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M.E.–Computer Science and Engineering

Curriculum and Syllabi

Regulations 2021

I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- ❖ Commitment to offer value-based education and enhancement of practical skills
- ❖ Continuous assessment of teaching and learning process through scholarly activities
- ❖ Enriching research and innovative activities in collaboration with industry and institute of repute
- ❖ Ensuring the academic process to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

To foster the students by providing learner centric teaching environment, continuous learning, research and development to become thriving professionals and entrepreneurs to excel in the field of computer science and contribute to the society.

Mission

- Providing value-based education and contented learning experience to the students.
- Educating the students with the state of art technologies and cultivating their proficiency in analytical and designing skills.
- Enabling the students to achieve a successful career in Computer Science and Engineering or related fields to meet the changing needs of various stakeholders.
- Guiding the students in research by nurturing their interest in continuous learning towards serving the society and the country.

III. Program Educational Objectives (PEOs)

PEO1: To enable graduates to pursue research or take up successful career in academia or industries allied with Computer Science and Engineering or become entrepreneurs.

PEO2: To equip students with advanced techniques, tools and competency in applying technology to develop innovative and sustainable solutions.

PEO3: To empower students with critical analysis, leadership and decision-making skills guided by professional, ethical, and societal considerations to serve the nation.

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IV. Program Outcomes (POs)

PO1: Demonstrate proficiency in the applied fields of Computer Science.

PO2: Write and present a substantial technical report/document

PO3: Independently carry out research investigation and development work to solve practical problems

PO4: Perform self-learning and to keep oneself up-to-date in the field of computer science and engineering.

PO5: Develop creative, innovative solutions for real life problems.

PO6: Demonstrate team building, goal setting and leadership development skills to create successful entrepreneurs.

V. PEO/PO Mapping

Following three levels of correlation should be used:

1: Low

2: Medium

3: High

	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	3	3	1	2	3	2
PEO2	3	2	3	3	3	3
PEO3	3	2	3	3	3	3

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VI. MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

Year	SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6
I Year	SEM I	Probability, Statistics and Graph Theory	√	√	√	-	-	-
		Advanced Data Structures and Algorithms	√	-	√	√	√	-
		Agile Software Development and Usability Engineering	√	√	√	√	√	√
		Machine Learning	√	-	√	√	√	-
		Research Methodology and IPR	√	√	√	√	√	-
		Machine Learning Laboratory	√	√	√	√	√	-
	SEM II	Modern Operating Systems	√	√	√	-	-	-
		Data science	√	-	√	√	√	-
		Big Data Analytics	√	√	√	√	√	√
		Data Analytics Laboratory	√	√	√	√	√	-
II Year	SEM III	-						
		-						
		-						
	SEM IV	-						
PE		Information retrieval techniques	√	-	√	√	√	-
		No SQL Database	√	√	√	√	√	-
		Software defined networks	√	-	√	-	√	-
		Vehicular systems	√	√	√	√	√	-
		Real time systems	√	-	√	√	√	-

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		Reconfigurable Computing	√	-	√	√	√	-
		Cyber security practices	√	-	√	√	√	-
		Digital Image processing and computer vision	√	-	√	√	√	-
		Social network analysis	√	-	√	√	√	-
		Data Visualization	√	√	√	-	-	-
		Applied natural language processing	√	-	√	√	√	-
		Bio Inspired Computing	√	-	√	-	√	-
		Deep learning	√	√	√	√	√	-
		Game design	√	√	√	√	√	-
		Cloud Computing Technologies	√	√	√	√	√	-
		Blockchain Technologies	√	√	√	-	-	-
		Mixed Reality	√	-	√	-	√	-
		Internet of Things	√	√	√	√	√	-
		Robotics	√	-	√	-	√	-
		Cognitive science	√	√	√	√	√	-

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M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATIONS – 2021

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I TO IV SEMESTERS

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P21MA101	Probability, Statistics and Graph Theory	FC	3	1	0	4
2	P21CS101	Advanced Data Structures and Algorithms	PCC	3	0	0	3
3	P21CS102	Agile Software Development and Usability Engineering	PCC	3	0	0	3
4	P21CS103	Machine Learning	PCC	3	0	0	3
5	-	Professional Elective - 1	PEC	3	0	0	3
6	P21RMC01	Research Methodology & IPR	RMC	3	0	0	3
PRACTICALS							
7	P21CS104	Machine Learning Laboratory	PCC	0	0	2	2
			TOTAL	**18**	**1**	**2**	**21**

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P21CS201	Modern Operating Systems	PCC	3	0	0	3
2	P21CS202	Data Science	PCC	3	0	0	3
3	P21CS203	Big Data Analytics	PCC	3	0	0	3
4	-	Professional Elective II	PEC	3	0	0	3
5	-	Professional Elective III	PEC	3	0	0	3
6	-	Professional Elective IV	PEC	3	0	0	3
PRACTICALS							
7	P21CS204	Data Analytics Laboratory	PCC	0	0	2	2
8	P21CS205	Technical Seminar	EEC	0	0	2	2
			TOTAL	**18**	**0**	**4**	**22**

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SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	-	Professional Elective V	PCC	3	0	0	3
2	-	Professional Elective VI	PEC	3	0	0	3
PRACTICALS							
3	P21CS301	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
THEORY							
1	P21CS401	Project Work – Phase II	EEC	0	0	24	12
2	P21CSI01	Industrial Training / Internship	EEC	0	0	0	2
			TOTAL	**0**	**0**	**24**	**14**

SUB. TOTAL CREDITS: 67

INTERNSHIP: 02

TOTAL NO. OF CREDITS: 69

LIST OF COURSES BASED ON ITS CATEGORY

FOUNDATION COURSES (FC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P21MA101	Probability, Statistics and Graph Theory	FC	3	1	0	4

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PROFESSIONAL CORE COURSES (PCC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P21CS101	Advanced Data Structures and Algorithms	PCC	3	0	0	3
2	P21CS102	Agile Software Development and Usability Engineering	PCC	3	0	0	3
3	P21CS103	Machine Learning	PCC	3	0	0	3
4	P21CS104	Machine Learning Laboratory	PCC	0	0	2	2
5	P21CS201	Modern Operating Systems	PCC	3	0	0	3
6	P21CS202	Data Science	PCC	3	0	0	3
7	P21CS203	Big Data Analytics	PCC	3	0	0	3
8	P21CS204	Data Analytics Laboratory	PCC	0	0	2	2

PROFESSIONAL ELECTIVES COURSES (PEC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P21CSP01	Information retrieval techniques	PEC	3	0	0	3
2	P21CSP02	No SQL Database	PEC	3	0	0	3
3	P21CSP03	Software defined networks	PEC	3	0	0	3
4	P21CSP04	Vehicular systems	PEC	3	0	0	3
5	P21CSP05	Real time systems	PEC	3	0	0	3
6	P21CSP06	Reconfigurable Computing	PEC	3	0	0	3
7	P21CSP07	Cyber security practices	PEC	3	0	0	3
8	P21CSP08	Digital Image processing and computer vision	PEC	3	0	0	3
9	P21CSP09	Social network analysis	PEC	3	0	0	3
10	P21CSP10	Data Visualization	PEC	3	0	0	3
11	P21CSP11	Applied natural language processing	PEC	3	0	0	3
12	P21CSP12	Bio Inspired Computing	PEC	3	0	0	3
13	P21CSP13	Deep learning	PEC	3	0	0	3
14	P21CSP14	Game design	PEC	3	0	0	3
15	P21CSP15	Cloud Computing Technologies	PEC	3	0	0	3
16	P21CSP16	Blockchain Technologies	PEC	3	0	0	3
17	P21CSP17	Mixed Reality	PEC	3	0	0	3
18	P21CSP18	Internet of Things	PEC	3	0	0	3
19	P21CSP19	Robotics	PEC	3	0	0	3

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20	P21CSP20	Cognitive science	PEC	3	0	0	3

RESEARCH METHODOLOGY & IPR COURSES (RMC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P21RMC01	Research Methodology & IPR	RMC	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P21CS205	Technical Seminar	EEC	0	0	2	2
2	P21CS301	Project Work – Phase I	EEC	0	0	12	6
3	P21CS401	Project Work – Phase II	EEC	0	0	24	12
4	P21CSI01	Industrial Training / Internship	EEC	0	0	0	2

VIII. Scheme of Credit distribution – Summary

S.No	Stream	Credits/Semester				Credits	%	Suggested by AICTE
		I	II	III	IV			
1.	Foundation Courses (FC)	4				4	6	-
2.	Professional Core Courses (PCC)	11	11			22	32	-
3.	Professional Elective Courses (PEC)	3	9	6		18	26	-
4.	Research Methodology & IPR Courses (RMC)	3				3	4	-
5.	Employability Enhancement Courses (EEC)		2	6	14	22	32	-
Total		**21**	**22**	**12**	**14**	**69**	**100**	-

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SEMESTER I

		Category: FC				
P21MA101	PROBABILITY, STATISTICS AND GRAPH THEORY	L	T	P	J	C
		3	1	0	0	4

PRE–REQUISITES:

- Probability and Queuing Theory, Statistics

COURSE OBJECTIVES:

- To understand the basics of probability, random variables, standard distributions
- To provide the advanced concepts of various statistical
- To be familiar the applications of graph theory for real world problems

UNIT I PROBABILITY 9+3

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 9+3

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

UNIT III STATISTICS 9+3

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 9+3

Graphs and graph models – Graph terminology and special types of Graphs – Matrix representation of graphs and Graph isomorphism – Connectivity – Euler and Hamilton graphs.

UNIT V MATCHING, PLANARITY AND COLOURABILITY 9+3

Matchings in Bipartite graphs- Planar graphs- Graph coloring- Applications: shortest path problem.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: - Periods Project: - 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.

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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	Apply graph theory models of data structure to solve problems of connectivity and constraint Satisfaction	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	-
CO2	3	1	1	-	-	-
CO3	3	2	1	-	-	-
CO4	3	2	1	-	-	-
CO5	3	2	1	-	-	-
CO	3	2	1	-	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)						

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P21CS101	ADVANCED DATA STRUCTURES AND ALGORITHMS	Category: PC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge in role of algorithms and tree structures
- To gain knowledge on the graphs and linear programming
- To understand the concept of NP completeness and approximation algorithms

UNIT I ROLE OF ALGORITHMS IN COMPUTING 9

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of Btrees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations

UNIT III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm

UNIT IV MULTITHREADED ALGORITHMS AND LINEAR PROGRAMMING 9

Dynamic multithreading – Multithreaded matrix multiplication – Multithreaded merge sort – Linear Programming – Standard and slack forms – Formulating problems as linear programs – Simplex algorithm – Duality – Feasible solution

UNIT V NP-COMPLETENESS AND APPROXIMATION ALGORITHMS 9

Polynomial time – verification – NP-completeness and reducibility – NP-completeness proofs – NP-complete problems – Approximation Algorithms – Vertex-cover problem – Traveling-salesman problem – Set-covering problem – Randomization and linear programming – Subset-sum problem

Contact Periods:

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

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, Prentice-Hall, 2019
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, Reprint 2016
3. S.Sridhar,Design and Analysis of Algorithms, First Edition, Oxford University Press, 2014
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, 2012
5. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", Universities Press, 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the role of algorithms in computing	Understand
CO2	Apply the importance of hierarchical data structures	Apply
CO3	Describe the elementary graph algorithms	Understand
CO4	Analyze the multithreaded algorithms and linear programming	Analyze
CO5	Apply NP Completeness and approximation algorithms	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	1	-
CO2	3	-	2	2	1	-
CO3	3	-	2	2	1	-
CO4	3	-	2	2	1	-
CO5	3	-	2	2	1	-
CO	3	-	2	2	1	-

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

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P21CS102	AGILE SOFTWARE DEVELOPMENT AND USABILITY ENGINEERING	Category: PCC			
		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 – Enhancement and replacement projects - Business process automation projects - Embedded and other real – time system projects.

UNIT III TRANSITIONING TO AGILE

Business Leadership Transition - Customer Relationship Transition, Project management Transition - Agile Transition in the public sector - Discussion for Critical Thinking.

UNIT IV TEST-DRIVEN DEVELOPMENT 9

Unit, integration, system and Acceptance testing – exploratory testing – automated and manual testing, exercising boundary conditions – driving development through constant testing. **Usability engineering:** Usability of interactive system – Development Processes – Interaction Styles and Design Issues.

UNIT V USABILITY ENGINEERING 9

Usability and other considerations – Generation of user interfaces – Usability Engineering life cycle – usability Heuristic – Usability Testing – Usability Assessment methods beyond testing – Case Study on user experience

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. Karl Weigers and John Beatty Software Requirement, Third edition,1993
3. John C.pasture Project Management the Agile Way Making It Work in the Enterprise, 2nd Edition,2015
4. Orit Hazzan, Yael Dubinsky, Agile software engineering, Springer, 2014
5. Laura M. Leventhal, Julie A. Barnes, Usability Engineering: Process, Products, and Examples, Pearson/Prentice Hall, 2008

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Elucidate agile software development and related methodologies	Understand
CO2	Develop user stories to manage and plan agile projects	Analyze
CO3	Make use of agile project transition and critical planning for a given software application	Apply
CO4	Implement test driven development to increase quality	Apply
CO5	Design an interface by applying usability guidelines and assessment methods beyond testing	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	_	-
CO2	3	3	2	3	3	2
CO3	3	_	3	3	_	3
CO4	3	3	3	3	2	-
CO5	3	2	2	3	3	2
CO	3	2	2	3	3	3

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

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P21CS103	MACHINE LEARNING	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge in learning methods to enhance the performance of learning
- To gain knowledge on the suitable machine learning techniques for data handling
- To evaluate the performance of algorithms provide solution for various real-world applications

UNIT I SUPERVISED LEARNING ALGORITHMS 9

Machine Learning – Applications – Supervised Learning – Learning a Class – Vapnik-Chervonenkis Dimension – Probably Approximately correct learning – Noise – Learning Multiple Classes – Regression – Model selection and Generalization – Dimensions – Bayesian Decision Theory – Classification – Discriminant Functions – Association Rules – Parametric Methods

UNIT II CLUSTERING AND NON PARAMETRIC METHODS 9

Introduction to clustering – Expectation Maximization Algorithm – Mixtures of Latent Variable Models– Spectral Clustering – Spectral Clustering – Choosing the Number of Clusters – Nonparametric Density Estimation – Generalization to Multivariate Data – Nonparametric Classification – Condensed Nearest Neighbor – Nonparametric Regression: Smoothing Models

UNIT III MULTILAYER PERCEPTRONS AND LOCAL MODELS 9

Introduction – Training a Perceptron – Learning Boolean Functions – MLP as a Universal Approximator – Backpropagation Algorithm – Training Procedures – Bayesian View of Learning – Learning Time – Deep Learning – Competitive Learning – The Mixture of Experts – Hierarchical Mixture of Experts

UNIT IV KERNEL MACHINES, GRAPHICAL AND HIDDEN MARKOV MODELS 9

Optimal Separating Hyperplane – Kernel Trick – Vectorial Kernels – Multiple Kernel Learning – Kernel Machines for Regression and Ranking – Canonical Cases for Conditional Independence – Belief Propagation – Undirected Graphs: Markov Random Fields – Three Basic Problems of HMMs – Learning Model Parameters – Model Selection in HMMs

UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS 9

Introduction – Factors, Response, and Strategy of Experimentation – Response Surface Design – Randomization, Replication, and Blocking – Cross-Validation and Resampling Methods – Measuring Classifier Performance – Interval Estimation – Hypothesis Testing – Comparing Two Classification Algorithms – Comparison over Multiple Datasets – Multivariate Tests

Contact Periods:

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

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REFERENCES:

1. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2017
2. MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar "Foundations of Machine Learning", MIT Press, 2018
3. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,2008
4. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019
5. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, CRC Press, 2015

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concept of supervised learning	Understand
CO2	Use of clustering and non parametric methods to real world problems	Apply
CO3	Describe the multi-layer perceptrons and local models	Understand
CO4	Analyze the kernel machines, graphical and hidden Markov models	Analyze
CO5	Design and Analyze the machine learning experiments using various testing methods	Analyze

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	2	-	-
CO2	3	-	2	2	3	-
CO3	3	-	-	2	-	-
CO4	3	-	2	2	-	-
CO5	3	-	3	3	3	-
CO	3	-	2	2	3	-

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

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P21RMC01	RESEARCH METHODOLOGY AND IPR	Category: RMC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge in problem formulation, analysis and solutions.
- To impart skills required for technical paper writing / presentation without violating professional ethics
- To familiarize knowledge on Patent drafting and filing patents

UNIT I RESEARCH PROBLEM FORMULATION 9

Meaning of research problem – Sources of research problem – Criteria characteristics of a good research problem – Errors in selecting a research problem – Scope and objectives of research problem. Approaches of investigation of solutions for research problem – data collection – analysis – interpretation – necessary instrumentations

UNIT II LITERATURE REVIEW AND DATA COLLECTION 9

Effective literature studies approaches – analysis – plagiarism and research ethics. Method of data collection, Types of data – Primary Data – Scales of measurement – Source and collection of data observation method – Secondary data

UNIT III TECHNICAL WRITING / PRESENTATION 9

Effective technical writing: How to write report – paper – developing a research proposal – format of research proposal – a presentation and assessment by a review committee

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 9

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

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 9

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

Contact Periods:

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

REFERENCES:

1. Ranjit Kumar, "Research Methodology: A Step-by-Step Guidefor beginners" 2nd Edition, 2010.
2. Cooper, DR and Schindler, P S., "Business Research Methods", Tata McGraw Hill, 9th Edition, 2014.
3. Robert P. Merges, Peter S, Menell, Mark A. Lemley, "Intellectual Property" in New Technological age, 2016.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Formulate research problem	Apply
CO2	Carry out research analysis	Analyse
CO3	Develop research proposal	Evaluate
CO4	Draft process of patenting	Apply
CO5	File and publish patents in R & D.	Evaluate

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	-	-
CO2	3	3	3	2	-	-
CO3	3	3	3	2	1	-
CO4	3	3	3	2	2	-
CO5	3	3	3	2	2	-
CO	3	3	3	2	2	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)		3: Substantial (High)	

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21CS104	MACHINE LEARNING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	2	2

COURSE OBJECTIVES:

- To acquire knowledge in learning methods to enhance the performance of learning
- To implement the suitable machine learning techniques for data handling
- To evaluate the performance of algorithms and to provide solution for various real-world applications

List of Experiments

1. Implement Decision Tree learning
2. Implement Logistic Regression
3. Implement classification using Multilayer perceptron
4. Implement classification using SVM
5. Implement Bagging using Random Forests
6. Implement k-nearest Neighbors algorithm
7. Implement K-means, K-Modes Clustering to Find Natural Patterns in Data
8. Implement Hierarchical clustering
9. Implement Gaussian Mixture Model Using the Expectation Maximization
10. Implement Principle Component Analysis for Dimensionality Reduction

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	Implement the concept of supervised learning	Apply
CO2	Use of clustering and non parametric methods to real world problems	Apply
CO3	Implement the multi-layer perceptrons and local models using classification techniques	Apply
CO4	Analyze the K-means, K-Modes Clustering to Find Natural Patterns in Data	Apply
CO5	Implement Principle Component Analysis for Dimensionality Reduction	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	-
CO2	3	1	2	1	1	-
CO3	3	1	2	1	1	-
CO4	3	1	2	1	1	-
CO5	3	1	2	1	1	-
CO	3	1	2	1	1	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)						

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SEMESTER II

P21CS201	MODERN OPERATING SYSTEMS	Category: PCC			
		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 and Trends in Distributed Operating Systems. Focus on resource sharing – Challenges. Case study: World Wide Web

UNIT II SYNCHRONIZATION 9

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

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. Case study: Enterprise Java Beans – from objects to components

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 Study – LDAP

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 Study – Face recognition app

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.

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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
CO1	2	-	-	-	-	-
CO2	2	2	2	-	-	-
CO3	2	2	2	-	-	-
CO4	2	2	1	-	-	-
CO5	2	2	2	-	-	-
CO	2	2	2	-	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)						

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P21CS202	DATA SCIENCE	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge of the various libraries and packages required to perform data analysis.
- To understand data visualization, web scraping and machine learning
- To implement data science using python
-

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation. Numpy basics: Arrays The NumPyndarray: A Multidimensional Array Object – Universal Functions: Fast Element- wise Array Functions – Data processing using arrays

UNIT II VECTORIZED COMPUTATION AND PANDAS 9

File Input and Output with Arrays – Linear Algebra – Random Number Generation – Random Walks Pandas data structures – Essential Functionality – Summarizing and Computing Descriptive Statistics – Handling Missing Data – Hierarchical Indexing

UNIT III DATA LOADING, STORAGE & DATA WRANGLING 9

Data loading, Storage, and File Formats: Reading and Writing Data in Text Format – Binary Data Formats – Interacting with HTML and Web APIs – Interacting with Databases. Data Wrangling: Clean, Transform, Merge, Reshape : Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String Manipulation – USDA Food Database

UNIT IV PLOTTING AND VISUALIZATION 9

Matplot lib API Primer – Plotting Functions in pandas – Plotting Maps: Visualizing Haiti Earthquake Crisis Data – Python Visualization Tool Ecosystem

UNIT V DATA AGGRETATION AND GROUP OPERATIONS 9

Groupby Mechanics – Data Aggregation – Group-wise Operations and Transformations – Pivot Tables and Cross-Tabulation, Time Series: Date and Time Data Types and Tools – Time Series Basics – Date Ranges, Frequencies, and Shifting – Time Zone Handling – Periods and Period Arithmetic – Resampling and Frequency Conversion – Time Series Plotting – Moving Window Functions – Performance and Memory Usage Notes

Contact Periods:
Lecture: 45 Periods Tutorial: - Periods Practical: - Periods Total: 45 Periods

REFERNCES:

1. Wes McKinney, "Python for Data Analysis", O'Reilly Media. 2012
2. Sebastian Raschka, "Python Machine Learning",Packpub.com, 2015
3. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
4. https://www.datacamp.com/courses/statistical-thinking-in-python-part1

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the roles and stages of data science with structures provided by numpy library for arrays.	Understand
CO2	Demonstrate the data structures provided by pandas library for data analysis	Apply
CO3	Perform data wrangling, cleaning and transformation using python	Apply
CO4	Use matplot lib for plotting and visualizing the datasets	Analyze
CO5	Demonstrate data aggregation and time series analysis using python programming Language	Analyze

COURSE ARTICULATION MATRIX:

POs COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	3	-	-
CO2	3	-	2	3	-	-
CO3	3	-	2	3	2	-
CO4	3	-	3	3	2	-
CO5	3	-	3	3	2	-
CO	3	-	2	2	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium). 3: Substantial (High)						

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P21CS203	BIGDATA ANALYTICS	Category: PCC			
		L	T	P	C
		3	0	0	3

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

Hadoop – Requirement of Hadoop Framework – Design principle of Hadoop – Comparison with other system – Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats – Map side join – Reduce Side Join – Secondary sorting – Pipelining MapReduce jobs

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

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REFERENCES:

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiely and SAS Business Series, 2016
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. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", First Edition, Wiley Publication, 2015
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012

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
CO1	3	2	2	2	2	1
CO2	3	2	2	2	2	1
CO3	3	2	2	2	2	1
CO4	3	2	2	2	1	1
CO5	3	2	2	2	1	1
CO	3	2	2	2	1	1

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

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KPRIET
Learn Beyond

P21CS204	DATA ANALYTICS LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	2

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 dataset in R
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

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2		2	3	-
CO2	3	3	2	2	3	-
CO3	3	2	1	1	-	-
CO4	3	3	1	2	-	-
CO5	3	3	2	2	3	-
CO	3	2	1	1	3	-

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

Passed on Board of Studies Meeting held on 5.10.2021

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P21CSP01	INFORMATION RETRIEVAL TECHNIQUES	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To understand the 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 9

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

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REFERENCES:

1. Christopher D. Manning, PrabhakarRaghavan, Hinrich Schutze, "Introduction to Information Retrieval', Cambridge University Press, First South Asian Edition, 2008
2. Implementing and Evaluating Search Engine', 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
4. C. D. Manning, P. Raghavan, and H. Schutze ,"An Introduction to Information Retrieval", Cambridge University Press, 2009
5. R. Baeza-Yates and B. Ribeiro-Neto "Modern Information Retrieval", Pearson Education,1999

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Discuss the basic concepts and processes of information retrieval systems	Understand
CO2	Build an information retrieval system using the available tools	Apply
CO3	Make use of the common algorithms and techniques for document indexing, retrieval, and query processing	Analyze
CO4	Apply machine learning techniques to text classification and clustering which is used for efficient information retrieval	Apply
CO5	Apply ranking, crawling and indexing principles for web search	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	2	-	-
CO2	3	1	2	3	3	-
CO3	3	-	2	3	3	-
CO4	3	-	3	3	3	-
CO5	3	-	2	3	3	-
CO	3	-	2	3	3	-

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

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P21CSP02	NOSQL DATABASE	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems
- Elucidate the architectures and common features of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
- Compare and contrast 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 DATA MODELS AND DATA MANAGEMENT 9

Data Management - Information Systems and Databases - SQL Databases - Big Data - NoSQL databases - Organisation of Data Management - Data Modeling - From Data Analysis to Database - The Entity Relationship Model - Implementation in the Relational model - Implementation in the Graph Model - Enterprise-Wide Data Architecture - Database design

UNIT II NOSQL AND AGGREGATE DATA MODELS 9

Reasons for NoSQL - The value of relational databases - Impedance mismatch - Application and Integration Databases - The emergence of NoSQL - Aggregate data models - Key-value and document data models - Column-family stores - Relationships - Graph databases - Schema-less databases - Materialised views - Modeling for data access.

UNIT III KEY VALUE DATABASES 9

Key-value store, key-value store features, use cases - session maintenance - user profile maintenance - shopping cart management - Understanding when not to use

UNIT IV DOCUMENT DATABASES 9

Document database features - consistency - transactions - availability - query features - scaling - use cases - event logging - content management systems, blogging platforms - web analytics - real time analytics - e-commerce applications - when not to use - complex transactions - varying aggregate structure

UNIT V COLUMN FAMILY STORES AND GRAPH DATABASES 9

Column family data store - features - consistency - transactions - availability - query features - scaling - use cases - event logging - content management systems - counters - expiring usage - graph databases - features of graph databases - use cases

Contact Periods:

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

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REFERENCES:

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
3. Luc Perkins, Redmond, E. &Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", A Kindle 2nd Edition,2018
4. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012
5. Adam Fowler, NoSQL for Dummies, For Dummies, 2015

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate data modeling and data management	Understand
CO2	Explain NoSQL and aggregate data models	Understand
CO3	Implement key value databases	Apply
CO4	Develop document databases	Apply
CO5	Develop column family stores and graph databases	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	3	-	-
CO2	3	3	-	3	-	-
CO3	3	-	2	2	2	-
CO4	3	-	2	2	2	-
CO5	3	-	2	2	1	-
CO	3	2	2	2	1	-

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

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P21CSP03	SOFTWARE DEFINED NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To differentiate traditional networks and software defined networks
- To understand advanced and emerging networking technologies
- To gain advanced networking research and programming skills

UNIT I INTRODUCTION 9

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

UNIT II SDN ABSTRACTIONS 9

SDN Work's – Model Openflow Protocol – SDN Controllers: 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

UNIT V SDN'S FUTURE AND PERSPECTIVES 9

SDN Open Source – SDN Futures – Tools

Contact Periods:

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

REFERENCES:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publications, 2014
2. Thomas D. Nadeau & Ken Gray, "SDN - Software Defined Networks", O'Reilly, 2013
3. Siamak Azodolmolky, "Software Defined Networking with OpenFlow", Packt Publishing, 2013
4. 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	Explain basics of software defined network	Understand
CO2	Analyze different SDN network protocols	Analyze
CO3	Elucidate the techniques employed in SDN programming	Understand
CO4	Develop SDN applications	Apply
CO5	Examine open source tools for SDN	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	-	-	-
CO2	3	-	-	-	-	-
CO3	3	-	-	-	-	-
CO4	3	-	-		2	-
CO5	3	-	-	-	2	-
CO	3	-	2	-	2	-

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

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P21CSP04	VEHICULAR SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the need and fundamentals of vehicular networks
- To analyze how information is disseminated in Adhoc Routing networks
- Conceptualize autonomous driving technologies and evaluate the systems

UNIT I INTRODUCTION 9

History - Overview of Vehicular Networks – Architecture, Applications. Overview of Enabling Technologies – 5G, Mobile Edge computing, Network virtualization, SDN, Computation offloading, Blockchain, Information centric Networks, edge caching, artificial intelligence

UNIT II FUNDAMENTALS OF VEHICULAR COMMUNICATION 9

Physical Layer – MAC Layer – Message Sets – Decentralized congestion control – Multichannel operations, Coexistence and spectrum sharing – Forwarding in VANETs – GeoNetworking, Use of IPV6, Security and Privacy.

UNIT III EVALUATION 9

Mobility models – Channel models – Simulation tools and techniques – Field operational tests and deployment plans.

UNIT IV AUTONOMOUS DRIVING 9

Deep Learning based Autonomous Driving in Vehicular Networks - Overview, Architecture, Learning with Groups, Simulation.

UNIT V FUTURE DIRECTIONS 9

Trading Mechanisms – Big Data – QoE Aware Services – IoT based Smart Transportation Systems – Resource Integration and Allocation- Intelligent Road side Infrastructure for Automated vehicle – Software defined networking for emergency traffic management in smart cities.

Contact Periods:

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

REFERENCES:

1. Zhou Su, Yilong Hui, Tom H Luan, Qiaorong Liu, Rui Xing, "The Next Generation Vehicular Networks, Modeling, Algorithm and Applications", Springer 2021
2. Claudia Campolo, Antonella Molinaro, Riccardo Scopigno, "Vehicular ad hoc networks – Standards, Solutions and Research", Springer 2015
3. Anis Laouiti, Amir Qayyum, Mohammed Naufal, Mohammed Saad, "Vehicular Ad-hoc Networks for Smart Cities", Third International Workshop on Advances in Intelligent Systems and Computing, Springer, 2019
4. Mohammed Watfa, "Advances in Vehicular ad-hoc networks – Developments and Challenges", Information Science Reference, Newyork, IGI Global, 2010
5. Stephen Olariu, Michele Weigle, "Vehicular Networks: From Theory to Practice", Chapman & Hall, 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the need for vehicular networks	Analyze
CO2	Summarize the applications of vehicular systems in near future	Apply
CO3	Analyze the architecture and evaluate the performance of vehicular networks	Apply
CO4	Create Use cases to evaluate autonomous driving vehicles	Apply
CO5	Apply the concepts and techniques in multiple disciplines	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	-	-
CO2	3	2	2	2	-	-
CO3	2	1	1	2	-	-
CO4	3	2	2	2	3	-
CO5	3	2	2	2	3	-
CO	3	2	2	2	3	-

Correlation levels:

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

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P21CSP05	REAL TIME SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn real time operating system concepts, the associated issues & techniques.
- To understand real time operating System and its performance evaluation.
- To explore the concepts of real time databases and learn the evaluation techniques of real time systems.

UNIT I REAL TIME SYSTEM AND SCHEDULING 9

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 REAL TIME OPERATING SYSTEMS 9

Pseudo kernel to OS – Theoretical Foundations of Scheduling – System Services for Application Programs – Memory Management Issues – Selecting Real-Time Operating Systems – Case Study

UNIT III PERFORMANCE ANALYSIS 9

Real-Time Performance Analysis – Arguments Related to Parallelization – Applications of Queuing Theory – Input / Output Performance – Analysis of Memory Requirements

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 – 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 and 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 practicell", 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 Introductionll", Prentice Hall of India, 1998

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Elucidate the principles RTS's and various scheduling methods	Apply
CO2	Explain RTOS foundation & scheduling	Apply
CO3	Apply various RTS performance analysis techniques	Apply
CO4	Develop a RTS using databases	Apply
CO5	Test RTS using different evaluation techniques	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	2	-	-
CO2	2	-	2	2	-	-
CO3	3	-	3	2	2	-
CO4	3	-	2	2	3	-
CO5	3	-	2	2	2	-
CO	3	-	2	2	2	-

Correlation levels:

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

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P21CSP06	RECONFIGURABLE COMPUTING	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose students to HDL programming and familiarize with the development environment
- To develop applications with FPGAs

UNIT I DEVICE ARCHITECTURE 9

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

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS 9

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

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS 9

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

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 9

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

UNIT V APPLICATION DEVELOPMENT WITH FPGAS 9

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

Contact Periods:

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

REFERENCES:

1. Christophe Bobda, "Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications‖", Springer, 2010
2. Scott Hauck and Andre Dehon , "Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation‖", Elsevier / Morgan Kaufmann, 2008
3. Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays‖", Springer, 2005
4. Nicole Hemsoth, Timothy Prickett Morgan, "FPGA Frontiers: New Applications in Reconfigurable Computing", 2017
5. Joao Cardoso, Michael Hübne, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign", Springer 2011

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Discuss the architecture of FPGAs	Understand
CO2	Point out the salient features of different reconfigurable architectures	Understand
CO3	Develop applications using any HDL and appropriate tools	Apply
CO4	Design reconfigurable platforms using FPGA	Apply
CO5	Build an SoPC for a particular application.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	-	-
CO2	3	-	2	3	-	-
CO3	3	-	3	3	3	-
CO4	3	-	3	3	3	-
CO5	3	-	3	3	3	-
CO	3	-	3	3	3	-

Correlation levels:

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

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P21CSP07	CYBER SECURITY PRACTICES	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the core fundamentals of system and network security concepts
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts

UNIT I SYSTEM SECURITY 9

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers

UNIT II NETWORK SECURITY 9

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

UNIT III SECURITY MANEGEMENT 9

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

UNIT IV CYBER SECURITY AND CRYPTOGRAPHY 9

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

UNIT V PRIVACY AND STORAGE SECURITY 9

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

Contact Periods:

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

REFERENCES:

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

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain fundamentals of system security	Understand
CO2	Apply the network security concepts related to networks in wired and wireless scenario	Apply
CO3	Implement the security essentials in IT sector	Apply
CO4	Explain the concepts of cyber security and encryption	Understand
CO5	Implement privacy and security measures for storage	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	-	-
CO2	3	-	3	3	2	-
CO3	3	-	3	3	3	-
CO4	3	-	2	3	-	-
CO5	3	-	3	3	2	-
CO	3	-	2	3	2	-

Correlation levels:

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

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P21CSP08	DIGITAL IMAGE PROCESSING AND COMPUTER VISION	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic principles of digital image processing techniques for computer vision
- To understand image processing theory for developing applications involving image processing
- To apply a variety of computer vision techniques for real- world applications

UNIT I INTRODUCTION 9

Motivation & Perspective, Applications, Components of Image Processing System, Steps in Image Processing, Image Sampling and Quantization, Some relationships like Neighbors, Connectivity, Distance Measures between pixels

UNIT II IMAGE ENHANCEMENT 9

Point processing, Neighborhood processing, Basic Gray Level Transformations, Histogram Processing, Enhancement using arithmetic and logic operations, Zooming, Spatial Filters, Smoothening and Sharpening, Combining Spatial Enhancement Methods

Fourier Transform Frequency Domain, Smoothing and Sharpening, Frequency Domain Filters

UNIT III IMAGE RESTORATION AND IMAGE COMPRESSION 9

Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Geometric Mean Filter, Geometric Transformations

Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards

UNIT IV IMAGE AND MORPHOLOGICAL IMAGE PROCESSING 9

Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Basic Morphological Algorithms

UNIT V OBJECT REPRESENTATION AND COMPUTER VISION TECHNIQUES 9

Morphology, Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods, Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

Contact Periods:

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

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REFERENCES:

1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 2nd Edition, Pearson Education. 2008, New Delhis
2. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Prentice Hall, 2012
3. A.K. Jain, "Fundamental of Digital Image Processing", PHI, 2006
4. Simon J.D. Prince, "Computer Vision: Models, Learning and Interface", Cambridge University Press, 2012

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 computer vision	Understand
CO2	Demonstrate the use of image enhancement in the spatial and frequency domain	Apply
CO3	Apply various image restoration and compression techniques	Apply
CO4	Analyze various segmentation and morphological image processing techniques	Analyze
CO5	Demonstrate the representation of objects in computer vision	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	2	1	-
CO2	3	-	2	2	2	-
CO3	3	-	2	2	2	-
CO4	3	-	2	2	2	-
CO5	3	-	-	2	2	-
CO	3	-	2	2	2	-

Correlation levels:

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

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P21CSP09	SOCIAL NETWORK ANALYSIS	Category: PEC			
		L	T	P	C
		3	0	0	3

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

Web Series – 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 – Electronic Discussion networks – Blogs and online communities – Web based networks

UNIT II MODELING AND VISUALIZATION 9

Evolution in Social Networks – Framework – Tracing Smoothly Evolving Communities– Models and Algorithms for Social Influence Analysis– Expert Location without Graph Constraints – With Score Propagation – Expert Team Formation

UNIT III MINING COMMUNITIES 9

Modeling and aggregating social network data –Ontological representation of social individuals and relationships – Reasoning with social network data – Advanced Representations –Taxonomy of Visualizations – Graph Representation – Centrality – Clustering – Node-Edge Diagrams – Visualizing Social Networks : Matrix - Based Representations ,Hybrid Representations

UNIT IV EVOLUTION 9

Web as a social network – Detecting Communities in Social Networks – Random Walks and their Applications– Node Classification in Social Networks – Link Prediction in Social Networks– Feature based Link Prediction – Bayesian Probabilistic Models – Probabilistic Relational Models

UNIT V APPLICATIONS 9

Learning Based Approach for Real Time Emotion Classification of Tweets – 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. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.

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

4. Applications of Social Media and Social Network Analysis,(Przemysław Kazienko, Nitesh Chawla), Springer ,2015,

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OUTCOMES:

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

COs	Statements	K-Level
CO1	Discuss the components of the social network	Understand
CO2	Examine the evolution and algorithms of the social network	Understand
CO3	Model and visualize the social network	Analyze
CO4	Analyze the behavior of the users in the social network	Analyze
CO5	Recognize the social network concepts in real time applications	Understand

COURSE ARTICULATION MATRIX:

POs COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	3	2	-
CO2	3	-	2	3	2	-
CO3	3	-	3	3	3	-
CO4	3	-	3	3	3	-
CO5	3	-	3	3	2	-
CO	3	-	2	3	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium). 3: Substantial (High)						

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P21CSP10	DATA VISUALIZATION	Category: PEC			
		L	T	P	C
		3	0	0	3

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.

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– 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.

UNIT IV INFORMATION DASHBOARD DESIGN 12

Information dashboard –Dashboard design issues and assessment– 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

REFERENCES:

1. Tamara Munzner, Visualization Analysis and Design, "AK Peters Visualization Series, CRC Press",Nov.2014
2. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
3. Gert H. N. Laursen and JesperThorlund, "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

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COURSE OUTCOMES:

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

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

COURSE ARTICULATION MATRIX:

POs COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	-	-
CO2	3	3	2	-	-	-
CO3	3	3	3	-	-	-
CO4	3	3	2	-	-	-
CO5	3	3	2	-	-	-
CO	3	3	2	-	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium). 3: Substantial (High)						

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P21CSP11	APPLIED NATURAL LANGUAGE PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge in language models and semantics
- To understand the role of grammars and parsing in NLP
- To learn the concept of Lexicons, Coreference and Coherence

UNIT I TEXT NORMALIZATION AND N-GRAM LANGUAGE MODELS 9

Regular Expressions – Words – Corpora – Text Normalization – Minimum Edit Distance – N-Grams – Evaluating Language Models – Generalization and Zeros – Smoothing –Kneser-Ney Smoothing – Huge Language Models and Stupid Backoff – Perplexity's Relation to Entropy

UNIT II SEMANTICS AND SEQUENCE LABELING FOR PARTS OF SPEECH 9

Lexical Semantics – Vector Semantics – Words and Vectors – TF-IDF: Weighing terms in the vector –Pointwise Mutual Information (PMI) – Applications of the TF-IDF or PPMI vector models – Word2vec – English Word Classes – Part-of-Speech Tagging – Named Entities and Named Entity Tagging – HMM Part-of-Speech Tagging – Conditional Random Fields –Evaluation of Named Entity Recognition

UNIT III CONSTITUENCY GRAMMARS AND PARSING 9

Constituency – Grammar Rules for English – Treebanks– Grammar Equivalence and Normal Form – Lexicalized Grammars – Ambiguity – CKY Parsing: Dynamic Programming Approach – Span-Based Neural Constituency Parsing – Evaluating Parsers – Partial Parsing – CCG Parsing

UNIT IV LOGICAL REPRESENTATIONS AND INFORMATION EXTRACTION 9

Computational Desiderata for Representations – Model-Theoretic Semantics – First-Order Logic – Event and State Representations – Relation Extraction – Algorithms – Extracting Times – Extracting Events and their Times – Template Filling

UNIT V LEXICONS, COREFERENCE RESOLUTION AND COHERENCE 9

Emotion – Creating Affect Lexicons by Human Labeling– Semi-supervised Induction of Affect Lexicons – Supervised Learning of Word Sentiment –Coreference Tasks and Datasets – Architectures for Coreference Algorithms – Evaluation of Coreference Resolution – Coherence Relations – Discourse Structure Parsing – Global Coherence

Contact Periods:

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

REFERENCES:

1. Daniel Jurafsky, James H. Martin Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2020.
2. Breck Baldwin, Language Processing with Java and Ling Pipe Cookbook, Atlantic Publisher, 2015.
3. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015
4. NitinIndurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010
5. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, OReilly Media, 2009

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concept of text normalizations and language models	Understand
CO2	Apply the semantics and sequence labeling	Apply
CO3	Implement the constituency grammars and parsing in NLP	Apply
CO4	Analyze the logical representation and information extraction	Analyze
CO5	Interpret the concept of Lexicons, Coreference	Apply

COURSE ARTICULATION MATRIX:

POs COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	1	2	3	-
CO2	1	-	1	2	3	-
CO3	1	-	1	2	3	-
CO4	1	-	1	2	3	-
CO5	1	-	1	2	3	-
CO	1	-	1	2	3	-

Correlation levels:

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

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P21CSP12	BIO-INSPIRED COMPUTING	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn bio-inspired theorem, algorithms and techniques
- To understand random walk and simulated annealing and genetic algorithms
- To learn swarm optimization and ant colony for feature selection

UNIT I INTRODUCTION 9

Introduction to algorithm – Newton ' s method – optimization algorithm – Search for Optimality - No-Free-Lunch Theorems – Nature-Inspired Metaheuristics – Analysis of Algorithms – Nature Inspired Algorithms – Parameter tuning and parameter control

UNIT II RANDOM WALK AND SIMULATED ANNEALING 9

Random variables –Isotropic random walks – Levy distribution and flights – Optimization as Markov chains – step sizes and search efficiency – Modality and intermittent search strategy –importance of randomization– Eagle strategy–Annealing and Boltzmann Distribution –parameters –SA algorithm – Unconstrained Optimization –Basic Convergence Properties – SA Behavior in Practice - 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 – Variants –choice of parameters – convergence analysis –implementation

UNIT IV PARTICLE SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

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

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

Contact Periods:

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

REFERENCES:

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

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COURSE OUTCOMES:

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

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

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	-	-	-
CO3	3	-	3	-	3	-
CO4	3	-	2	-	-	-
CO5	3	-	3	2	3	-
CO	3	-	2	-	3	-

Correlation levels:

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

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P21CSP13	DEEP LEARNING	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of neural networks and deep networks.
- To discuss the major architectures of deep networks.
- To demonstrate the applications of deep learning

UNIT I BASICS OF NEURAL NETWORKS 9

Neural Network Basics–Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation graph, Vectorization, 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-TensorFlow, Keras, MatConvNet.

Contact Periods:

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

REFERENCES:

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.
3. Python Machine Learning by Example, Yuxi (Hayden) Liu, First Edition, 2017.
4. Daniel Graupe, "Deep Learning Neural Networks: Design and Case Studies", World Scientific Publishing , 2016.
5. Yu and Li Deng, "Deep Learning: Methods and Applications", Now Publishers Inc 2014.

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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
CO1	3	2	2	3	3	-
CO2	3	3	2	2	3	-
CO3	3	3	3	3	3	-
CO4	3	3	3	3	3	-
CO5	3	3	3	3	3	-
CO	3	2	2	2	3	-

Correlation levels:

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

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P21CSP14	GAME DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the notion of a game, its solutions concepts, and other basic notions and tools of game theory
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory
- To draw the connections between game theory, computer science, and economics, emphasizing the computational issues

UNIT I INTRODUCTION 9

Basics of games – strategy – preferences – payoffs – Mathematical basics –Game theory –Rational Choice – Basic solution concepts-non-cooperative games –cooperative games – Basic computational issues – finding equilibria and learning in games

UNIT II GAMES WITH PERFECT INFORMATION 9

Strategic games – prisoner's dilemma, matching pennies- Nash equilibria- theory and illustrations – Cournot's and Bertrand's models of oligopoly- auctions- mixed strategy equilibrium- zero-sum games- Extensive Games with Perfect Information-repeated games (prisoner's dilemma)

UNIT III GAMES WITH IMPERFECT INFORMATION 9

Bayesian Games – Motivational Examples – General Definitions –Information aspects – Illustrations – Extensive Games with Imperfect –Information – Strategies- Nash Equilibrium – Beliefs and sequential equilibrium – Illustrations – Repeated Games – Prisoner's Dilemma – Bargaining

UNIT IV NON-COOPERATIVE GAME THEORY 9

Self-interested agents- Games in normal form – Analyzing games: from optimality to equilibrium – Computing solution concepts of Normal-Form games – Computing Nash equilibria of two-player, zero-sum games –Computing Nash equilibria of two player, general-sum games – Identifying dominated strategies

UNIT V MECHANISM DESIGN 9

Aggregating Preferences-Social Choice – Formal Model- Voting – Existence of social functions – Ranking systems – Protocols for Strategic Agents: Mechanism Design –unrestricted preferences- Efficient mechanisms – Vickrey and VCG mechanisms - Applications of mechanism design – Computer Science – eBay auctions – K-armed bandits

Contact Periods:

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

REFERENCES:

1. M. Machler, E. Solan, S. Zamir, "Game Theory", Cambridge University Press, 2013
2. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani , "Algorithmic Game Theory" Cambridge University Press, 2007
3. A.Dixit and S. Skeath, "Games of Strategy", Second Edition, W W Norton & Co Inc, 2004
4. YoavShoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press 2008
5. Zhu Han, DusitNiyato, WalidSaad, Tamer Basar and Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Discuss the notion of a strategic game , equilibria ,and characteristics of main applications	Understand
CO2	Explain the use of Nash Equilibrium for various games	Understand
CO3	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation	Apply
CO4	Apply Bayesian games for suitable gaming applications	Apply
CO5	Implement a typical Virtual Business scenario using Game theory	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	-	-	-	-
CO3	3	2	1	2	3	-
CO4	3	2	2	2	3	-
CO5	3	2	2	2	3	-
CO	3	2	2	2	3	-

Correlation levels:

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

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KPRIET
Learn Beyond

P21CSP15	CLOUD COMPUTING TECHNOLOGIES	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I VIRTUALIZATION 9

Virtual Machines –Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation – Taxonomy of Virtual Machines. 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: Infrastructure, platform, software –Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges – Public Cloud Platforms : GAE,AWS

UNIT IV PROGRAMMING MODEL 9

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

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 –privacy issues in the cloud – Cloud Security and Trust Management

Contact Periods:

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

REFERENCES:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012
2. Danielle Ruest, Nelson Ruest, Virtualization: A Beginner"s Guidell, McGraw-Hill Osborne Media, 2009
3. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009
5. Tim Mather, SubraKumaraswamy, and ShahedLatif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009

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Passed on Board of Studies Meeting held on 5.10.2021

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	Apply
CO2	Apply the concept of virtualization in the cloud computing	Apply
CO3	Explain 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	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	-	2	-	-
CO2	3	-	-	2	2	-
CO3	3	1	-	3	-	-
CO4	3	-	-	2	3	-
CO5	3	-	3	2	2	-
CO	3	1	2	2	2	-

Correlation levels:

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

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P21CSP16	BLOCK CHAIN TECHNOLOGIES	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of block chain technology.
- To familiarize bit coin and crypto currency principles.
- To explore distributed consensus of 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

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.

UNIT III BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW) – HashcashPoW , BitcoinPoW, 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.

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

Blockchain Hyperledger – Architecture of 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

REFERENCES:

1. EladElrom, 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, 2017.

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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	Distinguish the concepts of bitcoin and cryptocurrency	Understand
CO3	Classify the bitcoin consensus	Understand
CO4	Identify and understand the distributed consensus of blockchain	Understand
CO5	Implement the hyper ledger fabric and ethereum network framework	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	2	-	-
CO2	3	1	1	2	-	-
CO3	3	2	2	-	-	-
CO4	3	3	2	-	-	-
CO5	3	3	3	-	-	
CO	3	1	2	-	-	

Correlation levels:

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

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P21CSP17	MIXED REALITY	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Elucidate the virtual reality systems and its applications.
- Implement Basic virtual reality systems functions
- Make use of the integration of hardware and software in virtual reality applications.

UNIT I VIRTUAL REALITY MODELS 9

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

UNIT II GEOMETRIC MODELING GEOMETRICAL TRANSFORMATIONS 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation –Geometrical Transformations: 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: 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 – Objects falling in a graphical field –Rotating wheels – Elastic collisions – Simple pendulum – Springs – Flight dynamics of an aircraft

UNIT IV VR HARDWARES & SOFTWARES 9

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

UNIT V VR APPLICATIONS 9

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

Contact Periods:

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

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REFERENCES:

1. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", WileyInterscience,1 Edition,2008. John Vince, "Virtual Reality Systems ", Pearson Education Asia,3rd edition 2007
2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 1994
3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design",Morgan Kaufmann, 2nd Edition,2005
4. John Vince, "Virtual Reality Systems ", Pearson Education Asia,3rd edition 2007

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate 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 suitable domains.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	2	-
CO2	3	-	2	3	2	-
CO3	3	-	2	-	2	-
CO4	3	-	2	-	2	-
CO5	3	-	3	-	2	-
CO	3	-	2	-	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium). 3: Substantial (High)						

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P21CSP18	INTERNET OF THINGS	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things and its protocols
- To learn the data analytics and cloud in the context of IoT
- To apply the concept of Internet of Things in the real-world scenario

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II 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 III DESIGN AND DEVELOPMENT 9

Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

Contact Periods:

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

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, —IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2)
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. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011

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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	Analyze the various types of protocols in IoT	Analyze
CO3	Design a portable IoT application using Raspberry Pi	Apply
CO4	Apply the data analytics concepts for IoT	Apply
CO5	Apply the concepts of IoT for a real-world scenario	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	3	-	-
CO2	3	-	3	2	1	-
CO3	3	2	3	3	3	-
CO4	3	-	2	3	3	-
CO5	3	-	2	3	3	-
CO	3	2	2	3	3	-

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

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P21CS19	ROBOTICS	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic knowledge of mobile robots
- To understand perception in case of robots
- To solve the problems of SLAM and understand mobile robot path planning

UNIT I INTRODUCTION 9

Introduction to robots, various components of robot, applications of robots, classification of robots, mobile robot actuators, advantages and disadvantages of robots. Types of mobile robot locomotion in robots, legged mobile robots, wheeled mobile robots

UNIT II ROBOT FUNDAMENTALS 9

Elements of Robots-Joints, Links, Actuators, and Sensors - Classification of end effectors-tools as end effectors-drive system for grippers, mobile robot kinematics: kinematic models and constraints, mobile robot maneuverability, mobile robot work space, motion control

UNIT III PERCEPTION 9

Mobile robot perception, sensors for mobile robots, representing uncertainty, feature extraction, Mobile robot mapping, sonar sensor model, laser sensor mapping, fundamentals of vision sensor

UNIT IV VISION SYSTEM 9

Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations

UNIT V PLANNING AND NAVIGATION 9

Introduction, path planning-overview-road map path planning-cell decomposition path planning-potential field path planning-obstacle avoidance-case studies. Applications - Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space applications-Industrial robots-artificial intelligence in robots

Contact Periods:

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

REFERENCES:

1. Richared D.Klafter.Thomas Achmielewski and Mickael Negin, "Robotic Engineering an Integrated approach", Prentice hall of India, Newdelhi-2001
2. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, "Robotics – Modelling Planning and Control", Springer, 2009
3. Saeed B.Nikku, Introduction to Robotics, analysis, control and applications Wiley-India 2nd edition-2011
4. Tsunco Yoshikawa, "Foundations of Robotics, Analysis and Control", prentice Hall of India, 2001
5. Craig J J, "Introduction to Robotics: Mechanics and Control", 2nd Edition, Boston, Addison – Wesley, 2004

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basic concepts of working of robot	Understand
CO2	Understand the function of sensor in robot and design the robotic arm with various tools	Apply
CO3	Understand perception in case of robots	Understand
CO4	Explain the working of vision system	Understand
CO5	Understand mobile robot path planning	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	-	-	-
CO2	3	-	2	-	2	-
CO3	3	-	2	-	-	-
CO4	3	-	2	-	-	-
CO5	3	-	2	-	-	-
CO	3	-	2	-	-	-

Correlation levels:

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

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P21CSP20	COGNITIVE SCIENCE	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of Cognitive Science with focus on acquisition, representation and use of knowledge by individual minds, brains, and machines.
- To gain the role of neuro-science in the cognitive field.
- To learn about computational models for semantic processing.

UNIT I INTRODUCTION 9

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

UNIT II COGNITIVE NEUROSCIENCE 9

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

UNIT III LANGUAGE ACQUISITION, SEMANTICS AND PROCESSING MODELS 9

Milestones in Acquisition – Theoretical Perspectives- Semantics and Cognitive Science – Meaning and Entailment – Reference – Sense – Cognitive and Computational Models of Semantic Processing – Information Processing Models of the Mind- Neural networks and distributed information processing- Neural network models of Cognitive Processes

UNIT IV HIGHER-LEVEL COGNITION 9

Reasoning – Decision Making – Computer Science and AI: Foundations & Robotics – New Horizons - Dynamical Systems and Situated Cognition- Challenges – Emotions and Consciousness – Physical and Social Environments

UNIT V APPLICATIONS 9

Models of Language Learning – Object Perception and folk physics – Machine Learning to Deep Learning – Cognitive science of Consciousness – Looking Ahead: Challenges and Opportunities.

Contact Periods:

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

REFERENCES:

1. José Luis Bermúdez, "Cognitive Science: An Introduction to the Science of the Mind", Third Edition, Cambridge University Press, New York, 2020
2. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, Jay L. Garfield and Edwin L. Rissland, "Cognitive Science: An Introduction", Second Edition, MIT Press,1995
3. Robert L. Solso, Otto H. MacLin and M. Kimberly MacLin, "Cognitive Psychology, Pearson Education, 2007.
4. J. Friedenberg and G. Silverman, "Cognitive Science: An Introduction to the Study of Mind", 2011.
5. Steven Pinker, "How the mind works", W. W. Norton & Company; Reissue edition, 2009.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Analyze the methods of knowledge representation in cognitive processing	Analyze
CO2	Design cognitive architectures	Apply
CO3	Explain the connection between brain and cognition	Apply
CO4	Apply neural network models to cognition	Apply
CO5	Apply reasoning & decision making to design dynamic systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	-	-
CO2	3	2	2	2	-	-
CO3	2	1	1	2	-	-
CO4	3	2	2	2	3	-
CO5	3	2	2	2	3	-
CO	3	2	2	2	3	-

Correlation levels:

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

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