

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.

University campus,
Chhatrapati Sambhajnagar-431 004.
Ref. No. Syll. Sec./A.C. Res./
Curriculum/ 2026/ 2.2.-22f


Deputy Registrar
Syllabus Section

Date: 31/ 07/ 2026.

Copy forwarded with necessary action to:-

- 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 Sambhajnagar.

Dr.Babasaheb Ambedkar Marathwada University Chhatrpati Sambhajnagar.



Pre.Ph.d.Courses Subject wise curriculum List under the Faculty of Science & Technology

Sr.No.	Curriculum/Subject
1.	Biochemistry
2.	Biotechnology
3.	Botany
4.	Chemistry
5.	Computer Engineering
6.	Computer Science.
7.	Environmental Science
8.	Food Technology
9.	Geology
10.	Mathematics
11.	Microbiology
12.	Pharmacy
✓ 13.	Physics
14.	Statistics
15.	Zoology
16.	Civil Engineering
17.	Electronics Engineering
18.	Mechanical Engineering
19.	Nanotechnology
20.	Biophysics
21.	Pharmaceutical and Fine Chemical
22.	Forensic Science.
23.	Water and Land Managment

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY
CHHATRAPATI SAMBHAJINAGAR (M.S.) – 431001



FACULTY OF SCIENCE AND TECHNOLOGY

Pre-Ph.D. Coursework Curriculum

Subject: PHYSICS

Srinivas
Dr. R. H. Kadam

Effective from
Academic Year 2026-27

Shankar
08/10/2026
Faculty of Science & Technology,
Dr. Babasaheb Ambedkar
Marathwada University,
Chhatrapati Sambhajinagar

COURSE - 1. Research Methodology

Credits: 4 | Hours: 60

Introduction:

Research Methodology is a fundamental component of Ph.D. coursework that provides research scholars with a systematic understanding of the principles, processes, and practices involved in scientific research. The course develops the ability to identify meaningful research problems, formulate scientific questions and hypotheses, conduct an effective literature survey, design experiments, collect and analyse data, and interpret research findings objectively. It also emphasizes accuracy, precision, reproducibility, research ethics, and responsible conduct of research.

The course further introduces scholars to the preparation of research proposals, Ph.D. synopsis and thesis, as well as the drafting and publication of scientific manuscripts. Particular emphasis is placed on identifying research gaps and novelty, selecting appropriate journals, understanding the peer-review and publication process, and avoiding common ethical and technical errors in scientific communication. The course is designed to develop the conceptual, analytical, experimental, and scientific writing skills required for conducting independent and high-quality research in Physics and related disciplines.

Course Objectives

After completing this course, the research scholar will be able to:

1. Understand the fundamental concepts, principles, aims, objectives, types, and significance of scientific research and develop a scientific approach to research.
2. Identify and formulate research problems, scientific questions, research gaps, hypotheses, and research objectives based on a critical review of existing literature.
3. Design and conduct appropriate research and experimental studies using suitable research methods, sampling techniques, measurement procedures, and data collection strategies.
4. Analyse, interpret, and present research data using appropriate statistical methods, error analysis, tabulation, graphical representation, and scientific interpretation while ensuring accuracy and reproducibility.
5. Prepare and organize research proposals, pre-Ph.D. and Ph.D. synopses, research work plans, funding proposals, and Ph.D. theses in a systematic and scientific manner.
6. Develop scientific writing and communication skills for preparing high-quality research manuscripts, including effective presentation of methodology, results, discussion, references, tables, and figures.

Modules I: Research fundamentals and scientific method

Fundamentals of Research: Research concept (Meaning and Definition), aims and objectives, motivation in research, criteria of good research, significance of research, problems encountered in research, Identification of research gap, Understanding the scientific questions, Novelty of research in support of existing literatures.

Steps in Research: Types of research, Research methods and methodology, review of literature- definition, functions and importance of literature review, procedures of review of literature and common weakness, results or findings, discussion- purpose and importance of good discussion, writing research proposal/synopsis.

Modules II: Research Problem, literature survey and hypothesis

Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.

Data collection, analysis and interpretation: Fundamentals of data collection, primary and secondary data, Significance of data, methods of collecting data, sample and sampling methods, classification of data, tabulation and presentation of data.

Measurements and Errors: Definitions, Accuracy and Precision, Significant figures, Types of errors, statistical error analysis, probability of errors, Limiting errors, Standards of Measurement.

Modules III: Research Report and drafting Research Proposal:

Types of research reports: Pre-Ph. D. Synopsis, Ph. D. Synopsis (Final), Ph. D. Thesis: Outline of Ph.D. Thesis, Research Proposal for fellowship / funding, Overall Organization of proposal, Essentials for a Funded Proposal, Key Aspects of Drafting Research Proposal, Research Continuum. Work plan and schedule, Ethical Considerations, Outcomes / Results and Beneficiaries, Bibliography / References and Annexures.

Modules IV: Drafting Scientific Manuscript:

Key aspects of drafting of scientific manuscript (Novelty, Social Relevance / National Importance, Credibility / Credential of Research Scholar, Drafting skills of Research Scholar), common content errors, useful resources, background (author's perspective), Author Publishing priorities, Identification of journal, Author Priorities for Journal Selection, Reader's priorities, ethical issues, style and language, article submission process, Manuscript Template, Title of the Manuscript, Title page, Abstract, Introduction, Experimental Details, Material and Methods, Statistical Methods, Results, Tables and Figures, Discussion, Acknowledgements/Funding, Reference section, General rules, After Submission, Overview of Peer Review Process, Publishing Tips, Final advice.

Reference Books:

1. C.R. Kothari – Research Methodology: Methods and Techniques, New Age International.
2. Ranjit Kumar – Research Methodology: A Step-by-Step Guide for Beginners, Sage Publications.
3. John W. Creswell – Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Pearson.
4. Uma Sekaran and Roger Bougie – Research Methods for Business, Wiley.
5. Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams – The Craft of Research, University of Chicago Press.
6. Mandel, J. The Statistical Analysis of Experimental Data.
7. Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd (2013), ISBN-10: 8191064278, ISBN-13: 978-8191064278
8. Gerard Guthrie, Basic Research Methods, SAGE Publications, India, Pvt Ltd, New Delhi (2010), ISBN10: 8132104579, ISBN-13: 978-8132104575
9. Angelika Hofmann; Scientific Writing and Communication- Oxford University Press, US (2010), ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
10. Joshua Schimel, Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Oxford University Press, (2011), ISBN: 9780199760237
11. A. Yavuz Oruc; Handbook of Scientific Proposal Writing, CRC Press, Taylor & Francis group (2011), ISBN: 9781439869185

COURSE - 3. Subject Specific Advance Level Course

Credits: 3 | Hours: 45

Course Objectives

After completing this course, the research scholar will be able to:

1. Understand the fundamental concepts of crystal structure, crystal symmetry, defects, magnetic and dielectric properties, band theory, semiconductors, electromagnetic radiation, nuclear physics, and related applications.
2. Understand the principles and applications of microwave techniques, electromagnetic radiation, and their interaction with matter for scientific investigations.
3. Explain and select appropriate synthesis techniques for nanomaterials and advanced materials, including chemical, mechanical, physical vapour deposition, and plasma-assisted methods.
4. Understand the principles and working mechanisms of major characterization techniques used for structural, optical, chemical, morphological, and magnetic investigations of materials.
5. Analyse and interpret experimental data obtained from XRD, spectroscopic, microscopic, and surface-characterization techniques, including structural parameters, crystallite size, strain, defects, morphology, composition, and surface properties.
6. Develop the ability to select suitable synthesis and characterization techniques for a given research problem and critically evaluate the advantages, limitations, and applicability of different experimental methods.

Module – I: Fundamentals of Physics:

Crystal structure and crystal symmetry, crystal defects, magnetic and dielectric properties of materials, band theory of solids, semiconductors, microwave (X band, Q band), Electromagnetic Radiation and Electromagnetic Spectrum, interaction of electromagnetic radiation with matter, nuclear models and nuclear reactors, nuclear radiation detectors.

Module - II: Synthesis Techniques:

Introduction to nanoscience and nanomaterials. Size-dependent properties and surface-to-volume ratio. Sol-gel method, co-precipitation method, hydrothermal and solvothermal synthesis, microemulsion method. Advantages and limitations of chemical synthesis routes, Mechanical milling (high energy ball milling), physical vapour deposition (PVD), thermal evaporation, sputtering technique, pulsed laser deposition (PLD). Chemical vapour deposition (CVD) and plasma-assisted synthesis.

Module - III: Characterization Techniques:

X-ray Diffraction (XRD), XRD structural analysis: lattice constants, crystallite size, residual stress, disorder density, UV-VIS spectroscopy; Fourier-transform infrared spectroscopy (FTIR) and Raman Spectroscopy, X-ray photoelectron spectroscopy (XPS), X-ray photoluminescence spectroscopy (XPS). Field emission-scanning electron microscopy (FE-SEM), Energy-dispersive X-ray analysis (EDAX), Transmission Electron Microscope (TEM), SAED, HR-TEM, Preparation of samples for SEM and TEM, scanning probe microscopy (SPM), Scanning Tunneling Microscope (STM), Atomic Force Microscopy (AFM), Contact/non-contact/tapping mode of measurement for grain size, surface roughness.

Reference Books:

1. Kittel, C., Introduction to Solid State Physics, Wiley.
2. Krane, K. S., Introductory Nuclear Physics, Wiley.
3. Knoll, G. F., Radiation Detection and Measurement, Wiley.
4. Cao, G. and Wang, Y., Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific.
5. Ohring, M., Materials Science of Thin Films: Deposition and Structure, Academic Press.
6. Cullity, B. D. and Stock, S. R., Elements of X-Ray Diffraction, Pearson.
7. Williams, D. B. and Carter, C. B., Transmission Electron Microscopy: A Textbook for Materials Science, Springer.
8. Goldstein, J. I. et al., Scanning Electron Microscopy and X-Ray Microanalysis, Springer.


Dr. R.H. Kadam


Dr. M.C. Mane


Dr. Sayad S.B.


Dr. P.B. Undre


Dr. Sayar Shirsath