



BITS Pilani

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**WORK INTEGRATED
LEARNING PROGRAMMES**

M.Tech. Computing Systems & Infrastructure for Working Professionals



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Program Introduction

Cloud computing adoption is poised to be a major driver of the Indian economy by 2026, with projections of a \$380 billion GDP boost and the creation of 14 million jobs within the next 5 years, fueled by a growing digital population and increased digitization.

To seize these opportunities, consider M.Tech. Cloud Computing, a four-semester programme for working professionals, offering comprehensive expertise in Big Data, Distributed Computing, Cloud Network and Security, Cloud-native application development, Cloud Economics, and more.



Who Should Apply?



Driven engineers and managers in Infrastructure, Data Centers, Cloud Deployment, Application Development, and Solution Architecture.



IT professionals in technical roles such as Developer, Solution Architect, Cloud Solutioning Team Manager, DevOps Engineer, Systems Engineer, Network Administrator, Cloud Services Engineer, Infrastructure Lead / Infrastructure Manager.

Programme Highlights



M.Tech. Cloud Computing is a BITS Pilani Work Integrated Learning Programme (WILP). BITS Pilani Work Integrated Learning Programmes are UGC approved



Gain expertise in Cloud-native app design, APIs, and Cloud platform architecture



This programme is of 4 semesters and can be pursued only by working professionals. You can pursue the programme without any career break



Blend of classroom and experiential learning



The programme will also enable working professionals to attend contact classes from anywhere over a technology-enabled platform. The contact classes will be conducted mostly on weekends or after business hours



Become a part of elite and global BITS Pilani Alumni community



Employs Continuous Evaluation to provide ongoing feedback and support



Fee submission option using easy - EMI with 0% interest and 0 down payment

Programme Objectives



Grasp Cloud platform design choices from a provider viewpoint



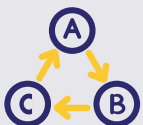
Learn Cloud-native app design and APIs with practical experience



Analyze, apply best practices for Cloud app deployment, management, and operations



Interpret pricing, evaluate cost optimization, and design technical solutions



Address security issues and apply best practices for Cloud apps and data

WILP Presence and Impact



45+

Years of
Educating Working
Professionals



1,20,000+

Working
Professionals
Graduated



46,000+

Working Professionals
Currently Enrolled



1100+

Faculty Members



46+

Programmes

Student

Learning Outcomes

Upon programme completion, learners will be able to:



Design and configure
Cloud infrastructure
and platform services



Create Cloud-native
app prototypes or
migrate existing
solutions



Manage the entire app
lifecycle from
development to
operations



Offer security
recommendations for
use cases



Assess Cloud service
fitment and utilize
API-enabled services



Design cost-optimized
solutions based on use
cases and billing plans

Mode of Learning

The Mode of Learning used in this programme is called - Work Integrated Learning. Internationally, Work Integrated Learning (WIL) is defined as "An educational approach involving three parties - the student, educational institution, and employer organization(s) - consisting of authentic work-focused experiences as an intentional component of the curriculum. Students learn through active engagement in purposeful work tasks, which enable the integration of theory with meaningful practice that is relevant to the students' discipline of study and/or professional development*.

An education model can be considered as WIL if and only if:

1. The programs are designed and developed by the institute in collaboration with industry.
2. Work-focused experiences form an active part of the curriculum.
3. The program structure, pedagogy and assessment enable integration of theory-with relevant practice.

The innovative **Work Integrated Learning Programs (WILP)** of BITS Pilani are quite aligned with the above definition and requirements. The programs are designed in collaboration with its industry partners, subject matter experts from industry and academia that enable the students to remain relevant in their chosen profession, grow in their career and retain the habit of lifelong learning. The continued availability of workplace related experiences along with the weekly instruction sessions promote integration of theory with practice. An active participation of the organization mentor in the learning process of the student plays a key role. Case studies, simulation exercises, labs and projects further strengthen this integration.

The **WILP** of BITS Pilani is comparable to its campus-based programs in terms of structure, rigor, instruction, labs, assessment, faculty profile and learning support. The pervasive adoption of technology in all its academic processes makes the same high-quality education of BITS Pilani available to the aspirants at scale with the required flexibility.



Key Benefits of BITS Pilani WILP

- Can pursue the programme without any career break and along with the job.
- The programme curriculum is highly relevant to sectors, industries and organisations they work for.
- In addition to the institute, the learning experience of working professionals in the programme is also supported by the employer organisation and Industry Mentors.
- Effective use of technology to deliver a range of learning interventions at the location of the working professional such as faculty contact sessions, asynchronous learning materials, remote, virtual and cloud labs, Learner support, peer to peer collaboration etc.
- Contact sessions with faculty take place mostly over weekends or after business hours and are conducted over a technology platform that can be accessed from anywhere.
- Mid semester and End semester examinations for every semester are conducted mostly at designated examination centres distributed across the country (for details refer to link mode of examinations).
- Learners can access engaging learning material which includes recorded lectures from BITS Pilani faculty members, course handouts and recorded lab content where applicable.

Experiential Learning



The program prioritizes experiential learning, enabling learners to apply classroom concepts in simulated and real work scenarios through remote and virtual lab exercises



Simulation Tools, Platforms & Environments: The programme makes use of simulation software, open source tools/frameworks and Public Cloud based deployment environments for hands-on labs and assignments



Continuous Assessment

The assessment includes graded assignments/quizzes, mid-semester and comprehensive exam

Case studies & Assignments

Carefully chosen real-world cases & assignments are both discussed and used as problem-solving exercises during the programme



Dissertation/ Project Work

The fourth semester offers an opportunity for learners to apply their knowledge gained during the programme to a real-world like complex project. The learner is expected to demonstrate understanding of vital principles learnt across semesters and their ability to successfully apply these concepts

Programme Curriculum

First Semester

- Introduction to Parallel and Distributed Programming
- Network Fundamentals for Cloud
- Big Data Systems
- Cloud Computing

Second Semester

- Cloud Infrastructure and Systems Software
- Distributed Computing
- Elective 1
- Elective 2

Third Semester

- Elective 3
- Elective 4
- Elective 5
- Elective 6

Fourth Semester

- Dissertation

Pool of Electives

- Data Storage Technology and Networks
- Security Fundamentals for Cloud
- Cloud Economics
- API-driven Cloud Native Solutions
- DevOps for Cloud
- Design and Operation of Data Centers
- Data Warehousing
- Introduction to Data Science
- Infrastructure Management
- Stream Processing and Analytics
- Secure Software Engineering
- Scalable Services
- Edge Computing

Choice of Electives is made available to enrolled students at the beginning of each semester. A limited selection of Electives will be offered at the discretion of the Institute.

Eligibility Criteria

Employed professionals holding an Integrated First Degree of BITS or its equivalent such as B.E./M.Sc. and relevant exposure to systems disciplines, with at least 60% aggregate marks and minimum one year work experience after the completion of the degree in IT services and products industry, are eligible to apply.

Minimum one year programming experience in C, Java or an equivalent language in backend systems OR a degree level course in a C/Java Programming Experience in Relational Database Management Systems with understanding of data schema, SQL queries and writing programs that access databases.

It is strongly preferred that professionals have taken the following basic courses: Computer Organisation and Operating Systems, Computer Networks, Data Structures and Algorithms.



Fee Structure

The following fees schedule is applicable for candidates seeking new admission during the academic year 2024-25.



Easy Monthly Payment Option with 0% Interest and 0 Down Payment

Instant EMI option with 0% interest and 0 Down Payment is now available that allows you to pay programme fee in an easy and convenient way.

- Instant online approval in seconds
- No Credit Cards/ CIBIL score required
- Easy & Secure online process using Aadhaar and PAN number
- Anyone with a Salary Account with Netbanking can apply Option to submit fee using easy- EMI with 0% interest and 0 down payment

Admissions will begin in November 2024.

[Click here](#)

to learn more



All the above fees are non-refundable.

Important: For every course in the programme, institute will recommend textbooks, students would need to procure these textbooks on their own.

Courses Description

Data Storage Technology and Network

Storage Media and Technologies – Magnetic, Optical and Semiconductor media, techniques for read/write operations, issues and limitations. Usage and Access – Positioning in the memory hierarchy, Hardware and Software Design for access, Performance issues. Large Storages – Hard Disks, Storage arrays, Networked Attached Storage, Scalability issues, Networking issues. Storage Architecture. - Storage Partitioning, Storage System Design, Caching, Legacy Systems. Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids, Storage QoS – Performance, Reliability, and Security issues, Object storage, Storage as a Service, Software defined storage.

Security Fundamentals for Cloud

Cloud security foundations; shared security model; identity, entitlement and access management - authentication techniques, access control methods, entitlement management, federated identities, IAM protocols; cloud infrastructure security; cloud network security - firewalls, IPS, segmentation; cloud storage security; securing hybrid cloud deployments; microservices and container security; secure serverless architectures; cloud data security; security verification - vulnerability assessment and penetration testing; cloud security posture management - threat modeling, risk visualization and assessment, vulnerability management, cloud instrumentation; cloud defense and recovery techniques - security information and event management (SIEM), security orchestration and automated response (SOAR), intrusion detection, incident response, cloud forensics, business continuity planning and disaster recovery techniques; cloud governance, risk and compliance.

Cloud Economics

Cost drivers and unit economics in a Cloud solution, key terminologies for Cloud expenses, understanding of billing plans and pricing options, cost allocation in an organization, optimization in terms of paying less vs using less, case studies on cost optimization options, impact of containerization in cost allocation, cost conscious solution architecture using case studies, migration decisions, SLA/SLO articulation, Cloud provider strategies for resource allocation.

API-driven Cloud Native Solutions

Analyze, Design, Develop and Deploy cloud native applications in innovative areas such as Artificial Intelligence/Machine Learning (AI/ML), IoT, Data Analytics etc.; Build an end to end complex application; Extensive usage of well-known PaaS/APIs; Demonstration of compliance with relevant, industry adapted best practices; Deployment using modern strategies; Presentation of the milestones and outcomes in appropriate forms; Periodic review of progress of the project by faculty.

DevOps for Cloud

Introduction to DevOps; need and evolution; culture - process, people and technology; agile methodology for DevOps; containerization with Docker, container orchestration with kubernetes; continual service - continuous integration and continuous delivery / deployment; version control, configuration management; DevOps and Cloud - use of virtual machines and containers for multi-cloud deployment, automated cloud migration in DevOps, stack management - life cycle of stack and events, resource and event monitoring, auto healing; cloud DevSecOps in practice; Infrastructure automation with GitOps - infrastructure-as-code (IaC) and building CI/CD pipelines; DataOps - pipeline environment, orchestration and continuous integration; MLOps - pipelines, strategies, challenges and containerization.

Design and Operation of Data Centers

Data Center Design: Principles (Scalability, Reliability, and Elasticity), Components - Computing Infrastructure (Processing, Storage, and Networking) and Physical Infrastructure (Power, Cooling, and Physical Security); Servers – Server Hardening, Server Optimization, Server Deployment and Consolidation, Converged and Hyper-Converged Infrastructure. Application monitoring and maintenance. Networking for data centers – device hardening, bandwidth aggregation, traffic management, redundancy, network isolation, deployment of internal security and peripheral security; Contingency Planning & Disaster Recovery: Backup, recovery, and redundancy /replication technologies and approaches. Data Center Architecture: Private, Public, and Hybrid models; Distributed Data Centers; Introduction to Software Defined Data Centers. Costing and Pricing– Costing and Cost Optimization, Pricing and Economics of Data Center Operation.

Data Warehousing

Need and evolution of data warehousing; Goals, benefit, and challenges of data warehousing; Architecture; Approaches- Data Marts/ODS/DataLakes/DataLakeHouse; Data warehouse design; ETL, ELT, EtLT and Data Quality; OLAP & Multidimensional Analysis, Business Intelligence; Query performance enhancement techniques; Metadata management; Infrastructure and Physical design process; Data lake design: ingestion, storage (conventional / multi-modal / data-dumps), processing (batch / incremental / streaming, in-memory); Deployment: on-premise, cloud, hybrid; Cloud Data Warehousing: Topologies, Provider Selection, Configuration, Management; Migration from on-prem to cloud DW; Real Time data warehousing

Big Data Systems

What is big data - are existing systems sufficient?; Data Warehouse v/s Data Lakes; Hadoop – Components; Storage - Relational DBs/ NoSQL dbs / HDFS / HBase / Object Data stores - S3; Serialization; Interfaces - Hive/ Pig; Stream Processing; Spark; Mahout.

Distributed Computing

The course focuses on the fundamental principles and models underlying all aspects of distributed computing. It addresses the principles underlying the theory, algorithms and system aspects of distributed computing. The course covers topics such as Logical and Vector clocks, Global state and Snapshot recording algorithms, Basic distributed algorithms, Message Ordering and termination detection, Distributed Mutual Exclusion & Deadlock detection, Consensus and Agreement Algorithms, Peer-to-Peer computing and Overlay graphs, Cluster Computing, consistency models, Paxos algorithm, example distributed databases.

Cloud Computing

Introduction to Cloud Computing, Virtualization Techniques and Types, Infrastructure as a Service, Container Technology, PaaS and SaaS, Capacity management and Scheduling in cloud computing, Issues and Challenges: Availability, Multi-Tenancy, Security and SLA, Overview of Cloud data storage, Programming models / architectural styles, Deployment and operations.

Introduction to Data Science

Data Analytics, Data and Data Models, Data wrangling, Feature Engineering, Classification and Prediction, Association Analysis, Clustering, Anomaly Detection, exploratory / explanatory data analysis with visual storytelling, Ethics for Data Science..

Infrastructure Management

Introduction to Systems Management of IT Infrastructure and ITSM; Introduction to Site Reliability Engineering (SRE): basic concepts and applicability, relation to traditional ITSM and DevOps, SRE view of a production Cloud environment; Core principles of SRE: using error budgets, risk assessment, identifying SLO metrics to manage application SLAs, monitoring distributed systems, approaches to automation, release engineering and change management, simplicity as the means to reliability; Techniques to make a service reliable: observability, alerting on time series data, incident response and management, root cause analysis, testing for reliability, capacity planning, load balancing at various levels and handling overloads or cascading failures; Special considerations for managing large scale systems: distributed consensus for reliability, distributed scheduling of periodic compute jobs, managing data processing pipelines, management of Virtual Resources, automated resource management - Infrastructure as Code.

Stream Processing and Analytics

Real Time , Streaming Data & Sources, Real time streaming system architecture , Characteristics of a Real Time Architecture and Processing ; Configuration and Coordination Systems: Distributed State and Issues, Coordination and Configuration using Apache Zoo Keeper; Data Flow Management : Distributed Data Flows , Various Data Delivery and Processing Requirements, N+1 Problem, Apache Kafka (High-Throughput Distributed Messaging); Processing Stream Data with Storm; Overview of Data Storage – Requirements: Need for long-term storage for a real time processing framework, In-memory Storage, No-Sql Storage Systems, Choosing a right storage solution; Visualizing Data :Requirements, Principles and tools; Bounds of Random variables, Poisson Processors, Maintaining Simple Statistics from Data Streams, Sliding Windows and computing statistics over sliding windows, Data Synopsis (Sampling, Histograms, Wavelets, DFT), Exact Aggregation, Timed Counting and Summation, Multi Resolution Time Series Aggregation, Stochastic Optimization; Statistical Approximation to Streaming Data: Probabilities and Distributions, Sampling Procedures for Streaming Data, Approximating Streaming Data with Sketching, Registers and Hash Functions, Working with Sets, The Bloom Filter, Distinct Value Sketches, The Count-Min Sketch; Clustering techniques for Streaming Data; Classification methods : Decision Tree (VFDT); Evaluating stream processing algorithms; Case Studies in Designing solutions to streaming data.

Secure Software Engineering

Best practices for designing secure systems, software engineering principles for designing secure systems, criteria for designing secure systems; analysis of system properties and verification of program correctness; use of formal methods and verification for security; tools for verification of security properties; techniques for software protection (such as code obfuscation, tamper-proofing and watermarking) and their limitations; analysis of software based attacks (and defenses), timing attacks and leakage of information, and type safety.

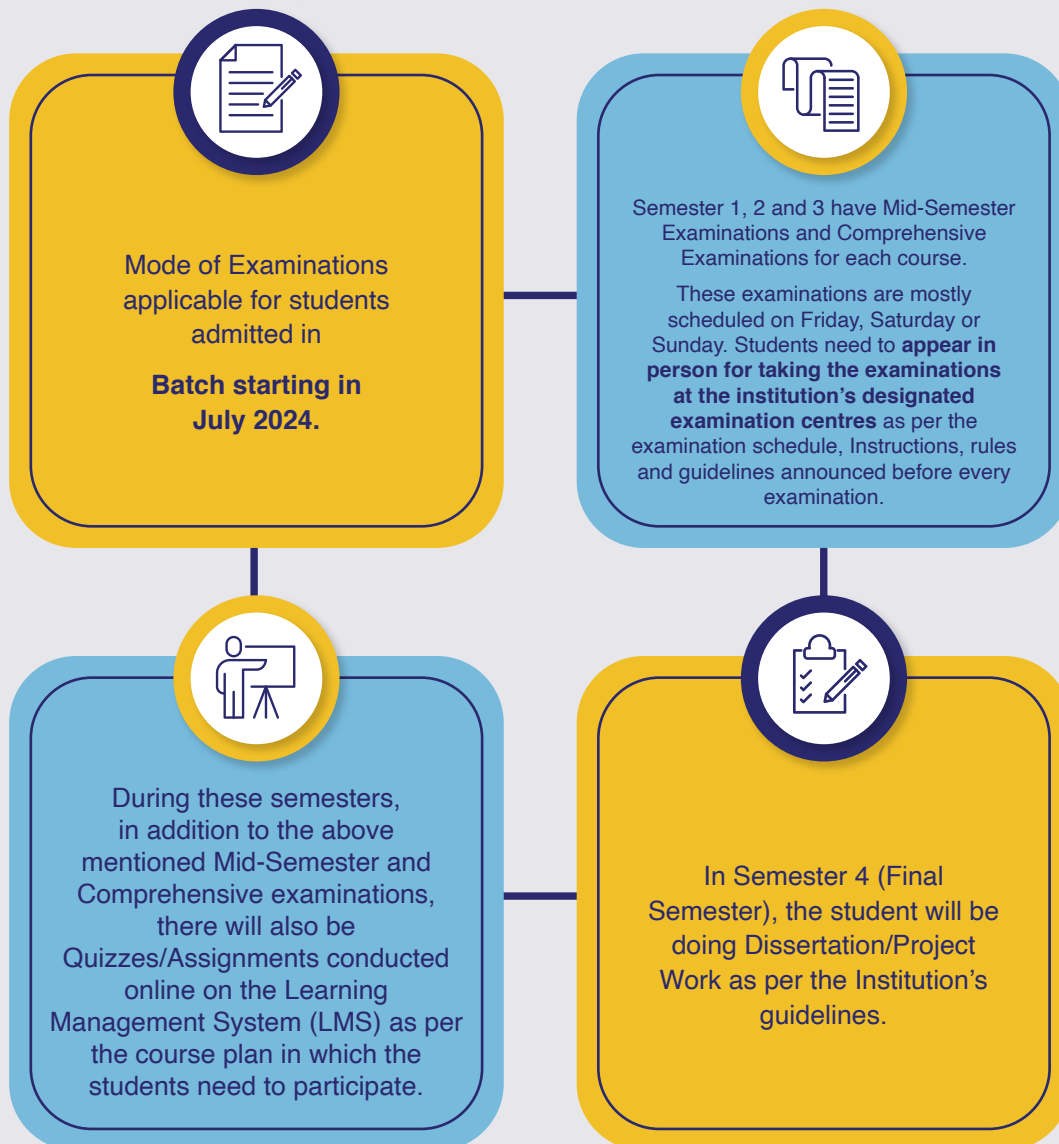
Scalable Services

Software principles related to scalability. Architectures for Scaling. Microservices - design, service discovery, load balancing, API management. Deployment - container configurations and orchestrations, automated deployments of microservices, integration with CI/CD pipelines. Performance: Scaling and load balancing with containers and microservices, Ensuring QoS and SLAs.

Edge Computing

Introduction, What Is Edge Computing, Edge, Fog and Cloud, edge to edge and edge to cloud communication, Sensor networks and related protocols, Key Techniques that Enable Edge Computing, Definition, Benefits, Edge Computing Systems, Multi Access Edge Computing, To Edge or Not to Edge, The Cloud Part of MEC, The Edge Part of MEC, The Access Part of MEC, Challenges and Opportunities in Edge Computing, Service Management, Privacy and Security, Application Distribution, Edge Computing Tools, Virtualization, Resource Management, Edge Analytics, Conceptual Framework for Security and Privacy in Edge Computing, Overview of Security, Privacy, and Threats in Edge Computing, Framework for Security and Privacy in Edge Computing, case study and use cases, Edge computing and the Hybrid and Distributed Cloud.

Mode of Examination



Students can take their examination at any of our **33 designated** examination centres in India at the following locations:

- **South Zone:** Bangalore - North, Bangalore - Central, Bangalore - South, Bangalore - East, Chennai - North, Chennai - Central, Chennai - South, Hyderabad, Secunderabad, Vijayawada, Visakhapatnam, Kochi, Thiruvananthapuram and Coimbatore.
 - **North Zone:** Delhi, Gurugram, Noida, Jaipur, Chandigarh, Lucknow and Pilani.
 - **West Zone:** Mumbai, Navi-Mumbai, Pune, Pune - Pimpri Chinchwad, Goa, Ahmedabad, Indore and Nagpur.
 - **East Zone:** Kolkata, Bhubaneswar, Guwahati and Jamshedpur.
- In addition to these locations, the Institution also has a designated examination centre in **Dubai**.

How to Apply



[Click here to Apply now](#)



Create your login at the Application Center by entering your unique Email id and create a password of your choice.



Once logged in, follow four essential steps:

- Step 1**
Fill and submit your application form for your chosen program.
- Step 2**
Download a PDF copy of the application form.
- Step 3**
Pay the application fee of INR 1,500 using Net banking/Debit Card/Credit Card.
- Step 4**
Print the downloaded Application Form and note your Application Form Number.

In the printout of the downloaded Application Form, you will notice on page no. 3 a section called the Employer Consent Form. Complete the Employer Consent Form. This form needs to be signed and stamped by your organisation's HR or any other authorised signatory of the company.

Important: In view of work-from-home policies mandated by many organisations, a few candidates may not be able to get the physical forms signed by their HR/other authorised organisational representative. Such candidates may instead request an email approval to be sent to their official email ID by the HR using the format available [through this link](#).

On page 4, complete the Mentor Consent Form, which needs to be signed by your Mentor.

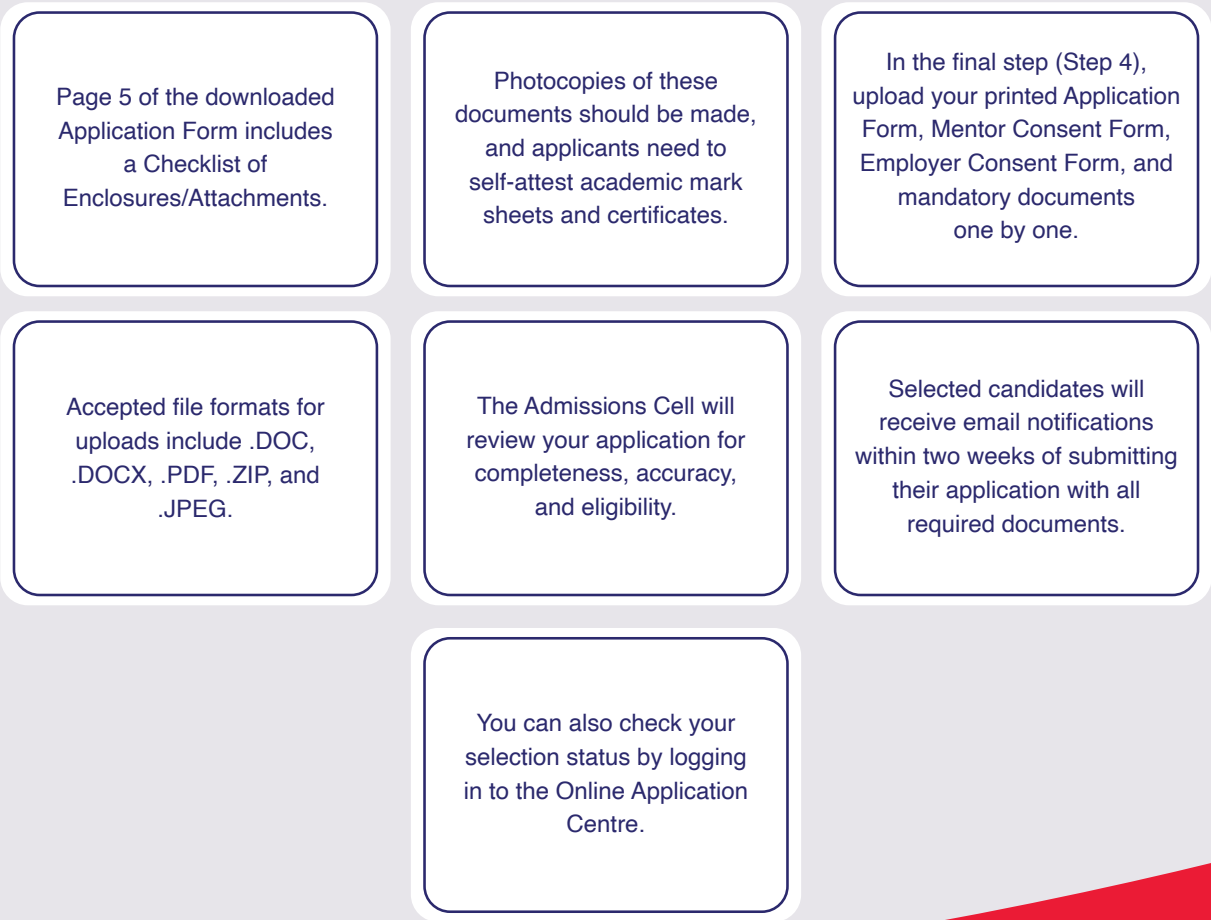
Due to remote work policies, some candidates may struggle to get physical mentor signatures. They can request email approval using a [provided format](#).

Who is a mentor:

- Candidates applying to Work Integrated Learning Programmes must choose a Mentor, who will monitor the academic progress of the candidate, and act as an advisor & coach for successful completion of the programme.
- Candidates should ideally choose the immediate supervisor or another senior person from the same organisation. In case a suitable mentor is not available in the same organisation, a candidate could approach a senior person in another organisation who has the required qualifications. Wherever the proposed Mentor is not from the same employing organization as that of the candidate, a supporting document giving justification for the same should be provided by the candidate’s employer.
- Candidates applying to B.Tech. programmes should choose a Mentor who is an employed professional with B.E./ B.S./ B.Tech./ M.Sc./ A.M.I.E./ Integrated First Degree of BITS or equivalent. Candidates applying to M.Tech., M.Sc., MBA, M.Phil programme should choose a Mentor who is an employed professional with:
- B.E./ M.Sc./ M.B.A./ M.C.A./ M.B.B.S. etc. and with a minimum of five years of relevant work experience.

OR

- M.E./ M.S./ M.Tech./ M.Phil./ M.D./ Higher Degree of BITS or equivalent.



Students **Speak**



My journey at BITS Pilani WILP has been nothing short of transformational. The programme's rigorous curriculum, outstanding faculty, and exposure to real-world financial scenarios have honed my financial acumen and analytical skills.

Chandra Kishor
Technical Expert



The BITS WILP courses are incredibly valuable for working professionals like me. I recommend these programs to both my colleagues and subordinates who seek higher education without career breaks. It offers experiential learning with quizzes, assignments, remote labs, group studies, and more, providing a rich interactive learning experience.

Satyavathi Divadari
Cybersecurity Architect and Cloud CTO



This program is unique—it's weekend-based and convenient, mirroring the campus experience. You learn from top-notch professors and a diverse peer group from various organizations, roles, and backgrounds, all serious about their studies. It's like going back to the classroom on your own schedule.

Pooja Agrawalla
Identity & Access Management Head



UGC Approval

BITS Pilani is an Institution of Eminence under UGC (Institution of Eminence Deemed to be Universities) Regulations, 2017. The Work Integrated Learning Programmes (WILP) of BITS Pilani constitutes a unique set of educational offerings for working professionals. WILP are an extension of programmes offered at the BITS Pilani Campuses and are comparable to our regular programmes both in terms of unit/credit requirements as well as academic rigour. In addition, it capitalises and further builds on practical experience of students through high degree of integration, which results not only in upgradation of knowledge, but also in up skilling, and productivity increase. The programme may lead to award of degree, diploma, and certificate in science, technology/engineering, management, and humanities and social sciences.

On the recommendation of the Empowered Expert Committee, UGC in its 548th Meeting held on 09.09.20 has approved the continued offering of BITS Pilani's Work Integrated Learning programmes.

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**WORK INTEGRATED
LEARNING PROGRAMMES**

**Let's start a conversation
to ignite the change you desire**



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