



SYLLABI

Ph.D. Course Work Paper-I & Paper-II

WITH EFFECT FROM 14.07.2020

DEPARTMENT OF COMPUTER SCIENCE

APPENDIX-C

**DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIAGRH, U.P.-202002**

**SYLLABUS COURSE WORK – Ph.D. in Computer Science
Paper-I (COURSE PHDCS-101: Research Methodology)**

OBJECTIVES OF THE COURSE:

- To learn the art of Literature Review and to focus on a research problem using scientific methods.
- To learn the scientific practices and academic ethics.
- To inculcate analytical thinking and data interpretation capability.
- To learn how to synthesize and communicate research findings to a wide range of audiences.
- To learn how to write scientific research proposals and reports.

Sessional Marks: 30

Exam Marks: 70

UNIT-I: Concepts of Research Design

Research-Overview, types and basic steps. Research problem-Characteristics,scope, objectives and variables of a research problem, Errors in selecting a research problem. **Literature review**-Importance and objective of Literature review, Locating relevant literature, Reliability of a source, Writing a survey and identifying the research problem. **Research Proposal**-Planning and writing a research proposal-Identifying variables, constructing hypotheses, Structure and components of research proposal, Presentation and evaluation of proposals.

UNIT-II: Scientific Research and Statistical Analysis

Scientific Research: Introduction, objective and methods.**Modelling**-Introduction, types and stages of Model building, Data consideration and testing heuristics. Mathematical Modelling and Simulation-Continuous and discrete models, Model validation. Monte Carlo simulation, stochastic state transition systems. **Statistical Analysis:**Scientific models/v/sArbitrary models, Deductive and Inductive Reasoning, Error Analysis and Accuracy,Descriptive Statistics, Probability, Random Variables, Concepts of Sampling distribution and Probability, Distribution, Hypothesis Testing, Regression Analysis, Multivariate Analysis and Demonstration using **SPSS/R/EViews**. Numerical computation, plotting of functions, implementation of algorithms etc. using MATLAB/Octave.

UNIT-III: Research Tools

Advanced Searching Methods for searching research materials in online repositories/consortium, like inflibnet, Indest, Scopus, etc., Meta search engines and techniques. Tools for Editing, Presentation, Data visualization-Monitoring research experiments, Collecting data, Writing Research Paper-Hands-on with **LaTeX**. Syntax of Research Paper-Hands-on with **Grammarly**. Data representation and visualization-Hands-on with **Tableau**, Hands-on with **Google Charts**. Referencing Tools-Introduction, Importance and citation, Hands-on with **Mendeley** or **Zotero**. Plagiarism-Introduction and Hands-on with **Turnitin** tool or any other tool.

UNIT-IV: Research Writing and Academic Ethics

Report writing and Publishing Research Findings: Pre-writing considerations, Formats of report writing, Formats of publications in Research journals. Preparation of thesis and research papers: Structure of a thesis/research article/ review article, including title, introduction, literature review, methods and materials, referencing. Editing and proofreading.

Academic Ethics-Introduction, Intellectual Property Rights, Fraud and unscientific practices in science. Plagiarism-Dimension of Plagiarism, Strategies to Minimize Plagiarism, Citation counting and Impact factor, Types of Indexing-SCI/SCIE/ESCI/SCOPUS/DBLP/Google Scholar/UGC-CARE etc. Significance of conferences and their ranking.

Text Books:

- C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, New Delhi, 2004.
- Justin Zobel, Writing for computer Science, Third Edition, Springer, 2014.
- Kumar R. Research Methodology: A Step by Step Guide for Beginners, 3rd ed., Pearson Education, 2010.
- Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", 2/e, Pearson India, 2005.
- Michael P. Marder, Research Methods for Science, Cambridge University Press, 2011.
- P. Oliver, Writing Your Thesis, New Delhi: Vistaar Publications, 2004.
- Gregory, Ethics in Research, Continuum, 2005.
- C. Radhakrishna Rao, Statistics and Truth, CSIR, 1989.
- Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, 2010.
- RA Day, How To Write and Publish a Scientific Paper, Cambridge University Press, London, 1992.
- B. Latour, Woolgar., Laboratory Life: The Construction of Scientific Facts, 2nd Edition, Princeton: Princeton University Press, 1986.

- S.K. Yadav, “Elements of Research Writing”, UDH Publishers & Distributors, Pvt. Ltd. New Delhi, 2015.
- Douglas C. Montgomery and George C. Runger, “Applied Statistics & Probability for Engineers”, 3rd ed, Wiley India, 2007.
- Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, “Theory of modeling and simulation integration discrete event and continuous complex dynamic systems”, Academic, 2000.

BOS: 14.07.2020

**Name of Students: 1) MR. TALHA UMAR (GE-1426)
2) MR. MD. SAQUIB JAWED (GE-0095)
Name of Supervisor: PROF. (DR.) RAFIQUL ZAMAN KHAN**

**DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH (UP)-202002**

ACADEMIC YEAR 2018-19

**SYLLABUS COURSEWORK- Ph.D. in Computer Science
Paper-II (COURSE TITLE: Cloud Security)**

**Credit: 04
Sessional Marks: 30
Exam Marks: 70**

UNIT-I:

Security Concepts: Confidentiality, Privacy, Integrity, Authentication, Non-Repudiation, Availability, Access Control, Defence in depth, Least privilege, How these concepts apply in the Cloud, What these concepts mean and their importance in PaaS, IaaS and SaaS, e.g. User authentication in cloud; Cryptographic Systems: Symmetric cryptography, Stream ciphers, block ciphers, mode of operation, Public-key cryptography, hashing, digital signatures, Public-key infrastructures, Key management, X.509 certificates, OpenSSL.

UNIT-II:

Multi-tenancy Issues: Isolation of users/VMs from each other; How the cloud provider can provide this; Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security, Storage considerations, Backup and Recovery.

UNIT-III:

Virtualization System Vulnerabilities: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, Guest VM vulnerabilities, Hypervisor vulnerabilities, Hypervisor escape vulnerabilities, Configuration issues, Malware (botnets etc.).

UNIT-IV:

Virtualization System-Specific Attack: Guest hopping, attacks on VM (delete the VM, Attack on Control of the VM, Code or file injection into the virtualized file structure), VM migration attack, Hyperjacking; Technologies for Virtualized-Based Security Enhancement: IBM security virtual server protection, virtualization-based sandboxing.

UNIT-V:

Storage Security: HIDPS, Log management, Data Loss Prevention, Location of Perimeter, Legal and Compliance Issues: Responsibility, Ownership of data, Right to penetration test, local law where data is held, Examination of modern Security Standards (eg PCIDSS), How standards deal with cloud services and Virtualization, Compliance for the cloud provider vs compliance for the customer; Research challenges in cloud security, Literature Review on Cloud Computing, Literature Review on Cloud Security.

REFERENCE BOOKS:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif; Cloud Security and Privacy: An Enterprise Perspective on Risk and Compliance [ISBN: 0596802765]
2. Ronald L. Krutz, Russell Dean Vines; Cloud Security [ISBN: 0470589876]
3. John Rittinghouse, James Ransome; Cloud Computing [ISBN: 1439806802]
4. J.R (“Vic”) Winkler; Securing the Cloud [ISBN: 1597495921]

BOS: 14.07.2020

Name of student: 1) Mr. Basil Hanafi

2) Mr. Imran Khan

Name of Supervisor: Prof. Mohammad Ubaidullah Bokhari

DEPARTMENT OF COMPUTER SCIENCE

ALIGARH MUSLIM UNIVERSITY

ALIGARH, U.P.-202002

ACADEMIC YEAR 2018-19

SYLLABUS: COURSEWORK- Ph.D. in Computer Science

PAPER-II (COURSE TITLE: Requisition of Machine Learning and Deep learning Dexterity)

Credit: 04

Sessional Marks: 30

Exam Marks: 70

UNIT-I

Intuition to Machine Learning: Introduction To ML, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Model Representation, Cost Function, Gradient Descent, Linear Regression, Linear Regression With One Variable, Linear Regression With Multiple Variable, Logistic Regression, Regularized Logistic Regression.

UNIT-II

Intuition to Deep Learning: Introduction To DL, Neural Network, Supervised Learning With Neural Networks, Why Deep Learning Is Taking Off, Logistic Regression As A Neural Network, Neural Networks Overview, Neural Network Representation, Deep Neural Network, Deep L-Layer Neural Network, Forward Propagation In Deep Network, Building Blocks of Deep Neural Networks, Forward And Backward Propagation, Parameters Vs Hyper Parameters.

UNIT-III

Requisition of Machine learning and Deep Learning Techniques: Neural Cryptography, Adversarial Neural Networks, Adversarial Neural Cryptography, Generative Adversarial Network and their Application, Implementation of GAN for Cryptography, Cyber Security and Network Security. CNN, Computer Vision, Edge Detection, Padding, Strided Convolution, Pooling, Classic Networks, ResNets, 1*1 Convolution, Inception Network Motivation, Inception Network, Object Localization, Landmark Detection, Object Detection, Convolution Implementation Of Sliding Windows, Bounding Box Prediction, Intersection Over Union, Non-Max Suppression, Anchor Boxes, YOLO Algorithm, Face Recognition, Neural Style Transfer.

UNIT-IV

Rundown of Tools and Platforms Used for Dexterity of Machine Learning and Deep Learning: Fundamentals of Python, Platform and IDE Used For Python, Programming Basics with R, IDE And Platforms For R.

REFERENCES:

1. Think Python By Allen B. Downey
2. R For Data Science By Hadley Wickham
3. R Programming For Data Science, Roger D Peng
4. Machine Learning (In Python And R) For Dummies By *John Paul Mueller And Luca Massaron*

BOS: 14.07.2020

Name of student: Mr. Mohd Farooq
Name of Supervisor(s): Professor Jamshed Siddiqui
Name of Co-Supervisor(s): Dr. Abdus Samad

DEPARTMENT OF COMPUTER SCIENCE
ALIGARHMUSLIMUNIVERSITY
ALIGARH, U.P.-202002

ACADEMIC YEAR 2018-19

SYLLABUS COURSEWORK- Ph.D. in Computer Science
PAPER-II (COURSE TITLE: PARALLEL COMPUTING)

Credit: 04
Sessional Marks: 30
Exam Marks: 70

UNIT-I **SCALABILITY AND CLUSTERING**

Evolution of Computer Architecture – Dimensions of Scalability – Parallel Computer Models – Basic Concepts of Clustering – Scalable Design Principles – Parallel Programming Overview – Processes, Tasks and Threads – Parallelism Issues – Interaction / Communication Issues – Semantic Issues in Parallel Programs.

UNIT-II **SYSTEM INTERCONNECTS**

Basics of Interconnection Networks – Network Topologies and Properties – Buses, Crossbar and Multistage Switches, Software Multithreading-Synchronization Mechanisms.

UNIT-III **PARALLEL PROGRAMMING**

Paradigms and Programmability – Parallel Programming Models– Shared Memory Programming.

Message Passing Paradigm – Message Passing Interface –Parallel Virtual Machine.

UNIT IV: **PERFORMANCE EVALUATION OF PARALLEL SYSTEMS**

Performance Evaluation Tools – Simulators – Types of Simulators – Usage of Simulators.

Scheduling Algorithms – Types of Scheduling Algorithms – Static and Dynamic Scheduling Evaluation – Tools Used for Scheduling Algorithms Evaluation.

MATLAB – Programming – Uses.

TEXTBOOK:

1. Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw-Hill, New Delhi, 2003. REFERENCES: 1. David E. Culler & Jaswinder Pal Singh, “Parallel Computing Architecture: A Hardware/Software Approach”, Morgan Kaufman Publishers, 1999.
2. Michael J. Quinn, “Parallel Programming in C with MPI & Open MP”, Tata McGraw-Hill, New Delhi, 2003.
3. Kai Hwang, “Advanced Computer Architecture” Tata McGraw-Hill, New Delhi, 2003.

BOS: 14.07.2020

Name of Student: Mr. Shivom Sharma
Name of Supervisor(s): Dr. Mohammad Sajid

DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH, U.P.-202002

ACADEMIC YEAR 2018-19

SYLLABUS COURSEWORK – Ph.D. in Computer Science
PAPER–II (COURSE TITLE: Evolutionary Computation for Optimization Problems)

OBJECTIVE OF THE COURSE:

1. To develop the understanding of evolutionary algorithms and multi-objective evolutionary optimization algorithms.
2. To develop the understanding of cloud computing, grid computing, internet of things, internet of vehicles, and others.
3. To learn the application of evolutionary algorithms for solving optimization problems in context of logistic and routing problems, Internet of vehicles, and others.

COURSE LEARNING OUTCOMES:

After completion of course, the student will be able-

- To explain the details of evolutionary algorithms such as GA, NSGA-II, SPEA-II and other related algorithms.
- To exploit various evolutionary algorithms for solving optimization problems such as vehicle routing problem and its variants.
- To propose and develop innovative evolutionary algorithms-based solutions for real-world problems in the context of logistic and routing problems, Internet of vehicles, and others.

Credit: 04
Sessional Marks: 30
Exam Marks: 70

UNIT-I: Evolutionary Computation

Computational Intelligence, Evolutionary Algorithms, Genetic Algorithm, Genetic Representations-Initial Population, Fitness Function, Genetic Operators-Selection, Crossover, Mutation and Repair, Variants of Genetic Operators; Artificial Immune Systems, Quantum Genetic Algorithm, Other Algorithms-Firefly Algorithm, Differential Evolution, and others.

UNIT-II: Multi-objective Evolutionary Computation

Multi-objective Optimization, Pareto-optimality, Pareto Epsilon Model, Performance Indicators-Generational Distance, Generational Distance Plus, Inverted Generational Distance, Inverted Generational Distance Plus, Hypervolume; Multi-objective evolutionary algorithms-Multi-objective Genetic Algorithm, Non-dominated Sorting Genetic Algorithm-II (NSGA-II), Strength Pareto Evolutionary Algorithm-II (SPEA-II) and others

UNIT-III: NP-completeness and Optimization Problems

NP-Completeness: Polynomial-time solvable problems, NP-complete problems, NP-hard problems; Optimization Problems-Scheduling Problem, Travelling salesman problem (TSP), Vehicle routing problem (VRP); Variants of VRP- Capacitated VRP, Open VRP, Dynamic VRP, Multi-depot VRP, Periodic VRP, VRP with time windows, VRP with simultaneous pickup and Delivery, VRP with stochastic demands and stochastic travel times, VRP with fuzzy demands, VRP with split deliveries; An integer programming formulation of VRP, Multi-depot VRP and VRP with split deliveries.

UNIT-IV: Computing Paradigms

Cluster Computing, Grid Computing, Cloud Computing: Service and Deployment Models, Internet of Things, Fog Computing, Internet of vehicles, Mobility, Performance, Computation offloading, Authentication and Trust Issues, Security Issues, Scalability and elasticity, energy consumption and other quality of service (QoS) parameters.

RECOMMENDED TEXTBOOKS-

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Introduction to Algorithms, 3rd Edition, The MIT Press, 3rd Edition.
2. P. Toth, D. Vigo, Vehicle Routing: Problems, Methods, and Applications, Second Edition, MOS-SIAM Series on Optimization.
3. P. Toth (Editor), D. Vigo (Editor), The Vehicle Routing Problem Discrete Math, SIAM, 1st Edition
4. K. Deb, Multi-objective Optimization Using Evolutionary Algorithms, Wiley.
5. C.A.C. Coello, G.B. Lamont, D.A.V. Veldhuizen, Evolutionary Algorithms for Solving Multi-Objective Problem, Springer
6. S. Datta, Materials Design Using Computational Intelligence Techniques, CRC Press, 2016.
7. G. Winter, J. Periaux and M. Galan, Genetic Algorithms in Engineering and Computer Science, John Wiley & Son Ltd., 1995.
8. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison-Wesley.
9. M. Mitchell, Introduction to Genetic Algorithms,
10. Rajkumar Buyya (Editor) and Amir Vahid Dastjerdi (Editor), Internet of Things- Principles and Paradigms, 2016.

RECOMMENDED WEB REFERENCES-

1. D. Samanta, Introduction to Soft Computing, https://swayam.gov.in/nd1_noc20_cs17/preview
2. NPTEL: Introduction to Soft Computing, <https://onlinecourses.nptel.ac.in/noc18cs13/preview>
3. Julian Blank, Multi-objective Optimization in Python <https://pymoo.org>

RECOMMENDED RESEARCH ARTICLES:

1. A. Mor, M.G. Speranza, Vehicle routing problems over time: a survey. 4OR-Q J Oper Res, 2020.
2. E. Demir, K. Huckle, A. Syntetos, A. Lahy, M. Wilson, Vehicle Routing Problem: Past and Future. In: Wells P. (eds) Contemporary Operations and Logistics. Palgrave Macmillan, Cham, 2019.
3. T.Vidal, G. Laporte, P. Matl, A concise guide to existing and emerging vehicle routing problem variants, European Journal of Operational Research, 2019.
4. A. M. Altabeeb, A. M. Mohsen, A. Ghallab, An improved hybrid firefly algorithm for capacitated vehicle routing Problem, Applied Soft Computing Journal, 84, 2019.

5. J. Zhang, F. Yang, X. Weng, An Evolutionary Scatter Search Particle Swarm Optimization Algorithm for the Vehicle Routing Problem with Time Windows, IEEE Access, 2018.
6. K. Ramaekers, K. Ramaekers, I.V. Nieuwenhuysse, The Vehicle Routing Problem: State of the Art Classification and Review, Computers & Industrial Engineering, 2015.
7. Q. Zhang, H. Li, MOEA/D: A Multi-objective Evolutionary Algorithm Based on Decomposition, IEEE Transactions on Evolutionary Computation, Vol. 11(6), 2007.
8. K. Deb, A. Pratap, S. Aggarwal, T. Meyarivan, A fast elitist multi-objective genetic algorithm: NSGA-II, IEEE T Evolutionary Computation, Vol. 6(2), pp. 182–97, 2002

BOS: 14.07.2020

Name of student: Mr. Ankur Kumar

Name of Supervisor(s): Dr. Mohammad Nadeem

**DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH, U.P.-202002**

ACADEMIC YEAR 2018-19

**SYLLABUS COURSE WORK: Ph.D. in Computer Science
PAPER-II (COURSE TITLE: MACHINE LEARNING AND SOFT
COMPUTING)**

OBJECTIVES OF THE COURSE:

- To introduce the concepts of basic and advanced concepts of machine learning.
- To learn the applications of machine learning techniques.
- To introduce the soft computing techniques primarily neural networks, fuzzy logic, genetic algorithm etc.
- To learn the applications of soft computing techniques.

Credit: 04

Sessional Marks: 30

Exam Marks: 70

UNIT-I

Machine Learning: Introduction, Types of machine learning: supervised, unsupervised and reinforcement learning, Supervised learning: Classification: Two class and Multiclass classification, Regression, Linear Regression, K-nearest neighbor, Decision Trees, Logistic Regression, Artificial neural network: multilayer perception, back-propagation algorithm, Support Vector Machines, Kernels, Unsupervised learning: Clustering, Techniques: K-means clustering and Hierarchical clustering, Introduction of Deep Learning, Convolutional Neural Network.

UNIT-II

Important concepts and Applications of Machine Learning: Underfitting, Overfitting, linearly separable and non-linearly separable dataset, Training set vs Testing set, Validation set, K-fold cross validation, Bias-Variance compromise, Learning curve, Data normalization: importance and techniques, min-max and z- score normalization, Treatment of missing values, Feature selection: Wrapper and filter methods, Performance matrices: classification accuracy, Confusion matrix, recall, precision, error measures. **Applications:** Flower data classification, Spam filtering, Handwritten-digit recognition, Readymade cloth grouping.

UNIT-III

Soft Computing: Introduction, Hard computing vs Soft Computing, Components of Soft Computing, Evolutionary Computation, Genetic Algorithm, Methods for crossover, mutation and selection, Particle swarm optimization, Gravitational Search Algorithm, Multi-objective optimization: NSGA-II, Fuzzy logic: introduction, crisp set vs fuzzy set, Linguistic variables, representation of fuzzy terms, discrete method, piecewise linear method, Fuzziness vs. probability, Fuzzy logic operations, fuzzy rules, Fuzzy inferencing: fuzzification, evaluation, defuzzification, applications of fuzzy logic.

UNIT-IV

Important concepts and Applications of Soft Computing: Metaheuristics, Intensification, Diversification, Encoding, Constraint Handling, Hybridization metaheuristics, Parallel metaheuristics, **Applications:** Travelling Salesman Problem (TSP), Test functions for optimization, Rastrigin function, Ackley function, Bukin function. Binh and Korn function, Fonseca–Fleming function, Kursawe function, **Tool:** Python programming, libraries and packages for machine learning and soft computing methods.

REFERENCES:

1. Tom Mitchell: Machine Learning- McGraw Hill.
2. Siman Haykin, Neural Networks, Prentice Hall of India
3. El-Ghazali Talbi, Metaheuristics: From Design to Implementation, Wiley.
4. S.N. Sivanandam, S.N. Deepa: Principles of Soft Computing, Wiley India.
5. Christopher Bishop: Pattern Recognition and Machine Learning, Springer.

**Name of student: 1) Ms. Khushnaseeb Roshan
2) Mr. Sheikh Burhan ul Haque
3) Mr. Ismail Rashid**

Name of Supervisor(s): Dr. Aasim Zafar

**DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH, U.P.-202002**

ACADEMIC YEAR 2018-19

**SYLLABUS COURSEWORK- Ph.D. in Computer Science
Part II (COURSE TITLE: Soft Computing)**

OBJECTIVE OF THE COURSE:

- To learn the concepts related to Soft Computing, Neural Network, and Back Propagation Network, Associative Memory, Fuzzy sets, Fuzzy logic, Fuzzy Systems, Genetic Algorithms and Applications of Soft Computing techniques to solve a number of real life problems

After completing this course, students will be able to understand:

- Fuzzy logic, Fuzzy system and its applications.
- Artificial neural networks and its applications.
- Solving single-objective optimization problems using GAs.
- Applications of Soft computing to solve problems in varieties of application domains.

**Credit: 04
Sessional Marks: 30
Exam Marks: 70**

UNIT-I **Introduction to Soft Computing:** Introduction to Fuzzy Computing, Neural Computing, Genetic Algorithms, Probabilistic Networks, Associative Memory, Deep learning, Adaptive Resonance Theory, SWARM Intelligence etc. Applications of Soft Computing in Pattern Recognition, Computer Vision, Natural Language Processing, Multimodal Information Access & Retrieval, Multisource Data Analysis, Image Processing, Video Analysis, Data Clustering etc.

UNIT-II **Fundamentals of Neural Network:** Introduction to Artificial Neuron, ANN Architectures, Learning Methods, Taxonomy of NN Systems, Single-Layer NN System, Training Techniques for ANN, Applications. *Back Propagation Network:* Background, Back-Propagation Learning, Back-Propagation Algorithm. Associative Memory and Adaptive Resonance Theory.

UNIT-III **Fuzzy Set Theory:** Introduction to Fuzzy Set: Membership, Operations, Properties; Fuzzy Relations. *Fuzzy Systems:* Introduction, Fuzzy Logic, Fuzzification, Fuzzy Inference, Fuzzy Rule Based System, Defuzzification.

UNIT-IV **Genetic Algorithms & Modeling:** Introduction to Encoding techniques, Operators of Genetic Algorithms (Selection, Crossover, Mutation), Optimization technique using GA, Basic Genetic Algorithms, *and Hybrid Systems*: Integration of NN, GA and FS.

Introduction to SVM, SOM, Supervised & Unsupervised learning, Problems related to Data Clustering, Multi-criteria Decision Making, Image Processing, Video Analysis, etc. Mathematical tools of Soft Computing.

Recommended Textbooks:

1. **Neural Network, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications**, S. Rajasekaran and G.A. Vijayalakshmi Pai (2005), Prentice Hall.
2. **Artificial Intelligence and Intelligent Systems**, N.P.Padhy (2005), Oxford University Press.
3. **Fuzzy Logic with Engineering Applications**, Timothy J. Ross (2011), Wiley India.
4. **Neuro-Fuzzy and Soft Computing**, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall.
5. **Genetic Algorithms in Engineering and Computer Science**, G. Winter, J. Periaux and M. Galan (1995), John Wiley & Son Ltd.

Reference Books:

1. **Introduction To Data Mining And Soft Computing Techniques**, M. Ramakrishna Murthy (2016), Laxmi Publications Private Limited.
2. **Deep Learning**, Ian Goodfellow, Yoshua Bengio and Aaron Courville (2016), MIT Press, <http://www.deeplearningbook.org>
3. **Pattern Recognition and Machine Learning**, Christopher Bishop (2006), Springer
4. **Learning and Soft Computing**, V. Kecman (2004), Pearson Education.
5. **Materials Design Using Computational Intelligence Techniques**, Shubhabrata Datta (2016), CRC Press.
6. **The Elements of Statistical Learning**, Trevor Hastie, Robert Tibshirani, and Jerome H. Friedman (2008), Springer.

Web References:

1. “SWAYAM: Introduction to Machine Learning”,
<https://swayam.gov.in/courses/4733-july-2018-introduction-to-machine-learning>.
2. “NPTEL: Deep Learning”,
https://onlinecourses.nptel.ac.in/noc18_cs41/
3. “SWAYAM: Artificial Intelligence”,
<https://swayam.gov.in/courses/5011-artificial-intelligence>.
4. “SWAYAM: Introduction to Soft Computing”,
https://swayam.gov.in/nd1_noc20_cs17/preview, (Prof. Debasis Samanta, IIT, Kharagpur).
5. “NPTEL: Introduction to Artificial Neural Networks”,
<https://nptel.ac.in/courses/117105084/>

Name of Student: Ms. Fakhrun Jamal.
Name of Supervisor: Prof. Rafiqul Zaman Khan

DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY,
ALIGARH, U.P-202002 (INDIA)

ACADEMIC YEAR 2018-19

SYLLABUS: COURSEWORK – Ph.D. in Computer Science
PAPER–II (COURSE TITLE: A study on load balancing based on resource
utilization in cloud computing)

OBJECTIVES OF THE COURSE

- To develop the understanding of cloud computing, grid computing, distributed computing and other computing paradigms.
- To develop the understanding of different service models, deployment models, virtualization, quality of service (QoS) parameters and challenges of load balancing algorithms.
- To develop the understanding of different types of load balancing algorithms using different techniques. To provide in depth concepts of search based security testing

Course Learning Outcomes

On successful completion of this course students will be able to:

- Explain the details of cloud computing and other related computing paradigms.
- Exploit various algorithms for solving load balancing problems.
- Propose and develop innovative load-balancing algorithms for cloud computing.

Credit: 04

Sessional Marks: 30

Exam Marks: 70

UNIT-I:

Cloud Computing definition, private, public and hybrid cloud. Cloud types; Cloud Computing model, IaaS, PaaS, SaaS, Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications. Difference between mainframe computing, distributed computing, cloud computing, grid computing, and green computing. Limitation of cloud computing, Issues on cloud computing.

UNIT-II:

Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloudbased services. Economics of choosing a Cloud platform for an organization, based on application requirement, economic constraints and business needs (e.g. Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Red hat).

UNIT-III:

Cloud computing load balancing algorithms, Different types of load balancing in cloud computing, Cloud Computing load balancing Comparison with DNS Load Balancing, Importance of Load Balancing in cloud computing, Load Balancing Techniques in cloud computing, Scheduling Algorithms, Load Balancing Policies, A Comparative Study of Algorithms, Client-side Load Balancer Using Cloud, cloud load balancing services, cloud load balancers, Various resource allocation strategies in cloud computing, Comparison of load balancing algorithms used in cloud computing, Load balancing issues among multifarious issues of cloud computing environment, Load balancing in cloud computing using soft computing technique's, Load balancing in public cloud by division of cloud based on the geographical location,

UNIT-IV:

Literature Review: A review of Cloud computing load balancing algorithms. A review of cloud computing load balancing strategies. A survey on cloud computing load balancing techniques. A Survey on cloud computing load balancing tools.

BOOKS & REFERENCES:

1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
3. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539], 2010.
4. Chee, Brian J.S. (2010). Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center. CRC Press. ISBN 9781439806173.
5. Shatz, Gur (15 October 213). "Bringing Layer 7 Load Balancing into the Cloud". Incapsula. Retrieved 30 January 2014.
6. Randles, Martin, David Lamb, and A. Taleb-Bendiab. "A comparative study into distributed load balancing algorithms for cloud computing". Advanced Information Networking and Applications Workshops (WAINA), 2010 IEEE 24th International Conference on IEEE, 2010.
7. Ferris, James Michael. "Methods and Systems for load balancing in cloud-based networks". U.S. Patent Application 12/127, 926

**Name of student: 1) Mr. Mohd Hanief Wani
2) Mr. Monir Yahya Ali Salmony
Name of Supervisor(s): Dr. Arman Rasool Faridi**

**DEPARTMENT OF COMPUTER SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH, U.P.-202002**

ACADEMIC YEAR 2018-19

**SYLLABUS COURSEWORK- Ph.D. in Computer Science
Part II (COURSE TITLE: Soft Computing)**

OBJECTIVE OF THE COURSE:

- To learn the concepts related to Soft Computing, Neural Network, and Back Propagation Network, Associative Memory, Fuzzy sets, Fuzzy logic, Fuzzy Systems, Genetic Algorithms and Applications of Soft Computing techniques to solve a number of real life problems

After completing this course, students will be able to understand:

- Fuzzy logic, Fuzzy system and its applications.
- Artificial neural networks and its applications.
- Solving single-objective optimization problems using GAs.
- Applications of Soft computing to solve problems in varieties of application domains.

**Credit: 04
Sessional Marks: 30
Exam Marks: 70**

UNIT-I **Introduction to Soft Computing:** Introduction to Fuzzy Computing, Neural Computing, Genetic Algorithms, Probabilistic Networks, Associative Memory, Deep learning, Adaptive Resonance Theory, SWARM Intelligence etc.
Applications of Soft Computing in Pattern Recognition, Computer Vision, Natural Language Processing, Multimodal Information Access & Retrieval, Multisource Data Analysis, Image Processing, Video Analysis, Data Clustering etc.

UNIT-II **Fundamentals of Neural Network:** Introduction to Artificial Neuron, ANN Architectures, Learning Methods, Taxonomy of NN Systems, Single-Layer NN System, Training Techniques for ANN, Applications. *Back Propagation Network:* Background, Back-Propagation Learning, Back-Propagation Algorithm. Associative Memory and Adaptive Resonance Theory.

UNIT-III **Fuzzy Set Theory:** Introduction to Fuzzy Set: Membership, Operations, Properties; Fuzzy Relations. *Fuzzy Systems:* Introduction, Fuzzy Logic, Fuzzification, Fuzzy Inference, Fuzzy Rule Based System, Defuzzification.

UNIT-IV **Genetic Algorithms & Modeling:** Introduction to Encoding techniques, Operators of Genetic Algorithms (Selection, Crossover, Mutation), Optimization technique using GA, Basic Genetic Algorithms, *and Hybrid Systems*: Integration of NN, GA and FS.

Introduction to SVM, SOM, Supervised & Unsupervised learning, Problems related to Data Clustering, Multi-criteria Decision Making, Image Processing, Video Analysis, etc. Mathematical tools of Soft Computing.

Recommended Textbooks:

1. **Neural Network, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications**, S. Rajasekaran and G.A. Vijayalakshmi Pai (2005), Prentice Hall.
2. **Artificial Intelligence and Intelligent Systems**, N.P.Padhy (2005), Oxford University Press.
3. **Fuzzy Logic with Engineering Applications**, Timothy J. Ross (2011), Wiley India.
4. **Neuro-Fuzzy and Soft Computing**, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall.
5. **Genetic Algorithms in Engineering and Computer Science**, G. Winter, J. Periaux and M. Galan (1995), John Wiley & Son Ltd.

Reference Books:

1. **Introduction To Data Mining And Soft Computing Techniques**, M. Ramakrishna Murthy (2016), Laxmi Publications Private Limited.
2. **Deep Learning**, Ian Goodfellow, Yoshua Bengio and Aaron Courville (2016), MIT Press, <http://www.deeplearningbook.org>
3. **Pattern Recognition and Machine Learning**, Christopher Bishop (2006), Springer
4. **Learning and Soft Computing**, V. Kecman (2004), Pearson Education.
5. **Materials Design Using Computational Intelligence Techniques**, Shubhabrata Datta (2016), CRC Press.
6. **The Elements of Statistical Learning**, Trevor Hastie, Robert Tibshirani, and Jerome H. Friedman (2008), Springer.

Web References:

1. “SWAYAM: Introduction to Machine Learning”,
<https://swayam.gov.in/courses/4733-july-2018-introduction-to-machine-learning>.
2. “NPTEL: Deep Learning”,
https://onlinecourses.nptel.ac.in/noc18_cs41/
3. “SWAYAM: Artificial Intelligence”,
<https://swayam.gov.in/courses/5011-artificial-intelligence>.
4. “SWAYAM: Introduction to Soft Computing”,
https://swayam.gov.in/nd1_noc20_cs17/preview, (Prof. Debasis Samanta, IIT, Kharagpur).
5. “NPTEL: Introduction to Artificial Neural Networks”,
<https://nptel.ac.in/courses/117105084/>

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ACADEMIC YEAR 2018-19

SYLLABUSCOURSEWORK- Ph.D. in Computer Science
Part II (COURSE TITLE: Search Based Security Testing)

OBJECTIVES OF THE COURSE

- To develop an understanding of ‘malicious attacks, threats, and vulnerabilities’
- To provide concepts related to reasons of security vulnerabilities.
- To introduce security testing techniques
- To provide in depth concepts of search based security testing

Course Learning Outcomes

On successful completion of this course students will be able to:

- Develop knowledge of optimization techniques in the context of search-based software engineering.
- Use various optimization methods and algorithms for particular classes of problems.
- Develop knowledge and experience in developing search-based software testing approaches for real-world applications.

Credit: 04
Sessional Marks:30
Exam Marks:70

UNIT: I

Software Security Concepts: Introduction to software security, Categories of software vulnerabilities, Instances of vulnerabilities in popular databases such NIST national vulnerability database, MITRE common vulnerabilities and exposures. Reasons of vulnerabilities. Software security protection mechanism. Secure software development life cycle.

UNIT: II

Programming Flaws and Security Testing: Understand the basics of secure programming and its standards, Understand the most frequent programming errors leading to software vulnerabilities. Understand and protect against security threats and software vulnerabilities, Programming flaws: Oversights, Time-of-Check to Time-of-Use, and Race Condition. Denial of Service, Execute Code, Overflow, XSS, Sql Injection, CSRF and others. **Security Testing:** Introduction to Security Testing, Need of Security testing, Current Trends in Security Testing, Popular security testing tools, Security Testing Techniques: Model-Based Security Testing, Symbolic Execution, Fuzz Testing, Mining Based Security Testing, Vulnerability Scanning Testing and others. Future of Security Testing.

UNIT: III

Metaheuristics: Common concepts for metaheuristics: Optimization Models, Other Models for Optimization, Optimization Methods, Main Common Concepts for Metaheuristics, Constraint Handling Parameter Tuning, Performance Analysis of Metaheuristics, Software Frameworks for Metaheuristics. Single-Solution Based Metaheuristic, Population-Based Metaheuristics, Metaheuristics for Multiobjective Optimization, Hybrid Metaheuristics, Parallel Metaheuristics

UNIT: IV

Evolutionary Algorithm: Introduction to optimization, Multi-Objective Optimization, Classical optimization Algorithms, Evolutionary Algorithms: Genetic Algorithm, Evolutionary Programming (EP), Genetic Programming (GP) etc. Multi-Objective Evolutionary Algorithms: Elitist, Non-Elitist, Constrained. Search based algorithms and their application in security testing.

Recommended Text Books:

1. Kalyanmoy Deb, “**Multi-Objective Optimization Using Evolutionary Algorithms**”, Wiley India Private Limited.
2. El-Ghazali Talbi “**METAHEURISTICS FROM DESIGN TO IMPLEMENTATION**”, Wiley
3. Randy L. Haupt and Sue Ellen Haupt, “**Practical Genetic Algorithms**”. Wiley Interscience.
4. Chris Wysopal, Lucas Nelson, Dino Dai Zovi and Elfriede Dustin, “**The Art of Software Security Testing**”, Symantec press.
5. Merkow&Breithaupt,“**Information Security: Principles and Practices**”,2nd Edition, 2014, Pearson.

Web References:

1. NIST National Vulnerability Database <https://nvd.nist.gov/>
2. MITRE Common Vulnerabilities Exposures: <https://www.cvedetails.com/vulnerabilities-by-types.php>
3. Cert Coding standards: <https://wiki.sei.cmu.edu/confluence/display/seccode/SEI+CERT+Coding+Standards>
4. Berkley Information Security Office :<https://security.berkeley.edu/secure-coding-practice-guidelines>

Online Courses:

1. SWAYAM: Introduction To Soft Computing:https://swayam.gov.in/nd1_noc20_cs17/preview
2. SWAYAM: Information Security - 5 - Secure Systems Engineering: https://swayam.gov.in/nd1_noc20_cs33/preview
3. Udemy: Optimization problems and algorithms, <https://www.udemy.com/course/optimisation/>
4. Udemy: Multi-objective Optimization Problems and Algorithms, <https://www.udemy.com/course/multi-objective-optimization-problems-and-algorithms/>