RM 6201
Research Methodology

Academic Research Eco System

Module I-A

@ CSE/Maths, IIT Patna

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Include 3rd Party &
LLM Generated Contents.

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ResM Syllabi : Research

- Module I: Foundations ➔ Terminology
- Module II: Problem Visualization & Conceptualization
- Module III: Design & Data Analysis ..... DONE
  - Design
  - Data Analysis
- Module IV: ..... DONE
  - Qualitative Methods
  - Quantitative (Statistical) Methods
- Module V: Ethics, Publishing, Quality, & IPR

ResM Syllabi:

CSE, IITP: RM 6201 (3-1-0-4)

Module I (6 lecture hours) – Research Method Fundamentals: Definition, characteristics and types, basic research terminology, an overview of research method concepts, research methods vs. method methodology, role of ICT in research, Nature and scope of research, information-based decision making and source of knowledge. The research process; basic approaches and terminologies used in research. Defining research problem and hypotheses framing to prepare a research plan.

Module II (5 lecture hours) - Research Problem Visualization & Conceptualization: Significance of literature survey in identification of a research problem from reliable sources and critical review, identifying technical gaps and contemporary challenges from literature review and research databases, development of working hypothesis, defining and formulating the research problems, problem selection, necessity of defining the problem and conceiving the solution approach and methods.

Module III (5 lecture hours) - Research Design & Data Analysis: Research design – basic principles, need of research design and data classification – primary and secondary, features of good design, important concepts relating to research design, observation and facts, validation methods, observation and collection of data, methods of data collection, sampling methods, data processing and analysis, hypothesis testing, generalization, analysis, reliability, interpretation and presentation.

Module IV (16 lecture hours) - Qualitative & Quantitative analysis: Qualitative Research Plan and designs, Meaning and types of Sampling, Tools of qualitative data Collection; observation depth Interview, focus group discussion, Data editing, processing & categorization, qualitative data analysis, Fundamentals of statistical methods, parametric and nonparametric techniques, test of significance, variables, conjecture, hypothesis, measurement, types of data and scales, sample and sampling techniques, probability and distributions, hypothesis testing, level of significance and confidence interval, t-test, ANOVA, correlation, regression analysis, error analysis, research data analysis and evaluation using software tools (e.g.: MS Excel, SPSS, Statistical, R, etc.).

Module V (10 lecture hours) – Principled Research: Ethics in research and Ethical dilemma, affiliation and conflict of interest; Publishing and sharing research, Plagiarism and its fallout (case studies), Internet research ethics, data protection and intellectual property rights (IPR) – patent survey, patentability, patent laws and IPR filing process

ResM: Modules I & II

I: Foundations

- Defn, Character/Types, Terms, Overview,
- Method(ology), ICT, Nature/Scope,
- Info-based DM & Know Process; Approaches.
- Define Problem, Hypotheses & Plan.

. . . (6 Lecture)

II: Visualization & Conceptualization:

- Littr Survey, Review, Gaps & Challenges ➔ Research Q
- Dev. Hypothesis, Define & Formulate,
- Solution approach/methods: Selection,

. . . (5 Lectures)

ResM: Module V

V: Ethics, Publishing, Quality, & IPR: :

- Ethics & dilemma, Research and Publication Ethics;
- Conflicts of Interest (CoIs);
- Publishing, Sharing, Affiliation;
- Plagiarism and its fallout
- (Digi Pers) Data Protection (DPDP Act/Rules);
  - (Right to) Transparency :
- IPR: Types of Patents, Patentability,
- Patent laws and IPR filing.
- . . .

(10 L)

Teaching

- AI
- Academic Ethics
- Algorithms
- Machine /Deep Learning
- Data Analytics
- Statistics & Tools
- Research Methodology
- Data Struct. & Algorithms
- Prog. Lang. & Methodology
- Compiler Construction
- Embedded System Design
- OO Design, Comp & Systems
- Image Processing
- Computer Vision
- Multimedia System
- Pattern Recog / Classification
- Software Engineering & Adv.
- Stochastic Optimization

Public Policy (Most in Use)

- Grievance Redressal (2019-26)
- CU Common Counselling (2022-23)
- CUET (2020-22)
- Prevention of Suicides (2022-23)
- IITs Admissions & Counselling (2006-16)
- NBA UG Accreditation (2008-11) ➔ NAAC

About Me
Professor CSE; Tech. & Edu, Consultant, Policy

Ext. Funding

- Google, India
- Microsoft, USA
- National, Germany

Recognition

- Test of Time Award (2022)
- Karamveer Chakra (2013)
- CVC: Whistleblower (2013)
- SC: Unsung Hero (2011)
- RTI National Award (2009)
- Distinguish PhD Nominee(1997)
- Commonwealth Scholarship
- Univ. Medal (1992)

Leadership

- Academic: IIT KGP, BITS, JNU
- Admin: IIT KGP, BITS

Research Interests

- Higher Edu. & Tech for Society
- Machine Learn, IoT, Multimedia
- Scientomterics, Edu. Data Ming.
- Prog. Lang., Software Systems
- Evo. Algo, Comb. Optimization

Research Articles (250)
Masters (80), Doctoral (20)

Worked for

- JNU (2015 – 24)
- IIT Kharagpur (2000-17)
- IIT Kanpur (2005-6, 2013-4)
- NSC Germany (2001-4)
- BITS Pilani (1997 – 2000)
- DRDO (1986 - 95)
- DST (1983 - 86)

Education

- Sheffield, UK
- NLU Delhi
- Roorkee
- Allahabad

About Me?

About You?

About Us

-
- About You ?
  - Your Exposure to?
    - D & D (Design & Development)
    - System Integration,
    - Applications
  - Case Studies in ResM?
    - Your Choice?
- ...

About Course?

Disclaimer:

Includes 3rd party and
LLM-generated contents.
(LLMs are constrained by errors.)

Acad. Res. Eco Sys Terminology & Foundations

Objective?

What is the Objective Of This Course?

ResM

➔ What is Research ?

- Research

➔➔

- Discovery of

New Knowledge.

Objective?

Make Thesis-Students Ready for Research, Etc.?

What? | How? | Let us do it

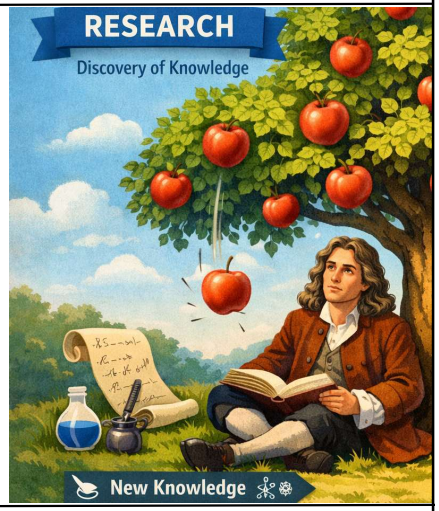
ResM

➔ Since childhood,

➔ Research ➔

➔ Discovery of

➔ New Knowledge.



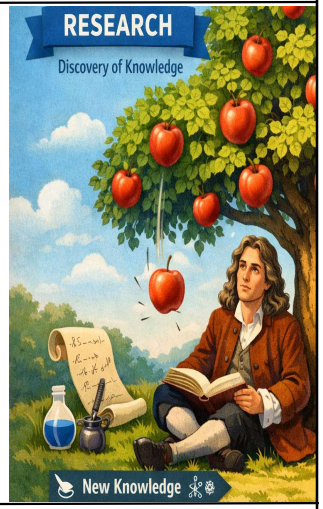
ResM

➔ Discovery !

➔ Can it be planned?

➔ Can it be studied ?

for
PhD MTech Theses, etc.?



ResM : New Mantra

Innovation ?

ResM

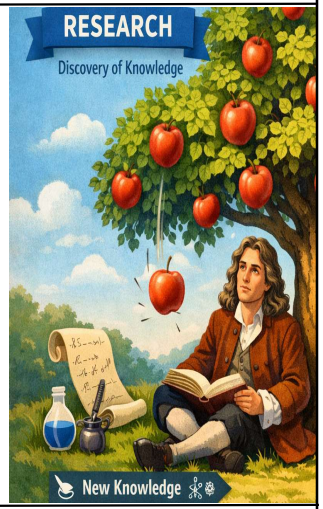
❖ Thesis Research

➔ Research = Re + Search

➔ For New Knowledge

➔ Mostly Incrementally?

➔ In ResM?



ResM : Innovation: R&I

New Mantra?

➔ R is added by I

R&I

- Discovery
- Research
- Innovation

Discovery of Knowledge

- Discovery
- Research
- Innovation

ResM : R&I

New Mantra?

➔R for R &D

➔R for R & I

➔R for I & Practices

➔R for P & P

➔ Academia & Industry

➔ Academia & Society

➔ Industry & Commercialization

ResM : Innovation: R&I

New Mantra? R&I

➔R is followed by D

➔ R & D

➔ I is followed by ???

➔ I & S

ResM : R&I

➔Research for

➔ Publications

➔ Practices

➔ Commercialization

➔ Applications,

➔ Patenting, etc.

➔ Start-ups, Unicorns, etc.

➔ Discovery for Knowledge,

➔ In tune with Resources for Money

➔

ResM : Innovation: R&I

New Mantra? R&D, I&S, Innovate PhD

NEWS | 05 February 2026

First 'practical PhDs' awarded in China — for products rather than papers

The programme is designed to train more elite engineers who can help to boost the country's innovation.

R&I

➔ **R & D**

➔ **I & S**

➔ Combining three ➔ **RDI**

➔ **RDI Fund ~ 1 Lakh Crore**

➔ **~ 1 Trillion**

➔ **ANRF India** (~NSF USA)

➔ For You to Grab.

ResM : Innovation: R&I

What's Emerging:

➔ **PhD Theses, by**

- ➔ **Publications**
- ➔ **Patenting**
- ➔ **Practices**
- ➔ **. . . (To Be Added (TBA))**

Research

Research ➔ Knowledge Creation

- Focuses on **creation of new knowledge,** or **deeper understanding** of existing concepts.
- Aims to **discover, explain, or validate** theories, models, or algorithms.
- Driven by **questions, hypotheses, problem exploration**.
- Success measured by **novelty, correctness, rigor, citations**.
- **New learning algorithm** or improving algo. complexity.
- Output: **papers, algorithms, models, system, prototypes, benchmark datasets**.

Innovation

Innovation ➔ Value Creation

- Focuses on **application of knowledge** to create **practical value**.
- Aims to translate **ideas into usable products, processes, or services**.
- Driven by **needs, impact, and adoption**.
- Output is typically **products, systems, startups, patents, or deployments**.
- Success ➔ **usability, scalability, adoption, and impact**.
- Output: A **system** or software.

Question ?

Feedback ?