German Academy of Digital Education

Internet of Things (IoT)

COURSE OVERVIEW

CREATING CHANCES

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WELCOME TO DADB
German Academy of Digital Education

The Internet of Things (IoT) is not just a technological revolution, it's a human revolution. It is transforming the way we interact with the world and each other, enhancing the quality of our lives in ways we could once only imagine. Everyday objects, from parking spaces and refrigerators to entire buildings, are evolving into intelligent systems that simplify our routines, save us time, and create opportunities for deeper connections.

IoT isn't just about connecting devices; it's about embedding intelligence into our surroundings to empower smarter decisions and foster innovation. It's about making our cities more sustainable, our homes more comfortable, and our workspaces more efficient. The impact is profoundly emotional when technology can predict our needs, reduce our burdens, and create safer, more fulfilling environments, it touches the essence of what it means to live well.

This course is an invitation to step into the heart of this transformation. By understanding IoT, you're not just learning about technology, you're exploring how it can create a more connected, efficient, and compassionate world. Together, let's harness this incredible potential to shape a future where technology enriches lives and empowers humanity.

Welcome to this journey, where innovation meets inspiration. Let's shape a better tomorrow!

> Together, let's harness this **incredible potential** to shape a future where **technology enriches lives** and **empowers humanity**.

Torsten Herfert
Managing Director
DADB German Academy of Digital Education GmbH

ABOUT DADB

As a global player in the digital education market, DADB offers industry-relevant online courses in the sustainable technologies sector, bringing German engineering know-how to the world.
Our vision is to become India's leading provider of high-quality German Engineering and Industrial Education, by making international standards of learning accessible to Indian students through innovative, hands-on, and affordable online learning experiences.

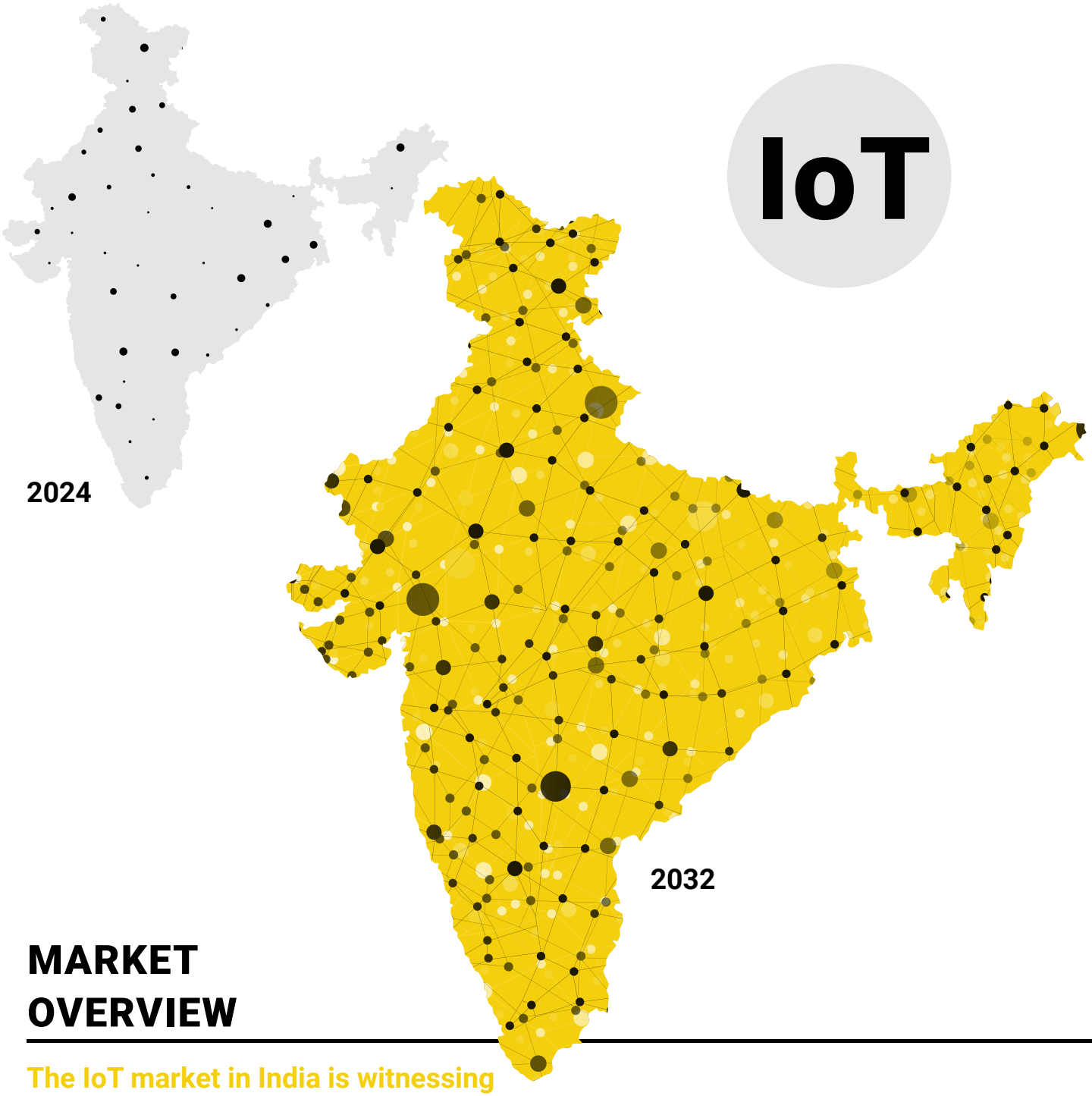
The idea emerged out of a lecture tour in India, when our Managing Director Dr.-Ing. Carsten Schröder was asked "Can we bring German professors to India and share German engineering know-how with students here?"

Back in Berlin, the idea was conceived to make professors' lectures available online rather than via their own classrooms. Immediately, it became apparent that online learning had very special requirements. A new learning format has been developed to integrate students interactively into the lectures and provide insight into practice from industry experts.

We are convinced that social responsibility does not exclude economic efficiency. Over the years, we have nurtured successful partnerships with industry, universities, colleges, and skills councils, aiming at one goal – making **Made in Germany** technical education accessible for the world's younger generations. This is why our claim – **Creating Chances** – strongly represents our belief that education is essential.

DADB courses are created in close cooperation with university professors and industry experts in Germany. The digital materials are geared towards the needs of teachers and students, with clear learning objectives and innovative course content that are responsive to industry requirements and the demand for well-educated talent.

CONNECTING. COLLABORATING. COOPERATING.



MARKET OVERVIEW

The IoT market in India is witnessing rapid expansion due to the growing demand for connected devices and smart solutions across industries.

By 2028, the Indian IoT market is expected to **REACH 59.99 BILLION USD**.

Projected Revenue by 2032 **USD 171.7 BILLION**
19.60 % projected **GROWTH MARKET RATE** 2024-2032

THIS SIGNIFICANT INCREASE HIGHLIGHTS THE POTENTIAL FOR IOT TO TRANSFORM VARIOUS SECTORS, INCLUDING MANUFACTURING, HEALTHCARE, AND SMART CITIES.

JOB PERSPECTIVES

Key skills needed are technical knowledge of devices, open-source architecture and IoT infrastructure.

IoT DEVELOPER

IoT developers are responsible for overseeing the complete software development lifecycle for IoT applications.

IoT SOLUTIONS ARCHITECT

IT professionals responsible for strategy-making and overseeing the deployment of IoT solutions across organisations; they develop practical uses and applications of IoT technology.

IoT NETWORK ADMINISTRATOR

Selectst and purchases equipment, configure, install, and administer systems built with the latest wireless and cloud technologies.

IoT SECURITY SPECIALIST

Conducts security assessments and risk analysis for IoT systems, develop and implement ssecurity protocols and standards for IoT deployments and monitors and analyzes IoT networks for potential vulnerabilities and threats.

IoT SMART CITIES PLANNER

Conducts comprehensive resource planning and allocation activities while ensuring appropriate project management for planning the cities infrastructure and networks.

Internet of Things (IoT)

This course aims to give students a thorough understanding of the Internet of Things (IoT) and how it's transforming different industries. Students will gain the skills and knowledge necessary to create and implement IoT systems, preparing them to effectively design, develop, and deploy these technologies in real-world scenarios.

LEARNING OBJECTIVES

- **Understand the Fundamentals of IoT**
- **Explore IoT Technologies and Platforms**
- **Analyse IoT Applications and Use Cases**
- **Develop Practical IoT Solutions**
- **Evaluate Future Trends and Innovations in IoT**

The course will be delivered through a combination of lectures, industrial demonstrations, interactive exercises and case studies, providing a balanced approach to both theoretical knowledge and its applications.

LEARNING OUTCOME

Upon successful completion of this course, students will be able to

1. **Understand the Fundamentals of IoT: Comprehend the basic principles, architecture, and components of the Internet of Things (IoT).**
2. **Explain the various communication protocols and standards used in IoT.**
3. **Analyse and Process IoT Data: Utilize data analytics tools to collect, analyse, and interpret data from IoT devices.**
4. **Explore IoT Use Cases: Examine practical applications of IoT in various domains such as smart homes, smart cities, and industrial automation.**
5. **Demonstrate the ability to interface with various sensors and actuators.**
6. **Understand the role of IoT in enhancing efficiency, sustainability, and quality of life in these domains.**
7. **Gain insights from interviews and case studies featuring IoT industry experts.**
8. **Understand current trends, challenges, and future developments in the IoT landscape.**

By the end of this course, students will have a comprehensive understanding of IoT technologies and their applications, equipping them with the skills needed to develop, implement, and manage IoT solutions in various professional settings.

LEARNING EXPERIENCE

A SERIES OF LECTURES BY GERMAN PROFESSORS

Using online technology, we create lectures by renowned German professors.

INTERACTIVE EXCERSICES AND APPLICATIONS

A variety of interactive applications are included in our courses. By practicing and applying their skills in a controlled digital environment, students gain hands-on experience.

INDUSTRY EXPERTS

We connect theory and practice with the expertise of German and international industry experts. As a result, theoretical knowledge is tested on practical showcases.

A LEARNING CONTROL

Students can monitor their progress on an ongoing basis with our self-assessment tools.

ASSESSMENTS

During the course, students take up to two intermediate exams and a final exam created in collaboration with the German professor and monitored using various proctoring tools. Upon passing the exam, students receive a blockchain-verified certificate of completion.

INNOVATIVE LEARNING PLATFORM

Our fast and interactive learning platform enables students to learn anytime and anywhere.


Characteristics
Geometric Parameters
Field Device
Server

Prof. Dr.-Ing.
Norbert Gronau

COURSE INSTRUCTOR

Prof. Dr.-Ing.Norbert Gronau is a professor of business informatics, with a focus on processes and systems, at the University of Potsdam, studied mechanical engineering and business administration at the Technical University of Berlin (TU), and received his doctorate in the Department of Computer Science (TU) on the subject of „Conception of a strategy-oriented management information system to support decisions in production management“.

- Prof. Gronau headed the teaching and research group for production-oriented business informatics at the TU Berlin.
- Head of the business informatics department at the University of Oldenburg from 2000 to 2004.
- Since 2004 professor at the University of Potsdam and chair for business informatics, processes and systems, including electronic government.
- Prof. Gronau is a research fellow and visiting lecturer for knowledge management at Stellenbosch University in South Africa.
- Prof. Gronau was also involved in several internet start-ups on the subject of knowledge management and sales acceleration.
- Research interests include Knowledge Management, Enterprise Modelling, Enterprise Resource Planning (ERP), and the Internet of Things (IoT).

INDUSTRY EXPERTS AND SHOWCASES

Centre of Industry 4.0 Potsdam

Prof. Dr. Martin Eigner
EIGNER Engineering Consult

Stefan Hoppe
OPC Fundation

Bastian Inthasane
Hahn-Schickard

Philip Schandelmeier
providata GmbH

Fiona Treacy
Analog Devices

Fabio Violante
Arduino

David Rahusen
STACKFORCE

Hansjörg Rietsche
Hahn-Schickard

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STMicroelectronics

Volker Goller
Analog devices

Thomas Höschele
Campus Genius

Sebastian Heidepriem
SICK AG

Frieder Hansen
Infrafon GmbH

Dr. Ing. Tolgay Ungan
endiio Engineering GmbH

MODULES OVERVIEW

MODULE 1
Introduction to IoT

MODULE 2
IoT Protocols and Standards

MODULE 3
Industry 4.0 and IIoT

MODULE 4
IoT Infrastructure and Sensing

MODULE 5
Automation Technology

MODULE 6
Product Development methods and Robotics

A self-study learning module includes an introduction, learning objectives, content chapters, and additional resources, including learning control exercises, study notes, and quizzes.

MODULE 1

Introduction to IoT

01 Course Introduction
- Devices, sensors, and software that make up IoT systems.
- How IoT connects everyday objects to the internet.
- Potential for innovation in various industries.

02 IoT Network Communication Systems
- Ethernet, LAN, fieldbus as primary communication technologies.
- Network topologies, industrial communication architecture for seamless integration.
- Trends in communication systems for IoT development.

03 Fieldbus Protocols
- Real-time communication capabilities in industrial IoT.
- Protocols at the field level supporting key industrial functions.
- Reliability and efficiency through fieldbus systems.

04 Industrial Ethernet
- Ethernet development, components, topologies for high-speed data transfer.
- Seamless communication in industrial IoT environments.
- Technological advancements enhancing network performance.

05 IoT Reference models
- Seven layers of the ISO-OSI model.
- Modularity and interoperability as key design features.
- Scalable communication solutions for IoT systems.

06 IoT Protocols Overview
- Ethernet, Wi-Fi, IP, TCP, UDP as critical protocols.
- Standardization and interoperability for reliable IoT ecosystems.
- Data transmission across various communication layers.

07 Semantics in IoT
- Semantic interoperability across different platforms and protocols.
- Wireless sensor networks (WSNs) integration through semantics.
- Big data analytics and standardization driven by semantic technologies.

MODULE 2

IoT Protocols and Standards

08 Protocols and Standards: IEEE 802.15.4
- Physical and MAC layers of the IEEE 802.15.4 protocol.
- Integration with IoT standards like 6LoWPAN.
- Low-power communication for industrial IoT applications.

09 Protocols and Standards: 6LoWPAN/RPL
- IPv6 use in constrained IoT environments with 6LoWPAN.
- Routing protocol RPL for reliable communication.
- Low-power networks for efficient data transmission.

10 IoT Application Protocols: COAP, LWM2M
- CoAP and LWM2M architecture for low-power devices.
- Security features and reliability for constrained environments.
- Device management and service discovery in IoT ecosystems.

11 IoT Application Protocols: MQTT
- Publish-subscribe model for efficient data transfer.
- Quality of Service (QoS) for reliable message delivery.

12 MQTT Sensor Networks
- Architecture of MQTT-SN with clients and gateways.
- Wireless communication tailored for sensor networks.
- Optimization of IoT sensor networks through MQTT-SN.

13 MQTT Spark Plug
- Sparkplug's architecture
- Structured topic namespace, payload optimization

14 MQTT Demo
- Hands-on demonstration of MQTT with tools like Mosquitto.
- Core features such as QoS, session persistence, and retain flag.
- Application of MQTT in real-world scenarios.

15 OPC Unified Architecture
- Client-server architecture for data exchange.
- Security features, data modeling for platform interoperability.
- Integration of legacy systems in IoT solutions.

16 OPC UA System Architecture
- Client-server, publish-subscribe models for data exchange.
- Discovery services, security mechanisms in IoT applications.
- Scalable system design through OPC UA.

17 OPC UA System Architecture Profiles
- Server, client, publisher, subscriber profiles for system flexibility.
- Compliance testing mechanisms ensuring standardization.
- Discovery services enhancing IoT network connectivity.

18 OPC UA Information Modelling
- Address spaces, nodes, objects in OPC UA.
- Object-oriented techniques for scalable IoT models.
- Interoperable systems supported by OPC UA's modeling framework.

19 OPC UA Demo
- Resilient IoT networks built through OPC UA models.
- Complex applications addressed through advanced techniques.
- Practical demonstration for applying OPC UA models.

MODULE 3

Industry 4.0 and IIoT

20 IIoT & Industry 4.0
- Real-time data processing, predictive capabilities in IIoT.
- Autonomous operations in industrial settings.
- Opportunities and challenges in IIoT implementation.

21 IIoT-Use Case for Energy Efficiency
- Optimized energy consumption through IIoT technologies.
- Real-world applications in sustainable energy systems.
- Challenges and solutions for energy-efficient IIoT systems.

22 Internet App Protocols
- HTTP, HTTP/2, HTTP/3, CoAP in IoT systems.
- Protocol differences and specific applications.
- Efficient communication through advanced protocols.

23 IIoT Web Server and Web Services
- Web client access to embedded devices for management.
- RESTful web services, HTTPS for secure communication.
- Scalability and efficiency driven by web technologies.

24 IIoT Websockets and Websockets Demo
- Persistent two-way communication via Websockets.
- Lower latency and continuous interaction compared to HTTP.
- Hands-on demo for setting up Websocket connections.

25 Reference Architecture Model
- Factory hierarchy levels, lifecycle management in RAMI 4.0.
- Digital twin concept for asset management.
- Seamless integration in industrial automation systems.

26 Reference Architecture Model
- IoT component interaction and service scalability.
- System interoperability across diverse environments.
- Secure, future-ready IoT ecosystems via the model.

27 Reference Architecture Model
- Component organization for efficient system functionality.
- Security features ensuring robust IoT systems.
- Scalability challenges addressed by the reference model.

MODULE 4

IoT Infrastructure and Sensing

28 5G for IoT
- Ultra-low latency, massive connectivity in 5G.
- Integration with industrial protocols for advanced IoT.
- Deployment challenges for 5G in various industries.

29 LPWAN
- Energy-efficient connectivity for remote IoT applications.
- LoRa, Sigfox, NB-IoT as key LPWAN technologies.
- Application across various industries.

30 LPWAN LoRa
- End devices, gateways, network servers in LoRaWAN architecture.
- Adaptive data rate for energy-efficient communication.
- Scalability and real-world applications of LoRaWAN.

31 LPWAN - Sigfox
- Low power consumption and large-scale IoT support.
- Sigfox architecture and protocols for minimal bandwidth use.
- Security features in IoT communication through Sigfox.

32 LPWAN - Mioty
- Ultra-narrowband protocol for high scalability.
- Energy efficiency and interference resilience in IoT networks.
- Compliance with ETSI standards and private network setups.

33 Narrowband IoT
- Global deployment insights from regions like China and Western countries.
- Energy efficiency, security measures for IoT networks.
- Role of NB-IoT in the future of 5G and IoT connectivity.

34 Systematic Functional Testing of NB-IoT
- Latency, reliability, energy consumption as key testing metrics.
- Structured testing setup for NB-IoT deployment.
- Real-world industrial applications for NB-IoT devices.

35 IoT Security
- Security vs safety distinctions in IoT environments.
- Security objectives for safeguarding sensitive information.
- Emerging challenges and best practices for IoT security.

36 Infrastructure Architecture Models and Sensor Technology
- Object layer, service management layer in IoT architecture.
- Sensor design and application in various industries.
- Automation and real-time processing enabled by sensor technology.

37 Distance and Temperature Measurement
- Ultrasonic sensors for non-contact distance measurement.
- Temperature measurement techniques in IoT environments.
- Challenges and applications of sensor measurements.

MODULE 5

Automation Technology

38 Automation Technology – Terms and Concepts
- Control systems, feedback loops, real-time data in automation.
- Types of automation: fixed, programmable, flexible.
- Applications in industrial IoT for automation technology.

39 Automation Systems – Components and Structures
- Sensors, actuators, automation computers in IoT automation.
- Centralized, decentralized, hybrid automation architectures.
- System synchronization for optimal control actions.

40 Programmable Logic Controllers
- Input signals, pre-programmed instructions processed by PLCs.
- PLCs architecture and key components for process optimization.
- Integration of PLCs into larger IoT automation frameworks.

41 Computerized Numerical Control (CNC)
- Evolution of CNC machines from early numerical control systems.
- CNC components, operational processes for machining accuracy.
- Integration with IoT to enhance automation and production.

42 IIoT Platform I
- Devices, edge gateways, connectivity solutions in IIoT.
- IoT architecture models for security and data integration.
- Platform functionalities as central hubs for industrial IoT.

43 IIoT Platform II
- AWS IoT, ThingsBoard as examples of advanced platforms.
- Edge computing features for reducing latency.
- Industrial process optimization through platform integration.

MODULE 6

Product Development Methods, CAD and Robotics

44 Product Development

- Key stages: market research, design, prototyping, testing.
- VDI-Standard 2221, V-model for structured product lifecycle.
- User-centered methodologies like Design Thinking.

45 Product Development Methods

- Quality Function Deployment (QFD), TRIZ for connecting customer needs to engineering solutions.
- Creative problem-solving methodologies to reduce errors.
- Efficiency improvements in product-to-market processes.

46 Computer Aided Design (CAD)

- 2D and 3D modeling for design precision.
- Integration with 3D printing and automated manufacturing.
- Collaboration and standardization in engineering teams.

47 CAD – Design Data Fromats

- Different file formats for managing design data.
- Format selection for interoperability across platforms.
- Collaboration in IoT projects through shared data formats.

48 Robotics I – Definition

- Definition of robots, types used in IoT environments.
- Core principles guiding robot design and function.
- Automation and task efficiency through robotics.

49 Robotics I – Description models

- Kinematic, dynamic, sensor-based models for robot design.
- Behaviour representation in IoT-enabled environments.
- Autonomous systems supported by description models.

50 Robotics II

- Robotic components and systems enhancing automation.
- Operational methodologies and technologies in robotic systems.
- Robotics in IoT for smart and connected industrial environments.

WE HAVE MORE

Step into the world of boundless knowledge with our comprehensive range of courses. At DADB, we believe in offering a diverse array of educational opportunities that cater to various interests and career aspirations.
From courses in renewable energies to the latest 5G technology, our offerings are thoughtfully designed to empower you on your learning journey. We invite you to explore the next page to discover the rich tapestry of possibilities that await, providing you with the tools and insights needed to excel in today's dynamic digital landscape.

DADB COURSES

5G TECHNOLOGY
Prof. Dr.-Ing. Axel Sikora
Offenburg University of Applied Sciences

SOLAR ELECTRIC ENERGY SYSTEMS
Prof. Dr.-Ing. habil. Stefan Krauter
University of Paderborn

HYDROGEN TECHNOLOGY
Prof. Dr.-Ing. Thomas Schmidt
University of Applied Sciences Münster

ACCESS OUR COURSES
ACCESS YOUR POTENTIAL
ACCESS THE FUTURE

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