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Meeting the Specifications

The Design Assignments outlined below are aimed at supporting the teaching of the GCSE in Engineering and the GCSE in Manufacturing. The specifications for the courses are available from the Awarding bodies' websites: www.edexcel.org.uk; www.ocr.org.uk.

This course is designed to be taught in a practical manner, with students carrying out design and make assignments. The design assignments in this resource cover the design aspects of the qualification: Unit 1 - design and Graphical Communication.

Engineers are often asked to provide ideas to solve engineering problems. The client presents the problem in the form of a design brief. The engineer then provides various solutions, one of which can be taken forward and developed as a final design solution.

In this unit students are required to develop graphical techniques, using the design process.

A range of graphical techniques will need to be taught so students are able to select the most appropriate technique to solve the design problem.

For many engineering sectors it is important that students are able to design an electro-mechanical product that includes a variety of components from electrical and mechanical fields. However, for teaching purposes it may be more relevant to look at these separately and then bring them together in terms of the product at a later stage.

Students should be taught to tackle the design assignments in a structured and professional manner:

- analysing client design briefs;
- developing design specifications and solutions;
- applying scientific principles;
- producing and reading engineering drawings;
- selecting appropriate drawing techniques;
- communicating a design solution.

Each Awarding Body requires that the student compiles a portfolio of their work for assessment and external moderation. It is therefore essential that students present quality work against the assessment criteria.

Each Design Assignment tackles a different aspect of the world of engineering:

- Bicycles - Producing designs for a test rig
- Buildings and Services - Produce designs for a warning device and water valve for a cistern
- Bridges and Tunnels - Designing a bridge to span a stream
- Alternative Energy - Designing a wind turbine producing electricity to illuminate a road sign
- Food Packaging - Developing a design for the transportation of pizzas

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- Theme Parks and Playgrounds - Designing a rollercoaster
- Scuba Diving - Producing designs for a snorkel and mask
- Surveillance - Designing an automatic lighting system and wall mounting

Each of these design solutions can be taken through to the manufacturing stage. However, for the purposes of this pack they are purely design exercises.

For each assignment the student is expected to study the design brief and use it as the basis of their design solutions:

- They must make a comprehensive list of the Key Design Features and use this to develop a Design Specification.
- Following the Design Specification they should investigate a range of resources that could be used to help inform their design ideas.
- They should generate a range of possible solutions and through careful evaluation narrow this range down to one workable solution.
- The final design solution should be communicated using a variety of techniques, appropriate to the solution. They should also clearly illustrate how their solution meets the Key Design Features and Design Specification.
- Finally, they should develop a Product Specification from their solution, detailing materials, techniques and processes that should be employed in the manufacture of their solution.

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Vocational Relevance

This GCSE is intended to develop students' understanding of the role of an engineer in developing design solutions. Therefore, it is important they are given the opportunity to carry out visits, and observations of practicing engineers.

They should also be encouraged to work in a professional manner, taking responsibility for their own learning and pathway through the assignment. However, for each assignment the student should be taught the knowledge required to successfully produce their design solutions.

Students must be taught how to analyse the client design brief to identify the key features of an engineered product or an engineering service:

- function - where and what the product will be used for;
- quality standards - sector and/or client quality standards;
- styling aesthetics - the appearance and appeal of the product;
- performance - how well the product has to perform;
- intended markets - who might use the product, competition with other similar products, client's own customer base;
- size - the approximate size in three dimensions;
- maintenance - how this is planned for in design and during the product's use;
- production methods and materials;
- cost - including design, production and material costs;
- regulations - including health and safety;
- scale of production - quantity required, use of mass- or batch production.

They must also be taught that there may be more than one design solution that meets the needs of a client and they must learn how to evaluate the strengths and weaknesses of different design solutions.

To enable the student to produce a design solution that meets the needs of the client, they must first analyse the design brief and related engineering drawings to identify the key design features. They must then be able to explain what is required, showing clear details and decisions they have made about the intended product.

They must be able to use their design specification to produce a design solution that meets the client's and sector's requirements. To produce a design solution, they must learn how to use all of the following techniques to develop their design ideas:

- research and analysis of information and data;
- consideration of scientific principles, for example recognition and use of structures and how to support and reinforce them;
- generation of ideas and solutions;
- evaluation of ideas, solutions, testing and subsequent modifications;
- 2-D and 3-D drawing and sketching techniques;

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- modelling techniques.

The student must be able to select the most appropriate design solution from the range of initial design ideas. To do this, they need to devise and apply tests against the design criteria at critical points in the development. The final design solution must include:

- justification for the final choice that refers to the key features in the client design brief and the Design Specification;
- details of the final design idea;
- an explanation of how they met the client's requirements and complied with sector standards.

They must be taught to read and use engineering drawings as well as produce a selection of engineering drawings using both manual and computer techniques.

All engineering drawings and diagrams must comply to sector specific standards and conventions, e.g. BS 8888.

They must be able to read electrical/electronic, pneumatic/hydraulic and mechanical engineering drawings and diagrams so they can explain the purpose of the components and the features used.

Typical standard symbols they must be able to recognise include:

- electrical/electronic components - resistors, thermistors, LEDs, capacitors, bulbs, batteries, motors, buzzers, variable resistors, diodes;
- mechanical features - holes, screw threads (internal and external);
- dimensions - including toleranced dimensions, radii, centres, springs;
- pneumatic/hydraulic valves, cylinders, reservoirs, pipework, filters.

Students must be able to produce engineering drawings that are sufficient to communicate their final design solution by selecting and using the following techniques appropriately:

- freehand sketches;
- isometric projection;
- oblique projection;
- perspective drawing;
- block diagrams;
- flow diagrams;
- schematic diagrams;
- circuit diagrams;
- first angle orthographic projection;
- third angle orthographic projection;
- assembly diagrams;
- exploded diagrams.

Students are not expected to become expert in any of these techniques but they must

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learn how to produce drawings, or appropriate parts of drawings and diagrams, by both manual and computer generated methods. They must be able to use computer-aided design (CAD) and link this with computer-aided manufacture (CAM).

When choosing drawing techniques, students must take account of the purpose of the engineering drawing and the intended audience. Drawings may be:

- a working/manufacturing drawing;
- a servicing/repairing drawing;
- an assembly drawing.

The types of audiences to consider are:

- service engineers;
- manufacturing engineers;
- technical customers.

Students must be able to explain their final design solution to other people. Their presentation must:

- give reasons for the final choice that refer to the key features in the design brief and the design specification;
- show details of the final design idea;
- give an explanation of how the final design solution meets the client design brief;
- respond to feedback, checking against the design criteria and suitability for the user, and modify the proposed solution if necessary.

NOTE: The British Standards Institution has an education guide, which can be used as a support document for teachers – *PP 8888-1: part 1: a guide for schools and colleges to BS 8888:2001. Technical product documentation*.

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Bicycles

Timescale

This assignment is expected to take approximately one term to deliver.

This should be made up from approximately 50 hours of lesson time, 20 hours of homework.

The first three weeks should be spent investigating the design brief and carrying out research into test rigs and other similar items already available. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately three weeks developing a range of possible solutions; these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean they should be poorly presented - this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four to five weeks should be spent producing their final design solution, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of materials and techniques, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design. This investigation will enable the students to develop a realistic Product Specification.

Finally, students should be given the opportunity to present their final design solution, with their product specification.

Preparation and preparatory teaching

The nature of this assignment is that students will be using graphical techniques and practical workshop skills. It is therefore essential that they have had experience of working in a practical environment and are aware of Health and Safety requirements.

Prior to embarking upon this assignment students should have had the opportunity to work with basic workshop equipment, tools and processes that they may wish to use to develop their solution. They should also have experience of working with a range of appropriate materials:

- Metals - ferrous and non-ferrous
- Polymers - thermoplastics and thermosetting
- Suitable finishes - paints, lacquers

As a certain level of workshop competence is envisaged, it is recommended that this assignment takes place in the second or subsequent term of the first year of the course. However, some students may have had the benefit of a comprehensive Key Stage 3 programme and therefore this assignment could be moved to the first term of Y10. Alternatively, post-16 students will need to spend the first term familiarising themselves

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with the facilities available to them and therefore this assignment should be set in the second term.

Practical hints

This assignment can be tackled in a variety of ways; it could be set for an individual, to develop one test rig, or a small group to develop a number of rigs.

If students are working in a group, it is important that the work of each member is clearly identifiable, for assessment purposes.

The test descriptions attached to the design brief give a clear starting point for students of all abilities.

The assignment could be adapted to become a test rig for a number of other items:

- Office seating
- Wheelchairs
- Shopping Trolleys
- Tools and equipment used in a workshop
- Shelving

For each of these there are standard tests to ensure British Standard compliance that could be investigated. The student could then develop their own test rig to carry out those tests.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the materials and components that may be used to manufacture their solution. A number of relevant tests are included with the Design Assignment:

- Mechanical Properties
  - Impact Resistance
  - Tensile Strength
  - Compressive strength
  - Stiffness
- Finishes

Prior to carrying out any of the tests the students should be taught what the test is for and the terms involved in testing such as tensile, compression etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out tensile tests on paper and fabrics, but be shown how the test would differ if the material being tested was a non-ferrous metal.

Students should also be clear about the units used in the results of the tests and the scale of the unit; newtons compared to kilograms and the difference between 20 newtons and 200 newtons.

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Buildings and Services

Timescale

This assignment is expected to take approximately one half term to deliver.

This should be made up from approximately 30 hours of lesson time, 10 hours of homework.

The first two weeks should be spent investigating the design brief and carrying out research into cistern valve systems and overflow detectors. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately two weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four weeks should be spent producing and presenting their final design solution and Product Specification, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of standard components, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design.

Students should be encouraged to utilise existing components wherever possible, this will help to keep costs down for the final solution, it will also make the solution easier to manufacture and fit. It will have the added bonus of allowing individuals, familiar with existing components, to be able to fit and maintain the system.

Preparation and preparatory teaching

This assignment concentrates on the utilisation of standard components to develop a solution to be affixed to an existing water cistern. It is therefore important that students have experience of assembling and disassembling valve units. They should be familiar with the components of the valves and appropriate drawing techniques to communicate the assembly of the valves.

As this assignment is expected to be based around the drawing of components and additional design aspects it does not need workshop facilities. It is therefore suitable to be delivered at the beginning of the course, perhaps as the first assignment.

Students will need knowledge of the valve components and appropriate electrical components for the alarm section. They should use the correct symbols in their drawings, complying with BS 8888.

Students should be made aware of suitable drawing techniques, such as exploded isometric, for communicating the installation of their design. They should be given the opportunity to develop high quality, colour presentations in the form of "How To..." leaflets.

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Practical hints

This assignment does not lend itself to group working, it is therefore expected that students will work individually to produce their solutions.

The assignment could be developed or adapted if needed, to encompass other devices:

- A timer switch for an electrical device
- A temperature controlled switch system
- A light sensitive switch system

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the components that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment:

- Electrical Properties
- Joints
- Finishes

Prior to carrying out any of the tests the student should be taught what the test is for and the terms involved in testing such as voltage, resistance, etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out resistance tests on a test circuit, but be shown how the test would differ if the circuit was powered using 240 V AC. However it should be stressed that students should not work with mains electricity without considerable guidance.

Students should also be clear about the units used in the results of the tests and the scale of the unit; MA compared to amp and the difference between 20 MA and 20 A.

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Bridges and Tunnels

Timescale

This assignment is expected to take approximately one half term to deliver.

This should be made up from approximately 30 hours of lesson time, 10 hours of homework.

The first two weeks should be spent investigating the design brief and carrying out research into bridges. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately two weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways. Due to the nature of this assignment it is recommended that the students make a number of models, scale models of the bridge itself, or models of some aspects, such as the joints to be used.

A further four weeks should be spent producing and presenting their final design solution and Product Specification, including their models used to help explain their ideas. Students should be given the opportunity to choose from a range of materials, which could be employed in producing their solution.

Students should be encouraged to use easily procured materials wherever possible, this will help to keep costs down for the final design solution, it will also make the solution easier to manufacture.

The solution is a relatively small bridge. Students should be encouraged to bear in mind the proposed location and use, and not to try to develop full Forth Bridge-type solutions!

Preparation and preparatory teaching

This assignment concentrates on designing and modelling their solution. It is therefore important that students have experience of joining materials in a variety of ways. They should be familiar with materials and appropriate drawing techniques to communicate their bridge designs.

As this assignment is expected to be based around the modelling of bridge designs, it may not need workshop facilities. It is therefore suitable to be delivered at the beginning of the course, perhaps as the first assignment.

Students will need knowledge of a variety of materials appropriate to outdoor use. They will also need knowledge of appropriate finishes and joining techniques.

As their solutions will be necessarily scaled, it is therefore essential that students are fully aware of techniques that they must employ to represent their solutions, such as scale and part drawings.

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Students should be made aware of suitable drawing techniques, such as exploded isometric, for communicating the installation of their design. They should be given the opportunity to develop high quality, colour presentations suitable for "selling" their design to the customer.

Practical hints

This assignment does not lend itself to group working, however students could be encouraged to work on one aspect of the final solution if the bridge was to be constructed, full size, in a later exercise.

The assignment could be developed or adapted if needed, to encompass other items:

- A set of stairs/fire escape
- A motorbike repair bench
- Patio furniture
- Car port

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the materials that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment:

- Mechanical Properties
  - Impact Resistance
  - Tensile Strength
  - Compressive Strength
  - Stiffness
- Finishes
- Joints

Prior to carrying out any of the tests the student should be taught what the test is for and the terms involved in testing such as tensile, compression, wear, etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out tests on small models of particular joints, but be shown how the test would differ if the joint were scaled up to full size.

Students should also be clear about the units used in the results of the tests and the scale of the unit; newtons compared to kilograms and the difference between 20 newtons and 200 newtons.

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Alternative Energy

Timescale

This assignment is expected to take approximately one term to deliver.

This should be made up from approximately 50 hours of lesson time, 20 hours of homework.

The first three weeks should be spent investigating the design brief and carrying out research into electricity generation and other similar items already available. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately three weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

They should also consider the siting of their solution and the impact this will have upon its efficacy.

A further four to five weeks should be spent producing their final design solution, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of materials and techniques, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design. This investigation will enable the students to develop a realistic Product Specification.

Finally students should be given the opportunity to present their final design solution, with their product specification.

Preparation and preparatory teaching

This assignment concentrates on the utilisation of standard components to develop a wind turbine. It is therefore important that students have experience of assembling and disassembling generators. They should be familiar with the components of the turbine system and appropriate drawing techniques to communicate their solution.

As this assignment is expected to be based around the drawing of components and additional design aspects it does not need workshop facilities. It is therefore suitable to be delivered at the beginning of the course, perhaps as the first assignment. However some modelling may be needed for the student to fully understand the pros and cons of their designs, this may involve relatively light materials, for the "propeller" and fixings and some electrical components.

Students will need knowledge of the appropriate electrical components for the generator section. They should use the correct symbols in their drawings, complying with BS 8888.

Students should be made aware of suitable drawing techniques, such as exploded

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isometric, for communicating the installation of their design. They should be given the opportunity to develop high quality, colour presentations in the form of "How To..." leaflets.

Practical hints

This assignment can be tackled in a variety of ways; it could be set for an individual, to develop one turbine and generator design, or a small group to develop a number of systems that could be used in different situations.

If students are working in a group, it is important that the work of each member is clearly identifiable, for assessment purposes.

The test descriptions attached to the design brief give a clear starting point for students of all abilities.

The assignment could be adapted to become a generator system for a number of other items:

- Outdoor lighting for the home
- Electrical generation for camping
- Emergency backup electricity supplies

Each situation will require the same basic elements, but the scenario could lead to very different solutions.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the components that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment:

- Electrical Properties
- Joints
- Finishes

Prior to carrying out any of the tests the student should be taught what the test is for and the terms involved in testing such as voltage, resistance, etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out resistance tests on a test circuit, but be shown how the test would differ if the circuit was powered using 240 V AC. However it should be stressed that students should not work with mains electricity without considerable guidance.

Students should also be clear about the units used in the results of the tests and the scale of the unit; MA compared to Amp and the difference between 20 MA and 20 A.

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Food Packaging

Timescale

This assignment is expected to take approximately one half term to deliver.

This should be made up from approximately 30 hours of lesson time, 10 hours of homework.

The first two weeks should be spent investigating the design brief and carrying out research into food packaging and heat resistant containers. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately two weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four weeks should be spent producing and presenting their final design solution and Product Specification, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of materials, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design.

Students should be encouraged to consider existing solutions wherever possible, this will help to keep costs down for their final design solution, it will also make the solution easier to manufacture. It will have the added bonus of allowing individuals familiar with existing systems to be able to transfer to using the new system with the minimum of disruption.

Preparation and preparatory teaching

This assignment concentrates on the design and development of a Pizza container and a temperature resistant moped carrier. It is therefore important that students are familiar with these types of items. Students should be encouraged to experiment with packaging design using standard materials, as well as looking at how to protect the pizzas from the elements when on the moped. They should be encouraged to investigate the methods of mass-producing food packaging, including printing onto the material used.

As this assignment is expected to be based around the drawing and modelling of Pizza boxes and the moped carrier, it does not need workshop facilities. It is therefore suitable to be delivered at the beginning of the course, perhaps as the first assignment.

Students will need knowledge of lightweight materials such as corrugated card and materials that could be formed into shapes suitable for the moped carrier. They should be encouraged to be creative, but realistic in their decoration of the packaging and carriers, while maintaining the technical elements of the engineering drawings.

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Students should be made aware of suitable drawing techniques, such as orthographic, perspective and isometric, for communicating their box designs. They should be given the opportunity to develop high quality, colour presentations to be used to illustrate their "concept".

Practical hints

This assignment does not lend itself to group working, it is therefore expected that students will work individually to produce their solutions.

The assignment could be developed or adapted if needed, to encompass other items:

- Frozen food packaging
- Storage devices for picnic foods
- Portable fridge for camping
- In-car storage system for snacks
- Modular storage systems for household equipment

These adaptations could allow for greater flexibility in the students choice of material area, food packaging is a particularly difficult area because of regulations, other containers may ease the complexity caused by this, yet increase the complexity due to the nature of that being stored.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the materials that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment:

- Mechanical Properties
  - Impact Resistance
  - Stiffness
- Finishes
- Joints
- Thermal Properties

Prior to carrying out any of the tests the student should be taught what the test is for and the terms involved in testing such as thermal, wear, etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out tests on materials for the packaging, but be shown how the test would differ if it were to be carried out on an industrial scale, testing batches of a mass-produced item.

Students should also be clear about the units used in the results of the tests and the scale of the unit; newtons compared to kilograms and the difference between 20 newtons and 200 newtons.

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Theme Parks and Playgrounds

Timescale

This assignment is expected to take approximately one term to deliver.

This should be made up from approximately 50 hours of lesson time, 20 hours of homework.

The first three weeks should be spent investigating the design brief and carrying out research into rollercoasters and slides and other similar items found in theme parks and playgrounds. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately three weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four to five weeks should be spent producing their final design solution, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of materials and techniques, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design. This investigation will enable the students to develop a realistic Product Specification.

Finally students should be given the opportunity to present their final design solution, with their product specification and models.

Preparation and preparatory teaching

The nature of this assignment is that students will be using graphical techniques and practical workshop skills. It is therefore essential that they have had experience of working in a practical environment and are aware of Health and Safety requirements.

Prior to embarking upon this assignment students should have had the opportunity to work with basic workshop equipment, tools and processes that they may wish to use to develop their solution. They should also have experience of working with a range of appropriate materials:

- Metals - ferrous and non-ferrous
- Polymers - thermoplastics and thermosetting
- Suitable finishes - paints, lacquers

As a certain level of workshop competence is envisaged, it is recommended that this assignment takes place in the second or subsequent term of the first year of the course. However some students may have had the benefit of a comprehensive Key Stage 3 programme and therefore this assignment could be moved to the first term of Y10. Alternatively, post-16 students will need to spend the first term familiarising themselves

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with the facilities available to them and therefore this assignment should be set in the second term.

Practical hints

This assignment can be tackled in a variety of ways; it could be set for an individual, to develop one such ride, or a small group to develop aspects of a larger rollercoaster.

If students are working in a group, it is important that the work of each member is clearly identifiable, for assessment purposes.

The test descriptions attached to the design brief give a clear starting point for students of all abilities.

The assignment could be adapted to become a test rig for a number of other items:

- Moving walkways
- Urban public transport systems
- Automatic vending systems

This assignment is designed around the theme park, although the concept of moving items, in this case people, could be adapted to a number of systems. For each of these safety is a major consideration, safety for the person on the ride and safety for the operator. If inanimate objects are to be transported, then it is also important not to damage the items as they are transported.

Maintenance of the system is also a consideration, as this can cause "downtime", this need for maintaining a safe ride as well as keeping it running to generate revenue is an important aspect that is sometimes missed in teaching about design.

This assignment could be developed still further to consider the control system that would need to be developed for the ride or transportation system. However this would probably involve extending the length of the project to cover two terms.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the materials and components that may be used to manufacture their solution, a number of relevant tests are are included with the Design Assignment:

- Mechanical Properties
  - Impact Resistance
  - Tensile Strength
  - Compressive Strength
  - Stiffness
- Finishes

Prior to carrying out any of the tests the student should be taught what the test is for and the terms involved in testing such as tensile, compression etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out tensile tests on paper and fabrics, but be shown

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how the test would differ if the material being tested was a non-ferrous metal.

Students should also be clear about the units used in the results of the tests and the scale of the unit; newtons compared to kilograms and the difference between 20 newtons and 200 newtons.

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Scuba Diving

Timescale

This assignment is expected to take approximately one half term to deliver.

This should be made up from approximately 30 hours of lesson time, 10 hours of homework.

The first two weeks should be spent investigating the design brief and carrying out research into swimming accessories, snorkels and goggles, as well as small bags that could be used to carry the equipment. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately two weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four weeks should be spent producing and presenting their final design solution and Product Specification, including any models that may be required to help explain their ideas. Students should be given the opportunity to be creative in their design work, while bearing the important aspects of the design in mind. They should also investigate methods of manufacturing such devices, as these are possibly very different from any manufacturing processes they have come across in previous work. This may mean that they carry out experiments and construct models of aspects of their design.

Students should be encouraged to utilise existing components wherever possible, this will help to keep costs down for the final solution, it will also make the solution easier to manufacture. They should also investigate the possibility of using an existing bag system, such as a "bum bag" to carry the equipment, however it may be that they will need to develop an existing bag in some way to make it more applicable to this assignment.

Preparation and preparatory teaching

This assignment concentrates on developing a new solution to an existing problem. The students should therefore investigate similar devices and spend some considerable time on finding out how such items are made. They should be familiar with these materials and components and appropriate drawing techniques to communicate the assembly of the snorkel and goggles.

As this assignment is expected to be based around the drawing of components and additional design aspects it does not need workshop facilities. It is therefore suitable to be delivered at the beginning of the course, perhaps as the first assignment.

Students will need knowledge of the materials that such items are manufactured from and the processes used to manipulate them. They should also be taught particular

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techniques in communicating complex shapes in a technical manner.

Students should be made aware of suitable drawing techniques, such as exploded isometric, for communicating the installation of their design. They should be given the opportunity to develop high quality, colour presentations as well as formal working drawings.

Practical hints

This assignment does not lend itself to group working, it is therefore expected that students will work individually to produce their solutions.

The assignment could be developed or adapted if needed, to encompass other items:

- Flippers
- Sports equipment
- The form of hand-held games consoles and controllers
- Spectacles
- Body armour
- Mobile telephones

These adaptations should be based around the development of ergonomically-designed forms (rather than the technology each product contains). This assignment is based around complex drawing techniques of a product that is closely associated with the human form.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the components that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment :

- Mechanical Properties
  - Impact Resistance
  - Tensile Strength
  - Compressive Strength
  - Stiffness
- Joints
- Finishes

Prior to carrying out any of the tests the student should be taught what the test is for the terms involved in testing such as shear, density, etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out resistance joining techniques on acrylic sheet, but be shown how the results would differ if the material were polycarbonate.

Students should also be clear about the units used in the results of the tests and the scale of the unit; ml compared to l and the difference between 20 ml and 20 l.

Teachers' Notes

Surveillance

Timescale

This assignment is expected to take approximately one half term to deliver.

This should be made up from approximately 30 hours of lesson time, 10 hours of homework.

The first two weeks should be spent investigating the design brief and carrying out research into automatic lighting systems and proximity detectors. The student should compile their research and use it to develop their Design Specification.

They should then spend approximately two weeks developing a range of possible solutions, these can then be evaluated against the design brief and specification. Although these are possible solutions this does not mean that they should be poorly presented, this aspect of the assignment could be used to develop drawing and presentation techniques, students should be encouraged to present their work in a variety of ways.

A further four weeks should be spent producing and presenting their final design solution and Product Specification, including any models that may be required to help explain their ideas. Students should be given the opportunity to choose from a range of standard components, which could be employed in producing their solution. This may mean that they carry out experiments and construct models of aspects of their design.

Students should be encouraged to utilise existing components wherever possible, this will help to keep costs down for the final design solution, it will also make the solution easier to manufacture and fit. It will have the added bonus of allowing individuals familiar with existing components to be able to fit and maintain the system.

Preparation and preparatory teaching

This assignment concentrates on the utilisation of standard components to develop a solution to be used to activate an external lighting system and the wall mounted fixing system. It is therefore important that students have experience of assembling and disassembling lighting units. They should be familiar with the components of the devices and appropriate drawing techniques to communicate the assembly of the lights and their fixings.

Although this assignment is expected to be based around the drawing of components and additional design aspects it could involve modelling of fixing devices, needing workshop facilities. It is therefore essential that students have had experience of working in a practical environment and are aware of Health and Safety requirements.

Students will need knowledge of appropriate electrical components for the lighting system. They should use the correct symbols in their drawings, complying with BS 8888.

Students should be made aware of suitable drawing techniques, such as exploded isometric, for communicating the installation of their design. They should be given the opportunity to develop high quality presentations in the form of "How To..." leaflets.

Teachers' Notes

Practical hints

This assignment does not lend itself to group working, it is therefore expected that students will work individually to produce their solutions. However the assignment could be extended to cover a range of similar devices and the students could be tasked with designing a particular facet, such as the control circuitry or the wall mounting.

The assignment could be developed or adapted if needed, to encompass other devices:

- A timer switch for an electrical device
- CCTV control system
- Automatic lighting systems for when a house is empty
- Burglar alarm system

For each of these the circuitry should be kept relatively simple, perhaps dealt with as a "black box". It is the system - controller, device and mounting system that should be concentrated upon.

Comparative Tests

Students should be encouraged to carry out a range of tests to investigate the materials and components that may be used to manufacture their solution, a number of relevant tests are included with the Design Assignment:

- Mechanical Properties
  - Impact Resistance
  - Tensile Strength
  - Compressive strength
  - Stiffness
- Finishes
- Electrical Properties

Prior to carrying out any of the tests the student should be taught what the test is for the terms involved in testing such as tensile, compression etc.

They should also be shown how to adapt a particular test to be useful in their investigations; they could carry out tensile tests on paper and fabrics, but be shown how the test would differ if the material being tested was a non-ferrous metal.

Students should also be clear about the units used in the results of the tests and the scale of the unit; newtons compared to kilograms and the difference between 20 newtons and 200 newtons.

They should also be encouraged to look into testing wall fixing components - rawl plugs, rawl bolts. http://www.diydata.com/materials/wallfix/wallfix.htm gives a comprehensive guide.