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Mandatory Course Topic: Industrial Metaverse
Type: Hybrid Course

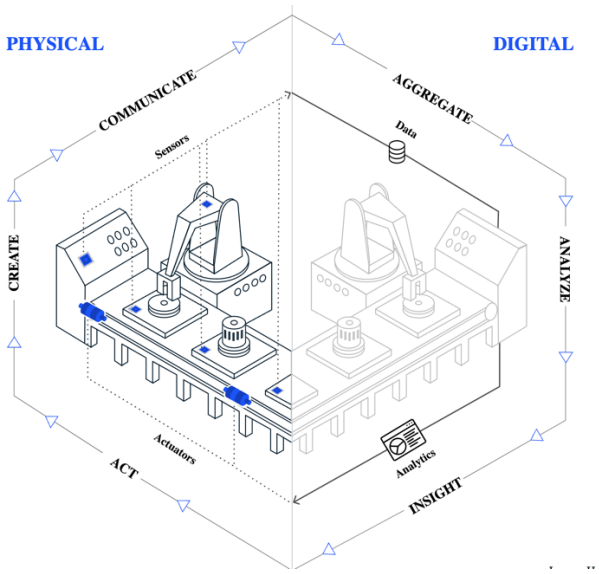
Target Group	**Engineering students –6th Semester (CSC, EEE, ECE & Mech)**

Subject	Industrial Metaverse for CS, EEE, ECE & Mech	**Total duration of the training in Hours**	45 hours (2 credits)
Theory Class Training in Hrs	15 hours (1 credit)	**Practical class Training in Hrs**	30 hours (1 credit)
Theory class focus area	Basic introduction, 3d models, AR VR, Industrial IoT platforms, AI/ML, data modeling, digital twins, simulation, business cases, use models	**Practical class focus area**	IoT integration to data modeling & simulating 3d (digital twin) equipments in metaverse
Total credits	2 credits	**Type of training**	**Hybrid**

Introduction to Industrial metaverse :

What is Digital Twin?

A digital twin is a virtual representation of an object or system in the digital world of the Metaverse. It is updated from real-time data and uses simulation, machine learning and reasoning to help decision making. In simple words, creating a complex virtual model is the counterpart or twin of the physical object in the real world. With sensors that relay information and two-way internet of things (IoT) object connections, this technology can synchronize the digital environment with the physical world and vice versa. Any changes or movement in the material world is reflected in the digital representation of the twin.

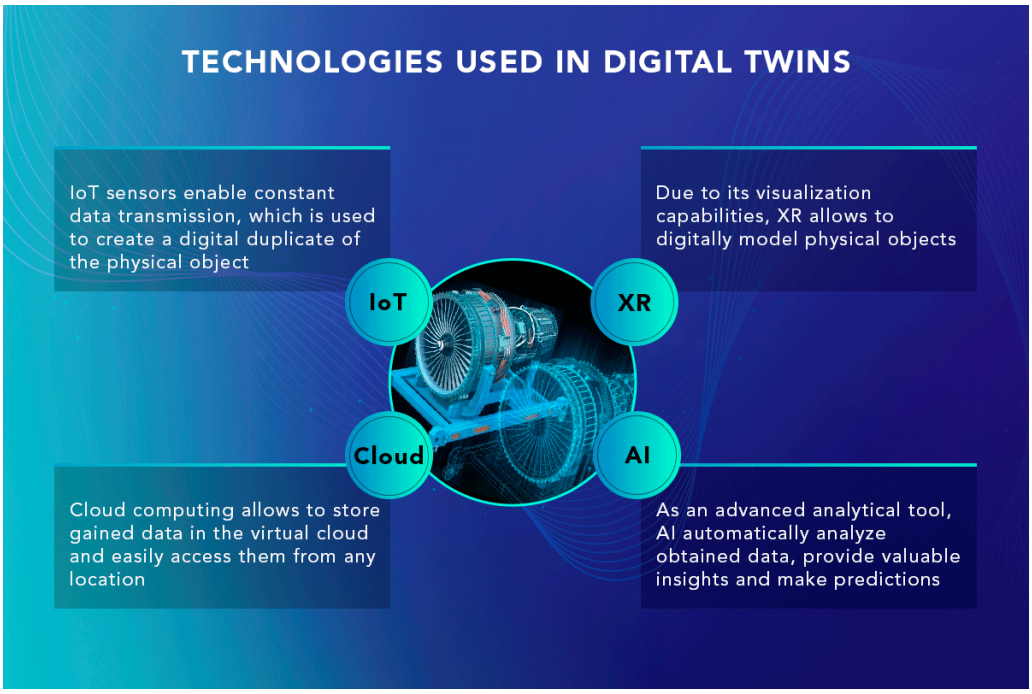


What are the essential building blocks of Metaverse?

The Metaverse and the Digital twin technology can bring realism into the virtual world and experiences beyond our imagination, creating exact replications of reality. Just imagine entering a virtual store of a fashion e-commerce company to try the clothes before buying them. It would be best suited for you to let your digital twin avatar try the clothes first to match your real measurements.

Similarly, a technical training program led by Metaverse will add value to the training if technicians can operate 3D representations of complex systems. Digital twin technology can drive all these ideas into reality and help build a metaverse that is more interviewed into reality.

Digital twin and simulation technology will empower Metaverse to support remote maintenance workshops of machines that need to be serviced and potentially connected with or mapped onto a real workshop.



Technologies used in Digital Twin: AR VR, IoT, Cloud computing & AI

How does Industrial Metaverse work ?

So to understand how Digital Twin works in the Metaverse, let's take a look at how can incorporate digital twins into the Metaverse:

- **Product:**
  Digital twins used to design products
- **Production:**
  Digital twins are used to validate process manufacturing or production
- **Performance:**
  The performance digital twin captures the data from products in operation and analyses it to provide actionable insight for informed decision-making.

What are the use cases of Industrial Metaverse?

There are several sectors where the application of digital twins in the Metaverse can turn out to be beneficial; let's look at some of those sectors as follows :

- **Manufacturing:** Digital twin technology is widely implemented in the manufacturing industry. Virtual copies of entire factories and plants ensure transparent production

processes. Digital twins significantly impact how the products are designed, manufactured, and maintained, making them more efficient and optimized while reducing the throughout time

- **Automobile:** Digital Twins in the automobile sector can create a virtual model of a physically connected vehicle. It captures the behavioural and functional data of the vehicle and helps in analysing the overall performance and connected features of the vehicle. Digital twin helps in delivering truly personalized customer service for the customers.
- **Retail:** Appealing customers has become the key in the retail sector. Digital twin applied in Metaverse can play a key role in mounting the retail customer experience by creating 3D virtual models of showrooms and products, delivering customers a real-like experience. The digital twin also helps with better in-store planning, security implementation, and energy management in an optimized manner.
- **Healthcare:** The medical sector has benefitted from digital twins in organ donation, surgery training, and making other medical procedures less risky. Digital twins with data from IoT can play a vital role in healthcare by improving patient monitoring. It can provide preventive measures for the patients with personalized health care.
- **Smart Cities:** 3D digital twins of whole cities already exist, such as Virtual Singapore. Hence, smart city planning and implementation with digital twins in the Metaverse can help enhance economic development, effective management of human resources, and reduction of ecological footprint to increase the overall quality of life of a citizen in both the physical and virtual world.
- **Industrial IoT:** Industrial firms can monitor, track and control industrial systems digitally by implementing digital twins in the Metaverse. The digital twin records operational data and is handy in catching environment data such as location, configuration, financial models, etc., helping predict future operations of the industries.

About the training Program:

Students will learn the fundamentals of Industrial metaverse and build simulation through unity and other software.

Training Objective:

1. Introduce students to the concept of AR,VR, digital twins and Industrial Metaverse
2. Familiarise students with the HW and SW used in the field of Digital twin
3. Develop an understanding of the structure and architecture involved in creation of Digital twin for Industrial metaverse application development
4. Develop an AR VR interface and connect to physical hardware layer

Course Syllabus:

Category	Course Code	Course Title	L	T	P	C
Hybrid	MEPHXXX	Meta PhyDigital Twin Foundations	1	0	2	2

Unit – I Fundamentals of Digital Twin 3

Digital realities- Communication Model – Product protocols – Gemini principle – pioneers – uses cases – benefits – Digital twin layers – Digital twin technologies – IoT-Meta phydigital – Digital twins differences with simulations

Lab component: 6

- Introduction to Opensource IoT platform

Outcome:

- Understand Digital twin concepts and business cases
- Learn Metaverse and Digital pipeline

Unit – II Data Driven Modelling 3

Types - Component twins – Asset Twins – System or Unit Twins – Process Twins – Fields used – BIM Structures – Power – Complex Mechanical objects – Industrial Line objects – Virtual Manufacturing – Virtual Prototyping

Lab component: 6

- Create your first 3D Model as per data layer requirements

Outcome: Create phygital assets that represent Data layers for interaction

Unit – III Physical Data structuring **3**

Introduction to Variables, Conditions, Loops, Patterns, - Scope of variables – OOPS in Realtime environments – Setting IDE – Scripting vs Programming – Enumeration – Memory management – Program states – Handing exceptions – Device considerations – Input systems – Hardware and Haptics feedback – HW security – Device status considerations

Lab component: 6

- Creating a data stream with IoT services

Outcome: Development of software and Hardware code for Realtime data sharing

Unit – IV Digital Twin Data Layering 3

Basic concepts of unity, Component mapping – component creation techniques – Connecting data layer with digital layers - layout and composition – Gui – Accessing Unity asset store – importing FBX assets – Adding sounds and interactions – DB connection

Lab component: 6

- Component Creation using Unity, mysql and IoT services

Outcome: Develop Component design within considerations of Unity Real-time rendering & Digital twin concept

Unit – V Digital twin interfacing AR VR 3

Design process – mood board – design specification document – technical project management – IoT architecture and component model design – Adding ARVR interfaces – real time data syncing – Controlling real world values – channelling feedbacks and haptics

Lab component: 6

- Mini Project on the Selected Component Twining

Outcome: Design, Develop & Deploy AR or VR Phydigital application either for component or asset twin.

Training Hours - 15 Hrs (Theory) + 30 Hrs (Practical) = 45 Hrs

Mode of Delivery: Hybrid

Hybrid of 45 hours with:

- 15 hours of physical practical/lab classes
- 15 hours of on-line theory classes
- 15 hours of on-line lab classes

Student Enrolment Plan

- Each college will be provided an “College Admin” login for their students.
- They will login to Ingage LMS and choose one of the 6 Batches available per day for enrolling their students.
- Upon successful enrolment student will need to accept the confirmation email and join class in the same link until the semester end.
- The Online classes will be assisted with PowerPoint and augmented with a live instructor
- Certain theory session would require students learn the concept and join the class for a group discussion as advised by the online instructor
- Attendance will be sent to “College Admin” for reconfirmation and for other office uses.
- During course progression student will have to submit their assignment, project work, and complete the MCQ Quiz to be eligible for the final certification.
- Their final grade will be shared with college and once approved it will be shared as a final email for students.
- Students will get access to course material and other learning content until the validity of the course or up to one year whichever is applicable

Faculty:

A team of 45 trainers distributed across all districts

- Trainers are all experienced in developing 3d design projects
- A reserve of 25 trainers in place to deal with new scenarios/issues
- Each trainer will have a hardware & software kit

Project Evaluation:

There would be exercises after every unit and a project at the end of the course in Unit 5. The exercises in units 1 to 4 would be evaluated online through virtualization screen (mirroring mode) and physically (face-to-face) of the project implementation at the end of the course when Ingage visits the college campus.

Course Evaluation:

Yes. There would be 2 evaluations through the semester including the final project and one for the theoretical contents of the course.

Multiple hybrid branch for students:

The graphic design course is being offered to multipledepartments. The course content will be the same for all branches but the exercises and the final mini-project can be chosen from the respective departments so the subject matter expertiseof the student can be leveraged.

NOS alignment:

- Yes. Aligned to SSC – MESC.

Train-the-trainer:

- We are providing the TOT physical training to all the selected faculty across 7 centers

Personalized Students support system:

- Support for competitions, Hackathons & Tech Jam
- Physical & virtual Internships & jobs supported
- Access to mentorships during & post course completion

Personalized Students support system for students who need additional help & failing students:

- Methodology to support students who need additional help:
    - These students would be identified based on the mid assessment
    - Additional classes (on-line & physical) would be offered with access to the tutor beyond the regular course timings.
- Methodology to support failing/low performing students:
    - Reassessment would be done to identify areas of improvement
    - Mentors & work groups would be assigned to specific students in small groups – online & physical
    - 1 mentor assigned for each district

12. Financials:

- Our cost for Naan Mudhalvan Initiative: Rs 3750 per student + GST for a minimum of 20,000 students. Cost will vary if the student count is below 20,000.
- The price includes all the hardware & software infrastructure required for student learning
- The price includes the "Training Of the Trainers" (ToT) program

Summary:

- **Technology Training:** Industrial Metaverse
- **NSQF Level:** NOS aligned. SSC - MESC - Level 4
- **Specialisation:** Engineering Students – CS, IT, EEE, ECE & Mech
- **Year of Study:** 6th Semester
- No. of students that can be supported: 20000
- **Mode of Delivery:** Hybrid (on-line & on-campus)
- **Certification Body:** InGage
- **Cost:** Rs 3750 per student + GST for a minimum of 20,000 students
- **Cost includes hardware/software infrastructure and faculty training.**