# *About the Programme*



**VIT - A Place to Learn; A Chance to Grow**

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## 1. Integrated M.Tech. Computer Science Engineering (Collaboration with Virtusa) (5 Year)

The <u>Integrated M.Tech.</u> Computer Science and Engineering <u>in collaboration with Virtusa programme</u> is a 5 year integrated course offered in these campuses of VIT i.e. Vellore-TN, and Amaravati-AP.

♦ Students who have  successfully completed 12$^{th}$  Grade.

♦ Students develop essential skills to analyze, design, develop and evaluate high-end computing systems.

♦ Students are provided with the necessary infrastructure and guidance to undertake challenging projects and carry out research activity.

**Important industry relevant courses offered:**

♦ Big data technologies

♦ Machine Learning

♦ Internet of Things (IOT)

♦ Software Engineering and Modelling.

♦ Multicore architectures.

**Key Features of program:**

♦ To emphasize on both the theoretical as well as the practical aspects  of Computer Science so as to meet the challenges of the technological changes.

♦ It is tailored to foster multidisciplinary research.

♦ Students develop essential skills to become analyse, design, develop an devaluate high-end computing systems.

♦ To provide the opportunities to work on specialised and specific domains with faculty in various research divisions.

**Job opportunities in India / abroad:**

♦ As Developers and specialists in high-end services and IT-product companies.

♦ As Development Engineers, Technical Leaders and Managers.

♦  As Academicians and Researchers in India and abroad.

♦ As Consultants, Solution Developers and Entrepreneurs.

♦ As Computing Specialists in Research Labs and as Technology Providers.

## 2. Integrated M.Tech Computer Science Engineering (Data Science) (5 Year)

The Integrated M.Tech. Computer Science and Engineering (Data Science) programme is a 5 year integrated course offered in VIT – Vellore campus.

### About the Programme

♦ Data Science is experiencing rapid and unplanned growth by the explosion of complex and rich data in science, industry and government.

♦ The major goal of this program is to impart theoretical knowledge and techniques to address any kind of creating, managing, processing and converting data into knowledge.

♦ This requires interdisciplinary areas namely algorithms, operating systems, databases, artificial intelligence, machine learning, probability and statistics, data warehousing, data mining, game theory, data analysis and data visualization.

♦ The main objective of data science and engineering is to make students to be familiar with how data science is used in other disciplines such as physical sciences, management and medicines.

### Program Educational objectives

• Graduates will be engineering professionals, innovators or entrepreneurs engaged in smart and intelligent technology development, technology deployment, or engineering system implementation in industry.

• Graduates will function in their profession with social awareness and responsibility.

• Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

• Graduates will pursue career paths in teaching and research.

    Graduates will develop and deploy their skills to achieve a thorough knowledge in data science and engineering.

♦ Ability to aggregate, interpret and manage large amount of heterogeneous data resources independent of the hardware and software resources.

**Outcomes of the program**

The course will enable students to:

♦ Able to design storage structures to represent big data

♦ Apply artificial statistics and computational analysis for data to make predictions.

♦ Implement data mining techniques even on large set of data for clustering, classification and ranking of data.

♦ Apply evolutionary computing techniques to create an intelligent data management system.

♦ Use data analytics tools for big data analysis and generate the expected or appropriate reports using visualization tools

♦ Use python and R programming language to clean and process the data.

♦ Implement data intensive computing techniques using cloud infrastructure


**Scope of employment**

♦ There is a big demand for analytics, data mining and data science professionals in near future.

♦ This program will enable the students to develop their skill sets and competencies of data scientists as they play main role in competitive intelligence which is a newly emerging field that encompasses data mining and analysis.

♦ This programme offers students an in-depth education experience to focus on data science as it pertains to their unique interests.

♦ As part of this course the students can do industry interaction and take up research activities in the data science field.

**The programme contains following Curriculum:**

**University Core**

Environmental Studies / Ethics and Values / Effective English / English for Engineers / Soft Skills / Calculus for Engineers / Probability & Statistics for Data Science / Applied Physics / Engineering Chemistry / Problem Solving and Programming / Problem Solving and Object Oriented Programming / Co / Extra Curricular / Comprehensive Examination / Foreign Language / Industrial Internship.

## Program Core

Discrete Mathematics and Graph Theory / Applied Linear Algebra / R Programming for Data Science / Basic Electrical and Electronics Engineering / Digital Logic and Design / Computer Architecture and Organization / Data Structures / Algorithms for Data Science / Database Management System / Software Engineering / Theory of Computation & Compiler Design / Operating System / Introduction to Data Science / Parallel and Distributed Computing / Internet and Web Programming / Microprocessor and Interfacing / Network and Communication / Data Mining / Machine Learning for Data Science / Cryptography & Cyber Security / Advances in Data Engineering / Big Data and Analytics / Java Programming.

## Program Electives

Natural Language Processing / Deep Learning / Intelligent Databases / Network Algorithmics / Social Network Analysis / Computer Graphics / Computer Vision & Image Analysis / Data Compression & Multimedia / Randomized Algorithms / Cloud Computing / Pervasive Computing / Information Retrieval / Software Quality and Testing / Distributed Databases / Security Modelling and Analysis / Internet of Things / Soft Computing / Statistical Inference & Modeling / Exploratory Data Analysis & Visualization **/** Mobile Computing / Artificial Intelligence / Wireless Networks / Open Source Operating System Internals / Computational Foundations for Robotics / Knowledge Engineering / Object oriented software development / Virtualization / Embedded System Design / Image Processing / Object Oriented Databases.

## 3. Integrated M.Tech. Software Engineering (5 year)

The Integrated M.Tech. Software Engineering programme is a 5 year integrated course offered in these campuses of VIT i.e. Vellore-TN, Chennai-TN & Amaravati-AP.

**The programme is offered with the following objectives:**

♦ To understand and apply principles of software development and evolution.

♦ To specify, verify and validate solutions to large-size problems.

♦ To plan, develop and manage large software using state-of-the-art technology.

♦ To learn emerging trends in software engineering and project management.

♦ To expose students to quality standards, CASE tools and best practices.

♦ To analyze, design and develop high-quality software solutions.

**Scope of Employment**

♦ As software developers, architects, design engineers, testing and QA professionals.

♦ As project managers, consultants, solution developers and entrepreneurs.

♦ As high-end system design engineers.

♦ As configuration managers and system analysts.

♦ As academicians and researchers.

**The programme contains following courses:**

Computer Programming: Python / Data Structures and Algorithms / Digital Logic and Microprocessor / Embedded Systems and IoT / Structured and Object Oriented Programming / Computer Architecture and Organization / Computer Programming: Java / Object-Oriented Analysis and Design / Theory of Computation / Database Management Systems / Operating Systems / Software Engineering / Computer Networks / Requirements Engineering and Management/ Web Technologies / Software Architecture / Software Project Management Software Testing / Design Patterns / UI and UX Programming / Software Configuration Management / Software Metrics / Artificial Intelligence / Information and System Security / Agile Development Process and DevOps / Metaverse / Computer Vision / Full Stack Development / Cross Platform Application Development / Data Mining / Quantum Computing

There are also electives from core sciences, languages, management and social sciences to round one's personality.

## 4. Integrated M.Tech Artificial Intelligence (5 Year)

The <u>Integrated M.Tech. Artificial Intelligence programme</u> is a 5 year integrated course offered in VIT – Bhopal campus.

♦ The artificial intelligence and machine intelligence technologies bring more complex data-analysis features to existing applications. Therefore, there is a thrust in using machine learning approaches to build new solutions.

♦ Artificial Intelligence (AI) has become an integral part of technology in our daily lives, be it driving to office, searching for a restaurant, getting news updates on your interested topics, and                 recommendations on social media, etc.

♦ With increase in usage, there is a significant requirement of researchers who can understand AI and build AI technologies for problem solving knowledge acquisition, Knowledge representation and Reasoning, Knowledge Based Decision making in various application domains.

♦ This M.Tech program will provide students an opportunity to specialize in Knowledge Engineering through an opportunity to learn both foundational and experimental components of AI and Machine Learning.

**Program Educational objectives**

The objectives of this programme are:

♦ To study the concepts of Artificial Intelligence from intelligence agent's perspective

♦ To analyse the application knowledge and to represent it using a suitable knowledge representation techniques

♦ To design analyse algorithms for searching the knowledge base using heuristics

♦ To conceptualize the knowledge base using proposition and predicate logic and to perform deductive inference using resolution and both forward and backward reasoning

♦ To handle uncertainty by applying machine learning techniques, fuzzy logic, rough-sets and spatial-temporal reasoning

♦ To perform data analysis using classification based on supervised learning techniques

To understand learning and deep learning methods for performing reinforcement learning

**Program Outcomes**

♦ The student is able to design agent based intelligent systems for engineering and commercial applications

♦ Suitable knowledge representation techniques including ontology are identified and applied for information retrieval and Web mining effectively Shortest path algorithms are applied for searching the knowledge stored in the knowledge base to minimize the overall search cost

♦ Mathematical methods are applied to represent crisp-set knowledge and to answer the queries through syntactic manipulation of well-formed formulas

♦ The students are capable of building Bayesian networks, temporal constraint networks, and fuzzy inference system to handle incomplete information for decision making

♦ The students could apply the learning techniques for binary classification, multi-label classification by the implementation of Neuro-fuzzy models and fuzzy classification techniques

♦ The students could carry out predictive analysis, explanation based reasoning, planning and learning

## Scope of employment:

• According to a survey 37 percent of organizations have now deployed AI. 270 percentage increase from four years ago.

• 50% of companies report that they have adopted AI in at least one business function.

• 85% of organizations are using AI and most are using it in production; the top three  are-as for AI use are research and development, IT, and customer service.

• 20%top skills shortages are of ML modelers and data scientists (58%) and data engineering (40%); reported by 26% of companies.

- 83% of businesses say AI is a strategic priority for their businesses today.

- 31% of marketing, creative, and IT professionals worldwide plan to invest in AI technology in the next 12 months.

- 61% of business professionals point to machine learning and AI as their company's most significant data initiative for next year.

- 27% of executives say their organization plans to invest this year in cybersecurity safeguards that use AI and machine learning.

- The AI market will grow to a $190 billion industry by 2025, according to research firm Markets and Markets.

- China will reap the most economic benefit from AI by 2030.

**CURRICULUM**

**PROGRAMME CORE**

Advanced Data Structures and Algorithms Analysis / Advanced Operating Systems and Virtualization / Advanced Database Technologies / Artificial Intelligence: Principles and Techniques / Machine Learning Techniques / Advanced Computer Networks / Multicore Architectures and Organization / Natural Language Processing/ Artificial Neural Networks/ Optimization Methods in Machine Learning/ Hardware Architecture for Machine Learning/ Introduction to Drones/ Data Visualization/ Cloud Computing. Natural Language Processing, Artificial Neural Networks, Optimization Methods in Machine Learning, Hardware Architecture for Machine Learning, Introduction to Drones, Data Visualization, Cloud Computing.

### PROGRAMME ELECTIVE

Big-data Analytics / Cryptography and Security / Web Technologies / Data warehousing and Mining / Advanced Compiler Design and Optimization / IoT Design and Applications / Soft Computing Techniques / Digital Imaging Techniques and Analysis / Knowledge Engineering and Intelligent Systems / Statistical Natural Language Processing / Deep Learning and its Applications / Fuzzy Logic and its Applications / Intelligent Information Retrieval/ Bayesian Data Analysis/ Knowledge Engineering / Human-Computer Interaction/ Agent-Based Intelligent System/ Data Analytics using Scala Programming/ Expert Systems and Fuzzy Logic/ Computational Intelligence/ Cognitive Analytics/ Advanced Associative Data Analytics. Bayesian Data Analysis, Knowledge Engineering, Human-Computer Interaction, Agent-Based Intelligent System, Data Analytics using Scala Programming, Expert Systems, and Fuzzy Logic, Computational Intelligence, Cognitive Analytics, Advanced Associative Data Analytics.

## 5. Integrated M.Tech. Computer Science and Engineering (Computational and Data  Science ) (5 Year)

The <u>Integrated M.Tech.</u> Computer Science and Engineering <u>(Computational and Data Science ) programme </u>is a 5 year integrated course offered in VIT – Bhopal campus.

**About the Programme**

♦ The programme is designed for students who would like to become Computer Science Engineers     specialized in Computational Systems and Data Science.

♦ The study of Computational Systems involves in mastering the design, development and analysis of high performance, parallel, scalable software and hardware. Likewise the study of Data Science     involves in mastering in Big Data Analysis, Image Analysis, Data Visualization, Machine Learning,     Artificial Intelligence, Distributed Systems and Cloud Computing.

♦ The fourth industrial revolution namely Industry 4.0 includes key technologies like Cloud Computing, high performance computing, Big Data Analytics, Image Analysis. The programme inculcates the     technologies and skills required for the future jobs in the IT industry. It also provides courses which  develop research aspirations.

♦ VIT Bhopal has bells and whistles to offer this course for the student fraternity through which they can be enlightened in their professional life.

**Curriculum Highlights**

The programme equips the student with basic foundations in Computational and Data Sciences.

♦ It indoctrinates advanced research based skills as a master of computational and data engineer.

♦ In addition to the subjects of a B.Tech Computer Science and Engineering programme, the graduate will also learn the following subjects:

Scalable Systems, Data Analysis and Visualization, Machine Learning, Parallel Programming, Cloud Computing, System Virtualization, Deep Learning for Computer Vision, Data Science, Numerical Linear Algebra, Hybrid Parallel Algorithms etc. The programme also requires three dissertation based projects to be     completed in the final semesters to enable the graduates to become industry ready.

## 6. Integrated M.Tech. Computer Science and Engineering (Cyber Security) (5 Year)

The Integrated M.Tech. Computer Science and Engineering (Cyber Security ) programme is a 5 year integrated course offered in VIT – Bhopal campus.

### About Cyber Security

♦ In this age of quick information, Internet is the engine that is ushering global economic growth, connectivity & relentless communication.

♦ The issues related to cyber security of any country, should not impede any of these factors.

♦ Instead it is important to create such initiatives and be well-equipped to face and take head-on those cyber offences, that could cause espionage, infringement into copyrights, financial thefts, stealing personal data etc, which can threaten security, financial issues and confidentiality of a person, organization or even a nation.

♦ It is no exaggeration to say that the battles in the future will probably be fought in cyberspace in-stead on land or sea, with the targets being critical infrastructure such as dams and power grids and even healthcare.

♦ This has already been attempted in the past. Till date, more than 26,000 websites have been defaced and 91 lakh infected systems have been detected in India. The year 2016 saw over 3 million debit cards getting hacked in India.

♦ Worse, 80% of all cybercrimes go unreported!

♦ This makes it super important that India fortifies its critical infrastructure and evolves a mechanism that can be practically implemented in case of any cyber breach.

And this is where the role of cyber warriors comes in.

## Career Prospects

♦ 3.5 million gobal shortage of Cyber Security professionals by 2021

♦ Hackers Attack Every 39 Seconds.

♦ The cyber security market in India is expected to grow from USD 1.97 billion in 2019 to USD 3.05 billion by 2022

♦ India's yearly cyber premium in range of INR80-100Cr. (USD11TO 14 Mn)

♦ India and the US have the largest cyber security talent pool.

♦ The IT Governance Analyst is responsible for providing IT governance, and will align IT investments with enterprise business goals, as well as Bureau and Agency guidance.

♦ An ethical hacker, also referred to as a white hat hacker, is an information security expert who systematically attempts to penetrate a computer system, network, application

♦ An expert witness who testifies or gives digital forensic related opinions at a dispute resolution trial or hearing by virtue of his/her specialized knowledge.

♦ A Vulnerability Assessor (a.k.a. Vulnerability Assessment Analyst) scans applications and systems to identify vulnerabilities

♦ A penetration tester is a type of network security consultant that tries to break into or find possible exploits in different computer systems and software. You can think of them as a type of ethical hacker.

♦ CISO is the senior-level executive within an organization responsible for establishing and maintaining processes to ensure information assets and technologies are adequately protected.

♦ The Security Compliance Analyst is responsible for monitoring, managing and closing existing compliance issues while also ensuring that internal systems are compliant with security standards.

♦ The Security Transformation Consultant's responsibility is to lead Strategy, Assessment, Transaction or Sourcing Management engagements.

## 7. Integrated M.Tech. AI & Bioinformatics

### About the Programme

The Integrated M.Tech. AI and Bioinformatics programme is a five-year course. Direct Admission to this course is after 10+2, without an entrance exam. The specialization in AI & Bioinformatics uses artificial intelligence (AI) techniques to solve challenging problems in bioinformatics, which deals with the processing and interpretation of biological data, especially at the molecular level. A graduate completing this program will be able to handle the tough biological problems encountered by industry, spanning from genome sequencing to protein structure prediction, as well as drug development to personalized medicine. This course offers AI-powered tools and algorithms, emphasizing their critical role in accelerating research, simplifying data interpretation, and igniting biomedical advances. Students gain hands-on experience in the theory and application of Artificial Intelligence and Bioinformatics, as well as practical experience through Engineering Laboratories, Capstone Project, and Internship.

# Curriculum Highlights

This course equips the student with basic foundations in Artificial Intelligence and Bioinformatics. It imparts sophisticated research-based skills as a master of AI engineering and bioinformatics. In addition, the graduate will also learn the following subjects:

Core Foundation

- Mathematics for AI & Bioinformatics
- Probability, Statistics & Linear Algebra
- Data Structures and Algorithms
- Introduction to Artificial Intelligence
- Fundamentals of Molecular Biology and Genetics

AI and Machine Learning modules

- Machine Learning and Deep Learning
- Neural Networks and Natural Language Processing
- Computer Vision and Pattern Recognition
- AI in Drug Discovery and Healthcare
- Reinforcement Learning and Evolutionary Algorithms

Bioinformatics and Computational Biology

- Genomics and Proteomics
- Sequence Alignment and Gene Prediction
- Systems Biology and Network Modeling
- Structural Bioinformatics
- Molecular Dynamics and Simulation

Advanced Tools & Technologies
Research and Industry Exposure
Skill Development and Electives

### Advanced Tools & Technologies

- Bioinformatics Programming (Python/R/BioPython)

- Big Data Analytics and Cloud Computing in Biology

- Visualization and Data Interpretation Tools

- Biomedical Signal and Image Analysis

- Omics Data Analysis (Genomics, Transcriptomics, Metabolomics)

- Research and Industry Exposure

- Mini Projects and Case Studies in AI for Life Sciences

- Summer Internships with Research Labs or Biotech Firms

- Industrial Lectures and Hands-on Workshops

- Final Year Capstone Project


Skill Development and Electives
- Technical Writing and Research Methodology
- Intellectual Property Rights and Bioethics
- Domain-Specific Electives (AI in Agriculture, Bioinformatics in Precision Medicine, etc.)
- Foreign Language/Communication Skills

## Scope of Employment

Because the degree focuses mostly on research, students can find employment in the R&D sector. The multi-degree course provides the graduating student with a variety of work prospects with a competitive salary package, including but not limited to:

- Machine Learning Engineer (Genomics)
- AI Researcher in Drug Discovery
- Biomedical Data Scientist
- Bioinformatics Scientist
- AI Engineer in Medical Imaging
- Precision Medicine Specialist
- Biomedical Image Analyst
- Computational Biologist
- Genomics Data Analyst
- Computational Biologist
- Bio-IT Specialist
- Precision Medicine Analyst
- AI Specialist in Digital Health

## Placement Opportunity

AI and Bioinformatics is a high-demand, interdisciplinary field, offering placement opportunities across biotechnology, pharma, healthcare, IT, and research sectors. The prominent companies that have high demand for these skillsets include Novartis, AstraZeneca, Pfizer, Sanofi, Thermo Fisher Scientific, Illumina, Qiagen, GSK, IBM Watson Health, NVIDIA BioNeMo, Microsoft Genomics, Amazon AWS for genomics, etc.

Laboratory Facilities

State of art laboratory facilities available to conduct experimentals in

- Microbiology
- Biochemistry
- Immunology
- Synthesis and characterization of Biomaterials
- Molecular Biology
- Cell & Tissue Culture
- Genetic Engineering