SCHEME OF EXAMINATION
AND
COURSE WORK

IN

PH.D. (COMPUTER SCIENCE)

(W. E. F. 2021-2022)

DEPARTMENT OF COMPUTER SCIENCE

FACULTY OF TECHNOLOGY

GURUKULA KANGRI (DEEMED TO BE UNIVERSITY),

HARIDWAR-249404, UTTARAKHAND, INDIA

(NAAC "A" GRADE ACCREDITED DEEMED TO BE UNIVERSITY U/S 3 OF UGC ACT 1956)

Ph. D. Course Work (Computer Science) Syllabus – 2021-22

COURSE WORK

PAPER CODE	PAPER TITLE	PERIODS PER WEEK			CREDIT	EVALUATION SCHEME		
		L	T	P	C	CIA	ESE	TOTAL
PCS-C101	RESEARCH METHODOLOGY	6	0	0	6	30*	70	100**
PCS-C102	RESEARCH AND PUBLICATION ETHICS	2	0	0	2	30*	70	100**
PCS-C103	ADVANCES IN COMPUTER SCIENCE	6	0	0	6	30*	70	100**
TOTAL		14	0	0	14	-	-	300

* 30 marks in each paper shall be for internal assessment out of which 20 marks shall be for written test (term paper) & 10 marks shall be given by the supervisor of the candidate on the basis of literature survey, review of research papers, presentation & attendance etc. The written test of 20 marks of each paper of internal assessment shall be evaluated by the concerned teaching faculty who has taught the course.

** The minimum pass percentage in each paper of the Ph.D. course work will be 55% (B Grade in 7 Point Grading System) and candidates will have to pass both the papers.

PCS – C101	RESEARCH METHODOLOGY	L	T	P	C	MM	TIME FOR ESE
		6	0	0	6	100	3 HRS.

PREREQUISITE: NIL

OBJECTIVES:

- To produce a well-developed research proposal.
- To select an appropriate methodology with which to conduct the research and defend the methodology of their selection.
- To understand the various tasks required to carry out the research.
- To find the resources needed to perform the research process.
- Documentation of its findings in the individual research area.
- To understand the academic theory and the preparation of high-quality research pertinent to the field of study.
- Appropriately employ methods and existing research results in the development of new knowledge, theories and presentation of research in the individual research area.

COURSE CONTENTS

Research Methodology: Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Methods, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.

Literature Survey : What is literature survey?, Functions of literature survey, maintaining a notebook, developing a Bibliography Methods of data collection – Observation, survey, contact methods, experimental, determining sample design

Searching for publications – Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web Online tools – Google, CiteSeer, ACM Digital Library, IEEE, The on-line Computer Science bibliography, Survey papers, Finding material not on the web, Searching patents.

Summarizing Paper: Reading abstracts and finding ideas, conclusion, Advantages of their approach, the drawbacks of the papers (What is lacking – can be found in the sections such as future work) Generalize results from a research paper to related research problems; Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject.

How to Write Scientific Paper: Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper: Abstract writing, chapter writing, discussion, conclusion, references, bibliography, and In-class discussion of technical writing examples, Poster papers, review papers, how to organize thesis/ Project report, How to write a research proposal? How research is funded? Research ethics – Legal issues, copyright, plagiarism.

Sampling Fundamentals: Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean (m), Estimating Population Proportion, Sample Size and its Determination, Determination of Sample Size through the Approach, Based on Precision Rate and Confidence Level, Determination of Sample Size through the Approach, Based on Bayesian Statistics.

SUGGESTED READINGS:

1. Kothari C.R., "Research Methodology: Methods and Trends", New Age International (P) Limited, Publishers, New Delhi.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta & Co, Ltd.
3. Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", Pearson Education.
4. Dawson, C., "Practical Research Methods", UBSPD Pvt. Ltd.
5. Sharma, N. K., "Research Methodology", KSK Publishers, New Delhi.
6. Bird, A, "Philosophy of Science", Routledge.
7. MacIntyre, Alasdair , "A Short History of Ethics", London.

8.   Chaddah, P., "Ethics in Competitive Research: Do Not Get Scooped; Do Not Get Plagiarized", ISBN: 9789387480865.

9.   National Academy of Sciences, National Academy of Engineering and Institute of Medicine, "On Being a Scientist: A Guide to Responsible Conduct in Research", National Academies Press.

10.   Resnik, D. B., "What is Ethics in Research & Why is it Important", National Institute of Environmental Health Sciences", 1—10.

11.   (https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cf in)

12.   Beall, J., "Predatory Publishers are Corrupting Open Access", Nature, 489(7415), 179—179. (https://doi.org/10.1038/489179a)

13.   Indian National Science Academy (INSA), "Ethics in Science Education, Research and Governance", ISBN:978-81-939482-1-7.

14.   (http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

COURSE OUTCOMES:

By the end of the course, the students will be able to:

- Learn the concept of research, research process, types of research, research models and basics formats of report writing.
- Understand the basic concepts of philosophy and ethics.
- Apply publication and research ethics in their research work.
- Use Internet in their research.
- Access the plagiarism tools.
- Write a research proposal in well format way.

PCS – C102	RESEARCH AND PUBLICATION ETHICS	L	T	P	C	MM	TIME FOR ESE
		2	0	0	2	100	3 HRS.

PREREQUISITE: NIL

OBJECTIVES:

- To understand professional, ethical, legal, security, social issues and responsibilities in research and publication.
- To learn open access publications and initiatives.
- To learn the use of plagiarism tools.

COURSE CONTENTS

PHILOSOPHY AND ETHICS: Introduction to philosophy: definition, nature and scope, concept, branches; **Ethics:** definition, moral philosophy, nature of moral judgments and relations.

SCIENTIFIC CONDUCT: Ethics with respect to science and research; Intellectual honesty and research integrity; **Scientific misconducts:** falsification, fabrication, and plagiarism; **Redundant publications:** duplicate and overlapping publications, salami slicing; Selective reporting and misrepresentation of data.

PUBLICATION ETHICS: Publication ethics: definition, introduction and importance; Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; **Publication misconduct:** definition, concept, problems that lead to unethical behavior and vice versa, types; Violation of publication ethics, authorship and contributorship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.

OPEN ACCESS PUBLISHING: Open access publications and initiatives; SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies; Software tool to identify predatory publications developed by SPPU; Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

PUBLICATION MISCONDUCT: Group Discussions; Subject specific ethical issues, FFP, authorship; Conflicts of interest; **Complaints and appeals:** examples and fraud from India and abroad.

SOFTWARE TOOLS: Use of plagiarism software like Turnitin, Urkund and other open source software tools.

DATABASES AND RESEARCH METRICS: Databases, Indexing databases, Citation databases, Web of Science, Scopus, etc.; **Research Metrics:** Impact Factor of journal as per journal citation report, SNIP, SJR, IPP and Cite Score; **Metrics:** h-index, g index, i10 index, altmetrics.

SUGGESTED READINGS:

1. Bird, A, "Philosophy of Science", Routledge.
2. MacIntyre, Alasdair , "A Short History of Ethics", London.
3. Chaddah, P., "Ethics in Competitive Research: Do Not Get Scooped; Do Not Get Plagiarized", ISBN:9789387480865.
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine, "On Being a Scientist: A Guide to Responsible Conduct in Research", National Academies Press.
5. Resnik, D. B., "What is Ethics in Research & Why is it Important", National Institute of Environmental Health Sciences", 1—10.
6. (https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfin)
7. Beall, J., "Predatory Publishers are Corrupting Open Access", Nature, 489(7415), 179—179. (https://doi.org/10.1038/489179a)
8. Indian National Science Academy (INSA), "Ethics in Science Education, Research and Governance", ISBN:978-81-939482-1-7.
9. (http://www.insaindia.res.in/pdf/ethics_book.pdf)

COURSE OUTCOMES:

By the end of the course, the students will be able to:

- Understand the basic concepts of philosophy and ethics.

- Apply publication and research ethics in their research work.
- Use Internet in their research.
- Access the plagiarism tools.
- Write a research proposal in well format way.

PCS – C103	ADVANCES IN COMPUTER SCIENCE	L	T	P	C	MM	TIME FOR ESE
		6	0	0	6	100	3 hrs.

PREREQUISITE: Knowledge of discrete mathematics and data structures.

OBJECTIVES:

- To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
- To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
- To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.
- To learn sampling and estimation methods and testing of hypothesis.
- To Analyze the asymptotic performance of algorithms.

COURSE CONTENTS

Fuzzy Systems

Classical sets: An overview of classical sets; Why fuzzy logic?: Motivation for paradigm shift from classical to fuzzy sets; **Fuzzy sets :** An introduction; Operations on fuzzy sets, Intersections, unions, complement, subset-hood and combinations of operations; Properties and geometric interpretation of fuzzy sets; Linguistic variables; **Membership functions:** Types and designing membership functions; Defuzzification.

Fuzzy numbers and arithmetic operations on intervals & fuzzy numbers, Lattice of fuzzy numbers; Fuzzy relations; Composition of fuzzy relations: Cylindrical extensions and projections; Binary fuzzy relations; Binary relations on a single set; Fuzzy equivalence relations; Fuzzy compatibility relations & Fuzzy ordering relations; Fuzzy graph.

Possibility and Possibility distribution; Fuzzy sets and possibility theory; Possibility theory versus Probability theory; **Fuzzy if-then rules:** Structure of fuzzy rules and fuzzy rule-based inference; **Types of fuzzy rules:** Fuzzy mapping rules and fuzzy

implication rules**; Fuzzy rule-based models for approximations:** Types and overview of fuzzy rule-based models- Mamdani model, TSK Model and Standard Additive Model.

Artificial Neutral Networks

Introduction: Some examples and applications of neural computation, History of artificial neural systems development. **Fundamental Concepts**: Biological neurons and their artificial models, Models of artificial neural networks, Neural processing, Learning and adaptation, Neural network learning rules – Hebbian learning rule, Perception learning rule, Delta learning rule, Widrow-Hoff learning rule, Winner-take-all learning rule, Outstar learning rule.

Genetic Algorithms

Introduction, Basic operators and technologies in GAs, Traditional algorithm vs Genetic Algorithm, Simple GA, General Genetic Algorithm, Schema Theorem, Classification of Genetic Algorithms (Messy, Adaptive, Hybrid, Parallel, ISGA, Red-coded), Holland Classifier Systems, Genetic Programming, Applications of Genetic Algorithms.

Analysis and Design of Algorithms

Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Applied Statistics

Basic Statistics: Measures of dispersion-Range, Mean deviation, Quartile deviation and Standard deviation; Moments, Skewness and Kurtosis, Linear correlation, Karl Pearson's coefficient of Correlation, Rank correlation and linear regression. **Theory of Sampling:** Population and sample, Types of sampling, **Theory of Estimation:** Introduction, point estimation. **Testing of Hypothesis:** Null and alternative hypothesis, types of errors, level of significance, critical region, Large sample tests – Testing of hypothesis concerning mean of a population and equality of means of two populations.

SUGGESTED READINGS:

1. J. Yen & R. Langari, "Fuzzy Logic", Prentice-Hall Inc..

2. G. J. Klir & Bo Yuan, "Fuzzy Sets and Fuzzy Logic", PHI.

3. J. M . Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House.

4. K. Gurney, "An Introduction to Neural Networks", UCL Press.

5. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", Wiley India (P) Ltd.

6. Melanie Mitchell, "An Introduction to Genetic Algorithms", The MIT Press.

7. Sivanandam, S.N., Deepa, S. N., "Introduction to Genetic Algorithms", Springer.

8. J. Kleinberg and E. Tardos, "Algorithm Design", Addison-Wesley.

9. T. Cormen, C. Leiserson, R. Rivest, and C. Stein, "Introduction to Algorithms", The MIT Press.

10. S. Dasgupta, C. Papadimitriou, and U. Vazirani, "Algorithms", McGraw-Hill.

11. M. T. Goodrich and R. Tommassia. "Algorithm Design", Wiley.

12. S. C. Gupta, "Fundamentals of Statistics", Himalaya Publications.

13. Medenhall, "Introduction to Probability and Statistics", Thomson Learning.

14. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand Publications.

15. Robert V. Hogg & Allen T. Craig, "Introduction to Mathematical Statistics", Pearson Education.

LEARNING OUTCOMES:

On completion of the course, student will be able to:

- Interpret the systems which include fuzziness within the scope of fuzzy set theory.
- Combine the information of decision theory and the information of fuzzy set theory.
- Solve problems that include uncertainty with using Fuzzy Set Theory.
- Describe basic artificial neural network models.
- Use the most common ANN architectures and their learning algorithms for a specific application.

- Evaluate the practical considerations in applying ANNs to real classification, pattern recognition, signal processing and control problems.
- Organize, manage and present data.
- Apply statistical procedures and the concepts that govern these procedures.
- Learn about common errors while using statistics and how to get the best analysis out of the data.
- Analyze worst-case running times of algorithms using asymptotic analysis.