

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.



Circular / Syll. Sec./ A.C. Res./ Curriculum/ 2026.

It is hereby inform to all concerned that, on the recommendation of Board of Studies; the Academic Council at it's Meeting held on 28th July, 2026 has accepted the "Curriculum of Pre-Ph.D. Course Work as per Guidelines of University".

This is effective from the Academic Year 2026-27 and onwards as per appended herewith.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

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Chhatrapati Sambhajanagar-431 004.
Ref. No. Syll. Sec./A.C. Res./
Curriculum/ 2026/ 2.2.-24f

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Deputy Registrar
Syllabus Section

Date: 31/ 07/ 2026.

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- 1] **The Head, all concerned departments,**
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**
- 3] **The Director, Board of Examinations & Evaluation,**
- 4] **Public Relation Officer [PRO],**

Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajanagar.

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Chhatrapati Sambhajanagar – 431 004, Maharashtra, India



*Pre.Ph.D. Course Work Subject Wise Curriculum List
Under the Faculty of Science & Technology*

<i>Sr.No.</i>	<i>Curriculum/Subject</i>
<i>01.</i>	<i>Biochemistry</i>
<i>02.</i>	<i>Biotechnology</i>
<i>03.</i>	<i>Botany</i>
<i>04.</i>	<i>Chemistry</i>
<i>05.</i>	<i>Computer Engineering</i>
<i>06.</i>	<i>Computer Science</i>
<i>07.</i>	<i>Environmental Science</i>
<i>08.</i>	<i>Food Technology</i>
<i>09.</i>	<i>Geology</i>
<i>10.</i>	<i>Mathematics</i>
<i>11.</i>	<i>Microbiology</i>
<i>12.</i>	<i>Pharmacy</i>
<i>13.</i>	<i>Physics</i>
<i>14.</i>	<i>Statistics</i>
<i>15.</i>	<i>Zoology</i>
<i>16.</i>	<i>Civil Engineering</i>
<i>17.</i>	<i>Electronics Engineering</i>
<i>18.</i>	<i>Mechanical Engineering</i>
<i>19.</i>	<i>Nanotechnology</i>

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Pre-Ph.D. Course Work in Biotechnology

Ph.D. Course Work

PART I: Research Methodology in Biotechnology

Credits: 4

UNIT I: Foundations of Scientific Research

1.1 Introduction to Research: Meaning, objectives, and significance of research; Basic, applied, translational, and interdisciplinary research; Scientific method and scientific reasoning; Characteristics of good research

1.2 Research Problem Formulation: Identification of research problems; Research questions and objectives; Hypothesis generation and testing; Conceptual and theoretical frameworks

1.3 Literature Review: Sources of scientific information; Literature survey using databases viz. PubMed, Scopus, Web of Science, Google Scholar etc; Bibliometric indicators:

1. Impact Factor
2. h-index
3. CiteScore

UNIT II: Experimental Design and Biostatistics

2.1 Principles of Experimental Design

- Variables and controls
- Replication, randomization and blocking
- Laboratory and field experiments
- Sampling techniques

2.2 Descriptive Statistics:(Statistical Methods) - Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); sampling distribution; difference


10/08/2016
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विज्ञान व तंत्रज्ञान, विद्याशाखा
डॉ. बाबासाहेब आंबेडकर मराठवाडा विद्यापीठ,
हवेली, धारशिवनगर


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UNIT IV :Practical / Assignments

1. Literature review and presentation on a selected topic.
2. Preparation of a research proposal (other than your research topic).
3. Reference management using Mendeley/Zotero.
4. Scientific paper critique.
5. Seminar presentation followed by a viva voce on **topic chosen by the student and approved by RRC**

Recommended Books

1. **Kothari, C.R.** – *Research Methodology: Methods and Techniques*.
2. **Montgomery, D.C.** – *Design and Analysis of Experiments*.
3. **Holmes, Moody & Dine** – *Research Methods for the Biosciences*. (Amrita Vishwa Vidyapeetham)
4. **Ruxton & Colegrave** – *Experimental Design for the Life Sciences*. (Amrita Vishwa Vidyapeetham)
5. **Daniel, W.W.** – *Biostatistics: A Foundation for Analysis in the Health Sciences*.
6. **Day & Gastel** – *How to Write and Publish a Scientific Paper*.
7. **Rajasekar et al.** – *Research Methodology for Scientists*. (arXiv)


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UNIT - II

Molecular Biology Techniques:

PCR, RT-PCR and qPCR; DNA sequencing technologies; CRISPR-Cas systems; Gene expression analysis

Electrophysiological Methods - Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT. Computational methods: Nucleic acid and protein sequence database; data mining methods for sequence analysis, web-based tools for sequence searches motif analysis and presentation.

UNIT III

Research Tools, Data Science and AI in Biotechnology

3.1 Machine Learning Applications

- Supervised and unsupervised learning
- Classification and regression models
- Neural networks
- Deep learning in genomics and imaging

3.2 Artificial Intelligence in Biotechnology

- AI-assisted drug discovery
- Protein structure prediction
- Generative AI in biological sciences
- Precision medicine and predictive biology

3.3 Big Data Analytics

- High-throughput data handling
- Cloud computing for biological datasets


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References

- C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age International (P) Ltd, Publishers, New Delhi. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
- Attwood. T.K and Parry-Smith D.J. (2002) Introduction to Bioinformatics, Pearson education Singapore.
- Sharma.BK. Instrumental methods of chemical analysis.
- Upadhyay, Upadhyay and Nath, Biophysical chemistry.
- Khandpur R.S. Handbook of biomedical instrumentation, Tata Mc Graw Hill.
- Brigal.L. Williams, A biologist guide to principle and techniques of practical biochemistry.
- Montgomery, D.C. – *Design and Analysis of Experiments*.
- Field, A. – *Discovering Statistics Using R*.
- Lesk, A.M. – *Introduction to Bioinformatics*.
- Alon, U. – *An Introduction to Systems Biology*.
- Brown, T.A. – *Genomes 5*.
- National Academies of Sciences – *Fostering Integrity in Research*.
- Day and Gastel – *How to Write and Publish a Scientific Paper*.
- Current Reviews from Nature Biotechnology, Trends in Biotechnology, Cell, Science, and Nature Reviews Genetics.***


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Ph. D. Course Work Syllabus (Computer Science)

Course.1.-C1 - Research Methodology

Teaching Scheme, Credits, Examination Scheme

Theory: 04 Hours/Week, Credits: 04, Examination Scheme: 100 Marks

Prerequisite Courses:

1. Differentiation, Integration, Maxima and Minima, Matrices and Determinants
2. Knowledge of basic statistics (mean, median, variance, standard deviation, probability concepts)

Course Objectives: The course aims to:

To familiarize the scholars with concepts and techniques in Calculus, Fourier series and Linear Algebra.

The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: Upon successful completion of this course, students will be able to:

- **C01:** Understand the fundamental concepts and types of research, including qualitative and quantitative approaches.
- **C02:** Select suitable tools for data collection and analysis.
- **C03:** Design appropriate research methodology
- **C04:** Analyse and interpret data using appropriate statistical tools and software.
- **C05:** Apply appropriate hypothesis testing techniques to analyse research data and draw statistically valid conclusions.

Course Contents _

Module I.- Introduction to Research and Literature Review

Meaning of Research, Objectives of Research, and Motivation in Research, Types of Research, qualitative and quantitative approaches for research, Research Approaches, Significance of Research, and Research Process, Criteria of Good Research, Overview of literature Survey, Research Problem Meaning of research

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problem, Sources of research problem Criteria / Characteristics of a good research problem Errors in selecting a research problem Scope and objectives of research problem

Case Study: Code of Ethics, IEEE Code of Ethics, ACM Software Engineering Code of Ethics and Professional Practice, Code of Ethics especially covering Computer Science discipline, various aspects- environment, sustainable outcomes, employer, general public, and Nation, Engineering Disasters.

Module II - Methods of data collection

Methods of Data Collection, Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method, Sampling

Case Study: Computer Science dictionary, Shodhganga, The Library of Congress, Research gate, Google Scholar, Bibliometrics, Citations, Impact Factor, h-index, I-index, plagiarism, copyright infringement

Module III - 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

Module IV - Processing and Analysis of Data

Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis.

Module V - Testing of Hypothesis

Basic Concepts Concerning Testing of Hypotheses, Tests of Hypotheses, Hypothesis Testing of Means, Hypothesis Testing of Proportions, Hypothesis Testing for Differences between Means, Hypothesis Testing for Difference between Proportions, Chi-square as a Test for Comparing Variance, Steps Involved in Applying Chi-square Test

Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis.

Module V - Testing of Hypothesis


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Learning Resources

Textbooks _

1. Donald Cooper and PS Schindler (2009), Business Research Methods, 9th edition, Tata McGraw Hill.
2. C.R.Kothari (2004), Research Methodology-Methods and Techniques, New Age International Publishers

Reference Books: _

1. Uma Sekaran (2010), Research Methods for Business, 4th edition, Wiley.
2. Ranjit Kumar (2009), Research Methodology, 2nd edition, Pearson Education
3. Naresh Malhotra and S Dash (2009), Marketing Research, 5th edition, Pearson Prentice Hall

SWAYAM / MOOC / YouTube Links _

1. https://www.youtube.com/playlist?list=PLm-zuel9b64QGMcf5Ckv_8W5Z1d3vMBY
2. https://onlinecourses.swayam2.ac.in/cec20_hs17/preview
3. https://onlinecourses.nptel.ac.in/noc23_ge36/preview
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge43
5. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed28
6. https://online-degree.swayam2.ac.in/mri24_07_d04_s2_cc01/preview

SWAYAM / MOOC / YouTube Links _

1. https://www.youtube.com/playlist?list=PLm-zuel9b64QGMcf5Ckv_8W5Z1d3vMBY
2. https://onlinecourses.swayam2.ac.in/cec20_hs17/preview
3. https://onlinecourses.nptel.ac.in/noc23_ge36/preview
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge43
5. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed28
6. https://online-degree.swayam2.ac.in/mri24_07_d04_s2_cc01/preview

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Ph D Course Work Syllabus (Computer Science): Course.3, C-3

Subject Specific Advanced Level course: Advances in Computer Science

Teaching Scheme, Credits, Examination Scheme

Theory: 03 Hours/Week, Credits: 03, Examination Scheme: 50 Marks

Course Objectives: the course aims to:

1. Familiarize scholars with current research trends and emerging areas in Computer Science.
2. Deepen understanding of advanced computing architectures, algorithms, and intelligent systems.
3. Develop the ability to critically analyse research literature and identify potential research problems.
4. Enhance skills in experimental design, simulation, and result analysis for high-quality research.

Course Contents

Module I - Intelligent Systems and Machine Learning

- Deep Learning Architectures (CNN, RNN, GNN, Transformers)
- Reinforcement Learning and Generative Models
- Explainable AI and Trustworthy AI
- Federated and Edge-based AI Systems
- Applications: Computer Vision, NLP, Cybersecurity

Module II - Network Security

- Network threats and attacks, Security Services,
- Cryptographic algorithms,
- Network Security Protocols, System Security,
- Security research in wired, wireless and ubiquitous networks,
- Security Standards and RFCs

Module III - Natural Language Processing and Language Translation

- Applications: Computer Vision, NLP, Cybersecurity

Module II - Network Security

- Network threats and attacks, Security Services,

- Grammars and Parsing, Grammars for Natural Language, Ambiguity Resolution: Statistical Methods, Linking Syntax and Semantics
- Language Processing: applications and key issues; lexicon and morphology; Phrase structure grammars and English syntax
- Part of speech tagging; Syntactic parsing, top down and bottom-up parsing strategies; Semantics, Word Sense Disambiguation,
- Semantic parsing; Information retrieval and Question answering; knowledge representation and reasoning, local discourse context and reference

Module IV - Emerging Technologies in Computer Science

- Internet of Things (IoT) and Cyber-Physical Systems
- Blockchain and Secure Distributed Ledgers
- 5G/6G Networks and Network Virtualization
- Human-Computer Interaction and Augmented Intelligence
- Quantum Communication and Cryptography

Module V - Data Engineering and Cloud Intelligence

- Big Data Analytics and Real-Time Stream Processing
- Cloud-Native Technologies and Microservices
- Serverless Computing and Orchestration (Kubernetes, Docker)
- Data Governance, Privacy, and Federated Learning
- Knowledge Graphs and Semantic Computing

Module VI - Cyber-Physical Systems and IoT

- Internet of Things (IoT) and Industrial IoT Architectures
- Cyber-Physical System Design Principles
- Embedded AI and Sensor Fusion
- Interoperability and Edge Security Challenges
- Real-Time Operating Systems (RTOS) and Scheduling for IoT

Textbooks

• Knowledge Graphs and Semantic Computing

Module VI - Cyber-Physical Systems and IoT

• Internet of Things (IoT) and Industrial IoT Architectures


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1. Stuart Russel, Peter Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, PHI/Pearson Education
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI
3. Holger Kars, "Protocols and architectures for WSN", Wiley publication
4. Robert Bragg, Mark Rhodes, "Network Security: The complete reference", TMH
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms," Third Edition PHI 2010.
6. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
7. Akshar Bharati, Vineet Chaitanya, Rajiv Sangal, "Natural Language Processing- A Paninian Perspective", PHI

Reference Books:

1. Simon Hhaykin, "Neural networks - A comprehensive foundations", Pearson Education 2nd Edition 2004
2. Tom Mitchell, "Machine Learning", IMGH
3. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Pearson Education.
4. M Jochen Schiller, "Mobile communication", Person Publication.
5. Mathew Gast, "802.11 wireless Networks the definitive guide", O'Reilly.
6. William Stallings, "Cryptography and Network Security", Fourth Edition, Pearson Education 2007.
7. Behrouz A. Forouzan, "Cryptography & Network Security", TMH 2007.
8. G Coulouris, J Dollimore and T Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education.
9. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", Mc Graw Hill
10. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition
5. Mathew Gast, "802.11 wireless Networks the definitive guide", O'Reilly.
6. William Stallings, "Cryptography and Network Security", Fourth Edition, Pearson Education 2007.
7. Behrouz A. Forouzan, "Cryptography & Network Security", TMH 2007.

11. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition 2.
12. Christopher D. Manning and Hinrich Schutze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

11. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition 2.

12. Christopher D. Manning and Hinrich Schutze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

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Ph D Course Work (Computer Science)

Course.4, C-4 - Research and Publication Ethics

Teaching Scheme, Credits, Examination Scheme

Theory: 02 Hours/Week, Credits: 02, Examination Scheme: 20 Marks

Course Outcomes: Upon successful completion of this course, students will be able to:

- To gain insight into the ethical considerations involved in research and publication.
- To foster a strong sense of research integrity among scholars.
- To recognize and address research misconduct and identify predatory publications.
- To become familiar with indexing and citation databases, open access publications, and research metrics such as citations, h-index, and impact factor.
- To understand the use of plagiarism detection tools.

Course Contents _

Module I: Introduction to Research Ethics and Integrity

Definition and importance of research ethics Historical context and key milestones in research ethics Definition and importance of research integrity Truthfulness and accuracy in data collection, analysis, and reporting, The role of reproducibility and transparency

Module II: Research Misconduct

Definitions and examples of research misconduct (fabrication, falsification, plagiarism -redundant publications, duplicate and overlapping publications etc.), Consequences of misconduct for researchers and the scientific community Procedures for reporting and addressing misconduct

Module III: Authorship and Publication Ethics

Criteria for authorship and contributors Responsibilities of authors, reviewers, and editors Handling conflicts of interest and disclosures

Module IV: Predatory Publishing and Misleading Journals

Characteristics of predatory journals and publishers

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How to identify and avoid predatory practices

Strategies for ensuring publication in reputable journals

Module V: Indexing and Citation Databases

Overview of indexing databases (e.g., PubMed, Scopus, Web of Science)

Citation metrics and their role (e.g., impact factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics) Understanding open access and its impact on research dissemination

Module VI: Plagiarism and its Detection

Definitions and types of plagiarism

Tools and techniques for detecting plagiarism Strategies for avoiding plagiarism and ensuring originality

Module VII: Regulations and Guidelines

Overview of relevant regulations and guidelines (e.g., Belmont Report, Declaration of Helsinki)

Institutional policies and procedures

International standards and agreements

Learning Resources

Textbooks _

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. Office of Research Integrity. "Introduction to the Responsible Conduct of Research." U.S. Department of Health and Human Services, 2007, ori.hhs.gov/education/products/RCRintro/

3. Oliver, Paul. The Student's Guide to Research Ethics. Open University Press, 2003

4. Shamoo, Adil E & Resnik David B. Responsible Conduct of Research. Oxford University Press: London 2003

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. Office of Research Integrity. "Introduction to the Responsible Conduct of Research." U.S. Department of Health and Human Services, 2007, ori.hhs.gov/education/products/RCRintro/

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5. Kambadur, Muralidhar, Ghosh, Amit, and Singhvi, Ashok Kumar. Ed. Ethics in Science Education, Research and Governance Indian National Science Academy, 2019.
6. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern. 1997.
7. Gustavii, Bijorn: How to write and illustrate scientific papers? Cambridge University Press.
8. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
9. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.
10. Resnik, David B. The Ethics of Science: An Introduction. Routledge, 1998.
11. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ge46



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