GCE Subject Criteria for Applied Engineering

For first teaching from September 2009

September 2011

Ofqual/11/4971

Contents

The criteria

Introduction

GCE subject criteria set out the knowledge, understanding, skills and assessment objectives common to all GCE specifications in a given subject.

They provide the framework within which the awarding organisation creates the detail of the specification.

Aims and objectives

1. Subject criteria define the relationship between the AS (3-unit), the AS double award (6-unit), the A level (6-unit) and the A level double award (12-unit).

2. Any GCE specification that contains significant elements of the vocational subject engineering must be consistent with the relevant parts of these subject criteria. Awarding organisations must ensure that GCE specifications and external assessment approaches are clearly differentiated from other qualifications they offer in this and similar subject(s) at this level.

3. The titles of the qualifications are:

    - Advanced Subsidiary General Certificate of Education in Engineering;
    - Advanced Subsidiary General Certificate of Education in Engineering (double award);
    - Advanced General Certificate of Education in Engineering;
    - Advanced General Certificate of Education in Engineering (double award).

4. All specifications in Engineering should encourage learners to develop broad skills, knowledge and understanding of the engineering sector. They should prepare learners for further study or training in engineering and related occupations.

5. The specifications should encourage learners to:

    - understand the nature of different areas of engineering and the demands of the engineering and related industries, and evaluate

the social, economic and environmental impact these have on society, identifying ethical issues that may arise;

- develop a knowledge and understanding of the range of engineering technologies, and the complex sub-groups that make up engineering and related industries;
- apply their knowledge of engineering technology in a variety of engineering contexts, including design, to become safe users of equipment, techniques and procedures used in engineering contexts, including those dependent on information and communication technology (ICT);
- apply their knowledge and understanding of engineering, its practical and technological aspects, through project-based practical study of engineering design, production, commission and maintenance.

Specification content

6. AS and A2 specifications should build on prior knowledge, understanding and skills equivalent to level 2 attainment.

7. The core content, which is common to all awarding organisation specifications, is grouped into 12 areas of study, with amplification. The core content to be included in AS is in normal type; the core content to be included in A2 is in **bold** type. Area of study titles do not necessarily constitute assessment unit titles. All areas of study must be covered in awarding organisation specifications, which should also normally cover all associated amplification.

8. A2 content will further develop and apply higher-level skills and extend beyond AS in terms of depth, complexity and application of knowledge and understanding of engineering and related industries.

AS (three-unit)

9. The core content, comprising 100 per cent of the content of the AS three-unit specification (which is also 50 per cent of the AS double award) is summarised in areas of study 1–11.

Area of study	Amplification (should normally include)
1. Legislation and documentation in engineering	Understand the importance of engineering documents, contracts,

	legislation and risk assessment, including: ■ current statutory health and safety legislation, including assessment and the identification of hazards in engineering activities; ■ industry sector standards; ■ employment rights and responsibilities.
2. Understanding the role of engineers	Investigate/understand the role of engineers in different engineering sectors and the tasks involved in a range of engineering disciplines, including: ■ characteristics and roles required for successful project completion in a range of industries and sectors in which engineering plays a role.
3. The impact of engineers and engineering on society and the environment	Investigate the role that engineers and engineering play in designing and creating a modern global society and the impact they have upon it and the environment, including: ■ the production of manufactured goods; ■ energy production, i.e. electricity, gas, coal, nuclear and petrochemicals, and renewable energy sources; ■ food production; ■ transport; ■ service industries; ■ current environmental legislation, including measures that can be taken to minimise the social and environmental

	impact of engineering activities; ▪ reduction of waste by the efficient use of resources.
4. The application of technology in engineering	Investigate how the development of technology impacts upon engineering, including: ▪ CAD/CAM; ▪ use of software applications; ▪ control systems; ▪ communications.
5. Characteristics, applications and properties of materials	Select materials for engineering applications according to their properties, including: ▪ natural materials; ▪ modern alloys and composite; ▪ understand the properties of materials and their potential for modification; ▪ perform simple calculations of stresses on simple structures.
6. Engineering drawing	Read, interpret and generate technical drawings and sketches using manual or IT-based techniques, with industry-standard symbols and drawing conventions.
7. Joining techniques	Investigate the techniques associated with permanent and non-permanent joining materials, including: ▪ thermal; ▪ chemical; ▪ mechanical.
8. Material processing	Understand and select one or more of the following processes to realise through to production:

	■ forming 2D and 3D; ■ wasting and machining; ■ casting and moulding; ■ fabrication; ■ surface treatment and finishing.
9. Electrical and mechanical systems	Understand the composition and application of linear and rotary systems, including energy systems in the context of electrical, mechanical and fluidic.
10. Electronics and control	Investigate electronics and engineering systems in the context of one of the following: ■ control; ■ monitoring; ■ measurement; ■ communications.
11. Designing and project management	Understand and apply the knowledge and skills applicable to the design process within the context of project-based work, including: ■ understanding client briefs; ■ planning a project, including planning, prototype and manufacture; ■ analysing and evaluating a design solution or project outcome; ■ project presentation and report writing; ■ preparing a design solution; ■ project management.

AS double award (six-unit)

10. Specifications must include other areas of study related to engineering in a vocational setting that build on the knowledge, understanding and skills set out in areas of study 1–11 in the remaining half of the AS double award.

A level (six-unit)

11. The core content, comprising two-thirds of the A2 content making up the A level (six-unit) specifications, is summarised in areas of study 1, 3, 4, 5, 9, 10, 11 and 12.

Area of study	Amplification
1. Legislation and documentation in engineering	**Identify and apply relevant engineering legislation and documentation.**
3. The impact of engineers and engineering on society and the environment	**Evaluate the impact of engineering activities on the environment and appropriate steps that can be taken to minimise them, including:** ▪ **efficient and effective energy use, by 'design in' or 'plant modification' techniques;** ▪ **determining the correct balance between the engineering activity and acceptance by society.**
4. The application of technology in engineering	**Investigate how the development of technology innovation impacts upon engineering, including:** ▪ **telemetry technology;** ▪ **new and smart materials;** ▪ **optical materials.**
5. Characteristics, applications and properties of materials.	**Select materials for engineering applications according to their properties, including:**

	▪ **performing simple calculations of stresses on simple structures, including pin-jointed frames and sections.**
9. Electrical and mechanical systems	**Understand the application of energy systems, including one or more of the following:** ▪ **lighting;** ▪ **pneumatics;** ▪ **control gear;** ▪ **drives (AC and DC).**
10. Electronics, instrumentation and control	**Investigate the application of electronics in a range of integrated engineering systems in one or more of the following contexts:** ▪ **control;** ▪ **monitoring;** ▪ **measurement;** ▪ **communication.**
11. Designing and project management	**Understand and apply the knowledge and skills applicable to the design process within the context of project-based work, including:** ▪ **understanding client briefs;** ▪ **planning a project, including planning, prototype and manufacture;** ▪ **analysing and evaluating a design solution or project outcome;** ▪ **project presentation and report writing;** ▪ **design for cost, manufacture and**

	sustainability; ■ **preparing a design solution;** ■ **project management.**
12. Application of mathematics and science	**Apply mathematical and scientific principles to solve engineering problems.**

12. Specifications must include other areas of study related to engineering in a vocational setting that build on the knowledge, understanding and skills set out in areas of study 1–12 in the remaining one-third of the A level.

A level double award (12-unit)

13. Specifications must include other areas of study related to engineering in a vocational setting that build on the knowledge, understanding and skills set out in areas of study 1, 3, 4, 5, 9, 10, 11 and 12 in the remainder of the A2 content of the A level double award.

14. Specifications must present content in a coherent and appropriate manner, fit for teaching, learning and assessment purposes.

15. All specifications must:

- include guidance for teachers on the provision of the vocational context;
- set out for learners the purpose and vocational relevance of the content (knowledge, skills and understanding);
- set out for learners the knowledge, skills and understanding that they will need to demonstrate to achieve the assessment units;
- set out for learners the evidence that they will need to produce for the internally assessed units;
- set out for learners the marking criteria for the internally assessed units against which they will be assessed.

Assessment objectives

16. Specifications must require learners to demonstrate the following objectives in a range of vocationally-related contexts.

17. The weightings of the assessment objectives must be within the ranges set out below:

Assessment objective		**Weighting (%)**		
		AS	**A2**	**A level / A level (double award)**
AO1	Knowledge and understanding Learners recall and apply knowledge, skills and understanding from across the specification content in a range of engineering situations.	**20–30**	**20–30**	**20–30**
AO2	Application of knowledge and understanding through investigation Learners plan and carry out investigations and tasks in which they analyse engineering issues and problems, and gather, record and analyse relevant information, data and other forms of evidence in the areas of study identified in the specification content in a range of engineering situations.	**30–40**	**30–40**	**30–40**
AO3	Design and production Learners integrate knowledge, skills and understanding to analyse independently an engineering situation or problem; and design, produce and communicate a response and evaluate outcomes and approaches, making contributions to team work.	**40–50**	**40–50**	**40–50**

Scheme of assessment

18. Each assessment unit must be assessed either internally or externally.

19. AS content and A2 content must be assessed separately.

20. In each AS specification, a minimum of one assessment unit must be assessed externally.

21. In each AS double award specification, a minimum of two assessment units must be assessed externally.

22. In each A level specification, at least two assessment units must be assessed externally, at least one of which must be in A2.

23. In each A level double award specification, at least four assessment units must be assessed externally, at least two of which must be in A2.

24. If short answer and objective questions are used, they must not account for more than half of the total credit assigned to external assessment.

25. Assessment must include opportunities for written communication.[1]

26. Internal assessment must include activities that enable learners to demonstrate skills in work-related contexts and should be project based.

27. All A level and A level double award specifications must include synoptic assessment at A2. Synoptic assessment involves the assessment of learners' ability to draw on their understanding of the connections between different aspects of the subject represented in the specification.

[1] Any reference to 'writing' or 'written communication' should be interpreted as the production of text by any means, for example pen, word processor and so on.

We wish to make our publications widely accessible. Please contact us if you have any specific accessibility requirements.

First published by the Office of Qualifications and Examinations Regulation in 2011

This publication is also available on our website at www.ofqual.gov.uk

Any enquiries regarding this publication should be sent to us at:

Office of Qualifications and Examinations Regulation

Spring Place	2nd Floor
Coventry Business Park	Glendinning House
Herald Avenue	6 Murray Street
Coventry CV5 6UB	Belfast BT1 6DN

Telephone	0300 303 3344
Textphone	0300 303 3345
Helpline	0300 303 3346