

**Federal Democratic Republic of Ethiopia**  
**Ministry of Education**

**Basic Technical Drawing, Grade 12**

**2009**

### **Grade 12 Basic Technical drawing Outcome**

The 12<sup>th</sup> grade basic Technical drawing course will enable students to:

- Develop reading and visualization skill of drawing;
- Understand basic principles of drawing in complete description of structure to be built;
- Show the principle and convention of shape and size description in applying to prepare working drawing;
- Recognize the rules and principles of development and intersection for cost effective work in sheet metal drawing.

**Unit 1: Sketching and Visualization (periods 5)**

**Unit outcome:** Students will be able to

- Understand basic principles and techniques of free-hand sketching;
- Understand how sketching integrate in to the design process;
- Apply the sketching techniques in the initial phases of design and product development;
- Appreciate the importance of free- hand sketching help to put idea on paper.

Competence	Contents	Suggested activities
<p><i>Students will able to:</i></p> <ul style="list-style-type: none"> <li>• describe the use and application of free- hand sketching;</li> <li>• Identify free-hand sketching materials;</li> <li>• use free hand sketching material properly;</li> <li>• prepare a sketch of line in free hand;</li> <li>• Sketch different types of lines, areas, angles, circles, and arcs by applying sketching techniques;</li> <li>• Lay out a sketch using proportion;</li> <li>• sketch multi-view drawing of 3D objects;</li> <li>• prepare a free-hand sketch of any 3D objects in three types of pictorial drawing.</li> </ul>	<p><b>1. Sketching and Visualization</b></p> <p><b>1.1 Introduction (2 periods)</b></p> <p>1.2 Sketching materials.</p> <p>1.3 Sketching lines</p> <p>1.4 Dividing lines and areas equally</p> <p>1.5 Sketching angles.</p> <p>1.6 Sketching circles and Arcs.</p> <p>1.7 sketching techniques of Objects (3 periods)</p> <p>1.7.1 proportion of large objects</p> <p>1.7.2 Multi-view sketching</p> <p>1.7.3 pictorial sketching</p> <ul style="list-style-type: none"> <li>- oblique</li> <li>- Axonometric</li> <li>- perspective</li> </ul>	<ul style="list-style-type: none"> <li>• Students should understand the use, application of sketching , advantage of sketching and general concept of sketching techniques</li> <li>• Discuss and demonstrate the types and use of sketching materials used in free-hand sketching by illustration.</li> <li>• Show and demonstrate the sketching techniques of lines, area, angles, circles, arcs and objects and give practical exercises.</li> <li>• Students should acquire sketching layout in a proper proportion.</li> <li>• Show how to use sketching proportion layout and give practical exercise.</li> <li>• Discuss and demonstrate the sketching techniques of different multi-view drawing of 3D objects.</li> <li>• Students should understand the sketching techniques of pictorial drawing and perform free hand drawing of isometric, oblique and perspective drawings.</li> <li>• Allow students to perform practical activities on the freehand sketching, by home work and class activities and in addition to practice sketching in the school surrounding</li> </ul>

## **Assessment**

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the specific objectives, to determine whether the student has achieved the minimum required level.

### **Students at minimum requirement level**

A student working at the minimum requirement level will be able to: Describe the use of free-hand sketching, Identify free-hand sketching materials, Sketch lines, angles, arcs, circles and areas with free-hand; Sketch multi-view drawings of an object with free hand and Sketch pictorial drawing of an object with free-hand.

### **Students above minimum requirement level**

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

### **Students below minimum requirement level**

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson at the end of the day or during breaks.

**Unit 2: Auxiliary Views (periods 13)**

**Unit outcome:** Students will be able to

- Understand the basic principle of orthographic projection;
- Recognize the type and main purpose of Auxiliary views;
- Show Auxiliary view drawing of objects to describe the true shape of inclined surface.

<i>Competence</i>	<i>Contents</i>	<i>Suggested activities</i>
<p><i>Students will be able to :</i></p> <ul style="list-style-type: none"> <li>• Explain the use of auxiliary views;</li> <li>• show the possible position of inclined surface may occur;</li> <li>• Describe the basic concept of orthographic projection;</li> <li>• Use reference or folding lines when creating auxiliary view;</li> <li>• Find the projection of a point, a line and a plane in space;</li> <li>• Identify the three classification of surfaces;</li> <li>• Describe normal view of a line and a plane, inclined surface, and the edge view of a plane;</li> <li>• Construct normal view of a line and a plane, inclined surface, and the edge view of a plane;</li> <li>• Explain the position of auxiliary projection plane;</li> </ul>	<p><b>2. Auxiliary Views</b></p> <p><b>2.1 Introduction</b> (1 periods)</p> <p><b>2.2 Over view of Orthographic drawing</b> (2 periods)</p> <ul style="list-style-type: none"> <li>• Position of reference line</li> </ul> <p>2.2.1 Projection of a point in space</p> <p>2.2.2 Projection of a line</p> <p>2.2.3 Projection of a plane (3 periods)</p> <ul style="list-style-type: none"> <li>• Types of plane surface</li> <li>• Principle of projection of plane</li> <li>• Edge view of a plane</li> <li>• Normal (true shape) view of plane</li> </ul> <p><b>2.3 Auxiliary projection of objects</b> (2 periods)</p>	<ul style="list-style-type: none"> <li>• Discuss and demonstrate by explaining the purpose of auxiliary views and possible position that inclined surface may occur</li> <li>• Discuss and demonstrate the basic concept of orthographic drawing and show projection of a point, line and plane in space.</li> <li>• students should able to draw reference line in appropriate position</li> <li>• Discuss and demonstrate the three classification surfaces.</li> <li>• show the normal view of a line, inclined surfaces and edge view of a plane.</li> <li>• give some practical work of inclined objects</li> <li>• Discuss and demonstrate the position of auxiliary projection plane.</li> <li>• Students should understand the construction steps of auxiliary views.</li> <li>• Give some activities to master the skill</li> </ul>

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<i>Competence</i>	<i>Contents</i>	<i>Suggested activities</i>
<ul style="list-style-type: none"> <li>• Identify the steps in drawing of auxiliary projection;</li> <li>• Identify the types of auxiliary views;</li> <li>• Describe the different between primary and secondary auxiliary views;</li> <li>• Draw the primary and secondary auxiliary views;</li> <li>• Describe the advantage of partial and complete auxiliary views;</li> <li>• Draw circular features in auxiliary projection;</li> <li>• Describe the advantage of half auxiliary view;</li> <li>• Perform the type of auxiliary view of an object.</li> </ul>	<p>2.3.1 Auxiliary planes 2.3.2 Construction of Auxiliary views</p> <p><b>2.4</b> Types of Auxiliary views (<i>5 periods</i>)</p> <p>2.4.1 Primary Auxiliary views</p> <ul style="list-style-type: none"> <li>• Front auxiliary</li> <li>• Top auxiliary</li> <li>• Side auxiliary</li> </ul> <p>2.4.2 Secondary auxiliary views</p> <p>2.4.3 Other features in Auxiliary</p> <ul style="list-style-type: none"> <li>• Partial and complete Auxiliary views</li> <li>• Circular features in auxiliary</li> <li>• Half auxiliary view</li> </ul>	<ul style="list-style-type: none"> <li>• Students should know the two types of auxiliary views and identify the advantage and disadvantage of them</li> <li>• show and discuss by drawing the principle of primary and secondary auxiliary views.</li> <li>• Discuss and demonstrate the advantage of other auxiliary views like partial and complete and half auxiliary.</li> <li>• show the general steps how circular features are projected in auxiliary.</li> <li>• Give some practical work on primary and secondary auxiliary views.</li> <li>• Allow students to practice more on auxiliary views if the time allow.</li> </ul>

**Assessment**

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the specific objectives, to determine whether the student has achieved the minimum required level.

**Students at minimum requirement level**

A student working at the minimum requirement level will be able to: Draw the projection of a point, a line and a plane on the three principal projection plane, Construct normal and edge view of a line and a plane, Draw normal (true shape) view of inclined and oblique surface, Describe the purpose and types of auxiliary views, Describe the steps to draw auxiliary projection, Draw circular features in auxiliary projection, Differentiate the partial and

complete auxiliary view of objects, and Draw the auxiliary view of an object for full shape description.

**Students above minimum requirement level**

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

**Students below minimum requirement level**

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson at the end of the day or during breaks.

**Unit 3: Sectional view (periods 12)**

**Unit outcome:** Students will be able to

- Understand the main purpose of sectional views;
- Analyze the types of sectional views according to their particular advantage in describing the interior feature of objects;
- Show sectional view of structure to describe the interior feature for complete description.

<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<p><i>Students will able to:</i></p> <ul style="list-style-type: none"> <li>• Define the concept of sectional views;</li> <li>• Describe the use of sectional views;</li> <li>• Describe the location of cutting plane to create sectional view;</li> <li>• Select the location of cutting plane line;</li> <li>• Identify the different types of section lining symbols;</li> <li>• Make different types of section lining;</li> <li>• Visualize the sectional view of an object;</li> <li>• Identify the types of sectional views;</li> <li>• Compare and contrast the advantage of all types of sectional views;</li> <li>• Select the appropriate type of section to the given object;</li> <li>• Perform the sectional view of an object with preferable type of section;</li> </ul>	<p><b>1. Sectional view</b>  <b>3.1 Introduction (1 period)</b></p> <p>3.2 Cutting plane and Section lining</p> <p>3.3 Visualizing sectional view</p> <p><b>3.4 Types of sectional view (8 periods)</b>            3.4.1 Full section            3.4.2 Half section            3.4.3 Offset section            3.4.4 Broken-out ( partial) section            3.4.5 Revolved section            3.4.6 Removed section</p>	<ul style="list-style-type: none"> <li>• Ask students the purpose of section in different condition what they know before</li> <li>• Students should understand the uses of sectional view and where they apply in technical drawing and identify the common section like longitudinal and cross-section.</li> <li>• Discuss and demonstrate by showing the location of cutting plane line, section line symbols and how to apply them.</li> <li>• Discuss and demonstrate how student visualize sectional views from different objects.</li> <li>• Students should name and differentiate the types of section</li> <li>• Discuss and demonstrate the advantage of each types of section by comparing.</li> <li>• Student should select and draw section of an object in appropriate section type.</li> <li>• Give enough examples and practical activities about section.</li> <li>• show the use and application of Full section, Half section, and Offset-section in special consideration</li> </ul>

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<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<ul style="list-style-type: none"> <li>• Identify other sectional view representation , using conventional practices;</li> <li>• identify the conventional representation of section;</li> <li>• apply conventional representation of section in technical drawing.</li> </ul>	<p><b>3.5 Other sectional view representation</b> (2 periods)</p> <p>3.5.1 Aligned section 3.5.2 Auxiliary section</p> <p><b>3.6 Conventional representation in sectioning</b> (1 periods)</p>	<ul style="list-style-type: none"> <li>• Students should understand and use other sectional view representation in different application</li> <li>• Give examples about aligned and auxiliary section</li> <li>• Students should understand the conventional representation in sectioning and apply in working drawing</li> <li>• Allow students to practice on mentioned topic specially on full, half and off-set section by class work or assignment level</li> </ul>

**Assessment**

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the specific objectives, to determine whether the student has achieved the minimum required level.

**Students at minimum requirement level**

A student working at the minimum requirement level will be able to: Describe the use & types of sectional views, Explain the use and location of cutting plane line, Show the different material representation of section lining symbols, Compare and contrast the advantage of each type of sectional views, and Draw the sectional view of an object with preferable type of section.

**Students above minimum requirement level**

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

**Students below minimum requirement level**

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson at the end of the day or during breaks.

**Unit 4: Dimensioning** (*periods 7*)

**Unit outcome:** Students will be able to

- Understand the purpose, convention and principle of dimensioning;
- Apply the standard dimensioning practice to describe the size of objects on technical drawing.

<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<p><i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Explain the use of dimensioning;</li> <li>• Identify the basic symbols, forms and elements of dimensioning;</li> <li>• Identify the two system in reading direction of figures;</li> <li>• Differentiate size and location dimensioning;</li> <li>• Apply size and location dimension on different drawing;</li> <li>• Select convenient dimensions properly to describe a feature of an object;</li> <li>• Identify the relationship between scale of drawing and dimension figures;</li> <li>• Identify the two arrangement of dimensions;</li> </ul>	<p><b>4. Dimensioning</b></p> <p><b>4.1 Introduction</b> (<i>1 period</i>)</p> <p><b>4.2 Lines and symbols</b></p> <p><b>4.3 Reading direction of figures</b></p> <p><b>4.4 Theory of dimensioning</b> (<i>2 periods</i>)</p> <p>4.4.1 Size dimensioning</p> <p>4.4.2 Location dimensioning</p> <p>4.4.3 Selection of dimensions</p> <p>4.4.4 Scale of the drawing</p> <p><b>4.5 Arrangement and indication of dimensions</b> (<i>2 periods</i>)</p>	<ul style="list-style-type: none"> <li>• students should understand the use and where to apply dimensioning</li> <li>• discuss and demonstrate the two basic dimension forms, including Dimension lines, Arrow heads, extension line, leaders, finished marks and others elements of dimensioning</li> <li>• discuss and demonstrate the two system in reading direction of dimensioning figures by giving different examples</li> <li>• Discuss and demonstrate the techniques of size and location dimensioning and student should apply in different drawings</li> <li>• Give examples and practical exercise</li> <li>• Student should select convenient dimension properly to describe the features of an object</li> <li>• Student should consider the relation between the scale of drawing and dimensioning figures</li> <li>• Discuss and demonstrate the two arrangement of dimensions such as datum and chain dimensioning and give practical exercise</li> </ul>

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<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<ul style="list-style-type: none"> <li>• Select the appropriate arrangement of dimensions;</li> <li>• Use the two basic arrangement of dimensions alternately on drawing;</li> <li>• Identify the methods of dimensioning on standard features</li> <li>• Identify the placement of dimensions on views, on limited space and pictorial drawing;</li> <li>• Apply dimension on views, on limited space rule and pictorial drawing;</li> <li>• select dimensions to reduce the number of dimension lines;</li> <li>• perform different types of dimensioning techniques for any shapes of objects;</li> <li>• prepare dimensions of different views and objects.</li> </ul>	<p>4.5.1 Datum dimensioning 4.5.2 Chain dimensioning 4.5.3 Dimensioning standard features</p> <p><b>4.6 Placement of dimensions (2 periods)</b> 4.6.1 Dimensioning views 4.6.2 Dimensioning in limited space 4.6.3 Dimensioning pictorial drawing</p>	<ul style="list-style-type: none"> <li>• Students should understand methods of dimensioning on standard features like dimensioning of diameters, arcs, hole sizes, chamfers, screw threads and others</li> <li>• Students should understand the conventions of placement of dimensioning like on               <ul style="list-style-type: none"> <li>- Views</li> <li>- pictorial drawing</li> <li>- limited spaces etc.</li> </ul> </li> <li>• Give examples and practical exercises</li> <li>• Give some practical work on dimensioning to apply the techniques for any shape of objects.</li> </ul>

## **Assessment**

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the specific objectives, to determine whether the student has achieved the minimum required level.

### **Students at minimum requirement level**

A student working at the minimum requirement level will be able to: Explain the use , basic symbols, forms and elements of dimensioning, Differentiate the two way of placing dimensioning figures, State the relationship between scale and dimension figures on drawing, Differentiate theory of dimensioning, Use the two basic arrangement of dimensioning alternately in drawing, Apply the principle of placement of dimension on

any type of features, and Perform working drawing with proper full size description.

### **Students above minimum requirement level**

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

### **Students below minimum requirement level**

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time at the end of the day or during breaks.

**Unit 5: Development and Intersection** (*periods 21*)

**Unit outcome:** Students will be able to

- Understand the principles and advantage of development and intersection;
- Recognize the types of hems and joints for different kinds of sheet metal job;
- Form different 3D models by using surface development in the real world application.

<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<p><i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Describe the use of surface development;</li> <li>• Identify the different types of surfaces and solids;</li> <li>• Identify the type of hems and joints used in sheet metal drawing;</li> <li>• Identify the principles of surface development;</li> <li>• Identify the rules and steps to use parallel-line development;</li> <li>• Perform the development of prism using parallel-line development;</li> <li>• Perform the development of cylinder using parallel-line development;</li> <li>• Identify the rules and steps to use radial-line development;</li> <li>• Apply the rule of true</li> </ul>	<p><b>5. Development and Intersection</b></p> <p><b>5.1 Introduction</b> (<i>1 period</i>)</p> <p><b>5.2 Principles of development</b></p> <p>5.2.1 Parallel- line development(<i>6 periods</i>)</p> <ul style="list-style-type: none"> <li>• Development of prism (full and truncated)</li> <li>• Development of cylinder (full and truncated)</li> </ul> <p>5.2.2 Radial-line development (<i>6 periods</i>)</p> <ul style="list-style-type: none"> <li>• True length by triangulation</li> </ul>	<ul style="list-style-type: none"> <li>• Allow students to discuss in group the application of surface development what they know before</li> <li>• Students should understand the advantage of surface development.</li> <li>• Discuss and demonstrate the different types of surfaces, solids, Hems and joints of sheet metal work and others</li> <li>• Student should understand the principle and types of surface development. Use enough illustration to this point.</li> <li>• Discuss and demonstrate by showing the rules and steps in parallel-line development</li> <li>• Students should perform the full and truncated prism and cylinder.</li> <li>• allow students to perform different exercises on parallel line development</li> <li>• discuss and demonstrate by showing the rules and steps in Radial-line development</li> <li>• Student should know how to find the true length by triangulation.</li> <li>• Students should perform the full and truncated pyramid development.</li> </ul>

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<i>Competence</i>	<i>Contents</i>	<i>Suggested Activities</i>
<p>length by triangulation;</p> <ul style="list-style-type: none"> <li>• Prepare the development of Pyramid using radial-line development;</li> <li>• Prepare the development of Cone using radial-line development;</li> <li>• Identify piercing point, visible and hidden line of intersection;</li> <li>• use the two methods of finding point of intersection alternatively;</li> <li>• Determine the line of intersection of two solids, such as prisms and cylinders;</li> <li>• Construct the development of two intersected regular solids such as, prisms and cylinders.</li> </ul>	<ul style="list-style-type: none"> <li>• Development of pyramid ( full and truncated)</li> <li>• Development of Cone (full and truncated)</li> </ul> <p><b>5.3 Intersection between geometrical solids</b> (8 periods)</p> <p>5.3.1 Piercing point, visible and hidden line of intersection</p> <p>5.3.2 Methods of locating point of intersection</p> <ul style="list-style-type: none"> <li>- Cutting plane method</li> <li>- End view method</li> </ul> <p>5.3.3 Intersection of two regular prism and their development</p> <p>5.3.4 Intersection of two cylinder and their development</p>	<ul style="list-style-type: none"> <li>• Students should perform the full and truncated Cone development.</li> <li>• allow students to perform different exercises on radial line development</li> <li>• Students should explain the application of Intersection between geometrical solids and show the types of intersections and developments and able to give an example of objects which can be made with this principle.</li> <li>• Students should describe about Piercing point and visible and hidden line of intersection.</li> <li>• Discuss and demonstrate by showing line of intersection of solids and construction method of development of two intersected regular solids</li> <li>• allow students to do some practice on the mentioned topic by assignment level</li> <li>• - Allow students to visit metal workshop factory</li> </ul>

## **Assessment**

The teacher should assess each student's work continuously over the whole unit and compare it with the following description, based on the specific objectives, to determine whether the student has achieved the minimum required level.

### **Students at minimum requirement level**

A student working at the minimum requirement level will be able to: Identify the types of surface, solids, hems and joints in sheet metal drawing, Describe the use and types of development, State the rules and steps to use parallel-line development, State the rules and steps to use radial-line development, perform the development of prism, cylinder, cone & pyramid,

Apply the rule of true length by triangulation, and Determine the piercing point and line of intersection between lines, planes and solids.

### **Students above minimum requirement level**

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

### **Students below minimum requirement level**

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time at the end of the day or during breaks.