DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SYLLABUS FOR Ph.D COURSE WORK

RAJIV GANDHI UNIVERSITY,
RONO HILLS, DOIMUKH

Ph.D Course Work Course Structure

Paper Code	Title	Credit	Mark Distribution		
			End Semester	Sessional	Total
CSCW-801	Research Methodology	4-0	75	25	100
CSCW-82X	Elective (***Any one from the list***)	4-0	75	25	100
	CSCW-821: Digital Signal Processing				
	CSCW- 822: Speech and Natural Language Processing				
	CSCW- 823: Soft Computing				
	CSCW-824: Data Mining				

PROGRAM OBJECTIVES:

- To develop an understanding of various research designs and techniques.
- To provide students an understanding of the expectations from research work.
- To improve research skills of engineering students
- To bridge the skill gaps and make students research ready
- To provide an opportunity to students to develop inter-disciplinary skills.
- The program focusses on research skill development and more than 50% of the time is spent on practical training and problem solving, to provide the requisite understanding towards application of academic topics from Computer Engineering disciplines into real world engineering research projects.

CSCW-801: RESEARCH METHODOLOGY (4-0)

COURSE OBJECTIVES:

- To develop understanding of the basic framework of research process, publication and patent scopes.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality.

Contents:

1. Introduction to Computer Science Research: What is Research, Types of Research, Why 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, Hypothesis formulation, Developing a research proposal, Planning your research, The wider community, Resources and Tools, How engineering research differs from scientific research, The role of empirical studies.

2. Qualitative Reasoning: Qualitative Representations, Representing Quantity, Representing Mathematical Relationship, Ontology, State, Time and Behaviors, Space and Shape, Compositional Modeling, Domain Theories, and Modeling Assumptions, Qualitative Reasoning Techniques, Model Formulation, Causal Reasoning, Simulation, Comparative Analysis, Teleological Reasoning, Data Interpretation, Planning, Spatial Reasoning.

3. Simulation: What is simulation? How a simulation model works? Time & randomness in simulation. Applications of simulations.

4. Research Data: What is data, Mathematical statistics and computer science views on data analysis, Methods for finding associations: regression and pattern recognition, Method for aggregation and visualisation: principal components and clustering, Hypothesis testing.

5. Literature Survey: Finding out about your research area, Literature search strategy, Writing critical reviews, Identifying venues for publishing your research.

6. Writing Papers and the Review Process: Preparing and presenting your paper. The conference review process, Making use of the referees' reports, The journal review process, Group exercise in reviewing research papers.

7. Thesis Writing: Planning the thesis, Writing the thesis, Thesis structure, Writing up schedule, The Oral examination and Viva Voce.

RECOMMENDED BOOKS

1. Research Methods By Francis C. Dane, Brooks/ Cole Publishing Company, California, 1st Edition, 1990.
2. Basic of Qualitative Research By Juliet Corbin & Anselm Strauss, Sage Publications, 3rd Edition, 2007.
3. The Nature of Research: Inquiry in Academic Context By Angela Brew, Routledge Falmer, 1st Edition, 2001.
4. Research Methods By Ram Ahuja, Rawat Publications, 1st Edition, 2001.
5. The Computer Science and Engineering Handbook By Allen B. Tucker, jr. (Editor-in-Chief), CRC Press.

CSCW-821: DIGITAL SIGNAL PROCESSING (4-0)

COURSE OBJECTIVES:

- To understand the difference between discrete-time and continuous-time signals
- To understand and apply Discrete Fourier Transforms (DFT)

1. Discrete Time Signals & System: Discrete–time signals, Discrete–time systems, Analysis of discrete-time LTI systems, Discrete-time systems described by differential equations, Implementation of discrete-time systems, Correlation of discrete-time systems

2. Z-Transform: Definition and Properties of Z-transform, Rational Z-transforms, Inverse Z-transform, one-sided Z-transform, Analysis of LTI systems in Z-domain

3. Application of Z-Transform: Time domain analysis, frequency response - graphical interpretation, application: digital audio effects

4. Frequency Analysis of Signals and Systems: Frequency analysis: Continuous time signals and Discrete-time signals, Properties of the Fourier transform for discrete-time signals, Frequency domain characteristics of LTI systems, LTI system as a frequency selective filter, Inverse systems and deconvolution

5. Discrete Fourier Transform: Frequency domain sampling, Properties of DFT, Linear filtering method based on DFT, Frequency analysis of signals using DFT, FFT algorithm, Applications of FFT, Goertzel algorithm, Quantisation effects in the computation of DFT

6. Implementation of Discrete Time Systems: Frequency domain sampling, Properties of DFT, Linear filtering method based on DFT, Frequency analysis of signals using DFT, FFT algorithm, Applications of FFT, Goertzel algorithm, Quantisation effects in the computation of DFT

7. Design of Digital Filters: Design of FIR filters, Design of IIR filters from analog filters, frequency transformations, Design of digital filters based on least-squares method digital filters from analogue filters, Properties of FIR digital filters, Design of FIR filters using windows, Comparison of IIR and FIR filters, and Linear phase filters.

8. Introduction to DSP co-processors: TMS 320C40/50, Analog Devices

9. Applications: Image processing, Speech, Audio, Telecommunication, Graphics, image enhancement, 3- D rendering , Navigation, GPS , Correlation, machine vision, Frequency domain filtering.

10. Advance DSP concepts: Multirate signal processing, adaptive signal processing, finite word length effect

RECOMMENDED BOOKS

1. J.G. Proakis, Digital Signal Processing: Principles, Algorithms, And Applications , Pearson, 4th Edition, 2011.
2. Oppenheim, Digital Signal Processing, Pearson, 1st Edition, 2006.
3. S Sallivahanan, Digital Signal Processing , Tata McGraw-Hill, 2nd Edition, 2011
4. Ashok Ambardar, Analog and Digital Signal Processing, CL Engineering, 2nd Edition, 1999.

CSCW- 822: SPEECH AND NATURAL LANGUAGE PROCESSING (4-0)

COURSE OBJECTIVES:

- Teach students the leading trends and systems in natural language processing.
- Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Teach them to recognize the significance of pragmatics for natural language understanding.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

LEARNING OUTCOMES :

- Understand approaches to syntax and semantics in NLP.

- Understand approaches to discourse, generation, dialogue and summarization within filters.
- Understand current methods for statistical approaches to machine translation.
- Understand machine learning techniques used in NLP, including Hidden Markov Models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP

CONTENTS:

Speech and Natural Language Processing: Introduction; Brief Review of Regular Expressions and Automata; Finite State Transducers; Word level Morphology and Computational Phonology; Basic Text to Speech; Introduction to HMMs and Speech Recognition. Indian language case studies; Part of Speech Tagging; Parsing with CFGs; Probabilistic Parsing. Representation of Meaning; Semantic Analysis; Lexical Semantics; Word Sense; Disambiguation; Discourse understanding; Natural Language Generation; Techniques of Machine Translation; Indian Language case studies.

RECOMMENDED BOOKS

1. Daniel Jurafsky & James H.Martin, Speech and Language Processing, Pearson Education, 1st Edition, 2009.
2. James Allen, Natural Language Understanding, Pearson Education, 2nd Edition, 2007.
3. Gerald J. Kowalski and Mark.T. Maybury, Information Storage and Retrieval systems, Springer, 2nd Edition, 2000.
4. Tomek Strzalkowski, Natural Language Information Retrieval, Springer, 1st Edition, 1999.
5. Christopher D.Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1st Edition, 1999.

CSCW- 823: SOFT COMPUTING (4-0)

COURSE OBJECTIVE:

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide studentan hand-on experience on MATLAB to implement various strategies.

Contents:

1. Introduction to Soft Computing: Hard Computing, Soft Computing, Features of Soft Computing, Constituents of Soft Computing, Applications of Soft Computing Crisp Logic, Fuzzy Logic (FL), Rough Logic and Systems based on it Probabilistic Theory, Genetic Algorithms (GA), Artificial Neural Network (ANN).

2. Introduction to Genetic Algorithm: Introduction to Genetic Algorithms - Definition of GA - Description of Terminology/Vocabulary of GA - Importance and Goal of

Traditional Optimization Methods - Classification of Search Techniques - Introduction to Hill climbing - Simulated annealing – Decision Tree – Difference between Genetic Algorithms and Traditional Methods - Simple Genetic Algorithm Examples. Genetic Modeling: Offspring – Encoding - Fitness Function – Reproduction – Crossover - Inverse and Deletion -Mutation Operator - Generational Cycle – Convergences - Application

3. Regression and Optimization: Least Square Methods for System Identification System Identification Introduction, Basics of Matrix Manipulation and Least Squares Estimators, Recursive Least Squares Estimators, Introduction to Derivative Based Optimization, Introduction to Derivative Free Optimization

4. Neuro-Fuzzy Modeling: Introduction to Neuro-Fuzzy Modeling, Approaches of Neuro-Fuzzy Systems, Fuzzy Neural approach, Cooperative Neuro-Fuzzy Approach, Concurrent Neuro-Fuzzy Approach, Hybrid Neuro-Fuzzy Approach, Applications of Cooperative Neuro-Fuzzy Systems

5. Advanced Neuro-Fuzzy Modeling: Framework of Adaptive Neuro-Fuzzy Inference Systems(ANFIS), Hybrid Learning Algorithm, Learning Methods, Universal Approximation, Generalized Adaptive Neuro-Fuzzy Inference Systems(ANFIS), Neuro-Fuzzy Spectrum, Analysis of Adaptive Learning Capability, Rule extraction, and Evolution, Evolution of Antecedents, Evolution of Consequents, Evolving Partitions

6. Other Hybrid System: Genetic–Fuzzy Systems, Genetic Algorithms Controlled by Fuzzy Logic, Fuzzy Evolutionary Systems, Evolving Knowledge Base and Rule Sets, Neuro-Genetic Systems, Neural Network Weight Training, Evolving Neural Nets, Genetic Fuzzy Neural Network.

RECOMMENDED BOOKS

1. Jang J S R, Sun C T, Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 1st Edition, 2009.
2. Akerkar RA and Sajja PS, Knowledge-Based Systems, Jones & Bartlett Publishers, Sudbury, 2009.
3. Ian Cloete and Jacek Zurada(Eds.), Knowledge Based Neuro-Computing, University (MIT Press), University Press, 2001.
4. Oscar Cordon, Francisco Herrera, Frank Hoffmann, Luis Magdalena, "Genetic Fuzzy Systems, Evolutionary Tuni", Word Scientific Publishing Ltd, 1st Edition, 2001.

CSCW-824: DATA MINING (4-0)

Course Objective:

- The objective of this course is to introduce data mining techniques.
- Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

CONTENTS:

1. Mining frequent Patterns, Associations and Correlations: Basic concepts and a road map for Association rule mining, efficient and scalable frequent itemset mining methods, mining various kinds of association rules, from association mining to correlation analysisi, constraint based association rule mining.

2. Classification and Predictions: Issues regarding classification and predication, Different classification methods including Decision tree induction – Bayesian Classification, Neural network technology, K- Nearest Neighbor Classifier- Case-based Reasoning - Fuzzy set theory - genetic algorithm, Prediction: Linear and Multiple Regression – Nonlinear Regression – Other Regression Models, Classifier Accuracy. Prediction, accuracy and error measures evaluating accuracy of a classifier , model selection

3. Cluster Analysis : Types of data in cluster analysis, Partition based Clustering, Hierarchical Clustering, Density based Clustering, Grid based Clustering, Model based Clustering, Discussion on scalability of clustering algorithm, Outlier analysis, Parallel approaches to clustering and outlier analysis

4. Mining Stream, Time Series and Sequence Data: Mining data streams, mining time-series data, mining sequence patterns in transactional databases and mining sequence patterns in biological data

5. Application of Data Warehousing and Data Mining: Exploration of web sites on data warehousing and data mining application including bibliography databases, Corporate Houses and Research labs. Use of data mining packages and data warehousing packages, e.g. SAS, IBM, excel miner tools.

RECOMMENDED BOOKS

1. Jiawei Han and Micheline Kamber, 'Data Mining: Concepts and Techniques, Morgan Kaufmann, India
2. A K Pujari, 'Data Mining Techniques, University Press, India
3. Han, Manilla and Smyth, 'Principles of Data Mining', PHI, India
4. Pang-ning Tan, Michael Steinbach, Vipin Kumar , Introduction To Data Mining, Pearson, 1st Edition, 2007.