DR. D. Y. PATIL SCHOOL OF SCIENCE & TECHNOLOGY
DR. D. Y. PATIL VIDYAPEETH, PUNE
(Deemed to be University)
(Accredited (3rd cycle) by NAAC with a CGPA of 3.64 on four-point scale at 'A++' Grade)
(Declared as Category - I University by UGC Under Graded Autonomy Regulations, 2018)
(An ISO 9001: 2015 and 14001:2015 Certified University and Green Education Campus)

Ph.D. Course Work Structure

Course Code	Course Name / Component	Teaching Scheme			Examination Scheme		Total	Credits
		L	T	P	Internal	End Sem		
PhD CS 1	Research Methodology	4	-	-	40	60	100	4
PhD CS 2	Research Publication & Ethics	2	-	-	20	30	50	2
PhD CS 3	Quantitative Techniques	4	-	-	40	60	100	4
PhD CS 4	Subject Specific Course (NPTEL/SWAYAM) * Course-I	4	-	-	-	-	100	4
PhD CS 5	Subject Specific Course (NPTEL/SWAYAM) * Course-II	4	-	-	-	-	100	4
	Total	18	-	-	100	150	450	18

NOTE: * indicates 2 certifications(NPTEL/SWAYAM) courses suggested by Guide or specific domain.

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Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Course Work Structure (2024-25 Course)
Ph.D. CS 1: Research Methodology

Teaching Scheme:	Credit	Examination Scheme:
TH: 4 Hours/Week	**4**	**Internal Th: 40Marks** **External Th: 60Marks**

Prerequisite Courses, if any:

Course Objectives:

- To understand the basics of research and research methodology.
- To develop skills for writing research papers, proposals, and theses.
- To impart knowledge of various research designs, data collection, and analysis methods.
- To understand ethical issues in research and how to ensure academic integrity.
- To introduce students to statistical tools and techniques used in data analysis for research.

Course Outcomes:

On completion of the course, learner will be able to–

1. Demonstrate an understanding of research processes and methodologies.
2. Design and structure research proposals, papers, and theses effectively.
3. Apply qualitative and quantitative research techniques in computer engineering.
4. Utilize statistical methods to analyze research data.
5. Identify ethical considerations in research and ensure adherence to academic integrity.

Course Contents

Unit I	Concept of Research	(06 Hours)
Overview of Research: Definition, types of research (qualitative vs quantitative, exploratory, descriptive, analytical), **Research Problem Identification**: How to choose a research problem, importance of literature review in shaping the problem, **Research Process**: Steps in the research process from problem definition to conclusion, **Formulation of Hypothesis**: Role and structure of hypotheses in research.		
Mapping of Course Outcomes for Unit I	CO1,CO2	
Unit II	**Literature Review and Hypothesis Formulation**	**(05 Hours)**
Literature Review: Searching academic databases, managing citations, synthesizing papers, **Framework for Literature Review**: Review techniques, analysis of gaps in the current research, **Hypothesis Testing**: Methods for testing hypotheses using statistical tools.		
Mapping of Course Outcomes for Unit II	CO1, CO3	

Unit III	Research Design and Methodology	(08 Hours)
Research Designs: Exploratory, experimental, and case study research designs, **Sampling Techniques**: Probability and non-probability sampling methods, **Data Collection Methods**: Surveys, interviews, observations, and experiments in computer engineering, **Data Analysis**: Techniques like statistical analysis, content analysis, and software tools.		
Mapping of Course Outcomes for Unit III	CO2,CO3	
Unit IV	**Research Writing and Publishing**	**(05 Hours)**
Research Paper Writing: Structure of a research paper (Abstract, Introduction, Literature Review, Methodology, Results, Discussion), **Thesis Writing**: Writing a comprehensive thesis and its organization, **Academic Writing Tools**: LaTeX, MS Word, and reference management tools, **Publication Ethics**: Avoiding plagiarism, citation styles (APA, IEEE, MLA), and ethical research publishing.		
Mapping of Course Outcomes for Unit IV	CO4, CO5	
Unit V	**Statistical Methods and Tools in Research**	**(06 Hours)**
Statistical Analysis: Descriptive and inferential statistics, correlation, regression, hypothesis testing, **Data Analysis Tools**: SPSS, MATLAB, R, Python for research data analysis, **Interpreting Results**: Understanding p-values, confidence intervals, and significance.		
Mapping of Course Outcomes for Unit V	CO3, CO4	
Unit VI	**Ethical Considerations in Research**	**(06 Hours)**
Research Ethics: Ethical dilemmas in research, avoiding misconduct (plagiarism, fabrication, falsification), **Academic Integrity**: The importance of honesty in writing and reporting results, **Ethical Approval and Institutional Review Boards**: Procedures for conducting ethical research.		
Mapping of Course Outcomes for Unit VI	CO5	
Learning Resources		

Reference Books:

1. Research Methodology Methods and Techniques, Kothari, C. R., Wiley EasternLtd.
2. Microsoft Excel Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Press, ISBN: 0735619018
3. Research Methodology: a step-by-step guide for beginners, Kumar, Pearson Education.
4. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd.
5. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education.2013

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	2	1	1	1	1	2	1	2
CO2	2	2	3	2	2	1	1	2	2	3	2	2
CO3	3	3	2	3	3	1	1	1	1	2	1	3
CO4	3	3	2	3	3	1	1	1	1	2	2	3
CO5	2	1	1	1	1	2	2	3	2	2	1	2

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Course Work Structure (2024-25 Course)
Ph.D. CS 2: Research Publications and Ethics

Teaching Scheme:	Credit	Examination Scheme:
TH: 4 Hours/Week	2	Internal Th: 20Marks External Th: 30Marks

Prerequisite Courses, if any: NO

Course Objectives:

- To introduce students to the process of academic research publishing, including selection of journals and conferences.
- To understand the principles of academic writing and how to structure and publish research papers.
- To explore ethical considerations in research publication, including issues like plagiarism, authorship, and conflicts of interest.
- To familiarize students with tools and techniques for enhancing the visibility and impact of their research.
- To understand the peer review process, manuscript preparation, and responding to reviewers.
- To discuss guidelines for proper citation practices and intellectual property rights in academic publishing.

Course Outcomes:

On completion of the course, learner will be able to–

1. Understand the academic publishing process and select appropriate journals or conferences.
2. Write and format research papers and proposals according to academic standards.
3. Identify and avoid common ethical issues in research publication such as plagiarism and authorship conflicts.
4. Apply strategies to improve the impact and visibility of research work.
5. Navigate the peer review process, including responding to reviewer feedback.
6. Demonstrate good practices in citation and referencing, ensuring compliance with academic integrity.
7. Understand legal and ethical issues regarding intellectual property and copyright.

Course Contents

Unit I	Introduction to Research Publication	(06 Hours)

Overview of the Publication Process: From research idea to published paper, **Types of Publications**: Journal papers, conference papers, book chapters, patents, **Selecting the Right Journal/Conference**: Impact factor, indexing, scope, and audience of journals, **Manuscript Structure**: Introduction, literature review, methodology, results, discussion, conclusion, and references, **Writing Tips for Academic Papers**: Clear, concise writing, effective abstract writing.

Mapping of Course Outcomes for Unit I	CO1,CO2

Unit II	**Academic Writing and Paper Formatting**	**(05 Hours)**
Academic Writing Style: Differences from other types of writing, tone, structure, and clarity, **Formatting Papers for Submission**: LaTeX vs. Word, formatting guidelines of specific journals and conferences, **Ethical Writing Practices**: Avoiding common mistakes, clarity in arguments, and proper referencing, **Common Pitfalls in Writing**: Avoiding redundancy, unclear arguments, and non-structured writing.		
Mapping of Course Outcomes for Unit II	CO2, CO3	
Unit III	**Ethical Issues in Research Publication**	**(08 Hours)**
Plagiarism: Definition, detection, prevention, and consequences, **Authorship and Contribution**: Defining authorship, order of authors, ghostwriting, and acknowledging contributions, **Conflicts of Interest**: Disclosure of funding sources, author conflicts, and financial conflicts, **Duplicate Submission**: What constitutes multiple submissions, and the risks of self-plagiarism, **Research Misconduct**: Fabrication, falsification, and ethical misconduct in reporting data.		
Mapping of Course Outcomes for Unit III	CO3,CO6	
Unit IV	**Peer Review Process**	**(05 Hours)**
Understanding Peer Review: The role of reviewers, types of peer review (single-blind, double-blind, open), **Responding to Reviewers**: How to handle reviewer comments, revisions, and resubmissions, **Revision Techniques**: Structural, content, and language improvements based on feedback, **Common Reviewer Criticism**: How to handle negative feedback and revise the manuscript accordingly		
Mapping of Course Outcomes for Unit IV	CO4, CO5	
Unit V	**Citations, Referencing, and Intellectual Property**	**(06 Hours)**
Proper Citation Practices: Importance of citations, citation styles (APA, IEEE, MLA), managing references, **Intellectual Property (IP)**: Understanding patents, copyrights, and licensing for software and research work, **Open Access Publishing**: Benefits, challenges, and funding models, **Copyright Issues**: Fair use, permissions for reuse, and public domain.		
Mapping of Course Outcomes for Unit V	CO6, CO7	
Unit VI	**Enhancing Research Impact and Visibility**	**(06 Hours)**
Maximizing Visibility: Using social media, professional networks (Research Gate, LinkedIn), and online repositories, **Open Science and Data Sharing**: Benefits of sharing research data, open data initiatives, and repositories, **Metrics of Research Impact**: Citation counts, h-index, Altmetrics, and Google Scholar profiles, **Ethical Implications of Enhancing Impact**: Avoiding unethical practices like citation manipulation and self-citation.		
Mapping of Course Outcomes for Unit VI	CO5, CO6	
Learning Resources		
Reference Books:		

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by KambadurMuralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019
5. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
6. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	3	-	-	-	-	-
CO2	3	3	3	2	2	-	3	-	-	-	-	-
CO3	3	2	3	3	3	-	3	-	-	-	-	-
CO4	3	2	3	3	3	-	3	-	-	-	-	-
CO5	3	3	2	3	3	-	3	-	-	-	-	-

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Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Course Work Structure (2024-25 Course)
Ph.D. CS 3: Quantitative Techniques

Teaching Scheme:	Credit	Examination Scheme:
TH: 4 Hours/Week	**4**	**Internal Th: 40Marks** **External Th: 60Marks**

Prerequisite Courses, if any: Basic knowledge of advanced mathematics (Calculus, Linear Algebra, Probability), Discrete Structures

Course Objectives:

- To provide a strong foundation in advanced mathematical concepts used in engineering research.
- To familiarize students with mathematical techniques for modeling and solving engineering problems in computer science and related fields.
- To develop analytical skills in applying mathematical tools to design algorithms, solve optimization problems, and analyze system behaviors.
- To provide knowledge of probability theory, linear algebra, and discrete mathematics for engineering applications.
- To enhance understanding of numerical methods and their application in simulation and modeling.
- To encourage the use of mathematical reasoning in theoretical and applied research in computer engineering.

Course Outcomes:

On completion of the course, learner will be able to–

1. Apply advanced mathematical methods for solving engineering problems.
2. Model complex systems using mathematical frameworks and techniques.
3. Utilize linear algebra, probability theory, and optimization techniques in algorithm design and analysis.
4. Analyze and solve problems related to optimization, machine learning, and signal processing.
5. Apply numerical methods for simulations, approximations, and system modeling.
6. Use mathematical tools for solving differential equations in engineering research.
7. Critically evaluate and apply mathematical concepts in the context of computer engineering and research.

Course Contents

Unit I	Advanced Linear Algebra	(06 Hours)

Matrices and Vectors: Matrix multiplication, inverse, eigenvalues and eigenvectors, **Systems of Linear Equations**: Gaussian elimination, LU decomposition, and applications in solving engineering systems, **Vector Spaces and Subspaces**: Basis, rank, null space, orthogonality, and projections, **Applications in Engineering**: Linear transformations, system analysis, and computer vision.

Mapping of Course Outcomes for Unit I	CO1,CO3	
Unit II	**Probability and Statistics for Engineering**	**(05 Hours)**
Probability Theory: Probability distributions (normal, binomial, Poisson), Bayes' theorem, and random variables, **Statistical Inference**: Estimation, hypothesis testing, and confidence intervals, **Applications in Engineering**: Signal processing, reliability analysis, and stochastic systems.		
Mapping of Course Outcomes for Unit II	CO2, CO	
Unit III	**Optimization Methods**	**(08 Hours)**
Linear Optimization: Linear programming, simplex method, and duality, **Convex Optimization**: Convex sets, convex functions, and optimization algorithms, **Integer and Nonlinear Optimization**: Integer programming, gradient descent, and heuristic methods, **Applications**: Machine learning, control systems, and optimization in algorithm design.		
Mapping of Course Outcomes for Unit III	CO2,CO5	
Unit IV	**Mathematical Modelling**	**(05 Hours)**
Differential Equations: First-order and higher-order differential equations, boundary value problems, **Partial Differential Equations**: Solving heat, wave, and Laplace equations, **Applications**: Modeling of physical systems, fluid dynamics, heat conduction, and signal processing.		
Mapping of Course Outcomes for Unit IV	CO3,CO6	
Unit V	**Numerical Methods**	**(06 Hours)**
Numerical Approximation: Newton-Raphson method, numerical integration (Trapezoidal, Simpson's rule), and differentiation, **Root Finding and Optimization**: Iterative methods for solving equations, solving nonlinear systems, **Finite Difference Methods**: Numerical solutions to differential equations, **Applications**: Simulations, data fitting, and optimization.		
Mapping of Course Outcomes for Unit V	CO4, CO5	
Unit VI	**Operational Research**	**(06 Hours)**
Stochastic Models and Simulation: Markov Chains and Queuing Theory, Monte Carlo Simulation, Stochastic Optimization, Reliability and Risk Analysis.		
Mapping of Course Outcomes for Unit VI	CO1,CO7	
Learning Resources		
Reference Books: 1. Mathematical Statistics – Gupta & Kapoor – Sulthanchand & Sons, New Delhi 2. Kothari CR – Quantitative Techniques (Vikas Publishing New Delhi) 3. Kapoor V.K. – Operations Research (Sultan chand & sons New Delhi)		

4. Khandelwal & M.. Gupta –Quantitative Techniques (TataMcgraw Hill Publishing Co. Ltd.New Delhi)

5. Agarwal N.P. – Quantitative Techniques

6. D.M. Mithani – Quantitative Techniques

7. D.S.Hira & P.K.Gupta – Operations Research

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	2	1	3	2	3
CO2	3	3	2	2	2	2	3	3	2	3	2	3
CO3	3	3	2	3	3	2	2	3	2	3	3	3
CO4	3	2	3	3	2	2	3	2	2	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3	3	2
CO6	2	2	3	3	3	3	3	3	3	3	3	3
CO7	2	3	-	-	-	-	-	-	-	-	-	-