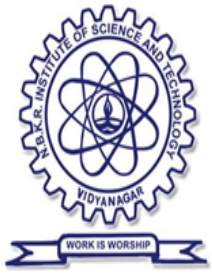

N.B.K.R. INSTITUTE OF SCIENCE & TECHNOLOGY
(AUTONOMOUS)
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Accredited by NAAC with 'A' Grade
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Full Stack Development with Java & Generative AI

Industry-Oriented Syllabus for B.Tech CSE (III Year)

This syllabus is designed specifically for modern software industry requirements in 2026 and focuses on:

- Frontend Engineering using HTML, CSS, JavaScript, ReactJS
- Backend Engineering using Java + Spring Boot + Spring AI
- Databases using MySQL and MongoDB
- REST APIs and Microservices
- AI-powered Full Stack Development
- Deployment, DevOps, GitHub, Cloud
- Real-time industry projects
- Placement-oriented coding and interview readiness

The goal is:

By the end of 4th B.Tech, students should be capable of working as:

- Full Stack Developer
- Java Backend Developer
- React Frontend Developer

- AI Application Developer
- Spring Boot Developer
- Generative AI Engineer
- AI-integrated Software Engineer

PROGRAM STRUCTURE

Duration

- 2 Semesters
- 3–4 Hours/Week
- Theory + Lab + Mini Projects + Capstone

COURSE ROADMAP

Foundation

Foundation Phase:

Traditional Full Stack & Modern AI Full Stack

- Modern software development ecosystem
- Traditional Full Stack architecture
- AI-powered Full Stack architecture
- Industry trends in web development
- Role of Generative AI in modern applications

PHASE 1 — WEB FOUNDATIONS (4 Weeks)

Module 1: Internet & Web Fundamentals

Topics:

- How internet works
- Client-server architecture

- HTTP/HTTPS
- Browser rendering
- Domain & hosting basics
- APIs and JSON
- REST concepts

Practical:

- Browser Developer Tools
- Postman introduction

PHASE 2 — FRONTEND DEVELOPMENT (8 Weeks)

Module 2: HTML5

Topics:

- HTML document structure
- Semantic tags
- Forms and validations
- Tables, media, iframe
- Accessibility basics
- SEO fundamentals

Lab:

- Student profile page
- College landing page
- Responsive forms

Module 3: CSS3 & Responsive Design

Topics:

- CSS selectors

- Box model
- Flexbox
- CSS Grid
- Responsive web design
- Media queries
- Animations
- Glassmorphism UI
- Modern UI trends

Industry Concepts:

- Mobile-first design
- UI/UX fundamentals

Lab:

- Responsive College Website
- Animated dashboard UI

Mini Project:

- Department Website Clone

Module 4: JavaScript (Core + Advanced)

Topics:

- Variables & datatypes
- Functions
- Arrays & Objects
- DOM manipulation
- Events
- ES6 Features
- Arrow functions

- Async programming
- Promises
- Fetch API
- Local Storage
- Modules
- Error handling

Advanced Topics:

- Event loop
- Closures
- Hoisting
- Debouncing
- Throttling

Lab:

- To-do App
- Calculator
- Weather App
- API Integration App

Module 5: ReactJS

Topics:

- React architecture
- JSX
- Components
- Props & State
- Hooks
- Routing

- Context API
- Forms
- Axios
- API integration
- Lifecycle methods
- Authentication
- Protected routes

Advanced React:

- Redux Toolkit
- Lazy loading
- React optimization
- Custom hooks

UI Libraries:

- Bootstrap
- Tailwind CSS
- Material UI

Lab:

- Student Management Portal
- E-Commerce Frontend
- AI Chat Interface

Mini Project:

- Full React Dashboard

PHASE 3 — JAVA BACKEND DEVELOPMENT (10 Weeks)

Module 6: Java Programming Fundamentals

Topics:

- OOP Concepts
- Classes & Objects
- Inheritance
- Polymorphism
- Abstraction
- Encapsulation
- Exception handling
- Collections Framework
- Multithreading
- Streams API
- Lambda Expressions

Industry Topics:

- Clean coding standards
- SOLID Principles

Lab:

- Banking System
- Employee Management System

Module 7: Database Management

MySQL

Topics:

- ER modeling
- SQL queries
- Joins
- Subqueries
- Stored procedures

- Indexing
- Transactions
- Normalization

Lab:

- Student database
- Placement management DB

MongoDB

Topics:

- NoSQL concepts
- Collections & documents
- CRUD operations
- Aggregation framework
- Indexing
- MongoDB Atlas

Lab:

- Product catalog system
- Chat application database

Module 8: Spring Boot

Topics:

- Spring framework basics
- Dependency Injection
- Spring Boot architecture
- REST API development
- MVC architecture

- Spring Data JPA
- Hibernate ORM
- Validation
- Exception handling
- Security basics
- JWT Authentication
- Role-based authorization

Advanced Topics:

- API Gateway
- Microservices basics
- Swagger/OpenAPI
- Logging
- Pagination
- File upload
- Email integration

Lab:

- RESTful APIs
- Authentication system
- Employee Management Backend

Mini Project:

- College ERP Backend

Module 9: Spring Boot + MySQL + MongoDB Integration

Topics:

- Database connectivity
- JPA repositories

- Mongo repositories
- Hybrid database architecture
- Transaction management

Lab:

- Real-time Full Stack CRUD Application

PHASE 4 — GENERATIVE AI & SPRING AI (8 Weeks)

Module 10: Introduction to AI & Generative AI

Topics:

- AI vs ML vs Deep Learning
- NLP basics
- Large Language Models (LLMs)
- Transformers
- Prompt Engineering
- Tokens & Embeddings
- AI APIs

Industry Tools:

- OpenAI
- Gemini
- Claude
- Hugging Face

Use Cases:

- AI Chatbots
- AI Search
- AI Assistants
- Content Generation

Module 11: Prompt Engineering

Topics:

- Zero-shot prompting
- Few-shot prompting
- Chain-of-thought prompting
- System prompts
- Prompt optimization
- AI safety

Lab:

- AI Resume Generator
- AI Content Writer

Module 12: Spring AI (MOST IMPORTANT)

Core Spring AI Topics

Topics:

- Introduction to Spring AI
- AI integrations in enterprise apps
- Spring AI architecture
- AI client configuration
- OpenAI integration
- Gemini integration
- Chat models
- Embeddings
- Vector databases
- Retrieval Augmented Generation (RAG)

Practical:

- AI chatbot with Spring Boot
- AI-powered REST APIs
- Document-based Q&A system

Advanced Spring AI

Topics:

- Function calling
- AI memory
- Prompt templates
- AI agents
- Multi-model integration
- AI workflow orchestration

Vector Databases:

- Pinecone
- ChromaDB
- pgvector

Lab:

- AI Knowledge Assistant
- AI College Admission Assistant
- AI FAQ Bot

Mini Project:

- AI-Powered Student Support System

Module 13: Full Stack AI Applications

Topics:

- React + Spring Boot + AI integration
- AI streaming responses
- Chat UI implementation
- AI file upload processing
- PDF processing
- AI search systems

Projects:

- AI Interview Preparation System
- AI Coding Assistant
- AI Placement Training Portal

PHASE 5 — DEVOPS & DEPLOYMENT (4 Weeks)

Module 14: Git & GitHub

Topics:

- Git basics
- Branching
- Pull requests
- GitHub workflows
- Collaboration

Lab:

- Team-based project collaboration

Module 15: Deployment & Cloud

Topics:

- Hosting frontend apps
- Deploying Spring Boot applications

- Docker basics
- CI/CD basics
- AWS introduction
- Vercel
- Netlify
- Render

Lab:

- Deploy Full Stack Application

PHASE 6 — INDUSTRY PREPARATION (Continuous)

Module 16: Coding & Interview Preparation

Topics:

- DSA basics
- Arrays
- Strings
- Linked Lists
- Stack & Queue
- Trees
- Recursion
- Time complexity
- Aptitude preparation

Platforms:

- LeetCode
- HackerRank
- CodeChef

Module 17: Soft Skills & Career Readiness

Topics:

- Resume building
- LinkedIn optimization
- GitHub portfolio
- Technical presentation
- HR interview preparation
- Group discussions

CAPSTONE PROJECTS (MANDATORY)

Students must complete at least ONE major project.

Suggested Industry Projects

Full Stack Projects

- College ERP System
- Placement Management System
- E-Commerce Platform
- Online Learning Portal

AI + Spring AI Projects

- AI College Admission Assistant
- AI Resume Analyzer
- AI Interview Coach
- AI Attendance Analytics
- AI Chatbot for College Website
- AI Question Paper Generator

TECHNOLOGY STACK

Frontend

- HTML5
- CSS3
- JavaScript ES6+
- ReactJS
- Tailwind CSS
- Material UI

Backend

- Java 21
- Spring Boot
- Spring Security
- Spring AI

Database

- MySQL
- MongoDB

AI Stack

- OpenAI APIs
- Gemini APIs
- Hugging Face
- Vector Databases

Deployment

- GitHub
- Docker
- AWS/GCP

LAB STRUCTURE

Every module should contain:

- Weekly coding exercises
- Lab assignments
- Mini projects
- Viva
- Hackathons
- Team projects

INDUSTRY CERTIFICATION RECOMMENDATIONS

Students can additionally complete:

- Oracle Java Certification
- MongoDB Associate
- AWS Cloud Practitioner
- React Developer Certification
- Spring Professional Certification

RECOMMENDED TEACHING MODEL

Semester 1

- Frontend
- Java
- Database
- ReactJS

Semester 2

- Spring Boot
- Spring AI

- Full Stack Integration
- Deployment
- Major Project

The next generation of software engineers will not just write code — they will build intelligent systems.