Hong Kong Diploma of Secondary Education Examination 2024
DESIGN AND APPLIED TECHNOLOGY

SBA Project – Suggested Contextual Challenges

Candidates are required to choose ONE contextual challenge from the following and complete the SBA project:

1. A scalable wave power generation system

Context:
The government is exploring the use of a scalable wave power generation system in facilities along the seaside/riverside, like promenades and piers, so that wave energy can be used to power streetlights. The system is one which consists of one or more electrical and/or mechanical units, such that more units can be added to generate more power.

The government is now inviting interested parties to construct and install a trial run prototype in a seaside/riverside to demonstrate the technical feasibility of this system.

Requirements:
To complete this challenge, you need to make physical, scaled models for (A) demonstrating the technical feasibility and (B) showing the construction of the trial run prototype in the actual environment. You can create two separate physical, scaled models or combined into one.

(A) Demonstrating the technical feasibility
Design a physical, scaled model of the scalable wave power generation system which demonstrates technical feasibility in producing electrical power. The model should:

- consist of at least one unit of the scalable wave power generation system, and should be able to demonstrate how additional units can be added to generate more power.
- be able to (1) measure electrical power generated with simulated water waves, which can be used to (2) estimate the amount of power generated through one unit of the scalable wave power generation system, and to (3) estimate how many units are required to power one typical streetlight by the trial run prototype.

(B) Showing the construction of the trial run prototype in the actual environment
You should choose a seaside/riverside in Hong Kong where the trial run prototype will be installed. Design a physical, scaled model which shows how a trial run prototype of the system can be constructed at the chosen location to power one streetlight. This can be a separate model or combined with the model above. Moreover, recommendations on appropriate use of materials for the trial run prototype should be provided.

2. Interactive playground for hamster

Context:

Hamsters are common household pets and friendly to humans. As they need plenty of exercise to stay healthy and happy, an interactive playground for hamster allows them to get exercise they need and to interact with their owners while the owners are away from home.

Requirements:

Design a playground to promote the physical activities for hamsters. The playground should:

- consist of at least four interconnected units. (1) The connections between these four units can be re-arranged by the owner to keep the hamster with fresh experience. (2) Each unit should have at least one sensor which can be triggered by a hamster, and provides at least one type of feedback to the hamster, excluding visual and aural ones.
- have at least **two** different types of sensors and **two** different forms of feedback to the hamster.
- allow owner to interact with the hamster in the playground while they are away from home through mobile devices (i.e. a mobile phone, tablet or laptop) by controlling at least one interactive device over the Internet.
- be easy to clean and durable.
- be safe and avoid causing any harm to hamsters.

Remark:
You do NOT need to buy a hamster for this research, development or testing purpose.
If you own a hamster and would like it to trial your designed playground, please ensure that the hamster will not experience any pain, suffering, lasting harm or distress. The aim of the playground is to improve their health and well-being.

3. Mechanical clock which can show and tell time of day

Context

In many cities around the world, mechanical clocks are often found in public space. While the primary function of these clocks is to tell time, they also leave a memorable impression on those who see them, especially tourists.

To attract audiences, some mechanical clocks report time for every half hour and every hour on the hour in different ways, like start a performance with mechanical movement and sound.

Requirements

Design a mechanical clock for use in a public space, which

- does **not** involve the use of an electrical circuit and is **not** powered by electricity.
- works continuously without intervention for at least 4 hours.
- has a means to show the time of day visually (with second, minute and hour of the day, for 24 hours) and intuitively to its audience.
- provides a means to easily adjust the time of day (second, minute and hour).
- reports time for every half hour and on the hour, and makes a distinct sound to indicate the difference between half hour and on the hour.
- starts a performance with mechanical movement and sound on the hour, lasting at least 5 seconds.

Notes for submission:

- Candidates should submit the following two items:
  - a working physical model/prototype, or a virtual 3D model plus a partial working physical model;
  - an A4 or A3 size portfolio.

- 'Prototype' refers to all working solutions including products, models and systems that are sufficiently developed to be tested and evaluated. A final prototype could be a highly finished product made as 'proof of concept' prior to manufacture, a scaled working model or a functioning system where a full-sized product would be impractical.

- The physical model/prototype produced by the candidates as the final solution for the project should be able to perform proper testing and evaluation in the environment it is intended for. The main body of the final physical model/prototype should be made from raw materials and not be directly built using commercially available kits. However, commercially available mechanical components, control components and programming devices are permitted. Solely using computer modelling and simulation in lieu of physical model/prototype are not considered as appropriate alternatives in this regard.

- For details of the requirements and assessment criteria of this subject applicable to the SBA projects starting from 2021 HKDSE, please refer to:
  http://www.hkeaa.edu.hk/DocLibrary/SBA/HKDSE/DAT-2021-Draft_Assess_Criteria-0318-E.pdf

Remarks:
The HKDSE Examination Regulations stipulate that a candidate may be liable to disqualification from part or the whole of the Examination or suffer a mark or grade penalty for breaching the regulations. For details, please refer to the SBA Teachers' Handbook for Design and Applied Technology:
http://www.hkeaa.edu.hk/en/sba/sub_info_sba/dse_subject.html?10