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Indian Institute of Technology
Jodhpur, Rajasthan, India

*Continuing Education Program Office Indian Institute of Technology Jodhpur*

# IIT Jodhpur
## Certification Program
# Next Generation OMICS Technologies and Applications

**Apply Before July 25, 2024**

**6 Months Online**

**IIT Alumni Status**

*In collaboration with Industry Partners*

premas life sciences

OMICSLOGIC
Bioinformatics & Data Science Training

miBiome therapeutics

BIOINFOPLATFORM
TAUBER BIOINFORMATICS RESEARCH CENTER

# ABOUT THE PROGRAM

The IIT Jodhpur Online Certification Program on Next Generation Omics Technologies and Applications is a **comprehensive training program** that provides participants with the **introductory skills** and knowledge necessary to **design**, **execute**, and **analyze** multi-omics experiments.

The program is offered by **IIT Jodhpur, Premas Life Sciences & OmicLogic**, collaboratively and is designed to bridge the gap between the growing demand for skilled professionals in the field of NGS Omics technologies.

The program covers a wide range of topics, including **next-generation sequencing techniques**, **multi-omics technologies**, **computational methods**, and **statistical** approaches. Explore cutting-edge OMICS technologies, including the latest in **genomics, transcriptomics, proteomics, and metabolomics.** Understand the transformative power of **single-cell technology and structural genomics**, and how these advances are reshaping our understanding of cellular functions and interactions. Upon successful completion of the program, participants will be proficient in next-generation OMICS technologies, setting you up for further specialization and advanced studies in this field.

## WHO IS THE PROGRAM FOR ?

Working professionals from pharma, sports, nutrition, health, wellness and diagnostic industries; Researchers from Academia & Industry; Clinicians and service providers; PhD, BTech or Masters students in bioscience, bioengineering or related fields.

## ELIGIBILITY

The applicant must have a Bachelor's degree in Engineering or Science or Medicine (min. 4-year program) or a Master's degree in Bioengineering or Bioscience or in a related field.

A minimum of 60% marks in UG/PG or a minimum CGPA of 6.0 on a scale of 10 with corresponding proportional requirements when the scales are other than 10.

IIT Jodhpur may at its discretion conduct a written test and/or interview to select candidates for the program.

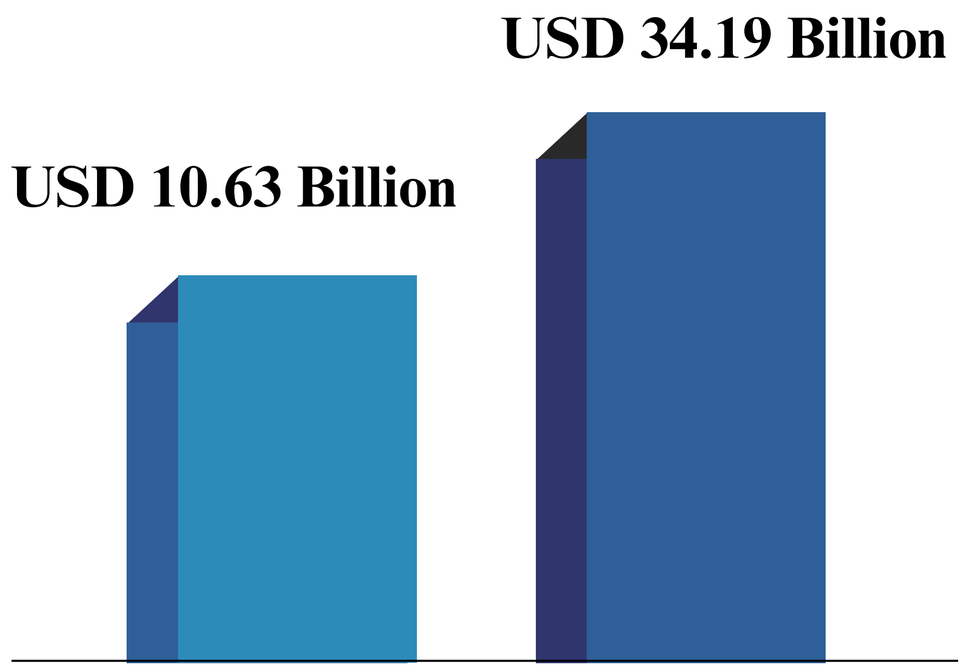
# WHY NGS OMICS TECHNOLOGIES ?

## GLOBAL NEXT GENERATION SEQUENCING MARKET

Next-Generation Sequencing (NGS) is revolutionizing healthcare, driving a projected 18.16% CAGR* from 2024 to 2030.

Its widespread adoption in clinical diagnostics and pivotal role in guiding personalized treatment decisions are propelling global market growth.

*Source: Research And Markets*

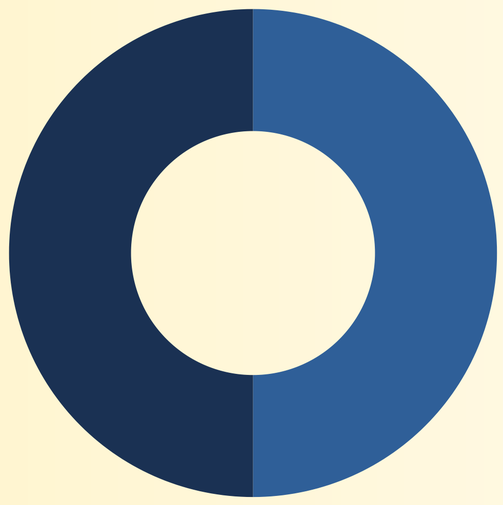



***Global Next Generation Sequencing Market is anticipated to experience a CAGR of 18.16% from 2024 to 2030.***

## PREVALENCE OF GLOBAL BIOINFORMATICS MARKET BY REGION & APPLICATION

**Regional Outlook**

- North America
- Europe
- Asia Pacific
- Latin America
- Middle East & Africa



**Application Outlook**

- Genomics
- Molecular Phylogenetics
- Metabolomics
- Proteomics
- Transcriptomics
- Other

*Source: Grand View Research*

**$ 34.19 Billion MV**

**Global Next Generation Sequencing MV- Market Value By 2030**

**18.16% Growth Rate***

**Expected Global Next Generation Sequencing Market Growth**

**CAGR - Compound annual growth rate*

# PROGRAM KEY FEATURES

**~200 hrs of real-time support** from **IIT Jodhpur faculty & industry experts** from leading sequencing & data science companies.

Bridge the gap between academic & industry by staying ahead with techniques for **sequencing & data analysis.**

Work with **open source scientific tools, softwares and powerful packages in R & Python to analyze omics data** for your projects.

Engage in an **interactive virtual classroom.** Access recorded lectures at your convenience for **flexible learning.**

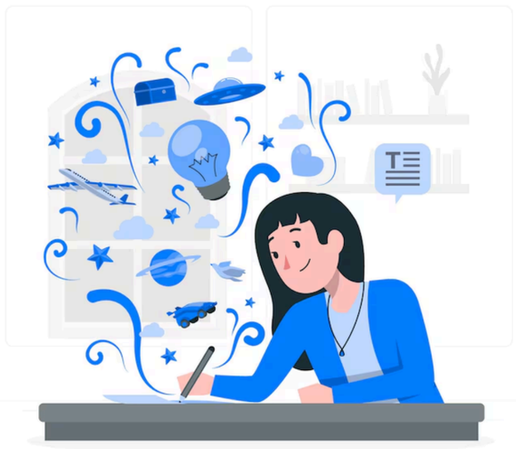
**Comprehensive online learning platform** comprising of 20+ courses & case studies on omics data analysis & research.

**Educational pipelines on bioinformatics cloud research infrastructure** for analyzing **different omics data types.**

Earn **13 credits** setting you up for further learning (**IIT Jodhpur Advanced Certification / PG Diploma Program.)**

Prestigious **certification upon completion** and join the **esteemed network of IIT alumni.**

# STUDENT JOURNEY



**Fill Out Registration Form**

**Submit Registration Fee**

**Submit Documents for Verifying Eligibility**

**Receive Offer Letter**

**Complete Program Fee Payment**

**Commencement of LIVE Classes**

**Option to Exit at Certification Program**

**Certification Program**

***Direct Entry at Advanced Certification Program**

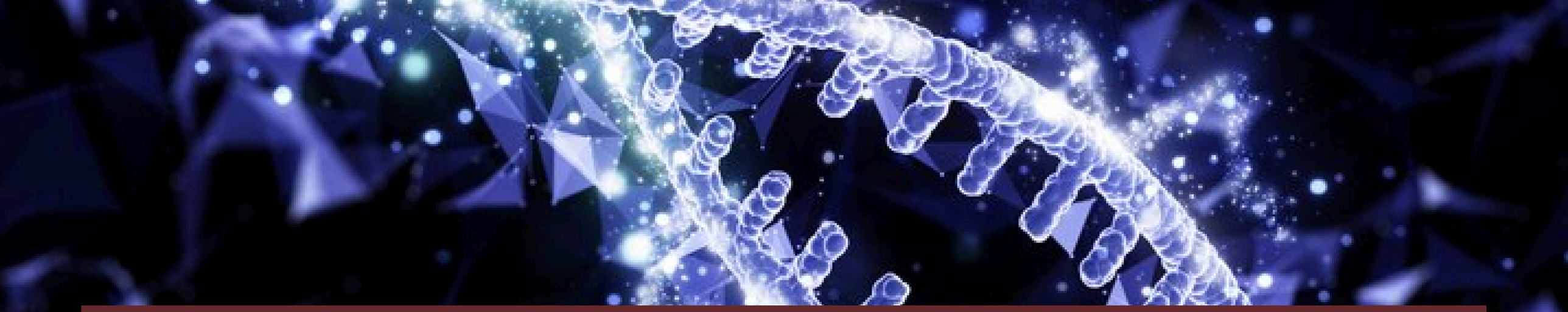
**Option to Exit at Advanced Certification Program**

**Advanced Certification Program**

**Become an IIT Jodhpur PG Diploma Graduate & Alumni**

**Placement Support and Opportunities**

**Postgraduate Diploma**



# PROGRAM DIRECTORS, ADVISORS, & MENTORS

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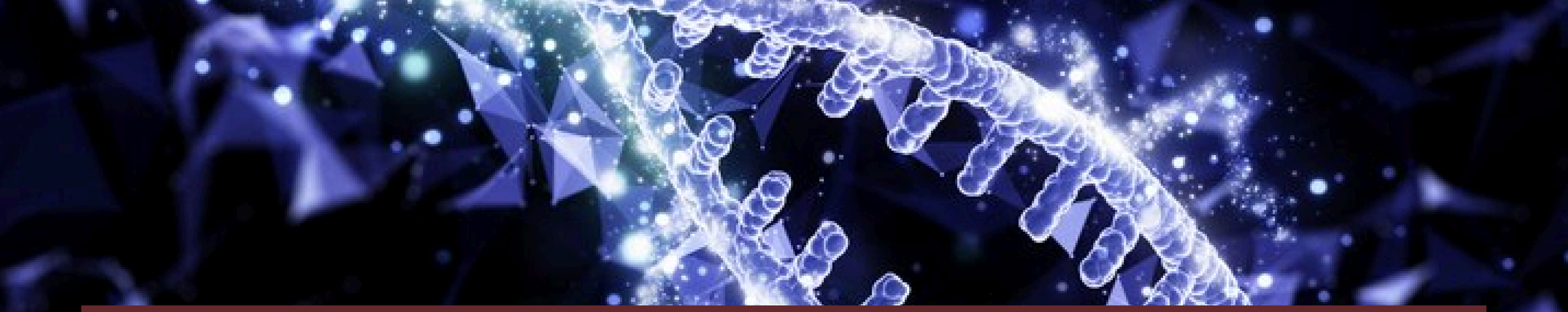

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**Dr. Rahul Ramekar**
NGS Training Specialist,
Premas LifeSciences,
New Delhi Area

**Sonalika Ray**
Research Scientist,
OmicsLogic India,
Chandigarh, Punjab

# PROGRAM CURRICULUM

## COMPULSORY MODULES

- Module 1: Design of OMICS Experiments
- Module 2: Next Generation OMICS Technologies
- Module 3: Basics of OMICS Data Analysis
- Module 4: OMICS Databases

## ELECTIVE MODULES

- Elective Module 1: Introduction to Non-Clinical NGS Applications and Genomics Analysis Tools
- Elective Module 2: Transcriptome Data Analysis

Click on the Course Booklet for complete list of topics

# EXPECTED LEARNING OUTCOMES

**Design OMICS experiments**, considering various study designs and data modeling techniques, to drive precision medicine advancements.

Design and implement **non-clinical NGS experiments** using various library preparation methods, data analysis tools, and best practices.

Effectively **utilize and manage various OMICS databases**, ensuring data quality, appropriate data submission and retrieval practices.

Apply OMICS technologies - **genomics, transcriptomics (bulk & single cell), and metagenomics**, to understand complex biological systems.

Perform **OMICS data analysis** and **integrate multi-omics datasets** using bioinformatics tools and techniques.

Acquire **foundational skills in R and Python coding** for data manipulation, visualization, & basic analysis required for omics data.

Utilize **machine learning algorithms** to identify patterns, classify data points, and make predictions within the context of omics research.

# 1. DESIGN OF OMICS EXPERIMENTS

**Learning Objective:**

Introduction of the principles and guidelines for design of experiments for multi-omics research studies



**Basic Design Principles:** steps in planning of an experiment, exploratory vs. hypothesis driven studies, deductive, inductive and abductive reasoning, biological and analytical variance, study design considerations for discovery and validation studies, data driven discovery with examples from different domains e.g. predictive, preventive, personalised and participatory (P4) and precision medicine, overview of molecular diagnostics and treatment development, design issues in omics experiments, randomization in omics experiments, multi-level replication in omics experiments, sample size and power determination, resource allocation, pooling biological samples

**Designs for Multi-Omics Experiments:** experiments with one factor and multiple levels, two sample experiments, completely randomized design (CRD), complete block design, randomized complete block design (RCBD), blocking scenarios in multi-omics experiments, incomplete block design, reference design, loop design, crossover designs, factorial designs with two treatment factors, unreplicated factorial designs, confounding and blocking in factorial designs, blocking in unreplicated design, 2-level fractional factorial designs

**Study Designs:** family-based designs, population-based designs, case-studies, descriptive studies, ecological studies, case-control design, case-only design, cross-sectional studies, cohort studies

**Multi-Omics Data Modelling:** types of variables, modelling process, model assumptions, simple linear regression, multiple linear regression, ANOVA, interpreting the coefficients, inferences about the population slope, examples from multi-omics studies

# 2. NEXT GENERATION OMICS TECHNOLOGIES

**Learning Objective:**

Introduction of various technologies and relevant instrumentation applicable in multi-omics research.



**Omics Approaches for Systems Biology:** Fundamentals of systems biology; Integrative omics approaches for systems biology, Model systems, Treatments, Measurements, case studies

**Technologies for Genomics & Transcriptomics:** Sanger vs Next Generation Sequencing Technologies; Introduction to microarrays; Microarray workflow; Limitations; Next-generation sequencing workflow - Preliminary sample quality control, Sample Preparation, Sequencing chemistries; Instrumentation; Multiplexing strategies; Strategies for aiding in analyses of data

**Technologies for Proteomics & Metabolomics:** Separation technologies for proteins - Gel based & gel independent; Instrumentation; Fundamentals of metabolomics - Quenching; Separation technologies - Basics of gas chromatography; Detection & identification of proteins & metabolites - Basics of Mass spectrometry

**Introduction to Single Cell Technology:** Overview; single cell isolation & sequencing and its applications, advances in and limitations of single-cell omics, use of single-cell omics in the study of cellular heterogeneity and cellular functions. Single cell technologies; single cell isolation technologies, Sample Preparation recommendation, Single Cell Gene Expression. Single Cell Immune Profiling,, Single Cell ATAC, Single Cell Multiome ATAC + Gene Expression. Introduction to Spatial technologies, fixed RNA profiling.

**Introduction to Structural Genomics:** Fundamentals- Structure of macromolecules, polypeptide conformation, secondary structures, folds, protein-protein interactions, structure modelling, Data resources- PDB, PISA, QSalignWeb, PPI databases (Biogrid, STRING), pfam.

# 3. BASICS OF OMICS DATA ANALYSIS

**Learning Objective:**

Introduction of omics data types which includes genomics, metagenomics, epigenomics, transcriptomics and single cell transcriptomics.



**Introduction to Genomic Data Analysis:** read quality assessment, raw and aligned genomics file formats, read alignment, genetic variants, variant calling for SNVs, CNVs, SVs, Functional Analysis of Variants, visualization genome browser tool, functional annotation of genetic variants, comparative genomics

**Introduction to Metagenomic Data Analysis:** data preprocessing and quality control, metagenomic data analysis workflow, taxonomic profiling and community composition analysis

**Introduction to Transcriptomic Data Analysis:** gene expression profiling, tools for preprocessing and quality control, assembly and annotation, differential gene expression analysis, pathway analysis, functional enrichment analysis

**Introduction to Proteomic and Metabolomic Data Analysis:** Analysis of Mass Spec data - peptide mass fingerprinting, NMR data analysis, differential proteomics/metabolomics, qualitative proteomics/metabolomics

**Introduction to OMICS Data Integration:** multi-omics data examples, challenges with high-throughput data, batch effect correction, normalization and transformation, horizontal integration schemes, meta-analysis methods, vertical integration schemes including parallel integration and hierarchical integration, example case-studies on multi-omics data integration

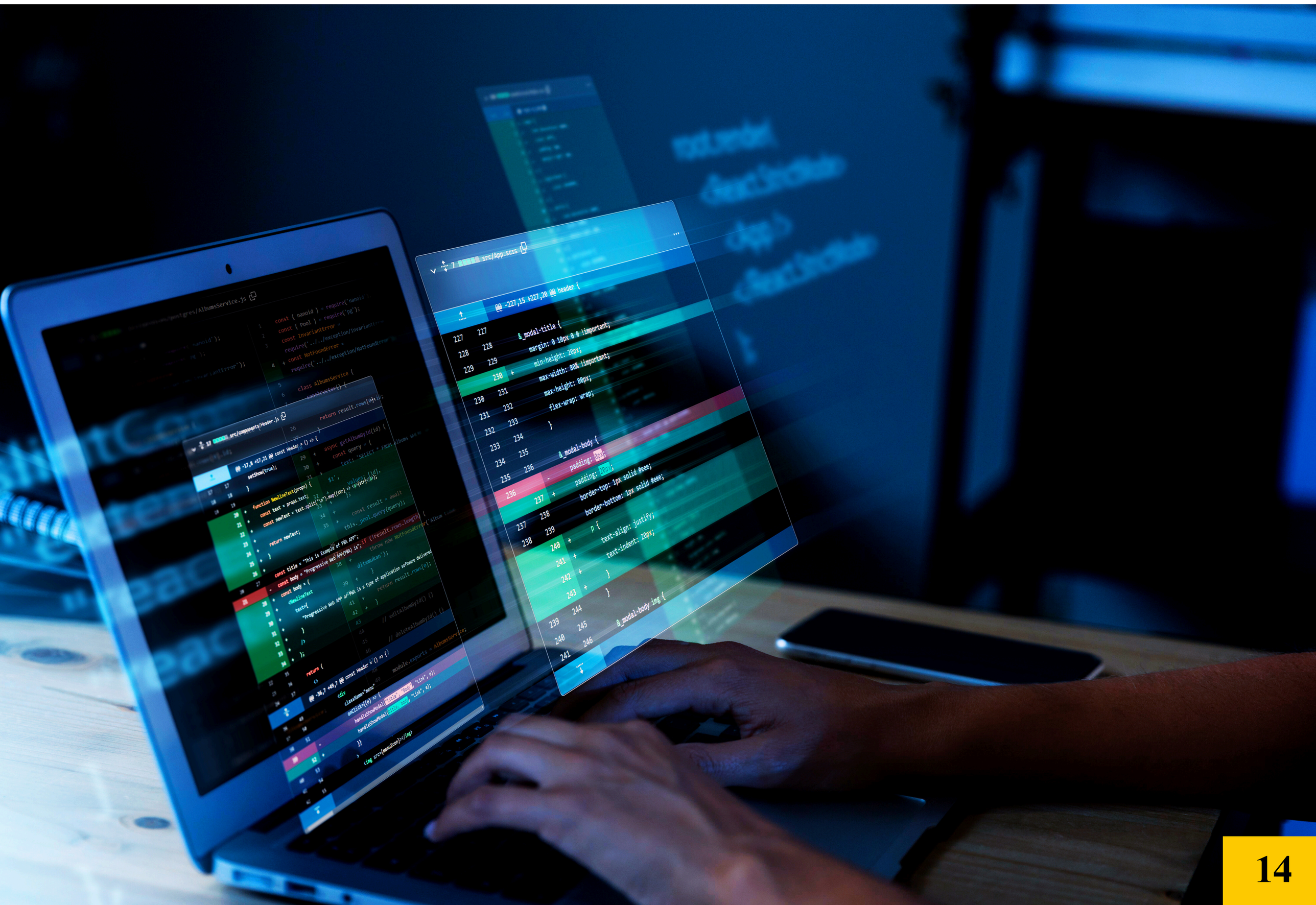
**Practical Hands-On:** Introduction to R Programming, genomic data analysis using R: variant calling, functional annotation, sequence alignment, phylogenetic analysis, visualization tools for the phylogenetic composition of microbial communities based on 16S rRNA, Transcriptomic Data Analysis: quantification of gene expression, generation and interpretation of multiQC report, differential gene expression analysis, pathway analysis

# 4. OMICS DATABASES

**Learning Objective:**

Introduction of biological databases commonly encountered in omics research and highlight how different data types are used across biology

**Biological Databases:** Sequence databases, gene expression databases, sequence read archives, peptide databases, metabolite libraries, Phenomic databases, data file formats, conversion between formats, considerations for data submission to databases, considerations for using data retrieved from databases, data quality control.





# 1. INTRODUCTION TO NON-CLINICAL NGS APPLICATIONS AND GENOMIC ANALYSIS TOOLS

**Learning Objective:**

Provide an in-depth foundation on the NGS library construction and introduce various NGS library solutions within the domains of research, agriculture, and microbiology portfolio.



**Fundamentals of NGS library construction:** Features of NGS libraries, Library preparation technologies, Indexing and multiplexing, Library validation, and quality control, Library normalization and pooling, Common challenges in library preparation, Best practices for library construction.

**Non-clinical library preparation methods:** Ligation-based workflow, Tagmentation based workflow, Target enrichment workflow, Whole genome sequencing for large and small genome, Whole Exome sequencing, Whole transcriptome sequencing, Small RNA sequencing, Gene expression profiling, RNA exome enrichment, Ribosome profiling, Protein-DNA interactions, Protein-Protein interaction, RNA-Protein interaction.

**NGS Experimental Design:**

- Case Study 1 - Metagenomics Experiment Design,
- Case Study 2 - Transcriptomics Experiment Design,
- Case Study 3 - Whole Genome Sequencing Experiment Design, Experimental Design Challenges, and Troubleshooting.

**Insights on onboard Instrument analysis solutions:** Benchtop sequencer local manager introduction, Analysis modules, Dashboard introduction, Result folder file structure, Analysis files details.

# 2. TRANSCRIPTOME DATA ANALYSIS

**Learning Objective:**

Illustrate the intricacies involved in choosing the right transcriptomic platform and highlight the key steps of data analysis



**Introduction to Microarray Data:** Gene expression biology, The technical foundations, Types of microarrays- two-channel cDNA arrays, single-channel Affymetrix genechips, microarray platforms, Designing a microarray experiment-The basic steps: Pre-processing steps: Importance of microarray data pre-processing, Background correction, Data normalization Analysis: Identification of differentially expressed genes, Classifying samples from two populations, grouping co-expressed genes

**Introduction to RNA Sequencing Data:** Sequencing chemistries, choosing the right method for an application, principal considerations while designing an RNA sequencing experiment; Quality Control: Sequence quality scores, pre-processing steps & considerations, FastQC, filtering & trimming of low-quality reads, detecting contaminants, removing adapters, red flags & troubleshooting, Reference mapping: Alignment tools, assessment of alignment statistics, manipulating alignments, visualizing alignments; De novo assembly: Transcriptome reconstruction & inherent complexities, pre-processing considerations for de novo assembly, de Bruijn graph, assembly tools, R & bioconductor for data analysis

**Gene expression analysis:** Annotation, counting reads per transcript (2 lectures), differential gene expression, importance of biological & technical replicates, graphical representation; Detecting Non-coding RNAs: Methods for detecting non-coding RNAs; Applications of RNA sequencing: Transcriptome response profiling, finding splice variants, detecting allele specific expression in disease

# POTENTIAL CAREER OPPORTUNITIES

## Pharmaceutical and Biotechnology Companies:

Sun Pharmaceutical Industries Ltd.
Dr. Reddy's Laboratories Ltd.
Serum Institute of India Pvt. Ltd.
Glenmark Pharmaceuticals Ltd.
Jubilant Life Sciences Ltd. Cipla Ltd.
Bharat Biotech International Ltd.
Biocon Ltd.
Piramal Enterprises Ltd.
Torrent Pharmaceuticals
Cadila Healthcare Ltd.
Cipla Ltd.
Lupin Limited

## Research Institutions and Laboratories:

Council of Scientific and Industrial Research Laboratories
Department of Biotechnology Laboratories
Indian Institutes of Technology
National Institutes of Technology
Indian Institutes of Science Education and Research

## Healthcare Organizations and Hospitals:

Apollo Hospitals
Max Healthcare
Narayana Health
AIIMS
PGIMER
Fortis Healthcare
Manipal Hospitals
Medanta - The Medicity
Tata Memorial Hospital
Rajiv Gandhi Cancer Institute

## Data Analytics and Bioinformatics Companies:

Illumina
Seven Bridges
TCS Bioinformatics Centre
BioAxis DNA Research Centre
Genotypic Technology
Thermo Fisher Scientific
Persistent Systems
Wipro Bioinformatics
Strand Life Sciences
Ocimum Biosolutions

## Genomic Diagnostic Laboratories:

MedGenome Labs
Mapmygenome
DNA Labs India
SciGenom Labs
Xcode Life Sciences
CORE Diagnostics
Positive Bioscience
Neuberg Diagnostics

# REGISTRATION PROCESS

### COMPLETE YOUR REGISTRATION

Fill out form to register: Click Here. Last date to apply is **July 25, 2024.**

### SCREENING PHASE

During this phase, applicants are required to submit a fee of Rs. 300/-, followed by which an eligibility form will be shared with you for uploading documents for verification.

### RECEIVE OFFER LETTER

Once reviewed and deemed eligible, you'll get an offer letter with program details such as start date, program schedule, and other instructions.

### COMPLETE FEE PAYMENT

Payment methods and deadlines will be provided to you. You can reach out to our team for recommendation for payment options.

### PROGRAM COMMENCEMENT

Following the orientation session to acquaint you with the program structure, faculty, and resources available, regular classes will commence from **August, 2024.**

# STUDENT FEEDBACK & HIGHLIGHTS

**4.4 / 5**

Overall coursework rating

**54.8%** Found coursework moderately difficult

**92.9%** Course recommendation

## Batch 2023 - 2024

**Mrinal Bamhotra**
**M.Sc Bioinformatics,**
**GGSD College, Chandigarh**

*"Professors demonstrated a keen interest in their subjects,* ***making lectures engaging.*** *Interaction was easy, as they readily answered questions. I gained the ability to* ***plan my own experiments*** *and* ***analyze biological data.*** *I'm eager to apply these skills in* ***experiment preparation and data analysis."***

**Manisha Mahapatra**
**M.S. Biotechnology,**
**Siksha 'O' Anusandhan, Bhubaneswar**

*"This program offers in-depth training in* ***genomics, metagenomics and transcriptomics techniques****, it blends theoretical knowledge with practical applications for comprehensive expertise. It is suitable for professionals seeking expertise in* ***cutting edge sequencing technologies.****"*

# PROGRAM FEES & DETAILS

**Program Duration**
= 6 Months

**No. of Credits**
= 13

**Program Mode**
LIVE, Online

**Hours of LIVE Sessions**
= ~200 Hours

**Program Fees**
= ₹1.2 Lakhs

**Certification**
= Yes

# ABOUT IIT JODHPUR

The **Indian Institute of Technology Jodhpur**, a technological Institute of National importance was founded in **2008.** Today, the Institute has undergone transformational changes since its humble origins.

The Institute has **over 240 Faculty Members** spread across various academic units including departments, centres, and schools with expertise in diverse thrust areas.

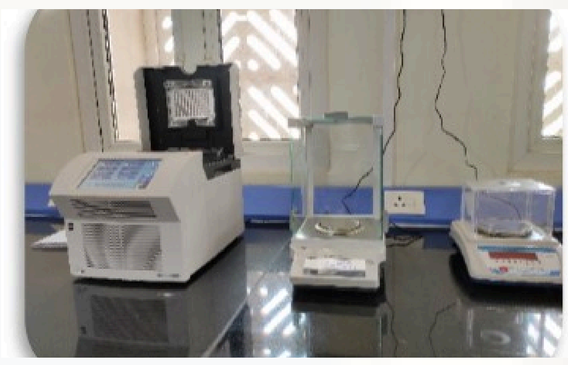
*At the Department of Biological sciences and Bioengineering (BSBE), IIT Jodhpur, we aspire to provide state-of-the-art domain knowledge and training to understand biological systems, provide innovative Bio-Tech solutions for applications in medical and environmental engineering domains that include biofuels, diagnostics, therapeutics, smart healthcare devices.*

***- Dr. Mitali Mukerji***

**Dr. Mitali Mukerji,**
**Head, Dept. of BSBE**
**IIT Jodhpur, Rajasthan**

Apart from imparting world-class education through its unique undergraduate and postgraduate programs, the Faculty Members are also pursuing cutting-edge research across disciplines.








***Fully Equipped Basic & Advanced Laboratory Facility for Advanced Level Certification / PG Diploma***

# ABOUT OMICSLOGIC

**OmicsLogic** (Formerly known as Pine Biotech) is a US-based company leading innovator in NGS bioinformatics, specializing in the training programs developed for analyzing high-throughput omics data.

Founded with the mission to make advanced computational biology methods accessible to researchers and students, OmicsLogic has developed a range of solutions that simplify complex data analysis tasks and get everyone started, especially those who have no background and exposure to modern biology.

Expertise spans multiple bioinformatics domains including all **NGS Genomics, Bulk & Single Cell Transcriptomics, Metagenomics, and other Omics analysis** expertise in biological research utilizing data-driven technologies **(Statistics, Machine learning, Generative AI, Cheminformatics & structural Biology)** to address scientific questions.

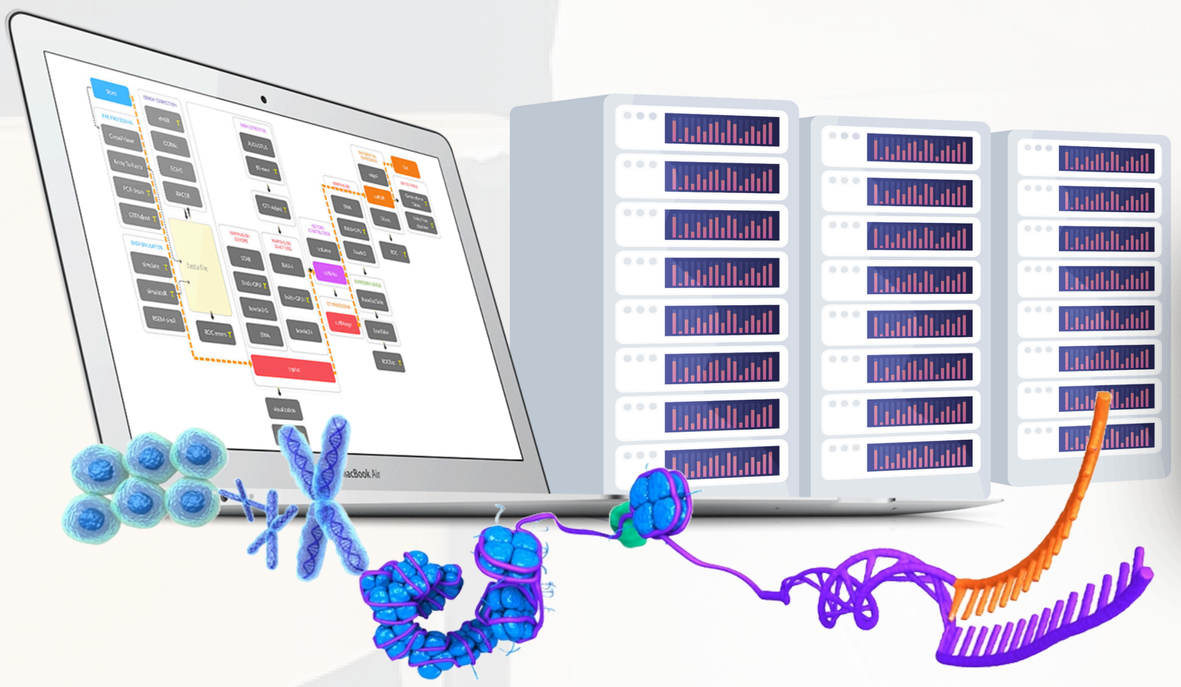
*We have developed a range of solutions that simplify complex data analysis tasks and get everyone started, especially those who have no background and exposure to modern biology.*

*With a focus on educational initiatives, we aim to equip the next generation of students and scientists with the skills they need to excel in the rapidly evolving landscape of big data bioinformatics.*

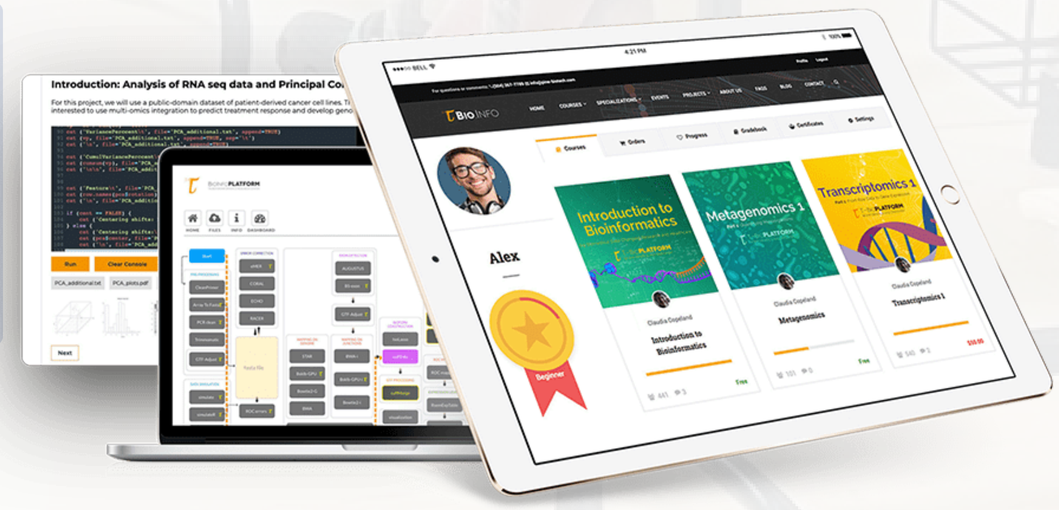
***- Dr. Mohit Mazumder***

**Dr. Mohit Mazumder**
**CEO & Co-founder**
**OmicsLogic India & US**

***NGS Multi-Omics & Biomedical Data Science***



**Bioinformatics Cloud Infrastructure**



**Industry Relevant Training Curriculum**

# ABOUT PREMAS

We are
Great Place To Work® Certified™
Recognized by Great Place To Work® India

**Premas Life Sciences (PLS)** is a young, dynamic, and focused organization introducing game-changing niche technologies in Genomics, Cell Biology, and Biopharma to boost innovative research and diagnostics in India. We are also the knowledge partners to several reputed research institutes and hospitals, enabling them to set up core genomics facilities with complete support at all fronts.

The biggest motivation behind the inception of PLS was to set up an organization that could contribute significantly to the life science research landscape in India and has the convergence of a committed and highly skilled workforce to catalyze this process.

*We are really hoping to create a space where technology can be used to answer important problems in science and how it influences people's lives. We believe in fostering the spirit of science among students and young adults through our scientific outreaches and we would definitely like PLS, in its own unique capacity, to contribute to the India story.*

***- Praveen Gupta***

**Praveen Gupta,**
**Managing Director,**
**Premas Life Sciences**

## *Genomics & Cell Biology*

# IIT Jodhpur
## Certification Program

## Next Generation Omics Technologies and Applications

## Enquire Now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**Apply Now**

*Reach out to us for any query related to the program and registrations.*