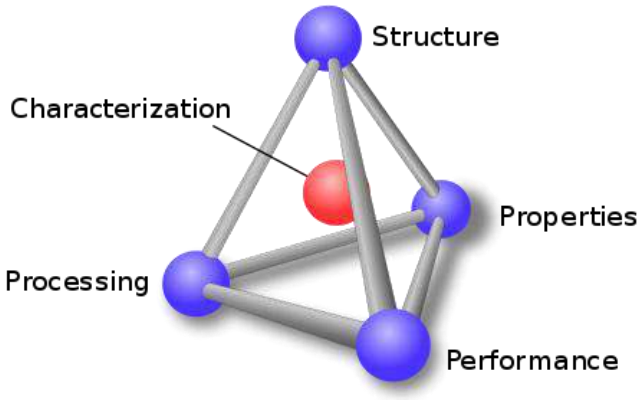
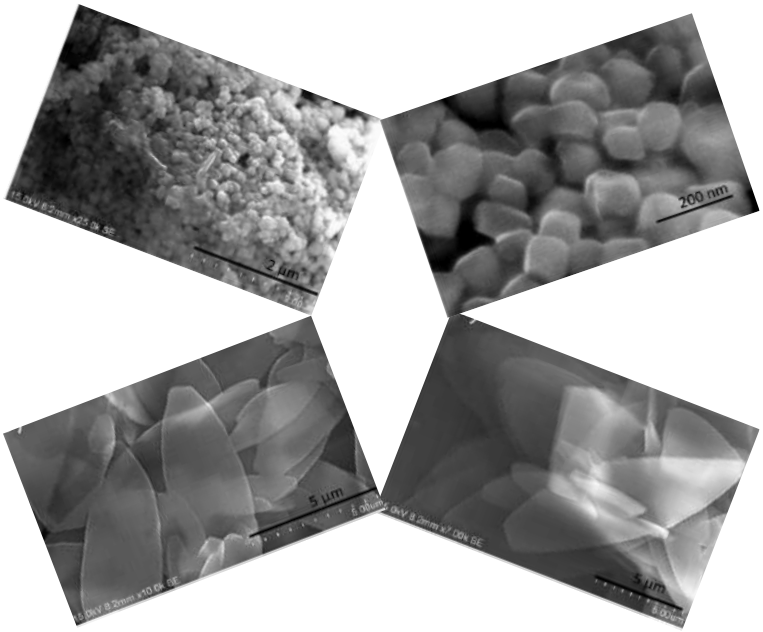
Ph.D. MATERIALS SCIENCE - SYLLABUS

DEPARTMENT OF MATERIALS SCIENCE
School of Technology
Central University of Tamil Nadu
(*Established under an act of Parliament 2009*)
Thiruvarur– 610 005





2025-2026

Ph.D in Materials Science

The Ph.D. programme is a competitive education program that specializes scholars in the area of new materials. The big leap of advances in modern technologies and products in recent decades relies to a large extent on the development of materials science.

This Ph.D. Programme has been proposed to offer students high level interdisciplinary education and training in novel materials and its applications. The Ph.D. (Materials Science) programme to be offered by CUTN is interdisciplinary in nature, with scholars joining from diverse backgrounds such as Physics, Chemistry and Materials Science. In order to cater students from various field, the degree will be provided with specialization in their respective PG program, for example, a student who completed M.Sc. in physics after their successful completion of the Ph.D. program, the student will receive Ph.D in Materials Science with an emphasis on specialization in Physics, similarly a student with M.Sc Chemistry will receive Ph.D. in Materials science with specialization in Chemistry, etc.

The studies begin with two mandatory courses on research methodology and research ethics and two elective courses in materials science (see the list of electives offered), in order to provide the students with a solid knowledge foundation for modern materials science. Advanced level elective courses are offered in close connection to cutting-edge technologies in order to give students a broad perspective of today's materials science and links to applications in semiconductor technology, functional materials, optoelectronics, bioengineering (biocompatibility), chemical and biosensors, energy storage and mechanical applications.

Eligibility Criteria / Entry Requirements

M.Sc. Physics /Chemistry /Materials Science/Applied Physics/Applied Chemistry/Nanoscience and Technology/Electronics/Applied Electronics or equivalent.

or

M.E/M.Tech.. in Materials Science and Technology or equivalent.

Career Opportunities:

This Ph.D. programme provides students with knowledge and skills required for modern science and technology. Graduates will be prepared for careers within academia or industry. The demand for talents in this field is large both in research institutes and industries. For example, wide-bandgap semiconductors, high-performance soft matters, advanced multifunctional materials, metallurgical engineering as well as hybrid smart materials are of high interest in the industries in India and abroad.

Programme Specific Outcomes (PSO)

1. show consistent career growth in the field of materials science
2. become capable to design novel materials for sustainable technologies
3. develop new materials processes, improvise existing processes in accordance to industrial needs
4. shape themselves into successful entrepreneurs through commercializing the innovation in materials science
5. well-performing and globally recognized academic researchers/scientists in the field of materials science and technology

Graduate Attributes for Ph.D. in Materials Science

1. Knowledge in the domain of materials science in sync with the current developments in research and academics
2. Communication Skills: Possess clarity in conveying ideas
3. Critical Thinking: Capacity to apply analytical thought in the designing of materials
4. Problem Solving: Participate in the research and development problems and apply the knowledge for self and societal growth
5. Forge cooperation and collaboration with materials scientists across the globe
7. Ethical and eco-friendly practices: Doing what is right for the environment and humanity
8. self-directed learning: developing self-sufficiency and self-discipline in professional development
9. creativity: the ability to create new materials, processes, methods, out-of-the-box materials solutions
10. Reasoning: the ability to interpret and conclude from quantitative/qualitative data

Contents and Credits

S.No	Semester	Course Code	Course Title	Credits	Marks	
					Internal	External
1	1	MSTRM01	Research Methodology	**4**	40	60
2	1	CPE-RPE	Research and Publication Ethics	**2**	40	60
3	1		Elective – 1*	**4**	40	60
4	1		Elective – 2*	**4**	40	60
			Total Credits	**14**		

Syllabus

Semester I **Course Type: Theory**
Course Code: MSTRM01 **Credit: 4**
Course Title: Research Methodology

Unit-I:

Introduction: Definition and Objectives of Research, Research Design, Need for Research Design, Components of Research Design, Various Stages of Scientific Research, Selection of Research Problem and Hypothesis. Basic Principles of Experimental Design, Important of Experimental Designs.

Unit-II

Literature Survey: Primary and Secondary Sources-Reviews, Monographs, Patents, Current Literature Methods, Abstract of Research Papers, Bibliography Databases, Web as source of information, Use of Search Engines, Application of Microsoft Package. Use of Library and Internet.

Unit-III:

Data Collection, analysis, Reporting and Thesis Writing: Collection of Data, Observation Method, Experimental Measurements, Analysis of Data, Error Analysis, Types of errors, Correlation and Regression analysis, Plotting Pictures and Graphs, **S**tructure and Components of Scientific papers, Technical Reports, illustrations and Tables. Preparation of Final Manuscript/Thesis, Publishing Research Finding in Good Academic Journals, Proof Reading/Correction of Research Manuscript, Style Manuals, Bibliography Reference and Footnotes etc., Layout of Thesis, Issues Related to Copyright-Reproduction of Published Materials – Royalty, IPR, patenting, TRIPS, Plagiarism, Structure of Viva, Defending Viva.

Unit- IV:

Characterisation Techniques: XRD, UV-VIS-NIR- SEM, TEM, CVD, DC/RF Sputtering, Absorption Spectroscopy-Photoluminescence and Raman spectroscopy, Emission Spectroscopy- FT-IR and NMR Spectroscopy and TG-DTA/BET analysis, Temporal measurement of Pulse duration – nanosecond, picosecond and femtosecond pulses. Impedance spectroscopy measurements, Electrical transport measurements: 2-probe and 4-probe techniques, I-V curve analysis, Lab-View interface techniques.

Unit-V:

Lab safety procedures/precautionary steps–MSDS – Storage and disposal of chemicals/ solvents – environmental issues.

Reference books:

1. Fundamental of Research Methodology and Statistics by Y. K. Singh
2. Research Methodology by R.Panneer selvam published by PHI LEARNING PVT LTD.

3. How to write and Publish" by Robert A. Day and Barbara Gastel, (Cambridge University Press).
4. "How to Research" by Loraine Blaxter, Christina Hughes and Malcum Tight, (Viva Books).
5. A Students's Guide to Methodology" by Peter Clough and Cathy Nutbrown, (Sage Publications).
6. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
7. University of New South Wales, "How to write a Ph.D. Thesis" Sydney, Australia, Science @ Unsw.

Semester I **Course Type: Theory**
Course Code: CPE-RPE **Credit:2**
Course Title: Research and Publication Ethics

OBJECTIVES
• To introduce philosophy and scientific conduct
• To learn publication ethics and open access publications
• To learn about plagiarism software and citation index
• To create scientific awareness and different research metrics

LEARNING OUTCOMES
After the completion of the course, the scholars will be able to
• Expected to learn about the ethical guidelines in carrying our research
• Ability to open access publications
• Expected to know the plagiarism software and research metrics
• Students should know scientific conducts

I. Theory

UNIT- 1: Philosophy and Ethics (3 hours)
Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions

UNIT- 2: Scientific Conduct (5 hours)
Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) – Redundant publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data

UNIT- 3: Publication Ethics (7 hours)
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 p violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals – Predatory publishers and journals.

II. Practice

UNIT- 4: Open Access Publishing (4 hours)
Open access publications and initiatives – SHERPA / RoMEO online resource to check publisher copyright & 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.

UNIT- 5: Publication Misconduct (4 hours)

A. Group Discussions (2 hours)

Subject specific ethical issues, FFP, authorship – Conflicts of interest – Complaints and appeals: examples and fraud from India and abroad

B. Software Tools (2 hours)

Use of plagiarism software like Turnitin, Urkund and other open sources of software tools

UNIT- 6: Databases and Research Metrics

A. Databases (4 hours)

Indexing databases - Citation data bases : Web of Science, Scopus, etc.

B. Research Metrics (3 hours)

Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score-Metrics: h-index, g-index, i10- index, altmetrics

References

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. MacIntyre, Alasdair (1967) A Short History of Ethics. London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865.
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179.https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019),ISBN:978-81-939482-1-7.http://www.insaindia.res.in/pdf/Ethics Book.pdf

List of Core & Elective Courses*

S.No	Course Code	Title of the Course	Credits
1.	MSTRM01	Research Methodology	4
2.	CPE-RPE	Research and Publication Ethics	2
3.	MSTREC01	Advanced Characterization Techniques for Materials	4
4.	MSTREC02	Artificial Intelligence in Materials Science and Technology	4
5.	MSTREC03	Computational Materials Science	4
6.	MSTREC04	Crystal Growth and Characterization Techniques	4
7.	MSTREC05	Electrochemical Energy Storage Systems	4
8.	MSTREC06	Experimental Techniques and Instrumentation	4
9.	MSTREC07	Fundamentals of Crystallography	4
10.	MSTREC08	Group Theory and Spectroscopy	4
11.	MSTREC09	High Temperature Superconductors	4
12.	MSTREC10	Introduction to Ferroelectric devices	4
13.	MSTREC11	Introduction to Nanoscience and Technology	4
14.	MSTREC12	Magnetic Materials and their applications	4
15.	MSTREC13	Mechanical Behavior of Materials	4
16.	MSTREC14	Manufacturing Technology	4
17.	MSTREC15	Materials Characterization Techniques	4
18.	MSTREC16	Nanoscale Fabrication Techniques	4
19.	MSTREC17	Nano Materials and Applications	4
20.	MSTREC18	Non-destructive Testing (NDT) Methods	4
21.	MSTREC19	Organic Electronics	4
22.	MSTREC20	Organic Light Emitting Materials: Design Strategy, Synthesis and Applications	4
23.	MSTREC21	Polymers and Composites	4
24.	MSTREC22	Porous Materials	4
25.	MSTREC23	Principle and Applications of Spectroscopy	4
26.	MSTREC24	Supramolecular systems and its applications	4
27.	MSTREC25	Synthetic and Natural Polymers and its applications	4
28.	MSTREC26	Thermodynamics and Thermochemistry	4
29.	MSTREC27	Thin films preparation and its applications	4
30.	MSTREC28	Thin Film Science and Technology	4
31.	MSTREC29	X-ray diffraction method and analysis	4
32.	MSTREC30	Electron Microscopy in Materials Science	4
33.	MSTREC31	Advanced Ceramics and Composites Technology	4

**Electives will be offered based on the availability of faculty member.*

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