Semiconductor Core Technologies: From IC Design to Advanced Packaging

A 22-Hour Journey Through the Complete Chip Development Process—from Design to Packaging

Building a Common Technical Language for Design, Process, Packaging, and Business Teams

Course Overview

From AI servers and smartphones to electric vehicles, every innovation depends on continuing advances in semiconductor technology. The semiconductor value chain connects chip design, manufacturing, and packaging. How do design specifications affect manufacturing complexity? Why does yield influence cost and delivery? How can advanced packaging unlock greater AI chip performance? **Understanding the links between these stages is essential to understanding how the industry works.**

Following **the complete journey from application requirements and IC design to wafer fabrication, packaging, and testing**, this structured course comprises **seven chapters, 43 learning units, and approximately 22 hours** of content. It begins with band theory and MOSFETs, then progresses through **EUV lithography, FinFET and GAA transistors**, and advanced packaging technologies such as **CoWoS and chiplets**. Rather than presenting isolated facts, each topic explores **why particular design choices are made and how decisions at one stage affect the others**. Examples from AI, mobile, and automotive chips illustrate differing requirements for power, performance, and area (PPA), helping learners build a coherent technical picture.

The course emphasizes concepts, workflows, and engineering trade-

offs. Engineers and professionals in sales, procurement, and project management can develop **a structured knowledge base and a shared cross-functional vocabulary** to support sound decisions and effective project discussions. Its modular format allows learners to select chapters relevant to their roles and replay videos without limit during the access period. Those who complete the videos, assessments, and post-course questionnaire may apply for an **ITRI Proof of Attendance**.

Learning Objectives

Upon completing this course, you will be able to:

- **Understand the entire chip development lifecycle:** Explain the major stages from **application requirements and IC design through wafer fabrication, packaging, and testing**, and how they connect. Recognize the industry roles of integrated device manufacturers (IDMs), Fabless companies, Foundry, and outsourced semiconductor assembly and test providers (OSATs).
- **Explain key technology trade-offs:** Use AI, smartphone, and automotive chips to illustrate **PPA trade-offs**; describe the evolution from planar transistors to FinFETs and GAA devices; and explain how interconnect materials and packaging approaches respond to different product requirements.
- **Interpret quality and yield issues:** Identify **Critical Dimension (CD), Overlay, defects, and reliability** as key metrics. Understand how metrology findings inform process adjustments and **how yield affects manufacturing costs and product delivery**.
- **Explore advanced packaging and emerging technology trends:** Explain why heterogeneous integration, **CoWoS**, and **Chiplets** are

critical for AI chips in the post-Moore era, and understand the development directions of **MRAM/RRAM memories, SiC/GaN wide-bandgap semiconductors, quantum computing, and photonic integration**.

- **Strengthen cross-functional technical communication:** Apply **shared terminology** from design, manufacturing, and packaging to structure technical questions and arguments, **contribute to cross-departmental project discussions**, and collaborate effectively with technical teams.

Course Highlights

1. One connected narrative across the semiconductor value chain. Organised around the real progression from design and fabrication to packaging and testing, the course links MOSFETs, Process Design Kits (PDKs), EUV lithography, FinFET/GAA, CoWoS, and Chiplets. Learn how these technologies fit together rather than memorizing disconnected terminology.

2. Learn the "why" behind the technology, culminating in an integrated case study. Topics address practical industry questions: **Why do design rules determine manufacturability? Why does yield directly affect cost and delivery?** A final case study, "Why Is Advanced Packaging Critical in the Post-Moore Era?", demonstrates how to combine knowledge across the entire process into a clear technical argument, developing judgement as well as factual understanding.

3. A shared technical language for technical and non-technical roles. Starting with the semiconductor value chain (IDM, Fabless, Foundry, and OSAT), the course explains the priorities and metrics of IC design, wafer

fabrication, and packaging and testing. Whether you work in engineering, project management, sales, or procurement, you can better follow technical discussions and communicate across functions.

4. English-language instruction with industry terminology. All lessons are delivered in English with English subtitles, enabling learners to become familiar with internationally used semiconductor terminology while building technical knowledge—useful for reading technical documents and joining international meetings.

5. Flexible modular learning with an ITRI training certificate. Purchase the complete course or individual modules relevant to your role, and replay videos without limit within the access period. After completing the videos, passing the assessment with a score of at least 80, and submitting the post-course questionnaire, learners may apply for an ITRI Certificate of Training.

6. Expert review and consistent terminology. Designed by an experienced course planner and produced using generative AI, the course maintains consistent presentation and terminology throughout. Semiconductor specialists review each chapter for technical accuracy and consistency.

Who Should Attend

1. **Semiconductor and electronics professionals** working in IC design, processes, equipment, materials, packaging, or testing who wish to broaden their understanding of adjacent stages and their interdependencies.
2. **Engineers and R&D professionals from related disciplines** with a science or engineering background who wish to clarify fundamental semiconductor device and process concepts and connect these

technologies to their applications.

3. **Business support and management professionals** involved in product planning, project management, sales, procurement, or industry analysis who need to understand semiconductor technologies and work closely with technical teams.
4. **University and college students and career changers** with foundational science or engineering knowledge who want an overview of the semiconductor value chain and the process from IC design through fabrication, packaging, and testing.

Language advisory: Instruction is in English and only English subtitles are available. Learners should be comfortable reading or listening to English technical content. A free course introduction video is available before registration to help assess whether the teaching format is suitable.

Course Design and Learning Material Production

Professional Curriculum Design × AI-Assisted Content Production × Semiconductor Expert Review

An experienced industry training curriculum specialist leads the course design. Generative AI supports curriculum architecture, instructional scriptwriting, image creation, English translation, and digital video production, enabling a systematic set of self-paced semiconductor learning materials.

To maintain quality and technical rigour, professionals with semiconductor expertise review and correct every chapter, checking core concepts, specialist terminology, and consistency to improve accuracy and completeness.

The lessons use AI-generated instructional videos rather than a live human instructor. Professional curriculum planning, AI production technologies, and human quality review combine to offer a structured, technically grounded, and flexible digital learning experience.

Course Information

【Course Period and Learning Approach】

- Current offering period: 1 November 2026 to 31 March 2027.
- Viewing period: From account activation until 31 March 2027. Unlimited replay is permitted within this period; earlier registration provides a longer learning duration.
- Learning approach: ITRI College+ online learning platform (Cloud Classroom).
- Duration: Approximately 22 hours (7 chapters, 43 learning units).
- Registration information:
  Ms Liao | +886-3-573-2859 | itri534758@itri.org.tw (registration, payment, and course administration).

  Mr Wan | +886-3-574-3996 | charleswan@itri.org.tw (content, technical enquiries, and corporate licensing).
- Language of instruction: English.
- Subtitles: English only; Chinese subtitles are not provided.

【Tuition Fees and Registration】

- Standard tuition: NT$23,800 (all prices include tax).
  New-course launch offer: NT$19,800 (refer to the registration

webpage for the offer deadline).

Group registration offer: NT$18,800 per person when three or more employees from the same company register at the same time. Available throughout this offering; cannot be combined with the early-bird/launch offer.

- Free preview: Watch Course introduction before enrolling to learn about the instructional approach and English-language presentation.

【Access and Scheduling Reminders】

- All participants in this offering will have access until 31 March 2027. At approximately three hours of study per week, the full course takes around eight weeks to complete; please allow enough time before registering.
- Following this offering, the course is planned to be offered quarterly (Q1, Q2, Q3, and Q4), with three months of learning access per offering. If insufficient time remains in the current period, please email us to enquire information about the next one.

Corporate Digital Course Licensing

In addition to individual enrolment, corporate digital course licensing is available. Companies can use this structured semiconductor training resource for employee development, cross-functional technical literacy, and internal talent development. For licensing arrangements, permitted use, and partnership details, contact Mr Wan at +886-3-574-3996 or charleswan@itri.org.tw.

Course Outline

Course	Syllabus	Duration
Semiconductor Core Technologies: From IC Design to Advanced Packaging	1. Semiconductor Fundamentals (5 units): Band theory; silicon and compound semiconductors; MOSFETs; Moore's Law; the industry value chain (IDM, Fabless, Foundry, OSAT). 2. IC Design (6 units): PPA trade-offs and application requirements; front-end and back-end design flows; design rules and process design kits (PDKs). 3. Front-End-of-Line (FEOL) Processing (10 units): Crystal growth and wafers; oxidation and thin-film deposition; lithography (DUV to EUV); etching; ion implantation; FinFET/GAA; chemical mechanical planarisation (CMP). 4. Back-End-of-Line (BEOL) Processing (6 units): Multilevel interconnects; RC delay; copper damascene processes; low-k dielectric materials; BEOL reliability. 5. Yield and Process Integration (5	Approx. 22 hours 7 chapters / 43 units

Course	Syllabus	Duration
	units): Critical-dimension and overlay metrology; yield definitions; defect sources and monitoring; process integration. 6. Packaging and Testing (6 units): Wire bonding and flip-chip packaging; Circuit Probing (CP) and final testing (FT); heterogeneous integration; CoWoS; Chiplets. 7. Industry Trends and Practical Applications (5 units): Emerging memory; SiC/GaN; quantum computing and photonic integration; an integrated advanced-packaging case study; cross-functional communication applications.	

Registration and Learning Process

Step 1 | Register Online

Complete online registration using the course registration link. An automatic Registration Confirmation email will be issued. Keep the registration details link in the email, as it is required for credit card payment.

Step 2 | Pay the Tuition Fee

Payment can be made immediately after registration by credit card or ATM bank transfer. Follow the Registration Confirmation email and the Payment Methods section below.

Step 3 | Payment Confirmation

Once payment is verified, the organiser will arrange activation of your course account.

Step 4 | Account Activation and Course Notification

Your registered email address will serve as your default login account. Activation generally takes approximately one working day.

Once your account is activated, you will receive a Cloud Course Notification email stating the course name, access period, duration, and learning URL, together with Cloud Classroom login instructions.

Step 5 | Log In and Begin Learning

Follow the Cloud Course Notification email to set your password and confirm your login. You may then study online and replay course materials without limit during the access period.

Step 6 | Complete All Learning Requirements

Within the access period, complete all course videos, achieve an assessment score of at least 80, and submit the post-course questionnaire.

Step 7 | Apply for a Certificate of Training

After completing all learning requirements, email the course administrator to request an ITRI Certificate of Training. The certificate will be issued upon verification of successful completion.

Payment Methods

- **Credit card and ATM bank transfer are accepted immediately after registration. Cash payments are not accepted.**
- **Recommended payment options:**

  1. Credit card is recommended for convenience. Where a refund is permitted, processing normally takes approximately two weeks.
  2. Alternatively, choose ATM bank transfer.
  3. For group registrations, each participant should pay individually by credit card or ATM bank transfer. Companies requiring consolidated payment should contact Ms Liao.

ATM Bank Transfer

The system generates a unique virtual bank account for the individual learner and course, including the bank code and transfer account number.

Transfer the exact amount displayed for the virtual account. Transfers for a different amount cannot be processed.

After transferring, please provide either of the following for payment reconciliation:

- Transfer date and the last five digits of the remitting account number; or

- A screenshot confirming the completed transfer.

Email this information to the course administrator. No additional form is required.

Credit Card (Recommended)

Credit card payment is available immediately after registration. Your card will be charged when payment is completed. If you wish to cancel, the refund policy below applies.

Credit card payment instructions:

1. In your Registration Confirmation email, find the link labelled "Payment Method Change URL: Registration Details URL".
2. Open the registration details link and enter the email address used at registration and the verification code to access the payment page.
3. Select credit card payment and enter the requested card details to complete the transaction.
4. Payment is complete only when the screen displays "You have completed the registration process".

※ If the credit card payment option is unavailable, email the course administrator for assistance.

Refund Policy — Please Read Carefully

- **Eligibility:** A cancellation requested before course account activation qualifies for a full refund. No refund is available after activation, because access to the complete digital course materials has been provided.

- **Processing time:** Credit card refunds typically take approximately two weeks. ATM transfer refunds take approximately two months due to administrative procedures and require a separate refund application form.

  We apologise for any inconvenience.

Important Notes

- Invoices are issued collectively on the 20th of each month after learners can successfully log in to Cloud Classroom and begin viewing the course.
- If an earlier invoice is required, please email the organiser to make arrangements.
- To protect course copyrights, downloadable electronic copies of the course handouts are not provided.
- Online learning accounts are for individual use only, may not be transferred or shared, and are subject to the ITRI College+ platform terms of use.