CURRICULUM AND SYLLABI FOR

Ph.D. – COMPUTER SCIENCE AND APPLICATIONS

(For the Scholars joining in 2017 and afterwards)

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS
The Gandhigram Rural Institute
(Deemed to be University)
Gandhigram - 624 302
Dindigul District
Tamil Nadu

THE GANDHIGRAM RURAL INSTITUTE – DEEMED TO BE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

Ph.D. (COMPUTER SCIENCE AND APPLICATIONS)

COURSE WORK AND SCHEME OF EVALUATION

(For the Scholars joining in 2017 and afterwards)

Code No.	Subject	Credit(s)	Lecture Hrs/ Week	ESE
	SEMESTER – I			
17CSAR0101	Advanced Algorithms	4	4	100
17CSAR0102	Advanced Computing Technologies	4	4	100
17CSAR0103	Machine Learning	4	4	100
17CSAR0104	Research Methodology	4	4	100
	SEMESTER – II			
17CSAR0205	Mathematical Techniques for Computer Science	4	4	100
17CSAR02SX	Area of Specialization (Thrust Area of Research) *	4	4	100
	Seminar 1	1	-	-
	Seminar 2	1	-	-
	Seminar 3	1	-	-
	Seminar 4 (Term Paper / Topical Research)	1	-	-
	RESEARCH CREDITS			
	Project Planning including Literature Collection, Finalization of Objectives and Methodology	4	-	-
	Field/Lab Studies, Data Collection, Compilation of Results, Statistical Analysis, Results and Final Conclusion	32	-	-
	Synopsis and Thesis Submission, Final Viva	6	-	-
	Total Credits	**70**		

ESE – End Semester Examination

***17CSAR02SX** - The title of the paper and syllabus within the Thrust Area of the Department will be framed by Doctoral Committee.

Thrust Area of the Department:

- Image Processing
- Computer Network
- Big Data Analytics

SEMESTER I

17CSAR0101	ADVANCED ALGORITHMS	Credits: 4

OBJECTIVES:

- To enhance the students' knowledge of algorithms and data structures
- To extend their expertise in algorithmic analysis and algorithm design techniques

LEARNING OUTCOMES

- Analyze the performance of algorithms
- Learns how to represent complex data using advanced data structures and their implementations
- Implement algorithm design techniques in computational geometry and parallel algorithms
- Learns how to select an appropriate algorithm for solving problems of different kind.

UNIT I: FUNDAMENTALS

Mathematical Proof Techniques: Induction, Proof by Contradiction, Direct Proofs – Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff

UNIT II: HEAP STRUCTURES

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

UNIT III: SEARCH STRUCTURES

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

UNIT IV: GEOMETRIC ALGORITHMS

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

UNIT V: PARALLEL ALGORITHMS

Flynn's Classifications – List Ranking – Prefix Computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on Mesh and Butterfly – Matrix Multiplication – Data Distribution on EREW, Mesh and Butterfly.

REFERENCES:

Books:

1. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++", Silicon Press, USA, 2007.

2. Gilles Brassard, Paul Bratley, “Algorithmics: Theory and Practice”, Prentice Hall, New Jersey, USA, 1988.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, “Computational Geometry Algorithms and Applications”, Third Edition, Springer, 2008.
4. J.A. Storer, "An Introduction to Data Structures and Algorithms", Springer Science and Business Media, New York, USA, 2002.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Prentice Hall of India, New Delhi, 2006.

Journals:

1. ACM Transactions on Algorithms, Association of Computing Machinery, New York, USA (*ISSN:* 1549-6325)
2. Algorithms, Multidisciplinary Digital Publishing Institute (MDPI), Switzerland. (ISSN 1999-4893)
3. Journal of Algorithms, Elsevier.
4. Journal of Algorithms & Computational Technology, Sage Journals, London, UK (eISSN: 17483026 | ISSN: 17483018)

Web Resources:

1. http://www.geeksforgeeks.org/data-structures /
2. https://www.beehyve.io
3. https://visualgo.net/en
4. https://www.coursera.org - Data Structures and Algorithms Specialization
5. https://www.edx.org/course?search_query=datastuctures
6. https://www.pdfdrive.net/Algorithms & Data Structures

Course Teacher: **Credits: 4**

LECTURE SCHEDULE

ADVANCED ALGORITHMS

Unit	Lecture No.	Date	Topic	Lecture Delivery Mechanism
I	1		Mathematical Proof Techniques	Lecture
	2		Asymptotic Notations	Lecture
	3		Properties of Big-oh Notation	Lecture
	4		Conditional Asymptotic Notation	Lecture
	5		Algorithm Analysis	Lecture
	6		Algorithm Analysis	Lecture
	7		Amortized Analysis	Web resources
	8		Introduction to NP-Completeness/NP-Hard	Web resources
	9		Recurrence Equations	Invited Lecture
	10		Recurrence Equations	Invited Lecture
	11		Solving Recurrence Equations	Invited Lecture
	12		Time-Space Tradeoff	Web resources
II	13		Min/Max heaps	SWAYAM
	14		Min/Max heaps	SWAYAM
	15		Deaps	SWAYAM
	16		Deaps	SWAYAM
	17		Leftist Heaps	Lecture
	18		Leftist Heaps	Student Seminar
	19		Binomial Heaps	Lecture
	20		Binomial Heaps	Assignment
	21		Fibonacci Heaps	Lecture
	22		Fibonacci Heaps	Student Seminar
	23		Skew Heaps	Assignment
	24		Lazy-Binomial Heaps	Assignment
III	25		Binary Search Trees	Lecture
	26		Binary Search Trees	Lecture
	27		AVL Trees	SWAYAM
	28		AVL Trees	SWAYAM
	29		Red-Black trees	Web resources
	30		Red-Black trees	Web resources
	31		Multi-way Search Trees	Web resources
	32		Multi-way Search Trees	Onl;ine
	33		B-Trees	SWAYAM
	34		B-Trees	SWAYAM
	35		Splay Trees	SWAYAM
	36		Tries	Assignment
IV	37		Segment Trees	PPT + Lecture
	38		Segment Trees	PPT + Lecture
	39		1-Dimensional Range Searching	Web resources
	40		1-Dimensional Range Searching	Web resources

	41		k-d Trees	PPT + Lecture
	42		k-d Trees	PPT + Lecture
	43		Line Segment Intersection	Student Seminar
	44		Convex Hulls	Student Seminar
	45		Computing the Overlay of Two Subdivisions	Assignment
	46		Range Trees	PPT
	47		Voronoi Diagram	PPT
	48		Voronoi Diagram	PPT
V	49		Flynn‟s Classifications	Lecture
	50		Flynn‟s Classifications	Lecture
	51		List Ranking	PPT
	52		Prefix computation	Lecture
	53		Array Max	Web resources
	54		Sorting on EREW PRAM	Lecture
	55		Sorting on Mesh and Butterfly	Lecture
	56		Prefix sum on Mesh and Butterfly	Self study
	57		Sum on mesh and butterfly	Assignment
	58		Matrix Multiplication	Self- study
	59		Data Distribution on EREW, Mesh and Butterfly	Assignment
	60		Data Distribution on EREW, Mesh and Butterfly	Assignment

17CSAR0102	ADVANCED COMPUTING TECHNOLOGIES	Credits: 4

OBJECTIVES:

- To introduce latest technological advancements in the field of Computer Science
- To make them understand the basic principles and use of recent technologies

LEARNING OUTCOMES

- Know the latest technological developments in the field of Computer Science and applications
- Gain knowledge about the working principles behind recent technologies and their applications

UNIT I: DISTRIBUTED COMPUTING

Introduction to Distributed Computing Concepts - Basic Concepts of Distributed Systems, Distributed Computing Models - Software Concepts, Issues in Designing Distributed Systems - Client Server Model, Distributed Shared Memory

UNIT II: GRID COMPUTING

Anatomy and Physiology of Grid-Review of Web Services - The Open Grid Forum, Grid Architecture - Overview of Resource Managers, Overview of Grid Systems - Application Management

UNIT III: PERVASIVE COMPUTING

Pervasive Computing - Wearable Computing, Modeling the Key Ubiquitous/Pervasive Computing Properties - Mobile Adaptive Computing, Mobility Management and Caching - Pervasive Computing Devices, Smart Environment

UNIT IV: MOBILE COMPUTING

Differences between Mobile Communication and Mobile Computing - Contexts and Names – Functions – Applications and Services - New Applications – Making Legacy Applications Mobile Enabled - Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies

UNIT V: CLOUD COMPUTING

Fundamentals of Cloud computing, Evolution of Cloud Computing - Key Characteristics of Cloud Computing - Cloud Deployment Models: Public, Private, Hybrid, Community - Categories of Cloud Computing - Everything as a Service - Infrastructure, Platform, Software - Pros and Cons of Cloud Computing – Virtualization.

REFERENCES:

Books:

1. Sunita Mahajan, Seema Shah, “Distributed Computing”, Oxford University Press, Chennai, 2010.
2. Andrew S. Tanenbaum, “Distributed Operating Systems”, Pearson Education India, 1995.

3. Kumar Saurabh, “Cloud Computing: Unleashing Next Gen Infrastructure to Application”, Third Edition,Wiley Publication, USA, 2014.
4. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, Second Edition, Tata McGraw Hill, India, 2010.
5. Frank Adelstein, “Fundamentals of Mobile and Pervasive Computing”, Tata McGraw Hill, India, 2005.
6. Stefan Poslad, “Ubiquitous Computing: Smart Devices, Environments and Interactions”, Wiley, USA, 2009.
7. Joshy Joseph & Craig Fellenstein, “Grid Computing”, Pearson Education, India, 2004.
8. Fran Berman, Geoffrey Fox, Anthony J.G.Hey, “Grid Computing: Making the Global Infrastructure a Reality”, John Wiley and Sons, USA, 2003.
9. D. Janakiram,“Grid Computing” , Tata Mcgraw Hill, India, 2005.

Web Resources:

1. https://www.pdfdrive.net/cloud-computing-a-practical-approach-e16208074.html
2. https://www.pdfdrive.net/distributed-computing-e33416176.html
3. https://www.pdfdrive.net/grid-computing-e19175811.html
4. https://www.pdfdrive.net/mobile-computing-e25107056.html
5. https://www.pdfdrive.net/pervasive-computing-and-networking-e39583430.html

Related Journals:

1. IEEE Transactions on Parallel and Distributed Systems
2. IEEE Transactions on Cloud Computing
3. IEEE Pervasive Computing
4. IEEE Transactions on Mobile Computing

Course Teacher: **Credits: 4**

LECTURE SCHEDULE

ADVANCED COMPUTING TECHNOLOGIES

Unit	Lecture No.	Date	Topic	Lecture Delivery Mechanism
I	1		Introduction to Distributed Computing Concepts	Lecture
	2		Basic concepts of distributed systems	PPT + Lecture
	3		Basic concepts of distributed systems	PPT + Lecture
	4		Distributed computing models	PPT + Lecture
	5		Distributed computing models	Online
	6		Software concepts	Lecture
	7		Software concepts	Self Study
	8		Issues in designing distributed systems	Self Study
	9		Issues in designing distributed systems	Self Study
	10		Client server model	Online
	11		Client server model	Online
	12		Distributed Shared Memory	Online
II	13		Anatomy and Physiology of Grid	SWAYAM
	14		Review of Web Services	SWAYAM
	15		The Open Grid Forum	Class Room Assignment
	16		The Open Grid Forum	Class Room Assignment
	17		Grid Architecture	Class Room Assignment
	18		Grid Architecture	Class Room Assignment
	19		Overview of Resource Managers	Self Study
	20		Overview of Resource Managers	Self Study
	21		Overview of Grid Systems	Class Room Assignment
	22		Overview of Grid Systems	Class Room Assignment
	23		Application Management	Lecture
	24		Application Management	Lecture
III	25		Pervasive Computing	Self Study
	26		Wearable Computing	Online
	27		Wearable Computing	Online
	28		Modeling the Key Ubiquitous	Online
	29		Pervasive Computing Properties	Online
	30		Mobile Adaptive Computing	Lecture
	31		Mobility Management and Caching	Lecture
	32		Mobility Management and Caching	Lecture
	33		Pervasive Computing Devices	Lecture
	34		Pervasive Computing Devices	Lecture
	35		Smart Environment	SWAYAM

	36		Smart Environment	Demo
IV	37		Differences between Mobile Communication and Mobile Computing	PPT + Lecture
	38		Contexts and Names – Functions	Lecture
	39		Applications and Services	PPT + Lecture
	40		New Applications	PPT + Lecture
	41		Making Legacy	PPT + Lecture
	42		Applications	Self Study
	43		Mobile Enabled	PPT + Lecture
	44		Design Considerations	Self Study
	45		Integration of Wireless	Lecture
	46		Wired Networks	Self Study
	47		Standards Bodies	Self Study
	48		Standards Bodies	Self Study
V	49		Fundamentals of Cloud computing	Lecture
	50		Evolution of Cloud Computing	Lecture
	51		Key Characteristics of cloud computing	SWAYAM
	52		Cloud deployment models	Lecture
	53		Public, private, hybrid, community	Class Room Assignment
	54		Categories of cloud computing	Online
	55		Everything as a service	Online
	56		Infrastructure, platform, software	Online
	57		Infrastructure, platform, software	Online
	58		Pros and Cons of cloud computing	Lecture
	59		Pros and Cons of cloud computing	Lecture
	60		Virtualization	Lecture

17CSAR0103	MACHINE LEARNING	Credits: 4

OBJECTIVES:

- To understand the neural network, genetic algorithm and machine learning techniques

LEARNING OUTCOMES

- Understand the deep learning algorithms like analytical, self-learning and re-inforced learning
- Know the basic concepts in neural networks and genetic algorithms

UNIT I : INTRODCTION

Learning Problems - Perspectives and Issues - Concept Learning - Version Spaces and Candidate Eliminations - Inductive bias - Decision Tree learning - Representation – Algorithm – Heuristic Space Search

UNIT II : NEURAL NETWORKS AND GENETIC ALGORITHMS

Neural Network Representation – Problems – Perceptrons - Multilayer Networks and Back Propagation Algorithms - Genetic Algorithms – Hypothesis Space Search - Genetic Programming - Models of Evalution and Learning

UNIT III : BAYESIAN AND COMPUTATIONAL LEARNING

Bayes Theorem – Concept Learning – Maximum Likelihood - Minimum Description Length Principle – Bayes Optimal Classifier - Naïve Bayes Classifier – Bayesian Belief Network Probability Learning – Sample Complexity - Finite and Infinite Hypothesis Spaces – Mistake Bound Model

UNIT IV: INSTANT BASED LEARNING

K- Nearest Neighbour Learning - Locally weighted Regression - Radial Bases Functions – Case Based Learning

UNIT V: ADVANCED LEARNING

Learning Sets of Rules – Sequential Covering Algorithm - Learning Rule Set – First Order Rules – Sets of First Order Rules - Induction on Inverted Deduction –Inverting Resolution - Analytical Learning - Perfect Domain Theories – Explanation Base Learning - Reinforcement Learning – Q-Learning

REFERENCES:

Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science /Engineering /Math; 1st Edition, USA, 1997.
2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press, USA, 2004.
3. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer, 1stEdition, Germany, 2001.

4. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, Germany, 2010.
5. Conway, “Machine Learning for Hackers”, O'Reilly Media, USA, 2012.
6. Ethem Alpaydi, “ Machine Learning”, Gildan Media, LLC, Canada, 2016.

Web Resources:

1. https://www.pdfdrive.net/introduction-to-machine-learning-e21918910.html
2. https://www.pdfdrive.net/machine-learning-e31767902.html
3. https://www.pdfdrive.net/machine-learning-in-computer-vision-e2728553.html

Related Journals:

1. IEEE Transactions on Pattern Analysis and Machine Intelligence
2. Machine Learning, Springer International Publishing

Course Teacher: **Credits: 4**

LECTURE SCHEDULE

MACHINE LEARNING

Unit	Lecture No.	Date	Topic	Lecture Delivery Mechanism
I	1		Introduction	Lecture
	2		Learning Problems	Lecture
	3		Learning Problems	Lecture
	4		Perspectives and Issues	Lecture
	5		Perspectives and Issues	Lecture
	6		Concept Learning	Lecture
	7		Version Spaces	Lecture
	8		Candidate Eliminations	PPT +Lecture
	9		Inductive bias	PPT + Lecture
	10		Decision Tree learning	PPT + Lecture
	11		Representation Algorithm	Self Study
	12		Heuristic Space Search.	Self Study
II	13		Neural Network Representation	Online
	14		Problems and Perceptrons	Online
	15		Multilayer Networks	SWAYAM
	16		Back Propagation Algorithms	SWAYAM
	17		Genetic Algorithms	Class Room Assignment
	18		Genetic Algorithms	Class Room Assignment
	19		Hypothesis Space Search	Class Room Assignment
	20		Hypothesis Space Search	Class room assignment
	21		Genetic Programming	Practical Demo
	22		Genetic Programming	Practical Demo
	23		Models of Evaluation and Learning	Lecture
	24		Models of Evaluation and Learning	Lecture
III	25		Bayes Theorem	Lecture
	26		Concept Learning	Lecture
	27		Maximum Likelihood	Lecture
	28		Minimum Description Length Principle	Online
	29		Bayes Optimal Classifier	Online
	30		Naïve Bayes Classifier	Self Study
	31		Bayesian Belief Network	Self Study
	32		Probability Learning	SWAYAM
	33		Sample Complexity	SWAYAM
	34		Finite and Infinite Hypothesis Spaces	Lecture
	35		Finite and Infinite Hypothesis Spaces	Lecture
	36		Mistake Bound Model	PPT + Lecture

IV	37		K- Nearest Neighbour Learning	Lecture
	38		K- Nearest Neighbour Learning	Lecture
	39		Locally weighted Regression	PPT + Lecture
	40		Locally weighted Regression	PPT + Lecture
	41		Locally weighted Regression	PPT + Lecture
	42		Locally weighted Regression	PPT + Lecture
	43		Locally weighted Regression	Practical demo
	44		Radial Bases Functions	Self Study
	45		Radial Bases Functions	Self Study
	46		Radial Bases Functions	Self Study
	47		Case Based Learning	Self Study
	48		Case Based Learning	Self Study
V	49		Learning Sets of Rules	Lecture
	50		Sequential Covering Algorithm	Lecture
	51		Learning Rule Set	SWAYAM
	52		First Order Rules	SWAYAM
	53		Sets of First Order Rules	SWAYAM
	54		Induction on Inverted Deduction	Class Room Assignment
	55		Inverting Resolution	Class Room Assignment
	56		Analytical Learning	Class room assignment
	57		Perfect Domain Theories	Practical demo
	58		Explanation Base Learning	Practical demo
	59		Reinforcement Learning	Lecture
	60		Q-Learning	Lecture

17CSAR0104	RESEARCH METHODOLOGY	Credits 4

OBJECTIVES:

- To introduce the basic concepts and methods of Scientific and Computer Science Research.
- To inculcate writing skills and make them write good scientific documents like articles, reviews and thesis
- To make the students aware of the various ethical issues and professional conducts

LEARNING OUTCOMES

- Understand the basic concepts and methods of scientific and computer research
- Abilie to analyze a research problem and make a design
- Acquire skills to write scientific documents
- Exposed to ethical issues and intellectual property rights

UNIT I: Introduction to Scientific and Computer Science Research

Objectives-Significance-Motivation of Research, Types and Approaches, Quantitative Research Methods, Research Methods versus Methodology, Research Process, Criteria of Good Research. Significance & Status of Research in Computer Science. Steps in Research: Having grounding in Computer Science, Major Journals & Publication in Computer Science, Major Research Areas of Computer Science. Identification, Selection & Formulation of Research Problem. Developing a Research Proposal, Planning your Research, The Wider Community, Resources and Tools

UNIT II: Research Problem and Design

Meaning and Selection of Research Problem, Meaning of Research Design, Need for a Research Design, Features of a Good Design. Important Concepts relating to Research Design. Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs

UNIT III: Research Data and Literature Survey

What is Data?, Mathematical Statistics and Computer Science views on Data Analysis, Methods for Finding Associations: Regression and Pattern Recognition, Method for Aggregation and Data Visualization tools and Techniques, Finding out about your Research Area, Literature Search Strategy, Writing Critical Reviews, Identifying Venues for Publishing your Research

UNIT IV: Writing Papers, Thesis and Review Process

Preparing and Presenting your Paper, The Conference View Process, Making use of the Referees' Reports, The Journal Review Process, Group Exercise in Reviewing Research Papers, Planning the Thesis, Writing the Thesis, Thesis Structure, Writing up Schedule, The Oral Examination and Viva Voce

UNIT V:Ethical Issues and Intellectual Property

Ethics in General, Professional Ethics, Ethical Issues that Arise from Computer Technology, General Moral Imperatives, More Specific Professional Responsibilities, Organizational Leadership Imperatives. Intellectual Property Rights, Legislations covering Intellectual Property Rights in India

REFERENCES:
Books:

1. C.R. Kothari, Gaurav Garg, "Research Methodology Methods and Techniques", 3rd Edition, New Age International Publishers, Lucknow, 2014.
2. Francis C.Dane, "Research Methods", Brooks/Cole Publishing Company, California, 1990.
3. Juliet Corbin, Anselm Strauss, "Basic of Qualitative Research", 3rd Edition, Sage Publications, New Delhi, 2008.
4. Angela Brew, Routledge Falmer, "The Nature of Research: Inquiry in Academic Context", Psychology Press, New York, 2001.
5. Allen B.Tucker, jr. (Ed.),"The Computer Science and Engineering Handbook", CRC Press, Boca Raton, 1997.
6. Robin Levin Penslar (Ed.),"Research Ethics Cases and Materials", Indiana University Press, Bloomington, 1995.

Web Resources:

1. http://desrist.org/desrist/content/design-science-research-ininformation-systems.pdf
2. http://study.com/academy/lesson/research-methodology-approaches-techniques-quiz.html
3. https://www/ 0deec5215604c11e41000000/Practical-Guide-to-Write-a-PhD-Thesis-and-publish-papers-based-on-the-thesis.pdf
4. https://www.bowiestate.edu/files/resources/the-fundamental-steps-to-writing-thesis.pdf
5. https://www.pdfdrive.net/research-methodology-books.html
6. https://www.pdfdrive.net/fundamental-of-research-methodology-and-statisticspdf-e10442087.html
7. https://www.pdfdrive.net/advanced-quantitative-research-methodology-e25608453.html
8. https://www.pdfdrive.net/introduction-1-research-methodology-11-the-concept-of-the-research-e870404.html
9. https://www.pdfdrive.net/research-methods-in-computer-science-e31324769.html

Course Teacher: **Credits: 4**

LECTURE SCHEDULE
RESEARCH METHODOLOGY

Unit	Lecture No	Date	Topic	Lecture Delivery Mechanism
I	1		Objectives-Significance- Motivation of Research	Lecture
	2		Types and Approaches	PPT + Lecture
	3		Quantitative Research Methods, Research Methods versus Methodology	Self Study
	4		Research Process, Criteria of Good Research	PPT + Lecture
	5		Significance & Status of Research in Computer Science	Lecture
	6		Steps in Research: Having grounding in Computer Science	Lecture
	7		Major Journals & Publication in Computer Science, Major Research Areas of Computer Science	Online
	8		Identification, Selection &Formulation of Research problem	Lecture
	9		Hypothesis Formulation	PPT + Lecture
	10		Developing a Research Proposal, Planning your Research	Lecture
	11		The Wider Community, Resources and Tools	Student Seminar
	12		The Role of Empirical Studies	Lecture
II	13		Meaning of Research Problem	Lecture
	14		Selection of Research Problem	PPT + Lecture
	15		Meaning of Research Design	Online
	16		Need for a Research Design	Group Discussion
	17		Features of a Good Design	PPT
	18		Important Concepts Relating to Research Design	Group Study and Presentation
	19		Important Concepts Relating to Research Design	PPT
	20		Different Research Designs	PPT
	21		Different Research Designs	Lecture
	22		Basic Principles of Experimental Designs	Student Seminar
	23		Basic Principles of Experimental Designs	Lecture
	24		Important Experimental Designs	Lecture
III	25		What is Data?	Group Discussion
	26		Mathematical Statistics and Computer Science views on Data Analysis	Lecture
	27		Methods for Finding Associations	Lecture
	28		Regression and Pattern Recognition	Lecture
	29		Regression and Pattern Recognition	Lecture

	30		Method for Aggregation and Data Visualization Tools and Techniques	PPT
	31		Method for Aggregation and Visualization	Lecture
	32		Finding out about your Research Area	Lecture
	33		Literature Search Strategy	Lecture
	34		Writing Critical Reviews	PPT
	35		Writing Critical Reviews	Practical Demo
	36		Identifying Venues for Publishing your Research	Online
IV	37		Preparing and Presenting your Paper	PPT + Lecture
	38		Preparing and Presenting your Paper	Practical Demo
	39		The Conference View Process	PPT
	40		Making use of the Referees' Reports	Lecture
	41		The Journal Review Process	PPT
	42		Group Exercise in Reviewing Research Papers	Group Discussion
	43		Planning the Thesis	Lecture
	44		Writing the Thesis	Lecture
	45		Thesis Structure	PPT
	46		Writing up Schedule	Practical Demo
	47		The Oral Examination and Viva Voce	Video + Lecture
	48		The Oral Examination and Viva Voce	Practical Demo
V	49		Ethics in General	Group Discussion
	50		Professional Ethics	Lecture
	51		Ethical Issues that Arise from Computer Technology	Group Discussion
	52		Ethical Issues that Arise from Computer Technology	Self-Study
	53		General Moral Imperatives	Online
	54		General Moral Imperatives	Lecture
	55		More Specific Professional Responsibilities	Lecture
	56		Organizational Leadership Imperatives	PPT
	57		Intellectual Property Rights	Assignment
	58		Intellectual Property Rights	Class Presentation
	59		Legislations covering Intellectual Property Rights in India	Invited Lecture
	60		Legislations covering Intellectual Property Rights in India	Invited Lecture

SEMESTER II

17CSAR0205	MATHEMATICAL TECHNIQUES FOR COMPUTER SCIENCE	Credits 4

OBJECTIVES:

This course introduces to the researchers to different areas of Mathematics which are fundamental for doing17CSAR research in Computer Science

LEARNING OUTCOMES

- Able to understand and utilize mathematical functions, empirical principles & processes
- Learn mathematical methods and techniques used for computer applications
- Gain knowledge on the applications of mathematical concepts
- Learn how to deal a problem in different domains using transform
- Able to analyze, evaluate or solve problems for a given circumstance or data
- Able to understand the mathematical basis of common algorithms, simulation model and prototype

UNIT I: Number Theory

Number theory –Introduction, Congruences, residue classes, theorems of Fermat, Euler and Wilson, linear congruences, elementary arithmetical functions, primitive roots, quadratic residues and the law of quadratic reciprocity.

UNIT II: Graph Theory

Trees, Representations of graphs, Spanning Tree and shortest path algorithms, Planarity, Connectivity, Traversability, Colorability, Network flow algorithms, Search procedure, Recurrence relations and generating functions,

UNIT III: Probability, Statistics and Estimation:

Random experiments, Sample space, Axioms of probability, Conditional probability: Bayes' Theorem. Independent events - Probabilistic models: standard discrete, continuous models and Markov models. Minimum Mean Square Estimation (MMSE), Maximum Likelihood Estimation (MLE), linear and interval estimation. Tests of Significance, ANOVA, Regression Analysis.

UNIT IV: Integral Transform

Introduction to Fourier, and Discrete Cosine Transform, Gabor transform, Gaussian function, Centre and width of Gaussian function, Time-frequency window of Gabor transform, Advantages in using Gabor transform, time frequency window of wavelets, Discrete wavelet transform, Haar wavelet ψ and its Fourier transform, Wavelets by convolution, Mexican hat wavelet, Morlet wavelet.

UNIT V: Fuzzy Sets and Relations

Crisp Sets- An Overview- The notion of fuzzy sets- Basie concepts of fuzzy sets- Classical Logic: An Overview- Fuzzy Logic- Fuzzy Complement- Fuzzy Union- Fuzzy Intersection- Combinations of Operations- General Aggregation Operations.

Crisp and Fuzzy Relations- Binary Relations- Binary Relations on a Single set- Equivalance and Similarity Relations- Compatibility or Tolerance Relations-Ordering- Morphisms-Fuzzy Relation Equations, Fuzzy Logic.

REFERENCES:
Books:

1. D. M. Burton,"Elementary Number Theory", 6th Ed., Tata McGraw-Hill, New Delhi, 2007.
2. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", 1st Ed., Tata McGraw-Hill, New Delhi, 1975.
3. K.R.Parthasarathy, "Basic Graph Theory", Tata McGraw-Hill, New Delhi, 1994.
4. Judith L. Gerstring, "Mathematical Structures for Computer Science", 5th Ed., McGraw Hill, Freeman, 2003.
5. Ralph P. Grimoldi, "Discrete and Combinatorial Mathematics - An Applied Introduction", 4th Ed., Pearson Education, 2013.
6. Yannis Viniotis, "Probability and Random Processes for Electrical Engineers", Mc-Graw Hill International Edition, 1998.
7. Ernest Davis, "Linear Algebra and Probability for Computer Science Applications", CRC Press, 2012.
8. Y. Meyer, "Wavelets: Algorithms and Applications", SIAM, Phildelphia, 1993.
9. A.M. Wazwaz, "A First Course in Integral Equations", 1st Ed., World Scientific Publications, 1997.
10. Geroge J. Klir and Tina A.Folger, "Fuzzy Sets, Uncertainty and Information", Prentice – Hall of India Pvt. Ltd, New Delhi, 2008.
11. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", 3rd Ed., Wiley, USA, 2010.

Journals:

1. Journal of Number Theory, Elsevier Publications, USA.
2. Journal of Graph Theory, Wiley Publication, Spain.
3. Statistics & Probability Letters, Elsevier Publications, Italy.
4. Integral Transform and Special Functions, Taylor & Francis.
5. Fuzzy Sets and Systems, Elsevier Publications, Belgium.

Web Resources:

1. https://www.pdfdrive.net/burton-david-m-elementary-number-theorypdf-e30988027.html
2. https://www.pdfdrive.net/discrete-mathematics-for-computer-science-e15324843.html
3. https://www.pdfdrive.net/graph-theory-with-applications-e10372178.html
4. https://www.pdfdrive.net/probability-and-random-processes-for-electrical-and-computer-e11436002.html
5. www.iausdj.ac.ir/ostad/.../Fuzzy%20Logic%20with%20Engineering%20Applications.pdf

Course Teacher: Credits: **4**

LECTURE SCHEDULE

MATHEMATICAL TECHNIQUES FOR COMPUTER SCIENCE

Unit	Lecture No.	Date	Topic	Lecture Delivery Mechanism
I	1		Introduction	Lecture
	2		Introduction	Lecture
	3		Congruences	Invited Lecture
	4		Residue classes	Lecture
	5		Theorems of Fermat	Invited Lecture
	6		Theorems of Euler	Seminar
	7		Theorems of Wilson	Lecture
	8		Linear congruences	Assignments
	9		Elementary arithmetical functions	Seminar
	10		Primitive roots	Lecture
	11		Quadratic residues	Invited Lecture
	12		The law of quadratic reciprocity	Assignments
II	13		Trees	Lecture
	14		Representations of graphs	Lecture
	15		Spanning Tree	Seminar
	16		shortest path algorithms	Assignments
	17		Planarity	Invited Lecture
	18		Connectivity	Lecture
	19		Traversability	Seminar
	20		Colorability	Assignments
	21		Network flow algorithms	Invited Lecture
	22		Search procedure	Lecture
	23		Recurrence relations	Seminar
	24		generating functions	
III	25		Random experiments	Lecture
	26		Sample space, Axioms of probability	Lecture
	27		Conditional probability: Bayes' Theorem.	Seminar
	28		Independent events	Lecture
	29		Probabilistic models: standard discrete and continuous models	Assignments
	30		Markov models	Invited Lecture
	31		Minimum Mean Square Estimation (MMSE)	Lecture
	32		Maximum Likelihood Estimation (MLE)	Seminar
	33		linear and interval estimation	Lecture
	34		Tests of Significance	Seminar
	35		ANOVA	Assignments
	36		Regression Analysis	Invited Lecture
IV	37		Introduction to Integral Transform	Lecture
	38		Fourier Transform	Seminar

	39		Discrete cosine Transform	Lecture
	40		Gabor transform, Gaussian function	Seminar
	41		Centre and width of Gaussian function	Lecture
	42		Time-frequency window of Gabor transform	Lecture
	43		Advantages in using Gabor transform	Lecture
	44		time frequency window of wavelets, Discrete wavelet transform,	Invited Lecture
	45		Haar wavelet ψ and its Fourier transform, Wavelets by convolution,	
	46		Mexican hat wavelet, Morlet wavelet.	Assignments
	47		Laplace Transform: Definition Properties, evaluation of Laplace and Inverse Laplace transforms of functions.	Seminar
	48		Convolution theorem for Laplace Transforms. Solving initial value problem and solving integral equation using Laplace Transforms	Assignments
V	49		Crisp Sets - An Overview- The notion of fuzzy sets	Lecture
	50		Basic concepts of fuzzy sets- Classical Logic: An Overview	Assignments
	51		Fuzzy Logic- Fuzzy Complement	Seminar
	52		Fuzzy Union - Fuzzy Intersection	Seminar
	53		Combinations of Operations General Aggregation Operations.	Lecture
	54		Crisp and Fuzzy Relations	Assignments
	55		Binary Relations- Binary Relations on a Single set	Seminar
	56		Equivalence and Similarity Relations	Seminar
	57		Compatibility or Tolerance Relations	Lecture
	58		Ordering- Morphisms	Lecture
	59		Fuzzy Relation Equations	Invited Lecture
	60		Fuzzy Logic	Invited Lecture