# Pre-approved Learning and Assessment Plan

Stage 2 Industrial or Entrepreneurial Design Solutions

Subs In Schools - Designing a submarine

Pre-approved learning and assessment plans are for *school use only*.

* Teachers may make changes to the plan, retaining alignment with the subject outline.
* The principal or delegate endorses the use of the plan, and any changes made to it, including use of an addendum.
* The plan does not need to be submitted to the SACE Board for approval.

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| --- | --- | --- | --- |
| School |  | Teacher(s) |  |

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| SACE school code | | |  | Year |  | Enrolment code | | | | |  | Program variant code (A–W) |
| Stage | Subject code | | | No. of credits (10 or 20) |
|  |  |  |  | **2** | **X** | **X** | **X** | **20** |  |

Addendum – changes made to the pre-approved learning and assessment plan

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| Describe any changes made to the pre-approved learning and assessment plan to support students to be successful in meeting the requirements of the subject. In your description, please explain:  what changes have been made to the plan   * the rationale for making the changes * whether these changes have been made for all students, or for individuals within the student group. |

Endorsement

The use of the learning and assessment plan is approved for use in the school. Any changes made to the plan support student achievement of the performance standards and retain alignment with the subject outline.

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| Signature of principal or delegate |  | Date |  |

# Assessment overview

Stage 2 Industrial or Entrepreneurial Design Solutions — 20-credits

The table below provides details of the planned tasks and shows where students have the opportunity to provide evidence for each of the specific features of all of the assessment design criteria.

Assessment Type 1:Specialised Skills Tasks – 20%

| Assessment details | Assessment design criteria | | | | Assessment conditions  (e.g. task type, word length, time allocated, supervision) |
| --- | --- | --- | --- | --- | --- |
| IA | D | P | E |
| **Pressure hull design challenge:**  Using all your skills in computer aided design, design a holder that will sit inside the pressure pipe and hold all of the components for your submarine. This could include the battery, air pumps, servo motors and the ESC. There may also be others that need to be accommodated into your design. You will need to create a table with all the parts listed and find out the width, length and height of each part to be fitted. Constraints;   * It needs to fit internally in the pressure hull * It must have room for the wires of the electronics to run * The parts must function normally and not be hindered in any way by the solution.   The prototype can be printed and tested for fit, form and function. |  | D2 | P1, P2 |  | Evidence for the task should be in multimodal form, to a maximum of 3 minutes or 500 words in written format. |
| **CFD analysis on a part of the submarine:**  Use Autodesk CFD to analyze a component of your submarine design for optimization. This could be the shape of the control planes, the conning tower or the propeller. Explain the results that you obtain and how you may use the data to improve your design.  Conducting the tests allows students to demonstrate their understanding of computational fluid dynamics and the science, particularly physics that is provided in the solutions and the setup of the CFD tests.  Students document what happens in each of the iterations of the testing and design phases and explain the results for each test. A conclusion based on these results should be reached and documented. | I1 | D1, D2 |  | E1 | Evidence for the task should be in multimodal form, to a maximum of 3 minutes or 500 words in written format. |

Assessment Type 2: Design Process and Product – 50%

| Assessment details | Assessment design criteria | | | | Assessment conditions  (e.g. task type, word length, time allocated, supervision) |
| --- | --- | --- | --- | --- | --- |
| IA | D | P | E |
| **Produce a model Submarine – Investigation and Analysis**  Produce a design brief based on your project. The design brief should outline the following: the problem or intended design, aesthetic considerations, functional considerations, constraints from the competition regulations.  Consider the following dot points;   * identify end users, need, problem or opportunity * research and analyse factors to inform a design brief * create design brief outlining context, constraints and considerations * Identify criteria to evaluate how well the finished product satisfies the design brief | I1 |  |  |  | The task must include a showcase and evaluation of the solution or product in the form of a video or photographic record. The rest of the evidence may be completed in written or multimodal form. The task should be up to a maximum of 2000 words or the equivalent in multimodal form where 6 minutes is equivalent to 1000 words. |
| **Produce a model submarine – Design development and planning**  Students begin to develop possible solutions to the brief; including design and form, how it may function (internal systems), linking to outcomes from the skills task 2 CFD modelling, the use of resources – materials, machinery and tools and human resources through mentors that may be available. The design for the submarine must meet the requirements listed (competition regulations) but you can freely design the allowable parts your own way.  Testing, validating and adapting components before the final product realization.  Consider the following dot points:   * Create concept sketches, drawings, prototypes, testing, modelling potential ideas * Design options, selections and justification * Show product specifications through working technical drawings and or content tables * Create a sequence plan and timeline |  | D1,D2 |  |  |
| **Produce a model Submarine - Solution**  Using Autodesk Fusion 360 model a submarine based on the design constraints discussed with the regulations booklet from the Subs in Schools competition and from information developed during the development and planning stage. Your model should reflect the design brief developed, it should also support the findings from your various investigations. It is expected that you support your own model with evidence in the form of screen shots and entries in your design solutions folio.  Consider the following dot points:   * Construct product * Students demonstrate evidence of product or solution |  |  | P1, P2 |  |
| **Produce a model Submarine - Evaluation**  Evaluate the finished product solutions against the design brief and the constraints of the competition.  Explanation of and the justification of any changes that have been made to the model. Reflection of possible improvements to the design and /or changes to the manufacturing processes that have been used.  Self-reflection on the students own skill development in the solution to the product.  Consider the following dot points:   * Evaluate individually how effectively the design specifications have been met * Recommended improvements * Recording any refinements and modifications * Visual record of any refinements and modifications |  |  |  | E1 |  |

Assessment Type 3: Resources Study – 30%

| Assessment details | Assessment design criteria | | | | Assessment conditions  (e.g. task type, word length, time allocated, supervision) |
| --- | --- | --- | --- | --- | --- |
| IA | D | P | E |
| **Resource Investigation – part a materials**  Students investigate and analyse the functional characteristics and properties of two or more materials or components they are considering for use in the creation of their solution. They report on how their research into and testing of the functional characteristics and properties of these materials or components will affect their selection for use in the realisation of their solution.  An example might be the examination of 3D printing filaments.  Students investigate the properties of two or more 3D printing filaments. They look at the chemical properties as well as the physical properties of the materials. They gather qualitative and quantitative data about the materials and draw conclusions about the results.  **Part b issues exploration**  Students investigate and analyse ethical, legal, economic and/or sustainability issues specific to their solution.  Students may investigate and analyse using one or more of the following strategies or approaches;   * ethical use and application of the end product * ethical concerns related to health and safety, discrimination, social media, advertising, data, images, conflicts of interest * sustainability: life cycle analysis, carbon footprint, potential to reuse or recycle, fair trade, customs, carbon footprint * target audience, end user and potential for entrepreneurship and marketing * economic considerations: costing of products including materials, labour and equipment and machinery, responsible use of resources, products built to last, time management and material availability * legal responsibilities- patents, safety requirements, intellectual property, creative commons, Australian International Standard , regulations and legislation including OH&S, safety of the product for the user * historical and cultural influences including social trends, the changing nature of work, technological change | I1, I2 | D2 |  | E1 | The Resource Study should be presented in written or multimodal form or a combination of both. It should be up to a maximum of 2000 words if written or the equivalent in multimodal form, where 1000 words is equivalent to 6 minutes. |

*Please refer to the Stage 2 Design, Technology, and Engineering subject outline.*