Develop an application that makes use of database.
6. Write an application that makes use of internet for communication (mobile web app).
7. Develop a native application that uses GPS location information.
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message.
10. Write a mobile application that creates alarm clock.

TOTAL: 75 PERIODS

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OUTCOMES:

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

1. Design the right user interface for mobile application.
2. Implement mobile application using UI toolkits and frameworks.
3. Design a mobile application that is aware of the resource constraints of mobile devices.
4. Develop web based mobile application that accesses internet and location data.
5. Implement android application to use telephony for SMS communication.
6. Implement android application with multimedia support.

REFERENCES:

1. Reto Meier, "Professional Android 4 Application Development", Wiley, 2012.
2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming Android", O'Reilly, 2011.
3. Alasdair Allan, "iPhone Programming", O'Reilly, 2010.

CP5075 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To study the basic concepts of crytocurrencies and blockchains.
- To explain the details of Bitcoin and its different components.
- To study the basics Hyperledger and Web3.
- To analyse the position of Web 3 and Hyperledger with different aspects of blockchain technologies.
- To differentiate between alternate blockchains and their advantages in application areas.
- To understand the Ethereum development environment and the application development process.

UNIT I INTRODUCTION 9

Cryptographic hash functions – hash pointers – digital signatures – public keys as identities – an example cryptocurrency. Bitcoin, history of blockchain and Bitcoin – Types of Blockchain – Consensus – Decentralization.

UNIT II BITCOIN 9

Bitcoin – Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the blockchain – Mining – Bitcoin Networks and Payments – Wallets – Alternative coins – Smart Contracts – Definition – Recardian contracts.

UNIT III WEB3 AND HYPERLEDGER 9

Web 3 Contract development – POST requests – Frontend – Development framework – Hyperledger Projects – Protocol – Reference architecture – Hyperledger Fabric – Corda.

UNIT IV ALTERNATIVE BLOCKCHAINS AND APPLICATIONS 9

Alternative blockchains – Applications, Internet of Things, Government, Health, Finance – Scaleability – Privacy.

UNIT V ETHEREUM 9

Setting up Ethereum development tools – Solidity language. – Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts – Smart contracts, structure, setting up and interaction, examples – Decentralised applications, implementation, case studies – Whisper protocol – Swarm architecture and concepts.

TOTAL : 45 PERIODS

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OUTCOMES:

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

- Explain cryptocurrencies and their relationship with the blockchain technology.
- Explain the different steps in the use of Bitcoins.
- Relate Web 3 and Hyperledger to concepts in blockchain technologies.
- Apply blockchains to different real-life problems
- Implement a simple application using Ethereum.

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016.
3. Arshdeep Bahga and Vijay Madisetti, “Blockchain Applications : A Hands-On Approach”, 2017
4. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly Publishing, 2014.
5. Roger Wattenhofer, “The Science of the Blockchain” Create Space Independent Publishing Platform, 2016.
6. Alex Leverington, “Ethereum Programming” Packt Publishing Limited, 2017.

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SE5071 MULTIMEDIA SYSTEMS AND APPLICATIONS L T P C
3 0 2 4

OBJECTIVES:

- To enrich student learning in Multimedia systems basics
- To train the students to acquire knowledge in multimedia Tools and authoring
- To acquire knowledge about multimedia data compression techniques
- To acquire knowledge in the area of multimedia communication systems
- To know about popular multimedia application areas

UNIT I MULTIMEDIA ELEMENTS 9+6

Principles – Cognition, Learning, Interaction, Medium of Consumption: Elements - Text – characteristics, standards, formats; Graphics – representation, file formats, Image / Graphics – file formats, standards;Digital Audio – Characteristics, formats, standards, Speech, Video – characteristics, formats; Animation – characteristics, formats; , Multidimensional Data Structures, k-d trees, Quad Trees, R-trees.

UNIT II MULTIMEDIA TOOLS and AUTHORING 9+6

Hardware – Display Devices, wearables, Graphics cards, I/O devices, software – Editing tools for Text, Image, Audio, Video and animation. Authoring tools, Authoring Multimedia presentations, Authoring Metaphors.

UNIT III MULTIMEDIA COMPRESSION 9+6

Symmetric and Asymmetric methods, Lossy and Lossless Compression, Text compression – RLE, Huffman, Arithmetic, Dictionary based; Document Image compression standards – CCITT Jand Color Image Compression – JPEG, Audio Compression – PCM, ADPCM, MPEG, AAC, AC3, speech compression; Video Compression-MPEG-4, H.265, DVI

UNIT IV MULTIMEDIA COMMUNICATION SYSTEMS 9+6

Multimedia Communication Standards, Transport Protocols, streaming protocols, Internet Protocols Wireless multimedia communications, synchronization and QOS, security, Entertainment networks, Collaborative multimedia support, Real-time distributed multimedia networks, Hypertext, Hypermedia.

UNIT V MULTIMEDIA APPLICATIONS 9+6

Applications for WWW.Multimedia databases – Indexing and Retrieval, Visualization, Virtual, Augmented and Mixed Reality, Interactive E-learning, HCI and UX design, Games and Animation, Real-Time video conferencing.

TOTAL: 75 PERIODS

PRACTICAL EXERCISES:

1. Editing various images (Image restoration, Changing colour image to Grey scale and vice versa) and adding special effects to images using tools like Photoshop, Gimp and flash
2. Creating and Editing various video clippings and adding special effects using tools like Adobe Premier Pro
3. Creating and Editing various audio files and adding special effects using tools like Sound Forge and Audacity
4. Creating three dimensional models and animations using tools like Blender, 3DS Max, Unity
5. Working on Text compression algorithms like Run length and Huffman
6. Implementation of transformations like DCT and FFT
   Designing User Interfaces and developing simple games using multimedia tools
7. Creating simple multimedia applications using any popular Authoring tools
8. Mini Project(4 Periods)

OUTCOMES:

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

- Handle the multimedia elements effectively
- Use Multimedia Hardware and Software for Editing and Authoring
- Use Compression algorithms for various multimedia applications
- Develop effective strategies to deliver Quality-of-Experience in networked Multimedia applications
- Design and develop multimedia applications in various domains

TEXTBOOKS:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, “Fundamentals of Multimedia”, Second Edition, Springer Nature (Texts in Computer Science), 2014.
2. Prabhat K. Andleigh, KiranThakrar, “Multimedia Systems Design”, Pearson Education India, Ist Edition, 2015
3. Ralf Steinmetz and KlaraNahrstedt, “Multimedia computing, communications, and applications”, Pearson India, Pearson, 2002.

REFERENCES:

1. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson Education, 2002.

2. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kauffman, 2012.
3. K.R. Rao, Zoran S. Bojkovic, Bojan M. Bakmaz, “ Wireless Multimedia Communication systems: Design, Analysis and Implementation”, CRC press, 2017.
4. V.S. Subrahmanian, “Principles of Multimedia Database Systems”, Elsevier / Morgan Kauffmann, 2008.

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SE5076 SOFTWARE TESTING AND QUALITY ASSURANCE L T P C
3 0 2 4

OBJECTIVES:
The student should be able to
- Know what is software and the usage of different types of softwares.
- Know the Quality Metrics of various Softwares.
- Know the methodologies used in developing software.
- Test the product finally to check the product Quality.

UNIT I INTRODUCTION 9+6
Introduction to Software Quality - Challenges – Objectives – Quality Factors – Components of SQA – Contract Review – Development and Quality Plans – SQA Components in Project Life Cycle – SQA Defect Removal Policies – Reviews.

UNIT II TESTING METHODOLOGIES 9+6
Basics of Software Testing – Test Generation from Requirements – Finite State Models – Combinatorial Designs - Test Selection, Minimization and Prioritization for Regression Testing – Test Adequacy, Assessment and Enhancement.

UNIT III TEST STRATEGIES 9+6
Testing Strategies – White Box and Black Box Approach – Integration Testing – System and Acceptance Testing – Performance Testing – Regression Testing - Internationalization Testing – Ad-hoc Testing – Website Testing – Usability Testing – Accessibility Testing.

UNIT IV TEST AUTOMATION AND MANAGEMENT 9+6
Test plan – Management – Execution and Reporting – Software Test Automation – Automated Testing tools - Hierarchical Models of Software Quality – Configuration Management – Documentation Control.

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UNIT V SQA IN PROJECT MANAGEMENT 9+6

Project progress control – costs – quality management standards – project process standards – management and its role in SQA – SQA unit.

TOTAL: 45+30:75 PERIODS

OUTCOMES

Upon completion of the course, the student will be able to

- Develop Quality plans and use SQA components in project life cycle.
- Analyze the product Quality.
- Judge the use of infrastructure components and use configuration items for Quality control.
- Use various testing methods and verify.
- Assess Quality standards of various software products.

REFERENCES

1. Daniel Galin, —Software Quality Assurance – from Theory to Implementation‖, Pearson Education, 2009
2. Yogesh Singh, "Software Testing", Cambridge University Press, 2012
3. Aditya Mathur, —Foundations of Software Testing‖, Pearson Education, 2008
4. Ron Patton, —Software Testing‖ , Second Edition, Pearson Education, 2007
5. Srinivasan Desikan, Gopalaswamy Ramesh, —Software Testing – Principles and Practices‖, Pearson Education, 2006
6. Alan C Gillies, —Software Quality Theory and Management‖, Cengage Learning, Second Edition, 2003.
7. Robert Furtell, Donald Shafer, and Linda Shafer, "Quality Software Project Management", Pearson Education Asia, 2002.

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CP5082 INFORMATION RETRIEVAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
- To learn measuring effectiveness and efficiency of information retrieval techniques.
- To get used to performing Parallel Information Retrieval.
- To understand the concepts of digital libraries.

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UNIT I INTRODUCTION 9

Basic Concepts – Practical Issues – Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR –IR Versus Web Search–Components of a Search engine

UNIT II RETRIEVAL MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model – Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models – Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching – Sequential Searching and Pattern Matching. Query Operations –Query Languages – Query Processing – Relevance Feedback and Query Expansion – Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce

UNIT V SEARCHING THE WEB 9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis – XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Build an Information Retrieval system using the available tools
- Identify and design the various components of an Information Retrieval system
- Measure effectiveness and efficiency of information retrieval techniques
- Use parallel Information Retrieval approaches in real world problems
- Design an efficient search engine and analyze the Web content structure

REFERENCES:

1. Ricardo Baeza – Yates, BerthierRibeiro – Neto, “Modern Information Retrieval: The Concepts and Technology behind Search”, (ACM Press Books), Second Edition, 2011.
2. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition, 2008.
3. S Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.

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CP5086 **SOCIAL NETWORK ANALYSIS** **L T P C**
3 0 2 4

OBJECTIVES:

- To gain knowledge about the current web development and emergence of social web.
- To study about the modeling, aggregating and knowledge representation of semantic web.
- To appreciate the use of machine learning approaches for web content mining.
- To learn about the extraction and mining tools for social networks.
- To gain knowledge on web personalization and web visualization of social networks.

UNIT I CLUSTERING AND CLASSIFICATION 9+6

Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers – Unsupervised Learning – K-means Clustering – Hierarchical Clustering – Partially Supervised Learning – Markov Models – Probability-Based Clustering – Vector Space Model

UNIT II SOCIAL MEDIA MINING 9+6

Data Mining Essentials – Data Mining Algorithms - Web Content Mining – Latent semantic Indexing – Automatic Topic Extraction – Opinion Mining and Sentiment Analysis – Document Sentiment Classification

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 9+6

Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks – Definition of Community – Evaluating Communities – Methods for Community Detection & Mining – Applications of Community Mining Algorithms – Tools for Detecting Communities – Social Network Infrastructure and Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities

UNIT IV HUMAN BEHAVIOR ANALYSIS AND PRIVACY ISSUES 9+6

Understanding and Predicting Human Behavior for Social Communities – User Data Management, Inference and Distribution – Enabling New Human Experiences – Reality Mining – Context-Awareness – Privacy in Online Social Networks – Trust in Online Environment – Trust Models Based on Subjective Logic – Trust Network Analysis – Trust Transitivity Analysis – Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons – Attack Spectrum and Countermeasures.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9+6

Graph Theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing Online Social Networks – Visualizing Social Networks with Matrix-Based Representations – Node-Link Diagrams – Hybrid Representations – Applications – Covert Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Recommendation in Social Media: Challenges – Classical Recommendation Algorithms – Recommendation Using Social Context – Evaluating Recommendations

TOTAL : 45+30 : 75 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Apply knowledge of current web development in the era of social web.
- Model, aggregate and represent knowledge for semantic web.
- Use machine learning approaches for web content mining.
- Design extraction and mining tools for social networks.
- Develop personalized web sites and visualization for social networks.

REFERENCES:

1. Peter Mika, “Social networks and the Semantic Web”, Springer, 2007.
2. BorkoFurht, “Handbook of Social Network Technologies and Applications”, Springer, 2010.
3. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data- Centric Systems and Applications)”, Springer; Second Edition, 2011.
4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, ”Social Media Mining”, Cambridge University Press, 2014.
5. GuandongXu, Yanchun Zhang and Lin Li, “Web Mining and Social Networking Techniques and applications”, Springer, 2011.
6. Dion Goh and Schubert Foo, “Social information retrieval systems: emerging technologies and Applications for searching the Web effectively”, Idea Group, 2007.

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CP5084 **PARALLEL ALGORITHMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn parallel algorithms development techniques for shared memory and DCM models.
- To study the main classes of fundamental parallel algorithms.
- Learn to design efficient parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.
- To understand parallel solutions for bitwise computation.

UNIT I INTRODUCTION **9**

Introduction to Parallel Algorithms – Models of Computation – Selection – Merging on EREW and CREW – Median of two sorted sequence – Fast Merging on EREW – Analyzing Parallel Algorithms

UNIT II SORTING & SEARCHING **9**

Sorting Networks – Sorting on a Linear Array – Sorting on CRCW, CREW, EREW – Searching a sorted sequence – Searching a random sequence – Bitonic Sort

UNIT III ALGEBRAIC PROBLEMS **9**

Permutations and Combinations – Matrix Transpositions – Matrix by Matrix multiplications – Matrix by vector multiplication.

UNIT IV GRAPH & GEOMETRY **9**

Connectivity Matrix – Connected Components – All Pair Shortest Paths – Minimum Spanning Trees – Point Inclusion – Intersection, Proximity and Construction Problems

UNIT V OPTIMIZATION & BIT COMPUTATIONS **9**

Prefix Sums – Job Sequencing – Knapsack - Adding two integers – Adding n integers – Multiplying two integers – Selection

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the difference between sequential and parallel algorithms.
- Design parallel algorithms in various models of parallel computation.
- Apply a suitable model for developing a parallel algorithm.
- Know the basic issues associated with implementing parallel algorithms.
- Understand the differences among several algorithms used for solving the same problem and recognize which one is better under different conditions.

REFERENCES:

1. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jercy, 1989.
2. Michael J. Quinn, “Parallel Computing: Theory & Practice”, Tata McGraw Hill Edition, 2003.
3. Joseph JaJa, “Introduction to Parallel Algorithms”, Addison-Wesley, 1992.

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CP5076 **CYBER SECURITY** **L T PC**
3 0 0 3

OBJECTIVES:

- To understand the nature of threats and cyber security management goals and technology
- To understand the landscape of hacking and perimeter defense mechanisms
- To develop strategies for cyber security and protecting critical infrastructure
- To understand policies to mitigate cyber risks
- To understand the IT Act, scheme, amendments and emerging cyber law and desired cyber ecosystem capabilities

UNIT I OVERVIEW OF CYBER SECURITY **9**

Introduction – Cyberspace – Cyber Crime – Nature of Threat – Cyber security – Policy, Mission and Vision of Cyber security Program. Cyber security management system – goals, technology categories – perimeter defense and encryption. Cyber security management framework.

UNIT II ATTACKS AND COUNTERMEASURES **9**

Malicious Attacks, Threats, and Vulnerabilities – Scope of cyber-attacks – Tools used to attack computer systems – security breach – Risks, vulnerabilities and threats. Malware – malicious software attack – social engineering attack – wireless network attack – web application attack – Countermeasures– Types of Network Security Devices –Firewalls, Intrusion Detection Systems, Content Filtering, Virtual Private Networks – Encryption

UNIT III STRATEGIES FOR CYBER SECURITY **9**

Creating a Secure Cyber, Types of Attacks, Comparison of Attacks, Creating an Assurance Framework, Encouraging Open Standards, Strengthening the Regulatory framework, Creating Mechanisms for IT Security, Securing E-Governance Services, and Protecting Critical Information Infrastructure. Areas for Intervention – Legal Responses – Harmonization of Legislation – Criminalization of Cyber Offences – National Security and issues related to Privacy and Freedom of Expression – Investigation Procedures – International Cooperation – Electronic Evidence – Liability of ISPs–Recommendations

UNIT IV POLICIES TO MITIGATE CYBER RISK 8

Promotion of R&D in Cyber security – Reducing Supply Chain Risks – Mitigate Risks through Human Resource Development – Creating Cyber security Awareness– Information sharing – Implementing a Cyber security Framework. Signatures– Digital Signature, Electronic Signature

UNIT V CRITICAL INFORMATION INFRASTRUCTURE PROTECTION 10

National Security – Information Sharing and Coordination – Innovation In Regulatory Approach – Innovation in Security Programs– Proactive Threat and Vulnerability Management - Promoting Best Practices In Critical Infrastructure Sectors – Assessing and Monitoring Security Preparedness of Sectors (Security Index) – Security in Information Technology Supply Chain - Taking Leadership and Participating in International Efforts – Capacity Building in Security Skills and training and Awareness. The Indian Cyberspace– Cyber Threats – Need for a Comprehensive Cyber Security Policy – Need for a Nodal Authority – Need for an International Convention on Cyberspace – Cyber War – Fifth Domain of Warfare – Meeting the Cyber Warfare Challenges.

TOTAL: 45 PERIODS

OUTCOMES:

- Gain knowledge on the nature of threats and cyber security management goals and framework
- Knowledge on the landscape of hacking and perimeter defense mechanisms
- Ability to differentiate and integrate strategies for cyber security and protecting critical infrastructure
- Able to understand policies to mitigate cyber risks
- Knowledge on IT Act, and amendments, copy rights, IPR and cyber law to deal with offenses.

REFERENCES:

1. David Kim and Michael G. Solomon, Fundamentals of Information Systems Security, Third Edition Transition Guide, Jones &Bartlett Learning, 2018.
2. Peter Trim and Yang - Im Lee, —Cyber Security Management- A Governance, Risk and Compliance Framework, Gower Publishing, England 2014.
3. Institute for Defence Studies and Analysis Report, India's Cyber Security Challenge, 2012 https://idsa.in/system/files/book/book_indiacybersecurity.pdf
4. John G. Voeller, Cyber Security, John Wiley & Sons, England, 2014.
5. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Addison-Wesley, 2016.
6. Edward Griffor, Handbook of System Safety and Security, Syngress an Elsevier Publications, 1st edition, 2017.
7. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, CRC Press, 2015.
8. NIST Cyber security Framework, Version 1.0, 2014.
9. CGI, —Cyber security in Modern Critical Infrastructure Environments, 2014.
10. Stuart Broderick J, Cyber Security Program, Cisco Security Solutions, June 2016.

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CP5087 **SOFT COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn the key aspects of Soft computing and Neural networks.
- To study the fuzzy logic components.
- To gain insight onto neuro fuzzy modeling and control.
- To know about the components and building block hypothesis of genetic algorithm.
- To gain knowledge in machine learning through neural networks..

UNIT I INTRODUCTION TO SOFT COMPUTING **9**

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II GENETIC ALGORITHMS **9**

Introduction to Genetic Algorithms (GA) – Applications of GA - Building block hypothesis-Representation– Fitness Measures – Genetic Operators-. GA based Machine Learning.

UNIT III NEURAL NETWORKS **9**

Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in Neural Networks.

UNIT IV FUZZY LOGIC **9**

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING **9**

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule based Structure Identification – Neuro-Fuzzy Control – Case Studies.

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TOTAL : 45 PERIODS

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OUTCOMES:

Upon completion of the course, the students will be able to

- Differentiate Conventional AI and Computational Intelligence.
- Discuss on machine learning through neural networks.
- Apply knowledge in developing a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Discover knowledge to develop Genetic Algorithm and Support vector machine based machine learning system.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
2. KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.
5. David E.Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 1989.
6. Mitchell Melanie, "An Introduction to Genetic Algorithm", MIT Press, 1996.
7. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer, 2008.

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CP5088 **USER INTERFACE DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To determine the necessity of user interaction by understanding usability engineering and user modeling.
- To learn the methodologies for designing interactive systems.
- To investigate the core and complex design issues for interaction.
- To examine the evaluation methodologies of design.
- To Understand design issues for web and mobile platforms.

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UNIT I INTRODUCTION 9

Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users-cognition and cognitive frame works, User Centred approaches - Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories

UNIT II INTERACTION DESIGN 9

Universal design principles, guidelines, heuristics, HCI Patterns, Design Frame Works, Design Methods, Prototyping, Understanding Interaction Styles, Direct Manipulation and Immersive Environments, Fluid Navigation, Expressive Human and Command Languages, Communication and Collaboration.

UNIT III DESIGN AND EVALUATION 9

Advancing the User Experience, Timely User Experience, Information Search, Data Visualization Evaluation Techniques- Assessing User Experience- Usability Testing – Heuristic Evaluation and Walkthroughs, Analytics Predictive Models.

UNIT IV MODELS AND THEORIES 9

Cognitive Models, Socio-Organizational Issues And Stake Holder Requirements, Communication And Collaboration Modelstask Analysis, Dialog Notations and Design, Models of the System, Modeling Rich Interaction, Ubiquitous Computing

UNIT V DESIGNING INTERACTIONS FOR WEB AND MOBILE PLATFORMS 9

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions - Lookup patterns-Feedback Patterns, Mobile Apps, Mobile Navigation, Content and Control Idioms, Multi-Touch Gestures, Inter-App Integration, Mobile Web.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Understand the basics of human computer interactions via usability engineering and cognitive modeling.
- Understand the basic design paradigms, complex interaction styles.
- Understand the fundamental design issues.
- Examine the evaluation of interaction designs and implementations.
- Use models and theories for user interaction.
- Use above concepts for above concepts for web and mobile applications.

REFERENCES:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, “Interaction Design: Beyond Human Computer Interaction”, Wiley Student Edition, 4th Edition, Wiley, 2015.
3. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Pearson Education, 2004.
4. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, “About Face: The Essentials of Interaction Design”, 4th Edition, Wiley, 2014.
5. Donald A. Norman, “Design of Everyday Things”, MIT Press, 2013.
6. Cameron Banga, Josh Weinhold, “Essential Mobile Interaction Design: Perfecting Interface Design in Mobile Apps”, Addison-Wesley Professional, 1 edition, 2014.
7. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O"Reilly, 2009.
8. Steven Hoober, Eric Berkman, “Designing Mobile InterfacesPatterns for Interaction Design”, O'Reilly, 2011.

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SE5074 SOFTWARE RELIABILITY METRICS AND MODELS L T P C
3 0 0 3

OBJECTIVES:

- Learn different definitions of software quality.
- Know different notions of defects and classify them.
- Understand the basic techniques of data collection and how to apply them.
- Learn software metrics that define relevant metrics in a rigorous way.
- Gain confidence in ultra-high reliability.

UNIT I INTRODUCTION 9

Automated Testing – Background on software testing – Automated test life cycle methodology (ATLM) – Test Maturity Model – Test Automation Development – Overcoming false expectations of automated testing – benefits – Test tool proposal

UNIT II TEST FRAMEWORK AND AUTOMATION 9

Automated Test Tool Evaluation and Selection – Organisation's system engineering environment – tools that support the testing life cycle – Test Tool Research – Hands-on Tool evaluation -Test process analysis – Test tool consideration – Selecting the test automation approach - Test team management – Organization Structure of a Test Team – Test Program Tasks – Test Effort Sizing

UNIT III TEST PLANNING AND DESIGN 9

Test Planning – Test Program Scope – Test Requirements Management – Test Program Events, Activities And Documentation – Test Environment – Test Plan – Test Requirements Analysis – Test Program Design – Test Procedure Design – Test Development Architecture – Test Development Guidelines – Automation Infrastructure – Test Execution And Review – Executing and Evaluating Test Phases - Test Metrics - Test Bench Design and Evaluation

UNIT IV TESTING THE APPLICATIONS 9

Testing Web Applications – Functional Web testing with Twill – Selenium – Testing a simple Web Application – Testing Mobile Smartphone Applications – Running automated test scripts – Test tools for Browser based applications – Test Automation with Emulators – Test Results reporting – Test defect tracking and fixing.

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UNIT V CASE STUDIES **9**

Test automation and agile project management – database automation – test automation in cloud – Mainframe and Framework automation – Model based test case generation – Model based testing of Android applications

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Perform some simple statistical analysis relevant to software measurement data.
- Classify defects on identification and work on them.
- Use data collection techniques aptly.
- Use software metrics for relevant measures in a rigorous way.
- Use from practical examples both the benefits and limitations of software metrics for quality control and assurance.

REFERENCES:

1. Elfriede Dustin, Jeff Rashka, "Automated software testing: Introduction, Management and Performance", Pearson Education, 2008.
2. C. Titus Brown, Gheorghe Gheorghiu, Jason Huggins, " An Introduction to Testing Web Applications with twill and Selenium ", O'Reilly Media, Inc., 2007.
3. Dorothy Graham, Mark Fewster, "Experiences of Test Automation: Case Studies of Software Test Automation", illustrated Edition, Addison-Wesley Professional, 2012.
4. Julian Harty, "A Practical Guide to Testing Mobile Smartphone Applications", Vol. 6 of Synthesis Lectures on Mobile and Pervasive Computing Seriesll, Morgan & Claypool Publishers, 2009.
5. Kanglin Li, Mengqi Wu, "Effective Software Test Automation: Developing an Automated Software Testing Tool", John Wiley & Sons, 2006.

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BD5001 STATISTICAL NATURAL LANGUAGE PROCESSING L T P C
3 0 2 4

OBJECTIVES:

- To understand the representation and processing of Morphology and Part-of Speech Taggers.
- To appreciate various techniques used for speech synthesis and recognition.
- To understand different aspects of natural language syntax and the various methods used for processing syntax and disambiguating word senses.
- To appreciate the various representations of semantics and discourse.
- To know about various applications of natural language processing.

UNIT I MORPHOLOGY AND PART-OF SPEECH PROCESSING 9+6

Introduction –Regular Expressions and Automata- Non-Deterministic FSAs.Tranducers – English Morphology – Finite-State Morphological Parsing - Porter Stemmer – Tokenization-Detection and Correction of Spelling Errors. N-grams – Perplexity - Smoothing - Interpolation - Backoff Part-of-Speech Tagging – English Word Classes - Tagsets - Rule-Based - HMM - Transformation-Based Tagging - Evaluation and Error Analysis. Hidden Markov and Maximum Entropy Models

UNIT II SPEECH PROCESSING 9+6

Phonetics – Articulatory Phonetics - Phonological Categories - Acoustic Phonetics and Signals - Speech Synthesis – Text Normalization – Phonetic and Acoustic Analysis - DiphoneWaveformsynthesis – Evaluation- Automatic Speech Recognition –Architecture - Hidden Markov Model to Speech - MFCC vectors - Acoustic Likelihood Computation - Evaluation. Triphones – Discriminative Training - Modeling Variation. Computational Phonology-Finite-State Phonology – Computational Optimality Theory - Syllabification - Learning Phonology and Morphology

UNIT III SYNTAX ANALYSIS 9+6

Formal Grammars of English – Constituency - Context-Free Grammars –Grammar Rules – Treebanks - Finite-State and Context-Free Grammars - Dependency Grammars. Syntactic Parsing – Parsing as Search - Ambiguity - Dynamic Programming Parsing Methods –CKY-Earley and Chart Parsing- Partial Parsing-Evaluation. Statistical Parsing – Probabilistic Context-Free Grammars – Probabilistic CKY Parsing of PCFGs –Probabilistic Lexicalized CFGs – Collins Parser Language and Complexity -The Chomsky Hierarchy -The Pumping Lemma

UNIT IV SEMANTIC AND PRAGMATIC INTERPRETATION 9+6

Representation of Meaning – Desirable Properties - Computational Semantics -Word Senses - Relations Between Senses – WorldNet - Event Participants- Proposition Bank - Frame Net – Metaphor. Computational Lexical Semantics – Word Sense Disambiguation- Supervised Word Sense Disambiguation - Dictionary and Thesaurus Methods- Word Similarity - Minimally Supervised WSD - Hyponymy and Other Word Relations - Semantic Role Labeling - Unsupervised Sense Disambiguation. Computational Discourse - Discourse Segmentation - Unsupervised Discourse - Segmentation - Text Coherence - Reference Resolution –Phenomena– Features and algorithms - Pronominal Anaphora Resolution

UNIT V APPLICATIONS 9+6

Information Extraction – Named Entity Recognition - Relation Detection and Classification – Temporal and Event Processing - Template-Filling - Biomedical Information Extraction. Question Answering and Summarization -Information Retrieval -Factoid Question Answering - Summarization - Single and Multi-Document Summarization - Focused Summarization - Evaluation. Dialog and Conversational Agents – Properties of Human Conversations - Basic Dialogue Systems - VoiceXML - Information- State and Dialogue Acts - Markov Decision Process Architecture. Machine Translation –Issues in Machine Translation - Classical MT and the Vauquois Triangle -Statistical MT - Phrase-Based Translation Model - Alignment in MT –IBM Models – Evaluation

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TOTAL: 45+30=75 PERIODS

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OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the different linguistic components of given sentences.
- Design a morphological analyser for a language of your choice using finite state automata concepts.
- Implement the Earley algorithm for a language of your choice by providing suitable grammar and words.
- Use a machine learning algorithm for word sense disambiguation.
- Build a tagger to semantically tag words using WordNet.
- Design a business application that uses different aspects of language processing.

REFERENCES:

1. Jurafsky and Martin, “Speech and Language Processing”, Pearson Prentice Hall, Second Edition, 2008.
2. Christopher D. Manning and HinrichSchütze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
3. Stevan Bird, “Natural Language Processing with Python”, Shroff, 2009.
4. James Allen, “Natural Language Understanding”, Addison Wesley, Second Edition, 2007.
5. NitinIndurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, (Chapman& Hall/CRC Machine Learning & Pattern Recognition), Second Edition, 2010.
6. Alexander Clark, Chris Fox, Shalom Lappin, “The Handbook of Computational Linguistics and Natural Language Processing”, Wiley-Blackwell, 2012.

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BD5002 **LINKED OPEN DATA AND ITS APPLICATIONS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the computational aspects of creation, storage & retrieval of Linked Open Data (LOD).
- To understand the need of RDF & SPARQL in querying LOD.
- To understand the publishing & consumption of LOD in WWW.
- To design recommendation systems applicable to LOD.
- To learn how to handle large scale machine learning for LOD.

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UNIT I INTRODUCTION **9**

Introduction–Principles of Linked Data– URIs, RDF data model, RDF Serialisation, Relationship links, Identity links, Vocabulary Links– Linked Data Design Considerations–Web of Data– Bootstrapping – Topology

UNIT II RDF & SPARQL **9**

RDF database systems–RDF and Semantic Web – Encoding, storage, indexing – Query processing – reasoning– SPARQL– Improving Linked Data quality

UNIT III PUBLISHING & CONSUMING LINKED OPEN DATA **9**

Publishing Linked Data – Publishing patterns – Recipes for publishing – Consuming Linked– Data Querying Linked Data Architecture of Linked Data Applications - Advertising on the web: Issues in Online Advertising - Online Algorithms - The Matching Problem

UNIT IV RECOMMENDATION SYSTEMS **9**

Recommendation systems: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction

UNIT V LARGE SCALE MACHINE LEARNING **9**

Mining social network graphs – Social Networks as Graphs, Clustering of Social-Network Graphs, Discovery of Communities, Partitioning of Graphs, Overlapping Communities, Simrank, Counting Triangles, Large scale machine learning– Machine-Learning Model, Perceptrons, SVM, Learning from Nearest Neighbours

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Create, Store & Retrieve LOD.
- Design methodologies for publishing & consuming LOD.
- Use RDF & SPARQL to query LOD.
- Design recommendation algorithms based on LOD.
- Design algorithms for handling LOD using large scale machine learning.

REFERENCES:

1. Tom Heath, Christian Bizer, “Linked Data: Evolving the Web into a Global Data Space”, Morgan & Claypool Publishers, 2011.
2. David Wood, “Linking Government Data”, Springer Science & Business Media, 2011.
3. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
4. Olivier Curé, Guillaume Blin, “RDF Database Systems: Triples Storage and SPARQL Query Processing”, Morgan Kaufmann, 2014.
5. Bob DuCharme, “Learning SPARQL”, "O'Reilly Media, Inc.", 2011.

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BD5003 **DATA INTENSIVE COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basics of the various database systems including databases for Big data.
- To learn about the architecture of data intensive computing.
- To learn about parallel processing for data intensive computing.
- To learn about Security in Data Intensive Computing Systems.
- To learn about the applications that involve Data intensive computing.

UNIT I INTRODUCTION **9**

Introduction to Distributed systems – Databases Vs. File Systems - Distributed file systems(HDFS) – Distributed Machine-Learning System - Data Parallelism – Characteristics -Hadoop –Execution Engines -Map Reduce- Distributed Storage System for Structured Data – NoSQL databases - Casandra, Mongo DB-Developing a Distributed Application

UNIT II ARCHITECTURES AND SYSTEMS **9**

High performance Network Architectures for Data intensive Computing – Architecting Data Intensive Software systems – ECL/HPCC: A Unified approach to Big Data – Scalable storage for Data Intensive Computing - Computation and Storage of scientific data sets in cloud- Stream Data Model - Architecture for Data Stream Management-Stream Queries –Sampling Data in a Stream Filtering Streams

UNIT III TECHNOLOGIES AND TECHNIQUES **9**

Load balancing techniques for Data Intensive computing – Resource Management for Data Intensive Clouds – SALT - Parallel Processing, Multiprocessors and Virtualization in Dataintensive Computing - Challenges in Data Intensive Analysis and Visualization - Large-Scale Data Analytics Using Ensemble Clustering - Ensemble Feature Ranking Methods for Data Intensive Computing Application - Record Linkage Methodology and Applications- Semantic Wrapper

UNIT IV SECURITY **9**

Security in Data Intensive Computing Systems - Data Security and Privacy in Data-Intensive Supercomputing Clusters - Information Security in Large Scale Distributed Systems -Privacy and Security Requirements of Data Intensive Applications in Clouds

UNIT V APPLICATIONS AND FUTURE TRENDS **9**

Cloud and Grid Computing for Data Intensive Applications -Scientific Applications - Bioinformatics Large Science Discoveries - Climate Change - Environment - Energy - Commercial Applications - Future trends in Data Intensive Computing

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Design applications that involve data intensive computing.
- Suggest appropriate architecture for data intensive computing systems.
- Decide on the appropriate techniques of Map Reduce, Mongo DB, for the differentApplications.
- Identify parallel processing techniques for data intensive computing.
- Decide on the various security techniques that are necessary for data intensiveapplications.

REFERENCES:

1. Tom White, “Hadoop: The Definitive Guide”, O'Reilly Media. October 2010.
2. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom., “Database Systems: The Complete Book”, Pearson, 2013.
3. Furht, Borko, Escalante, Armando, “Handbook of Data Intensive Computing”, Springer 2011.

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CP5074 **COGNITIVE SCIENCE** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn the basics of Cognitive Science with focus on acquisition, representation and use of knowledge by individual minds, brains, and machines.
- To study the mind and intelligence, embracing psychology, artificial intelligence, neuroscience and linguistics.
- To understand the role of neuro-science in the cognitive field.
- To learn about computational models for semantic processing.
- To appreciate the role of reasoning in cognitive processing.

UNIT I INTRODUCTION TO COGNITIVE SCIENCE 9

The Cognitive view –Some Fundamental Concepts – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science – Artificial Intelligence: Knowledge representation -The Nature of Artificial Intelligence - Knowledge Representation – Artificial Intelligence: Search, Control, and Learning

UNIT II COGNITIVE PSYCHOLOGY 9

Cognitive Psychology – The Architecture of the Mind - The Nature of Cognitive Psychology- A Global View of The Cognitive Architecture- Propositional Representation- Schematic Representation- Cognitive Processes, Working Memory, and Attention- The Acquisition of Skill- The Connectionist Approach to Cognitive Architecture

UNIT III COGNITIVE NEUROSCIENCE 9

Brain and Cognition Introduction to the Study of the Nervous System – Neural Representation – Neuropsychology- Computational Neuroscience - The Organization of the mind - Organization of Cognitive systems - Strategies for Brain mapping – A Case study: Exploring mindreading

UNIT IV LANGUAGE ACQUISITION, SEMANTICS AND PROCESSING MODELS 9

Milestones in Acquisition – Theoretical Perspectives- Semantics and Cognitive Science – Meaning and Entailment – Reference – Sense – Cognitive and Computational Models of Semantic Processing – Information Processing Models of the Mind- Physical symbol systems and language of thought- Applying the Symbolic Paradigm- Neural networks and distributed information processing- Neural network models of Cognitive Processes

UNIT V HIGHER-LEVEL COGNITION 9

Reasoning – Decision Making – Computer Science and AI: Foundations & Robotics – New Horizons - Dynamical systems and situated cognition- Challenges – Emotions and Consciousness – Physical and Social Environments – Applications

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Explain and analyse the methods of knowledge representation in cognitive processing.
- Be proficient in designing cognitive architectures.
- Understand the connection between brain and cognition.
- Apply neural network models to cognition.
- Apply reasoning & decision making to design dynamic systems.

REFERENCES:

1. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, Jay L. Garfield and Edwin L. Rissland, “Cognitive Science: An Introduction”, Second Edition, MIT press 1995.
2. José Luis Bermúdez, “Cognitive Science: An Introduction to the Science of the Mind”, Cambridge University Press, New York, 2014.
3. Robert L. Solso, Otto H. MacLin and M. Kimberly MacLin, “Cognitive Psychology, Pearson Education, 2007.
4. J. Friedenberg and G. Silverman, “Cognitive Science: An Introduction to the Study of Mind”, 2011.
5. Steven Pinker, “How the Mind Works”, W. W. Norton & Company; Reissue edition, 2009.
6. Carolyn Panzer Sobel and Paul Li, “Cognitive Science: An Interdisciplinary Approach”, 2013.
7. Paul Thagard, “Mind: Introduction to Cognitive Science”, 2nd Edition, MIT Press, 2005.

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BD5004 **DATA VISUALIZATION** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand how to accurately represent voluminous complex data set in web and from other data sources.
- To understand the methodologies used to visualize large data sets.
- To understand the various process involved in data visualization.
- To get used to with using interactive data visualization.
- To understand the different security aspects involved in data visualization.

UNIT I INTRODUCTION **9**

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT II VISUALIZING DATA METHODS **9**

Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

UNIT III VISUALIZING DATA PROCESS **9**

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder ,Asynchronous Image Downloads, Advanced Web Techniques, Using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV INTERACTIVE DATA VISUALIZATION **9**

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3, .js, tablo.

UNIT V SECURITY DATA VISUALIZATION **9**

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the representation of complex and voluminous data.
- Design and use various methodologies present in data visualization.
- Understand the various process and tools used for data visualization.
- Use interactive data visualization to make inferences.
- Discuss the process involved and security issues present in data visualization.

REFERENCES:

1. Scott Murray, “Interactive data visualizationfor the web”, O"Reilly Media, Inc., 2013.
2. Ben Fry, “Visualizing Data”, O"Reilly Media, Inc., 2007.
3. Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”, NoStarch Press Inc, 2007.

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BD5005 **REAL TIME DATA STREAMING** **L T P C**
3 0 0 3

OBJECTIVES:

- Introduce the students with data stream models and to present the use cases of stream processing.
- Present algorithmic techniques for stream processing including random sampling, graph sketches, and merge-and-reduce.
- Present current techniques on monitoring distributed data streams.
- Provide practical perspective on analysing data stream systems.
- Show their application to problems such as subgraph counting, graph connectivity, random sampling from graphs, graph matchings, etc.

UNIT I INTRODUCTION TO DATA STREAMS 9

Data stream models - basic streaming methods– applications. Change detection - maintaining histograms from data streams

UNIT II STREAM MINING ALGORITHMS 9

Evaluating streaming algorithms - learning from data streams - evaluation issues – open issues. Clustering from data streams - clustering examples - clustering variables. Frequent pattern mining - frequent Itemset mining - heavy hitters - mining frequent item set from data streams - sequence pattern mining.

UNIT III CLASSIFICATION METHODS IN DATA STREAMS 9

Decision trees from data streams - very fast decision tree algorithm (VFDT) – extensions - OLIN: info-fuzzy algorithms. Novelty detection in data streams -learning and novelty - novelty detection as a one-class classification problem - learning new concepts - the online novelty and drift detection algorithms

UNIT IV ANALYSIS OF STREAM DATA 9

Multi-dimensional analysis of data - architecture for on-line analysis of data streams - stream data cube computation. Load shedding in data stream systems - load shedding for aggregation queries - load shedding in aurora - load shedding for sliding window joins - load shedding for classification queries

UNIT V ADVANCED CONCEPTS ON STREAM COMPUTING 9

Synopsis construction in data streams - sampling methods - wavelets – sketches – histograms. Join processing in data streams - indexing and querying data streams - dimensionality reduction and forecasting on streams - distributed mining of data streams

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the applicability and utility of different machine learning algorithms.
- Describe and apply current research trends in data-stream processing.
- Analyze the suitability of stream mining algorithms for data stream systems.
- Program and build stream processing systems, services and applications.
- Solve problems in real-world applications that process data streams.

REFERENCES:

1. Charu C. Aggarwal, “Data Streams: Models and Algorithms”, Kluwer Academic Publishers, Springer 2007 Edition.
2. Joao Gama, “Knowledge Discovery from Data Streams”, CRC Press, 2010.
3. Byron Ellis, “Real Time Analytics: Techniques to Analyze and Visualize Streaming Data”, John Wiley and Sons, 2014.
4. Shilpi Saxena, Saurabh Gupta, “Practical Real-time Data Processing and Analytics”, Pack publishing 2017.

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BD5006 BIG DATA ACQUISITION L T P C
3 0 0 3

OBJECTIVES:

- To understand the complexity and volume of Big Data and their challenges.
- To analyse the various methods of data collection.
- To comprehend the necessity for pre-processing Big Data and their issues.
- To understand predictive analytics and descriptive analytics.
- To understand and implement Big Data Analytics with data convergence and Business Maturity Model.

Attested

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UNIT I INTRODUCTION TO BIG DATA ACQUISITION 6

Big Data framework - fundamental concepts of Big Data management and analytics - Current challenges and trends in Big Data Acquisition.

UNIT II DATA COLLECTION AND TRANSMISSION 9

Big data collection- Strategies- Types of data sources- Structured vs Unstructured data- ELT vs ETL - storage infrastructure requirements -collection methods-log files- Sensors- Methods for acquiring network data (Libcap-based and zero-copy packet capture technology) -Specialized network monitoring softwares (Wireshark, Smartsniff and Winnetcap)- Mobile equipments- Transmission methods- Issues.

UNIT III DATA PRE-PROCESSING 9

Data pre-processing overview-Sampling - Missing Values - Outlier Detection and Treatment - Standardizing Data - Categorization - Weights of Evidence Coding - Variable Selection and Segmentation.

UNIT IV DATA ANALYTICS 12

Predictive Analytics: Regression, Decision Tree, Neural Networks - Descriptive Analytics: Association Rules, Sequence Rules, Survival Analysis: Survival Analysis Measurements, Kaplan Meir Analysis, Parametric Survival Analysis - Social Network Analytics: Social Network Learning- Relational Neighbor Classification.

UNIT V BIG DATA PRIVACY AND APPLICATIONS 9

Data Masking – Privately Identified Information (PII) -Privacy preservation in Big Data- Popular Big Data Techniques and tools- Map Reduce paradigm and the Hadoop system – Applications- Social Media Analytics- Recommender Systems- Fraud Detection.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Identify the various sources of Big Data.
- Apply several key big data technologies used for storage, analysis and manipulation of data.
- Design new algorithms for collecting Big Data from various sources.
- Design algorithms for pre-processing Big Data other than the traditional approaches.
- Design methodologies to extract data from structured and un-structured data for analytics.

REFERENCES:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications"**,** John Wiley & Sons, 2014
2. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung,Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.
3. Michael Minelli, Michele Chambers, AmbigaDhiraj ,"Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
4. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.

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BD5007 **TEXT PROCESSING AND MINING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basic issues and types of text mining.
- To appreciate the different aspects of text categorization and clustering.
- To understand the role played by text mining in Information retrieval and extraction.
- To appreciate the use of probabilistic models for text mining.
- To appreciate the current trends in text mining.

UNIT I INTRODUCTION **8**

Overview of text mining- definition- general architecture – algorithms – core operations – Pre-processing – types of problems- basics of document classification - information retrieval- clustering and organizing documents - information extraction - prediction and evaluation-textual information to numerical vectors -collecting documents- document standardization – tokenization-lemmatization-vector generation for prediction - sentence boundary determination -evaluation performance

UNIT II TEXT CATEGORIZATION AND CLUSTERING **10**

Text Categorization – definition – document representation – feature selection - decision tree classifiers - rule-based classifiers - probabilistic and naive bayes classifiers - linear classifiers-classification of linked and web data - meta-algorithms– clustering –definition- vector space models – distance - based algorithms - word and phrase-based clustering - semi-supervised clustering - transfer learning

UNIT III TEXT MINING FOR INFORMATION RETRIEVAL AND INFORMATION EXTRACTION **10**

Information retrieval and text mining- keyword search- nearest-neighbor methods- similarity- web-based document search – matching- inverted lists- evaluation. information extraction - architecture - co-reference - named entity and relation extraction- template filling and database construction – applications. inductive -unsupervised algorithms for information extraction. text summarization techniques - topic representation - influence of context - indicator representations - pattern extraction - Apriori algorithm – FP tree algorithm

UNIT IV PROBABILISTIC MODELS **9**

Probabilistic models for text mining -mixture models - stochastic processes in bayesian - nonparametric models - graphical models - relationship between clustering, dimension reduction and topic modeling - latent semantic indexing - probabilistic latent semantic indexing -latent dirichlet allocation- interpretation and evaluation - probabilistic document clustering and topic models - probabilistic models for information extraction - hidden markov models - stochastic context-free grammars - maximal entropy modeling - maximal entropy markov models -conditional random fields

UNIT V RECENT TRENDS **8**

Visualization approaches - architectural considerations - visualization techniques in link analysis - example- mining text streams - text mining in multimedia - text analytics in social media - opinion mining and sentiment analysis - document sentiment classification - opinion lexicon expansion - aspect-based sentiment analysis - opinion spam detection – text mining applications and case studies

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the different features that can be mined from text and web documents.
- Use available open source classification and clustering tools on some standard text data sets.
- Modify existing classification/clustering algorithms in terms of functionality or features used.

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- Design a system that uses text mining to improve the functions of an existing open source search engine.
- Implement a text mining system that can be used for an application of your choice.

REFERENCES:

1. Sholom Weiss, NitinIndurkhya, Tong Zhang, Fred Damerau "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Springer, paperback 2010.
2. Ronen Feldman, James Sanger," The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data",Cambridge University press, 2006.
3. Charu C. Aggarwal ,Cheng Xiang Zhai**, "**Mining Text Data", Springer; 2012.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√			√	√		
2.	√	√	√	√		√	√	√	
3.	√		√	√		√		√	√
4.	√		√	√	√	√		√	√
5.	√		√	√	√	√	√	√	√

BD5008 BIG DATA SECURITY LT P C
3 0 0 3

OBJECTIVES:

- To understand the mathematical foundations of security principles.
- To appreciate the different aspects of encryption techniques.
- To understand the role played by authentication in security.
- To understand the security concerns of big-data.
- To appreciate applications of security analytics.

UNIT I SYMMETRIC TECHNIQUES 9

Mathematics of symmetric cryptography : Modular Arithmetic, Euclid theorem, congruence, algebraic structures – Foundations of Modern cryptography – Model of cryptosystems – Classical encryption techniques : Substitution techniques, Transposition techniques and steganography - cipher models : stream cipher and block cipher design principles - Block cipher modes of operation - DES - DDES and TDES - strength of DES - AES – strength of AES – RC4 – Symmetric key distribution.

UNIT II ASYMMETRIC TECHNIQUES 9

Mathematics of symmetric cryptography: Primes, Primality Testing, Factorization, EulerToient Function, Fermat's and Euler's theorem, Discrete logarithm – Asymmetric key cipher : RSA cryptosystems & cryptanalysis – ElGamal cryptosystem – Elliptic curve arithmetic and cryptography – Asymmetric key distribution and management.

UNIT III MESSAGE AUTHENTICATION 9

Authentication requirements – Authentication functions – Message authentication codes(MAC) – Hash functions – Security of hash functions and MACS – MD5 Message Digest algorithm – Secure hash algorithm – Digital Signatures.

UNIT IV INTRODUCTION TO SECURITY ANALYTICS 9

Introduction to Security Analytics – Techniques in Analytics – Analysis in everyday life – Challenges in Intrusion and Incident Identification – Simulation and Security Process, Analytical Softwares and tools, Malware Analysis – static and dynamic analysis - Security Intelligence – Security Breaches.

UNIT V APPLICATIONS OF SECURITY ANALYTICS 9

Access Analytics – Analysis of Log file -Security analysis with text mining –Machine Learning and data mining applications for security: Intrusion detection and network anomaly detection. Big data analytics for security: Analyzing DDOS – Distributed Denial of Service attack: counter based method, and access pattern based method – Machine learning for Ransom ware detection and prevention.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- To use cryptographic security algorithms to secure big data in transmissions and storage
- To design algorithms in a secure manner for Big data applications
- To use available security practices in big-data computation.
- To use big-data analytics principles to build security applications.
- To detect security threats and vulnerabilities using security analytics

REFERENCES:

1. William Stallings, "Crpyptography and Network security: Principles and Practices", Pearson/PHI, 5th Edition, 2010.
2. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw Hill Education, 2nd Edition, 2010.
3. Douglas R. Stinson ,"Cryptography Theory and Practice ", Chapman & Hall/CRC, 3rd Edition, 2006.
4. Mark Talabis, Robert McPherson, I Miyamoto and Jason Martin, "Information Security Analytics: Finding Security Insights, Patterns, and Anomalies in Big Data", Syngress Media, U.S., 2014.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√		√			√	√	√	
2.	√		√	√		√		√	√
3.	√		√	√		√	√		
4.	√		√	√		√	√	√	√
5.	√		√	√		√	√	√	

SE5073 **SENTIMENT ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the need for sentiment analysis.
- To explore the various methodologies involved in text sentiment classification.
- To learn the fusion of Natural Language processing with sentiment analysis.
- To explore available sentiment summarization methods.
- To learn the various tools used for sentiment analysis.

UNIT I INTRODUCTION **9**

Need for Sentiment Analysis – Problem of Sentiment Analysis - Subjectivity – Stance – Words to Discourse – Pragmatics – Natural Language Processing issues – Opinion Definition – Sentiment analysis Tasks – Opinion Summarization – Types of opinion – Subjectivity and emotion – Author and Reader Standpoint

UNIT II DOCUMENT SENTIMENT CLASSIFICATION **9**

Sentiment Classification Using Supervised Learning – Unsupervised Learning – Rating Prediction – Cross-Domain Sentiment Classification – Cross-Language Sentiment Classification – Sentence Subjectivity and Classification – Subjectivity Classification – Sentence Sentiment Classification – Conditional Sentences - Sarcastic Sentences – Cross-Language Subjectivity and Sentiment Classification – Discourse Information for Sentiment Classification

UNIT III ASPECT BASED SENTIMENT ANALYSIS **9**

Aspect Sentiment Classification – Rules Of Opinions and Compositional Semantics – Aspect Extraction – Identifying Resource Usage Aspect – Simultaneous Opinion Lexicon Expansion and Aspect Extraction – Grouping Aspects Into Categories – Entity, Opinion Hold And Timing Extraction – Coreference Resolution and Word Sense Disambiguation – Aspect and Entity Extraction - Sentiment Lexicon Generation – Corpus Based Approach – Dictionary Based Approach – Desirable and Undesirable Facts

UNIT IV OPINION SUMMARIZATION **9**

Aspect Based Opinion Summarization – Improvements to Aspect-Based Opinion Summarization – Contrastive View Summarization – Traditional Summarization – Analysis of Comparative Opinions – Identifying Comparative Sentences – Identifying Preferred Entities – Opinion Search and Retrieval – Opinion Spam Detection – Types of Spam Detection - Supervised and Un-Supervised Approach – Group Spam Detection

UNIT V TOOLS FOR SENTIMENT ANALYSIS **9**

Detecting Fake or Deceptive Opinions - Quality of Review – Quality as Regression Model – Other Methods – Case Study – Sentiment Analysis Applications – Tools for Sentiment Analysis – Semantria – Meltwater – Google Analytics – Face Book Insights – Tweetstats.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Apply the various algorithms to perform opinion mining and classification.
- Learn various supervised and unsupervised machine learning methods for sentiment analysis.
- Generate sentiment lexicons by applying NLP techniques.
- Solve problems on opinion summarization.
- Learn to use tools for sentiment analysis.

REFERENCES:

1. Bing Liu, “Sentiment Analysis and Opinion Mining”, Morgan and Claypool publishers, 2012.
2. Bing Liu, “Sentiment Analysis – Mining opinion, Sentiments and Emotions”, Cambridge University Press, 2015.
3. Bo Pang and Lillian Lee, “Opinion Mining and Sentiment Analysis”, Now Publishers Inc,2008.
4. Roy De Groot, “Data mining for Tweet Sentiment Classification – Twitter Sentiment Analysis”, LAP Lambert Academic Publishing, 2012.

CO	PO						PSO		
	1	2	3	4	5	6	1	2	3
1.	√			√	√	√	√		
2.	√	√		√		√	√		
3.			√		√	√		√	
4.	√		√	√	√				√
5.		√		√		√		√	

OE5091 **BUSINESS DATA ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
  - Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 **INDUSTRIAL SAFETY** **LT P C**
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION **9**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

OE5093 **OPERATIONS RESEARCH** **L T P C**
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

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OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

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REFERENCES:

1.Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5			✓	✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY** **L T P C**

3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION **9**

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY **9**

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

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1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING **L T P C 2 0 0 0**

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX5092 DISASTER MANAGEMENT L T P C
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

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UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

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AX5093 **SANSKRIT FOR TECHNICAL KNOWLEDGE** **L T P C**
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING
1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 CONSTITUTION OF INDIA L T P C 2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

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UNIT II

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

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