RM 6201
Research Methodology
Academic Research Eco System
Module I-B

@ CSE/Maths, IIT Patna

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Include 3rd Party &
LLM Generated Contents.

Feb. 2026

ReCap

- **Acad. Res. Eco Sys:** Understanding with Trends
  - **Publications & IPRs**
  - **Applications**
  - **Practices**
- **Research for**
  - **Knowledge Discovery,**
  - **Making Applications/Products/Startups/…**
    - ➔ ➔ **Unification of Knowledge with Wealth**
- …

RM 6201
Acad. Res. Eco Sys
Explain & Apply

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Any Query?
- Question
- Clarification
- Your Thoughts?

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Ethically . . .

Disclaimer:

Includes 3rd party and LLM-generated contents.
(LLMs are constrained by errors.)
Ethics ➔ Fairness to All?
However,
Accountability for correctness and logic rests with the Author & Presenter.

Research Methodology vs. Methods

Methodology

- **Overall strategy and rationale**
- **Why** particular techniques, models, or approaches?
- **Research design, assumptions, and logical framework**.
- Focuses on **planning, justification, and validity**
- In CSE: **Experimental, simulation-based, or Analytical approach**

ResM

2nd Key Word:

- **Methodology ?**

Methodology ?
➔ Why and What approach?
Method:
➔ How it is done? The SoPs.

Research Methodology vs. Methods

Method

- **Specific techniques and procedures**
- **How** data is collected, processed, and analyzed.
- Deals with **Implementation and execution**
- **Tools, algorithms, datasets, and experiments**.

- CSE: **Dijkstra's** algorithm with **Python/MATLAB**, Experiments on **benchmark** datasets

Research Methodology: Gen.

- **Systematic framework of methods and techniques** used to collect, analyze, and interpret data for a research question.
- Refers to the **scientific and logical approach** adopted to **design, conduct, and validate** a research study.
- **Study of methods**, explaining why specific methods are chosen; how they ensure **reliability, validity, objectivity**.
- **Overall strategy** that integrates **research design, data collection, analysis, and interpretation**.
- **Blueprint of research**, guiding the study from problem **formulation to conclusions in a structured** manner.
- **Research ➔ Publications, Applications, Product, Practices**

Research Methodology: CSE/Maths.

- **Problem formulation**, solution development,
- **Mathematical**, algorithmic, experimental techniques
- **Algorithm**, data structure, model selection
- **Design, implement**, Modeling, simulation, experiment
- **Datasets**, benchmarks, computational Tools ➔Benchmarking
- **Analysis:** Complexity, Statistical validation,
- **Evaluation**: Algorithms, Models, Systems
- **Validation**: Software & Hardware validation
- **Performance** Analysis & Evaluation:
- **Efficiency,** Correctness, Scalability, Reproducibility, Robustness
- **Blueprint**: Theory-to-implementation-to-Applications

Research Methodology: Gen

- Systematic framework of methods & techniques
- Data collection, analysis, interpretation
- Research question–driven approach
- Scientific & logical study design
- Study execution & validation
- Rationale for method selection
- Reliability, validity, objectivity
- Integrated research strategy
- Design, data, analysis, interpretation
- Problem formulation to conclusions
- Structured research blueprint

Types of Methodologies in CSE:

Paradigms

- **Analytical**
- **Algorithmic**
  - Deterministic
  - Approximation
  - Randomized
  - Stochastic Tech
  - Hybrid . . .
- **Empirical: Experimental**
- **Statistical & Probabilistic**
- **Combinations**

Types of Methodologies in CSE:

- **Types of Solutions**
  - Optimal
  - Near-Optimal
  - Approximate
  - Probabilistic
  - . . .
- **Algorithmic Complexity**
- **Time Bounds: limits**
- **Correctness Bounds**

Final Objective ?

Post Mid-Sem Project?

Make/Plan (?)
an ARE System

What? | How? | Let us do it

Types of Systems

- **Manual / Conventional**
- **Mechanized**
- **Semi-Autonomous**
- **Autonomous**
- **Assisted Tech.**
- **IoT Enabled : Smart**
- **AI/ML Enabled : Intelligent**

ARES Planner

- **Mid-Sem Exam: 30% Weightage**
  - **One Question with Two Sub-Questions**
- One Project by Prof. SP (**20%** Weightage)

- **Post Mid-Sem Examination**
  - **My Engagement**
    - **MonTue: Mar. 09 – 10 Eve**
    - **Second Project: 20% weight: ARES**
- . . .

Question ?

Feedback ?