

ALGOPROFESSOR CAMPUS · SKILL & EXPLORATION
FRAMEWORKS



Semester-wise Skill & Exploration Curriculum Framework

B.Tech in Artificial Intelligence & Data Science

An 8-semester, 8-exploration project model mapping each semester's core skill
to industry, village, state, national and SDG problems

Curriculum suggestions & framework design

Dr. S. Satyanarayana

Founder, CEO & Chief Agentic AI Scientist, AlgoProfessor AI R&D Solutions
campus.algoprofessor.com · ceo@algoprofessor.com

Preface & vision statement

A note for heads of department

The industry does not hire syllabi: it hires **demonstrable capability**. This framework converts every semester of the B.Tech (AI & DS) programme into a paired unit of *skill acquisition* and *applied exploration*, so that by graduation each student carries not just a transcript but a portfolio of eight real, verifiable, deployed projects that speak directly to placement panels, startup incubators and global research programmes.

Every exploration project is anchored to a **real-world problem statement**, sourced from industry, neighbouring villages, state departments, India's national missions or the UN Sustainable Development Goals, so that students learn to build technology *for* people and places, not merely for assignments.

Guiding principle: "Learn a skill. Solve a real problem. Prove it publicly."

Each semester has three fused components:

1. **Core skill track:** one dominant technical competency, taught to depth.
2. **Exploration project (E1–E8):** a mandatory, individually assigned project applying that semester's skill to a live problem statement.
3. **Public proof of work:** a mandatory e-Portfolio entry and GitHub repository submission under departmental governance.

1 Framework overview

Framework name: *EXPLORE: Eight-semester eXPerience Ladder for Original Research & Engineering*

Applicability: all B.Tech (AI & DS) students, all batches, mandatory

Mandate: every student completes **8 exploration projects**, one per semester, each mapped to that semester's core skill and to at least one external problem category (industry / village / state / national / SDG).

1.1 Semester → skill → exploration snapshot

Sem	Core skill track	Exploration project	Primary problem lens
I	Programming Foundations (Python)	E1: Community Digitisation Utility	Village record-keeping and small-business automation
II	Data Structures & Algorithms	E2: Efficient Systems for Public Services	Village and state logistics, queueing and resource-allocation optimisation
III	AI Skill Set: Search, Knowledge Representation, Expert Systems, Intro ML	E3: AI for Social Good	Rule-based advisory and diagnostic systems for SDG themes
IV	Machine Learning & Deep Learning	E4: Predictive Intelligence Engine	Agriculture, health, disaster or industry prediction models
V	Data Science & Data Engineering	E5: End-to-End Data Pipeline & Dashboard	Village and state open-data pipelines and public dashboards
VI	Reinforcement Learning & Large Language Models	E6: Conversational & Adaptive Intelligence	Multilingual assistants and RL-based scheduling for national missions
VII	Agentic AI, Physical AI, AGI & ASI Exploration	E7: Autonomous & Embodied Intelligence System	Multi-agent automation, robotics/IoT, frontier-AI research seminar

VIII	Capstone Integration	E8: Combined Capstone Project	Full-stack deployable product: placement, startup or global track
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2 Semester-wise skill & exploration details

SEMESTER I | Programming Foundations (Python)

Skill outcomes: Syntax mastery, data types, control flow, functions, file handling, OOP basics, exception handling, basic API/CLI tool building.

Exploration-1 (E1): Community Digitisation Utility

A Python-based tool (CLI, script or lightweight app) that digitises a manual, paper-based process for a real stakeholder.

- *Sample problem statements:* (VILLAGE) Village ration-card record digitiser; (VILLAGE) Farmer input-cost tracker; (INDUSTRY) Local shop billing and inventory script; (VILLAGE) School attendance automation; (SDG) Well and borewell water-log tracker
- *Problem source(s):* Nearest village panchayat, local MSMEs, school administration
- *SDG mapping:* • SDG 1 No Poverty • SDG 9 Industry, Innovation & Infrastructure

SEMESTER II | Data Structures & Algorithms

Skill outcomes: Arrays, linked lists, stacks and queues, trees, graphs, hashing, sorting and searching, greedy and DP paradigms, complexity analysis.

Exploration-2 (E2): Efficient Systems for Public Services

An algorithm-driven solution that measurably improves an inefficient local or state process.

- *Sample problem statements:* (VILLAGE) Shortest-route optimiser for village waste collection; (NATIONAL) Ration / PDS queue-token allocation algorithm; (STATE) Graph-based irrigation-canal water distribution scheduler; (STATE) Hospital OPD token-priority system
- *Problem source(s):* Gram Panchayat, State Rural Development Dept., district hospitals
- *SDG mapping:* • SDG 11 Sustainable Cities • SDG 6 Clean Water & Sanitation

SEMESTER III | AI Skill Set: Search, Knowledge Representation, Expert Systems, Intro ML

Skill outcomes: State-space search, heuristics, knowledge graphs, rule-based expert systems, intro classification and regression, basic NLP.

Exploration-3 (E3): AI for Social Good

A rule-based or hybrid AI advisory or diagnostic system solving a community-facing decision problem.

- *Sample problem statements:* (VILLAGE) Crop-advisory expert system for local farmers; (VILLAGE) Symptom-checker chatbot for a Primary Health Centre; (NATIONAL) Government-scheme eligibility advisor; (STATE) Local-language FAQ knowledge-base bot
- *Problem source(s):* State Agriculture Dept., PHC health workers, District Collector's office
- *SDG mapping:* • SDG 2 Zero Hunger • SDG 3 Good Health & Well-being

SEMESTER IV | Machine Learning & Deep Learning

Skill outcomes: Supervised and unsupervised ML, model evaluation, CNNs, RNNs, transfer learning, deployment basics (Flask/FastAPI, ONNX/TFLite).

Exploration-4 (E4): Predictive Intelligence Engine

A trained ML/DL model addressing a prediction, classification or detection problem with measurable accuracy targets.

- *Sample problem statements:* (STATE) Crop-yield and drought prediction for the district; (VILLAGE) Leaf-disease image classifier for local farms; (SDG) Flood-risk prediction for state river basins; (INDUSTRY) Industry predictive-maintenance model using partner data
- *Problem source(s):* Industry partners, State Water Resources Dept., agri-research stations
- *SDG mapping:* • SDG 13 Climate Action • SDG 9 Industry, Innovation & Infrastructure

SEMESTER V | Data Science & Data Engineering

Skill outcomes: ETL pipelines, data warehousing, big-data tools (Spark/Kafka basics), visualisation (Power BI/Tableau), statistical inference, dashboarding.

Exploration-5 (E5): End-to-End Data Pipeline & Dashboard

A live data pipeline plus public dashboard built on real (open or collected) data for a governance or industry stakeholder.

- *Sample problem statements:* (VILLAGE) Village water-resource monitoring dashboard; (STATE) School-dropout analytics for the district education office; (STATE) District health-indicator dashboard; (INDUSTRY) Industry sales and operations analytics pipeline
- *Problem source(s):* District administration, State Education Dept., industry partners
- *SDG mapping:* • SDG 4 Quality Education • SDG 6 Clean Water & Sanitation

SEMESTER VI | Reinforcement Learning & Large Language Models

Skill outcomes: MDPs, Q-learning and policy gradients, transformer architecture, prompt engineering, fine-tuning and RAG, LLM deployment.

Exploration-6 (E6): Conversational & Adaptive Intelligence

An LLM-based or RL-based system solving a scheduling, optimisation or multilingual-access problem at national scale.

- *Sample problem statements:* (NATIONAL) Multilingual RAG assistant for government-scheme information; (STATE) RL-based traffic-signal or public-transport scheduling simulation; (VILLAGE) Farmer-helpline LLM chatbot in a regional language; (SDG) RL-tuned energy-usage optimiser for a campus or village micro-grid
- *Problem source(s):* National Digital India mission themes, State Transport and Energy Depts., industry partners
- *SDG mapping:* • SDG 10 Reduced Inequalities • SDG 7 Affordable & Clean Energy

SEMESTER VII | Agentic AI, Physical AI, AGI & ASI Exploration

Skill outcomes: Multi-agent orchestration frameworks, tool-use and agentic pipelines, robotics and IoT integration (Physical AI), and a guided research seminar on AGI/ASI trajectories, safety and alignment.

Exploration-7 (E7): Autonomous & Embodied Intelligence System

A multi-agent or physically embodied AI system, or a supervised frontier-AI research report, oriented toward industry, startup or global exposure.

- *Sample problem statements:* (INDUSTRY) Multi-agent workflow automating an industry back-office process; (VILLAGE) IoT + AI smart irrigation controller for a village farm cluster; (STATE) Autonomous campus-monitoring robot or drone prototype; (INDUSTRY) Contribution (PR/issue) to an open-source agentic-AI framework; (SDG) AGI/ASI alignment literature review with a proposed safety framework
- *Problem source(s):* Industry partners, startups, global open-source community, state smart-village missions
- *SDG mapping:* • SDG 9 Industry, Innovation & Infrastructure • SDG 17 Partnerships for the Goals

SEMESTER VIII | Capstone Integration

Skill outcomes: Full-stack system integration, product thinking, MLOps, UI/UX, documentation, pitching, IP awareness.

Exploration-8 (E8): Combined Capstone Project

Students combine skills and, wherever feasible, prior explorations (E1–E7) into one deployable product on a chosen track.

- *Tracks:* **Placement track** (Industry problem statement, mentored jointly by department faculty and a recruiting partner.); **Startup track** (Student-founded idea pitched to the institution's incubation cell, guided by industry mentors.); **Global Exposure track** (Co-supervised with international postdoctoral and Ph.D. research collaborators.)
- *Deliverables:* Deployed application, technical report, demo video, pitch deck, complete GitHub repository and e-Portfolio capstone entry.
- *Example capstone themes:* (STATE) District decision-support platform combining prediction and dashboards; (INDUSTRY) AI product for an industry partner's operations; (VILLAGE) Farm-to-market price-intelligence app; (SDG) Climate-risk analytics with international collaborators
- *Problem source(s):* Recruiting partners, incubation cell, international research collaborators
- *SDG mapping:* aligned to whichever SDGs the chosen capstone theme serves; declared at proposal stage.

3 Compulsory subjects, programming languages & tools, and global certification roadmap

Basis of this mapping

Compiled by aligning (a) global-standard practice for computing programmes: core theory before applied specialisation, with a mandatory capstone; (b) ABET / NBA-style outcome-based subject sequencing; and (c) the skill sets most consistently sought by leading employers, so that learning outcomes and industry-recognised certifications reinforce each other every semester.

3.1 Semester-wise mapping table

Sem	Compulsory subjects	Programming languages & tools	Recommended global certifications
I	Programming for AI & Problem Solving; Mathematics I (Linear Algebra & Calculus); Digital Logic Design; Communication & Technical Writing	Python 3.x; Git & GitHub; VS Code; Jupyter Notebook	PCEP – Certified Entry-Level Python Programmer (Python Institute); Google IT Automation with Python (foundation module)
II	Data Structures & Algorithms; Discrete Mathematics; Probability & Statistics; Object-Oriented Programming; Database Management Systems	Java or C++; SQL; MySQL/PostgreSQL; GitHub Projects/Actions	Oracle Certified Professional: Java SE 17 Developer (or C++ Institute CPA); HackerRank Problem Solving (Data Structures) certificate; MongoDB Associate Developer
III	Artificial Intelligence: Search & Knowledge Representation; Computer Networks; Operating Systems; Linear Algebra & Optimisation for AI	Python (NumPy, SciPy); basic Prolog/LISP concepts; Linux/Bash	Microsoft Certified: Azure AI Fundamentals (AI-900); IBM AI Foundations for Everyone
IV	Machine Learning; Deep Learning & Neural Networks; Software Engineering & Design Patterns; Model Evaluation & MLOps Basics	Python; scikit-learn; TensorFlow; PyTorch/Keras; Flask/FastAPI for deployment	DeepLearning.AI Machine Learning Specialisation; AWS Certified AI Practitioner; NVIDIA DLI: Fundamentals of Deep Learning
V	Data Science & Statistical Inference; Big Data Systems; Data Engineering & ETL; Cloud Computing & Distributed Systems; Data Visualisation & Business Intelligence	Pandas/NumPy; Apache Spark; Hadoop/Kafka; SQL/NoSQL (MongoDB); Power BI/Tableau; AWS (EC2, S3, Lambda)/Azure/GCP	Google Data Analytics Professional Certificate; Microsoft Certified: Azure Data Fundamentals (DP-900); AWS Certified Cloud Practitioner; Databricks Fundamentals accreditation

VI	Reinforcement Learning; Natural Language Processing; Large Language Models & Generative AI; Vector Databases & Retrieval-Augmented Generation; AI Ethics & Responsible AI	Hugging Face Transformers; LangChain/LlamaIndex; OpenAI API (GPT models); Anthropic API (Claude models); Gymnasium/RLlib; Pinecone/FAISS/ChromaDB/Weaviate	DeepLearning.AI Natural Language Processing Specialisation; Generative AI with Large Language Models (DeepLearning.AI); ChatGPT Prompt Engineering for Developers (DeepLearning.AI); IBM AI Engineering Professional Certificate
VII	Agentic AI Systems; Robotics & Physical AI; IoT for Intelligent Systems; Full-Stack AI Application Development; AGI/ASI: Frontier Research & Alignment Seminar	LangGraph/AutoGen/CrewAI; ROS (Robot Operating System); NVIDIA Jetson/Edge AI; React.js/Next.js; Node.js/Django REST Framework; Docker & Kubernetes	NVIDIA Jetson AI Specialist; Certified Kubernetes Application Developer (CKAD); IAPP Artificial Intelligence Governance Professional (AIGP)
VIII	Capstone Engineering Project (Full-Stack AI Product); MLOps & Cloud Deployment; AI Product Management & Entrepreneurship; IP, Patents & Technical Communication	MLflow/Kubeflow; CI/CD (GitHub Actions/Jenkins); React/Node full-stack layer; vector DB + LLM integration; full-stack cloud deployment (AWS/Azure/GCP)	AWS Certified Machine Learning Engineer – Associate; Google Cloud Professional Machine Learning Engineer; Microsoft Certified: Azure AI Engineer Associate

3.2 Cross-cutting skill ladders

These skills do not belong to a single semester. Employers expect them as continuous, compounding skills, so each is introduced, applied and brought to production grade across the eight semesters.

Skill track	Introduced	Applied	Production-grade	Core tools & certifications
Cloud Computing	Sem III (cloud and OS fundamentals, virtualisation)	Sem V (data-engineering pipelines on cloud; storage, compute)	Sem VII–VIII (containerised deployment, CI/CD, capstone hosting)	AWS/Azure/GCP; Docker/Kubernetes; AWS Cloud Practitioner, Azure Fundamentals (AZ-900), Google Cloud Digital Leader
Vector Databases	Sem V (embeddings, similarity-search basics)	Sem VI (RAG pipelines for LLM applications)	Sem VII–VIII (production RAG in agentic and capstone systems)	Pinecone, FAISS, ChromaDB, Weaviate, Milvus; LangChain/LlamaIndex integration
Full-Stack AI Development	Sem II (web and database fundamentals, REST basics)	Sem V (interactive dashboards, API-served models)	Sem VII–VIII (complete AI product: front end, back end, model, cloud, database)	React.js/Next.js, Node.js/Django, REST/GraphQL, Flask/FastAPI, PostgreSQL/MongoDB

4 Problem-statement sourcing matrix

How the HoD curates individual problem statements each semester

For every semester, the HoD (with mentor faculty, industry liaisons and local administration contacts) compiles and *individually assigns* one problem statement per student from the five lenses below, so that no two students in the same batch receive an identical statement.

Problem lens	Source channel	Coordinating body
Industry	Live or simulated challenges from industry partners and R&D collaborators	Industry partners and MoUs, startup network, alumni network
Village	Field visits, panchayat consultations, farmer and artisan interviews	Gram Panchayat, NSS unit, faculty field coordinators
State	Departmental open-problem calls and e-governance portals	State Agriculture, Rural Development, Water Resources and Health departments
National	Alignment with Digital India, Smart Cities, Skill India and NEP 2020 missions	Ministries' open datasets and challenge portals, AICTE / NBA guidance
SDG	UN Sustainable Development Goals framework (17 goals)	Department SDG cell, mapped explicitly to each exploration

Duplication-avoidance rule: every assigned problem statement is logged in the **Central Exploration Register** (section 5) with semester, academic year, roll number and status. Before any new statement is issued, the register is checked so that the same problem is never reassigned to a later batch unless the HoD explicitly marks it "open for extension", encouraging students to pick unsolved or extension-worthy problems from the growing repository.

5 e-Portfolio & GitHub governance

5.1 Departmental GitHub organisation

- **Organisation:** one department-owned GitHub organisation (suggested: YourInstitution-AIDS-Explorations) with one repository per student per semester.
- **Repository naming convention:** SEM<n>_<AcademicYear>_<RollNo>_<ShortProjectTitle>, e.g. SEM4_2026-27_21AD045_CropYieldPredictor
- **Mandatory repository contents:** problem statement, readme with objective, approach and results, source code, dataset or data-source citation, results and screenshots, short reflection on skill outcomes achieved.
- **Access:** mentor faculty and HoD as organisation owners and reviewers; the student as repository maintainer.

5.2 Student e-Portfolio

- An e-Portfolio page per student, updated at the end of every semester with that semester's exploration summary, skill badge and GitHub link.
- By the end of Semester VIII each student has a public, chronological, eight-project portfolio for placement interviews, startup pitches and international collaboration applications.

5.3 Central Exploration Register (sample structure)

Sem	A.Y.	Roll No.	Project title	Problem lens	GitHub repo	Status
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IV	2026-27	21AD045	Crop Yield Predictor	State + SDG 13	SEM4_...	Completed
IV	2026-27	21AD046	Leaf Disease Classifier	Village + SDG 13	SEM4_...	In progress

Maintained live by the department office; illustrative rows only.

6 Assessment & evaluation rubric (per exploration project)

Criterion	Weight	Descriptor
Problem understanding & real-world fit	15%	Correct interpretation of the assigned industry, village, state, national or SDG problem statement
Skill application (semester's core skill)	25%	Depth and correctness of the semester's designated technical skill in the solution
Implementation & functionality	25%	Working prototype or system, code quality, reproducibility
Data / evidence basis	10%	Use of real or realistic data, field inputs, or validated assumptions
Documentation (README, report)	10%	Clarity, completeness, reproducibility instructions
GitHub & e-Portfolio compliance	10%	Correct repository structure, timely submission, portfolio update
Presentation / viva	5%	Communication of approach, results and learnings to a mentor or panel

7 Governance roles

Role	Responsibility
Head of Department	Curates and individually assigns problem statements each semester; maintains the Central Exploration Register; approves Semester VIII capstone tracks
Mentor faculty (per section)	Weekly technical mentoring, mid-semester review, GitHub and portfolio compliance checks
Industry / startup liaison	Supplies live industry problem statements; co-mentors Semester VII–VIII projects
International co-supervisors	Research partners who co-mentor selected Semester VII–VIII students on the Global Exposure track
Student	Executes the exploration project, maintains the GitHub repository and e-Portfolio, presents at the semester-end review

8 Implementation roadmap

Suggested roll-out timeline
Phase 1: Framework approval: Present the framework to the Board of Studies / Academic Council for formal adoption into the B.Tech curriculum. Phase 2: Infrastructure set-up: Create the departmental GitHub organisation, e-Portfolio hosting space and the Central Exploration Register. Phase 3: Problem bank seeding: HoD, faculty and industry, village and state liaisons jointly seed the first problem statements across all five lenses for every semester. Phase 4: Pilot batch roll-out: Launch with the current Semester I–II cohort and run E1–E2 as pilot explorations. Phase 5: Full-scale adoption: Extend E1–E8 across all active batches; integrate exploration outcomes into OBE / CO–PO attainment and NBA / NAAC documentation. Phase 6: Annual review: Review the register and rubric every academic year to retire saturated problem statements and induct new ones.

Curriculum suggestions & framework design

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AlgoProfessor AI R&D Solutions, Hyderabad
ceo@algotprofessor.com · campus.algotprofessor.com