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Learn Beyond

KPR INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous Institution)
M.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Curriculum

SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P19MA102	Probability, Statistics and Graph Theory	FC	3	1	0	4
2	P19CS101	Modern Operating Systems	PC	3	0	0	3
3	P19CS102	Agile Software Development and Usability Engineering	PC	3	0	0	3
4	P19CS103	Machine Learning	PC	3	0	0	3
5	-	Professional Elective I	PE	3	0	0	3
6	P19CS104	Research Methodology	FC	3	0	0	3
PRACTICAL(S)							
7	P19CS105	Design and Analysis of Algorithms Lab	PC	0	0	2	2
			TOTAL	18	1	2	21

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P19CS201	Protocol Design and Verification	PC	3	0	0	3
2	P19CS202	Internet of Things	PC	3	0	0	3
3	P19CS203	Big Data Analytics	PC	3	0	0	3
4	-	Professional Elective II	PE	3	0	0	3
5	-	Professional Elective III	PE	3	0	0	3
6	-	Professional Elective IV	PE	3	0	0	3
PRACTICAL(S)							
7	P19CS204	Data Analytics Laboratory	PC	0	0	2	2
8	P19CS205	Mini Project	EEC	0	0	2	2
9	P19CS206	Internship	EEC	-	-	-	1
			TOTAL	18	0	4	23

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SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	-	Professional Elective V	PE	3	0	0	3
2	-	Professional Elective VI	PE	3	0	0	3
PRACTICAL(S)							
3	P19CS301	Project Work Phase I	EEC	0	0	12	6
			TOTAL	6	0	12	12

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
PRACTICAL(S)							
1	P19CS401	Project Work Phase II	EEC	0	0	24	12
			TOTAL	0	0	24	12

SUB. TOTAL CREDITS: 67
INTERNSHIP: 01
TOTAL NO. OF CREDITS: 68

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PROFESSIONAL ELECTIVES (PE)

STREAM 1: NETWORKING AND DATABASE

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19CSP03	Information Retrieval Techniques	3	0	0	3
2	P19CSP28	NoSQL Databases	3	0	0	3
3	P19CSP08	Web Engineering	3	0	0	3
4	P19CSP09	Formal Models of Software System	3	0	0	3
5	P19CSP11	Software Defined Networks	3	0	0	3
6	P19CSP14	Fault Tolerant Computing Systems	3	0	0	3
7	P19CSP25	Information Storage Management	3	0	0	3
8	P19CSP26	Social Network Analysis	3	0	0	3

STREAM 2: ARTIFICIAL INTELLIGENCE AND COMPUTER VISION

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19CSP04	Image Processing and Analysis	3	0	0	3
2	P19CSP05	Real Time Systems	3	0	0	3
3	P19CSP10	Data Visualization	3	0	0	3
4	P19CSP13	Parallel Programming Paradigms	3	0	0	3
5	P19CSP15	Natural Language Processing	3	0	0	3
6	P19CSP22	Computer Vision	3	0	0	3
7	P19CSP23	Speech Processing and Synthesis	3	0	0	3
8	P19CSP27	Bio-inspired Computing	3	0	0	3

STREAM 3: CURRENT TRENDS

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19CSP01	Cloud Computing Technologies	3	0	0	3
2	P19CSP02	Mobile and Pervasive Computing	3	0	0	3
3	P19CSP29	Block chain Technologies	3	0	0	3
4	P19CSP30	Mixed Reality	3	0	0	3
5	P19CSP31	Data Science	3	0	0	3
6	P19CSP19	Cyber Physical Systems				
7	P19CSP20	Deep Learning	3	0	0	3
8	P19CSP32	User Experience Design	3	0	0	3

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EMPLOYABILITY ENHANCEMENT COURSES (EEC) – PRACTICAL COURSES AND PROJECT WORK

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P19CS205	Mini Project	EEC	0	0	2	2
2	P19CS301	Project Work Phase I	EEC	0	0	12	6
3	P19CS401	Project Work Phase II	EEC	0	0	24	12

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SEMESTER-1

P19MA102	PROBABILITY,STATISTICS AND GRAPH THEORY	Category: FC			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Probability and Queuing Theory/ Statistics

COURSE OBJECTIVES:

- To understand the basics of probability, random variables, standard distributions, and statistics
- To be familiar the applications of graph theory for real world problems
- To learn the fundamentals of machine learning

UNIT I PROBABILITY 11

Discrete time Markov Chain –Computation of n-step Transition Probabilities– State Classification and Limiting Probabilities – Distribution of Times between State Changes–Markov Modulated Bernoulli Process –Irreducible Finite Chains with Aperiodic States.

UNIT II SAMPLING DISTRIBUTION 11

Random samples –sampling distributions of estimators – Methods of Moments and Maximum Likelihood.

UNIT III STATISTICS 11

Statistical inference–Introduction to multivariate statistical models: regression and classification problems–principal components analysis –the problem of over fitting model assessment.

UNIT IV GRAPH THEORY 11

Isomorphism – Planar graphs–Graph coloring–Hamilton circuits and Euler cycles–Permutations and Combinations with and without repetition.

UNIT V MACHINE LEARNING IN BIOINFORMATICS 11

Support Vector Machine– Prediction of Protein Secondary Structure of DNA sequence – Genome analysis with software tools–Case Study.

Contact Periods:

Lecture: 55 Periods Tutorial: 5 Periods Practical: – Periods Total: 60 Periods

REFERENCES:

1. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley & Sons 2016.
2. Alan Tucker, Applied Combinatory, 6th Edition John Wiley & Sons, 2012.
3. PierriBaldi and Soren Brunak, Bioinformatics-Machine Learning Approach, 2nd Edition (EBook).
4. John Vince, Foundation Mathematics for Computer Science, Springer.
5. Devore, J. L. Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning, 2014.
6. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan and Sons, New Delhi, 2001.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Compute transition probabilities and limiting probabilities of various process	Apply
CO2	Find the sampling distributions of estimators and to estimate the moments	Apply
CO3	Identify the methods of statistical inference, to apply principal component analysis and to solve over fitting model	Apply
CO4	Apply the knowledge of graph theory in to model a real time problem	Apply
CO5	Use machine learning techniques to analyze genome structure	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	-	-	-	-	-
CO2	3	1	1	-	-	-	-	-	2	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	1	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	2	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	2	-	-	-	-	-
CO	3	2	1	-	-	-	-	-	1	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CS101	MODERN OPERATING SYSTEMS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Operating System

COURSE 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 mobile and cloud operating systems

UNIT I DISTRIBUTED SYSTEMS 9

Introduction of Distributed Computing System – Distributed Computing System Models – Distributed Operating Systems – Issues In Distributed Operating Systems.

UNIT II SYNCHRONIZATION 9

Clock Synchronization – Event Ordering – Mutual Exclusion – Deadlock Modelling – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection and Recovery - Election Algorithms.

UNIT III DISTRIBUTED SHARED MEMORY 9

General Architecture – Structure of Shared Memory Space – Issues in design and implementation of Distributed Shared Memory - Consistency Models – Replacement Strategy – Thrashing.

UNIT IV DISTRIBUTED FILE SYSTEMS 9

Distributed File Systems – File Models – File Accessing Models – File Sharing Semantics – File Caching Semantics – File Replication – Atomic Transactions – Case Studies.

UNIT V CLOUD AND MOBILE OS 9

Cloud OS - Introduction to Cloud Computing, Features of Cloud OS, Case Studies - Mobile OS - Introduction to Mobile Computing, Features of Mobile OS, Case Studies.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Pradeep K. Sinha, Distributed Operating Systems Concepts and Design, Prentice Hall of India Private Limited, 2008.
2. M. Singhal, N. Shivaratri, Advanced Concepts in Operating Systems, Tata McGraw- Hill, 2008.
3. Andrew S. Tanenbaum, Maarten Van Steen, Distributed Systems Principles and Paradigms, Pearson Education, 2007.
4. Pattnaik, Prasant, Kumar, Mall, Rajib, Fundamentals of Mobile Computing, PHI, 2012.
5. Asoke K Talukder, Roopa Yavagal, Mobile Computing - Technology, Applications, and Service Creation – 1st edition, McGraw-Hill, 2006.
6. Thomas A. Limoncelli Strata R. Chalup, Christina J. Hogan, The Practice of Cloud System Administration: Designing and Operating Large Distributed Systems, Addison-Wesley Professional; 1st Edition, 2014.
7. Thomas Erl, Ricardo Puttini, ZaighamMahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall; 1st Edition, 2013.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the concepts of operating system to a distributed environment and identify the features specific to distributed systems	Apply
CO2	Apply the process synchronization concepts for the given scenario in distributed environment	Apply
CO3	Illustrate the different consistency model, replacement strategy in distributed shared memory (DSM)	Understand
CO4	Apply the distributed file system concepts for a given scenario	Apply
CO5	Identify the role of operating system in cloud and mobile environment	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	2	-	1	-	-	-	-	-	1	-	-	-
CO	2	2	1	-	-	-	-	-	-	-	1	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CS102	AGILE SOFTWARE DEVELOPMENT AND USABILITY ENGINEERING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Software Engineering

COURSE OBJECTIVES:

- To understand agile software development process, planning and management
- To use advanced software testing techniques
- To understand process of usability engineering

UNIT I AGILE SOFTWARE DEVELOPMENT 9

Agile vs Traditional models – Agile manifesto– Agile methodologies– DSDM–FDD–Crystal–Scrum–Agile Modeling– Extreme Programming– Lean Software Development– Unified Process (UP).

UNIT II MANAGING AND PLANNING AGILE PROJECTS 9

Gathering software requirements –Eliciting requirements from users– Adopting Agile values–writing user stories. Planning Agile Projects– Prioritizing and estimating work–organizing projects by features– dividing features into tasks.

UNIT III REPORTING TEAM PROGRESS 9

Documenting work completed with backlogs– tracking progress with burn down charts– Projecting project costs and completion dates– Monitoring work in progress with task boards.

UNIT IV TEST-DRIVEN DEVELOPMENT AND USABILITY ENGINEERING 9

Unit, integration, system and Acceptance testing– exploratory testing–automated and manual testing, exercising boundary conditions– driving development through constant testing. **Usability engineering:** Usability engineering life cycle– Human-computer interaction and user interface design– Importance of interface design in software design– benefits of good interface design.

UNIT V USABILITY ENGINEERING 9

User interface development - Needs analysis– Systems analysis– User profiling– Preliminary design– Rapid prototyping. GUI design–navigation and information hierarchy– user interaction diagrams– GUI design heuristics– usability testing. **Usability across interface types:** Web–Desktop– Mobile– touch and video games.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Mike Holcombe, Running an Agile Software Development Project, Wiley, 2008.
2. Laura M. Leventhal, Julie A. Barnes, Usability Engineering: Process, Products, and Examples, Pearson/Prentice Hall, 2008.
3. Orit Hazzan, Yael Dubinsky, Agile software engineering, Springer, 2014.
4. Jakob Nielsen, Usability Engineering, Academic Press, 1993.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Write user stories for given software specification.	Understand
CO2	Plan iterations based on relative effort and business value	Apply
CO3	Create backlogs and burn-down charts to monitor progress of a project	Apply
CO4	Increase quality with test-driven development	Apply
CO5	Design an interface by applying usability guidelines and standards for given system development problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	2	2	2	1	-	-	-
CO2	3	3	3	-	3	-	-	-	2	2	1	-	-	-
CO3	3	3	3	-	3	-	-	2	2	2	1	-	-	-
CO4	3	3	3	2	3	-	-	-	2	2	1	-	-	-
CO5	3	3	3	2	3	-	-	2	2	2	1	-	-	-
CO	3	3	3	2	2	-	-	2	2	2	1	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CS103	MACHINE LEARNING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Principles of data mining

COURSE OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques and graphical models of machine learning algorithms

UNIT I INTRODUCTION 9

Introduction – Probability-Review, Designing a Learning system. Supervised learning– K-NN– Decision trees and rule learning– Naïve Bayes algorithm–Linear regression– Logistic regression– The Perceptron Algorithm– Neural Networks and Belief Networks–SVMs and Margin Classifiers– SVM: duality and kernels.

UNIT II COMPUTATIONAL LEARNING THEORY 9

Introduction– PAC learning– Mistake Bounds (Find-S, Halving Algorithm)– Weighted Majority Algorithm– Complexity for infinite hypotheses spaces: VC dimension for Neural Networks.

UNIT III UNSUPERVISED LEARNING 9

Clustering– K-means – EM Algorithm- Mixtures of Gaussians. The Curse of Dimensionality – Dimensionality Reduction – Factor analysis – Principal Component Analysis – Probabilistic PCA– Independent components analysis.

UNIT IV REINFORCEMENT LEARNING 9

Q-learning– Nondeterministic rewards and actions– Temporal difference learning–Single state case– elements of reinforcement learning – Model-based learning – Generalization – Partially observable states.

UNIT V SCALABLE LEARNING AND APPLICATIONS 9

Practical aspects of implementing parallel Machine Learning methods– Biotechnology– NLP–Image processing.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Christopher M.Bishop, Pattern recognition and machine learning, Springer, 2007.
2. Tom M. Mitchell, Machine learning, McGraw Hill, 1997.
3. Kevin Murphy, Machine Learning - A Probabilistic Perspective, Adaptive Computation and Machine Learning, MIT Press, 2012.
4. Ethem Alpaydin, Introduction to machine learning, The MIT Press, 2004.
5. Stephen Marsland, Machine learning: An algorithmic perspective, CRC, 2009.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the steps involved in designing a machine learning algorithm	Understand
CO2	Construct training and prediction algorithms for classification using decision trees, artificial neural networks and Support Vector Machines	Apply
CO3	Construct learning algorithms using Bayesian probabilistic models for complex applications.	Apply
CO4	Illustrate the fundamentals of computational learning theory with an understanding of the mistake bounds	Understand
CO5	Construct learning algorithms which involves linear regression with a comprehension of regularization, bias-variance and evidence approximation	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	1	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	1	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	2	-	1	-	-	-	-	-	-	-	-
CO	3	2	1	1	-	1	-	-	-	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CS104	RESEARCH METHODOLOGY	Category: FC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand basic concepts of research and methodologies
- To select and define appropriate research problem and parameters
- To write a research report and thesis

UNIT I MEANING OF RESEARCH - FUNCTION OF RESEARCH 9

Meaning of Research – Function of Research – Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences – Inter Disciplinary Research. Factors which hinder Research – Significance of Research – Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

UNIT II IDENTIFICATION OF RESEARCH PROBLEM 9

Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem – Source of problems – Personal consideration.

UNIT III RESEARCH DESIGN 9

Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design. Different research designs – Basic principles of experimental designs – Computer and internet in designs.

UNIT IV INTERPRETATION AND REPORT WRITING 9

Meaning and Technique of interpretation – Precautions in interpretation – Significance of report writing – Different steps in writing a report – Layout of a Research report. Types of report – Mechanics of writing a research report – Precautions for writing a research report – Conclusion.

UNIT V STATISTICAL TECHNIQUES AND TOOLS 9

Introduction of statistics – Functions – Limitations – Measures of central tendency - Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete serious and continuous serious) – Correlation - Regression – Multiple Regression. Sampling distribution – Standard error – Concept of point and interval estimation – Level of significance – Degree of freedom – Analysis of variance – One way and two way classified data – 'F'-test.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya Press, 1976.
2. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.
3. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
4. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
5. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi, 1999.
6. Statistical Methods, G.W. Snedecor and W.G. Cochrans, Lowa state University Press, 1967.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the functions of research and process involved in literature review	Understand
CO2	Formulate and discuss research problem	Apply
CO3	Frame different research design methodologies	Apply
CO4	Write research reports by following research ethics	Apply
CO5	Utilize sampling, statistical techniques and tools for effective reporting	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	1	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	2	-	-	-	2	-	-	-	2	-	-
CO5	3	2	-	2	1	-	-	-	-	-	-	2	-	-
CO	3	1	-	1	1	-	-	1	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CS105	DESIGN AND ANALYSIS OF ALGORITHMS LAB	Category: PC			
		L	T	P	C
		0	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To implement basic algorithms of data structure
- To analyze the performance of algorithms

List of Experiments:

1. Crossword puzzles as Constraint Satisfaction problems
2. Graph coloring problem by backtracking and constraint propagation (using heuristics)
3. Shortest path in multi-stage graph using dynamic programming
4. Ford–Fulkerson algorithm to compute the maximum flow in a graph
5. Maximum clique problem using branch and cut method
6. Boyer–Moore string search algorithm for substring search
7. Implement any two clock synchronization algorithms and compare their performances. (Berkeley algorithm, Cristian's algorithm, Intersection algorithm, Marzullo's algorithm)
8. Lamport's distributed mutual exclusion algorithm
9. Banker's algorithm for deadlock avoidance
10. Approximation algorithm for the problems like Graph coloring, Vertex cover problem, maximal flow, shortest path problems, maximum subsequence generation etc.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Develop algorithms on encryption, decryption and distributed mutual exclusion and deadlock concepts	Apply
CO2	Develop approximation, randomization, linear and non-linear algorithms for various problems like scheduling, graph, network, string and subsequence problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	1	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	1	-	-	-	-	-
CO	3	2	2	-	-	-	-	-	-	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER-II

P19CS201	PROTOCOL DESIGN AND VERIFICATION	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn about process synchronization
- To understand the working of basic network protocols with protocol encoding
- To study the evolution made in network security mechanisms

UNIT I INTRODUCTION 9

CSP Descriptions and Proof Rules – Processes and Process Synchronization – Channel History Semantics –Failure Semantics–Protocols and Services – Providing a service-Service Features - OSI and other layered architectures.

UNIT II BASIC PROTOCOL MECHANISMS 9

Sequence Error and Flow control – change of service- Multiplexing – splitting –Segmenting – Reassembly – Prioritization- Multipeer Consensus – Reliable broadcasts – Election – Commitment – Byzantine Agreement – Clock Synchronization.

UNIT III SECURITY 9

Crypto systems – Integrity – Digital Signature – Entity Authentication –Key Exchange - Naming Addressing and Routing – General Principle – Addressing Structures – routing – Congestion..

UNIT IV PROTOCOL ENCODING 9

Simple binary encoding – TLV –ASN.1 – ASCII Encoding –Protocols in the OSI Lower Layers – Data Link Layer– Network layer –Transport Layer.

UNIT V APPLICATION SUPPORT PROTOCOLS 9

Session Layer- Presentation Layer –Application Layer – Commitment –Concurrency and recovery - Client Server Systems– Security Middle ware – Application Protocols – FTP – Distributed Transaction Processing Notation – Data types Inference Rules.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Gerard J. Holzmann, Design and Validation of Computer Protocols, Prentice Hall; 1stedition.
2. König, Hartmut, Protocol Engineering, ISBN 978-3-642-29145-6, Springer-Verlag Berlin Heidelberg.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply CSP descriptions and rules and synchronize services	Apply
CO2	Apply basic protocol Mechanisms for multiplexing and segmenting	Apply
CO3	Achieve integrity by adopting integrity and authentication	Apply
CO4	Compare and contrast and select relevant encoding mechanisms	Understand
CO5	Compare and contrast distributed transaction processing protocols	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO	3	2	1	1	-	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CS202	INTERNET OF THINGS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things and its protocols
- To build a small low cost embedded system using Raspberry Pi
- To apply the concept of Internet of Things in the real world scenario

UNIT I INTRODUCTION TO IoT 9

Internet of Things – Physical Design- Logical Design– IoT Enabling Technologies – IoT Levels &Deployment Templates –Domain Specific IoTs – IoT and M2M –IoT System Management with NETCONF–YANG–IoT Platforms Design Methodology.

UNIT II IoT ARCHITECTURE 9

M2M high–level ETSI architecture – IETF architecture for IoT – OGC architecture – IoT reference model –Domain model – information model – functional model – communication model – IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT–Efforts–M2M and WSN Protocols–SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol Modbus –Zigbee Architecture - Network layer – 6LowPAN – CoAP– Security.

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

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

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints – Applications – Asset management, Industrial automation, smartgrid, Commercial building automation, Smart cities – participatory sensing – Data Analytics for IoT Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT – Amazon Web Services for IoT.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

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

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the fundamentals of IoT design methodology	Understand
CO2	Explain the architecture of various IoT models	Understand
CO3	Analyze various protocols for IoT	Analyze
CO4	Design a portable IoT using Rasperry Pi	Apply
CO5	Apply the concept of Internet of Things in the real-world scenario	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO	3	2	1	1	-	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

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P19CS203	BIG DATA ANALYTICS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks and data analysis methods
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT I INTRODUCTION TO BIG DATA 9

Big Data Definition, Characteristic Features Big Data Applications –Big Data vs Traditional Data – Risks of Big Data –Structure of Big Data – Challenges of Conventional Systems – Web Data Evolution of Analytic Scalability – Evolution of Analytic Processes, Tools and methods – Analysis vs Reporting – Modern Data Analytic Tools.

UNIT II HADOOP FRAMEWORK 9

Distributed File Systems – Large-Scale File System Organization HDFS concepts – Map Reduce Execution, Algorithms using Map Reduce, Matrix–Vector Multiplication Hadoop YARN.

UNIT III DATA ANALYSIS 9

Statistical Methods: Regression modelling, Multivariate Analysis – Classification: SVM& Kernel Methods – Rule Mining –Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data – Predictive Analytics Data analysis using R.

UNIT IV MINING DATA STREAMS 9

Streams: Concepts Stream Data Model and Architecture – Sampling data in a stream – Mining Data Streams and Mining Time-series data – Real Time Analytics Platform (RTAP) Applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V BIG DATA FRAMEWORKS 9

Introduction to NoSQL Aggregate Data Models Hbase: Data Model and Implementations Hbase Clients Examples. Cassandra: Data Model Examples Cassandra Clients Hadoop Integration. Pig Grunt Pig Data Model Pig Latin developing and testing Pig Latin scripts. Hive Data Types and File Formats HiveQL Data Definition HiveQL Data Manipulation HiveQL Queries.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiely and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Micheal Berthold, David J. Hand, "Intelligent Data Analysis", Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

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6. Richard Cotton, "Learning R A Step-by-step Function Guide to Data Analysis", O'Reilly Media, 2013.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain how to leverage the insights from big data analytics	Understand
CO2	Analyze data by utilizing various statistical and data mining approaches	Analyze
CO3	Perform analytics on real-time streaming data	Analyze
CO4	Illustrate steam computing and various data analysis methods	Understand
CO5	Discuss the various NoSql alternative database models	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	1	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	1	-	1	-	-	-	-	-	-	-	2	-	-
CO5	3	1	-	1	3	-	-	-	-	-	-	2	-	-
CO	3	1	-	1	3	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CS204	DATA ANALYTICS LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To implement Map Reduce programs for processing big data
- To realize storage of big data using Hbase, Mongo DB
- To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering

List of Experiments:

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

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Process big data using Hadoop framework	Apply
CO2	Build and apply linear and logistic regression models	Apply
CO3	Perform graphical data analysis	Apply
CO4	Make use of SVM/ Decision tree algorithms for a given scenario	Apply
CO5	Implement Hbase, Mongo DB for big data storage	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2	3	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	2	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	1	2	-	-	-	-	-	-	-	2	-	-
CO5	3	3	2	2	3	-	-	-	-	-	-	2	-	-
CO	3	2	1	1	3	-	-	-	-	-	-	2	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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STREAM 1: NETWORKING AND DATABASE

P19CSP03	INFORMATION RETRIEVAL TECHNIQUES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search, and digital libraries

UNIT I INTRODUCTION: MOTIVATION 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 MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model – Term Weighing – 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 CLASSIFICATION AND CLUSTERING 9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents – Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Christopher D. Manning, PrabhakarRaghavan, Hinrich Schutze, "Introduction to Information Retrieval', Cambridge University Press, First South Asian Edition, 2008
2. Implementing and Evaluating Search EnginF', The MIT Press, Cambridge, Massachusetts London, England, 2010
3. Ricardo Baeza– Yates, Berthier Ribeiro – Neto, "Modern Information Retrieval: The concepts and Technology behind Search" (ACM Press Books), Second Edition, 2011

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the basic concepts and processes of information retrieval systems	Apply
CO2	Build an Information Retrieval system using the available tools	Analyze
CO3	Identify and design the various components of an Information Retrieval system	Understand
CO4	Make use of the common algorithms and techniques for document indexing, retrieval, and query processing	Analyze
CO5	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	2	-	-	-	-	-	-	2	-	-	-	3
CO4	3	2	-	-	-	-	-	-	-	2	-	-	-	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO	3	2	2	-	-	-	-	-	-	1	-	-	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP28	NOSQL DATABASE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems
- Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
- Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases

UNIT I NOSQL DATA ARCHITECTURE PATTERNS 9

NoSQL Data model: Aggregate Models – Document Data Model – Key – Value Data Model – Columnar Data Model – Graph Based Data Model Graph Data Model – NoSQL system ways to handle big data problems – Moving Queries to data – not data to the query – hash rings to distribute the data on clusters – replication to scale reads – Database distributed queries to data nodes

UNIT II KEY VALUE DATA STORES 9

From array to key value databases – Essential features of key value Databases – Properties of keys – Characteristics of Values – Key-Value Database Data Modeling Terms – Key-Value Architecture and implementation Terms, Designing Structured Values – Limitations of Key – Value Databases – Design Patterns for Key – Value Databases – Case Study – Key – Value Databases for Mobile Application Configuration

UNIT III DOCUMENT ORIENTED DATABASE 9

Document – Collection – Naming – CRUD operation – querying – indexing – Replication, Sharding – Consistency Implementation: Distributed consistency – Eventual Consistency – Capped Collection – Case studies: document oriented database: MongoDB and/or Cassandra

UNIT IV COLUMNAR DATA MODEL 9

Data warehousing schemas: Comparison of columnar and row-oriented storage – Column-store Architectures: C-Store and Vector-Wise – Column-store internals and – Inserts/updates/deletes – Indexing – Adaptive Indexing and Database Cracking – Advanced techniques: Vectorized Processing – Compression – Write penalty – Operating Directly on Compressed Data Late Materialization Joins – Group-by – Aggregation and Arithmetic Operations – Case Studies

UNIT V DATA MODELING WITH GRAPH 9

Comparison of Relational and Graph Modeling – Property Graph Model Graph Analytics: Link analysis algorithm – Web as a graph – Page Rank – Markov chain – page rank computation – Topic specific page rank (Page Ranking Computation techniques: iterative processing – Random walk distribution Querying Graphs: Introduction to Cypher – case study: Building a Graph Database Application – community detection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS:

1. Andreas Meier ,Michael Kaufmann, SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, Springer vieweg,1st ed. 2019.
2. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence Pearson Education 2012.

REFERENCES:

1. Luc Perkins, Redmond, E. &Wilson, Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement,Â Kindle 2nd Edition,2018.
2. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the detailed architecture, Database properties and storage requirements	Apply
CO2	Outline Keyvalue architecture and characteristics	Analyze
CO3	Design Schema and implement CRUD operations, distributed data operations	Understand
CO4	Compare data ware housing schemas and implement various column store internals	Analyze
CO5	Develop Application with Graph Data model	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	2	2	-	2	-	-
CO2	3	3	2	-	2	-	-	-	2	2	-	2	-	-
CO3	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO4	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO5	3	3	2	-	1	-	-	-	2	2	-	2	-	-
CO	3	3	3	-	1	-	-	-	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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P19CSP08	WEB ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods

UNIT I INTRODUCTION TO WEB ENGINEERING 9

Motivation – Categories of Web Applications – Characteristics of Web Applications – Requirements of Engineering in Web Applications – Web Engineering-Components of Web Engineering-Web Engineering Process-Communication – Planning

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

Introduction – Categorizing Architectures – Specifics of Web Application Architectures – Components of a Generic Web Application Architecture – Layered Architectures – 2-Layer Architectures, N-Layer Architectures – Data-aspect Architectures – Database-centric Architectures – Architectures for Web Document Management – Architectures for Multimedia Data – Modeling Specifics in Web Engineering – Levels – Aspects – Phases Customization – Modeling Requirements – Hypertext Modeling – Hypertext Structure Modeling Concepts – Access Modeling Concepts – Relation to Content Modeling – Presentation Modeling – Relation to Hypertext Modeling – Customization Modeling – Modelling Framework-Modeling languages – Analysis Modeling for Web Apps – The Content Model – The Interaction Model – Configuration Model

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps – Goals – Design Process – Interactive Design – Principles and Guidelines – Workflow – Preliminaries – Design Steps – Usability – Issues – Information Design – Information Architecture – structuring – Accessing Information – Navigation Design – Functional Design – Web App Functionality – Design Process – Functional Architecture – Detailed Functional Design

UNIT IV TESTING WEB APPLICATIONS 9

Introduction – Fundamentals – Test Specifics in Web Engineering – Test Approaches – Conventional Approaches – Agile Approaches – Testing concepts – Testing Process – Test Scheme- Test Methods and Techniques – Link Testing – Browser Testing – Usability Testing – Load – Stress – and Continuous Testing – Testing Security – Test – driven Development – Content Testing – User Interface testing – Usability Testing – Compatibility Testing – Component Level Testing – Navigation Testing – Configuration testing – Security and Performance Testing – Test Automation

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction – challenges in launching the web Application – Promoting Web Application – Content Management – Usage Analysis – Web Project Management – Challenges in Web Project Management – Managing Web Team – Managing the Development Process of a Web Application – Risk – Developing a Schedule – Managing Quality – Managing Change – Tracking the Project – Introduction to node JS – web sockets

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

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1. Roger S. Pressman, David Lowe, —Web Engineeringll, Tata McGraw Hill Publication, 2007

REFERENCES:

1. Chris Bates, —Web Programming: Building Internet Applicationsll, Third Edition, Wiley India Edition, 2007.
2. Guy W. Lecky-Thompson, —Web Programmingll, Cengage Learning, 2008.
3. John Paul Mueller, —Web Development with Microsoft Visual Studio 2005, Wiley Dream tech, 2006.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the characteristics of web applications.	Apply
CO2	Model web applications.	Analyze
CO3	Design web applications.	Understand
CO4	Test web applications.	Analyze
CO5	Web project management	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	3	2	-	-	-	-	2	2	2	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CSP09	FORMAL MODELS OF SOFTWARE SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity
To understand the fundamentals of abstraction and formal systems
To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems

UNIT I SPECIFICATION FUNDAMENTALS 9

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

UNIT II FORMAL METHODS 9

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

UNIT III LOGIC 9

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

UNIT IV SPECIFICATION MODELS 9

Mathematical Abstractions for Model – Based Specifications – Formal Specification Based on Set Theory – Relations and Functions – Property – Oriented Specifications – Algebraic Specification – Properties of Algebraic Specifications – Reasoning – Structured Specifications – Case Study – A Multiple Window Environment: requirements – Modeling Formal Specifications – Calculus of Communicating Systems: Specific Calculus for Concurrency – Operational Semantics of Agents – Simulation and Equivalence – Derivation Trees – Labeled Transition Systems

UNIT V FORMAL LANGUAGES 9

The Z Notation – abstractions in Z – Representational Abstraction – Types – Relations and Functions – Sequences – Bags – Free Types-Schemas – Operational Abstraction – Operations Schema Decorators – Generic Functions – Proving Properties from Z specifications – Consistency of Operations – Additional Features in Z – Case Study: An Automated Billing System – The Object-Z Specification Language – Basic Structure of an Object-Z – Specification – Parameterized Class – Object-Orientation – composition of Operations – Parallel Communication Operator – Nondeterministic Choice Operator – and Environment Enrichment – The B-Method – Abstract

Machine Notation (AMN) – Structure of a B Specification – arrays – statements – Structured Specifications – Case Study – A Ticketing System in a Parking

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994.

REFERENCES:

Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011

Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004

Mathematical Logic for computer science ,second edition, M.Ben-Ari ,Springer,2003

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity	Apply
CO2	Gain knowledge on fundamentals of abstraction and formal systems	Analyze
CO3	Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems	Understand
CO4	Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study	Analyze
CO5	Have working knowledge on Z, Object Z and B Specification languages with case studies	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	3	2	-	-	-	-	2	2	2	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CSP11	SOFTWARE DEFINED NETWORKS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To Differentiate between traditional networks and software defined networks
- To Understand advanced and emerging networking technologies
- To Obtain skills to do advanced networking research and programming

UNIT I INTRODUCTION 9

SDN Origins and Evolution – Introduction – Why SDN? – Centralized and Distributed Control and Data Planes – The Genesis of SDN

UNIT II SDN ABSTRACTIONS 9

How SDN Works – The Openflow Protocol – SDN Controllers: Introduction – General Concepts – VMware – Nicira – VMware/Nicira – OpenFlow-Related – Mininet – NOX/POX – Trema – Ryu – Big Switch Networks/Floodlight – Layer 3 Centric – Plexxi – Cisco OnePK

UNIT III PROGRAMMING SDN'S 9

Network Programmability – Network Function Virtualization – NetApp Development – Network Slicing

UNIT IV SDN APPLICATIONS AND USE CASES 9

SDN in the Data Center – SDN in Other Environments – SDN Applications – SDN Use Cases – The Open Network Operating System 3

UNIT V SDN'S FUTURE AND PERSPECTIVES 9

SDN Open Source – SDN Futures – Final Thoughts and Conclusions

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014

REFERENCES:

1. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013
2. Software Defined Networking with OpenFlow By SiamakAzodolmolky, Packt Publishing, 2013
3. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	To understand basics of Software defined network	Apply
CO2	To Understand protocols of SDN working	Analyze
CO3	To Understand programming of SDN	Understand
CO4	Use case and applications of SDN	Analyze
CO5	Open source SDN Developmentt	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	2	2	-	2	-	3
CO2	3	2	2	-	-	-	-	2	2	2	-	2	-	3
CO3	3	2	2	-	-	-	-	2	2	2	-	2	-	3
CO4	3	2	2	-	-	-	-	2	2	2	-	2	-	3
CO5	3	2	2	-	-	-	-	2	2	2	-	2	-	3
CO	3	2	2	-	-	-	-	2	2	2	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP14	FAULT TOLERANCE COMPUTING SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the error model and its operation
- To Study and investigate existing fault-tolerant systems
- To be able to specify the use of fault tolerance in the design of application software

UNIT I INTRODUCTION 9

Fault Prevention – Fault tolerance – anticipated and unanticipated Faults – Test generation for digital systems – Combinational logic – Network Boolean difference method test generation for sequential circuits – fault simulation

UNIT II ERROR MODEL 9

General coding scheme – Parity checking code – arithmetic code – code for computer memories – checking errors in logical operation – communication coding

UNIT III FAULT TOLERANCE 9

Coding technique – fault tolerant self checking and fail safe circuits – fault tolerant in combinatorial and sequential circuits – synchronous and asynchronous fail safe circuits

UNIT IV ARCHITECTURE 9

Fault tolerant computers – general purpose commercial systems – fault tolerant multiprocessor and VLSI based communication architecture

UNIT V FAULT TOLERANT SOFTWARE 9

Design – N – version programming recovery block – acceptance tests – fault trees – validation of fault tolerant systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. K.Pradhan, "Fault Tolerant computing theory and techniques" volume III. Prentice Hall, 1989
2. Israel Koren and C. Mani. Krishna, "Fault Tolerant Systems", Elsevier.2007

REFERENCES:

1. Shem , toy Levei , Ashok K.Agarwala , "Fault Tolerant System design", Tata McGraw Hill, 1994
2. N. N. Biswas, "Logic Design theory", PHI 1990

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the requirements of a fault tolerance error model and its operations	Apply
CO2	Understand the basic concepts of fault-tolerance and different fault-tolerance techniques available for real- time systems.	Analyze
CO3	Use simulated software to develop and test different fault tolerant models.	Understand
CO4	Interpret the need and necessity to consider fault tolerant design in digital systems	Analyze
CO5	Categorize the various methods for SW fault tolerance. NVP, recovery blocks	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	2	2	-	2	3	3
CO2	3	2	2	3	-	-	-	2	2	2	-	2	3	3
CO3	3	2	3	3	-	-	-	2	2	2	-	2	2	3
CO4	3	2	2	2	-	-	-	2	2	2	-	2	2	2
CO5	3	2	2	2	-	-	-	2	2	2	-	2	2	3
CO	3	2	2	2	-	-	-	2	2	2	-	2	2	3
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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P19CSP25	INFORMATION STORAGE MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the storage architecture and available technologies
- To learn to establish & manage datacenter
- To learn security aspects of storage & datacenter

UNIT I STORAGE TECHNOLOGY 9

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

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

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

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

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

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

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

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS:

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

REFERENCES:

1. Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne, 2001

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the value of data and identify the challenges of data storage	Apply
CO2	Apply the storage system techniques	Analyze
CO3	Select from various storage technologies to suit for required application.	Understand
CO4	Apply security measures to safeguard storage & farm.	Analyze
CO5	Analyse QoS on Storage.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	1	1	1	-	2	-	-
CO2	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	2	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	2	2	-	-	-	-	2	2	2	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CSP26	SOCIAL NETWORK ANALYSIS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the components of the social network
- To mine the users in the social network
- To understand the evolution of the social network

UNIT I INTRODUCTION 9

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

UNIT II MODELING AND VISUALIZATION 9

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

UNIT III MINING COMMUNITIES 9

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

UNIT IV EVOLUTION 9

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

UNIT V APPLICATIONS 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1 st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Work on the internals components of the social network	Apply
CO2	Model and visualize the social network	Analyze
CO3	Mine the behaviour of the users in the social network	Understand
CO4	Predict the possible next outcome of the social network	Analyze
CO5	Apply social network in real time applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	1	1	1	-	2	-	3
CO2	3	3	2	2	2	-	-	1	1	1	-	2	-	3
CO3	3	3	3	2	2	-	-	1	1	1	-	2	-	3
CO4	3	3	2	2	2	-	-	1	1	1	-	2	-	3
CO5	3	3	2	2	2	-	-	2	1	1	-	2	-	3
CO	3	3	2	2	2	-	-	1	1	1	-	2	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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STREAM 2: ARTIFICIAL INTELLIGENCE AND COMPUTER VISION

P19CSP04	IMAGE PROCESSING AND ANALYSIS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications
- To appreciate the use of image processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

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 Arithmetic – logical – statistical and spatial operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms – Discrete and Fast Fourier Transform and Discrete Cosine Transform – Spatial Domain – Gray level Transformations – Histogram Processing – Spatial Filtering – Smoothing and Sharpening – Frequency Domain: Filtering in Frequency Domain Smoothing and Sharpening filters Homomorphic Filtering – Noise models – Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation – Image Morphology: 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 IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation – pixel based – edge based – region-based segmentation – Active contour models and Level sets for medical image segmentation – Image representation and analysis – Feature extraction and representation – Statistical – Shape – Texture – feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization – Principal axis registration – Interactive principal axis registration – Feature based registration – Elastic deformation-based registration – Image visualization 2D display methods – 3D display methods – virtual reality based interactive visualization.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Alasdair McAndrew, Introduction to Digital Image Processing with Matlab, Cengage Learning 2011, India.
2. Anil J Jain, Fundamentals of Digital Image Processing, PHI, 2006.

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REFERENCES:

1. KavyanNajarian and Robert Splerstor, Biomedical Signals and Image Processing, CRC-Taylor and Francis, New York, 2006.
2. Rafael C.Gonzalez and Richard E.Woods, Digital Image Processing, Third Edition, Pearson Education, 2008, New Delhi
3. S. Sridhar, Digital Image Processing, Oxford University Press, 2011.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the principles of image processing and analysis	Understand
CO2	Demonstrate the use of image enhancement and restoration using various transformation and filtering techniques	Apply
CO3	Analyze various segmentation and morphology techniques to image processing applications	Analyze
CO4	Apply feature extraction, representation and image classification methods	Apply
CO5	Implement image registration and visualization techniques for real-time problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO	2	1	1-	-	-	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP05	REAL TIME SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

UNIT I REAL TIME SYSTEM AND SCHEDULING 9

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II SOFTWARE REQUIREMENTS ENGINEERING 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object-oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

UNIT IV REAL TIME DATABASES 9

Real time Databases – Basic Definition– Real time Vs General Purpose Databases– Main Memory Databases–Transaction priorities–Transaction Aborts–Concurrency control issues–Disk Scheduling Algorithms–Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

Reliability Evaluation Techniques – Obtaining parameter values– Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock– A Non fault–Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

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

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6. Allen Burns, Andy Wellings, —Real Time Systems and Programming Languages, Pearson Education, 2003

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply principles of real time system design techniques to develop real time applications.	Apply
CO2	Make use of database in real time applications.	Apply
CO3	Apply replacement algorithms	Apply
CO4	Make use of architectures and behaviour of real time operating systems.	Apply
CO5	Apply evaluation techniques in application.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	1	2	-	-	2	-	-
CO2	3	3	3	3	3	1	-	-	-	1	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	1	2	2	-
CO4	3	3	3	3	3	-	1		2	-	-	-	-	-
CO5	3	2	3		2	-	-	-	2	-	-	2	-	-
CO	3	3	3	3	3	1	1	1	2	1	1	2	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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P19CSP10	DATA VISUALIZATION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 12

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

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 11

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

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 12

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

UNIT IV INFORMATION DASHBOARD DESIGN 12

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

UNIT V INFORMATION DASHBOARD DESIGN 13

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

REFERENCES:

1. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.

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2. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
3. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
5. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
6. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	To develop skills to both design and critique visualizations.	Apply
CO2	To introduce visual perception and core skills for visual analysis.	Remember
CO3	To understand visualization for time-series analysis.	Understand
CO4	To understand visualization for ranking analysis.	Understand
CO5	To understand visualization for deviation analysis.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	3	2	-	-	-	-	2	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP13	PARALLEL PROGRAMMING PARADIGMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats– coordinating processes/ threads- hybrid model – shared memory model and distributed memory model –I/O – performance of parallel programs– parallel program design.

UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMDprograms– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast–scatter– gather– allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs– A Parallel Sorting Algorithm.

UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads– Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples – Caches– cache coherence and false sharing – Thread safety– Pthreads case study.

UNIT IV SHARED MEMORY PARADIGM: OPENMP 9

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

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, —OpenCL programming guidell, Addison Wesley, 2011
2. M. J. Quinn, —"Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
3. Peter S. Pacheco, —"An introduction to parallel programming", Morgan Kaufmann, 2011.
4. Rob Farber, —CUDA application design and development", Morgan Haufmann, 2011.

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5. W. Gropp, E. Lusk, and A. Skjellum, —"Using MPI: Portable parallel programming with the message passing interface", Second Edition, MIT Press, 1999

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Identify issues in parallel programming.	Analyze
CO2	Develop distributed memory programs using MPI framework.	Apply
CO3	Design and develop shared memory parallel programs using Pthreads and using OpenMP.	Apply
CO4	Understand shared memory paradigm	Understand
CO5	Implement Graphical Processing OpenCL programs.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	2	-	2	3
CO2	3	2	2	-	-	2	-	-	-	-	-	-	2	3
CO3	3	2	3	-	3	-	2	-	2	-	2	-	2	3
CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO5	3	2	-	2	-	3	-	-	-	-	-	-	2	3
CO	3	3	2	1	1	2	2	-	2	-	2	-	2	3
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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P19CSP15	NATURAL LANGUAGE PROCESSING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques to IR applications

UNIT I INRODUCTION 9

Origins and challenges of NLP – Language Modeling: Grammar-based LM–Statistical LM – Regular Expressions– Finite-State Automata – English Morphology–Transducers for lexicon and rules– Tokenization– Detecting and Correcting Spelling Errors– Minimum Edit Distance

UNIT II WORD LEVEL ANALYSIS 9

Unsmoothed N-grams–Evaluating N-grams– Smoothing–Interpolation and Backoff – Word Classes– Part-of-Speech– Tagging– Rule-based– Stochastic and Transformation-based tagging– Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III SYNTACTIC ANALYSIS 9

Context-Free Grammars– Grammar rules for English–Treebanks– Normal Forms for grammar – Dependency Grammar – Syntactic Parsing– Ambiguity– Dynamic Programming parsing – Shallow parsing – Probabilistic CFG– Probabilistic CYK– Probabilistic Lexicalized CFGs – Feature structures– Unification of feature structures.

UNIT IV SEMANTICS AND PRAGMATICS 9

Requirements for representation– First-Order Logic– Description Logics – Syntax-Driven Semantic analysis– Semantic attachments – Word Senses– Relations between Senses– Thematic Roles– selectional restrictions – Word Sense Disambiguation–WSD using Supervised– Dictionary & Thesaurus– Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V DISCOURSE ANALYSIS AND LEXICAL RESOURCES 9

Discourse segmentation– Coherence – Reference Phenomena–Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer– Lemmatizer– Penn Treebank– Brill's Tagger– WordNet– PropBank– FrameNet–Brown Corpus–British National Corpus (BNC).

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.

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REFERENCES:

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	To tag a given text with basic Language features	Understand
CO2	To design an innovative application using NLP components	Apply
CO3	To implement a rule-based system to tackle morphology/syntax of a language	Apply
CO4	To design a tag set to be used for statistical processing for real-time applications	Apply
CO5	To compare and contrast the use of different statistical approaches for different types of NLP applications.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	-	-	-	-	-	2	-	-
CO2	3	3	2	-	2	-	-	2	-	-	-	2	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	-	-	2	2	-	-	2		2	-	2
CO5	3	3	-	2	-	-	-	-	-	-	-	3	-	2
CO	3	2	1	2	1	2	2	2	-	2	-	2	-	2
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)						3: Substantial (High)		

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P19CSP22	COMPUTER VISION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

UNIT I IMAGE PROCESSING FOUNDATIONS 9

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

UNIT II SHAPES AND REGIONS 9

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

UNIT III HOUGH TRANSFORM 9

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

UNIT IV 3D VISION AND MOTION 9

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

UNIT V APPLICATIONS 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. D. L. Baggio et al., —Mastering OpenCV with Practical Computer Vision Projectsll, Packt Publishing, 2012.
2. E. R. Davies, —Computer & Machine Visionll, Fourth Edition, Academic Press, 2012.

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3. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing imagesll, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Visionll, Third Edition, Academic Press, 2012.
5. R. Szeliski, —Computer Vision: Algorithms and Applicationsll, Springer 2011.
6. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inferencell, Cambridge University Press, 2012.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Implement fundamental image processing techniques required for computer vision	Apply
CO2	Implement boundary tracking techniques	Apply
CO3	Apply chain codes and other region descriptors	Apply
CO4	Apply 3D vision techniques	Apply
CO5	Develop applications using computer vision techniques	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	3	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	3	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	2	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	2	-	-	-	2	2	2	-	2	-	-
CO	3	3	2	2	-	-	-	2	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP23	SPEECH PROCESSING AND SYNTHESIS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

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

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

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

UNIT III SPEECH RECOGNITION 9

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

UNIT IV TEXT ANALYSIS 9

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

UNIT V SPEECH SYNTHESIS 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. K.K.Pradhan, "Fault Tolerant computing theory and techniques" volume III. Prentice Hall, 1989
2. Anderson and Lee, "Fault Tolerant principles and practice" , PHI 1989.
3. Israel Koren and C. Mani. Krishna, "Fault Tolerant Systems", Elsevier.2007.

REFERENCES:

1. Joseph Mariani, —Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, —Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
3. SadaokiFurui, —Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.

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4. Thomas F.Quatieri, —Discrete-Time Speech Signal Processingll, Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, —Spoken Language Processing – A guide to Theory, Algorithm and System Developmentll, Prentice Hall PTR, 2001

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Model speech production system and describe the fundamentals of speech.	Understand
CO2	Determine the various encoding techniques for representing speech.	Understand
CO3	Design a speech recognition system.	Analyze
CO4	Use different text analysis to real– world applications	Apply
CO5	Identify the apt approach of speech synthesis depending on the language to be processed	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	2	2	-	1	-	3
CO2	3	3	2	3	-	3	-	-	2	2	-	1	-	3
CO3	3	3	3	3	-	2	-	-	2	2	-	1	-	3
CO4	3	3	2	3	-	3	-	-	2	2	-	1	-	3
CO5	3	3	2	2	-	3	-	-	2	2	-	1	-	3
CO	3	3	2	2	-	2	-	-	2	2	-	1	-	3
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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P19CSP27	BIO-INSPIRED COMPUTING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II RANDOM WALK AND ANEALING 9

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

UNIT III GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION 9

Introduction to genetic algorithms – role of genetic operators – choice of parameters – GA varients– schema theorem – convergence analysis – introduction to differential evolution –varients–choice of parameters – convergence analysis –implementation.

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

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

UNIT V APPLICATION IN IMAGE PROCESSING 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

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

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Implement and apply bio-inspired algorithms	Apply
CO2	Explain random walk and simulated annealing	Understand
CO3	Implement and apply genetic algorithms	Apply
CO4	Explain swarm intelligence and ant colony for feature selection	Apply
CO5	Apply bio-inspired techniques in image processing	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	1	1	1	-	2	-	2
CO2	3	3	2	2	2	-	-	1	1	1	-	2	-	2
CO3	3	3	3	2	2	-	-	1	1	1	-	2	-	2
CO4	3	3	2	2	2	-	-	1	1	1	-	2	-	2
CO5	3	3	2	2	2	-	-	1	1	1	-	2	-	2
CO	3	3	2	2	2	-	-	1	1	1	-	2	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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STREAM 3: CURRENT TRENDS

P19CSP01	CLOUD COMPUTING TECHNOLOGIES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the security issues in the grid and the cloud

UNIT I VIRTUALIZATION 9

Basics of Virtual Machines –Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization – Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT III CLOUD PLATFORM ARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework–Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications – Design of Hadoop file system –Setting up Hadoop Cluster – Cloud Software Environments – Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V CLOUD SECURITY 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud–Key privacy issues in the cloud –Cloud Security and Trust Management.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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REFERENCES:

1. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guidell, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation,
4. Management, and Security", CRC Press, 2010.
5. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
6. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009.
7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
8. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Employ the concepts of storage virtualization, network virtualization and its management	Understand
CO2	Apply the concept of virtualization in the cloud computing	Apply
CO3	Identify the architecture, infrastructure and delivery models of cloud computing	Understand
CO4	Develop services using Cloud computing	Apply
CO5	Apply the security models in the cloud environment	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3		2	2	2			2	2	3
CO2	3	3	3	3	3	1	2	2	2	1	1	2	2	3
CO3	3	3	3			1							2	3
CO4	3	3	3	3	3		2	2	2	1	1	2	2	3
CO5	3	3	3	3	3	1				1	1		2	3
CO	3	3	3	3	3	1	2	2	2	1	1	2	1	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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P19CSP02	MOBILE AND PERVASIVE COMPUTING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II MODERN 4G TELECOMMUNICATIONS SYSTEM 9

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

UNIT III PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview – Pervasive Computing: Concepts – Challenges – Middleware — Context Awareness – Resource Management – Human–Computer Interaction – Pervasive Transaction Processing –Infrastructure and Devices – Wireless Networks – Middleware for Pervasive Computing Systems – Resource Management – User Tracking– Context Management -Service Management – Data Management – Security Management – Pervasive Computing Environments – Smart Car Space–Intelligent Campus.

UNIT IV HCI IN PERVASIVE COMPUTING 9

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

UNIT V PERVASIVE MOBILE TRANSACTIONS 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

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

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basic architecture and concepts of various generations of communication systems	Understand
CO2	Explain the latest 4G telecommunication system principles	Understand
CO3	Incorporate the pervasive concepts for real-world scenarios	Apply
CO4	Implement the HCI in pervasive environment	Apply
CO5	Apply the pervasive concepts in mobile environment	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	-	-	-	-	-	1	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	1	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	2	-	-	-	-	-	1	-	-	-	-
CO	2	1	2	1	-	-	-	-	-	1	-	-	-	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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P19CSP29	BLOCK CHAIN TECHNOLOGIES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVES:

- Understand the basic concepts of block chain technology.
- Understand the bit coin and crypto currency principles.
- Understand the distributed consensus of the block chain technology.

UNIT I BLOCKCHAIN FUNDAMENTALS 9

Blockchain– Public Ledgers, Blockchain as Public Ledgers –Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions–Distributed Consensus, The Chain and the Longest Chain – Cryptocurrency to Blockchain 2.0 –Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function–Hash pointer and Merkle tree.

UNIT II BITCOIN AND CRYPTOCURRENCY 9

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay, Consensus introduction, Distributed consensus in open environments–Consensus in a Bitcoin network.

UNIT III BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW)– Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem– Proof of Stake– Proof of Burn–Proof of Elapsed Time – Bitcoin Miner, Mining Difficulty, Mining Pool–Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts– Consensus models for permissioned blockchain–Distributed consensus in closed environmentPaxos.

UNIT IV DISTRIBUTED CONSENSUS 9

RAFT Consensus–Byzantine general problem, Byzantine fault tolerant system–Agreement Protocol, Lamport–Shostak–Pease BFT Algorithm–BFT over Asynchronous systems, Practical Byzantine Fault Tolerance.

UNIT V HYPER LEDGER FABRIC & ETHERUM 9

Architecture of Hyperledger fabric v1.1–Introduction to hyperledger fabric v1.1, chain code– Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity, Smart contracts, Truffle Design and issue Crypto currency, Mining, DApps, DAO.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

4. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Bashir, Imran,2017.
5. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

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REFERENCES:

1. Elad Elrom,The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects,Apress, 1st Edition,2019.
2. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the public ledger and blocks in block chain.	Understand
CO2	Identify and classify the concepts of bitcoin and cryptocurrency.	Understand
CO3	Exposure to classify the bitcoin consensus.	Apply
CO4	Identify and understand the distributed consensus of blockchain.	Understand
CO5	Exposure to explicate the hyper ledger fabric and ethereum network framework.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	2	-	2	-	-
CO2	3	2	2	-	-	-	-	-	2	2	-	2	-	-
CO3	3	2	2	-	-	-	-	-	3	2	-	2	-	-
CO4	3	3	2	-	-	-	-	-	2	2	-	2	-	-
CO5	3	2	3	-	-	-	-	-	2	3	-	2	-	-
CO	3	2	2	-	-	-	-	-	2	2	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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P19CSP30	MIXED REALITY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Understand the virtual reality systems and its applications.
- Understand the Basic virtual reality systems functions(operations)
- Understand the integration of hardware and software in virtual reality applications.

UNIT I VIRTUAL REALITY MODELS 9

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- 3D Computer Graphics : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – Human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms.

UNIT II GEOMETRIC MODELING GEOMETRICAL TRANSFORMATIONS 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation –Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection - A Generic VR system.

UNIT III VIRTUAL ENVIRONMENT 9

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation – The animation of objects – linear and non-linear translation – shape & object – freeform deformation – particle system- Physical Simulation : Introduction – Objects falling in a graphical field –Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft

UNIT IV VR HARDWARES & SOFTWARES 9

Human factors : Introduction – the age- the ear- the somatic senses – VR Hardware : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems–VR Software: Introduction – Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML

UNIT V VR APPLICATION 9

Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia,3rd edition 2007.
2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 1994.

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REFERENCES:

1. Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology" , WileyInterscience,1 Edition,2008.
2. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design",Morgan Kaufmann, 2nd Edition,2005.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the various virtual reality models.	Understand
CO2	Implement geometric modeling geometrical transformations for 2D and 3D.	Apply
CO3	Implement the virtual environment for graphical object.	Apply
CO4	Identify the VR hardware and software.	Understand
CO5	Apply VR application in an engineering field.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO2	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO3	3	3	2	-	2	-	-	-	3	2	-	2	-	-
CO4	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO5	3	3	3	-	1	-	-	-	2	3	-	2	-	-
CO	3	2	2	-	1	-	-	-	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PCS19P31	DATA SCIENCE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Implement data analytics concepts using R
- Apply the different types of modeling methods for analysis the data.
- Understand the concepts of map reduce in big data.

UNIT I INTRODUCTION TO DATASCIENCE 9

Data science process –roles, stages in data science project –working with data from files –working withrelational databases –exploring data –managing data–cleaning and sampling for modeling and validation–introduction to NoSQL.

UNIT II MODELING METHODS 9

Choosing and evaluating models –mapping problems to machine learning, evaluating clustering models.

UNIT III INTRODUCTION TO R 9

Reading and getting data into R –ordered and unordered factors –arrays and matrices –lists and data frames–reading data from files –probability distributions –statistical models in R –manipulating objects –data distribution – Sentiment Analysis Approach –Neutral, Negative, Positive Comparative Analysis –Testing in R–test –Test workflow.

UNIT IV MAP REDUCE 9

Introduction –distributed file system –algorithms using map reduce, Matrix–Vector Multiplication by Map Reduce —Hadoop – Understanding the Map Reduce architecture – Writing Hadoop Map Reduce Programs– Loading data into HDFS–Executing the Map phase – Shuffling and sorting – Reducing phase execution.Time.

UNIT V DELIVERING RESULTS 9

Documentation and deployment –producing effective presentations –Introduction to graphical analysis – plot() function –displaying multivariate data–matrix plots –Scatter Plot –Histogram – Bar & Stack Bar Chart – Box Plot – Area Chart – Heat Map –Correlogram–Polarity Plot – multiple plots in onewindow–exporting graphs–using graphic parameters-case studies.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Boris Lublinsky, Kevin T. Smith and Alexey Yakubovich, Professional HadoopSolution, Wiley,2015.
2. Avrim Blum , John Hopcroft , Ravindran Kannan, "Foundations of Data Science", Cambridge university press,2018

REFERENCES:

1. Jure Leskovec, Anand Rajaraman and Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press, 2014.
2. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort and Abhijit Dasgupta, Practical DataScience Cookbook, Packt Publishing Ltd., 2014.
3. Nina Zumel and John Mount, Practical Data Science with R, Manning Publications, 2014.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Analyze the fundamental concepts of data science.	Analyze
CO2	Apply fundamental algorithmic ideas to process data.	Apply
CO3	Implement the sentiment analysis approach using R language.	Apply
CO4	Identify the purpose of Map Reduce and HDFS.	Understand
CO5	Apply different types of visualization techniques to predict the future set.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	2	2	-	2	-	-
CO2	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO3	3	3	2	-	2	-	-	-	3	2	-	2	-	-
CO4	3	2	2	-	2	-	-	-	2	2	-	2	-	-
CO5	3	2	3	-	1	-	-	-	2	3	-	2	-	-
CO	3	2	2	-	1	-	-	-	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP19	CYBER PHYSICAL SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective
- To expose to real world problems in cyber-physical system
- To provide a walk through in the design and validation problems for cyber-physical system.
- To offer an idea of how to develop products specific to needs

UNIT I CYBER PHYSICAL SYSTEMS - INTRODUCTION 9

Cyber-Physical Systems (CPS) in the real world – Basic principles of design and validation of CPS Industry 4.0, AutoSAR, IIOT implications.CPS Platform components: CPS HW platforms – Processors, Sensors, Actuators, CPS Network – WirelessHart, CAN, Automotive Ethernet Scheduling Real Time CPS tasks.

UNIT II PRINCIPLES OF DYNAMICAL SYSTEMS 9

Dynamical Systems and Stability, Controller Design Techniques, Performance under Packet drop and Noise.

UNIT III CPS IMPLEMENTATION ISSUES 9

From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis – effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Building real-time networks for CPS.

UNIT IV INTELLIGENT CPS 9

Safe Reinforcement Learning: Robot motion control, Autonomous Vehicle control. Gaussian Process Learning: Smart Grid Demand Response, Building Automation.

UNIT V SECURE DEPLOYMENT OF CPS 9

Cryptographic Primitives – Protocol and Network Security – Software Security – Information Flow – Advanced Topics.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

REFERENCES:

1. E. A. Lee, SanjitSeshia, "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press, 2017.
2. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain embedded systems and cyber-physical systems (CPS) with examples	Understand
CO2	Describe hybrid automata and state-space methods modelling formalisms for CPS	Understand
CO3	Apply the security and safety aspects of CPS for real-world scenario	Apply
CO4	Model an intelligent CPS for a real-world problem	Analyze
CO5	Discuss the design and validation problems for CPS	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	-
CO	3	1	2	1	-	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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P19CSP20	DEEP LEARNING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To explain the basic concepts of neural networks and deep networks.
- To discuss the major architectures of deep networks.
- To examine the core concepts in deep architecture tuning
- To demonstrate the applications of deep learning.

UNIT I BASICS OF NEURAL NETWORKS 9

Neural Networks – Training Neural Networks – Activation Functions – Loss Functions –Hyper parameters.

UNIT II FUNDAMENTALS OF DEEP NETWORKS 9

Defining Deep Learning – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks.

UNIT III MAJOR ARCHITECTURES OF DEEP NETWORKS 9

Unsupervised Pre–Trained Networks – Convolutional Neural Networks – Recurrent Neural Networks – Recursive Neural Networks –Tuning Deep Networks

UNIT IV TUNING SPECIFIC DEEP NETWORK ARCHITECTURES 9

Convolution Neural Networks (CNNs)– Recurrent Neural Networks– Restricted Boltzmann Machines– DBNs

UNIT V APPLICATIONS 9

Large-Scale deep learning – Computer Vision – Speech Recognition – Natural Language Processing– Recommender systems.**Case Study**– Applications of Deep Learning in Health care, Deep learning tools.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Adam Gibson, Josh Patterson, "Deep Learning, A Practitioner's Approach", O'Reilly Media, 2017.
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2016.

REFERENCES:

1. Daniel Graupe, "Deep Learning Neural Networks: Design and Case Studies", World Scientific Publishing , 2016.
2. Yu and Li Deng, "Deep Learning: Methods and Applications", Now Publishers Inc, 2014.
3. Zurada, J.M. "Introduction to Artificial Neural systems", Jaico Publishing House, 2012.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Distinguish neural and deep networks	Understand
CO2	Select the appropriate deep network architecture.	Understand
CO3	Analyze the performance of a deep learning network.	Analyze
CO4	Apply deep learning for solving real world problems.	Apply
CO5	Develop new deep network models	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	3	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-	3	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	3	-	-
CO	3	2	2	2	3	-	-	-	-	-	-	3	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PCS19P32	USER EXPERIENCE DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Describe the web user Interface.
- Describe the structure of user Interface and design process.
- Organize the web systems and control

UNIT I INTRODUCTION **9**

Human–Computer Interface – Characteristics Of Graphics Interface –Direct Manipulation Graphical System – Web User Interface –Popularity –Characteristic & Principles.

UNIT II HUMAN COMPUTER INTERACTION **9**

User Interface Design Process – Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed –Business Functions –Requirement Analysis – Direct – Indirect Methods – Basic Business Functions – Design Standards – System Timings – Human Consideration In Screen Design – Structures Of Menus – Functions Of Menus– Contents Of Menu– Formatting – Phrasing The Menu – Selecting Menu Choice– Navigating Menus– Graphical Menus.

UNIT III WINDOWS **9**

Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– Device– Based Controls Characteristics– Screen – Based Controls – Operate Control – Text Boxes– Selection Control– Combination Control– Custom Control– Presentation Control.

UNIT IV MULTIMEDIA **9**

Text For Web Pages – Effective Feedback– Guidance & Assistance– Internationalization– Accesssibility– Icons– Image– Multimedia – Coloring..

UNIT V WINDOWS LAYOUT– TEST **9**

Prototypes – Kinds Of Tests – Retest – Information Search – Visualization – Hypermedia – WWW– Software Tools.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Ben Sheiderman, "Design the User Interface", Pearson Education, 2010.
2. Wilbent. O. Galitz ,"The Essential Guide To User Interface Design", John Wiley& Sons,3rd edition 2007.

REFERENCES:

1. Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd., 2002.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the Characteristics of Graphics Interface and its Principles	Understand
CO2	Design the standards and structures for Human computer interaction	Apply
CO3	Understand the components of web systems and text boxes	Understand
CO4	Demonstrate the Guidance of multimedia systems and its accessibility	Apply
CO5	Summarize the concepts of windows layout and visualization	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO2	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO4	3	2	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	2	3	-	-	-	-	2	2	2	-	2	-	-
CO	3	2	2	-	-	-	-	2	2	2	-	2	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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