IMPORTANT NOTICE

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With effect from the June 2003 examination Cambridge International Examinations will only accept entries in the UK and USA from students registered on courses at CIE registered Centres.

UK and USA private candidates will not be eligible to enter CIE examinations unless they are repatriating from outside the UK/USA and are part way through a course leading to a CIE examination. In that case a letter of support from the Principal of the school which they had attended is required. Other UK and USA private candidates should not embark on courses leading to a CIE examination after June 2003.

This regulation applies only to entry by private candidates in the UK and USA. Entry by private candidates through Centres in other countries is not affected.

Further details are available from Customer Services at Cambridge International Examinations.

GEOMETRICAL AND MECHANICAL DRAWING
GCE Ordinary Level/School Certificate
Subject 7040

This syllabus is available for examination in **November only**.

INTRODUCTION

The syllabus is designed to introduce candidates to the basic skills of engineering drawing, geometry and graphics and to develop an understanding and appreciation of this subject.

The course of study will require the use of a drawing board, tee-square and drawing instruments i.e. set squares, compasses, protractor, a metric scale rule (1:1, 1:2, 1:5, and 1:10 scales) and pencils of appropriate hardness values.

It is important that tuition in respect of engineering drawing follows the recommendations contained in BS308 Parts 1 and 2 Engineering Drawing Practice Students Edition or, PP 7308 Engineering Drawing Practice for Schools and Colleges.

When completing the syllabus in respect of Plane and Solid Geometry it is most important that strictly geometrical methods are used and that all construction lines are clearly shown. However, lines which are parallel, perpendicular or inclined at angles of 30°, 45° or 60° to other lines may be drawn using set squares.

Protractors and adjustable squares must not be used for the division of angles during the examinations.

When freehand sketches are required, it is most important that they are in good proportion and produced without the aid of compasses, straight edges or templates.

Isometric drawings do not require the use of an isometric scale, nor should this be used in examination work, but centres may wish to make candidates aware of its use.

1   AIMS

The aims listed below set out the purpose of the course which is in preparation for the ordinary level GCE/SC examination in Geometrical and Mechanical Drawing. The aims are not listed in order of priority.

The aims are:

1.1   To develop spacial thinking and the ability to translate two dimensional representation into 3D images and vice versa.

1.2   To appreciate and apply standard conventions to methods of projection and the representation of solids in plane surfaces.

1.3   To develop the ability to read and interpret formal working drawings and diagrammatic illustrations.

1.4   To develop graphical skills including freehand sketching and drawings to scale.

1.5   To develop a sound understanding of the principles of plane and solid geometry.

1.6   To develop the ability to apply the basic principles of both plane and solid geometry in the solution of practical problems.

1.7   To appreciate the importance of producing formal working drawings which comply with the appropriate British Standard Specifications.

1.8   To develop a working knowledge of the contents of BS308 Engineering Drawing Practice relating to methods of projection, scales, paper sizes and orthographic representation of common engineering details (including sections) and conventional dimensioning.

2 ASSESSMENT OBJECTIVES

The objectives, which are not listed in order of priority, describe what a candidate should be able to do on completion of the course.

Candidates should be able to:

2.1 Read and interpret drawings conforming to British Standard drawing practice.

2.2 Produce fully dimensioned and annotated working drawings of engineering component part(s) from dimensioned sketches or from measurements of component parts.

2.3 Produce freehand orthographic or pictorial views of engineering components working from pictorial or orthographic drawings.

2.4 Produce general assembly drawings of simple engineering products from detail drawings of their various component parts assisted by a general description listed in sequence of their method of assembly.

2.5 Solve specific geometrical problems in plane geometry involving lines, plane figures, circles, loci and cycloidal curves.

2.6 Produce specified geometrical constructions in solid geometry involving the completion of partially drawn solutions.

3 SCHEME OF ASSESSMENT

3.1 Examination components

Component number	Title	Duration	Weighting
1	Plane & Solid Geometry	2 hours 40 minutes	50%
2	Engineering Drawing	2 hours 40 minutes	50%

3.2 Component 1

Plane & Solid Geometry (2 hrs 40 mins, 100 marks)

For the first 10 minutes candidates will be allowed to read the question paper and make notes but will not be allowed to commence their answers to the questions during this time period.

The paper will be divided into two sections and contain a total of eight questions all of equal value. Section 1 will contain three questions all based upon plane geometry and Section 2 will comprise five questions based upon solid geometry. Not more than five questions may be attempted, with a maximum of three taken from either section.

3.3 Component 2

Engineering Drawing (2 hrs 40 mins, 100 marks)

Candidates will be allowed 10 minutes to read the question paper and make notes but will not be allowed to commence to answer the questions in this time period.

The question paper will contain TWO questions both of which must be attempted. The first will be devised to test the candidate's ability in sketching and spacial thinking and will carry 16% or 20% of the total marks. The question will follow one of two formats.

Orthographic views of an engineering component will be supplied and the candidate required to produce a freehand pictorial sketch, drawn without mechanical aids, from a specified view point (16%); OR a pictorial sketch of a component will be supplied and the candidate required to produce orthographic freehand drawings involving two or three views, one probably in section, to a specified angle of projection and with three or four major dimensions added conforming to British Standard practice. This type of question will be valued at 20% of the total marks.

The second question carrying either 80% or 84% of the total marks will be designed to test the candidate's ability to read orthographic working drawings and to produce either a general assembly drawing including specified sections from given detailed component parts or dimensioned detail component parts working from dimensioned sketches drawn in orthographic or pictorial projection.

Question 2 will call for a specified number of major dimensions to be added if this feature of the syllabus has not been tested in Question 1.

4 SYLLABUS CONTENT

4.1 Plane Geometry

Students should be able to:

4.1.1 Divide or extend a given line in stated proportions.

Construct and use scales of stated ratios.

4.1.2 Construct triangles, quadrilaterals and other polygons to specified requirements. Produce similar plane figures and figures of equal area.
Reduce and enlarge regular and irregular figures to specified linear and area ratios.

4.1.3 Recognise the parts of a circle and know the common relationships between the component parts.
Recognise a tangent and normal and understand their various properties.
Find the mean proportional of two given lines.
Construct circles to satisfy stated requirements involving points, straight lines and other circles.

4.1.4 Construct the paths of points in simple mechanisms.
Construct an involute and its tangent and normal at a given point.
Construct an archimedian spiral.
Construct an ellipse, parabola, and hyperbola as a loci and construct a tangent and normal to these curves.

4.1.5 Construct the paths traced out by a point on the circumference of a rolling circle, rolling without slipping along (i) a straight path (cycloid), (ii) along the outside of a circular path (epicycloid) and (iii) along the inside of a circular path (hypercycloid). Construct a tangent and normal at a point on a cycloid only.
N.B. Trochoids are not required.

4.2 Solid Geometry

Diagrams printed on the question paper may NOT be to scale and may be in either First or Third Angle projection; the projection used will be stated. Solutions expected will be in either First or Third Angle projection.

Candidates should be able to:

4.2.1 Understand the principles and apply the projection of points, lines and planes from one view to another.
Demonstrate an understanding of how the intersection of lines and planes, perpendicular or inclined to one another, can be used to solve problems relating to common practical applications.
Determine the true length of a line in space.

4.2.2 Understand the orthographic projection of simple solids including projections on to the first auxiliary plane.
Produce sectional views of simple geometric solids.
Solve simple problems on the intersection of prisms, pyramids, cylinders, right circular cones and spheres.
Produce surface developments of prisms, pyramids, cylinders, right circular cones and simple combinations of these solids.

4.2.3 Produce a helix curve as a locus on a right cylinder and right circular cone and apply such a curve to the projection of screw threads and helical springs.

4.2.4 Produce an ellipse, parabola and hyperbola constructed as a conic section from a right circular cone.

4.2.5 Produce in isometric projection views of common components which include curved surface or edges. Questions will not involve the use of an isometric scale although in teaching this form of projection the scale could reasonably be included. The use of approximate constructions for circles in isometric projection is allowed.

4.3   Drawing (Mechanical)

Throughout the following, the recommendations of BS308 Parts 1 and 2, or PP7308 Engineering Drawing Practice for Schools and Colleges should be adopted.

Candidates should be able to:

4.3.1. Understand and apply the principles of orthographic projection in First and Third Angle to the production of scale drawings of general engineering details and assemblies. Such drawings to include both exterior and sectional views. These drawings will be made from detail drawings of components shown in either pictorial or orthographic projection. The subjects of the drawings may be taken from typical engineering examples and cover a wide spectrum such as pumps, valves, machine tools or components produced from castings, forgings, mouldings and pressings.

4.3.2 Understand and apply the principles of dimensioning and be able to produce parts lists and drawing identification i.e. title block data.

4.3.3 Be able to identify and produce conventional representation of threads, bolts, studs, rivets, nuts, keys, pins and locking devices for simple screwed fastenings.

4.3.4 Produce freehand sketches in both orthographic and pictorial form from details of simple engineering components. Sketches must be in good proportion and produced without the aid of compasses, straight edges, set-squares, templates or isometric scales.

Recommended textbooks for Geometrical and Mechanical Drawing at GCE O/SC Level

Engineering drawing and construction, L. C. MOTT (1976)

Engineering geometry, R. H. TURNER & H. J. SMITH (1963)

Exercises in technical drawing for GCE, A. W. LEWIS & R. W. MILLARD (1970)

Engineering drawing with worked examples, vol. 1, F. PICKUP & M. A. PARKER

Engineering drawing with worked examples, vol. 2, M. A. PARKER & F. PICKUP (1981)

Theory and practice of drawing in S.I. units, A. W. BARNES & A. W. TILBROOK (1970)

Practical geometry and engineering graphics: a textbook for engineering and other students, W. ABBOTT (1971)

Geometrical drawing (Published by Oxford University Press), GEORGE PEARMAN

Geometry of construction (Published by Cleaver-Hulme), NICHOLLS & KEEP

Construction geometry, vol. 1, R. CHUDLEY

Draughtsmanship, 3rd edition, FRAZER REEKIE

Further graphic communication (Published by Hodder and Stoughton), J. A. AUSTEN