AI Engineering — Master Exam Index

Course: AI Engineering, WS 2025/2026, TU Braunschweig (Dr.-Ing. J. Abel). All chapters live in this folder as Chapter_XX_*.md and Chapter_XX_*.pdf. This edition: English main text with **বাংলা** ব্যাখ্যা after every key concept, no German, full worked math, generated figures, and a 5-level mock exam per chapter.

How to use this folder

1. Study chapters in order 1 → 7 (each forward-references the previous).
2. In every chapter: read the section notes → work the worked examples by hand (calculator only) → study the figures → take the chapter mock exam before reading its solutions.
3. After all chapters: AI_Final_Exam_Revision.md, then AI_Deep_Question_Bank.md, then AI_Coding_Practice.md.
4. Sample_Exam_Analysis.md decodes the official sample exam's format and grading style — read it twice: once at the start (to know the target) and once in the last week.

The PDFs render the Bangla text correctly. The .md files are best in VS Code / Obsidian / Typora. The figures/ folder holds all diagrams referenced by the chapters.

All chapters

#	Title	File	Pages (PDF)	Difficulty	Mock exam
1	Introduction	Chapter_01_Introduction	31	*	5 levels + solutions
2	Foundation Models / LLMs	Chapter_02_Foundation_Models	40	*****	5 levels + solutions
3	Prompt Engineering	Chapter_03_Prompt_Engineering	37	**	5 levels + solutions
4	Retrieval-Augmented Generation	Chapter_04_RAG	33	***	5 levels + solutions
5	Agents	Chapter_05_Agents	35	***	5 levels + solutions
6	Fine-tuning	Chapter_06_Finetuning	24	***	5 levels + solutions
7	Legal & Ethical Aspects	Chapter_07_Legal_and_Ethical	24	**	5 levels + solutions

Every chapter now contains:

1. Section-by-section lecture notes (English, intuition-first) with **বাংলা** ব্যাখ্যা blocks after every key concept.

2. Every formula with a symbol table and a fully worked numerical example (2-decimal rounding, calculator-style — exactly how the exam asks).
3. Embedded figures (attention heatmaps, pipelines, architecture diagrams, curves) from figures/.
4. A glossary table: | Term | Meaning | বাংলা | Example |.
5. Common mistakes / exam traps per section.
6. Mock Exam with 5 levels → Basic (MC + definitions) → Intuitive ("explain why", cause→mechanism→consequence) → Harder (numerical, fully worked) → Transfer (slightly out of topic — TU-hard) → Coding (Python, solutions verified by execution). Full model solutions and grading guides included.

Exam facts (from the released sample)

- 120 minutes, 50 points, answers in English, non-programmable calculator allowed.
- Three exercise types: Fundamentals (MC, exactly one correct, no partial credit), Analysis ("explain why", 3 P), Application (mini-case, 5 P — always state technique + justification + trade-off).
- Rule: "Use the technical terms from the lecture. Do not use abbreviations."
- Numerical answers: "Round to 2 decimals."

Sample-question → chapter mapping:

#	Sample question	Primary chapter	Secondary
1	Cosine similarity for embeddings (MC, 1 P)	Ch 2.4	Ch 4.2
2	Deduplication & generalization (3 P)	Ch 2.1	Ch 2.8, Ch 7.2
3	Agent loop failure & mitigation (5 P)	Ch 5.1	Ch 5.2

High-priority topics (drill until automatic): self-attention by hand (Ch2.5), BPE merges (Ch2.2), sampling/temperature/top-p (Ch2.7), SFT vs RLHF vs DPO (Ch2.10), cosine similarity (Ch2.4 — confirmed by sample), deduplication (Ch2.1 — confirmed), RAG pipeline + BM25/hybrid/RRF (Ch4), ReAct vs Planner-Executor + failure modes (Ch5 — confirmed), LoRA parameter math (Ch6.3), EU AI Act risk pyramid + 80% rule (Ch7).

14-day study schedule

Day	Focus
1	Ch1 + bigram drill (Ch1 mock L3 by hand)
2–3	Ch2.1–2.5 (data → tokenization → embeddings → attention)
4	Ch2.5 attention deep dive — redo the worked example blind
5	Ch2.6–2.9 (variants, sampling, pretraining, ICL)
6	Ch2.10–2.12 (alignment, scaling, evaluation) + Ch2 mock
7	Ch3 + Ch3 mock
8	Ch4 + BM25/RRF hand computation + Ch4 mock
9	Ch5 + ReAct trace writing + Ch5 mock
10	Ch6 + LoRA math drill + Ch6 mock
11	Ch7 + AI-Act case practice + Ch7 mock

Day	Focus
12	AI_Coding_Practice.md end to end
13	AI_Deep_Question_Bank.md (time yourself)
14	AI_Final_Exam_Revision.md + redo every mock L3 with calculator only

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File checklist

- ☒ Chapter_01_Introduction.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ Chapter_02_Foundation_Models.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ Chapter_03_Prompt_Engineering.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ Chapter_04_RAG.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ Chapter_05_Agents.md / .pdf — rewritten (figures, mock, বাংলা; full Ch5 deck coverage incl. A2A protocol)
- ☒ Chapter_06_Finetuning.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ Chapter_07_Legal_and_Ethical.md / .pdf — rewritten (figures, mock, বাংলা)
- ☒ AI_Exam_Master_Index.md / .pdf (this file)
- ☒ AI_Final_Exam_Revision.md / .pdf
- ☒ AI_Deep_Question_Bank.md / .pdf
- ☒ AI_Coding_Practice.md / .pdf
- ☒ Sample_Exam_Analysis.md / .pdf
- ☒ figures/ — all chapter diagrams (33+ PNG)

End of Master Index.