



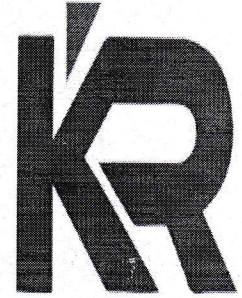
**M.KUMARASAMY**  
**COLLEGE OF ENGINEERING**

NAAC Accredited Autonomous Institution

Approved by AICTE & Affiliated to Anna University

ISO 9001:2015 Certified Institution

Thalavapalayam, Karur, Tamilnadu.



**M.E. – COMPUTER SCIENCE AND  
ENGINEERING**

**REGULATION 2019  
CURRICULUM AND SYLLABUS**



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## CURRICULUM AND SYLLABUS

REGULATION 2019

**Programme: M.E. – Computer Science and Engineering**

### Vision of the Department:

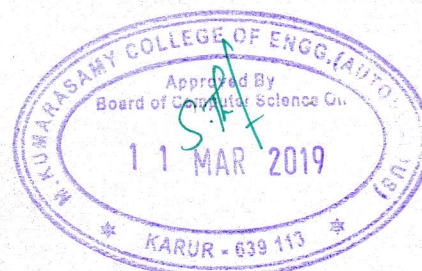
↓ To achieve education and research excellence in computer Science and Engineering

### Mission of the Department:

**M1: To excel in academic through effective teaching learning techniques.**

**M2: To promote research in the area of computer science and engineering with the focus on innovation.**

**M3: To transform students into technically competent professionals with societal and ethical responsibilities.**





## STRUCTURE OF CURRICULUM

Sl.No.	Category	Credits
1	Professional core courses (C)	11
2	Basic Science courses (B)	04
3	Professional Elective courses relevant to chosen specialization/branch (E)	20
4	Project work, Minor project**, seminar and internship in industry or elsewhere (P)	28
5	Mandatory Courses (M)	02
<b>Total Credits</b>		<b>65</b>

### 1. Professional core courses (C)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCSC101J	Advanced Data Structures	3	0	2	4
19PCSC102J	Advanced Algorithms	3	0	2	4
19PCSC103T	Soft Computing	3	0	0	3
<b>Total Credits</b>					<b>11</b>

L-Lecture T-Tutorial P-Practical

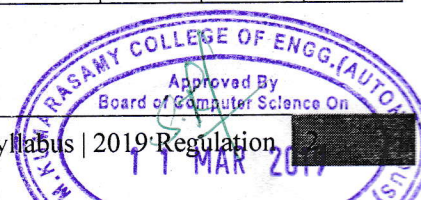
### 2. Basic Science courses (B)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCSB101T	Mathematical foundations of Computer Science	3	1	0	4
<b>Total Credits</b>					<b>04</b>

L-Lecture T-Tutorial P-Practical

### 3. Program Elective courses relevant to chosen specialization/branch (E) (Any 6 Subjects)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCSE001J	Machine Learning Techniques	3	0	2	4
19PCSE002J	Web Engineering	3	0	2	4
19PCSE003J	Agile Software Development and Usability Engineering	3	0	2	4
19PCSE004J	IoT Architecture and Programming	3	0	2	4
19PCSE005J	Cloud Services and Virtualization	3	0	2	4
19PCSE006J	Data Science and Analytics	3	0	2	4
19PCSE007J	Image Processing and Analysis	3	0	2	4
19PCSE008T	Distributed Systems	3	0	0	3





19PCSE009T	Human and Computer Interaction	3	0	0	3
19PCSE010T	GPU Computing	3	0	0	3
19PCSE011T	Advanced Wireless Sensor Networks	3	0	0	3
19PCSE012T	Security for IoT	3	0	0	3
19PCSE013T	Software Project Management	3	0	0	3
19PCSE014T	Mobile Application Development	3	0	0	3
19PCSE015T	Software Quality Assurance	3	0	0	3
19PCSE016T	Block Chain Technology	3	0	0	3
19PCSE017T	Cyber Security and Computer Forensics	3	0	0	3
19PCSE018T	Recommender Systems	3	0	0	3
19PCSE019T	Modern Computer Architecture	3	0	0	3
19PCSE020T	Advanced Database	3	0	0	3
19PCSE021T	Optimization Techniques	3	0	0	3
19PCSE022T	Compiler for High Performance Computing	3	0	0	3
19PCSE023T	Social Network Analysis	3	0	0	3
19PCSE024T	Computer Vision	3	0	0	3
19PCSE025T	Information Retrieval Techniques	3	0	0	3
Total Credits					20

L-Lecture T-Tutorial P-Practical

#### 4. Project work, minor project, seminar and internship in industry or elsewhere (P)

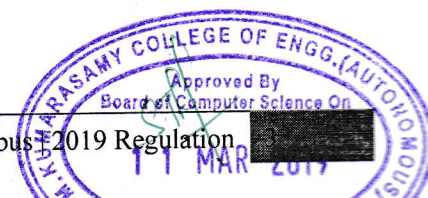
Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCSP101L	Mini Project with Seminar	2	0	0	2
19PCSP102L	Project Phase I	0	0	20	10
19PCSP103L	Project Phase II	0	0	32	16
Total Credits					28

L-Lecture T-Tutorial P-Practical

#### 5. Mandatory Courses (M)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PATM101	Research Methodology and IPR	2	0	0	2
19PATM102	English for Research Paper Writing	1	0	0	Nil
19PATM103	Pedagogy Studies	1	0	0	Nil
Total Credits					2

L-Lecture T-Tutorial P-Practical





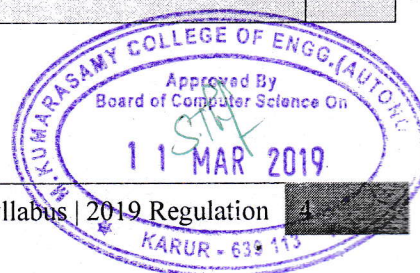
**I to IV Semester Curriculum**

Semester I						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	19PCSB101T	Mathematical foundations of Computer Science	3	1	0	4
C	19PCSC101J	Advanced Data Structures	3	0	2	4
E	*****J	Program Elective I	3	0	2	4
E	*****T	Program Elective II	3	0	0	3
M	19PATM101	Research Methodology and IPR	2	0	0	2
M	19PATM102	English for Research Paper Writing	1	0	0	0
Total Credits						17

L-Lecture T-Tutorial P-Practical

Semester II						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCSC102J	Advanced Algorithms	3	0	2	4
C	19PCSC103T	Soft Computing	3	0	0	3
E	*****J	Program Elective III	3	0	2	4
E	*****T	Program Elective IV	3	0	0	3
M	19PATM103	Pedagogy Studies	1	0	0	0
P	19PCSP101L	Mini Project with Seminar	2	0	0	2
Total Credits						16

L-Lecture T-Tutorial P-Practical



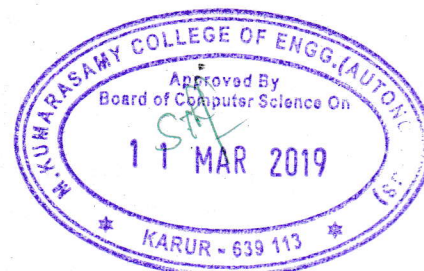


Semester III						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	*****T	Program Elective V	3	0	0	3
E	*****T	Program Elective VI	3	0	0	3
P	19PCSP102L	Project Phase I	0	0	20	10
Total Credits						16

L-Lecture T-Tutorial P-Practical

Semester IV						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
P	19PCSP103L	Project Phase II	0	0	32	16
Total Credits						16

**Total Credits: 65\***



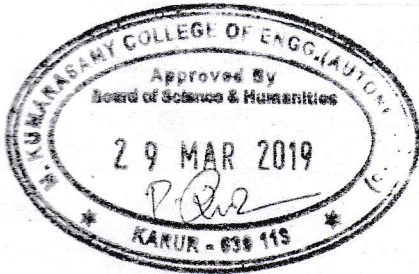


Regulation 2019		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	19PCSB101T	Mathematical foundations of Computer Science	3	1	0	4
<b>Prerequisite Course (s)</b>						
Discrete Mathematics						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.					
2	Develop the understanding of mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.					
3	Study various sampling and classification problems.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain the basic notions of discrete and continuous probability.					
CO2	Understand the role that sampling distributions play in those methods.					
CO3	Illustrate the methods of statistical inference implemented in various models.					
CO4	Summarize the correct and meaningful statistical analysis.					
CO5	Understand the recent trends and application of statistics in the field of computer science.					
<b>UNIT I</b>	<b>PROBABILITY</b>					<b>9 + 3</b>
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains						
<b>UNIT II</b>	<b>RANDOM SAMPLES</b>					<b>9 + 3</b>
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.						
<b>UNIT III</b>	<b>STATISTICAL INFERENCE</b>					<b>9 + 3</b>
Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal component analysis, The problem of overfitting model assessment.						
<b>UNIT IV</b>	<b>GRAPH THEORY</b>					<b>9 + 3</b>
Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems						





UNIT V	COMPUTER SCIENCE AND ENGINEERING APPLICATIONS	9 + 3
<p>Computer science and engineering applications Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.</p> <p>Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.</p>		
<b>Reference (s)</b>		
1	John Vince, Foundation Mathematics for Computer Science, Springer.	
2	K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.	
3	M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.	
4	Alan Tucker, Applied Combinatorics, Wiley	







Regulation 2019		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCSC101J	Advanced Data Structures	3	0	2	4

**Prerequisite Course (s)**

Data Structures

**Course Objective (s):**

The purpose of learning this course is to:

1	Choose appropriate data structures, understand the ADT/libraries and use it to design algorithms for a specific problem.
2	Understand the necessary mathematical abstraction to solve problems.
3	Familiarize students with advanced paradigms and data structure to solve algorithmic problems.
4	Come up with analysis of efficiency and proofs of correctness.
5	Study about NP Completeness of problems.

**Course Outcome (s) (COs):**

At the end of this course, learners will be able to:

CO1	Make use of Dictionaries and hashing to solve real world problems.
CO2	Illustrate the Hierarchical Data Structures.
CO3	Outline algorithms for text processing to its applications.
CO4	Explain data structures to develop algorithms for computational geometry problems.
CO5	Summarize NP Complete and NP Hard problems.

**UNIT I                      DICTIONARIES AND HASHING                      9**

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

**UNIT II                      HIERARCHICAL DATA STRUCTURES                      9**

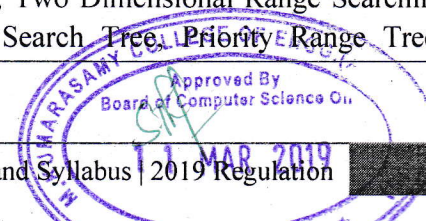
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.

**UNIT III                      TEXT PROCESSING                      9**

Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

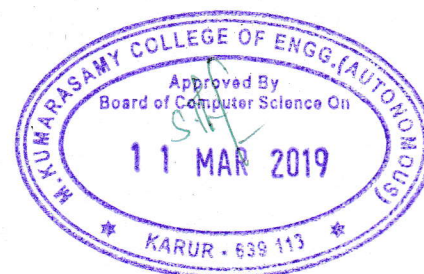
**UNIT IV                      COMPUTATIONAL GEOMETRY                      9**

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees,



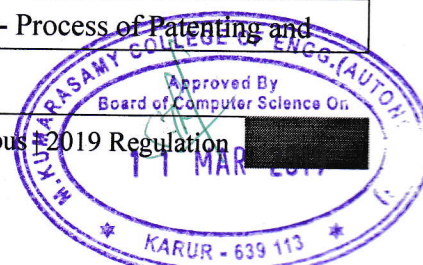


Quadrees, k-D Trees.		
<b>UNIT V</b>	<b>NP COMPLETE AND NP HARD</b>	<b>9</b>
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems.		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Implementation of Dictionaries</li> <li>2. Implementation of Hashing</li> <li>3. Implementation of a Binary Search Tree</li> <li>4. Red-Black Tree Implementation</li> <li>5. AVL Tree Implementation</li> <li>6. Implementation of Boyer Moore Algorithm</li> <li>7. Huffman Coding Algorithm Implementation</li> <li>8. Knuth-Morris-Pratt Algorithm</li> <li>9. Implementation of Longest Common Subsequence Problem</li> <li>10. Priority Search Tree Implementation.</li> </ol>		
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.	
2	M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.	
<b>Reference (s)</b>		
1	S.Sridhar,  Design and Analysis of Algorithms  , First Edition, Oxford University Press. 2014	
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, —Introduction to Algorithms  , Third Edition, Prentice-Hall, 2011.	





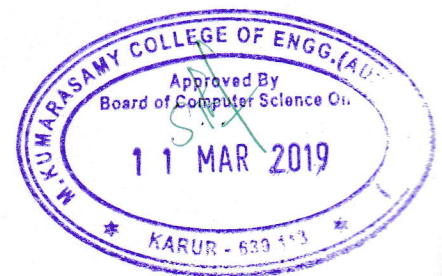
Regulation 2019		Semester I	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM101	Research Methodology and IPR	2	0	0	2
Prerequisite Course (s)						
Nil						
Course Objective (s):						
The purpose of learning this course is to:						
1	Understand and analyse the fundamental of research problem					
2	Understand the Research Ethics					
3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity					
4	Understand Intellectual Property Rights					
5	Understand Patents Rights					
Course Outcome (s) (COs):						
At the end of this course, learners will be able to:						
CO1	Understand research problem formulation					
CO2	Analyze research related information					
CO3	Follow research ethics					
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular					
CO5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>6</b>
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.						
<b>UNIT II</b>	<b>ANALYSIS OF REARCH</b>					<b>6</b>
Approaches of investigation of solutions for research problem- data collection- analysis- interpretation- Necessary instrumentations Effective literature studies approaches- analysis Plagiarism,- Research ethics.						
<b>UNIT III</b>	<b>RESEACRH PRPOSAL AND TECHNICAL WRITING</b>					<b>6</b>
Effective technical writing - how to write report-Paper Developing a Research Proposal- Format of research proposal- a presentation and assessment by a review committee.						
<b>UNIT IV</b>	<b>INTELLECTUAL PROPERTY</b>					<b>6</b>
Nature of Intellectual Property: Patents –Designs - Trade and Copyright- Process of Patenting and						





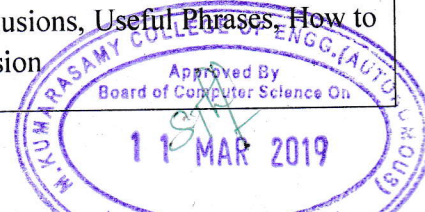
Development: technological research- innovation- patenting- And development. International Scenario: International cooperation on Intellectual Property- Procedure for grants of patents- Patenting under PCT.

<b>UNIT V</b>	<b>PATENTS RIGHTS</b>	<b>6</b>
Patent Rights: Scope of Patent Rights- Licensing and transfer of technology -Patent information and databases- Geographical Indications.		
<b>Text Book (s)</b>		
1	Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”.	
2	Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007	
<b>Reference (s)</b>		
1	Ranjit Kumar, 2 nd Edition , “Research Methodology: A Step by Step Guide for beginners”	
2	T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008	
3	Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.	
4	Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”	



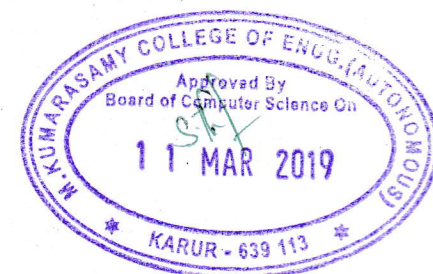


Regulation 2019		Semester II	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM102	English For Research Paper Writing	1	0	0	0
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand that how to improve your writing skills and level of readability					
2	Learn about what to write in each section					
3*	Understand the skills needed when writing a Title					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Understand the basics of writing skills					
CO2	Illustrate the level of readability					
CO3	Explain about what to write in each section					
CO4	Summarize the skills needed to form a title					
<b>UNIT I</b>						<b>3</b>
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness						
<b>UNIT II</b>						<b>3</b>
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction						
<b>UNIT III</b>						<b>3</b>
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.						
<b>UNIT IV</b>						<b>3</b>
Key skills are needed when writing a title, Key skills are needed when writing an abstract, Key skills are needed when writing an introduction, Skills needed when writing a review of the literature						
<b>UNIT V</b>						<b>3</b>
Skills are needed when writing the methods, Skills needed when writing the results, Skills are needed when writing the discussion, Skills are needed when writing the conclusions, Useful Phrases. How to ensure paper is as good as it could possibly be the first- Time Submission						



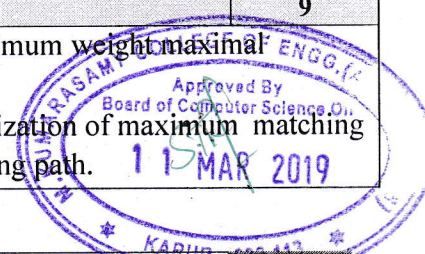


Reference (s)	
1	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4	Adrian Wallwork,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



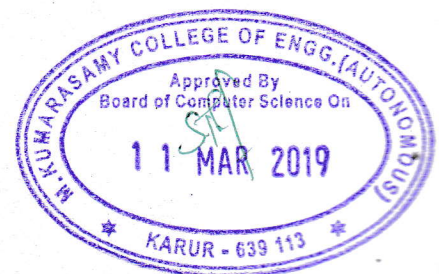


Regulation 2019		Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCSC102J	Advanced Algorithms	3	0	2	4
<b>Prerequisite Course (s)</b>						
Algorithm Design and Analysis						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Introduce advanced methods of designing and analyzing algorithms.					
2	The student should be able to choose appropriate algorithms and use it for a specific problem.					
3	To familiarize students with basic paradigms and data structures to solve advanced algorithmic problems.					
4	Students should be able to understand different classes of problems concerning their computational difficulties.					
5	To introduce recent developments in the area of algorithmic design.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Analyze the complexity/performance of different algorithms.					
CO2	Determine the appropriate data structure for solving a particular set of problems using graph theory.					
CO3	Categorize the different problems in to various classes according to their complexity.					
CO4	Students should have an insight of recent activities in the field of advanced data structure.					
CO5	Determine the appropriate data structure for solving a particular set of problems using linear programming.					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
<b>Sorting:</b> Review of various sorting algorithms, topological sorting.						
<b>Graph:</b> Definitions and Elementary Algorithms: Shortest path by Breadth First Search, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm, and time/space analysis, example of amortized analysis.						
<b>UNIT II</b>	<b>MATROIDS AND GRAPH MATCHING</b>					<b>9</b>
<b>Matroids:</b> Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.						
<b>Graph Matching:</b> Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.						





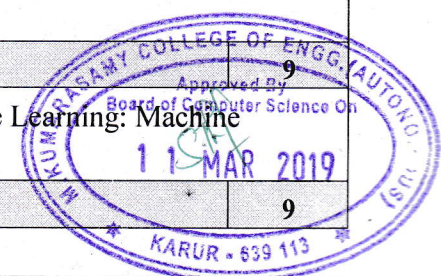
<b>UNIT III</b>	<b>FLOW-NETWORKS AND MATRIX COMPUTATIONS</b>	<b>9</b>
<p><b>Flow-Networks:</b> Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.</p> <p><b>Matrix Computations:</b> Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.</p>		
<b>UNIT IV</b>	<b>GRAPH ALGORITHM</b>	<b>9</b>
<p><b>Shortest Path in Graphs:</b> Floyd-Warshall algorithm introduction to dynamic programming paradigm examples of dynamic programming.</p> <p><b>Modulo Representation of integers/polynomials:</b> Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.</p>		
<b>UNIT V</b>	<b>LINEAR PROGRAMMING AND NP-COMPLETENESS</b>	<b>9</b>
<p><b>Linear Programming:</b> Geometry of the feasibility region and Simplex algorithm.</p> <p><b>NP-completeness:</b> Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest, Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.</p>		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Implement single-source shortest-path problem using Bellman-Ford algorithm</li> <li>2. Implement single-source shortest-path problem using Dijkstra's algorithm</li> <li>3. Implement algorithm to compute a maximum weight maximal independent set</li> <li>4. Implement Minimum spanning tree using greedy techniques</li> <li>5. Implement Strassen's Matrix multiplication algorithm</li> <li>6. Implement Ford-Fulkerson Method to compute maximum flow</li> <li>7. Implement Edmond-Karp maximum-flow algorithm</li> <li>8. Implement Floyd Algorithm using Dynamic programming</li> </ol>		
<b>Text Book (s)</b>		
1	"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.	
2	"The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.	
<b>Reference (s)</b>		
1	"Algorithm Design" by Kleinberg and Tardos.	







Regulation 2019		Semester II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCSC103T	Soft Computing	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Introduce soft computing concepts and techniques to foster their abilities in designing appropriate technique for a given scenario.					
2	Implement soft computing based solutions for real-world problems.					
3	Understand knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic and genetic algorithms.					
4	Provide hands-on experience to the students on MATLAB to implement various strategies.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Identify and describe soft computing techniques and their roles in building intelligent machines					
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.					
CO3	Apply Neural Networks to solve the various engineering problems.					
CO4	Apply genetic algorithms to combinatorial optimization problems.					
CO5	Evaluate and compare solutions by various soft computing approaches for a given problem.					
<b>UNIT I</b>	<b>INTRODUCTION TO SOFT COMPUTING</b>					<b>9</b>
Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.						
<b>UNIT II</b>	<b>FUZZY LOGIC</b>					<b>9</b>
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.						
<b>UNIT III</b>	<b>NEURAL NETWORKS</b>					<b>9</b>
Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning in Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning in Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.						
<b>UNIT IV</b>	<b>GENETIC ALGORITHMS</b>					<b>9</b>
Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.						
<b>UNIT V</b>	<b>MATLAB/PYTHON LIB</b>					<b>9</b>





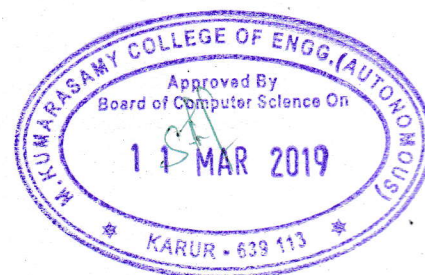
Introduction to Matlab/Python, Arrays and its operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

**Text Book (s)**

- |   |   |
|---|---|
| 1 | Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003. |
|---|---|

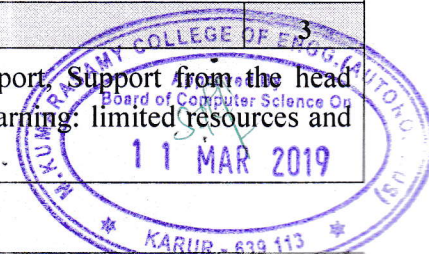
**Reference (s)**

- |   |   |
|---|---|
| 1 | George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995. |
| 2 | MATLAB Toolkit Manual.  |



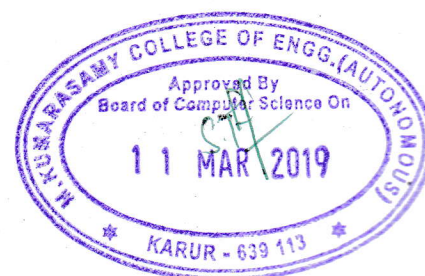


Regulation 2019		Semester II	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM103	Pedagogy Studies	1	0	0	0
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.					
2	Identify critical evidence gaps to guide the development.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.					
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.					
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.					
CO4	Discuss the passage of the Hindu Code Bill of 1956.					
<b>UNIT I</b>	<b>INTRODUCTION AND METHODOLOGY</b>					<b>3</b>
Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching						
<b>UNIT II</b>	<b>THEMATIC OVERVIEW</b>					<b>3</b>
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education						
<b>UNIT III</b>	<b>PEDAGOGIC STRATEGIES</b>					<b>3</b>
Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and Pedagogic strategies						
<b>UNIT IV</b>	<b>PROFESSIONAL DEVELOPMENT</b>					<b>3</b>
Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes						



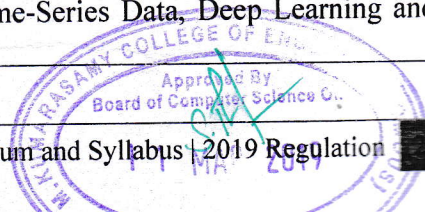


UNIT V	RESEARCH GAPS AND FUTURE DIRECTIONS	3
Research design , Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact		
<b>Text Book (s)</b>		
1	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.	
2	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.	
<b>Reference (s)</b>		
1	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.	
2	Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.	
3.	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.	



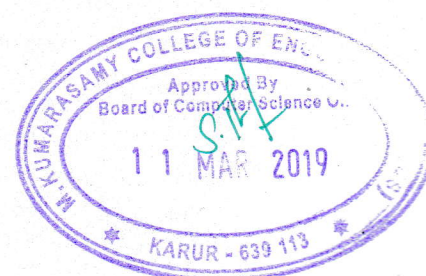


Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE001J	Machine Learning Techniques	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Learn patterns and concepts from data without being explicitly programmed in various IOT node					
2	Design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advance					
3	Explore supervised and unsupervised learning paradigms of machine learning					
4	Explore Deep learning technique and various feature extraction strategies.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Apply machine learning techniques such as classification, regression.					
CO2	Apply machine learning techniques such as clustering					
CO3	To compare various machine learning techniques and to get an insight of when to apply a particular machine learning approach.					
CO4	Outline the basics of neural networks, data science and deep learning.					
CO5	Extract features that can be used for a particular machine learning approach in various IOT applications.					
<b>UNIT I</b>		<b>SUPERVISED LEARNING</b>				<b>9</b>
<b>REGRESSION:</b> Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes , Linear models: Linear Regression, Logistic Regression, Generalized Linear Models						
<b>CLASSIFICATION:</b> Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.						
<b>UNIT II</b>		<b>UNSUPERVISED LEARNING</b>				<b>9</b>
Supervised Learning Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor model).						
<b>UNIT III</b>		<b>EVALUATION AND MODEL SELECTION</b>				<b>9</b>
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Rand Forests)						
<b>UNIT IV</b>		<b>DEEP LEARNING</b>				<b>9</b>
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning						



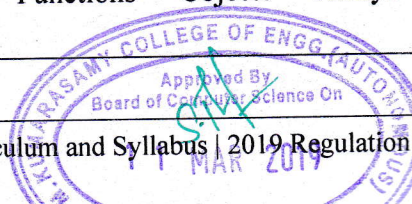


<b>UNIT V</b>	<b>SCALABLE LEARNING AND IOT APPLICATIONS</b>	<b>9</b>
Scalable Machine Learning (Online and Distributed Learning),Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference. Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Case Study on R.</li> <li>2. Implementation of R Programs using Vectors and Lists.</li> <li>3. Implementation of R Programs using Arrays.</li> <li>4. Implementation of R Programs using Factors.</li> <li>5. Implementation of R Programs using Data Frames</li> <li>6. Implementation of R Programs using Decision Making Statements.</li> <li>7. Implementation of R Programs using Looping statements.</li> <li>8. Implementation of R Programs using Function with Argument.</li> <li>9. Implementation of R Programs using Function without Argument.</li> <li>10. Implementation of R Charts &amp; Graphs</li> </ol>		
<b>Text Book (s)</b>		
1	Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012	
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)	
<b>Reference (s)</b>		
1	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.	





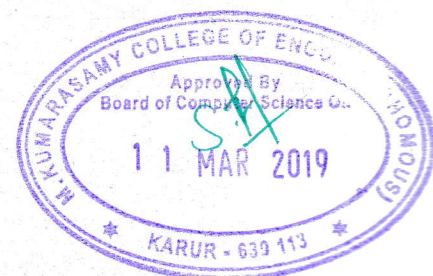
Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE002J	Web Engineering	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Create simple webpages					
2	Create styles in webpages					
3	Perform client side validation					
4	Learn the concepts of servlets and jsp					
5	Create dynamic web pages using server side scripting					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Apply HTML concepts to develop Webpages					
CO2	Build Web applications using Cascading Style Sheets.					
CO3	Choose JavaScript to develop Webpages.					
CO4	Design Web application using JSP and Servlet.					
CO5	Develop PHP program to manipulate a database.					
<b>UNIT I</b>		<b>PROGRAMMING HTML</b>				<b>9</b>
Overview of HTML- Using the HTML Canvas API- Working with HTML Audio and Video- Using the HTML Geolocation API- Using the Communication APIs- Using the HTML Forms API- Using the HTML Web Storage API.						
<b>UNIT II</b>		<b>CASCADING STYLE SHEETS (CSS)</b>				<b>9</b>
Properties Table: Using the style Attribute, Creating Classes and IDs, Generating External Style Sheets, Typography, Consistency, Types of styles, specifying class within HTML document, Style placement: Inline style, Span & div tags, header styles, Text and font attributes: Font Vs CSS, changing fonts, text attributes, Advance CSS properties: Backgrounds, Box properties and Positioning.						
<b>UNIT III</b>		<b>JAVASCRIPT</b>				<b>9</b>
Client-Side Programming: Introduction to JavaScript – Functions – Objects – Arrays – Built - in Objects - JavaScript Debuggers.						





Host Objects: Browsers and the DOM - Introduction to the Document Object Model DOM History and Levels - Intrinsic Event Handling - Modifying Element Style - The Document Tree -DOM Event Handling

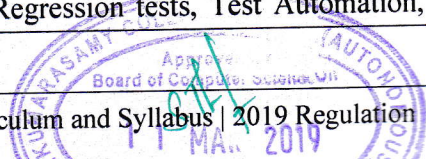
<b>UNIT IV</b>	<b>JSP AND SERVLETS</b>	<b>9</b>
<p>JSP application Basics: Introducing Java Server Pages-HTTP and Servlet Basics-JSP Overview-Setting up the JSP Environment. JSP Application Development: Generating Dynamic Content-Using JavaBean Components in JSP Pages-Using Custom Tag Libraries and the JSP Standard Tag Library-Processing Input and Output-Error Handling and Debugging-Sharing Data between JSP Pages, Request, and Users-Accessing a Database.</p>		
<b>UNIT V</b>	<b>PHP</b>	<b>9</b>
<p>PHP: Introduction – Programming in Web Environment – Variables – Constants –Data; Types – Operators – Statements – Functions – Arrays – OOP – String Manipulation and Regular Expression – File Handling and Data Storage – PHP and SQL Database – PHP and LDAP – PHP Connectivity – Sending and Receiving E-mails – Debugging and Error Handling – Security – Templates.</p>		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Create a HTML webpage to play/Pause a video and if the video is paused, resize it by small, normal and big.</li> <li>2. Create a HTML webpage that contains a button to retrieve Latitude and Longitude.</li> <li>3. Develop a webpage that consists of three types of CSS implementation</li> <li>4. Develop a webpage that contains form validation using JavaScript.</li> <li>5. Develop a webpage to perform mouse event handling.</li> <li>6. Develop a webpage to add two numbers using JSP and servlet.</li> <li>7. Develop a JSP program to use Java Bean component.</li> <li>8. Develop a webpage to retrieve the database table using JSP</li> <li>9. Develop a webpage to perform CRUD operation using PHP</li> <li>10. Develop a PHP program to use the send mail configuration.</li> </ol>		
<b>Text Book (s)</b>		
1	Jeffrey C.Jackson, "Web Technologies-A Computer Science Perspective", Pearson Education, 2013. (Unit 2 &3).	
2	Peter Lubbers, Brian Albers, Frank Salim-Pro HTML5 Programming Powerful APIs for Richer Internet Application Development-Apress (2010)	
<b>Reference (s)</b>		
1	Hans Bergsten, "JavaServerPages", Second Edition, O'Reilly Publication, 2002.	







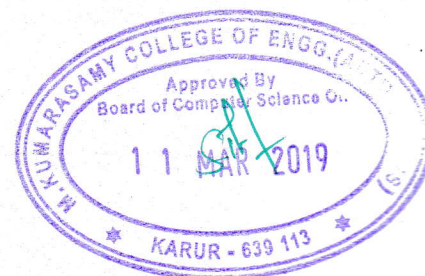
Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE003J	Agile Software Development and Usability Engineering	3	0	2	4
<b>Prerequisite Course (s)</b>						
Software Engineering						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Experiment the Agile development practice					
2	Perform development with unit tests using Test Driven Development					
3	Apply design principles and refactoring to achieve Agility					
4	Deploy and justify automated build tools, version control and continuous integration					
5	Build testing activities within an Agile project					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Experiment the Agile development practice					
CO2	Perform development with unit tests using Test Driven Development					
CO3	Apply design principles and refactoring to achieve Agility					
CO4	Deploy and justify automated build tools, version control and continuous integration					
CO5	Build testing activities within an Agile project					
<b>UNIT I</b>		<b>FUNDAMENTALS OF AGILE</b>				<b>9</b>
The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools.						
<b>UNIT II</b>		<b>AGILE SCRUM FRAMEWORK</b>				<b>9</b>
Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.						
<b>UNIT III</b>		<b>AGILE TESTING</b>				<b>9</b>
The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to						





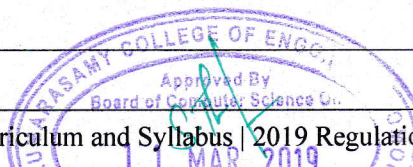
support the Agile tester.

<b>UNIT IV</b>	<b>AGILE SOFTWARE DESIGN AND DEVELOPMENT</b>	<b>9</b>
Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.		
<b>UNIT V</b>	<b>INDUSTRY TRENDS</b>	<b>9</b>
Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Understand a given business scenario and identify product backlog, user stories and sprint tasks</li> <li>2. Define user stories for a given feature</li> <li>3. Fill user stories, sprint schedule and sprint tasks in an Agile tool such as AgileFant</li> <li>4. Write unit tests aligned to x-Unit framework for TDD</li> <li>5. Refactor a given design for next sprint requirements</li> <li>6. Execute continuous integration using a tool such as Jenkins</li> <li>6. Execute continuous integration using a tool such as Jenkins</li> </ol>		
<b>Text Book (s)</b>		
1	Agile Software Development with Scrum, Ken Schawber, Mike Beedle, Publisher: Pearson.	
2	Agile Testing: A Practical Guide for Testers and Agile Teams, Lisa Crispin, Janet Gregory, Publisher: Addison Wesley	
<b>Reference (s)</b>		
1	Agile Software Development, Principles, Patterns and Practices, Robert C. Martin, Publisher: Prentice Hall	
2	Agile Software Development: The Cooperative Game, By Alistair Cockburn Publisher: Addison Wesley	
3	David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003	
4	Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.	





Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE004J	IoT Architecture and Programming	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the concepts of Internet of Things and build IoT applications					
2	Build IoT applications through programming					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Understand the concepts of Internet of Things					
CO2	Analyze basic protocols in wireless sensor network					
CO3	Design IoT applications in different domain and be able to analyze their performance					
CO4	Implement basic IoT applications on embedded platform					
CO5	Developing applications through programming					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Defining IoT- Characteristics of IoT- Physical design of IoT- Logical design of IoT- Functional blocks of IoT- Communication models & APIs						
<b>UNIT II</b>	<b>INTERNET OF THING &amp; MACHINE TO MACHINE</b>					<b>9</b>
Machine to Machine- Difference between IoT and M2M- Software define Network						
<b>UNIT III</b>	<b>NETWORK AND COMMUNICATION ASPECT</b>					<b>9</b>
Wireless medium access issues,- MAC protocol survey- Survey routing protocols- Sensor deployment & Node discovery- Data aggregation & dissemination						
<b>UNIT IV</b>	<b>CHALLENGES &amp; DOMAIN SPECIFIC APPLICATION OF IOT</b>					<b>9</b>
Design challenges- Development challenges- Security challenges- Home automation- Industry applications- Surveillance applications- Other IoT applications						
<b>UNIT V</b>	<b>DEVELOPING OF IOT</b>					<b>9</b>
Introduction to Python- Introduction to different IoT tools- Developing applications through IoT tools- Developing sensor based application through embedded system platform- Implementing IoT concepts with python						
<b>LIST OF EXPERIMENTS</b>						<b>15</b>
<ol style="list-style-type: none"> <li>1. An Overview of IoT and High level Architecture</li> <li>2. Setting up IoT work-flow</li> <li>3. Programming with Advanced C / Embedded C</li> </ol>						





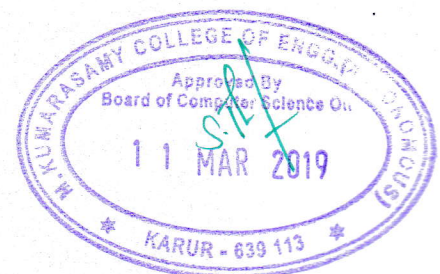
4. Micro-controller programming using Arduino
5. Programming with Python
6. Building IoT Applications using Raspberry Pi
7. IoT Protocols: HTTP, CoAP, MQTT, AMQP, 6LoWPAN.
8. IoT Cloud Infrastructure
9. Performance and Security in IoT
10. Case Study Performance and Security in IoT

**Text Book (s)**

1	Vijay Madiseti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2	Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

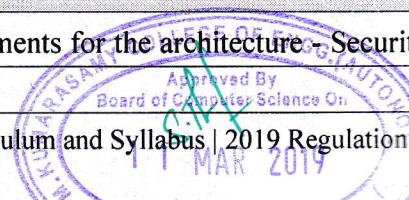
**Reference (s)**

1	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
2	Cuno Pfister, "Getting Started with the Internet of Things", O'Reilly Media, 2011.
3	Introduction to Open Source Software & Open Standards (IBM ICE Publication)
4	The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
5	Getting Started With The Internet Of Things: Connecting Sensors and Microcontrollers to the Cloud" By Cuno Pfister (O REILLY)





Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE005J	Cloud Services and Virtualization	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	To understand the concept of cloud and utility computing.					
2	To understand the various issues in cloud computing.					
3	To familiarize themselves with the lead players in cloud.					
4	To appreciate the emergence of cloud as the next generation computing paradigm.					
5	To be able to set up a private cloud.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Identify the real time cloud providers and their service levels.					
CO2	Illustrate the design of on-demand and scalable Cloud Computing Infrastructure.					
CO3	Apply the various forms of virtualization technique to the enterprise architecture.					
CO4	Illustrate the security issues of the enterprise adapting cloud computing principles.					
CO5	Illustrate the data availability, data replication, data protection and data footprint reduction techniques of cloud storage services.					
<b>UNIT I</b>	<b>CLOUD FUNDAMENTALS AND SERVICES DELIVERED</b>					<b>9</b>
Cloud Computing Overview – benefits – limitations – Layers and types of cloud – Desired features of Cloud – Real time cloud providers - Cloud Services Model - Software-as-a-Service (SaaS) with case studies - Platform-as-a-Service (PaaS) - Infrastructure-as-a-Service (IaaS) - Communication-as-a-Service (CaaS) .						
<b>UNIT II</b>	<b>CLOUD COMPUTING ARCHITECTURE</b>					<b>9</b>
Workload Distribution Architecture – Resource Pooling Architecture – Dynamic Scalability Architecture – Elastic Resource Capacity Architecture – Service Load Balancing Architecture – Cloud Bursting Architecture – Redundant Storage Architecture – Hypervisor Clustering Architecture – Load Balanced Virtual Server Instances Architecture – Non-Disruptive Service Relocation Architecture – Zero Downtime Architecture – Cloud Balancing Architecture – Resource Reservation Architecture – Dynamic Failure Detection and Recovery Architecture – Rapid Provisioning Architecture – Storage Workload Management Architecture						
<b>UNIT III</b>	<b>VIRTUALIZATION</b>					<b>9</b>
Components and Benefits of Virtualization - OS Level Virtualization - Application Virtualization - Desktop Virtualization - Network Virtualization - Server Virtualization – Tools for Virtualization						
<b>UNIT IV</b>	<b>SECURITY IN THE CLOUD</b>					<b>9</b>
Security concerns in cloud computing - Security requirements for the architecture - Security patterns						





and Architectural elements - Cloud Security Architecture – Data Security in Cloud Computing - Data encryption Application and limits – Cloud data security and sensitive data categorization- Security controls

<b>UNIT V</b>	<b>STORAGE IN THE CLOUD</b>	<b>9</b>
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Server and storage I/O fundamentals – Virtual, Physical and Cloud data protection - Data Footprint Reduction Techniques – Storage services, functionalities and challenges – Storage system architectures – Storage virtualization

<b>LIST OF EXPERIMENTS</b>		<b>15</b>
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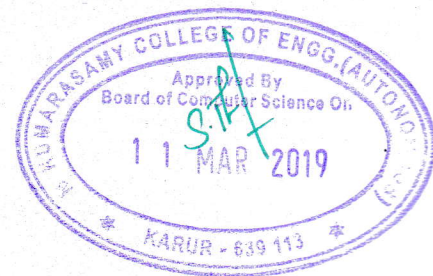
1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install Hadoop single node cluster and run simple applications like wordcount.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Install Google App Engine. Create hello world app and other simple web applications using python/java.

**Text Book (s)**

1	Thomas Erl, Zaigham Mahood, Ricardo Puttini, —Cloud Computing, Concept, Technology and Architecture, Prentice Hall, 2013.
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**Reference (s)**

1	John Rittinghouse, James Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press 2010.
2	Vic (J.R.) Winkler, —Securing the Cloud: Cloud Computer Security Techniques and Tactics, Elsevier, 2011
3	Greg Schulz, —Cloud and Virtual Data Storage Networking, CRC Press, 2012.
4	Nelson Ruest, Danielle Ruest, —Virtualization, A Beginner’s Guide, McGraw-Hill Companies, 2009





Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE006J	Data Science and Analytics	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Provide you with the knowledge and expertise to become a proficient data scientist.					
2	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.					
3	Produce Python code to statistically analyse a dataset.					
4	Critically evaluate data visualizations based on their design and use for communicating stories from data.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain the basic concepts of Data Science.					
CO2	Apply the process of Data storage to store the real world data.					
CO3	Apply the basic machine learning algorithms to analysis the various engineering problems.					
CO4	Explain the basic concepts of Data Visualization and its types.					
CO5	Explain the various applications and recent trends in Data Science.					
<b>UNIT I</b>	<b>INTRODUCTION TO CORE CONCEPTS AND TECHNOLOGIES</b>					<b>9</b>
Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.						
<b>UNIT II</b>	<b>DATA COLLECTION AND MANAGEMENT</b>					<b>9</b>
Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources						
<b>UNIT III</b>	<b>DATA ANALYSIS</b>					<b>9</b>
Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.						
<b>UNIT IV</b>	<b>DATA VISUALISATION</b>					<b>9</b>
Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.						
<b>UNIT V</b>	<b>APPLICATIONS AND RECENT TRENDS</b>					<b>9</b>
Applications of Data Science, Technologies for visualisation, Bokeh (Python), Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.						



**List of Experiments:**

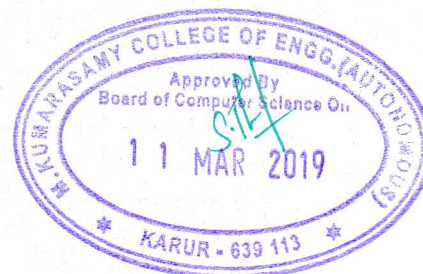
1. Implement Linear/Logistic regression
2. Implement Decision trees / Naïve Bayes
3. Implement SVM
4. Implement K-means clustering
5. Implement Hierarchical based Clustering
6. Implement Association rules
7. Implement K-Nearest neighbours algorithm

**Text Book (s)**

- |   |   |
|---|---|
| 1 | Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, 2013. |
|---|---|

**Reference (s)**

- |   |  |
|---|--|
| 1 | Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press, Reprinted 2015. |
| 2 | Peter Bruce, Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.   |



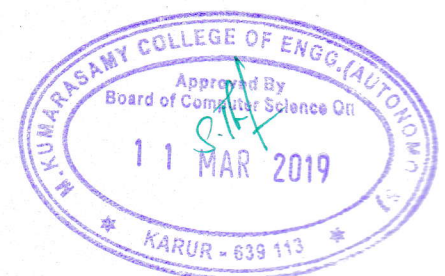




Regulation 2019		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE007J	Image Processing and Analysis	3	0	2	4
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the image processing concepts and analysis					
2	Understand the image processing techniques					
3	Familiarize the image processing environment and their applications,					
4	Appreciate the use of image processing in various applications					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain the fundamentals of image processing					
CO2	Explain the concepts of image transformation					
CO3	Explain the concepts of image segmentation and morphology					
CO4	Explain the various techniques in image classification and analysis					
CO5	Explain image registration techniques and visualization					
<b>UNIT I</b>	<b>IMAGE PROCESSING FUNDAMENTALS</b>					<b>9</b>
Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations						
<b>UNIT II</b>	<b>IMAGE ENHANCEMENT AND RESTORATION</b>					<b>9</b>
Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering, Noise models, Constrained and Unconstrained restoration models.						
<b>UNIT III</b>	<b>IMAGE SEGMENTATION AND MORPHOLOGY</b>					<b>9</b>
Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations. Distance Transforms-Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions-Component Labeling – Regional descriptors and Feature Selection Techniques.						

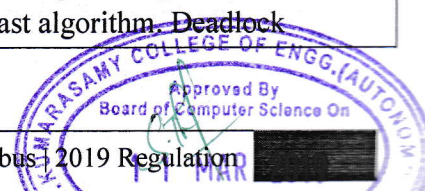


<b>UNIT IV</b>	<b>IMAGE ANALYSIS AND CLASSIFICATION</b>	<b>9</b>
Image segmentation- Pixel Based, Edge Based, Region Based Segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification		
<b>UNIT V</b>	<b>IMAGE REGISTRATION AND VISUALIZATION</b>	<b>9</b>
Rigid body visualization, Principal axis registration, Interactive principle axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.		
<b>LIST OF EXPERIMENTS</b>		<b>15</b>
<ol style="list-style-type: none"> <li>1. Write a program for image enhancement</li> <li>2. Write a program for image compression</li> <li>3. Write a program for color image processing</li> <li>4. Write a program for image segmentation</li> <li>5. Write a program for image morphology</li> <li>6. Image Restoration</li> <li>7. Edge detection</li> <li>8. Blurring 8 bit color versus monochrom</li> </ol>		
<b>Text Book (s)</b>		
1	Alasdair McAndrew, —Introduction to Digital Image Processing with MATLAB, Cengage Learning 2011,India	
2	Anil J Jain, —Fundamentals of Digital Image Processing, PHI, 2006.	





Regulation 2019		--	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE008T	Distributed Systems	3	0	0	3
<b>Prerequisite Course (s)</b>						
Operating Systems						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the foundations of distributed systems.					
2	Learn issues related to clock Synchronization and the need for global state in distributed systems.					
3	Learn distributed mutual exclusion and deadlock detection algorithms.					
4	Understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.					
5	Learn the characteristics of peer-to-peer and distributed shared memory systems.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Elucidate the foundations and issues of distributed systems					
CO2	Understand the various synchronization issues and global state for distributed systems.					
CO3	Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems.					
CO4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems.					
CO5	Describe the features of peer-to-peer and distributed shared memory systems					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
<b>Introduction:</b> Definition –Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Synchronous versus asynchronous executions –Design issues and challenges. A model of distributed computations: A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts –Past and future cones of an event –Models of process communications. Logical Time: A framework for a system of logical clocks –Scalar time –Vector time – Physical clock synchronization: NTP.						
<b>UNIT II</b>	<b>MESSAGE ORDERING &amp; SNAPSHOTS</b>					<b>9</b>
Message ordering and group communication: Message ordering paradigms –Asynchronous execution with synchronous communication –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) – Total order. Global state and snapshot recording algorithms: Introduction –System model and definitions –Snapshot algorithms for FIFO channels.						
<b>UNIT III</b>	<b>DISTRIBUTED MUTEX &amp; DEADLOCK</b>					<b>9</b>
Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport’s algorithm – Ricart-Agrawala algorithm – Maekawa’s algorithm – Suzuki-Kasami’s broadcast algorithm. <del>Deadlock</del>						





detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp’s classification – Algorithms for the single resource model, the AND model and the OR model.

<b>UNIT IV</b>	<b>RECOVERY &amp; CONSENSUS</b>	<b>9</b>
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Check pointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated checkpointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure –free system – Agreement in synchronous systems with failures.

<b>UNIT V</b>	<b>P2P &amp; DISTRIBUTED SHARED MEMORY</b>	<b>9</b>
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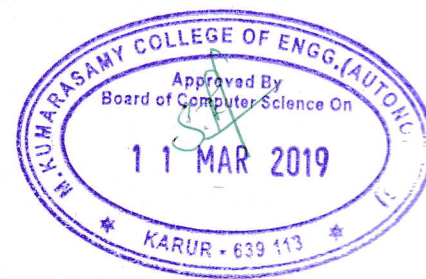
Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models –Shared memory Mutual Exclusion.

**Text Book (s)**

1	Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
2	George Coulouris, Jean Dollimore and Tim Kindberg, —Distributed Systems Concepts and Designl, Fifth Edition, Pearson Education, 2012.

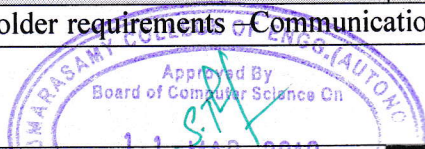
**Reference (s)**

1	Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.
2	Mukesh Singhal and Niranjan G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.
3	Tanenbaum A.S., Van Steen M., —Distributed Systems: Principles and Paradigmsl, Pearson Education, 2007.
4	Liu M.L., —Distributed Computing, Principles and Applicationsl, Pearson Education, 2004.
5	Nancy A Lynch, —Distributed Algorithmsl, Morgan Kaufman Publishers, USA, 2003.



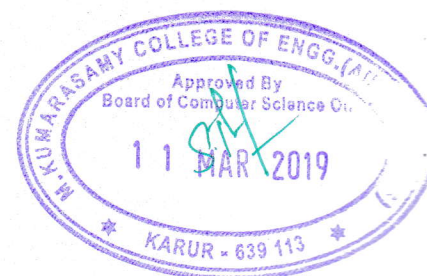


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE009T	Human and Computer Interaction	3	0	0	3
<b>Prerequisite Course (s)</b>						
NIL						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Learn the foundations of Human Computer Interaction					
2	Be familiar with the design technologies					
3	Be aware of Cognitive models and windows layout test					
4	Learn the guidelines for user interface					
5	Be aware of mobile Human Computer interaction					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	To explain the foundations of Human Computer Interaction					
CO2	Illustrate standard design heuristics for making human computer interactive systems					
CO3	Describe impact and necessity of dialogs and groupware prospective in HCI systems					
CO4	Explain user models and task models to study various norms available in human computer interactions					
CO5	Explain the various insights of mobile application in terms of HCI					
<b>UNIT I</b>	<b>INTRODUCTION TO HUMAN COMPUTER INTERACTION</b>					<b>9</b>
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.						
<b>UNIT II</b>	<b>DESIGN PROCESS</b>					<b>9</b>
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.						
<b>UNIT III</b>	<b>COGNITIVE MODEL AND WINDOWS LAYOUT TEST</b>					<b>9</b>
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and						



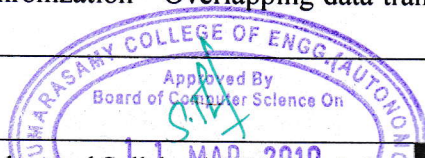


collaboration models-Hypertext, Multimedia and WWW.		
<b>UNIT IV</b>	<b>MULTIMEDIA</b>	<b>9</b>
Text for Web Pages – Providing Effective Feedback and Guidance and Assistance – Providing the Proper Feedback – Guidance and Assistance – International Considerations – Accessibility – Icons and Images – Multimedia – Coloring – Choosing the Proper Colors.		
<b>UNIT V</b>	<b>MOBILE APPLICATIONS</b>	<b>9</b>
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.		
<b>Text Book (s)</b>		
1	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3 <sup>rd</sup> Edition, Pearson Education, 2004	
2	Wilbert. O. Galitz, —The Essential Guide to User Interface Designl, Wiley - India, Second Edition, 2012.	
3	Brian Fling, “Mobile Design and Development”, First Edition , O’Reilly Media Inc., 2009	
<b>Reference (s)</b>		
1	Ben Sheiderman, —Design the User Interfacel, Pearson Education, 1998.	
2	Alan Cooper, —The Essential of User Interface Designl, Wiley – Dream Tech Ltd 2002.	
3	Sharp, Rogers, Preece, _Interaction Design’, Wiley India Edition, 2007.	



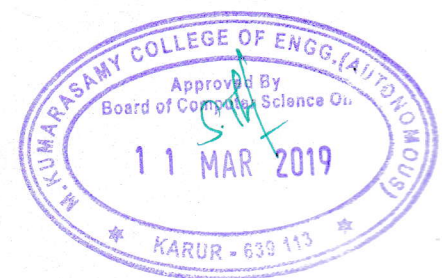


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE010T	GPU COMPUTING	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
Learn parallel programming with Graphics Processing Units (GPUs).						
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Outline the basics of GPU Computing					
CO2	Explain different memories in GPU					
CO3	Illustrate synchronization concepts in CPU and GPU					
CO4	Summarize various support and streams in GPU					
CO5	Outline the use of GPU in various applications					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL . / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs						
<b>UNIT II</b>	<b>MEMORY</b>					<b>9</b>
Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories						
<b>UNIT III</b>	<b>SYNCHRONIZATION</b>					<b>9</b>
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.						
<b>UNIT IV</b>	<b>SUPPORT AND STREAMS</b>					<b>9</b>
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based Synchronization - Overlapping data transfer and kernel execution, pitfalls						





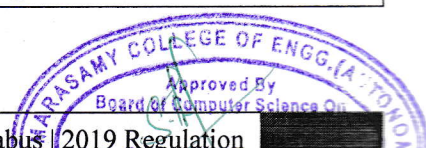
UNIT V	CASE STUDY	9
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning, Multi-GPU processing		
Text Book (s)		
1	Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)	
2	CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)	







Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE011T	Advanced Wireless Sensor Networks	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1.	Understand the concepts of sensor networks.					
2.	Learn how to program sensor modes.					
3.	Understand the challenging issues in each layer of sensor networks					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Learn the fundamentals and architecture of wireless sensor networks.					
CO2	Understand the several protocols used in WSN for data disseminating and data gathering.					
CO3	Study the various types of algorithms and methods for data aggregation.					
CO4	Understand the agriculture applications constructing a system or model for agriculture productivity.					
CO5	Explain the industrial applications for constructing design a system or model for industrial monitoring and control.					
<b>UNIT I</b>	<b>INTRODUCTION TO WSN</b>					<b>9</b>
Overview of WSN, Technological background, Network architecture, Classification of WSN, Protocols stack for WSN, Fundamental MAC protocols.						
<b>UNIT II</b>	<b>ROUTING, DATA DISSEMINATION AND DATA GATHERING</b>					<b>9</b>
Fundamentals and Challenges, Taxonomy of routing and Protocols, Location aided protocols, Data gathering protocols, Data centric protocols and Multipath – based protocols.						
<b>UNIT III</b>	<b>DATA AGGREGATION AND ENERGY ISSUES</b>					<b>9</b>
Introduction, Node clustering algorithm for WSN, Query processing in WSN, Data aggregation in WSN, Need of energy efficiency and Power control in WSN and Future directions.						
<b>UNIT IV</b>	<b>AGRICULTURAL WSN</b>					<b>9</b>
Introduction, Potential applications, Design of WSN for agriculture applications, Technological and standards, Existing Real-world applications, Future challenges and Issues.						
<b>UNIT V</b>	<b>INDUSTRIAL WSN</b>					<b>9</b>
Introduction to IoT and IIoT, Challenges and Issues, IIoT Technologies and its standards, IIoT						





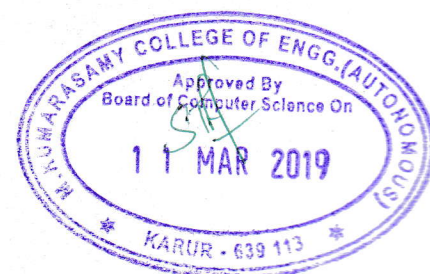
protocols, Security and privacy in IIoT, Future directions.

**Text Book (s)**

1	Jun Zheng and Abbas Jamalipour, —Wireless Sensor Networks: A Networking Perspective”, 1st Edition, A John Wiley & Sons, Inc., Pub. 2009.
2	Tamoghna Ojha, Sudip Misra, Narendra Singh Raghuwanshi, “Wireless sensor networks for agriculture: The state-of-the-art in practice”, Computers and Electronics in Agriculture, Science Direct, 2015.
3	Ramakrishna Budampati and Soumitri Kolavennu, “Industrial Wireless Sensor Networks Monitoring, Control and Automation”, Woodhead Publishing Series in Electronic and Optical Materials, 2015.

**Reference (s)**

1	Dr. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, John Wiley & Sons, Inc., 2007.
2	Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, A John Wiley and Sons, Ltd, Publication, 2010.



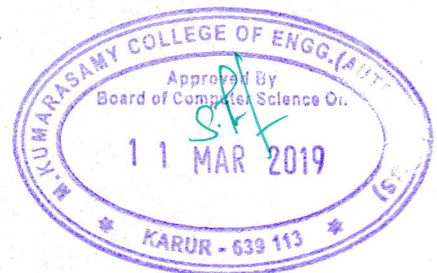


Regulation 2019		-	Total Hours				45
Category	Course Code	Course Name	Hours / Week				C
			L	T	P	J	
E	19PCSE012T	Security for IoT	3	0	0	0	3
<b>Prerequisite Course (s)</b>							
Internet of Things							
<b>Course Objective (s):</b>							
The purpose of learning this course is to:							
1	Understand the importance of security in IOT.						
2	Learn about attack models in IOT.						
3	Learn the significance of front end security measures.						
4	Understand the networking function security.						
5	Analyse and represent the backend security.						
<b>Course Outcome (s) (COs):</b>							
At the end of this course, learners will be able to:							
CO1	Outline the features of Security provided in IOT.						
CO2	Understand about the attack possibilities in IOT.						
CO3	Explain the security measures available for front ends in IOT						
CO4	Make use of IOT networking function security.						
CO5	Understand the security options available for backends used in IOT						
<b>UNIT I</b>	<b>INTRODUCTION</b>						<b>9</b>
Fundamentals,Architecture of IoTs, IoT Security Requirements, IoT Privacy Preservation Issues.							
<b>UNIT II</b>	<b>ATTACK MODELS</b>						<b>9</b>
Attacks to Sensors in IoTs, Attacks to RFIDs in IoTs,Attacks to Network Functions in IoTs,Attacks to Back-end Systems							
<b>UNIT III</b>	<b>FRONT END SECURITY</b>						<b>9</b>
Security in Front-end Sensors and Equipment,Prevent Unauthorized Access to Sensor Data,M2M Security,RFIDSecurity,Cyber-Physical Object Security,HardwareSecurity,Front-end System Privacy Protection.							
<b>UNIT IV</b>	<b>NETWORKING FUNCTION SECURITY</b>						<b>9</b>
IoT Networking Protocols,Secure IoT Lower Layers,Secure IoT Higher Layers,Secure							



Communication Links in IoTs.

UNIT V	BACKEND SECURITY	9
Secure Resource Management, Secure IoT Databases, Security Products-Existing Testbed on Security and Privacy of IoTs, Commercialized Products.		
<b>Text Book (s)</b>		
1	Fei HU, "Security and Privacy in Internet of Things (IoT): Models, Algorithms, and Implementations", CRC Press, 2016	
2	Russell, Brian and Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016.	
<b>Reference (s)</b>		
1	Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014	





Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE013T	Software Project Management	3	0	0	3
<b>Prerequisite Course (s)</b>						
Software Engineering						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	The student should be made to understand the overview of software project management, project planning and Step Wise framework in project planning.					
2	The student should be made to learn about how to assess the projects and to find the cost of the project using cost benefit evaluation techniques and to evaluate the risks involved in the project.					
3	The student should be made to understand the activity plan for a project and to estimate the overall duration of the project by analyzing the risks involved in it.					
4	The student should be made to learn how to monitor the progress of projects and to assess the risk of slippage so that project's requirements can be controlled.					
5	To identify the factors that influence people's behavior in a project environment and selection of appropriate people for the project, continual training and learning to improve group working to select appropriate leadership styles.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	The student should be able to plan the project in stepwise manner.					
CO2	The student should be able to apply cost benefit evaluation techniques to find the cost of the project and to evaluate the risk of project					
CO3	The student should be able to know activity plan for a project and to estimate the overall duration of the project.					
CO4	The student should be able to monitor the progress of projects and to assess the risk of slippage.					
CO5	The student should be able to identify the factors that influence people's behavior in a project environment and selection of appropriate people for the project and to improve group working.					
<b>UNIT I</b>	<b>INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT</b>					<b>9</b>
Project Definition – Contract Management – Activities covered By Software Project Management – Overview of Project Planning – Stepwise Project Planning.						
<b>UNIT II</b>	<b>PROJECT EVALUATION</b>					<b>9</b>
Strategic Assessment – Technical Assessment – Cost Benefit Analysis –Cash Flow Forecasting – Cost Benefit Evaluation Techniques – Risk Evaluation.						
<b>UNIT III</b>	<b>ACTIVITY PLANNING</b>					<b>9</b>
Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models –						



Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature of Risk – Types of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning And Control.

<b>UNIT IV</b>	<b>MONITORING AND CONTROL</b>	<b>9</b>
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Creating Framework – Collecting the Data – Visualizing Progress – Cost Monitoring – Earned Value – Prioritizing Monitoring – Getting Project Back to Target – Change Control – Managing Contracts – Introduction – Types of Contract – Stages in Contract Placement – Typical Terms of a Contract – Contract Management – Acceptance.

<b>UNIT V</b>	<b>MANAGING PEOPLE AND ORGANIZING TEAMS</b>	<b>9</b>
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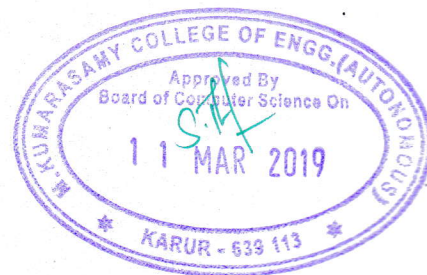
Introduction – Understanding Behavior – Organizational Behaviour: A Background – Selecting the Right Person for the Job – Instruction in the Best Methods – Motivation – The Oldham – Hackman Job Characteristics Model – Working In Groups – Becoming A Team – Decision Making – Leadership – Organizational Structures – Stress – Health And Safety – Case Studies.

**Text Book (s)**

1	Bob Hughes, Mike Cotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004
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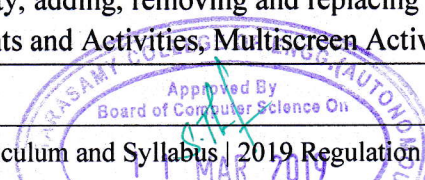
**Reference (s)**

1	Ramesh, Gopalswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
2	Royce, “Software Project Management”, Pearson Education, 1999.
3	Jalote, “Software Project Management in Practice”, Pearson Education, 2002.



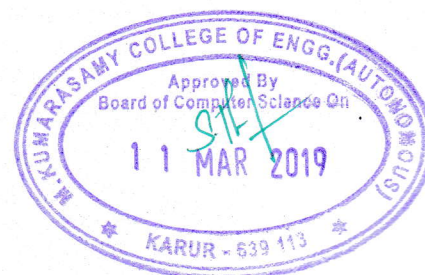


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE014T	Mobile Application Development	3	0	0	3
<b>Prerequisite Course (s)</b>						
Wireless Communication and Mobile Computing						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Demonstrate their understanding of the fundamentals of Android operating systems					
2	Demonstrate their skills of using Android software development tools					
3	Demonstrate their ability to develop software with reasonable complexity on mobile platform					
4	Demonstrate their ability to deploy software to mobile devices					
5	Demonstrate their ability to debug programs running on mobile devices					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain the fundamentals of Android operating system					
CO2	Describes the basics of layout, activity and fragment					
CO3	Illustrate the working of multi window application					
CO4	Outline the use of persistent storage					
CO5	Summarize the usage of sensors					
<b>UNIT I</b>	<b>INTRODUCTION TO ANDROID OPERATING SYSTEM</b>					<b>9</b>
Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools. Android application components – Android Manifest file, Externalizing resources values, themes, layouts, Menus, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes						
<b>UNIT II</b>	<b>ANDROID USER INTERFACE</b>					<b>9</b>
Measurements – Device and pixel density independent measuring units Layouts – Linear, Relative, Grid and Table Layouts User Interface (UI) Components – Editable and non editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multiscreen Activities						





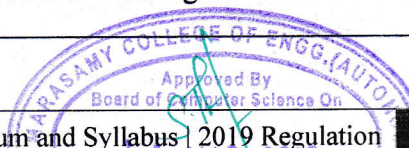
<b>UNIT III</b>	<b>INTENTS AND BROADCASTS</b>	<b>9</b>
<p>Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts</p>		
<b>UNIT IV</b>	<b>PERSISTENT STORAGE</b>	<b>9</b>
<p>Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)</p>		
<b>UNIT V</b>	<b>ADVANCED TOPICS</b>	<b>9</b>
<p>Alarms – Creating and using alarms Using Internet Resources – Connecting to internet resource, using download manager, Location Based Services – Finding Current Location and showing location on the Map, updating location</p>		
<b>Text Book (s)</b>		
1	Professional Android Application Development, Reto Meier, Wiley India, (Wrox), 2012	
2	Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013	
<b>Reference (s)</b>		
1	Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013	







Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE015T	Software Quality Assurance	3	0	0	3
<b>Prerequisite Course (s)</b>						
Software Engineering						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the basic tenets of software quality and quality factors.					
2	Get exposed to the Software Quality Assurance (SQA) architecture and its components.					
3	Understand how the SQA components can be integrated into the project life cycle.					
4	Get exposed to the management components of software quality.					
5	Get exposed to the management components of software quality.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Understand the software quality & architecture					
CO2	Utilize the concepts in software development life cycle.					
CO3	Demonstrate their capability to adopt quality standards.					
CO4	Assess the quality of software product					
CO5	Apply the concepts in preparing the quality plan & documents.					
<b>UNIT I</b>	<b>INTRODUCTION TO SOFTWARE QUALITY &amp; ARCHITECTURE</b>					<b>9</b>
Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall’s quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans.						
<b>UNIT II</b>	<b>SQA COMPONENTS AND PROJECT LIFE CYCLE</b>					<b>9</b>
Software Development methodologies – Quality assurance activities in the development process- Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management.						
<b>UNIT III</b>	<b>SOFTWARE QUALITY INFRASTRUCTURE</b>					<b>9</b>
Procedures and work instructions – Templates – Checklists – 3S developmenting – Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.						



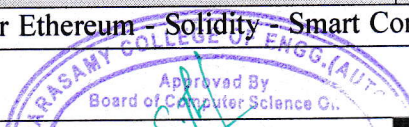


UNIT IV	SOFTWARE QUALITY MANAGEMENT & METRICS	9
Project process control – Computerized tools – Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of software quality – Classical quality cost model – Extended model – Application of Cost model.		
UNIT V	STANDARDS, CERTIFICATIONS & ASSESSMENTS	9
Quality Management standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies – Bootstrap methodology – SPICE Project – SQA project process standards – IEEE Standard 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities – SQA units and other actors in SQA systems.		
Text Book (s)		
1	Daniel Galin, “Software Quality Assurance”, Pearson Publication, 2009	
Reference (s)		
1	Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press, 1997.	
2	Mordechai Ben-Menachem “Software Quality: Producing Practical Consistent Software”, International Thompson Computer Press, 1997.	





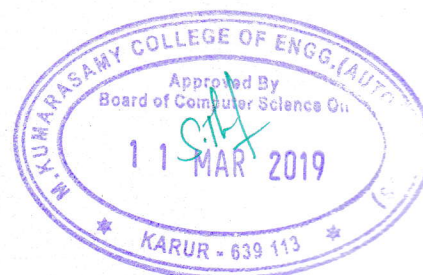
Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE016T	Block Chain Technology	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Familiarize the functional/operational aspects of cryptocurrency ECOSYSTEM.					
2	Understand emerging abstract models for Blockchain Technology.					
3	Identify major research challenges and technical gaps existing between theory and practice in cryptocurrency domain Syllabus					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Summarize the concepts of consensus problems and the Models of blockchain					
CO2	Explain the significance of cryptographic algorithms in blockchain					
CO3	Describe the features and importance of Bitcoin					
CO4	Explain about the principles of Ethereum Virtual Machine					
CO5	Illustrate the protocols in Blockchain					
<b>UNIT I</b>		<b>INTRODUCTION</b>				<b>9</b>
The consensus problem - Asynchronous Byzantine Agreement - ACP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for Blockchain - GARY model - RLA Model - Proof of Work ( PoW) as random oracle - formal treatment of consistency, liveness and fairness -Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).						
<b>UNIT II</b>		<b>CRYPTOGRAPHY</b>				<b>9</b>
Cryptographic basics for Cryptocurrency - A short overview of Hashing, Signature Schemes, Encryption schemes and elliptic curve cryptography						
<b>UNIT III</b>		<b>BITCOIN TECHNOLOGY</b>				<b>9</b>
Bitcoin - Wallet - Blocks - Merkle Tree - Hardness of mining - Transaction verifiability - Anonymity - Forks - Double spending - Mathematical analysis of properties of Bitcoin.						
<b>UNIT IV</b>		<b>ETHEREUM</b>				<b>9</b>
Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts -						





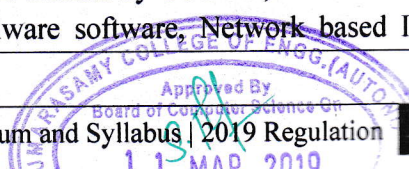
Some attacks on smart contracts

UNIT V	BLOCKCHAIN TECHNOLOGY	9
Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - Pairing on Elliptic curves - Zcash.		
<b>Text Book (s)</b>		
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder.	
2	Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.	
<b>Reference (s)</b>		
1	Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015	
2	R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, ( eprint.iacr.org/2016/454) . A significant progress and consolidation of several principles).	
3	R.Pass et al, Fruitchain, a fair blockchain, PODC 2017 ( eprint.iacr.org/2016/916).	





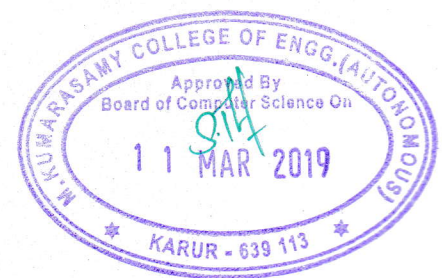
Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE017T	Cyber Security and Computer Forensics	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1.	Learn to analyze and validate forensics data					
2.	Be familiar with cyber security vulnerabilities and safeguards					
3.	Learn Computer Forensics					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain about the basics of Cyber security					
CO2	Discuss the cyber security vulnerabilities and safeguards					
CO3	Illustrate the security services and applications					
CO4	Explain about Intrusion Detection and Prevention					
CO5	Explain the forensics data validation					
<b>UNIT I</b>	<b>INTRODUCTION TO CYBER SECURITY</b>					<b>9</b>
Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.						
<b>UNIT II</b>	<b>CYBER SECURITY VULNERABILITIES AND CYBER SECURITY SAFEGUARDS</b>					<b>9</b>
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.						
<b>UNIT III</b>	<b>SECURING WEB APPLICATION, SERVICES AND SERVERS</b>					<b>9</b>
Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.						
<b>UNIT IV</b>	<b>INTRUSION DETECTION AND PREVENTION</b>					<b>9</b>
Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion						





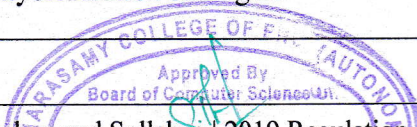
detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT V	CYBER FORENSICS	9
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.		
<b>Reference (s)</b>		
1	Man Young Rhee Internet Security: Cryptographic Principles Algorithms and Protocols, Wiley Publications, 2003.	
2	Nelson, Phillips, Enfinger, Steuart, Computer Forensics and Investigations, Cengage Learning, India Edition, 2008.	
3	John R. Vacca, Computer Forensics, Cengage Learning, 2005	
4	Richard E. Smith, Internet Cryptography, 3rd Edition Pearson Education, 2008	
5	Marjie T. Britz, Computer Forensics and Cyber Crime, An Introduction, 3rd Edition, Prentice Hall, 2013.	



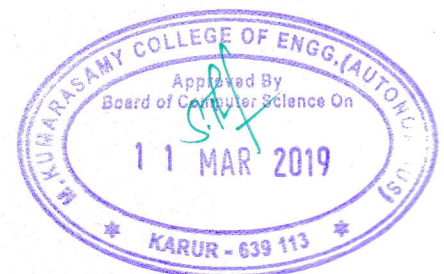


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE018T	Recommender System	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1.	Learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering.					
2.	Automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Design recommendation system for a particular application domain.					
CO2	Understand the availability of filtering based on contents.					
CO3	Apply different Collaborative filtering methods in different systems available.					
CO4	Design recommendation system based on various hybrid approaches.					
CO5	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity.					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Overview of Information Retrieval, Retrieval models, Search and Filtering techniques: relevance feedback, user profiles, recommender system functions, matrix operations, covariance matrices, understanding ratings, applications of recommendation systems, issues with recommender system.						
<b>UNIT II</b>	<b>CONTENT-BASED FILTERING</b>					<b>9</b>
High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.						
<b>UNIT III</b>	<b>COLLABORATIVE FILTERING</b>					<b>9</b>
User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.						
<b>UNIT IV</b>	<b>HYBRID APPROACHES</b>					<b>9</b>
Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies						





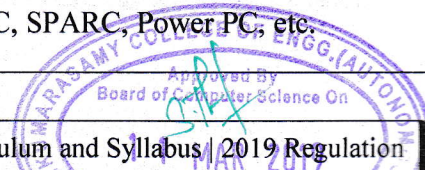
UNIT V	TYPES AND EVALUATING RECOMMENDER SYSTEM	9
Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations. Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.		
<b>Text Book (s)</b>		
1	Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.	
2	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.	
<b>Reference (s)</b>		
1	Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.	
2	Manouselis N., Drachslar H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.	





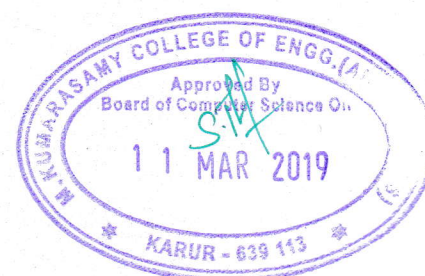


Regulation 2019					Total Hours		45
Category	Course Code	Course Name	Hours / Week			C	
			L	T	P		
E	19PCSE019T	Modern Computer Architecture	3	0	0	3	
<b>Prerequisite Course (s)</b>							
Computer Architecture							
<b>Course Objective (s):</b>							
The purpose of learning this course is to:							
1	Understand the concepts of register transfer logic and arithmetic operations						
2	Explain the different types of addressing modes and memory organization.						
<b>Course Outcome (s) (COs):</b>							
At the end of this course, learners will be able to:							
CO1	Interpret the basic of pipelining						
CO2	Outline the concept vector processors						
CO3	Classify the memory technologies and I/O systems						
CO4	Explain the computer organization components, instructions and addressing modes						
CO5	Outline the concept of parallelism and multi-core processor						
<b>UNIT I</b>		<b>PIPELINING</b>					<b>9</b>
Review of Pipelining, Examples of some pipeline in modern processors, pipeline hazards, data hazards, control hazards. Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance.							
<b>UNIT II</b>		<b>VECTOR PROCESSORS</b>					<b>9</b>
Vector processors- Use and effectiveness, memory to memory vector architectures, vector register architecture, vector length and stride issues, compiler effectiveness in vector processors.							
<b>UNIT III</b>		<b>MEMORY MANAGEMENT</b>					<b>9</b>
SISD, MISD, MIMD, Single instruction multiple data stream (SIMD) architectures. Array processors, comparison with vector processors, example of array processors such as MMX Technology. Memory hierarchy, Cache Introduction, Techniques to reduce cache misses, techniques to reduce cache penalties, technique to reduce cache hit times. Effect of main memory bandwidth, effect of bus-width, memory access time, virtual memory, etc.							
<b>UNIT IV</b>		<b>ADDRESSING MODES</b>					<b>9</b>
RISC architectures, addressing modes, instructions formats, effect of simplification on the performance, example processors such as MIPS, PA-RISC, SPARC, Power PC, etc.							



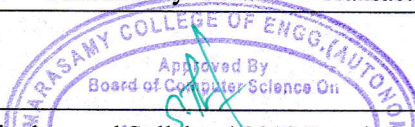


UNIT V	MEMORY MODELS	9
MIMID Multiprocessors, Centralized shared architectures, distributed shared memory architectures, synchronization and memory consistency models, message passing architectures, comelier issues. Data flow architectures, Interconnection networks.		
<b>Text Book (s)</b>		
1	Hwang, K. "Advanced Computer architecture with parallel programming", McGraw Hill, 1993	
2	Carter Computer Architecture ( Schaum Series),TMH	
<b>Reference (s)</b>		
1	Hwang & Briggs Computer Architecture & Parallel Processing, TMH 5. Stone, H.S.,	
2	"Advanced Computerat", Addison Wesley, 1989 6. Siegel, H.J.,	
3	"Interconnection Network for Large Scale parallel Processing", 2nd Ed., McGraw Hill, 1990	
4	Computer Organization & Architecture (TMH WBUT Series), Ghosh & Pal,TMH	





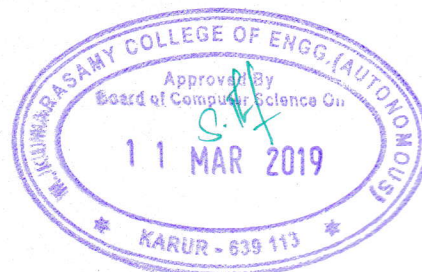
Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE020T	Advanced Database	3	0	0	3
<b>Prerequisite Course (s)</b>						
Database Management Systems						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the principles of parallel and distributed databases					
2	Sketch the features of object databases and object relational systems					
3	Learn the techniques for controlling concurrent transactions					
4	Study about Query processing and its optimization techniques					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Explain the principles of parallel and distributed databases					
CO2	Understand the concepts of object databases and object relational systems					
CO3	Explain the concepts of xml databases and data warehousing					
CO4	Explain the concepts of mobile databases					
CO5	Explain the concepts of multimedia databases					
<b>UNIT I</b>	<b>PARALLEL AND DISTRIBUTED DATABASES</b>					<b>9</b>
Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Three Tier Client Server Architecture- Case Studies.						
<b>UNIT II</b>	<b>OBJECT AND OBJECT RELATIONAL DATABASES</b>					<b>9</b>
Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems : Object Relational features in SQL/Oracle – Case Studies.						
<b>UNIT III</b>	<b>XML DATABASES</b>					<b>9</b>
XML Databases: XML Data Model – DTD - XML Schema - XML Querying – Web Databases – JDBC – Information Retrieval – Data Warehousing – Data Mining						
<b>UNIT IV</b>	<b>MOBILE DATABASES</b>					<b>9</b>
Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit						





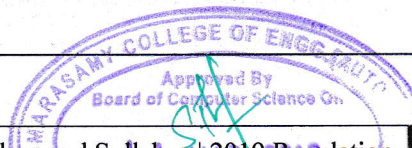
Protocols- Mobile Database Recovery Schemes

UNIT V	MULTIMEDIA DATABASES	9
Multidimensional Data Structures – Image Databases – Text/Document Databases Video Databases – Audio Databases – Multimedia Database Design.		
<b>Text Book (s)</b>		
1	Henry F. korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, fifth edition, McGraw hill, 2006.	
<b>Reference (s)</b>		
1	R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, fifth edition, pearson education/addison wesley, 2007.	
2	Thomas cannolly and carolyn begg, “ Database Systems, a practical approach to design, implementation and management”, third edition, pearson education, 2007.	
3	C.J. Date, A. Kannan and S. Swamynathan, ”An introduction to Database Systems”, eighth edition, pearson education, 2006.	
4	V.S. Subramanian, “Principles of Multimedia Database Systems”, harcourt india pvt ltd., 2001.	



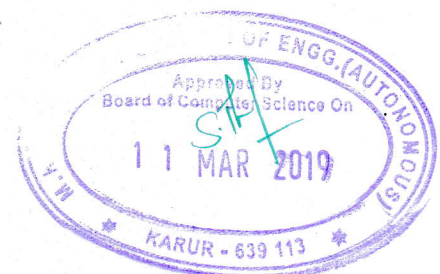


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE021T	Optimization Techniques	3	0	0	3
<b>Prerequisite Course (s)</b>						
Linear Algebra and Numerical Methods						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	The objective of this course is to provide insight to the mathematical formulation of real world problems.					
2	To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems					
<b>Course Outcome (s) (COs):</b>						
At the end of this course, learners will be able to:						
CO1	Formulate optimization problems					
CO2	Understand and apply the concept of optimality criteria for various types of optimization problems.					
CO3	Solve various constrained and unconstrained problems in Single variable as well as multivariable.					
CO4	Apply the methods of optimization in real life situation					
CO5	Able to solve the applications					
<b>UNIT I</b>	<b>ENGINEERING APPLICATION OF OPTIMIZATION</b>					<b>9</b>
Engineering application of Optimization, Formulation of design problems as mathematical programming problems. General Structure of Optimization Algorithms, Constraints, The Feasible Region.						
<b>UNIT II</b>	<b>MATHEMATICAL PROGRAMMING -- OPTIMIZATION</b>					<b>9</b>
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.						
<b>UNIT III</b>	<b>OPTIMIZATION ALGORITHMS</b>					<b>9</b>
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.						
<b>UNIT IV</b>	<b>PROBLEMS IN OPTIMIZATION</b>					<b>9</b>
Real life Problems and their mathematical formulation as standard programming problems.						
<b>UNIT V</b>	<b>APPLICATIONS</b>					<b>9</b>
Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.						





Text Book (s)	
1	Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9
2	Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
Reference (s)	
1	Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
2	John K. Karlof (2006). Integer programming: theory and practice. CRC Press. ISBN 978-0-8493-1914-3.
3	H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9
4	Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
5	Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.





Regulation 2019		-			Total Hours		45
Category	Course Code	Course Name	Hours / Week			C	
			L	T	P		
E	19PCSE022T	Compiler For High Performance Computing	3	0	0	3	
<b>Prerequisite Course (s)</b>							
Data Structure, Compiler Design, Theory of Computation							
<b>Course Objective (s):</b>							
The purpose of learning this course is to:							
1	To introduce structure of compilers and high performance computing						
2	To study the Concepts of cache coherence and parallel loops in compilers						
3	To understand the importance of compiler in various programming languages						
<b>Course Outcome (s) (COs):</b>							
At the end of this course, learners will be able to:							
CO1	Understand the fundamentals of Compiler High Performance Systems						
CO2	Learn the concepts involved in scalar analysis						
CO3	Study the compiler optimization techniques						
CO4	Learn concurrency and vector analysis concepts						
CO5	Learn the concepts of message-passing and scalable shared-memory machines						
<b>UNIT I</b>		<b>INTRODUCTION</b>					<b>9</b>
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance. <b>Data Dependence:</b> Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph							
<b>UNIT II</b>		<b>SCALAR ANALYSIS</b>					<b>9</b>
Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use- Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays. Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis							
<b>UNIT III</b>		<b>LOOP RESTRUCTURING &amp; OPTIMIZATION</b>					<b>9</b>
Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.							

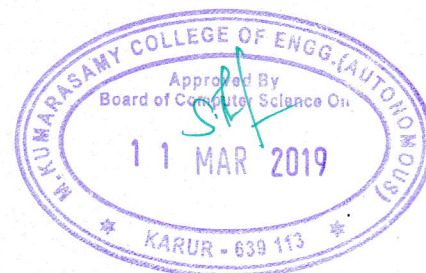


**M.KUMARASAMY**  
**COLLEGE OF ENGINEERING**

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UNIT IV	CONCURRENCY & VECTOR ANALYSIS	9
Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers		
UNIT V	MESSAGE-PASSING & SCALABLE SHARED-MEMORY MACHINES	9
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.		
Text Book (s)		
1	Michael Wolfe, High-Performance Compilers for Parallel Computing, Addison-Wesley Longman Publishing Co., 1996	







Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE023T	Social Network Analysis	3	0	0	3

**Prerequisite Course (s)**

Computer Networks

**Course Objective (s):**

The purpose of learning this course is to:

- |   |   |
|---|---|
| 1 | Understand the concept of semantic web and related applications.  |
| 2 | Learn knowledge representation using ontology.                    |
| 3 | Understand human behaviour in social web and related communities. |
| 4 | Learn visualization of social networks.                           |

**Course Outcome (s) (COs):**

At the end of this course, learners will be able to:

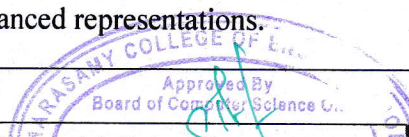
- |     |   |
|-----|---|
| CO1 | Explain the concept of semantic web and social Network analysis                     |
| CO2 | Explain the role of ontology and their various representations.                     |
| CO3 | Understand the concepts of Extraction And Mining Communities In Web Social Networks |
| CO4 | Predict human behaviour in social web and related communities                       |
| CO5 | Explain the Visualization and Applications of social networks                       |

UNIT I	INTRODUCTION	9
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Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks - Blogs and online communities – Web based networks - Applications of Social Network Analysis.

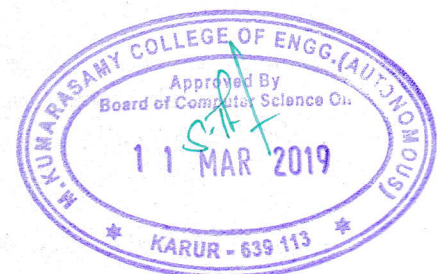
UNIT II	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION	9
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Ontology and their role in the Semantic Web - Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework - Web Ontology Language - Modeling and aggregating social network data – State of the art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.



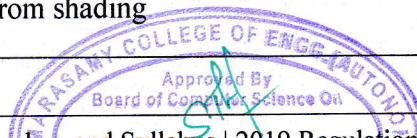


<b>UNIT III</b>	<b>EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS</b>	<b>9</b>
<p>Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.</p>		
<b>UNIT IV</b>	<b>PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES</b>	<b>9</b>
<p>Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.</p>		
<b>UNIT V</b>	<b>VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS</b>	<b>9</b>
<p>Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.</p>		
<b>Text Book (s)</b>		
1	Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.	
2	Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010	
<b>Reference (s)</b>		
1	Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011	
2	Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008	
3	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009	
4	John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009	



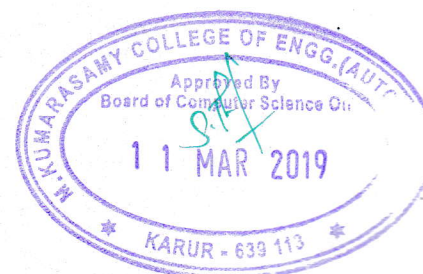


Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE024T	Computer Vision	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	Understand the vision of computer					
2	Understand about the image filtering and processing methods					
3	Know the significance of range measurement					
4	Understand the significance of motion estimations					
5	Analyse and represent the polyhedral scene effectively					
<b>Course Outcome (s) (COs):</b>						
CO1	Outline the features of computer vision					
CO2	Make use of the image filtering and processing methods					
CO3	Understand the techniques of range measurement, recovery scene geometry and use them effectively					
CO4	Make use of motion estimation					
CO5	Explain and represent the polyhedral scene model					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Machine vision systems, optics and lenses, image sensors, human vision and Neuro,visual model, Marr's paradigm, Imaging geometry - world co-ordinate system and camera co-ordinate system, co-ordinate transformations, projection geometry, camera calibration, radiometry						
<b>UNIT II</b>	<b>EARLY PROCESSING AND IMAGE FILTERING</b>					<b>9</b>
Noise removal, region segmentation, concept of primal sketch, scale space, edge detection and localization, edge linking, Hough transform, corner and junction detection. Reflectance map and photometric stereo, Image brightness and radiometry, image formation and surface reflectance under different conditions, reflectance map and bidirectional reflectance distribution function, photometric stereo recovering albedo and surface orientation, shape from shading						



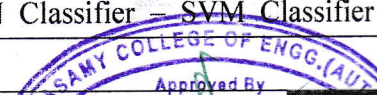


UNIT III	RANGE MEASUREMENT AND RECOVERING SCENE GEOMETRY	9
Binocular technique stereo pair, epipolar line and plane, Stereo matching, photogrammetry, monocular technique - texture processing and shape from texture, depth from focusing and symmetry, different range finder (active) - laser range finder, light-stripe method		
UNIT IV	MOTION ESTIMATION	9
Motion field, optical flow - smoothness, boundary conditions, discontinuities of optical flow, block based method, pre-recursive method, Bayesian method, Motion segmentation method, motion from points and lines, token tracking, stereo and motion tracking, use of Kalman filter, focus of expansion, structure from motion, motion compensated filtering and restoration, video compression, active and passive surveillance		
UNIT V	REPRESENTATION AND ANALYSIS OF POLYHEDRAL SCENE	9
Understanding line drawings, gradient and dual space, generalized cylinder, volumetric representation, edge and junction labelling; Labelling and recognition of scene objects; Construction of model-base and visual learning, model based recognition system - Acronym, model based recognition from sparse range data, 3D model based vision system, scene understanding. Special systems for computer vision: Visual information processing architecture, language and control, Applications		
Text Book (s)		
1	D. H. Ballard and C. M. Brown: Computer Vision, Prentice Hall, New York, 1986	
2	R. M. Haralick, L. G. Shapiro: Computer and Robot Vision, Addison	
Reference (s)		
1	Y. Shirai: Three-Dimensional Computer Vision, Springer-Verlag Berlin, 1988.	
2	B. K. P. Horn: Robot Vision, MIT Press, Cambridge, 1986	





Regulation 2019		-	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCSE025T	Information Retrieval Techniques	3	0	0	3
<b>Prerequisite Course (s)</b>						
Nil						
<b>Course Objective (s):</b>						
The purpose of learning this course is to:						
1	To understand the basics of Information Retrieval.					
2	To understand machine learning techniques for text classification and clustering.					
3	To understand various search engine system operations.					
4	To learn different techniques of recommender system.					
<b>Course Outcome (s) (COs):</b>						
CO1	Use an open source search engine framework and explore its capabilities					
CO2	Apply appropriate method of classification or clustering.					
CO3	Design and implement innovative features in a search engine.					
CO4	Design and implement a recommender system.					
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
. Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.						
<b>UNIT II</b>	<b>MODELING AND RETRIEVAL EVALUATION</b>					<b>9</b>
Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.						
<b>UNIT III</b>	<b>TEXT CLASSIFICATION AND CLUSTERING</b>					<b>9</b>
A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier –						





Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing.

<b>UNIT IV</b>	<b>WEB RETRIEVAL AND WEB CRAWLING</b>	<b>9</b>
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The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations — Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

<b>UNIT V</b>	<b>RECOMMENDER SYSTEM</b>	<b>9</b>
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Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.

**Text Book (s)**

1	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2	Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, First Edition, 2011.

**Reference (s)**

1	C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2008.
2	Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

