

## **Gifted Education Fund: Off-school Advanced Learning Programmes**

### **Programme No. 2023-07 (For secondary students)**

Title of programme	Quantum Quest: Practical Experience for Gifted Students
Programme provider	Department of Physics, The Hong Kong University of Science and Technology  Supporting organisation(s): The Hong Kong Academy for Gifted Education
Theme(s)	STEAM-related mentorship programme
Intake	50 students (Secondary 4-5 in the 2023/24 school year)
Prerequisite	Applicants should be studying physics (HKDSE) or other equivalent levels of physics.
Programme delivery period	from May 2024 to Jan 2025 (around 9 months)
Medium of instruction	Course material: English Class teaching/ discussion: English supplemented with Cantonese
Objectives	<ul style="list-style-type: none"><li>• to equip the gifted students with the knowledge of the scientific principles on quantum computing, quantum information and other quantum technologies;</li><li>• to familiarise the students with the applications of quantum computing in different fields, including cryptography and searching;</li><li>• to provide student with hands-on learning opportunities to apply quantum algorithms on small-scale computation projects;</li><li>• to introduce students to the Nobel prize in physics related quantum technology development; and</li><li>• to nurture positive values and attitudes such as perseverance, ethical use of quantum computing for the well-being of mankind, and willing to collaborate with others, as well as to promote the affective development of the gifted students</li></ul>
Programme outline	This programme aims to enable gifted students to understand the operation of quantum computers, the algorithms that are used in quantum computing and the potential applications. Students will acquire useful skills in quantum computing for research. They can also learn and appreciate the current development of quantum computing in China and the connection between quantum physics and art. Besides, through the learning and teaching activities, students can develop positive values and attitudes essential for personal growth and development. An educational psychologist will be deployed to conduct a lesson on affective education for the student participants.

	<p>The programme consists of three phases.</p> <p><b>Phase 1 (5 months)</b></p> <ul style="list-style-type: none"> <li>• 12 lessons (3 hours each; 36 hours in total)</li> <li>• Students will acquire essential mathematics knowledge (matrix algebra and complex numbers) for understanding the language of quantum computing, architecture of quantum computers, quantum states and qubits, multiple qubits and entanglement, ways of building a quantum computer, quantum circuits, quantum algorithms, etc.</li> <li>• The last lesson features a session on affective education conducted by an educational psychologist and a session on the current development of quantum computing in China.</li> </ul> <p><b>Phase 2 (2 months)</b></p> <p><b>Programming quantum algorithms</b></p> <ul style="list-style-type: none"> <li>• 6 programming tutorials with hands-on exercises (3 hours each, 18 hours in total)</li> <li>• Students will learn the principles and mechanisms of quantum algorithms in computing, and their advantages. During the programming exercises and tutorials, students will apply the quantum algorithms learnt and complete hands-on exercises using quantum protocol with an online quantum programming toolbox.</li> <li>• The last tutorial features a session on the connection between quantum physics and the world of art inclusive of musical notes and graphics.</li> </ul> <p><b>Phase 3 (2 months)</b></p> <p><b>Small-scale projects and showcase event</b></p> <ul style="list-style-type: none"> <li>• In groups of 4, students will conduct small-scale project studies on quantum computation or experiments related to quantum technology. A mentor will be assigned to each group to guide students through the small-scale projects (2 sessions per week; 18 hours in total for each group).</li> <li>• Students will collaborate and conduct literature search of quantum algorithms or experiments. Students will understand the design of quantum circuits and do relevant quantum computer coding and/or understand the design of setup and carry out experiments for related quantum technologies. They will report their progress and seek advice from the instructor/mentor during mentorship meetings.</li> <li>• Excluding mentorship meetings, each student is expected to spend around 3-5 hours on the small group project.</li> <li>• A showcase event (around 4 hours) will be arranged by the end of the programme for students to present their projects and results in groups. Parents, teachers and other guests will be invited to attend the event.</li> </ul>
Admission fee	Free of charge

Application method	<p>Application form can be downloaded from the following webpage:  <a href="https://www.edb.gov.hk/en/curriculum-development/curriculum-area/gifted/ge_fund/gef/osalp.html">https://www.edb.gov.hk/en/curriculum-development/curriculum-area/gifted/ge_fund/gef/osalp.html</a></p> <p>Please complete the application form and send it by post <b><u>on or before 19 April 2024</u></b> to the following address:</p> <p>Address:  Department of Physics  The Hong Kong University of Science and Technology  Clear Water Bay, Kowloon  (Attn: Prof Li Jensen Tsan Hang)</p>
Document(s) to be submitted	<ul style="list-style-type: none"> <li>• a completed application form;</li> <li>• please write about the following in the section of Student's Self-introduction in the application form (in 500 words): <ul style="list-style-type: none"> <li>- reasons for applying for this programme;</li> <li>- what helps you to overcome different challenges and what drives you to keep learning science (use one recent/current experience to explain); and</li> <li>- list of certificates/awards of participation in various competitions/ courses related to physics or mathematics</li> </ul> </li> </ul>
Enquiry	<p>If you have any questions about this programme, please contact:</p> <p>Mr Yu Chiu-kwan (Department of Physics, The Hong Kong University of Science and Technology)</p> <p>Tel no.: 3469 2431  Email: <a href="mailto:yuck@ust.hk">yuck@ust.hk</a></p>
Announcement of results	by late May 2024