

## **Accreditation Report**

Program Accreditation of **TUM Asia, Singapore**

**"Electronics and Data Engineering" (B.Eng. (Hons))**

### **I Procedure**

**Date of contract:** 07 September 2023

**Date of the submission of self-assessment report:** 10. February 2024

**Date of site visit:** 28 February 2024 – 01. March 2024

**Attendance by ACQUIN office:** Dr. Jasmine Rudolph / Robert Raback / Dr. Michael Mayer

**Accreditation decision:** 12 September 2024

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The **Assessment Report** of the peer-review experts is **based on** the self-assessment report of the Higher Education Institution (HEI) and extensive discussions with the HEI management, deans and/or heads of the departments, heads of study program, lecturers, staff representatives, students, and alumni.

The basis of the **Assessment Criteria** is part 1 of the “Standards and Guidelines for Quality Assurance in the European Higher Education Area” (ESG) in the current official version. At the same time the national context, particularly the national regulations regarding the establishment of study programs, are taken into account.

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## **II Introduction**

The experts would like to thank the representatives of the HEI as well as students that they have taken part in the discussions and willingly shared information and their views during the site visit. The discussions are valuable not only for the assessment of the institution, but also for a better understanding of the legal and sociocultural context of the local higher education system.

Evaluation basis for the peer-review experts is the self-assessment report of the HEI as well as intensive discussions during the site visit with the HEI management, deans and/or heads of the departments, head(s) of the study program, study program coordinators, teachers, lecturers, administrative staff, students, and graduates.

Main objective of the accreditation procedure is to assess the quality of the study programs and compliance with the "Standards and Guidelines for Quality Assurance in the European Higher Education Area" (ESG). The ESG standards are applied as main assessment criteria in the international accreditation procedure. In addition, the respective country-specific criteria and standards are taken into account.

A group of experts was set up, which ensured that all areas relevant to the accreditation procedure (e.g. legal, structural, social etc. aspects) as well as the ESG and national criteria were considered. The peer-review experts include professors, representatives of the professional practice and the student representative. A certificate with the ACQUIN seal is awarded upon accreditation of the study program.

### **1 The Higher Education System in Singapore**

The higher education system in Singapore is structured to provide a comprehensive range of undergraduate and postgraduate programs, aligning with international standards and fostering a globally competitive academic environment. Due to the close connection to other surrounding Asian countries and its broad history, Singapore is strongly connected within the ASEAN countries as a member state since 1967.

A typical undergraduate program spans three to four years. Undergraduate education in Singapore is provided by public universities such as the National University of Singapore (NUS), Nanyang Technological University (NTU), and the Singapore Management University (SMU). These HEI cover a broad spectrum of disciplines, including arts and social sciences, business, engineering, and science, often incorporating practical and industry-related components to enhance employability. Postgraduate education includes Master's programs, which usually require one to two years of study. These programs may be coursework-based, research-based, or a combination of both. They aim to provide advanced knowledge and



specialized skills in various fields, offering to both academic and professional aspirations. PhD programs usually last three to five years, highlighting original research and the contribution of new knowledge to a specific field. These programs involve rigorous coursework, comprehensive examinations, and the submission of a dissertation. They are designed to prepare graduates for careers in academia, research, and high-level professional practice.

Singapore's higher education system is generally characterized by a strong emphasis on research and development, robust industry linkages, and a commitment to innovative development. Institutions in Singapore are known for their high academic standards, international collaborations, and comprehensive support for students, including scholarships and research grants. The system's alignment with global educational frameworks ensures that degrees awarded are recognized internationally, enhancing graduates' mobility and career prospects.

## **2 Short profile of HEI**

### **Technical University of Munich (TUM)**

TUM is one of Europe's leading research universities. Since its founding in 1868, TUM has been at the forefront of Science and Innovation, playing a vital role in Europe's technological advancement. As of 2023, 18 scientists and alumni of TUM have received the Nobel Prize. Some notable inventions from the TUM alumni include the refrigeration technology invented by Carl von Linde; the Dornier airplane by Claude Dornier; and the diesel engine invented by Rudolf Diesel, just to mention a few.

Having earned itself a reputation of being an institute that produces world-changing technologies, TUM strives to create lasting value for society through excellence in education and research, and the active promotion of next-generation talent with strong entrepreneurial spirit. As an entrepreneurial university, TUM has won recognition as a German "Excellence University", the most prestigious funding from the German State since 2006. TUM is regularly placed among the best universities in national and international rankings. In the respected QS World University Rankings 2023, TUM is yet again number one in Germany – for the ninth time in succession. In the European Union it is ranked second and is number 37 worldwide.

In its basic philosophy, TUM is committed to promoting innovation in scientific fields that promise to improve the quality of life and cohabitation in the long term. The responsibility owed to the future generations forms the basis for the interdisciplinary focal points of health & nutrition, energy & raw materials, environment & climate, information & communication, mobility & infrastructure.



Since 2022, the former TUM Department of Electrical and Computer Engineering is part of the TUM School of Computation, Information and Technology (CIT). The founding of the TUM School of Computation, Information and Technology is part of TUM's structural transformation. Inspired by international peers, TUM is transforming its internal structure into a modern matrix organization. In a move away from its traditional, discipline-specific departmental structure, seven schools with a broader focus are linked by Interdisciplinary Research Centres. The TUM School of CIT unites the disciplines of Mathematics, Informatics and Electrical and Computer Engineering. Computation, Information and Technology can be seen as three fundamental fields that enable the understanding and shaping of today's highly digitized world, interacting with each other and turning data into knowledge. The TUM staff teaching in the EDE program is mostly associated to the TUM School of CIT.

### **Singapore Institute of Technology (SIT)**

In 2024 the SIT is envisioned to be a key university in Singapore that lives and breathes industry, with its students and alumni (collectively called SITizens) being thinking tinkerers, lifelong learners and catalysts for transformation who care for the community and stay connected to SIT and their fellow SITizens. SIT aims to maximise the potential of learners and to innovate with industry, through an integrated applied learning and research approach, so as to contribute to the economy and society.

In addition, the SIT aims to graduate students who possess five distinctive qualities which together are denoted as 'the SIT DNA'. These are (1) Thinking Tinkerers, (2) Able to Learn, (3) Unlearn and Relearn, (4) Catalyst for Transformation and (5) Grounded in the Community.

Applied learning requires active learning. Learning at the SIT is reinforced through a range of learning techniques such as experiential learning, flipped classrooms, problem-based learning with real-industry context, gamification, and sharing sessions by experienced industry players. With the technical skills and knowledge attained, students can apply what they have learnt to actual work situations in the Integrated Work Study Program (IWSP). Students are trained to become deep specialists in their respective engineering disciplines. Skill sets such as critical problem-solving, decision making, project management and communication skills, acquired in the classroom and through industry experience are transferable across many sectors as they are highly valued by employers everywhere. Engineering programs at SIT have been developed through extensive consultation with the industry, thus creating a curriculum that supports the industry's needs in manpower development and innovation.

TUM and SIT offer this 4 years joint degree program in Bachelor of Engineering with Honours [B.Eng. (Hons)] in Electronics and Data Engineering (EDE). The Bachelor of Engineering



program in EDE (full time) is administered by SIT and by the German Institute of Science and Technology – TUM Asia (TUM Asia) in Singapore.

### **German Institute of Science and Technology – TUM Asia (TUM Asia)**

TUM Asia is an affiliate of the TUM. As the first German academic venture abroad, TUM Asia is supported by the Singapore Government through the Economic Development Board (EDB), and by the German Government through the Federal Ministry of Education and Research and the German Academic Exchange Service (DAAD). TUM Asia was set up in 2002, with the aim of bringing German academic excellence to Singapore. The academic model employed by TUM Asia places an emphasis on industry readiness and innovation. Blending German academic excellence with industry relevance in Asia, TUM Asia conducts Bachelor and Master programs in Singapore with partner universities such as National University of Singapore (NUS), Nanyang Technological University (NTU) and Singapore Institute of Technology (SIT). Through these joint programs, the international visibility of TUM has increased. Moreover, the teaching portfolio of the German Institute of Science and Technology (GIST) at TUM Asia also allows teaching staff to gain international teaching experience.

### **3 General information on the study program**

Location	Singapore
Title of Study Program	Electronics and Data Engineering
Date of introduction	Trimester 1, Academic Year 2020
Faculty/ department	TUM School of Computation, Information and Technology SIT Engineering Cluster
Degree	B.Eng. (Hons) Electronics and Data Engineering
Standard period of study (semesters)	11 Trimesters
Matriculation period	Trimester 1 (September)
Number of ECTS credits	240
Frequency of Offered Program	Annually
Number of study places	70
Number of students currently enrolled	248



Average number of graduates per year	
Target group(s)	Diploma holders from any of the five Singapore polytechnics and A Level / IB Diploma graduates or a formal 12-year education equivalent to A-Levels
Admission requirements	Aptitude assessment (EFV – Bachelor's)
Form of study	Full-time
Tuition fee	SGD 41,280 incl. GST (Subsidised, Singaporean)

#### 4 Results of the previous accreditation

With regard to external quality assurance, the programs taught in Singapore at TUM Asia such as the EDE program undergo an individual program accreditation. The master's programs offered at TUM Asia received accreditation in 2020. The TUM-SIT program EDE was established in 2020. The program is now being reviewed within the frame of a first accreditation in Germany.



### III Implementation and assessment of the criteria

#### 1 ESG 1.1: Policy for quality assurance

**Institutions should have a policy for quality assurance that is made public and forms part of their strategic management. Internal stakeholders should develop and implement this policy through appropriate structures and processes, while involving external stakeholders.**

##### 1.1 Implementation

###### **Quality Management at TUM and TUM Asia**

TUM Asia has always laid emphasis on high quality which is aligned with TUM's quality management. Since TUM Asia courses must meet the study regulations of the TUM quality management, the responsible units at TUM are involved from the beginning (TUM Centre for Study and Teaching – Quality Management and Legal Division). This includes the definition of the process, the design of the conceptual draft, preparation of the course documentation, module descriptions and establishing academic and examination regulations. The programs are developed according to the prevailing laws imposed by TUM and the corresponding local partner university.

Further development of the courses also takes place with the involvement of relevant units of TUM (guidelines by TUM Centre for Study and Teaching – Quality Management and Legal Division, review by TUM administrative boards). Existing courses are continuously developed further, performed in close collaboration with the responsible program committee and other units at TUM.

###### **Quality Management at SIT**

The SIT Academic Policies apply to undergraduate, postgraduate, and other credit-bearing programs offered by SIT and those jointly offered by SIT with Overseas University (OU) partners. These policies are in accordance to the university's education philosophy to produce work-ready graduates imbued with the "SITizen"-DNA.

###### **Management of the joint TUM-SIT Program**

The program has received support from the Singapore Economic Development Board Singapore (EDB) and various industrial partners. The faculty is involved in the planning and design of the curriculum structure, and the program was approved by the SIT Board of Trustees and the Ministry of Education in Singapore.



For the joint management of the program, a Collaboration Agreement between TUM and SIT was signed. In this document, all organizational aspects of the joint management of the program are defined (e.g. the responsibilities of each university, financial agreement, academic administration). The Collaboration Agreement includes a section about the quality assurance of the program. It is regulated that SIT and TUM are jointly responsible for ensuring the quality and standards of the program. This includes internal and external requirements for quality assurance, and the maintenance of academic standards. It is also regulated that accreditation is obtained in Singapore (Engineering Accreditation Board, EAB) as well as in Germany.

### **TUM-SIT Joint Undergraduate Program Administration**

EDE is a joint degree program between TUM and SIT. The joint degree program is managed by the Joint Board of Examiners (JBOE), Joint Program Operations Committee (JPOC), as well as Program Leader (PL) from SIT and Program Director (PD) from TUM. SIT and TUM have jointly established a JBOE for the joint undergraduate program by nominating relevant and qualified examiners. The terms of reference, operation, and constitution of the JBOE are set out in the TUM-SIT Collaboration Agreement. The JBOE meets every trimester after the examinations, with the Chair and Co-Chair alternating on an annual basis between SIT and TUM. The SIT Chair will be Associate Provost or a nominee for SIT, while the TUM Chair will be the Dean of the school or a nominee from TUM.

### **Quality Management for TUM-SIT Joint Programs**

The Joint Board of Examiners (JBOE) and Joint Program Operations Committee (JPOC) are responsible for quality management and continuous development. They consist of representatives from each institution, i.e. the TUM School of CIT and SIT Engineering Cluster. The JBOE adopts a plan-do-check-act (PDCA) model for carrying out change for continuous improvement. TUM Asia also takes into consideration the opinions of teaching staff involved in the programs, feedback from graduates, alumni and industry partners to improve the quality of the EDE program. The performance of the teaching staff is also evaluated from time to time. TUM Asia's faculty prepares concept drafts, study documentation, module description and articles for each program, while the relevant TUM departments (TUM Centre for Study and Teaching (TUM CST) Quality Management and TUM CST Legal Division) assure the quality of the program to maintain TUM quality standards.



## Operations Management

The Joint Program Operations Committee (JPOC) was established to jointly review, coordinate, manage, and advise on academic, operational, and administrative matters for the EDE program. The terms of reference, operation and constitution of the JPOC are set out in the SIT-TUM Collaboration Agreement. The JPOC meets every six months to discuss administrative and operational matters arising from the program operation, with the Chair alternating between TUM/TUM Asia and SIT each Academic Year. At SIT, the Chair will be the Associate Provost or nominee. At TUM, the Chair will be a faculty professor from TUM (nominee by the Dean / Dean of Studies).

In TUM, the EDE program is led by the Program Director (PD) in consultation with the Managing Director of TUM Asia as well as the Dean and Dean of Studies or their nominee in the TUM School of CIT. In SIT, the EDE program is headed by the Program Leader (PL) who is responsible for the day-to-day operations of the program. The PL reports to the Provost through the Director of Programs (DoP) and Associate Provost. The PDs and PLs manage and coordinate all issues related to curriculum planning, quality management and examination management.

The SIT PL and TUM PD are supported by the team of EDE faculty members who contribute to the teaching of the program based on their domain expertise, interests, and time commitment, both from SIT and TUM. In SIT, the program is administratively supported by the Academic Program Administration (APA) for faculty and student matters. In TUM, the program is administratively supported by the Academic Service Department (ASD) from TUM Asia.

SIT and TUM have also jointly established a Student Management Committee (SMC) for the EDE Program. The SMC shall be representative of all students in the EDE Program. SIT and TUM jointly support the SMC by providing representatives from their teaching and support staff to meet with the SMC once each trimester.

In addition, other student activities and campus events such as the Integrated Work Study Program (IWSP), students' involvement in outreach, and the Overseas Immersion Program (OIP) are supported by the SIT Centre for Career Readiness, Student Life, and Global Experience.

The standard processes for quality assurance are described in the official documents. The modules are evaluated by a web-based evaluation system in the learning management system of SIT, which is suitable for standardized evaluations of different dimensions. The results of the evaluations are shared with the respective teaching staff, who can share their opinions on the received feedback as well as their impressions of teaching the module during the discussions at the Program Level Board of Examiners (PBOE) meetings. Additionally, the



feedback from students, graduates, teaching staff and administration staff is collected and processed by SIT through their web-based system. The compiled information is then discussed with the Student Management Committee (SMC) and in the JBOE and JPOC meetings. In the JBOE and JPOC meetings, steps are taken to work on the feedback and address potential shortcomings.

## **1.2 Assessment**

TUM Asia and SIT have a robust quality assurance practice in place, reflecting their commitment to providing high-quality education and ensuring the continuous improvement of their academic programs.

### **Formal Policy for Quality Assurance**

TUM Asia and SIT have well-documented quality assurance policies that serve as guiding frameworks for maintaining and enhancing the quality of their educational offerings. These policies are readily accessible to all stakeholders, including students, faculty members, administrative staff, and external partners, through the institutions' official websites and handbooks.

### **Coverage of Relevant Areas**

The quality assurance policies of TUM Asia and SIT comprehensively cover all relevant areas pertinent to academic excellence and program quality. They address aspects such as curriculum design, teaching methodologies, assessment practices, student support services, research integrity, and administrative processes. These policies are designed to ensure alignment with international best practices and accreditation standards, thereby enhancing the overall quality of education delivered by both institutions.

### **Involvement of Stakeholders**

TUM Asia and SIT actively involve a wide range of stakeholders in the development and implementation of their quality assurance policies. This includes input from academic and administrative staff, students, industry partners, accreditation bodies, and relevant government agencies. Both institutions emphasize transparency and inclusivity in their decision-making processes, soliciting feedback and suggestions from stakeholders through various channels such as surveys, focus groups, and advisory committees.

### **Implementation, Monitoring, and Revision**

TUM Asia and SIT have well-defined mechanisms for implementing, monitoring, and revising their quality assurance policies. They appoint dedicated quality assurance teams or committees responsible for overseeing the implementation of quality assurance measures and monitoring compliance with established standards. Regular reviews and evaluations are



conducted to assess the effectiveness of existing quality assurance practices and identify areas for improvement. The feedback from students, faculty members, and external stakeholders is actively incorporated into the revision process to ensure that quality assurance policies and internal processes remain relevant and responsive to evolving needs and expectations.

### **Streamline the joint monitoring and evaluation processes**

Additionally, TUM Asia and SIT can benefit from streamlining their monitoring and evaluation processes to ensure greater efficiency and effectiveness. Implementing automated data collection and analysis tools can help streamline the assessment of key performance indicators and facilitate evidence-based decision-making. The expert group therefore recommends encouraging internal processes to streamline these activities even more. [Recommendation 1]

### **1.3 Conclusion**

The criterion is **fulfilled**.

The expert panel suggests the following recommendations:

**Recommendation 1:** Joint monitoring and evaluation processes should be streamlined.



## 2 ESG 1.2: Design and approval of programs

**Institutions should have processes for the design and approval of their programs. The programs should be designed so that they meet the objectives set for them, including the intended learning outcomes. The qualification resulting from a program should be clearly specified and communicated and refer to the correct level of the national qualifications framework for higher education and, consequently, to the Framework for Qualifications of the European Higher Education Area.**

### 2.1 Implementation

#### Design and approval of the study program

The TUM study programs follow the General Academic and Examination Regulations (APSOs) for Bachelor's and Master's degree programs at TUM. Program-specific Academic and Examination Regulations (FPSOs) apply specifically to the relevant degree programs, establishing unique regulations and requirements that differ from those outlined in the APSO.

The TUM Centre for Study and Teaching - Quality Management team (TUM CST) advises TUM schools and colleges on drafting degree program outlines and establishing academic and examination regulations. TUM CST will guide through the entire development process, up to and including the final stages, before submitting the program outline for review by TUM administrative boards. TUM CST outlines the procedure for the design and approval of the study programs along with a list of TUM contact persons and administrative boards in the form of a flowchart.

This procedure, incidentally, represents the core element of quality management at TUM. The manuals include guidelines for each stage of the process as well as a timeline showing the applicable deadlines.

At TUM, the key information concerning a degree program is catalogued in the degree program documentation, which includes a description of the qualification profiles issued to graduates as well as an overview of the structure, thematic focal points, modularization plan, and resources required to run the program.

The degree programs currently in use are not set in stone; rather, they are continually being revised and adapted for reasons such as curriculum updates, improvements to degree program design and studyability, requests from students, and various additional external requirements. The degree program administrations at schools or colleges are first notified of the possible changes to the degree programs. The legal division of the TUM Study and Teaching Unit will advise later on updating the program-specific Academic and Examination Regulations (FPSOs) and assist in preparing for the administrative board review.



In many cases, program modifications must be recorded in the Program-Specific Academic and Examination Regulations (FPSOs) and documented by means of modification statutes. These statutes, unless exceptionally complicated, are generally reviewed at TUM Senate meetings.

As defined by the Standing Conference of the Ministers of Education in Germany (KMK), modules are thematically and chronologically related, self-contained units of study assigned with a certain number of credits and subject to assessment. With the aim of promoting transparency, the KMK has now made module descriptions mandatory. These documents serve a dual purpose: By providing an overview of desired learning outcomes, the estimated workload, instructional and self-study methods, and key facts relating to course content and delivery, module descriptions also serve as an important basis for the assessment of academic and study qualifications with respect to their transferability.

In addition to summarizing the desired learning outcomes, module catalogues must contain detailed descriptions of the methods used to achieve these objectives. A module catalogue can comprise the full set of module descriptions for a degree program, a school or college, or the entire university. Module size and scope will generally depend on the estimated time required by students to work through the instructional materials. Since module content and didactic approach can vary widely, there are no hard and fast reference values available.

### **Program Initiation**

Ideas for new programs can originate from a top-down approach (government, SIT Board or senior management] or a bottom-up approach (faculty or industry] approach. For new program ideas originating from the bottom up, DoPs are responsible for evaluating the feasibility of the program before proposing it to the provost, who may then approve the formation of a Program Development Working Group (PDWG).

The curricula of the proposed programs are presented for approval to the BOS to ensure they meet the academic requirements of SIT and that students that are completing the program are instilled with SIT's DNA. The BOS reviews the curriculum rigour and structure, the pedagogical approach, assessment methodologies and the integration of key SIT elements. Before the program is submitted to the Ministry of Education for launch approval, it must first be approved by the BOT. This program is a joint degree program and therefore it is subject to joint program management.

### **Joint Program Management**

In managing the joint program, additional joint management committees are set up. These includes the Joint Board of Examiners (JBOE) and Joint Program Operations Committee (JPOC), which are collaboratively formed by SIT, TUM, and TUM Asia.



The JBOE meets once every trimester after the completion of examinations, with the Chair and Co-Chair alternating between both parties on an annual basis. The composition of the JBOE includes representatives from both SIT and TUM.

### **History and Purpose of the EDE Program**

Singapore's electronics industry is a key sector of growth for Singapore's economy. Back in 2016, electronics manufacturing contributed 4.4% to Singapore's Gross Domestic Product (GDP), accounting for close to S\$90 billion in manufacturing output. In 2020, the electronics sector accounted for almost 38% of the S\$17.2 billion in fixed asset investments. It is the largest contributor to manufacturing output in Singapore and the employment for the industry stands at about 70,500, which is almost 20% of total manufacturing jobs (Corporate, 2023).

The emergence of new technologies such as autonomous vehicles, artificial intelligence, and smart factory, which are largely enabled by electronics, have brought about new growth opportunities for the industry. These new applications will drive greater diversity of demand for electronics and advancements in hardware. Unlike other established electrical engineering degree programs, the EDE program was drawn up to cater to the needs and directions identified under the Industry Transformation Map (ITM) for the electronics industry (EDB, 2017).

To meet the manpower needs of 5,200 new Professionals, Managers, Executives and Technicians (PMETs) by 2025 (Enterprise SG, 2023), the Skills Framework for electronics was launched. Notably, the emerging skills and competencies identified include those in the areas of Artificial Intelligence (AI), Internet of Things (IoT), data analytics, robotics, and automation.

The curriculum for the EDE program encompasses all these emerging topics such that the students will pick up the necessary skillsets for their future employment. The combination of electronics and data engineering, which is rare not only in Singapore but also worldwide, is designed to equip students with the core fundamentals of electronics and at the same time, to apply emerging technologies to revolutionise the operations of electronics manufacturing. There is a strong presence of leading global semiconductor companies in Singapore, including 21 wafer fabrication plants.

The hardware advancements will be tremendous in coming years with much faster processors, higher quality sensors, lower power semiconductors, and more storage devices. For the electronics specialisation in this program, students will be equipped with knowledge and skills to cater for industry needs, such as silicon device fabrication technology and reliability, radio frequency electronics, etc.





## **Development of the EDE Program**

The 4-year joint TUM-SIT EDE Program was first offered in 2020. It is based on an expanded version of the 3-year program Bachelor of Science in Electrical Engineering and Information Technology (EEIT) that was offered by TUM in Singapore between 2010 – 2019.

In 2020, TUM together with SIT launched a new 4-year joint degree program named Bachelor of Engineering with Honours in Electronics and Data Engineering (EDE) to equip students with the above-mentioned required emerging skills and competencies in the areas of AI, IoT, data analytics, automation and robotics in addition to the core electronics engineering background. Thus, students are equipped with the necessary skillsets required in the digital workforce. In deriving the direction for this program, references have also been made to the Industry Transformation Map (ITM) (MTI, 2017) and Skills Framework (EDB, 2017) for the electronics sector. The program is a combination of German engineering, interdisciplinary skills, and understanding of Southeast Asian culture and industry. Furthermore, the program is designed to offer students university education with a mélange of academic and industrial-linked courses in modular, project-based and practice- oriented format. During the B.Eng. EDE program the students can apply the knowledge they have gained in the Integrated Work Study Program (IWSP) and Bachelor thesis. Students will be awarded a joint Bachelor's degree from TUM and SIT upon successful completion of the program. Graduates should be prepared for challenging roles in engineering positions in electronics and information technology sectors, with growth potential into leadership roles. Graduates can also choose to pursue their postgraduate degree.

### **3-Year TUM Program EEIT (2010 intake – 2019 intakes)**

From 2010-2019, the 3-year Bachelor of Science (Electrical Engineering and Information Technology, EEIT) program recruited students with relevant polytechnic diplomas and A level certificates. Polytechnic students could be exempted from certain modules and thus complete their studies in 2.5 years. There were two teaching and assessment semesters per academic year, with a long break between academic years. The modules were mostly taught in block teaching mode. Students would travel to TUM for a 3-month Overseas Immersion Program (OIP) in semester 5 where they typically conducted their Bachelor thesis with a TUM professor.

### **4-Year TUM-SIT Program EDE (2020 intake – 2021 intake)**

The 3-Year program evolved into the current 4-year Bachelor of Engineering degree program EDE jointly offered by TUM, SIT and TUM Asia. It had its first intake in 2020. The curriculum of the new program includes all the core Electronics engineering elements of the previous program, while adding more fundamental modules. The program is based on a trimester



system with a 1-week break during each trimester and an average of 3-week break between trimesters.

#### **4-Year TUM-SIT Program EDE (2022 intake – present)**

The 4-year Bachelor of Engineering degree program EDE undergoes a harmonization process to incorporate interdisciplinary learning and transferrable skills components into the curriculum to better prepare the students for the workplace.

#### **Student Learning Outcomes (SLOs)**

The assessment and evaluation processes for the SLOs rely on several tools that seek feedback from students, alumni (in future), faculty, and the program lead. The program has established a comprehensive assessment process for its SLOs to ensure that it is being monitored and measured adequately and appropriately. Various direct and indirect assessment methods are adopted to evaluate the attainment of the SLOs periodically using the Module Learning Outcomes (MLOs): In each module, students acquire competencies that add towards the Student Learning Outcomes. The achievement of Module Learning Outcomes is assessed with direct measurements (i.e. how well students perform in the module) as well as indirect measurements (MLO survey). The input is evaluated by the Program lead and proper corrective actions are taken whenever necessary.

The Assessment Methods are split into direct and indirect modes. The direct Assessment Methods include: overall module results, quizzes/tests/midterms, oral presentations, project reports, demonstration of laboratory or design skills, and final examination results. The indirect Assessment Methods consist of module learning outcome survey on selected modules and exit survey of graduating students.

Below is the list of the 12 Student Learning Outcomes (SLOs) for the EDE program:

- a) Engineering Knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
- b) Problem Analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.



- d) Investigation: Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- f) The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
- h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
- j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) Life-long Learning: Recognise the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

At the program level, the Program Leads are responsible for collating and interpreting all the direct and indirect data. They would identify any weaknesses from the directly measured data presented for each module. Where there is significant deviation from its performance target for three consecutive semesters, a closer evaluation of the teaching processes and assessment strategies in the module will be required to determine if expectations have been inappropriately set. Changes can then be made accordingly, after consultation with module leads/instructors.



The Program Leads provide the final recommendations if any change is required at the program level.

## **2.2 Assessment**

The EDE study program aligns with international, particular European standards due to its strategic partnership with TUM. This collaboration allows for the ongoing refinement and guidance of the academic framework, ensuring the program is rigorously designed, reviewed, and updated to meet high academic standards and stakeholders' expectations.

The curriculum of the EDE program is well documented, outlining the student's qualification profiles, thematic focus areas, modularization plans, and resource requirements. The process of development can be seen as a continuous review and adaptation in response to curriculum updates, student feedback, and external requirements. This is part of a dynamic approach to ensure that the program remains relevant and capable of equipping students with the necessary skills and knowledge in a rapidly evolving field.

Assessment methods in the program are clearly defined, comprising both direct (e.g., final examinations, project reports, demonstration of practical skills) and indirect (e.g., module learning outcome surveys, exit surveys) modes. The responsibility for analysing these assessments and identifying areas for improvement lies with the Program Leads, who systematically review performance data and recommend adjustments where necessary. This data-driven approach to quality assurance aligns with ESG standards, ensuring that the program maintains high educational standards and addresses any identified weaknesses in a timely manner.

The EDE program also complies with the standards set by the Standing Conference of the Ministers of Education in Germany (KMK), particularly regarding the modular structure and transparency of module descriptions. This compliance ensures that the program's design and content meet recognized high national and international standards, promoting transparency and transferability of credits within the broader European higher education framework.

### **Intercultural and academic mobility opportunities**

The program's nature is to actively integrate intercultural experiences into the curriculum by encouraging student participation in international projects, exchange programs, and collaborations with global partners. These opportunities are designed to enhance students' understanding of different cultural contexts and perspectives, which are crucial for innovation and leadership in a global industry. TUM Asia's strategic location in Singapore, a multicultural hub, already provides a unique environment where students can naturally engage with a



diverse community, enriching their educational experience and intercultural awareness. To promote academic mobility, the program offers structured exchange opportunities with TUM in Munich and other partner institutions worldwide. These exchanges allow students to experience different educational systems, research methodologies, and industry practices, broadening their academic and professional horizons. In order to further align the EDE program outside of the ASEAN countries, it is committed to expanding its intercultural and academic mobility opportunities. This includes the potential development of new partnerships with universities and industry leaders across Asia, Europe, and beyond. Additionally, the program is exploring the integration of virtual mobility initiatives, leveraging digital platforms to connect students with peers and experts globally, thereby enhancing their intercultural competence even when physical mobility is limited. [Recommendation 2]

### **Strengthening joint research activities**

TUM Asia is committed to strengthening joint research activities as a key element of its academic strategy. Recognizing that collaborative research is crucial for advancing knowledge and innovation, the program actively promotes partnerships between students, faculty, and global research institutions. These collaborations not only enhance the program's research output but also provide students with valuable opportunities to engage in pioneering projects alongside leading experts in the field. To support these efforts, the program encourages interdisciplinary research initiatives that influence the diverse expertise within TUM's global network. Joint research projects with TUM in Munich and other international partners enable the exchange of ideas, methodologies, and technologies, strengthening a rich academic environment that benefits students and faculty itself. Nevertheless, the program should stay focused on expanding its research collaborations with industry partners in Singapore and beyond. By strengthening ties with the private sector, the program ensures that research activities remain relevant to industry needs, thereby enhancing the real-world impact of its findings. These initiatives collectively contribute to the program's goal of cultivating a vibrant research culture that drives innovation and academic excellence. [Recommendation 3]

### **Overlapping block modules**

By allowing students to choose from overlapping block modules, the program enables them to tailor their studies to their specific interests and strengths. This flexibility not only raises deeper engagement with the material but could also encourage interdisciplinary learning, as students can explore connections between different areas of the EDE program. This modular approach could be particularly beneficial in accommodating diverse learning paces and styles, as students have the option to balance their workload according to their preferences and schedules. Additionally, it supports the integration of practical and theoretical knowledge, as students can select modules that align with ongoing research projects or industry



collaborations. Ultimately, by providing better freedom in module selection, the program empowers students to take control of their education, nurturing a more dynamic and student-centred learning environment that prepares them for the complexities of the engineering field. [Recommendation 4]

In conclusion, the EDE program at TUM Asia is well designed and continuously refined in line with international frameworks and requirements. The program benefits from a rigorous quality assurance process, ensuring that it meets the academic standards expected by TUM and the needs of its students and stakeholders.

### 2.3 Conclusion

The criterion is **fulfilled**.

The expert panel suggest the following recommendations:

**Recommendation 2:** More intercultural and academic mobility opportunities should be considered.

**Recommendation 3:** Joint research activities should be strengthened.

**Recommendation 4:** Overlapping block modules should be taken into account for deeper understanding in the module selection.



### 3 ESG 1.3: Student-centred learning, teaching, and assessment

**Institutions should ensure that the programs are delivered in a way that encourages students to take an active role in creating the learning process, and that the assessment of students reflects this approach.**

#### 3.1 Implementation

TUM Asia employers use a variety of teaching and learning approaches, while the most common being lectures, tutorials, computer classes, laboratory work and individual or group projects. The lectures are conducted via Microsoft PowerPoint and video presentations, which are supplemented by smart board, white board or digital visualizer. Academic staff is encouraged to adopt and utilize the full range of pedagogic techniques to enhance the quality of the student's learning experience and, in some cases, improve the overall efficiency of delivery. Furthermore, all lectures are recorded and published on the xSiTe (SIT's learning management system) to provide students a convenient way to review the lectures after they were held. Many of the modules taught by TUM faculty are conducted in "block-teaching" mode. In such cases, the lessons are run daily for 2 weeks.

#### Tutorials

During class, tutorial sessions are offered as part of the student's self-assessment. The instructor discusses application examples and case studies that reinforce principles, concepts, and analytical techniques covered during lectures. In some sessions, students have the opportunity to present their or their groups' views or solutions, which allows them to learn, unlearn, and relearn from their peers and instructors. Tutorial rooms with movable tables and chairs which facilitate active learning, interactions and discussions between instructors and students, and among students are available.

#### Laboratory Work

Lab experiments are normally conducted in small groups of two to three students each in modules such as EDE1102 Programming and EDE2102 Object Oriented Programming. Each group performs one experiment each week in the respective lab. All students have to first complete a risk assessment (where applicable) before they begin the lab session. Each lab session usually begins with a theoretical briefing by a faculty or professional officer, followed by demonstration. Students will then conduct the experiment under appropriate supervision by the faculty/professional officer. The experiments are designed to reinforce students' understanding of theoretical concepts covered in lectures and tutorials.



**Project Work**

The EDE program incorporates fourteen laboratory-based and three project-based learning activities which connect academic knowledge and skills with real-world applications. The applied learning approach is embraced to produce graduates who will be industry-ready and armed with relevant skillsets and knowledge upon graduation. In these modules there will be a mix of individual and group-based assessments, and the varied assessments train the students in their individual proficiency/mastery of the subject material as well as how to work together in teams. Using the example of EDE2105 Control Engineering module, students will have their individual design assignments while being part of a team and align their work with their teammates to implement various designed digital controllers for motion control of a DC motor. The program also incorporates various aspects of applied learning such as the flipped classroom/remote teaching model where the student will first read up and understand the subject material in his or own time/location via videos, before coming to the assigned class time to participate in discussions and clarify doubts with the instructor and fellow classmates. Simulation tools, e.g., MATLAB and SIMULINK, Python, SQL, etc., and elements of e-learning will be incorporated in the various modules such as EDE2105 Control Engineering, EDE3101 Data Analytics, EDE3102 Machine Learning, EDE3104 Internet of Things, etc., where appropriate to improve the students' learning and mastery of the subject content.

**Seminars and Site Visits**

Seminars and site visits are arranged to increase students' exposures to the latest industrial practices and to strengthen their interactions with their future potential employers, thereby grounding students in the community. Seminars are conducted by industrial experts.

**Study environment and support**

TUM and TUM Asia value the diversity of talents. TUM and TUM Asia support equal opportunities for men and women, acknowledge and promote the diversity and differences among the students, regardless of gender, nationality, religion and worldview, disability, age, or sexual orientation. Openness and mutual respect are the basis of intellectual advancement. Diversity among scholars and scientists, students and employees make TUM an innovative and dynamic university. With the motto "Talents in Diversity", TUM Asia creates a study and work environment in which individual abilities can develop and flourish. The result is a study and workplace characterized by vibrant teams, fruitful debate and outstanding research. The Academic Service Department (ASD) offers a broad range of advising and services to support students in all life circumstance. The academic staff and the Academic Service Department work closely to create a conducive study environment for students. Furthermore, teaching staff offers support via email or even Teams/Zoom/Skype in case students have further inquiries.





## **EDE Module Assessment**

The modules will be graded according to SIT's 5-point Grade Point Average (GPA) system. An exception is the OIP which will be graded as non-letter pass/fail grade. The total mark obtained by a student for each module is translated into a letter grade with an assigned grade point and descriptor in accordance with the grading scheme. An F grade is deemed as "Failure to attain most learning outcomes".

Students will be able to submit an appeal for review of results for all modules upon results release after the concurrence from examiners in the JBOE. Module leads ensure that results have been accurately reflected and tabulated upon receipt of an appeal request by students in the learning management system before either agreeing/rejecting the appeal based on the investigation outcome. Students will then be informed of the outcome of the appeal via SIT's Registrar's Office (RO).

### **3.2 Assessment**

A diverse range of teaching and learning methods is used to enhance and consolidate the learning outcomes of students. Various pedagogical approaches are designed to complement each other, ensuring a comprehensive educational experience. The primary focus of most teaching strategies is to engage students actively in their own learning process, enabling them to gain new knowledge and deepen their understanding of theoretical concepts effectively. This student-centred approach places learners at the heart of the educational process, encouraging them to take an active role in their academic development.

The study environment is considerably designed to support student learning, providing access to resources such as libraries, online databases, and study spaces conducive to both individual and group work. Support services are readily available to assist students in navigating academic challenges, offering guidance and advice tailored to individual needs. In addition, project work plays a crucial role in the curriculum, allowing students to apply theoretical knowledge to practical problems, developing critical thinking, collaboration, and problem-solving skills.

Laboratory work is another integral component of the educational program, offering hands-on experience that is vital for understanding complex scientific and technical concepts. Through laboratory exercises, the students at TUM Asia can experiment, observe, and analyse results in a controlled environment, bridging the gap between theory and practice.

Tutorials provide an additional layer of support, enabling students to engage in small-group discussions facilitated by instructors or teaching assistants. These sessions offer opportunities



for personalized feedback, clarification of difficult concepts, and deeper exploration of subject matter.

### **Implement transparent grading system**

During the session with the students, it was not always clear to the students, which achievements must be made in order to individually complete the tasks in the modules. To ensure a clearer understanding of what needs to be done for the final grade, students should be informed more transparently about how the grade result of their examination management is made up. Students should be able to understand how the grading was achieved. [Recommendation 5]

### **High scientific level of the Bachelor thesis**

More attention should be paid to a high scientific level of the bachelor thesis. The reason for this is that most students won't continue with another academic study program after the bachelor program. Therefore, this is the last scientific proof for most of the students and it could be beneficial to support the students in that direction as long as they are still part of the program. Topic identification is strongly practice-oriented influenced by the industry, a certain research component should therefore be a continuous focus, which could also lead to a stronger connection of the students to the TUM Asia and SIT. [Recommendation 6]

## **3.3 Conclusion**

The criterion is **fulfilled**.

The expert panel suggest the following recommendations:

**Recommendation 5:** The introduction of a transparent grading system should be implemented.

**Recommendation 6:** There should be an stronger focus on a high academic standard of the Bachelor's thesis.

## **4 ESG 1.4: Student admission, progression, recognition, and certification**

**Institutions should consistently apply pre-defined and published regulations covering all phases of the student "life cycle", e.g. student admission, progression, recognition and certification.**



## 4.1 Implementation

In general, admission for the EDE program is handled by SIT (this is regulated in the TUM-SIT Collaboration Agreement).

### General Admission Requirements

Applicants presenting the following qualifications may apply to the BEng (Hons) Electronics and Data Engineering program:

1. **Local Polytechnic Diploma:** Applicants presenting the polytechnic diploma from one of the five local polytechnics, namely, Nanyang Polytechnic, Ngee Ann Polytechnic, Singapore Polytechnic, Temasek Polytechnic, and Republic Polytechnic may apply. Final semester polytechnic students may apply for admission with their first five semesters' results within the stipulated application period. They are required to furnish the results of their sixth semester and diploma certificate as proof of graduation upon receiving them.
2. **Singapore-Cambridge GCE A-Level:** Applicants presenting the Singapore-Cambridge GCE A-Level certificate may apply.
3. **International Baccalaureate Diploma:** Applicants presenting the International Baccalaureate (IB) Diploma awarded by the International Baccalaureate Organisation (IBO) may apply.
4. **NUS High School Diploma:** Applicants presenting the National University of Singapore (NUS) High School Diploma awarded by the NUS High School of Mathematics & Science may apply and will be evaluated on a case-by-case basis.
5. **International & Other Qualifications:** Applicants presenting a Year-Twelve International qualification (e.g., Malaysia Higher School Certificate (STPM), Unified Examination Certificate (UEC), India Standard Twelve, Peoples' Republic of China GaoKao (University Entrance Examination), etc.), or other equivalent Year-Twelve qualifications not specified in the preceding groups above may apply and will be evaluated on a case-by-case basis.

Levels and IB Diploma applicants are also required to fulfil TUM's additional requirements. This information is also stated on the website. Applicants can find information about the admission requirements on SIT's website.

### Holistic and Aptitude-based Assessment for EDE Admission

SIT adopts a holistic and aptitude-based approach in assessing applicants for admission, with broad merit-based admissions criteria. Apart from academic achievements, non-academic merits such as relevant work experience, passion, co-curricular interests and personal qualities will be duly considered in the admission process.



For the consideration of the applicants' personal qualities, a brief personal statement has to be submitted. The applicant elaborates on his/her motivation to apply to the program, further describing any achievements and personal growth & development from past education or work experience. Applicants also share their aspirations after graduating from the program.

All shortlisted applicants are required to go through an admissions interview assessment. In general, SIT will review applicants on their suitability for a degree program based on their aptitude to complete the program, likelihood of pursuing a career in the area after graduation, and their personal attributes/character (passion, determination, team-spirit, and interpersonal skills), as well as their professional experience in the area.

Specifically, applicants shortlisted (based on both academic and non-academic merit) for consideration to the BEng (Hons) Electronics and Data Engineering program are assessed during the interview on their passion/interest in the program, domain knowledge including relevant work experience or prior learning, problem-solving and adaptability skills, positive attitude towards learning, and communication (articulation) skills.

Shortlisted applicants will be assessed through an interview (either via a video platform or a face-to-face assessment) to determine their suitability for the program by the academic staff from SIT as well as TUM Asia or TUM.

### **Discretionary Admission for Applicants with Relevant Work Experience**

Discretionary admission will be considered for BEng (Hons) Electronics and Data Engineering applicants who have not met the cut-off point for the program within an accepted margin but are outstanding on other aspects, including relevant work experience, demonstrated ability and interest, and other areas such as participation in prestigious competitions which are of relevance to the program.

### **Application Processes**

Application for admission is usually open from mid-January to March every year. The application procedure is as follows:

1. Apply via the SIT online application portal, which requires payment of application fee, and uploading of required supporting documents to the portal;
2. Shortlisted applicants are invited for interviews;



3. Check final application outcome via email notification from SIT or via the SIT online application portal;
4. Successful applicants are required to accept their offer via the Joint Acceptance Exercise (JAE) Platform, or by completing an acceptance form (instructions are detailed in the e-offer letter);
5. Successful applicants who have accepted their offer will receive a pre-matriculation package via email and are required to complete the stipulated matriculation procedures by the deadline. Details of the admission process are available on SIT's website.

If the applicant is not offered his/her choice of program, the applicant may make an appeal during the Joint Admissions Exercise (JAE) appeal exercise that is usually conducted in late May-early June after the JAE acceptance closing date. If successful, the applicant can decide to accept the new offer as specified in the offer letter via the JAE Platform as well. He/she will then receive a pre-matriculation package via email and will be required to complete the stipulated matriculation procedures by the deadline.

#### **4.2 Assessment**

The recognition of prior learning and qualifications within the program follows the General Academic and Examination Regulations (APSOs) and is fully compliant with the Lisbon Recognition Convention. This guarantees that students' previous academic achievements are fairly and consistently recognized, facilitating smooth transitions for those entering the program with prior qualifications or transferring from other institutions. The recognition procedure is clearly outlined, ensuring that students are fully aware of how their prior learning is evaluated and credited.

Graduation documentation provided to students is comprehensive and includes all necessary information, such as qualification profiles, learning outcomes, and the specifics of the completed modules. This documentation is not only essential for academic recognition but also serves as a valuable resource for graduates as they enter the workforce or pursue further studies.

Regarding student progression, the program employs a proactive approach to monitoring academic performance. SIT in collaboration with TUM Asia, has developed a thorough system to detect underperforming students early in their studies. This early detection is critical in addressing academic difficulties before they become challenging for the further progress. Students identified as struggling receive personalized attention, with the institution working closely with them to diagnose issues and develop tailored support strategies. This may include academic counselling, tutoring, or adjustments to their study plans, ensuring that each student has access to the resources necessary to succeed.



While the admission requirements are clearly defined and accessible, there is an opportunity to enhance the visibility and transparency of the process and criteria on the institution's websites. Improving the clarity and accessibility of this information will better inform prospective students and ensure a more streamlined and user-friendly admission process. [See Recommendation 7 in chapter 8]

### 4.3 Conclusion

The criterion is **fulfilled**.

## 5 ESG 1.5: Teaching staff

**Institutions should assure themselves of the competence of their teachers. They should apply fair and transparent processes for the recruitment and development of the staff.**

### 5.1 Implementation

In its basic philosophy, TUM is committed to promoting innovation in scientific fields that promise to improve the quality of life and cohabitation in the long term. With scientific and technical skills being promoted as the cornerstone for securing the future development of a nation, TUM is responsible for a high quality of teaching with active participation from all faculties involved. Excellence in fundamental research on a high scientific level and close scientific connections to the industry by TUM faculty serve as a basis for a high quality and practically oriented education of the students. TUM's education emphasizes fundamentals, which will serve graduates for decades in their careers. The university-wide principles for teaching are set out in the TUM Teaching Constitution.

SIT recognises that the quality of the educators defines the quality of the programs and the graduates. The University is committed to establishing a culture of educational excellence by recruiting academic staff with strong industry experience, a heart for students and the passion to bring the best out of them. This will train graduates with distinctive qualities highly valued by the industry. Over time, SIT aims to achieve distinction in education based on its unique applied learning pedagogy, thereby enabling the University to attract and retain more like-minded educators with a strong standing in their community.

The average student/teacher ratio since the start of the program is 27.7/1 over the past three years. For TUM staff, teaching in the EDE program is not obligatory. It is a voluntary assignment with the EDE program and TUM Asia in Singapore. Therefore, student/teacher ratios are not computed for them.



### **Academic Staff Structure**

The TUM is gearing its recruitment policy toward highly distinguished scientists of international calibre. In addition to recruiting from academia, TUM continues the German tradition of recruiting top candidates with an outstanding industrial career, especially in engineering disciplines. A systematic, ongoing screening process proactively identifies top-flight talents who are then recruited into TUM by means of headhunting principles: TUM Faculty Executive Search. Moreover, TUM's recruitment strategy is increasingly oriented toward outstanding young scientists: Attractive employment conditions and career prospects will help them to further develop their scientific potential and to actively shape the academic landscape at TUM.

To stay nimble, cost effective as well as responsive to industry and community needs, SIT adopts a nontraditional matrix academic structure that promotes inter-disciplinary collaborations and allows academic staff to teach across numerous degree programs that require their expertise.

### **Academic Staff Profile**

TUM/TUM Asia academic staff can be broadly classified into the following two categories: Faculty and Associate Faculty (e.g. Adjunct Professors, Honorary Professors, Lecturers). SIT academic staff can be broadly classified into the following three categories: Faculty, Professional Officers (POs) and Associate Faculty.

### **Faculty (TUM)**

The faculty of the TUM includes more than 600 professors, who represent the core subjects of the 8 TUM Schools and Departments (as of Aug 2023). Honorary professors and adjunct professors lecture on specific aspects of professional practice. Lecturers (pre or post PhD) often offer tutorials and supervise lab sessions in addition to the fundamentals taught by professors. The teaching staff currently consists of the following categories: Professors including joint appointments with non-university research institutes (e.g. Max-Planck, Fraunhofer, Helmholtz), Adjunct and Honorary Professors and Lecturers.

The criteria upon which each decision is based are academic qualifications, experience, reputation and future potential. In all cases, the candidates must have gained experience outside Germany and possess intercultural skills. Endowed chairs are assigned to one of the categories A–D depending on the purpose of the endowment and the qualification and maturity of the applicant.

### **Faculty (SIT)**



Faculty is the core group of educators responsible for the development, design, delivery and review of the academic programs. They are expected to contribute to the three pillars of Education, Applied Research & Innovation and Service to the university, industry and/or community. With the focus on applied learning and applied research, the qualities that SIT looks for in faculty are distinct from other traditional universities. Having the required academic qualifications, faculty are expected to be well aware of the industry needs in the area(s) that they will be teaching. They are also expected to create and maintain industry linkages that allow them to keep abreast with and anticipate the new technologies and skills required by industry.

In addition, the faculty are expected to adopt the practice-oriented applied learning approach in teaching. Assessment methods should closely resemble real work to ensure students' acquisition of knowledge and skills that are highly relevant to industry. In summary, the qualities SIT looks for in faculty are:

1. Innovative, practical and exploratory
2. Able to develop new pedagogies to equip students with capabilities to adapt to the fast-changing knowledge economy
3. Able to build strong connection with industry through successful and impactful applied research that brings value to the industrial partners, students, and the university
4. Able to nurture and inspire the students with innovative ideas and hands-on experience through close collaboration with industry.

SIT faculty are organised in technical domain clusters, which form the vertical components of the matrix structure. In the area of teaching, they are expected to contribute to a primary program while supporting another one or two secondary programs requiring their expertise.

### **SIT Professional Officers**

The SIT Professional Officers Division (POD) houses a centralized pool of academic staff under the professional officer scheme. Professional Officers come with specialised and deep technical skills acquired through extensive industry experience. They form the talent pool which brings a much-needed industry perspective to student learning. They facilitate applied learning and applied research in SIT, complementing the academic expertise of the faculty to bring industry practices and applications into the curriculum.

Professional Officers (POs) are respected as equals to the faculty in SIT. They leverage on their industry experiences to create authentic learning environments, where discovery and innovation take place. They act as coaches and mentors to students during practical learning





activities such as laboratory sessions, Capstone Projects and the Integrated Work Study Program (IWSP). Professional Officers could also lead or work with faculty on industry innovation projects to provide solutions to the industry.

In addition to their role in applied learning and applied research, POs manage the centralised laboratory facilities and resources in SIT. With Technical Officers (TOs), laboratory safety professionals, and administrators in POD, they jointly develop central policies and processes for the safe and seamless operation of laboratories in SIT.

### **TUM Faculty Professional Development in Research**

First and foremost, TUM professors are expected to be at the forefront of research in their area of expertise. They will regularly present their research at the leading conferences in their field which they attend on a regular basis and publish their research in the most prestigious journals of their field. TUM professors will often contribute to the program, executive or steering committees of the leading conferences. They will hold relevant editorships at the key journals. This way they not just stay abreast of key developments in their fields, they actively influence and shape them. Their research acumen and achievement will find its way into their lectures (of course, current research results will primarily enter graduate courses; foundation undergraduate courses are affected by new developments in research typically with some time lag and primarily in case of fundamental paradigm shifts).

Financial support and time-off are also provided for faculty and professional officer to attend international academic and trade conferences, workshops and masterclasses. This allows them to keep abreast of the latest development in their respective areas of expertise. These new ideas and development will be infused into lesson content and/or module design, where appropriate. It is also at these conferences that academic staff share with the academia and industry communities about SIT, which potentially creates opportunity for collaboration. Faculty without a PhD may be sponsored for qualifications upgrading. Their PhD topics are expected to be applied in nature, with direct relevance to Singapore and the region.

## **5.2 Assessment**

The EDE program at TUM Asia and SIT aims to recruit top-tier educators from academia and the industry. This commitment to excellence aligns with the ESG Standard 1.5, which emphasizes the importance of qualified and diverse teaching staff in enhancing the educational experience.



In partnership, TUM Asia and SIT run an active search strategy to attract leading experts through comprehensive recruitment processes, ensuring transparency and inclusivity by involving various stakeholders, including students. These procedures are guided by established legal frameworks that guarantee a fair and equitable hiring process. Beyond academic qualifications, significant emphasis is placed on candidates' educational experience and their intercultural competencies, particularly those gained outside of Singapore and Germany. This approach ensures a multicultural and dynamic learning environment.

The engineering program actively supports the career development of young academics by providing clear career pathways, such as the TUM Faculty Tenure Track. This system is supported by initiatives like the TUM Tenure Track Academy and dedicated mentoring teams, which systematically nurture young scientists' growth, guiding them towards full professorships through regular evaluations and performance assessments.

In Singapore, teaching at TUM Asia is a voluntary endeavour for TUM faculty, yet it benefits significantly from the enthusiasm of newly recruited professors eager to contribute to the program. This has resulted in a robust pool of highly qualified TUM professors actively engaged in teaching, ensuring technical diversity and continuity in the curriculum. The faculty is further strengthened by teaching assistants who manage tutorials and laboratory courses, enhancing the hands-on learning experience for students.

SIT adopts an industry-focused teaching approach, requiring educators to remain attuned to current industry needs. This approach is supported by professional officers who bring extensive industry experience, facilitating applied learning and the use of centralized lab facilities. This industry-oriented methodology complements TUM's research-focused approach, creating a well-rounded educational experience for students.

Both institutions provide substantial support for teaching staff development. TUM's "ProLehre" program offers comprehensive support in teaching and didactics, including course planning, revision, coaching, e-learning, and innovative teaching methods. Similarly, SIT has established the Centre for Learning Environment and Assessment Development (CoLEAD), which promotes an application-oriented teaching approach and offers dedicated programs for staff development across various career stages, focusing on learning design, classroom practices, and media production. Additionally, grants for teaching projects are available to encourage pedagogical innovation.

### 5.3 Conclusion

The criterion is **fulfilled**.



## 6 ESG 1.6: Learning resources and student support

**Institutions should have appropriate funding for learning and teaching activities and ensure that adequate and readily accessible learning resources and student support are provided.**

### 6.1 Implementation

SIT's main campus is located at Dover Drive, where classes for SIT and joint degree programs are held. SIT have five satellite campuses located across Singapore, within the grounds of a polytechnic, offering SIT, joint and overseas university degree programs.

SIT will move to a newly built campus, called "SIT Punggol" and is set to transform this in Singapore into a vibrant learning and economic hub. SIT's new campus has been designed to seamlessly integrate with the industry and community as part of the Punggol Digital District. This will enable SIT to deliver a practical, industry-focused education that will prepare its students for the future.

SIT is leading the way in creating an intelligent and sustainable university experience by harnessing the power of the Internet of Things. SIT students have the opportunity to work closely with industry partners in SIT's smart laboratory. These partners can take advantage of SIT's living lab, which provides an open innovation ecosystem for testing and piloting their prototypes in a real-life environment.

EDE students can use all of SIT's physical resources available for students.

### Funding for Learning & Teaching Activities

SIT is a publicly funded university. Ministry of Education (MOE) is the primary source of operating and capital development funding for the University. The allocation mechanisms for the various pools of funds are performance-driven, i.e. MOE's funding is provided in return for delivery of a set of predetermined outcomes.

The program is heavily subsidized through MOE grants. Together with the tuition fees received from students, it is sufficiently resourced to support its operations. MOE grants comprise operating grants and capital funding for the acquisition of Information Technology, Furniture, and Equipment (ITFE).

### Academic Service Teams at TUM Asia and SIT

A dedicated Academic Services Department (ASD) at TUM Asia ensures the smooth running of the EDE program, as well as other programs administered by TUM Asia. This team consists



of one academic service manager (ASM, TUM-Asia) and one academic service executive (ASE, TUM-Asia).

The Academic Programs Administration (APA) division at SIT provides administrative support for all degree programs and to faculty at SIT. Within APA, the functional sections comprise of support teams for the five clusters and two horizontal pillars - Academic Services and Faculty Support teams as APA adopts a centralised approach in efficient allocation of its resources to support the wide spectrum of activities within the Academic Group.

### **Student Support Services**

There are many services available for students seeking support during their study life cycle. The SIT Counselling Service, conducted by in-house, professional counsellors, is available for all students, either in person on campus or via online counselling sessions. Student counsellors provide assistance and support to students facing personal challenges in their lives. For regular academic counselling, this is usually handled by the assigned academic mentors and/or the program academic advisor to the SMC. A counselling advisory committee was set up in July 2018 for optimal systems and processes to meet best practices.

Centre of Career Readiness (CCR) conducts various information sessions and workshops to prepare the students for their IWSP. These activities include networking workshops, resume review clinics and mock interview sessions, self-discovery through Myers-Briggs Type Indicator (MBTI), IWSP reflection learning, pre-departure briefing etc. CCR also organizes annual Career Nexus which is a networking event for students and graduates seeking IWSP and full-time employment opportunities, respectively. Through the interactions with the representatives from participating companies, students get a chance to better understand the company's culture and various career opportunities, thus allowing them to make more informed choices of their employment application.

The Global Experience Division (GED) provides potential overseas internship opportunities and coordinates the 3-week Overseas Immersion Program (OIP) at TUM.

### **Material Resources and Student/Teacher Ratio**

The average student/ teacher ratio since the start of the program is 18/1. Students are enrolled in these joint degrees have free access to the facilities and benefit from both universities: TUM Library Membership and Study Resources; SIT Library Membership and Study Resources; SIT Lab facilities; SIT Sports facilities; SIT Intranet, Email, and Wi-Fi; and SIT Computer Labs; SIT Study and Collaboration Areas; and SIT Health and Wellness.



## **Library and Information Resources**

The library's mission is to provide timely access to relevant information resources and services to support SIT's teaching and learning needs. It serves as a virtual library, as an instructional unit for information literacy and as a learning space.

Students pursuing Chemical Engineering can tap on both SIT Library's resources and TUM Library's e-resources for their study and learning.

## **TUM Library Resources**

With over 2 million printed and electronic items, 260,000 loans, over 4.8 million full-text downloads and 1.5 million library visitors each year, the university library is the academic information centre of TUM (TUM University Library). These services support students, scientists and university staff in their studies, research, teaching, further education and advanced training.

At TUM's nine branch libraries, situated at the university's campuses in Munich, Garching, Freising and Straubing. TUM carries out tasks in the area of literature and information provision for research facilities, companies and private individuals both in Bavaria and nationwide. As a library for legal deposits, TUM archives an essential part of the technical literature published in Bavaria.

By using modern information and communication technologies and professional knowledge management, librarians have adopted an important role as information professionals, who make literature and information available - wherever and whenever required. Working at the interface between knowledge production, knowledge archiving and knowledge transfer, TUM offers immediate and efficient access to scientific information and support academics and students in carrying out their research projects, learning and teaching processes efficiently.

## **TUM Learning Commons and Meeting Point**

The TUM university library is composed by nine branch libraries. Patrons find a modern environment for learning and studying with computer workstations, internet access, scanning facilities. This, along with long opening hours until midnight and on weekends, makes the library a preferred location for learning and communicating at university for many students.

## **Loan Services and Textbook Collections**

An extensive range of literature and five textbook collections are available to all library patrons. TUM's courier service enables library items to be borrowed and returned free of charge at any branch library.



### **E-Book and E-Journal Collections**

TUM ensures that the latest academic books and printed journals reach the library shelves quickly. Furthermore, TUM purchases and licenses numerous e-books, e-journals and specialized databases and make them accessible for TUM students and university staff, on campus and off-campus.

### **Document Delivery Services**

TUM provide library patrons with articles and books delivered directly to their desks and literature that is not available at the university library. TUM's document delivery portfolio comprises the following online services: interlibrary loan, digitisation-on-demand and the in-house delivery service dokumenTUM.

### **Information Literacy Training**

In today's information-based society, skilled handling of information and media is a key competence for success at university and work. As information professionals, TUM Library provides a wide range of information literacy training options to support studies, further education and lifelong learning. TUM Library offers library tours, lectures and courses as part of bachelor and master programs and information literacy workshops for students, doctoral candidates, high-school students and teachers.

### **Electronic Publishing and MediaTUM**

TUM Library offer academics at the university the opportunity to publish their dissertation or habilitation thesis electronically on mediaTUM, the media server at TUM. mediaTUM is based on the open-source software mediaTUM to manage, present, publish, archive and retrieve digital images, documents and videos. mediaTUM was originally developed by the university library, in the framework of the DFG project IntegraTUM.

### **SIT Library Resources**

To facilitate fast and easy access to resources, SIT Library focuses on building a robust online collection. Currently, electronic resources account for 99% of the library's collection. The library provides access to over 250,000 e-books, more than 115,000 online journals, 36,000 online standards and numerous databases. The SIT Community can access virtual resources anytime and from anywhere via the SIT Library website.

To facilitate the discovery of these resources, the SIT Library has implemented a One Search discovery service. This allows students and faculty to search across multidisciplinary



databases using One Search box and refine their results using sophisticated filters. In addition to searching for subject specific databases, the discovery service searches across 147 indexes. This significantly expands the scope and coverage of discoverable resources available to SIT Faculty and Students. There are 25 databases relevant to this program that are available in the library's collection.

Access to the library collections and services is further extended via Inter-Library Loan & Document Delivery Service (ILL&DDS) arrangements. The library has established formal ILL&DDS arrangements with more than ten local libraries as well as with more than 250 overseas libraries through RapidILL resource sharing system. In terms of document delivery services, materials that are not available via these arrangements may also be bought directly from publishers e.g. online article purchase.

### **Learning Services**

The library is staffed by experienced academic librarians holding professional qualifications such as MSc Library & Information Science. This is vital in providing value added services to SIT faculty and students. These services include: (1) Course Material Support, (2): Course Subject Guides (3) How-To Guides, (4) Information Service Desk & Research Consultations, (5) Information and Digital Literacy (IDL) Instruction, (6) Micro-modules.

## **6.2 Assessment**

The TUM/SIT program is supported by a big variety of facilities and equipment convenient to satisfy the program learning requirements for students and teachers.

### **Classrooms:**

SIT offers modern laboratories and classrooms with the necessary tools and technology to facilitate practical learning and experimentation. The classrooms are equipped with modern video projectors that teachers can use to show the teaching material they have prepared for their classes. Classrooms with high capacities, these resources are duplicated for a better view by the students who are attending the class. These classrooms are also equipped with audio systems that allow the teacher's explanations to be heard without any problems.

### **Laboratories:**

The laboratories are also well equipped with experimental, instrumentation and even manufacturing devices. Although these laboratories are used in other programs, their equipment is sufficient to meet the needs of students enrolled in the Electronics and Data Engineering program. The electronics laboratory, which contains a sufficient number of workstations for students to work comfortably in pairs at the same time, stands out favourably.



Each workstation is equipped with a signal generator, an oscilloscope and a multimeter. This instrumentation is considered to be very complete and allows a wide variety of practical work to be carried out.

The electronics laboratory also contains several machines for printing circuit boards (PCBs) and even an anechoic chamber for radio frequency experiments. The presence of these facilities is highly appreciated by the expert group.

### **TUM/SIT library:**

The joint library offers a comprehensive collection of academic resources, including a wide array of books, journals, and digital databases suitable for the needs of electronics and data engineering students. The library provides various spaces for learning, including individual study areas and collaborative spaces. This versatility supports a range of learning activities, from focused solo work to group projects and discussions.

The library allows access to media studios and equipment like VR headsets and the integration of technology in education. These resources are particularly beneficial for the EDE program, as they can simulate real-world scenarios and provide hands-on experience with tools relevant to the industry.

The library contains a wide array of books, journals, and databases which cover the contents of the different subjects in the EDE program. The library's commitment to offering both foundational texts and cutting-edge research materials supports a well-rounded academic experience.

The library provides services like online reservations and smart lockers for equipment pick-up. This user-friendly approach is appreciated as it enhances accessibility and convenience for students.

Overall, the library is a cornerstone of the educational infrastructure for the program. It provides a comprehensive range of services and resources essential for supporting the students.

### **Administrative staff**

The academic and operational aspects of the program are conveniently supported by a dedicated Academic Services Department. The team of this department is well-structured into the Academic Service Manager and the Academic Services Executive. The administrative staff has the qualifications and capabilities necessary to support the EDE program. Individuals showed excellent experience and education in academic administration during the site visit.

The administrative staff is well-organized to efficiently handle the specific operational aspects of the program, ensuring targeted and expert support for both faculty and students. The staff





possess a high level of competence and were highly involved in all the program accreditation processes.

Student mobility is fundamental in this joint TUM-SIT program. The administrative staff conveniently assists students with the logistical aspects of studying abroad, including coordination with partner institutions, managing exchange agreements, and ensuring students meet the requirements for study trips and exchanges.

Administrative personnel also manage the recognition of credits and certifications obtained abroad, ensuring that students' mobility does not hinder their academic progression within the program.

The program provides a broad spectrum of learning materials, from traditional textbooks and academic papers to digital resources and multimedia content. This variety ensures that students with different learning preferences (visual, auditory, reading/writing, and kinaesthetic) can find materials that suit their style.

The program provides both online and physical resources. This way, students can access learning materials regardless of their physical location or time constraints, benefiting those who may be part-time students or international students. The program also combines traditional in-class instruction with online activities and project-based learning and flipped classroom approaches, to offer flexibility in how and when students engage with the given materials and real scenarios.

SIT provides mental health services and well-being initiatives to support students' overall health. It also includes support for students with disabilities while studying together.

The program provides a wide array of learning materials and comprehensive support services. This illustrates the commitment of SIT to a student-centred educational approach. Therefore, the program features modern, industry-standard equipment and facilities, ensuring that students have access to tools and resources that reflect current professional practices. Additionally, there are systems in place to ensure that all students, including those with disabilities, can access the necessary equipment, thereby supporting an inclusive learning environment. The program's commitment to regular updates and responsiveness to student feedback suggests a proactive method to maintaining the relevance and accessibility of their resources.

SIT utilizes multiple platforms such as email, learning management systems, social media, and dedicated portals to disseminate information about their services. It also offers introductory sessions for new students that cover all available services, from academic support to health and wellness resources.



The given information in the report and during the session did not specify particular actions for the further qualification of supervising/administrative staff. It merely outlines the program's general approach to staff development, or the quality of education provided, but does not detail specific strategies or methods for a general staff development. This topic could be strengthened in the future.

### 6.3 Conclusion

The criterion is **fulfilled**.

## 7 ESG 1.7: Information management

**Institutions should ensure that they collect, analyse and use relevant information for the effective management of their programs and other activities.**

### 7.1 Implementation

In their collaborative corporate study programs, TUM Asia and SIT integrate their information management systems to provide seamless and comprehensive support to students. This collaboration ensures that all information regarding joint programs are consistently and accurately communicated, leveraging the strengths of both institutions' systems. Joint efforts include coordinated updates to program details, shared access to student support services, and unified channels for feedback and inquiries. This integrated approach not only enhances the student experience but also strengthens the overall quality assurance framework in line with the ESG.

By adhering to these rigorous information management standards, TUM Asia and SIT demonstrate their commitment to upholding the highest levels of quality assurance and transparency, thereby ensuring that their corporate study programs in Singapore meet and exceed the expectations of students, industry partners, and regulatory bodies.

### 7.2 Assessment

SIT clearly identifies the sections in charge of collecting and analysing the information on the EDE program. The program's approach to collecting and analysing information is thorough, ensuring that decisions are based on accurate and up-to-date data, with the ultimate goal of enhancing the educational experience and outcomes for students.

Data is available over the last four years as the program was setup in AY2020. Student numbers are fairly stable over the period AY2020 to AY2023. The number of intake students was slightly higher in AY2020. Yet, the number of students withdrawn from the program were



also higher than in subsequent years. It is appreciated that no students were dismissed from the program during AY2022 and AY2023.

Both students and employees are engaged in supplying and evaluating data as well as in the planning of follow-up activities. Their participation ensures that the data collected is relevant and that the resulting actions are well-informed and effective, considering the perspectives and experiences of those directly involved with the program. This inclusive approach leads to more comprehensive and actionable insights for follow-up activities, driving improvements that are aligned with the needs of all stakeholders.

### 7.3 Conclusion

The criterion is **fulfilled**.

## 8 ESG 1.8: Public information

**Institutions should publish information about their activities, including programs, which is clear, accurate, objective, up-to date and readily accessible.**

### 8.1 Implementation

TUM, TUM Asia and SIT regularly provide and update information about the institutions' activities, through various platforms to all stakeholders (including but not limited to prospective students, current students, alumni, stakeholders in academia and industry and so on). Stakeholders can find all relevant information on the study programs which TUM, TUM Asia and SIT offer.

### 8.2 Assessment

TUM Asia and SIT provide comprehensive information about the structure and content of the study program on their respective websites, serving as the main information website. Administrative procedures are handled via the standard SIT application process on the SIT website. Although it is clearly mentioned on the website that some courses will be taught by TUM staff in Singapore for this purpose, it might be pointed out more clearly on the website that these courses will be organized in a block-teaching manner, which was not known prior to enrolling in the course to students interviewed during the audit.

#### **Transparent information on the website**

To ensure that all potential students from national and international universities have access to the relevant program information, the design of the study program should be even more described more transparently on the website and thus refer to the block modules of the



curriculum so that students can find clear information about the structure of the study program.  
[Recommendation 7]

### **8.3 Conclusion**

The criterion is **fulfilled**.

The expert panel suggest the following recommendation:

**Recommendation 7:** The publication of study program information on the website should be more transparent.

## 9 ESG 1.9: On-going monitoring and periodic review of programs

**Institutions should monitor and periodically review their programs to ensure that they achieve the objectives set for them and respond to the needs of students and society. These reviews should lead to continuous improvement of the program. Any action planned or taken as a result should be communicated to all those concerned.**

### 9.1 Implementation

#### Program Constituent Stakeholders

The following two groups of stakeholders closely related to the programs are identified by the HEI:

- a) TUM and SIT constituencies: Current undergraduate students (“students”); Faculty members of the School (“faculty”); Administrative staff supporting the programs’ operations; Other administrative departments of TUM and SIT such as the Academic Program Administration, Office of Admissions, TIE. (“SIT Administration”)
- b) External constituencies: Alumni; Employers; Members of the Industrial Advisory Committee (IAC); Ministry of Education; Community

#### Process for Establishing Program Educational Objectives (PEO)

The PEOs are established based on the needs of the program's various constituencies. Specifically, the following requirements have been incorporated into the PEOs:

1. The definition of the PEOs as given by the EAB guidelines. (Engineering Accreditation Board, 2020)
2. Both formal and informal feedback from the program’s industrial partners on the required skill set for the CE engineering graduates
3. The recommendations from the Industrial Advisory Committee (IAC) on the desired curriculum content of program

#### Achievement of Program Educational Objectives

There are three feedback loops. The inner loop assesses the effectiveness of teaching and learning at the level of individual module learning outcomes (MLOs), the middle loop assesses the student learning outcomes (SLOs) while the outer loop assesses the PEOs. The outer loop is closed over a longer cycle (3 to 5 years) through external assessment and review with various stakeholders. The MLOs for each module state the educational goals of the module in terms of learning outcomes and allow faculty as well as students to assess their attainment.



Students will give their feedback on the degree to which they have attained the Module Learning Outcome and on the teaching of the module lead. Based on feedback and the results, the module lead will then be able to reflect on and assess the extent to which the MLOs have been achieved and suggest ways in which the teaching of the module could be improved. These insights can then be shared during the Program-Level Board of Examiners (PBOE) discussions involving the module lead.

This joint-degree program is aligned with the Engineering Accreditation Board (EAB) in adopting the set of Graduates' Attributes (GAs) published by the Washington Accord as the basis of SLOs. These relate to the knowledge, skills and behavioural traits that are desired for the EDE students to acquire while progressing through the program. For the EDE program, upon graduation the students will be equipped with knowledge and skills in the following key areas: (i) fundamental engineering principles and application-based skills in microelectronics, semiconductor technology, and automation, as well as (ii) emerging technologies, such as Internet of Things (IoT), data science, artificial intelligence, machine learning.

The review and assessment of PEOs will be based on alumni surveys, employer surveys and focus group discussions. For alumni surveys, the assessment will use data gathered from surveys of alumni 3-5 years after their graduation. The survey will ask the alumni questions on their perceptions of their abilities and attributes as engineering graduates. These questions will be mapped to the four PEOs. For each PEO, the percentage of positive responses to each question related to that PEO will be averaged. This average percentage will be taken as an indicator of attainment as perceived by the alumni.

Similar questions will also be used in a survey for the employers. Their responses will be evaluated to arrive at the attainment of the PEO as seen from the employers' perspective.

### **Evaluation of Curriculum and Teaching Processes**

The Program Leads regularly evaluate the curriculum and teaching processes to identify areas of improvement and corrective actions which can help the program to better meet its goals.

### **Inner Feedback Loop at Module Level**

At the end of every trimester, before the final exams start, students will be asked to provide feedback for every module through the online Module Feedback and Teaching Feedback survey forms. At the end of every run of a module, the faculty who is the Module Lead is expected to evaluate the assessment results and Module/Teaching Feedback data to identify what had gone well in the module and what areas would need improvement for the next run. The Module and Teaching Feedback data inform the Module Lead about how well classroom



teaching has been received by the students. The MLO feedback gives an indication of students' confidence in achieving the MLOs. In this way, the Module Lead has a comprehensive view of how students have performed in the module from different perspectives. The Module Lead will also provide his/her own reflections of the module. Possible actions for improvement may include changes to teaching pedagogy, changes to type of assessments, assignments, etc. which can help the whole class to fully attain the MLOs. Relevant samples of students' work (homework, midterm and/or final exam solutions, lab and project reports) are saved on a regular basis for future comparison and evaluation. This allows the Module Leads to compare the results between consecutive student intakes to assess if the teaching intervention introduced is effective for the attainment of the MLOs so that they can recommend changes necessary for improvement.

At the end of each trimester, the Program Lead/Director convene with all the module leads to discuss examination results. The discussion centres around overall performance of students, best practices in teaching and assessments, and recommendations for changes.

### **Middle Feedback Loop at SLO Level**

The middle feedback loop monitors the effectiveness of the program in delivering the Student Learning Outcomes. The data from the EAB Outcomes Survey for graduating students is the main instrument for assessing the attainment of the SLOs at the point of graduation. This survey is conducted every year for all graduating students. Furthermore, feedback sessions with students, IAC members, alumni and industry partners can also provide insights on improving the program.

### **Outer Feedback Loop at PEO Level**

The outer feedback loop evaluates the effectiveness of the program's graduates several years after graduation. For this, the Program plans to use surveys of alumni and their employers as well as focus group discussions with both groups.

### **Actions to improve the Program**

As EDE is a new program and has yet to graduate their first cohort of students, there have not been major corrections which arose from the feedback loops. Feedback will be continuously collected from the students.

The direct and indirect assessment exercises will be continued to cover all modules in the EDE curriculum as the students completed them and to cover more cohorts of students. At the end of every run of the module, the module lead will reflect on what went well and which aspects need improvement for the run and recommend changes to teaching pedagogy, type of assessments, assignments, etc. to better achieve the MLOs and SLOs.



In AY-2021, SIT implemented the Undergraduate Program Structure (UPS) as part of the university-wide effort to harmonize their programs. The UPS introduced changes in the program including efforts to improve based on past student feedback. The changes in the program include the increase in modular credits for each module from 5 credits to 6 credits as well as the reorganization of modules for a better knowledge transfer to the students.

## 9.2 Assessment

TUM Asia and SIT exemplify excellence in higher education through their meticulous attention to quality assurance practices. Both institutions have established formal policies for quality assurance that serve as pillars supporting their commitment to academic excellence and continuous improvement.

At TUM Asia, the quality assurance policy is a cornerstone of its academic framework, reflecting the institution's unwavering dedication to delivering world-class education. Developed in consultation with faculty members, administrative staff, and external experts, this policy encompasses a wide array of areas crucial to ensuring educational quality. From curriculum design and teaching methodologies to assessment practices and student support services, every aspect is meticulously outlined to uphold the highest standards of academic integrity and excellence.

Similarly, SIT boasts a comprehensive quality assurance policy that underpins its reputation as a leading institution in higher education in Singapore. This policy, developed in alignment with international accreditation standards and best practices, is readily accessible to all stakeholders, ensuring transparency and accountability. Covering essential areas such as curriculum development, pedagogical innovation, and student engagement, the policy serves as a guiding framework for maintaining and enhancing the quality of education offered at SIT.

Both TUM Asia and SIT recognize the importance of making their quality assurance policies publicly available. These policies are easily accessible through the institutions' official websites and handbooks, ensuring transparency and providing stakeholders with clear guidance on the institutions' commitment to quality education.

The quality assurance policies of TUM Asia and SIT comprehensively cover all relevant areas essential to academic excellence and program quality. From the initial design and development of curricula to the delivery of courses and assessment of student learning outcomes, every facet of the educational process is meticulously addressed.

Both institutions recognize the importance of staying up to date of emerging trends and best practices in higher education. Their quality assurance policies are regularly reviewed and updated to reflect the evolving needs of students, industry partners, and society at large, ensuring that they remain at the forefront of educational innovation and excellence.





### Transparency of the Quality Assurance Policy

TUM Asia's quality assurance policy emphasizes the importance of curriculum design that is responsive to industry needs and aligned with global best practices. It outlines rigorous procedures for the development and review of academic programs, ensuring that they meet the highest standards of quality and relevance. Similarly, SIT's quality assurance policy places a strong emphasis on curriculum development that is informed by industry trends and stakeholder feedback. It emphasizes the integration of real-world experiences and practical learning opportunities into the curriculum, preparing students for the demands of the global workforce. TUM Asia and SIT demonstrate a strong commitment to the effective implementation, monitoring, and revision of their quality assurance policies. Both institutions have dedicated quality assurance teams responsible for overseeing the implementation of quality assurance measures and ensuring compliance with established standards. Besides this it was seen that the policy should have more transparency and accessibility internally for everyone to participate. This will allow TUM Asia and SIT to establish even greater trust, accountability and collaboration within their academic communities. [Recommendation 8]

### 9.3 Conclusion

The criterion is **fulfilled**.

**Recommendation 8:** The Transparency of the Quality Assurance Policy should be increased.

## 10 ESG 1.10: Cyclical external quality assurance

**Institutions should undergo external quality assurance in line with the ESG on a cyclical basis.**

### 10.1 Implementation

The EDE program as joint degree follows both TUM's and SIT's degree regulations. The program was granted provisional accreditation by the Singapore Engineering Accreditation Board (EAB) in 2022/2023 for the graduating batches of the Academic Years 2023/2024 and 2024/2025 and seeks to be fully accredited later on before the end of Academic Year 2025/2026. The program also seeks for accreditation in Germany.

#### TUM External Quality Assurance

TUM as whole institution is system-accredited in Germany. The internal quality management ensures that all structures and processes relevant to studying and teaching meet high quality



requirements. The current system-accreditation is valid through 30 September 2028. The accreditation procedure essentially consists of an internal self-evaluation followed by a series of external appraisals conducted by an agency certified by the Accreditation Council. Besides evaluating the specific degree programs, an evaluation of the Schools (former Departments) at TUM takes place. The School evaluations are held every 6 to 8 years and include external evaluation in the form of an “Informed Peer Review”. In this way, external expertise is engaged in the strategic development of School profiles and their degree programs.

With regard to external quality assurance, the programs taught in Singapore at TUM Asia such as the EDE program undergo an individual program accreditation. The Master’s programs offered at TUM Asia received accreditation in 2020.

The TUM-SIT program EDE was established in 2020. The program is now being reviewed within the frame of a first accreditation in Germany.

### **SIT External Quality Assurance**

Provisional accreditation was awarded to the TUM-SIT EDE program by the Engineering Accreditation Board (EAB) in March 2023.

### **Industry Advisory Committee (IAC)**

As a university of applied learning, SIT strives to integrate learning, industry, and community. To remain industry-relevant, SIT continually fine-tunes its curricula and pedagogy. This is vital to the success and growth of SIT’s programs and to equip SIT’s students with employment ready knowledge, skills and competencies.

The Industrial Advisory Committee (IAC) provides a platform for on-going exchange of information between the industry and the university. The principal purpose of the IAC is to provide feedback and advice concerning the development, maintenance, and stakeholder acceptance to the degree programs offered by the University. SIT considers IAC as instrumental in understanding the industries’ needs with respect to the type of talents that they require. With these needs, SIT is thus able to develop and equip its students with the right skills and traits that the industries require.

The term of references for IAC are as follows:

1. Review the program educational objectives and statistics/data to ensure that they meet the needs of business, industry and society as well as the relevant accreditation criteria;
2. Advise, recommend and assist in identifying the need for new majors/specialisations to be offered by the degree program;



3. Evaluate strengths, merits, and weaknesses of the program and propose strategies for continuous improvement of the program;
4. Provide recommendations related to the curriculum so as to improve the relationship between academic and best professional practices;
5. Provide inputs and feedback on new program(s) that are of similar domains proposed by SIT;
6. Advise on current and future employment opportunities, industry trends and employer needs;
7. Assist in identifying and creating opportunities that will be of benefit to the degree program, for example, student placements, and partnerships with industry majors, scholarships, endowments, etc.;
8. Promote and enhance the visibility of SIT and its degree program both locally as well as internationally; and
9. Explore and connect SIT and Industry on possible collaboration in applied research.

The IAC will meet at least twice every Academic Year but may meet more frequently when necessary. Individual members of the IAC may also be approached on an ad-hoc basis, subjected to his/her availability, for advice or further discussions of specific matters arising from meetings. IAC meeting agenda could cover (but is not limited to): Existing and/or new academic programs and development; How to equip students with the relevant skills to meet industries' needs; Ensuring current academic curriculum meets industry needs; Recommendations for Integrated Work Study Program (IWSP); Securing scholarships for students in the industry; and Possible areas for applied research projects/consultancy/collaboration.

Members of IAC are selected for their expertise and leadership in their respective fields and sectors. They are invited as individuals to represent their professional standing within an industry; members do not represent their company.

## **10.2 Assessment**

The external quality assurance practices of the TUM Asia and SIT are evaluated very positively from a holistic view, demonstrating a robust commitment to ensuring excellence across all aspects of its operations.

## **Comprehensive Coverage**



The quality assurance framework of the HEI is appropriately designed to cover different organizational levels and status groups within the institution. It encompasses a wide range of activities, including teaching, research, administration, and support services, ensuring that all areas crucial to the institution's functioning are subject to rigorous evaluation and improvement.

### **Alignment with Legal Framework**

The quality assurance mechanisms of the HEI are meticulously aligned with the relevant legal framework governing higher education. By adhering to national regulations and standards, the institution ensures compliance with legal requirements while upholding the integrity and credibility of its academic programs and services.

### **Confirmation and Improvement**

The external quality assurance processes serve to both confirm the internal quality assurance practices of the HEI and stimulate continuous improvement. External evaluators provide valuable feedback and recommendations based on thorough assessments, validating the institution's existing quality assurance measures and identifying areas for enhancement. This iterative approach fosters a culture of continuous improvement, driving the institution towards higher levels of excellence and effectiveness.

### **Transparency and Accountability**

The quality assurance mechanisms of the HEI are transparent and accountable, providing the university community and the public with comprehensive information on the quality of its activities. Reports, evaluations, and accreditation outcomes are made readily available to stakeholders, facilitating informed decision-making and promoting accountability at all levels of the institution.

Overall, the external quality assurance practices of the HEI demonstrate a strong commitment to excellence, accountability, and continuous improvement. By ensuring comprehensive coverage, alignment with legal requirements, and transparency in reporting, the institution upholds the highest standards of quality and integrity in its academic endeavours.

## **10.3 Conclusion**

The criterion is **fulfilled**.



#### IV Recommendation to the Accreditation Commission of ACQUIN

##### 1 **Assessment of compliance with the Standards and Guidelines in the Higher European Area (ESG) in the actual official version**

The study program „Electronics and Data Engineering“ ((B.Eng. (Hons)) were assessed on the basis of the "Standards and Guidelines for Quality Assurance in the European Higher Education Area" (ESG).

The expert group concludes that the **ESG standards** 1.1 (Policy for quality assurance), 1.2 (Design and approval of programs), 1.3 (Student-centred learning, teaching and assessment ), 1.4 (Student admission, progression, recognition and certification), 1.5 (Teaching staff), 1.6 (Learning resources and student support), 1.7 (Information management), 1.8 (Public information), 1.9 (On-going monitoring and periodic review of programs) and 1.10 (Cyclical external quality assurance) are fulfilled.

The assessment criteria are as follows:

**Standard 1.1 Policy for quality assurance:** Universities have a publicly accessible quality assurance strategy, which is part of their strategic management. This strategy is developed and implemented by internal stakeholder representatives through appropriate structures and processes, involving external stakeholders.

The criterion is **fulfilled**.

**Standard 1.2 Design and approval of programs:** Universities have procedures for the design and approval of their courses. The courses are designed in such a way that their objectives, including the desired learning outcomes, can be achieved. The qualification obtained during a degree program is clearly defined and communicated; it refers to the corresponding level of the national qualification's framework for higher education and, consequently, the qualifications framework for the European Higher Education Area.

The criterion is **fulfilled**.

**Standard 1.3 Student-centred learning, teaching and assessment:** Universities ensure that the courses offered are carried out in such a way as to encourage students to play an active role in the design of the learning process and that this approach is also taken into account when assessing students / examinations.

The criterion is **fulfilled**.



**Standard 1.4 Student admission, progression, recognition and certification:** Universities ensure that the courses offered are carried out in such a way as to encourage students to play an active role in the design of the learning process and that this approach is also taken into account when assessing students / examinations.

The criterion is **fulfilled**.

**Standard 1.5 Teaching staff:** Universities ensure the competence of their teachers. They use fair and transparent procedures for the recruitment and further training of their employees.

The criterion is **fulfilled**.

**Standard 1.6 Learning resources and student support:** The university has adequate funding to finance study and teaching and ensure that there is always a sufficient and readily available range of learning and support available for their studies.

The criterion is **fulfilled**.

**Standard 1.7 Information management:** Universities ensure that they collect, analyse and use the relevant data relevant to the successful conduct of studies and other activities.

The criterion is **fulfilled**.

**Standard 1.8 Public information:** Universities publish easily understandable, correct, objective, up-to-date and well-accessible information about their activities and courses of study.

The criterion is **fulfilled**.

**Standard 1.9 On-going monitoring and periodic review of programs:** Universities are constantly monitoring their courses and regularly reviewing them to ensure that they achieve the goals set and meet the needs of students and society. The tests lead to a continuous improvement of the courses. All affected parties will be informed about any measures planned or resulting from this.

The criterion is **fulfilled**.

**Standard 1.10 Cyclical external quality assurance:** Universities regularly undergo external quality assurance procedures in accordance with the ESG.

The criterion is **fulfilled**.



## 2 Accreditation Recommendation

The peer-review experts recommend an unconditional accreditation of the study program "Electronics and Data Engineering" ((B.Eng. (Hons))).

The peer-review experts recommend the following **recommendations**:

### **General recommendations for the study program:**

1. The TUM Asia should streamline the joint monitoring and evaluation processes to ensure greater efficiency and effectiveness with their automated data and analytics tools.
2. More intercultural and academic mobility opportunities should be considered to enable students to immerse themselves with the German culture.
3. Joint research activities to focus on the stated internationalization strategy should be strengthened.
4. A better freedom of overlapping block modules in the design of the curriculum and associated regulations in Singapore should be taken care of.
5. A transparent grading system should be implemented so that students are able to understand how their grading was achieved.
6. Focus on high scientific level of the Bachelor thesis as the identification of a strongly practice-oriented outcome which is often influenced by the industry.
7. The TUM Asia should publish transparent information on the website so that students can find clear information about the structure of the study program.
8. Consideration should be given to creating more transparency in quality assurance policies as a substitute for more trust, accountability and co-operation within the respective academic communities.



## **V Decisions of the Accreditation Commission of ACQUIN**

Based on the evaluation report of the expert group and the statement of the Higher Education Institution, the Accreditation Commission of ACQUIN has made its decision on the 12 September 2024:

### **Electronics and Data Engineering (B.Eng. (Hons))**

**The study programme "Electronics and Data Engineering" (Bachelor of Engineering (Hons)) is accredited without any conditions.**

**The accreditation is valid until 30. September 2030.**

The following recommendations are given for the further development of the study programme:

- The TUM Asia should streamline the joint monitoring and evaluation processes to ensure greater efficiency and effectiveness with their automated data and analytics tools.
- More intercultural and academic mobility opportunities should be considered to enable students to immerse themselves with the German culture.
- Joint research activities to focus on the stated internationalization strategy should be strengthened.
- A better freedom of overlapping block modules in the design of the curriculum and associated regulations in Singapore should be taken care of.
- A transparent grading system should be implemented so that students are able to understand how their grading was achieved.
- Focus on high scientific level of the Bachelor thesis as the identification of a strongly practice-oriented outcome which is often influenced by the industry.
- The TUM Asia should publish transparent information on the website so that students can find clear information about the structure of the study program.
- Consideration should be given to creating more transparency in quality assurance policies as a substitute for more trust, accountability and co-operation within the respective academic communities.

