



For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL (ZIMSEC)

**ADVANCED LEVEL SYLLABUS
For 2013 - 2016**

**Geometrical & Mechanical/
Building Drawing
9196**

1.0 PREAMBLE/INTRODUCTION

This syllabus provides a two year course in Geometrical and Mechanical/Building Drawing. The knowledge, understanding and skills gained is to be of great benefit to candidates pursuing further studies.

The subject should be studied together with related sciences and technical/vocational subjects to prepare students into institutions of higher learning.

2.0 AIMS

The aims of this syllabus are to:-

- 2.1** stimulate and sustain the interest of candidates in graphics and technology.
- 2.2** develop the ability to discriminate and make value judgements.
- 2.3** apply the general principles of graphical communication with sensitivity to refinement and accuracy.
- 2.4** develop a working knowledge of the contents of the Conventional Standard Practice relating to the methods of projection, scales and orthographic representation of common mechanical and building details and conventional dimensioning.
- 2.5** provide knowledge and skills which will be of benefit to candidates in their personal and working lives.
- 2.6** provide an opportunity for candidates to exercise initiative, imagination and resourcefulness in solving design problems.
- 2.7** encourage candidates to apply knowledge acquired, understanding of design and technology in different situations.

3.0 ASSESSMENT OBJECTIVES

By the end of the course candidates should be able to:-

- 3.1** read and interpret drawings conforming to acceptable conventional standards.
- 3.2** produce fully dimensioned and annotated working drawings of mechanical/building component part(s) from dimensioned sketches or from measurements of component parts.
- 3.3** produce orthographic or pictorial views of mechanical/building components working from pictorial or orthographic drawings.

- 3.4 solve specific geometrical problems in plane and solid geometry.
- 3.5 analyse and identify necessary information including scientific numerical data to solve the problem.
- 3.6 select suitable materials and processes in solving problems.
- 3.7 generate ideas creatively as the basis for more detailed design solutions.
- 3.8 produce appropriate design specifications after full consideration of the aesthetic and technological aspect of a problem.
- 3.9 evaluate technological aspects of a product.

4.0 SCHEME OF ASSESSMENT

The examination will consist of **three** papers: Paper 1 and Paper 4 and either Paper 2 or Paper 3.

4.1 Paper 1

Applied Geometry (3hrs) 100 marks.

The examination paper will be in **two** sections:

Section A (40 marks)

Questions will be set on basic graphics taken from the syllabus. Candidates will be required to answer all questions in this section. The questions will test basic graphical constructions.

Section B (60 marks)

Five questions will be set on Applied Geometry taken from the syllabus. Candidates will be required to answer **three** questions from this section. The questions will test the application of graphical constructions.

4.2 Paper 2: Mechanical Drawing (3hrs and 10 mins) 100 marks

A question will be set relative to an assembly of parts and this will require a number of views. Several design problems, associated with the assembly, will also be set and these may require freehand sketches to clarify the solutions to the problems. A further question may also be set, relatively to either a detailed drawing of a part associated with the design problems, or to a list of parts, typical of those associated with General Assembly (G.A) drawings.

4.3 Paper 3: Building Drawing (3hrs and 10 mins) 100 marks

A question will be set on the working drawings, floor plan, elevations and sectional views in preparation for construction details of a building with the addition of some given information.

Further questions may also be set, relatively to a detailed drawing of a part associated with the design problems, site plans, septic tank and soak-away, pictorial, typical of those associated with model by-laws of 1987.

4.4 Paper 4: Project (100 marks)

The project will arise from the chosen option (paper 2 or 3). The project theme will be sent to schools by ZIMSEC at least **2 months** before the examination. Candidates are expected to formulate a project brief from the given theme. The project will be done in a period of **20 hrs** under the supervision of the teacher. The project should be done in April/May for the June examination, and in September/October for the November examinations.

4.5 SPECIFICATION GRID

Assessment Objectives	Applied Geometry (1)	Mechanical/Building Drawing (2 or 3)		Project (4)
3.1	x	x	x	x
3.2	x	x	x	x
3.3	x	x	x	x
3.4	x			
3.5		x	x	x
3.6		x	x	x
3.7				x
3.8		x	x	x
3.9				x
Weighting	40%	40%	40%	20%

Objectives/Skills	Paper 1	Paper 2	Paper 3	Paper 4	Average %
Knowledge with understanding	40%	40%	40%	25%	34%
Practical skills and their application	30%	45%	45%	40%	40%
Decision making and judgement	30%	15%	15%	35%	26%
Totals	100%	100%	100%	100%	100%

5.0 CONTENT

5.1 Paper 1 Applied Geometry

The Applied Geometry paper will include:

- 5.1.1** The representation of solids in oblique, planometric, two point angular perspective pictorial and orthographic projections.
- the application of isometric scale to construct isometric views.
 - the use of approximate constructions for circles in isometric view.
- 5.1.2** The projections of section or sections of solids divided by inclined plane or oblique plane.
- the true shape of such sections and the use of first and second auxiliary planes.
- 5.1.3** Lines of intersections of surfaces of solids.
- development of surfaces including surfaces or part surfaces of more than one basic geometrical shape.
- 5.1.4** Conics: their construction as loci and conic sections.
- 5.1.5** Loci and its application, special curves. Link mechanisms and cycloidal curves, including involutes and spirals.
- 5.1.6** True angles between intersecting straight lines and planes and intersecting planes.
- traces of lines and planes.
 - oblique plane and its inclination to the planes reference.
 - the determination of perpendiculars to oblique plane from given points.
 - the shortest distance and shortest horizontal and vertical distances between two non-parallel and non-intersecting straight lines.

- 5.1.7** Triangle and parallelogram of forces, space and polar diagrams, funicular polygons.
- the construction of bending moment and shear force diagrams.
 - determination of forces in members of statically determinate plane; pin-jointed structures and simple three dimensional pin-jointed structures.
- 5.1.8** Determination of area by construction (including graphical integration) and measurement.
- 5.1.9** The helix and its application to threads and springs on cylindrical and conical forms.
- 5.1.10** Construction of radial plate cams to produce uniform velocity, uniform acceleration/retardation or simple harmonic motion in flat or roller type followers moving in a straight line or circular arc.

5.2 Paper 2: Mechanical Drawing

In this Option:

Candidates will be expected to produce scale drawings in correct projection either first angle or third angle projection, and to make well proportioned freehand sketches to supplement their scale drawings. A working knowledge of the recommendations of **BS 308** and **PP7308** will be required.

The preparation of assembly drawings from dimensioned drawings of components and the preparation of detailed drawings of components from assembly, drawings will be required. Such assembly drawings might require the compilation of a suitable parts list and the use of component identification. The use of centre lines, reference points and planes in dimensioning, tolerance dimensions, machining and surface finish symbols are required. Candidates will be expected to demonstrate their understanding of the selection of materials for components, the functions of components and lubrication of parts in assemblies. Candidates will be expected to undertake the design and completion of a design or to modify a design including the use of any of the following:-

- 5.2.1** Fastenings - Bolts, screws, studs, nuts, rivets, keys, pins and locking devices.
- 5.2.2** Hydraulic systems
- 5.2.2.1** Pumps - centrifugal and reciprocating.
- 5.2.2.2** Valves - non-return isolating and safety for steam, water and gas.
- 5.2.2.3** Piping and joints, flanged, small bore hydraulic and expansion.

- 5.2.2.4** Seals, for rotating and reciprocating shafts. Seals for static application.
- 5.2.3.0** Transmission of motion and power.
- 5.2.3** Rigid and flexible couplings, clutches, brakes, universals joints and methods of connecting them to shafts.
- 5.2.3.2** Journal Bearings (sleeve, ball and roller) and their housings. Thrust bearings (collar, ball and taper roller) and their housings.
- 5.2.4** Engines - Rotating and reciprocating parts, cylinder blocks and heads, carburettor and injectors.
- 5.2.5** Machine Tools - Parts for drilling machines, lathes, milling machines and shaping machines (including jigs and fixtures).
- 5.2.6** Gears - The conventional methods of showing details of spur, helical and bevel gears. The assembly of rotating gears and the mounting of bearings and shafts.

While it is expected that most of the syllabus subject matter will be taught in schools, this should be supplemented whenever possible by visits to relevant industries.

5.3 Paper 3: Building Drawing

This option of the syllabus is intended to give the candidates experience in all aspects of the Graphic Communication used in the construction industry. Candidates will be expected to follow the recommendations given in the Model Bylaws of 1987 up to two storey buildings. Candidates should investigate the different types of drawings and techniques available for presenting drawings. These include:

- 5.3.1** Orthographic projection - block plans, site plans, floor plans, design sections, (interior and exterior of buildings) isometric views, elevations, oblique views, perspective sections, pseudo perspective views, including aerial views, cut away drawings, expanded views, plain oblique views.
- 5.3.2** Description of the main historical developments in the construction of buildings and in the building crafts. The form and proportions of buildings, walls, doors, windows, roofs, chimneys, floors and staircases and the relation of these elements to the whole building.

5.3.3 Knowledge of the choice and use of materials and their suitability for particular purposes: their geographical distribution, methods of manufacture or extraction, chemical and physical properties including texture and colour.

5.3.4 The principal methods of construction including:

5.3.4.1 Past and present methods of construction in wood, stone, brick, concrete and steel including prefabrication, the functions of the main parts of the structure. Foundations, solid construction, framed construction in wood and steel, surface coverings (including weather boarding, lath and plaster ashlar brick).

5.3.4.2 Walls in English (Garden walls) and Flemish wall bonds, up to 1½ bricks in thickness, hollow walls. Boundary walls in brick, in rubble masonry and in concrete. Damp resisting courses, chimney breasts and flues. Openings in walls with brick or stone arches, lintels and sills.

5.3.4.3 Floors in wood, concrete and hollow tiles.

5.3.4.4 Roofs in wood (flat and ridged , roof trusses) steel, in stone (barrel vault, dome, arched roof) and in concrete. Roof coverings and ceilings.

5.3.4.5 Doors, windows and staircases.

5.3.5 Preservation and decoration of buildings

5.3.6 Planning for services

5.3.6.1 Hot water supply

5.3.6.2 Electricity supply

5.3.6.3 Drainage (above ground and below ground)

5.3.6.4 Insulation

While it is expected that most of the syllabus subject matter will be taught in schools, this should be supplemented whenever possible by visits to observe and record buildings in the process of construction as well as existing buildings. Links with representatives of construction industry and lectures by and visits to offices of local architects, building inspectors and planning offices will be ideal.

REFERENCE BOOKS

1. Engineering Drawing and Construction - L.C. Mott (1976)
2. Engineering Geometry - R.H. Turner and H.J. Smith (1963)
3. Engineering Drawing with Worked Examples Volume 2 - F. Pickup and M.A. Parker (1981)
4. Practical Geometry and Engineering Graphics - W. Abbott
5. Construction Technology Volumes 1 and 2 - E. Chadley
6. Construction Technology - R. Barry Volumes 1, 2 and 3
7. Further Graphic Communication - J.A. Austen
8. Advanced Level Technical Drawing - E. Jackson
9. Building Construction - Obande
10. Building Technology - Ezeji
11. Advanced Geometrical Drawing - Hawitt
12. Geometrical and Engineering Graphics - Bedford
13. Motivated Series A- Level Drawing - A. Yarwood
14. Structured Mechanics - Frank Dukkar