

Research Methodology – Group Assignment

Drafting a Mini Research Paper (40 Marks)

Research Paper Structure – Master Guide (with Step-by-Step Explanation)

- ✦ **Paper Length:** 8–10 pages (excluding references)
 - ✦ **Format:** IEEE or Springer template
 - ✦ **Sections:** Abstract → Introduction → Methodology → Results & Discussion → Conclusion & Future Work → References
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1. Abstract (150–200 words, 4 marks)

👉 **What it is:** A **summary of the whole paper**. It should stand alone, meaning someone can understand your research without reading the full paper.

👉 **What to include (in order):**

1. **Background/Problem** (Why this research is important)
2. **Methodology** (What you did, how you did it)
3. **Results** (Main findings with numbers if possible)
4. **Conclusion/Implication** (Why it matters, who benefits)

✅ **Mini Example (Topic: Smart IoT Irrigation System):**

Water scarcity is a pressing global issue, and efficient irrigation is vital for sustainable agriculture. This paper presents an IoT-based smart irrigation system using soil moisture sensors, ESP32 microcontroller, and cloud-based analytics. The system automatically adjusts water flow based on real-time soil data. Experiments conducted in a test farm plot showed a 28% reduction in water consumption compared to traditional methods. The findings suggest that IoT-enabled irrigation can significantly reduce water usage while maintaining crop health, making it a viable solution for sustainable agriculture.

✗ **Common mistakes:**

- Writing it like an *introduction* (too much background).
 - Being too vague (“We got good results” instead of “28% reduction”).
 - Exceeding word count (must be 150–200 words).
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2. Introduction (1–2 pages, 4 marks)

👉 **What it is:** The **entry point** of your research. It sets the stage.

👉 **What to include (step by step):**

1. **Background:** Start broad (general problem area).
2. **Narrow down:** Show what has been done before and where gaps remain.

3. **Problem Statement:** What specific issue are you solving?
4. **Research Objectives:** What exactly are your goals? (List them if needed).
5. **Scope:** What your paper covers and what it does not.

✓ **Mini Example (Topic: AI for Student Dropout Prediction):**

- **Background:** Student dropout is a major challenge in higher education, affecting graduation rates and institutional reputation.
- **Gap:** Traditional dropout prediction relies on manual analysis of attendance and exam results, which is time-consuming and often inaccurate.
- **Problem Statement:** Current methods fail to capture hidden patterns in large educational datasets.
- **Objectives:**
 1. Develop an AI model to predict student dropout based on LMS activity logs.
 2. Compare the model with existing statistical methods.
 3. Suggest early intervention strategies based on predictions.
- **Scope:** This study focuses only on undergraduate engineering students at XYZ University using 2 years of LMS activity logs.

✗ **Common mistakes:**

- Writing too general (“AI is very popular today”).
- No clear research question.
- Mixing results/discussion in the introduction.

3. Methodology (2–3 pages, 4 marks)

👉 **What it is:** A **recipe book** of your research. If someone wants to replicate your work, they should be able to do it from this section.

👉 **What to include:**

1. **Dataset/Data Source** – where data came from (open dataset, simulation, experiment).
2. **Preprocessing/Setup** – how you cleaned/organized the data.
3. **Tools & Algorithms** – programming languages, frameworks, models, methods.
4. **Workflow/Steps** – what sequence of steps you followed.
5. **Evaluation Metrics** – how you measured success.

✓ **Mini Example (Topic: Sentiment Analysis on Twitter Data):**

- **Dataset:** 50,000 tweets collected using Twitter API with #UnionBudgetIndia hashtag.

- **Preprocessing:** Removed stop words, hashtags, mentions, punctuation; converted text to lowercase; tokenized.
- **Model/Tools:** RoBERTa NLP model implemented in Python using HuggingFace Transformers.
- **Training Setup:** 80/20 train-test split, batch size 16, Adam optimizer, 3 epochs.
- **Evaluation Metrics:** Accuracy, Precision, Recall, F1-score.
- **Hardware:** Google Colab GPU, Python 3.10.

✗ Common mistakes:

- Being vague (“We used machine learning”).
- Not mentioning dataset size or source.
- Forgetting metrics (accuracy, precision, recall, etc.).

4. Results & Discussion (2–3 pages, 4 marks)

👉 **What it is:** The **heart of your paper**. You show what you found and why it matters.

👉 **What to include:**

1. **Present Results:** Use tables, graphs, or figures.
2. **Compare with Existing Work:** Show improvement or differences.
3. **Interpretation:** Explain *why* results came out that way.

✅ **Mini Example (Topic: NIFTY 50 Stock Prediction):**

Table – Model Comparison

Model	RMSE	R ² Score
ARIMA (baseline)	0.092	0.81
LSTM (ours)	0.065	0.89

Discussion:

The LSTM model achieved an RMSE of 0.065, which is significantly lower than ARIMA’s 0.092, indicating better predictive accuracy. The improvement is attributed to LSTM’s ability to capture long-term dependencies in time-series data. However, performance degraded when trained with fewer than 2 years of data, showing the model’s dependence on large datasets.

✗ Common mistakes:

- Only showing numbers with no explanation.
- Using screenshots from code output without formatting.
- Not comparing with baseline models.

5. Conclusion & Future Work (1 page, 4 marks)

👉 **What it is:** The **closing argument** of your paper.

👉 **What to include:**

1. **Summary of findings** (without repeating the whole paper).
2. **Main contribution** (What new thing did you add?).
3. **Limitations** (Be honest — no research is perfect).
4. **Future directions** (Where can it go next?).

✅ **Mini Example (Topic: IoT Garbage Collection Optimization):**

This paper proposed an IoT-enabled smart garbage collection system using dynamic routing algorithms. Results showed a 25% reduction in fuel consumption compared to static routes. The contribution of this research lies in integrating IoT sensors with AI-driven route optimization. Limitations include testing in only one city and limited sensor coverage. Future work will expand the system to multi-city deployments and test with heterogeneous waste management vehicles.

❌ **Common mistakes:**

- Rewriting the introduction.
 - No mention of limitations.
 - Ending abruptly without “future work.”
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6. Formatting & Presentation (3–4 marks)

👉 **Why it matters:** Even the best research loses marks if it looks unprofessional.

◆ **IEEE Format Rules:**

- Two-column layout
- Font: Times New Roman, 10 pt
- Figure caption below figure (*Fig. 1. CNN architecture*)
- Table caption above table (*Table I. Accuracy Comparison*)
- References numbered in order of appearance ([1], [2])

✅ **Good Example Sentence:**

As shown in Fig. 2, the CNN achieved higher accuracy compared to SVM. Table I presents the performance metrics.

❌ **Bad Example Sentence:**

The CNN model performed better (see graph below). (No proper reference to figure/table).

 **Quick Section-to-Page Breakdown (8–10 pages target)**

- Abstract → 0.5 page
 - Introduction → 1.5–2 pages
 - Literature Review (from assignment guidelines) → 2–3 pages
 - Methodology → 2–3 pages
 - Results & Discussion → 2–3 pages
 - Conclusion & Future Work → 1 page
 - References → 1–2 pages (not counted in 8–10 pages)
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 **Final Instruction to Students**

 *“Imagine your research paper is like telling a story to a judge: Why does this problem matter? How did you solve it? What did you find? Why is it important? If your paper answers these four things clearly, you will score well.”*