Faculty of Mathematical and Computational Science
Dept of Computer Science and Information Technology (CSIT)
Guru Ghasidas Vishwavidyalaya, Bilaspur

Session 2016-17

Scheme and syllabus for Ph. D. Course work in Computer Science

Code	Subject	Max Marks	Min Passing Marks
PHDCS01	Fundamentals of Research in Science	100	60
PHDCS02	Soft Computing Techniques	100	60
PHDCS03	Pattern Recognition	100	60
PHDCS04	Evolutionary Computing and Its Application	100	60
PHDCS05	Machine Vision	100	60
PHDCS06	Seminar	Open Viva – Qualified / Not Qualified	

General Instruction

1. There shall be three theory papers.
2. There shall be an Open Seminar/ Evaluation that will be organized in the University Campus. An Examinee shall be awarded either "Qualified" or "Not Qualified". Marks shall not be allotted for it.
3. Duration of the theory paper shall be three hours.
4. The duration of the course work shall be six months / one Semester.
5. Student has to choose any two subjects from PHDCS02, PHDCS03, PHDCS04 and PHDCS05.

PHDCS01: Fundamentals of Research in Science

Note: A candidate has to attempt five questions out of eight questions. All questions will carry equal marks. Question No. 01 is Compulsory which will consist of 10 sort answered type questions spread all over the syllabus carrying 2 marks each.

A. Ethics in Science

Science and ethics, science as the social, cultural and human pursuit, Ethical theory and applications, Interrelationship of science with technology and delivery.

The source of ethical issues, in science, example from disciplines, e.g. biotechnology, medical sciences, defense research and development, environmental issues, Space research, energy, food security etc., Social and normal responsibilities of scientists and activists. Ethical issues in science research and reporting, objectivity and integrity, the problem of plagiarism and related issues, international norms and standards, Scientific temper and virtues, expectations from scientific community, Desired temper of scientists, truthfulness, simplicity, humility, open mindedness, attitude of service towards social and human well being.

B. Fuzzy Sets and Neural Network

Fuzzy Sets, Probability Theory and Possibility Theory: A comparison.
Structure of a Biological neuron, An artificial neurons with its components, A network of artificial neuron (ANN), Feed forward networks, Transfer function, Computation of out put of an ANN.

C. Science Communication

Nature and importance of Communication in Science, Preparation of manuscripts, review articles, research papers, books, monograms, research projects, review of manuscript, Survey of literature and presentation of data, Preparation of power point presentation, Population of Sciences, Socio – Legal issues, Originality, Integrity, IPR, Patents, Plagiarism

Recommended Books:

Ethics in Science
1.David B. Resnik (1998): The Ethics of Science: An Introduction. Routledge publisher, USA.
2.Callahan D. & Bok S. (1996): Ethics teaching in Higher Education. Plenum Press, New York, USA.
3.Kapur J. N. (1996): Ethical values Excellence in Education and Science. Wishwa
4.Prakashan, New Delhi.
Tripathi A. N. (2008) : Human values. New Age International Publishers, New Delhi.

Fuzzy Sets and Neural Network
1.G. J. Klir and B. Yuan: Fuzzy sets and Fuzzy logic theory and application, PHI (EEE).
2.Simon Haykin: Artificial Neural Network, PHI.

Science Communication
1.A. Willson: Handbook of Science Communication, 1998 Institute of Physics Publishing, Bristol, Philadelphia.
2.Stocklmayer, Gore MM, Bryant C.: Science Communication Theory & Practice; (Eds.) 2002, Springer.
3.Laszis P: Communicating Science, A practical Guide, 2006, Springer.
Laszis P:Communicating Science: A practical Guide(2006), Springer.

PHDCS-02: Soft Computing Techniques

Note: A candidate has to attempt five questions out of eight questions. All questions will carry equal marks. Question No. 01 is Compulsory which will consist of 10 sort answered type questions spread all over the syllabus carrying 2 marks each.

Introduction – What is soft computing ?, Different tools of soft computing and its comparison, area of application .

Artificial Neural Network and Genetic Algorithm – ANN:Architecture, Different types of ANN,Supervised and unsupervised learning, EBPA network , Kohenen network. Genetic algorithm: Introduction and operators.

Fuzzy Logic – Type-1 Fuzzy logic: Introduction ,Operations , membership function,Fuzzy inference System ,Fuzzy rule base ,Fuzzy control system.Type-2 fuzzy logic:Introduction, operations, membership function, Comparison with type-1 fuzzy logic ,Type-2 fuzzy system, Rule base generation ,design of intelligent system with type-2 fuzzy logic.

Hybrid soft commuting : Design of Neuro-Fuzzy ,Neuro – Genetic ,Fuzzy –Genetic Neuro-Fuzzy-Genetic model .

Experimental Work : Application of different soft computing tool in different problem domain.

Reference Books:
1. Type-2 fuzzy logic :Theory and Applications by Oscar Castillo and Partricia Melin ,Springer publication
2. Uncertain rule-based fuzzy logic systems: Introduction and new directions by Jerry M.Mendel ,Prentic Hall of India .
3. Intelligent hybrid System : Neural Network ,Fuzzy Logic and Genetic Algorithm by Da Ruan ,Kluwer Academics publishers
4. Neural Network ,Fuzzy logic and Genetic Algorithm :Synthesis and application by S. Rajshekhran and G.A. Vijay Laxmi ,PHI publication
5. Fuzzy logic with engineering applications by Timothy J Ross, Wiley Publication
6. Neural network by Simon Haykins: Prentice Hall of India

PHDCS03: Pattern Recognition

Note: A candidate has to attempt five questions out of eight questions. All questions will carry equal marks. Question No. 01 is Compulsory which will consist of 10 sort answered type questions spread all over the syllabus carrying 2 marks each.

Pattern Classification: Meaning of pattern, patterns classification, pattern recognition

Classification: Meaning of classification, supervised and unsupervised classification, k-nn,. Decision Trees, clustering, k-Means clustering

Data Mining: Meaning, concepts, types of databases for data mining, Dimensionality reduction, feature selection, Principal Component Analysis

Review paper on any ONE topic including research work carried upto current year.

Reference Books:

1. Pattern Classification: Duda, R.O., Hart, P.E., Stork, D.G., 2001. John Wiley and Sons (Asia) Pte. Ltd.
2. Data Mining : Concepts and Techniques - Jiawei Han, Micheline Kamber, Morgan Kaufmann,Harcourt India 2001.
3. Data Mining Methods for Knowledge Discovery - Cios, Pedrycz, Swiniarski, Kluwer Academic Publishers, London – 1998.

PHDCS04: Evolutionary Computing and Its Applications

Genetic algorithm : Encoding, fitness function evaluation, selection, crossover, mutation, Real coded GA, Adaptive GA : adaptive crossover probability and adaptive mutation probability. Differential Evolution (DE): Generation of population, mutation, crossover, comparison with GA. Multi-Objective GA(NSGA-II) : Single/multi-objective, domination, non-domination, Pareto front, generation of population, fitness function evaluation, non-dominated sorting, crowding distance, selection, crossover, mutation, flowchart.

Particle swarm optimization(PSO) : Generation of population, fitness function evaluation, updation equations, flowchart of PSO, comparison with GA. Multi-objective PSO(MOPSO) : External repository, archive controller, archive grid, velocity calculation, position update, flow chart. Cat swarm optimization (CSO) : Generation of cat population, seeking mode, tracing mode of cats, algorithm, updation equations.

Ant colony optimization (ACO): Introduction, tabu list, pheromone, symmetrical and unsymmetrical traveling sales man problem. Bacterial foraging optimization (BFO) : Introduction of E-coli bacteria, chemotaxis, swarming, reproduction, elimination and dispersal.

Applications: Parameter estimation, channel equalization, prediction of exchange rates and stock market, classification, Portfolio optimization and forecasting scheme.

Text Books :

1. Fundamentals of computational swarm intelligence by A. P. Engelbrecht, Wiley Publication, 1st Edition, 2005.
2. Differential Evolution : Fundamentals and applications in electrical engineering by Anyong Qing, IEEE Press, 2009.

References : Research papers

PHDCS05:

MACHINE VISION

Aim

The objective is to provide the Students with an overview of Machine Vision Systems, their applications, algorithms, Graphics and modeling.

Content

1. Machine Vision: Introduction of Machine Vision, Applications, Algorithms.

2. Image Formation and Image Analysis: Image enhancement, Frequency analysis, Segmentation, Morphology and Object analysis, Augmented Reality and Virtual Reality, Construction of 3D model from images, Image Processing and Feature Extraction, Image Watermarking, Motion Estimation.

3. Camera Technology, Systems For Machine Vision and Digital Imaging: Analog and digital Camera, Pinhole camera model, Perspective geometry , Simple Lens Model ,Selection of Lens, Camera Parameters. Calibration :Perspective Projection ,Calibration Matrix ,Orthographic projection, Calibration Procedure, Solving for Calibration Matrix ,Solving for Camera Parameters.

4.   Graphics and 2D Measurement Methods : Introduction of Graphics and Its applications, Modeling transformation, Coordinate systems, Clipping, Windows and Viewports, Wireframe models, Models for illumination (Diffused, directed, structured, and polarized light), Optics ,Animation Techniques.

5. 3D Measurement Methods: Visual Reconstructions and Image Recognition, Object/scene/activity categorization, Object detection and algorithms, Supervised and Unsupervised classification algorithms, Probabilistic models for sequence data , Learning to rank , Active learning , Dimensionality reduction and manifold learning, Non-parametric methods and big data, Deep learning, convolution neural networks, Scene Recognition with Bag of Words, Shading and smoothing techniques, Crowdsourcing and dataset creation.

Reference Books:
- Carsten Steger Markus Ulric, Christian Wiedermann, Machine Vision Algorithms and Applications,Wiley-VCH,978-3-527-40734-7.
- Faugeras, O. Three Dimensional Computer Vision. The MIT Press, 1993.
- Gonzales/ Woods/ Eddins, Digital Image Processing using MATLAB, 2nd edition, Gatesmark Publishing, ISBN 9780982085400.
- N.Efford, Digital Image Processing, Addison Wesley 2000, ISBN 0-201-59623-7.
- M Sonka, V Hlavac and R Boyle, Image Processing, Analysis and Machine Vision, PWS 1999, ISBN 0-534-95393-X.
- W K Pratt, Digital Image Processing, John Wiley and Sons, 1991, ISBN 0-471-85766-1.
- R Jain, R Kasturi and B G Schunck, Machine Vision, McGraw-Hill, 1995, ISBN 0-07-113407-7.
- Goodfellow, Bengio, and Courvill, Deep Learning,2016. http://www.deeplearningbook.org/
- Hearn and Baker, *Computer Graphics,* C Version, 2nd ed. ISBN 0-13-530924-7.
- Alan Watt, *3D Computer Graphics,* 3rd ed. ISBN 0-20-139855-9.
- Understanding Virtual Reality, interface, Application and Design, William R.Sherman, Alan Craig, Elsevier(Morgan Kaufmann).

Additional reading: Research Papers.

PHDCS06:   **Seminar**

There shall be an Open Seminar/ Evaluation that will be organized in the University Campus. An Examinee shall be awarded either "Qualified" or "Not Qualified". Marks shall not be allotted for it.