

Gifted Education Fund: Off-school Advanced Learning Programmes

Programme No. 2022-10 (For secondary students)

Title of Programme	Advanced Physics Enrichment EXperience (APEX)
Programme Provider	Department of Physics, The Chinese University of Hong Kong
Theme	STEAM-related Mentorship Programme; Self-initiated Research Study
Maximum No. of Participants and Class Level in the 2022/23 School Year	30 students (Secondary 2-4)
Pre-requisite	Applicants should show great interest and good academic performance in STEAM-related subjects, more importantly in physics and mathematics.
Programme Delivery Period	From May 2023 to April 2024 (12 months) (tentative)
Medium of Instruction	Course Material: English Class teaching/ Discussion: Cantonese supplemented with English
Objectives	• To enrich the learning experiences of junior secondary students gifted in physics by exposing them to the more advanced and emerging physics of significance; • To enhance the knowledge and skills of students in mastering and solving advanced physics problems through in-depth study of major physics topics applicable to different STEAM-related fields such as mathematical physics, classical and quantum mechanics, and material sciences; • To provide a learning opportunity for students to engage in a range of authentic physics research of challenge under mentorship and support of academics and researchers of relevant expertise in the university; • To motivate the students and provide a firm foundation for them to pursue their studies and careers in science and engineering in future; and • To nurture positive values and attitudes among students such as curiosity, optimism, perseverance, ethical use of science and technology, etc.
Programme Outline	This programme enriches the learning experiences of gifted students by exposing them to the more advanced and emerging topics of physics. Students will master relevant knowledge and skills through in-depth study of selected topics and engagement in an authentic physics research under mentorship and support of academics and researchers. Besides, positive values and attitudes conducive to students' growth and development are infused in the learning and teaching activities of the programme.

	The programme consists of three phases. Phase 1: Core modules (42 hours for lectures/ practicals and 14 hours for tutorials) • This phase consists of 4 core modules to be attempted by all students. These modules provide foundation knowledge and practical skills that the students need to study the electives in Phase 2 and conduct the mentorship research in Phase 3. Major topics covered in the core modules are as follows: - Core Module 1 – Mathematical Physics - Partial Differentiation - Ordinary Differential Equations - Methods and Applications - Matrices and Applications - Core Module 2 – Classical Mechanics - Kinematics and Dynamics - Gravitation and Orbital Motion - Waves and Doppler Effect - Core Module 3 – Quantum Mechanics - Basics of Quantum Physics - Elements of Wave Mechanics - Spin Systems - Core Module 4 – Experimental and Computational Skills - Data and Error Analysis - Practical Skills in LabVIEW - Physics Experiment Phase 2: Elective modules (12 hours for lectures and 4 hours for tutorials) • Two elective modules are available for students' selection in this phase. A student can only choose 1 module to study after consultation of the academics/ mentors. These modules are more specialised and designed to cater for students with different aspirations and preferences of the mentorship research in Phase 3. Major topics covered in the two electives are as follows: - Elective Module 1 – Relativity and Astrophysics - This module introduces the theories of special and general relativity, and their applications in astrophysics. The features and useful information available from various electromagnetic spectra essential for study of astrophysics are also covered in this module. - Elective Module 2 – Optics, Wave and Particle Physics - This module covers a more in-depth discussion on the theories and applications of optics and wave, such as the propagation of light under different optical conditions. It also covers the topics in particle physics which are useful for the study of fundamental particles and forces in nature.
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	Phase 3: Research projects and presentation - Based on the preferences of the students and their performances in the first two phases, students will be assigned to one of the research projects available in this phase. Students will conduct theoretical or experimental research individually or in small groups under the supervision of an academic/ researcher who will serve as the mentor of the student(s). - There will be at least 18 hours of face-to-face contact for each student with his/ her mentor who is specialized in the research topic chosen by the student, plus at least 22 hours of individual or group work in the laboratory/ research corner, which may be theoretical, computational or experimental. Postgraduate/ post-doctoral research students, teaching assistants and technicians will be deployed to serve as facilitators to help the students complete their tasks. The titles of the projects led by different academics/ researchers are tentatively proposed as follows: - Analysing Data in Particle Physics Experiments - Optical Interferometry - Superconductivity and Magnetic Field - Gamma Ray Astrophysics - Neutron Star Physics - Sound Resonator and Artificial Acoustic Structure - Discovery of Exoplanets - Modelling of Complex Networks - Celestial Mechanics in Space Travel - By the end of the programme, students need to write a paper/ essay to report their research findings. A showcase event will be arranged for students to present their results and achievements, and share their learning experiences with parents, teachers, peer students, academics, mentors and other guests.
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 21 April 2023</u> to the following address: Room 108, Science Centre North Block Department of Physics The Chinese University of Hong Kong Shatin, New Territories (Please mark “Application for Advanced Physics Enrichment EXperience” on the envelope)

Documents to be Submitted along with the Application	• One copy of the most recent school academic report • Reference letter by school principal or teacher (optional)
Enquiry	Mr Henry PANG (Department of Physics, The Chinese University of Hong Kong) Tel No.: 3943 1193 Email: henrypang@cuhk.edu.hk
Date of Announcement of Result	By 9 May 2023 (tentative)