

Introduction

The GCSE in **Engineering** (Double Award) is a vocational GCSE, which is equivalent, upon completion, to two GCSE's. It has been designed to provide a broad educational basis for further training, for further education or for moving into employment.

The course itself consists of three compulsory units, which are equally weighted. Two units are assessed 'internally' after the student has produced an assignment involving the planning and development of a product requiring engineering input, whilst the third unit is assessed externally through a written test. The three units are:-

Unit 1

Design and Graphical Communication

Unit 2

Engineered Products

Unit 3

(which is externally assessed) Application of Technology.

Whilst on first inspection it would appear that the Engineering GCSE could be completed without reference to a vocational environment, this would completely miss the spirit in which the award has been created. As the students become involved in planning and creating their own product, it is essential that they are exposed to the commercial elements that the engineering sector is driven by. They need to appreciate that there are standards for the different types of engineering drawings that are created during the planning stages. They need to appreciate that there are vital quality control issues throughout the procedure. They need to understand how a product specification can vary from the original design brief and the reasons why this occurs. Seeing the theory in practice both reinforces and brings alive this subject for the students.

This Engineering GCSE began in September 2002 and teachers are under great pressure to instil vocational realism to the subject through visits and speakers to allow students to appreciate how engineering companies function. Simulated exercises have a limited role, the aim is to immerse the student in the actual working sector they are studying.

This GCSE 'map' should provide EBP's and employers with an understanding of the issues and degree of depth that need to be addressed within engineering organisations to enable students to specifically meet the requirements of their course.

Unit I

Design and Graphical Communication

This unit introduces the student to five main themes:

- DESIGN BRIEFS
- DESIGN SPECIFICATIONS AND SOLUTIONS
- ENGINEERING DRAWINGS
- CHOOSING ENGINEERING DRAWING TECHNIQUES
- PRESENTING A DESIGN SOLUTION

DESIGN BRIEFS

Explanation of Term

This involves the document and drawings provided by the client to help the company understand what the client wants.

Key features of a **design brief** include:

- Function
- Quality standards
- Styling aesthetics
- Performance
- Intended markets
- Size
- Maintenance
- Production methods and materials
- Cost
- Regulations
- Scale of production

Factor/Evidence

Any design briefs the company has had in and evidence on how they have responded to these. Any evidence of engineering tools and processes being tested.

Types of Companies

All that use engineering processes, do not mix this up with those that use solely manufacturing processes. There needs to be an engineering input into the procedure.

Unit 1

Generic examples of questions for companies

With a specific client brief in mind...

- What is the client hoping to do?
- What were the most important features in this instance for the Client?
- How did they communicate their design brief to you?
- How many different design solutions, on average, do you come up with to answer a brief?
- How do you evaluate these design solutions?
- How do you help a client complete a design brief?
- Does the company have a standard structure for design briefs?
- Do most design briefs lead to a modification of an existing product or the design of a new one?

DESIGN SPECIFICATIONS AND SOLUTIONS

Explanation of Term

A design specification is the solution the company comes up with to meet the needs of the client.

It includes:

- Research and analysis of information and data
- Consideration of scientific principles
- Generation of ideas and solutions
- Evaluation of ideas
- 2D and 3D drawing and sketching techniques
- Modelling solutions
- All solutions need to have been tested and shown to meet the design criteria.

Factors/Evidence

Any design specifications the company comes up with to answer the design brief, including engineering and other technical drawings. Examples of testing to discover the solution that is best going to meet the brief.

Unit 1

Types of Companies

All involved with engineering processes.

Generic examples of questions for companies

- What special skills are needed to initially research a design ?
- How many solutions do you tend to come up with before choosing your final one ?
- How long on average does it take to answer a client's brief ?
- At what stages do you test your solutions and what criteria do you use ?
- How are designs modelled ?
Can ICT model solutions for you ?
- What sort of drawings and sketches do you use and do these have to meet standards ?

ENGINEERING DRAWINGS

Explanation of Term

These are the engineering drawings and diagrams that have to meet sector-specific standards and conventions such as B58888:2000/B53939-1 . Students must learn to read and use engineering drawings as well as produce a selection of engineering drawings using both manual and computer techniques.

Factors/Evidence

Any electrical/electronic, pneumatic/hydraulic and mechanical engineering drawings and diagrams.

Also any diagrams/drawings with the following standard symbols;

- Electrical/electronic components
- Mechanical features
- Dimensions
- Pneumatic/hydraulic valves, cylinders, reservoirs, pipework, filters.

Types of Companies

Engineering companies that make extensive use of engineering drawings.

Unit 1

Generic examples of questions for companies

- Why did you use the drawing standard you have chosen ?
- Do you have employees that can originate or modify such drawings ? What qualifications do they have ?
- What are the recognised standards for the various drawings you use ?
- Where did you learn about the standards that apply ?
- Do you have examples of both manual and computer generated drawings ?
- What ICT software do you use to manage technical drawings ? What extra facilities does this package offer ?

CHOOSING ENGINEERING DRAWING TECHNIQUES

Explanation of Term

This is about choosing the right engineering drawing for the right purpose and the right audience.

Factors/Evidence

Different drawings including a working/manufacturing drawing, a servicing/repairing drawing and/or an assembly drawing.

Types of Companies

Engineering companies that make extensive use of engineering drawings.

Generic examples of questions for companies

- What types of audiences do you have to produce drawings for ?
- Which employees can 'read' these drawings ?
- Depending on the audience, how do the drawings differ ?

Unit I

PRESENTING A DESIGN SOLUTION

Explanation of Term

How the final solution is explained to the client.

Factors/Evidence

Reports and drawings explaining the final solution to the client.

Types of Companies

Most engineering companies.

Generic examples of questions for companies

- Why did you choose the final solution that you did ?
- How long on average does it take to come up with a solution ?
- Have you an example of a design brief and final solution ?
- What type of changes do customers want to make after your presentation ?
- What is the next stage after this ?

Unit 2

Engineering Products

This unit introduces the student to six main themes:

- USING A PRODUCT SPECIFICATION
- PRODUCTION PLANNING
- CHOOSING MATERIALS, PARTS AND COMPONENTS
- USING PROCESSES, TOOLS AND EQUIPMENT
- QUALITY CONTROL TECHNIQUES
- HEALTH AND SAFETY

USING A PRODUCT SPECIFICATION

Explanation of Term

A product specification includes the following information:

- Size, shape, form.
- Materials, parts and components.
- Process methods where these are specified.
- Quantity required.
- Timescales.

All of these need to be understood before making decisions about the development of a product.

Factor /Evidence

Examples of product specifications being used, with all the essential information.

Types of Companies

All that use engineering processes, do not mix this up with those that use solely manufacturing processes. There needs to be an engineering input into the procedure.

Unit 2

Generic examples of questions for companies

- What sort of working drawings/diagrams do you use within the product specification ?
- What units of measurement do you use (or expect).
- What accuracy is normally required ?
- Does the product require single unit, batch or volume production ?
- What factor of costs is the set up as opposed to the making of the product ?
- What timescales do you normally work under – how long does it take from design brief to actual production ?

PRODUCTION PLANNING

Explanation of Term

The production plan gives all the information for your product.

It will give information about:

- Materials, parts and components to be used.
- Processes to be used.
- Tools, equipment and machinery to be used.
- The sequence of production.
- How quality will be checked.
- Health and safety factors.

Factors/Evidence

Access to the production plan for different products.

Types of Companies

All that use engineering processes.

Unit 2

Generic examples of questions for companies

- How do you decide where your quality control points are going to be ?
- Who contributes to the production plan ?
- Are there a set of standard health and safety checks that are applied ?
- To what degree was the engineering tool room used in the development of the production plan ?
- How long does it take to finalise a production plan ?
- What constraints can you face when finalising production plans ?

CHOOSING MATERIALS, PARTS AND COMPONENTS

Explanation of Term

This involves the selection of materials and components with suitable characteristics and properties to meet a product specification. With regard to materials, for example, choices could include metals and alloys, or ceramics, or polymers. Components can include mechanical components like nuts, bolts, electrical/electronic such as resistors and transistors.

Characteristics properties and features include the ability to shape and form by hammering, bending and so on. The ability to be treated by heat or chemicals or the ability to be given a surface finish. Features could include ease of handling, cost and availability.

Factors/Evidence

The materials, parts and components used by the company.

Catalogues with specifications.

Sources of materials.

Material test information.

Unit 2

Types of Companies

All that use engineering processes.

Generic examples of questions for companies

- Why do you use the materials and components that you do ?
- What particular features are important to you in the making of the product ?
- What selection processes do you go through ?
- How do you ensure continued availability ?
- Do you obtain materials and components from the UK or abroad ?
- How does the changing exchange rate impact on your decisions ?
- How much of the materials or components are kept in stock ? Is this expensive ?
- What packaging and transport problem does your selection cause ?

USING PROCESSES. TOOLS AND EQUIPMENT.

Explanation of Term

Processes include material removal, shaping and manipulation, joining and assembly, heat and chemical treatment, surface finishing. Tools and equipment include both manual and computer-aided manufacture.

Factors/Evidence

An explanation of the processes, tools and equipment used by the company.

Employee job descriptions for those using specialist skills.

Catalogues of tools in use.

Types of Companies

All engineering companies.

Generic examples of questions for companies

- What processes are used during the making of your product ?
- In proportion terms how long does this stage of the process take ?
- Do you use any computer-aided manufacture ?
- Why did you select the processes, tools and equipment that you did ?
- What new skills are needed to utilise CAM systems ?
- Do these processes cause any particular health and safety problems ?

Unit 2

QUALITY CONTROL TECHNIQUES

Explanation of Term

These are the inspections and tests that take place to ensure that the engineered products comply with the standards required.

Factors/Evidence

Any evidence to show quality control testing the following; dimensions, tolerances, fit, finish, performance, quality.

Types of Company

As before.

Generic examples of questions for companies

- At what stages do you introduce quality control mechanisms ?
- What is it important to test ?
How is this measured ?
- Do all the tests take place in the business ?
What other agencies are used ?
- What do you measure quality against ?
- How do you test your product and/or procedures ?

HEALTH AND SAFETY

Explanation of Term

All the health and safety features that a company undertakes during the manufacture of its product. This can include the individuals care of himself and others, the wearing of appropriate clothing and using safety equipment, carrying out risk assessments, following procedures, cleanliness and maintenance.

Factors/Evidence

Anything that demonstrates the maintaining of health and safety procedures.

Posters, policies, notices.

Sample extracts from the accident report (with personal details removed).

Recent improvements and changes.

Examples of goggles, gloves, ear plugs etc.

Types of Companies

All engineering companies.

Unit 2

Generic examples of questions for companies

- How often do you undertake a risk assessment ?
- Do some machines and processes present a larger risk and require more monitoring ?
- What safety clothing and equipment do you use ?
- How does COSHH apply to the company ?
- How much maintenance do the machines and equipment require to keep them safe ?
- How does the company eliminate risk ?
- How can materials be substituted to minimise risk ?
- Is noise a health and safety issue ?
- How are employees trained in, for example, manual handling ?