Gifted Education Fund: Off-school Advanced Learning Programmes

Programme No. 2021-09 (For secondary students)

Title of Programme	**Quantum Computing for Gifted Students**
Programme Provider	Department of Physics, The Hong Kong University of Science and Technology (Supporting organisation: The Hong Kong Academy for Gifted Education)
Theme	STEM-related Mentorship Programme
Maximum No. of Participants and Class Level in the 2021/22 School Year	40 students (Secondary 4-5)
Pre-requisite	Applicants should show interest in physics and computing, demonstrate outstanding performance in mathematics, and study one or more STEM-related electives at senior secondary levels, e.g. Physics, Mathematics Extended Part Module 1 (Calculus and Statistics), Mathematics Extended Part Module 2 (Algebra and Calculus), etc.
Programme Delivery Period	From July 2022 to January 2023 (7 months) (tentative)
Medium of Instruction	Course Material: English Class teaching/ Discussion: English supplemented with Cantonese/ Putonghua
Objectives	• To equip gifted students with the knowledge of the scientific principles on quantum computing and quantum information processing; • To familiarise students with the applications of quantum computing in different fields; • To provide opportunities for students to acquire the skills of applying quantum algorithms on small-scale computation projects; and • To nurture positive values and attitudes among students such as perseverance, ethical use of quantum computing for the well-being of mankind, willingness to collaborate with people, etc.
Programme Outline*	This programme enables gifted students to understand the theory of operation of quantum computers, the algorithms that are used in quantum computing and also the available applications. Students will acquire useful skills in writing and testing programmes on a desktop quantum computer for education and research. Positive values and attitudes useful for students' growth and development are also emphasised in this programme. The programme consists of three phases.

	Phase I: Fundamentals of quantum computing (36 hours in total) • Mode: lectures • Students will acquire, in this phase, essential knowledge related to quantum computing including the mathematics (e.g. matrix algebra and complex numbers) used in quantum computing, architecture of quantum computers, quantum states and qubits, multiple qubits and entanglement, means of building a quantum computer, quantum circuits, quantum algorithms, etc. **Phase II: Programming quantum algorithms (22 hours in total)** • Mode: lessons and tutorials • Students will learn the principles and mechanisms of common quantum algorithms in computing, and also their advantages. During the tutorials, students will apply the quantum algorithms learnt and complete hands-on and minds-on tasks using quantum protocols with an online quantum programming toolbox. **Phase III: Small-scale projects and showcase event (about 12 hours for each group)** • Students will be divided into groups of 4, who will work on a small-scale project on quantum computing. An instructor will be assigned to each group as a mentor who will meet and supervise the students. • Students will collaborate and conduct literature search of a particular algorithm, try to understand the design of relevant quantum circuits and start coding the algorithm on quantum computer simulators and/ or using other quantum computer resources online. They will report their work progress and seek advices from the instructors/ mentors during the meetings. • A showcase event/ closing ceremony will be arranged by the end of the programme for each group of students to present their projects and results. Parents, teachers and other guests will be invited to attend the event. * In view of the latest development of the COVID-19 pandemic, the programme provider may need to modify the learning and teaching activities as a contingency.
Admission Fee	Free of charge
Application Method	Application form can be downloaded from the following webpage: https://www.edb.gov.hk/en/curriculum-development/curriculum-area/gifted/ge_fund/gef/programme/current.html Please complete the application form and send it by post <u>on or before 16 May 2022</u> to the following address:

	Department of Physics The Hong Kong University of Science and Technology Clear Water Bay, Kowloon (Attn: Dr CHOY Ting Pong)
Documents to be Submitted along with the Application	• Please write about the following in the section of Student's Self-introduction in the application form (in 500 words): - reasons for applying for this programme; - subjects that the student is currently taking; and - physics, computer knowledge and skills
Enquiry	Dr CHOY Ting Pong (Department of Physics, The Hong Kong University of Science and Technology) Tel No.: 3469 2265 Email: tingchoy@ust.hk
Date of Announcement of Result	By late May 2022 (tentative)