COTTON UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY Syllabus for Ph.D. Course Work in Computer Science & IT

FACULTY OF PHYSICAL, CHEMICAL AND MATHEMATICAL SCIENCES

Ph.D students of Computer Science & IT at Cotton University are required to complete a course work of 12 credits, spread over 3 courses, in the first semester of Ph.D Programme. Each course of 4 credits will be in the L+T+P format. For the purpose of computation of workload the mechanism is

> 1 credit = 1 theory period of 1 hour duration per week
> 1 credit = 1 tutorial period of 1 hour duration per week
> 1 credit= 1 practical period of 2 hours duration per week

Courses :

1. Research Methodology: Common course for the Department of CSIT, Physics, Chemistry and Statistics **(Compulsory)**

2. Course Course : Common Course for all branches of CSIT Department **(Compulsory)**

3. Special Paper : Only one optional paper shall be opted which is related to the topic of his research from the given optional papers and is considered as his/her **"Special Paper".**

Paper Wise Credit distribution

Paper Code	Paper Title	Credit (L+T+P)	Marks
PHDRM100	Research Methodology(Compulsory paper)	3+0+1=4	70+30
CSITCC200	**Advances in computer Science:**Core Course(Compulsory paper)	3+1+0=4	100
CSITSP301	**Mobile Computing :**Special Paper(Optional)	3+1+0=4	100
CSITSP302	**Network Security and Cryptography** :Special Paper(Optional)	3+1+0=4	100
CSITSP303	**Digital Image Processing**:Special Paper(Optional)	3+1+0=4	100
CSITSP304	**ANN and Pattern Recognition**:Special Paper(Optional)	3+1+0=4	100

CSITSP305	**Soft Computing**:Special Paper(Optional)	3+1+0=4	100

Research Methodology

Title: Research Methodology (3 + 0 + 1 = 4 Credits)
Paper code: PHDRM100
(# *Common for all the departments of the faculty of Physical, Chemical and Mathematical Sciences.*)

Unit-I: Introduction to Research Methodology
Meaning and objectives of research, Types of Research, Qualitative and Quantitative approaches of research, Criteria of good research, Research problem, Importance of defining the research problem, Techniques involved in defining a research problem, Illustration of research problem, Characteristics of Scientific method, Research Process, Literature survey

Unit-II: Hypothesis and research methodology
Research Design: Meaning, Importance of designing of research, Features of a good research design, Design of Exploratory Research and Descriptive Research
Experimental Design: Concept of Independent & Dependent variables. Concept of Hypotheses, Characteristics of Hypothesis, Null hypothesis & Alternative Hypothesis
Hypothesis Testing –Logic & Importance

Unit-III: Data collection and analysis
Observation and collection of data- primary and secondary data, Methods of collection of data- Sampling methods, Data processing and analysing strategies, Data analysis with statistical methods, Hypothesis testing, Generalization and Interpretations

Unit-IV: Scientific paper writing
Research communication and publication, when and where to publish, Layout of a research paper, Journal impact factor and citation, Scientific Citation Index and Extended List, H-index and i-10 index

Unit-V: Ethics in Research, Copyright and Intellectual Property Rights
Brief introduction to ethics and etiquettes in research with reference to honesty in scientific communication, reporting data, fabricating, falsifying and misinterpreting data
Plagiarism: Definition, various forms of plagiarism, self plagiarism, software for checking plagiarism
Intellectual property rights: Intellectual property and intellectual property rights, patent, trade mark, industrial design, geographical indication, copyright laws, world intellectual property organization.

Reference
1. Research Methodology-Methods and Techniques 2/e by C. K. Kothari, New Age International, New Delhi, 2004.
2. Research Methodology: A Step by Step Guide for Beginners 2/e by R. Kumar, Pearson India, 2005.
3. Statistics By T. R. Jain & S. C. Aggarwal, VK Enterprises, India.
4. The Researcher's Bible by A. Bundy, B. D. Boulay, J. Howe and G. Plotkin, University of

Edinburgh, 1995

5. Reports and mannuals available in the official website of IPO (www.ip india .nic.in/) and WIPO (www. wipo .int/).

   [For Credit 1: The students have to prepare a report of literature survey (up to 3000 words) on a research topic assigned to him/her and submit the same to the concerned department before the 2 (two) weeks of final Course Work Examinations. This credit is in lieu practical (P) as stated in the L+T+P credit format]

Core Paper

Paper Title: Advances in computer Science (Credit: 3 + 1 + 0 = 4)
Paper Code:CSITCC200

Unit-I: Theory of computation and algorithms
Advanced topics on theory of computation, compiler construction, data structures, and design/analysis of algorithms.

Unit-II: Systems, networks and databases
Advanced topics on operating systems, network protocols, next generation networks, database organizations.

Unit-III: Software engineering and programming languages
Software engineering architectures, fundamentals of programing language design, object oriented programming, distributed computing.

Unit-IV: Advances in Knowledge Discovery
Comprehensive overview about data mining techniques, machine learning techniques, digital image processing, and principles of information security.

Unit-V: Recent advances
Overview of advances in neural networks, cloud computing, big data analytics

Reference

1. Martin, J. C., Introduction to Languages and the Theory of Automata, New Delhi: Tata McGraw-Hill
3. Horowitz, E.; Sahni, D. Mehta, Fundamentals of Data Structures in C++, New Delhi: Galgotia Publications, 2002
4. Lipschutz, S., Theory and Problems of Data Sturctures (International Edition), Schaum's Outline Series, New Delhi: Tata McGraw-Hill, 1986
5. Aho, A. V.; J. D. Ullman, Principles of Compiler Designs (First Edition), New Delhi: BPB Publications, 2003
6. Aho, A. V.; J. E. Hopcroft; J. D. Ullman, The Design and Analysis of Computer Algorithms, New Delhi: Addison Wesley, 2001.
7. Tenenbaum, A. S., Modern Operating Systems (Second Edition), New Delhi: Prentice-Hall India, 2002
8. Tenenbaum, A. S., Computer Networks (Fourth Edition), New Delhi: Prentice-Hall India, 2002
9. Elmasri, R.; S. B. Navathe, Fundamentals of Database Systems (Third Edition), New Delhi: Addison Wesley, 2000
10. Pressman, R. S., Software Engineering A Practitioner's Approach (Sixth Edition), New Delhi: Tata McGraw-Hill, 2005
11. Balagurusamy, E., Object-Oriented Programming with C++, New Delhi: Tata McGraw-Hill,1995

12. Coulouris, G.; J. Dollimore; T. Kindberg, Distributed Systems – Concepts and Design (Second Edition), New Delhi: Pearson Education, 2000
13. Han, J.; M. Kamber , Data Mining: Concepts and Techniques , San Fransisco: Morgan Kaufman Publisher, 2001
14. Gonzalez, R. C.; R. E. Woods, Digital Image Processing, New Delhi: Addison Wesley, 2000
15. Stallings, W., Cryptography and Network Security: Principles and Practice, Third Edition,New Delhi: Prentice-Hall India, 2003
16. B. Yegnanarayana - Artificial neural network PHI Publication
17. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition, 2009.
18. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", 1st Edition, IBM Corporation, 2012.

Elective Papers

Paper Title: Mobile Computing (3 + 1 + 0 = 4 Credits)
Paper Code:CSITSP301

Unit - I: Introduction to Mobile Communications and Computing

Introduction to Mobile Computing: novel applications, limitations, architecture; GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services.

Unit - II: Medium Access Control

Motivation for a specialized MAC: Hidden and exposed terminals, Near and far terminals; SDMA; FDMA; TDMA; CDMA.

Unit - III: Mobile Network Layer

Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations; Dynamic Host Configuration Protocol (DHCP).

Unit - IV: Mobile Transport Layer

Traditional TCP; Indirect TCP; Snooping TCP; Mobile TCP; Fast retransmit/fast recovery; Transmission /time-out freezing; Selective retransmission; Transaction oriented TCP.

Unit - V: Data Dissemination and MANETs

Communications asymmetry; classification of new data delivery mechanisms; push based mechanisms; pull-based mechanisms; hybrid mechanisms; selective tuning (indexing) techniques; Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.

Unit - VI: Protocols and Tools

Wireless Application Protocol – WAP: Introduction, protocol architecture, and treatment of protocols of all layers; Bluetooth: User scenarios, physical layer, MAC layer, networking, security, link management; J2ME, Emerging trends in mobile communication.

Reference

1. Mobile Communications by J. Schiller, Addison-Wesley, second edition, 2004.
2. Handbook of Wireless Networks and Mobile Computing by Stojmenovic and Cacute, Wiley, 2002.
3. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", Cambridge University Press, October 2004.

Title: Network Security and Cryptography   (3 + 1 + 0 = 4 Credits)
Paper Code: CSITSP302

Unit - I: Some Preliminary Mathematical Background

Mathematical induction; Binomial Number theorem; Elementary Number Theory; Integer Arithmetic; Modular Arithmetic; Factorization; Exponentiation and Logarithm; Primes; Matrices; Groups; Rings; Fields; Finite Fields/Galois Fields.

Unit - II: Basics of Cryptography and cyber law

Data Security; Encryption and Decryption; Plain Text and Cipher Text; Attacks on Security; Active vs. Passive Attacks; Types of Attacks; Security Goals: Confidentiality, Integrity, Availability; Substitution Cipher (Monoalphabetic Cipher, Polyalphabetic Cipher); Transposition Cipher; The one time pad: Vernam's cryptosystem; Perfect secrecy; Stream Ciphers; Block Ciphers; Symmetric Key Cryptography: DES, AES; Public Key Cryptography: RSA and Elliptic Curve Cryptography; Digital signatures; Non-repudiation; Message authentications and Hash functions, overview of cyber law.

Unit - III: Authentication Basics

Introduction; Passwords; Authentication Tokens; Certificate-based Authentication; Biometric Authentication; Kerberos.

Unit - IV: Public Key Infrastructure

Introduction; Digital Certificates; Private Key Management; PKI and Security; Internet Security Protocols: Basic Concepts, Secure Socket Layer (SSL), Secure Hyper Text Transfer Protocols (SHTTP); Time Stamping Protocol (TSP); Secure Electronic Transaction (SET); SSL versus SET; 3-D Secure Protocol; Wireless Application Protocol (WAP).

Unit - V: Cryptanalysis and Attacks

Cryptanalysis: Linear cryptanalysis, Differential Cryptanalysis, Algebraic Cryptanalysis, Attacks: Linear Attacks; Algebraic Attacks; Structural attacks, Brute Force Attack, Resynchronization attack; Sniffing; Spoofing, Replay attack, Reflection attack, Man in the Middle Attack, DoS attack, DDoS attack.

Reference

1. Cryptography and Network Security 4/e by W. Stallings, Pearson Education India, 2008.
2. Applied Cryptography 2nd Ed by B. Schneier, John Wiley & Sons, Inc., 1996.

3. Handbook of Applied Cryptography 1/e by A. Menezes, P. van Oorschot, and S. Vanstone, CRC Press, 1996.

Paper Title: Digital Image Processing (3+1+0=4 Credits)
Paper Code: CSITSP303

Unit - I: Fundamentals of Image Processing

Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels and distance measurement, connectivity, Image Geometry, Photographic film, Light, Brightness adaption and discrimination, Perspective Projection, Spatial Domain Filtering, Grayscale and Color fundamentals, color models (RGB, CMY, HIS), formulation, color complements, color slicing, tone and color corrections, image file formats

Unit - II: Image Filtering

Spatial Domain Filtering- Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian; Frequency domain Filtering- Hotelling Transform, Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering, Inverse filtering, Least squares filtering.

Unit - III: Image Compression

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Hufiman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation; Wavelet based Image Compression- Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking; Fidelity criterion- MSE, PSNR, Compression ratio

Unit - IV: Image Restoration

Basic Framework and models, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

Unit - V: Morphological Image Processing

Basics, SE, Erosion, Dilation, Opening, Closing, Hit-orMiss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Unit - VI: Image Segmentation

Definition, Detection of Discontinuities, Point, line detection, Edge detection, Edge linking,

local processing, regional processing, Hough transform, Iterative and Multivariable thresholding, Otsu's method, Moving averages, Boundary detection based techniques; Characteristics of segmentation, Pixel based, Region based and histogram based segmentation methods, segmentation by sub region aggregation, split and merge technique, Watershed segmentation, Use of motion in segmentation (spatial domain technique only)

Unit -VII: Image Enhancement

Spatial Domain Methods- Arithmetic and Analytical operations, pixel or point operations, size operations) Smoothing filters Mean, Median, Mode filters. Low pass filters, high pass filters, sharpening filters; Frequency Domain Method- Design of Low Pass, High Pass, Edge enhancement, Sharpening filters in frequency domain, Bufier Worth Filter, Homomorphic filters in frequency domain and spatial domain. Application: Different application domains of digital image processing i.e. steganography, medical image processing, GIS etc.

Reference

1. Gonslaez, et.a1, "Digital Image Processing", Addison Wesley, Reading, M.A., 1990
2. Anil K Jain; Fundamentals of Digital Image Processing
3. Rafael C Gonzalez, Richard E Woods; Digital Image Processing, Pearson Education
4. Rafael C Gonzalez, Richard E Woods, Eddins; Digital Image Processing using MATLAB, Pearson Education
5. B Chanda & D Dutta Majumder; Digital Image Processing and Analysis, PHI

Paper Title: ANN and Pattern Recognition (3 + 1 + 0 = 4 Credits)
Paper Code: CSITSP304

Unit - I: Fundamentals of AI

Definitions, foundations of AI, Brief History of Artificial Intelligence, solving Problems by Searching, Informed Search and Exploration, constraint Satisfaction Problems, Adversarial Search, Knowledge Representation, different branches and application domainsof AI, Applications of ANN.

Unit - II: Introduction to ANN

Introduction- Features, structure and working of Biological Neural Network, Trends in Computing Comparison of BNN and ANN; Basics of Artificial Neural Networks- History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture; Backpropagation networks (BPN) - Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning; Activation & Synaptic Dynamics - Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks; Neural Network Classifier - Single and Multilayer Perceptron, Back Propagation Learning , Hopfield Network, Fuzzy Neural

Network; <mark>Unsupervised Classification- Clustering, Hierarchical , clustering ,</mark> Graph Based Method , Sum of Squared Error Technique, Iterative Optimization, <mark>Applications of ANN.</mark>

Unit -III: Pattern Recognition

Feature extraction and Pattern Representation , Concept of Supervised and Unsupervised Classification , Application Areas; Statistical Pattern Recognition - Bayes Decision Theory , Minimum Error and Minimum Risk Classifiers; Discriminant Function and Decision Boundary, Normal Density , Discriminant Function for Discrete Features, Parameter Estimation; Dimensionality Problem- Dimension and accuracy , Computational Complexity , Dimensionality Reduction ,Fisher Linear Discriminant , Multiple Discriminant Analysis; Nonparametric Pattern Classification - Density Estimation , Nearest Neighbour Rule , Fuzzy Classification; Linear Discriminant Functions- Separability , Two Category and Multi Category Classification, Linear Discriminators , Perceptron Criterion , Relaxation Procedure , Minimum Square Error Criterion , Widrow-Hoff Procedure, Ho-Kashyap Procedure , Kesler's Construction; Time Varying Pattern Recognition - First Order Hidden Markov Model, Evaluation , Decoding,

Unit -IV: Learning Basic functional units of ANN for pattern recognition tasks

Basic feed forward, Basic feedback and basic competitive learning neural network, Pattern association, pattern classification and pattern mapping tasks; Feedforward neural networks – - Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods; Feed back neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning

Unit - V: Competitive learning neural networks

Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

Reference

1. Artificial Intelligence A Modern Approach, Second Edition By Stuart Russell, Peter Norving., Prentice Hall of India Private Limited New Delhi-110001,(2003).

2. Artificial Intelligence (second edition) by E. Rich & K. Knight, (McGraw Hill, 1991)

3. Introduction to Artificial Intelligence by D. W. Patterson, (Prentice Hall, 1990)

4. B. Yegnanarayana - Artificial neural network PHI Publication

5. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms

6. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005

7. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press , 1995

8. Nelson Morgan – Artificial neural network: Electronic Implementations – IEEE Press, 1990

Title: Soft Computing (3 + 1 + 0 = 4 Credits)
Paper Code: CSITSP305

Unit - I: Soft Computing

Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing; Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies; Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Unit - II: Optimization

Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton‟s Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.

Unit - III: Fuzzy Logic

Basic concepts of crisp and fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion; Fuzzy rule base system-Membership functions, features of membership functions, fuzzy reasoning, interference in fuzzy logic, fuzzy decision making, fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Applications of fuzzy logic, Industrial applications,

Unit - IV: Genetic Algorithm(GA)

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, fitness function, reproduction.

Unit - V: Genetic modeling

Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator; Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

Unit - VI: Hybrid Systems

Integration of neural networks, fuzzy logic and genetic algorithms Graphics and Animation.

Reference

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI.

2. Siman Haykin, Neural Netowrks, PHI

3. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997

4. Kumar Satish, Neural Networks, TMH

5. J. Yen and R. Langari., Fuzzy Logic, Intelligence, Control and Information, Pearson Education

6. J. S. R. Jang, C. T. Sun and E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 2004