Basic Technical Drawing
for
Grade 11 and 12

Preface

Many young people have an early interest in a career in engineering. Often they are not certain what an engineer does. Generally they do not have the opportunity to get the plants and laboratories of industry and see that actually takes place but they want to be one due to many reasons. The work of engineers covers a wide range of activities. In area such as: In design, in manufacturing, construction, maintenance, management, teaching, research etc.

Study of the basic technical drawing course is a key for success as an engineer and may be said to be the language of engineering. The basic technical drawing course is therefore designed to give students a brief look to some of the well rounded introductory information's, aspects, problems and opportunities in engineering. Technical drawing is the language used in industry by technicians and engineers to record their ideas and to give the basic information necessary for building, machines and structures.

Our aim is to study this technical language so that we may write it, express ourselves clearly to one familiar with it, and read those written by others. To achieve this we must learn its basic theory and composition by familiar with its accepted conventions and abbreviations. This technical language is universal as its principles are essentially world-wide.

Technical drawing is the name given to all drawing carried out with the aid of technical drawing instruments. All drafting may be grouped in to five main areas. These are Industrial drafting, Architectural drafting, Electrical drafting, Topographical drafting and civil engineering drafting. The people employed in these different areas must all have special training.

Technical drawing can be interpreted by acquiring a visual knowledge of the subject represented and the student's success in it will be indicated not only by his skill in doing it, but also by his ability to interpret his impression and visualize other peoples idea expressed in this language.

The curriculum guide for grade 11 and grade12 of basic Technical drawing are developed to implement the new educational and training policy. The contents of those grades are organized / incorporated for students to acquire knowledge further studies pertinent to drawing. So, these curriculum guides are designed taking in to consideration the students who may quit schooling at the first cycle of secondary education and those who will pursue their education or training in higher institution. The new curriculum framework for Ethiopian schools has allotted 2 periods per week for Basic Technical drawing in grade 11 and 12.Though the academic calendar is made of 40 weeks ,the curriculum guides are prepared for 34 weeks(68 periods) and 28 weeks(58 periods) for grade 11 and 12 respectively. The distribution of periods for each unit of each grade level is also indicated in the curriculum guides.

In these curriculum guides, basic Technical drawing subject area outcome, grade outcome, chapter outcome, competence, content, suggested activities, and ways of assessment have been briefly stated for the discipline. The competencies have been stated in behavioral terms in order to facilitate evaluation at the end of each unit. This document of grade 11 and 12 Basic Technical drawing curriculum guides was reviewed ,discussed, and finalized at a national workshop held in the general framework development department of the MOE(TIR 1-MIazia 30) by Abebe Basazinew a member of GECFDD and Wondim Maru from Yekatit 12 preparatory school.

Outcome of the Subject Area

The basic Technical drawing course in the second cycle of secondary education will enable students to:

- appreciate the contribution of technical drawing to society and in the industrial arts processes;
- understand basic principles and conventions of technical drawing;
- Acquire basic knowledge and skill for further studies pertinent to Technical drawing.

Grade 11

Basic Technical drawing course titles and time allotment distribution

Unit No.	*Course title or units*	*Theory and practice periods*		
		Theory	*Practice*	*Total*
1.	Introduction to Basic Technical Drawing	1	-	1
2..	Basic technical drawing Equipments	1	1	2
3.	Alphabet of Lines	1	-	1
4.	Lettering	2	-	2
5.	Geometrical construction	4	8	12
6.	Multi-view drawings	7	18	25
7.	Pictorial drawing	7	18	25
	Total periods per year	23	45	68

Grade 12

Basic Technical drawing course titles and time allotment distribution

Unit No.	*Course title or units*	*Theory and practice periods*		
		Theory	*Practice*	*Total*
1.	Free-hand Sketching	2	3	5
2.	Auxiliary view	4	9	13
3.	Sectional view	3	9	12
4.	Dimensioning	3	4	7
5.	Development and Intersection	8	13	21
	Total periods per year	20	38	58

Basic Technical Drawing
for
Grade 11

Grade 11 Basic Technical drawing Outcome

The 11th grade basic Technical drawing course will enable students to:

- understand the basic concepts of Technical drawing;
- develop accuracy, speed, neatness and visualization skill of technical drawing;
- apply basic principles and conventions for making technical drawing of an object.

Unit 1: Introduction to Technical drawing *(1period)*

Unit outcome: students will be able to

- Appreciate the contribution of graphical language (Drawing) in human civilization;
- Understand the basic concepts, purpose and areas/ professional disciplines of technical drawing.

Competencies	***Contents***	***Suggested activities***
Student will be able to: • define drawing in their own concepts; • write the role of drawing in human civilization; • explain how and when drawing is originated; • Distinguish the two classification of drawing;	***1. Introduction to basic Technical drawing*** *(1 period)* • Definition and History of drawing	• Ask students to identify the use of drawing around their school and out of the school. • give a clear clarification about drawing using models of different paintings, sign and marks, graphic art and posters. • Student should be Introduced the history of drawing by showing pictures of ancient Egyptians hieroglyphs. • Students should be asked to define drawing with their own understanding and then give the right definition of drawing. • discuss about the two distinct classification of drawing in related to real world practice
• describe the areas/ professional disciplines of technical drawing involves; • describe some important applications of technical drawing in every day life;	• Areas/ professional disciplines of Technical drawing	• student should clearly distinguish technical drawing from other arts and list areas/professional disciplines of technical drawing by class discussion.
• state the advantage of CADD in related to manual work;	• Technical drawing today Computer-Aided design drafting (CADD)	• Discuss and demonstrate the advantage and disadvantage of manual and AUTOCAD drawings,
• explain the educational value of technical drawing;	• Uses and educational value of Technical drawing	• students should understand the Uses and educational value of Technical drawing • arrange a visit to industrial drafting rooms, professional drafting training centers (engineering colleges, municipality drafting rooms etc)

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 role of drawing in human civilization, Distinguish the two classification of drawing, List the areas/professional disciplines of technical drawing, Describe the educational value of Technical drawing.

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 2: Basic Technical Drawing Equipments *(2 periods)*

Unit outcome: students will be able to

- understand the types, proper uses and applications of basic Technical drawing Equipments;
- Apply each basic technical drawing instruments and materials in making drawings.

Competencies	*Contents*	*Teaching and learning activities*
Students will be able to: • identify the difference between materials and instruments of drawing;	***2. Basic Technical drawing Equipments*** *(2 periods)* **2.1 Introduction** *(1 period)*	• Ask students to recall drawing materials which they know before • students should understand the difference between materials and instruments of drawing
• list the different types Technical drawing materials; • describe the purpose of each drawing materials; • state the different types of pencils, paper and Rapidograph; • use drawing materials properly on making drawing of objects in activities;	**2.2 Selection of drawing materials**	• student should recognize the types and purpose of drawing materials such as: Drawing paper, masking tape, drawing pencil, eraser, Rapidograph and tracing paper by chart or physical real object • students should identify the types of pencil, paper and Rapidograph….etc by real picture
• list the different types Technical drawing instruments; • describe the purpose of each drawing instrument; • Select drawing instruments in their specific application;	**2.3 Selection of drawing instruments** *(1 period)*	• discuss and demonstrate the type and purpose of drawing instruments such as: drawing board, dusting brush, T-square, set-square, scale, French curve, protractor, compass, divider and Template…etc by chart or physical real object

Competencies	*Contents*	*Teaching and learning activities*
• prepare oneself for making technical drawing; • arrange appropriate working area before starting drawing; • prepare the title block on drawing paper.	**2.4 Applications of basic Technical drawing Equipments**	• Demonstrate main steps help to prepare students in starting drawing such as cleaning instruments and one's hand surrounding working area then prepare Title block format • Discuss and show the application of basic technical drawing instruments

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: List the types of technical drawing materials & instruments, Describe the purpose of each Technical drawing materials & instruments, Identify the types of pencils, paper and radiograph, Show the proper uses of Technical drawing materials & instruments and prepare the title block on drawing paper.

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 3: Alphabet of lines *(1periods)*

Unit outcome: students will be able to

- understand the types of lines according to their purpose, weight and thickness in drawing;
- Apply alphabet of lines for making proper working drawings.

Competencies	***Contents***	***Teaching and learning activities***
Students will be able to: • list the types of lines; • explain the purpose and weight of alphabet of lines; • perform alphabet of lines in their weight and thickness; • use alphabet of lines on proper drawings.	***3. Alphabet of lines*** *(1 period)* • Introduction • purpose, weight and thickness of lines • Applications of alphabet of lines	• Ask students to list the types of lines they know before in related subjects. • student should be introduced about alphabet lines in related to other language • Discuss and demonstrate the types, purpose, weight, thickness and continuity of lines by using like charts and drawings. • show how to apply alphabets of line in working drawing such as On Title block, On working drawing like architectural and engineering And On map drawing and others • Allow students to perform practical activities on alphabet of lines, by class work or home work level.

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: List the types of lines used in Technical drawing, Explain the purpose and weight of each line and apply the proper weight & thickness of lines on working drawings.

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 4: Lettering *(2periods)*

Unit outcome: Students will be able to:

- distinguish the different lettering styles and guide lines for letter writing;
- understand the rules and principles of lettering;
- Execute (draw) the common Technical drawing lettering styles.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • state the role of lettering in technical drawing; • identify the four type of lettering styles; • make Technical lettering, Single-strokes letters properly; • write/ draw vertical and inclined letters and numerals;	*4.* ***Lettering*** *(2 periods)* **4.1 Introduction** *(1 period)*	• Ask students the styles of letter which they know before • students should be introduced how information's can be convey in drawing and the types of lettering styles • discuss and demonstrate different lettering strokes using graph paper. • students should understand technical lettering called single-stroke letters, and Vertical and Inclined letters, numerals & Fractions • demonstrate the height of letters and numerals
• prepare guide lines properly for capital letters, lowercase letters, numerals and fractions; • draw letters and numerals with proportional height and width; • draw letters with proper spacing; • make proper space between words and sentences;	**4.2 Techniques of lettering** • Stability of letters	• Students should understand how to draw lettering guide lines for capital, lower case letters, numerals and fractions using model of letter drawn with proper space • Students should understand the concept of stability of letters to draw in the right shape
• compose letters in balance between words and sentences	• Composition of letters	• Discuss and demonstrate about composition of letters between words and sentences to create a balanced effect • student should keep Space between letters, words and sentences

Competencies	*Contents*	*Suggested activities*
• select proper types of pencils for lettering; • identify types of guide line devices and lettering guides;	**4.3 Pencil for lettering, lettering devices and Lettering guide** *(1 period)*	• Students should select the basic types of lettering pencils • Demonstrate the two basic types of lettering devices for guide lines and types of lettering guide like Templates.
• apply single stroke vertical gothic letters in Title block.	**4.4 Application of technical lettering** **(single stroke vertical gothic lettering)**	• Give exercise for students to perform practical activities on the mentioned topics by class work and assignment level

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 main purpose of lettering in drawing, Identify the types of lettering styles, Draw the universally applicable single stroke vertical Gothic letters with free-hand, Describe the techniques of lettering to draw free hand letters properly, Draw letter, words & sentences with proper spacing, Select proper types of pencils for lettering and identify types of guide line devices and lettering guides.

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: Geometrical construction *(12 periods)*

Unit outcome*:* Students will be able to:

- understand different types of plane geometry and their basic elements;
- construct different types of geometrical figures;
- Apply methods and rules of construction for different types of geometrical shapes.

Competencies	***Contents***	***Suggested activities***
Students will be able to:	***5. Geometrical construction*** *(12 periods)*	
• Explain different types of geometrical elements;	**5.1 Introduction** *(2 period)*	• Ask students to discuss in group by identify the geometrical elements • Students should understand the aim of geometrical construction and how to formulate an accurate solution for geometrical figures. • Discuss and demonstrate about geometrical elements such as point, line, angle, plane and arc etc.
• construct different types of lines; • perform steps of bisect and trisecting straight line; • divide a line in to any number of equal parts without ruler; • construct angles with different methods; • perform steps of bisect and trisecting an angle; • divide an angle in to any number of equal parts; • transfer by coping angles for different places;	**5.2 construction of Point, line and angle**	• student should construct different lines and angles such as Draw parallel and perpendicular lines, Bisect and trisect a straight lines, Divide a line in to any number of equal parts, angle drawing (cord, sine and tangent method etc), Bisect and trisect an angle and Dividing and coping/ transferring an angle
• define polygon in their own words; • differentiate regular and irregular polygons; • construct triangles with	**5.3 Polygons***(4 periods)* • Regular and Irregular polygons • construction of regular polygons	• Discuss and demonstrate about polygon and differentiate regular and irregular polygons • Student should understand and construct about regular polygons like triangle, quadrilateral, pentagon etc.

Competencies	***Contents***	***Suggested activities***
different methods; • define quadrilateral in their own words; • construct different types of quadrilateral; • draw regular polygons using their specific method; • construct any type of regular polygon using general methods;		• Discuss and show the different construction method of regular polygons and give some practical activities.
• define circle in their own words; • construct circles using three points in space; • define tangency and tangent point; • construct tangent line and tangent curves to join circles and arcs; • apply different tangency concepts to real object drawing; • differentiate an Ellipse from other curved planes;	**5.4 Circles and Tangents** (*3 periods)* • Circle construction using three points • a line tangent to circles • An arc tangent to circles	• Discuss about circle and tangent and show the construction method circle with three points, and how to make/draw tangents and allow to do some practical activities • give exercise related to tangency about real objects like flower cap.
• construct an ellipse using different methods.	**5.5 Construction of Ellipse** *(3 periods)*	• student should understand construction method of ellipse and allow to do some practical activities on four center, Concentric circle and Parallelogram method • Allow students to practice on Geometrical construction in home work and class activities. • student should draw different patterns includes all types of geometrical elements

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: Define geometrical elements, draw a bisecting and trisecting straight lines, divide a line in to any number of equal parts with out rules, show the methods how to bisect & trisect an angle using compass, copy an angle to any other places with drawing steps, differentiate regular and irregular polygons, construct triangles and quadrilateral using different methods, construct regular polygons with specific and general methods, construct circle through three points not on a straight line on space, Construct tangent line and tangent curves to join circles and arcs, and Construct an ellipse using different methods.

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 6: Multi-view drawing *(25 periods)*

Unit outcome: Students will be able to

- Understand the basic principle of Multi-view drawing;
- Develop visualization skill to represent a 3D objects using the six principal views;
- Appreciate the convention and principle of describing the shape of an object.

Competencies	***Contents***	***Suggested activities***
Students will be able to: • Explain the importance of multi-view drawings; • define the concept of projection;	***6. Multi-view drawing*** *(25 periods)* **6.1 Introduction** *(1 periods)* **6.2 Projection** • Types of projection	• Students should understand the importance and application of multi-view drawings. • discuss and demonstrate the concept of projection and type of projection in short.
• Explain the concept orthographic projection; • Identify the three main projection planes; • Describe the methods of orthographic projection; • Prepare arranged view with first angle projection; • Prepare arranged view with 3rd angle projection;	**6.3 Orthographic projection** *(7 periods)* 6.3.1 plane of projection 6.3.2 Method of Orthographic projection - 1st angle projection - 3rd angle projection	• Give a brief explanation about orthographic projection • Students should know the three main projection planes and how they use in orthographic projection. • Discuss and demonstrate the 1st and 3rd angle projection methods and give some practical exercise. • Student should compare first and third angle projection
• Identify the six principal views; • Arrange the six principal views in 1st and 3rd angle projection methods; • Identify the common dimension of views; • analyze guide lines for	**6.4 The six principal views** *(10 periods)* 6.4.1 alignment of view 6.4.2 common dimension 6.4.3 Adjacent placement of views 6.4.4 Orientation of the object & choice of views	• Show the arrangement of the six principal views and explain the rules (like common dimension, adjacent placement of views and alignment of views)in both first and third angle of projection and give some practical activities. • Students should understand the guide lines orientation of objects and choice of views with their practical applications

Competencies	***Contents***	***Suggested activities***
orientation of an object and choose of views that most describe of an object • Laying out one-view, two view and three-view drawings; • Prepare the multi view drawing of an object;	6.4.5 One and two view drawing 6.4.6 Three-view drawing	• Explain, discuss and show the methods of one-view, two- view and three-view laying out methods • Allow students to practice on multi-view drawings, by home work and class work activities
• show hidden features of an object; • Apply the rule of precedence of line in view drawings.	6.4.7 Invisible lines and arcs 6.4.8 Precedence of lines	• Discuss and demonstrate hidden features of an object and applications of precedence of lines using examples and practical exercise
• identify normal, inclined, and oblique surface;	**6.5 Fundamental views of edges and surface** *(3 periods)* • Normal surface • Inclined surface • Oblique surface • curved surface	• Demonstrate and discuss about fundamental views of edges and surfaces such as: - normal surface - Inclined surface - oblique surface - curved surface - Hidden edge
• Apply visualization skills by solid and surface to multi-view drawings.	**6.6 Visualization and free hand multi-view sketching** *(4 periods)*	• Discuss and demonstrate by giving examples and exercises to develop visualization skill including surface identification, missing line and missing views and else.

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: Differentiate the method of orthographic projection, draw the shape of an object with 1st and 3rd projection, Arrange the six principal views in 1st & 3rd angle projections, Identify the three main projection plane and their common dimension, Determine the orientation of objects that help to choose views most descriptive, Laying out one view, two view and three-view drawing of objects, Prepare multi-view drawing of an object, Differentiate the three common surfaces and their projection, and Apply the rule of precedence of line in view drawing.

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 7: Pictorial Drawing *(25 periods)*

Unit outcome: Students will be able to

- Understand the basic principle of pictorial drawing;
- Recognize the different types of projection and the three types of pictorial drawing;
- Apply the principle of Axonometric, Oblique and perspective projection in describing 3D objects;
- Appreciate the importance of pictorial drawing to describe the shape of structures in today's world.

Competence	***Contents***	***Suggested activities***
Students will be able to: • Describe the concept of projection and its constituting elements; • Identify the types of pictorial drawing;	***7. Pictorial drawing*** **7.1 Introduction** *(1 period)* • Overview of the theory of projection • Types of pictorial drawing	• Ask students to define projection in their own understanding using the previous chapter knowledge. • Discussion and explain concept of projection and constituting elements using illustrations. • Student should identify the types of pictorial drawing by understanding the two classification of projection
• Define the principle of axonometric projection; • Identify the types of axonometric projection; • Choose appropriate position of isometric axis to describe the shape of an object;	**7.2 Axonometric projection** *(14 periods)* 7.2.1 Types of axonometric projection 7.2.2 Isometric drawing 7.2.3 Alternative position of isometric axis	• Students should understand the principle of axonometric projection and their classification and show the 3D image of an object in both types. • Discuss and demonstrate about Isometric drawing with different objects including Isometric axes and Reverse axis.
• Identify isometric and non isometric lines; • Identify the procedure of constructing angles are located in isometric drawing;	7.2.4 Lines and angles in isometric drawing • Isometric & non-isometric lines • angle in Isometric drawing	• Students should understand about Isometric lines, Non - isometric lines and Angles in isometric and apply in isometric drawing.
• Draw circles, arcs and irregular curves in isometric; • Apply offset location measurement in isometric	7.2.5 regular and Irregular curves in isometric • circle & arcs in isometric • Irregular curves in	• Students should understand about Circles, arcs and irregular curves in isometric and apply in isometric drawing.

Competence	*Contents*	*Suggested activities*
drawing; • Prepare the isometric drawing using box method and center line layout method; • Perform Isometric drawing of an object with its principle; • Describe the principle of oblique projection; • Identify the types of oblique drawing; • Identify the axis and position of objects in oblique drawing; • Apply method of construction of oblique drawing; • Draw circle and arcs in oblique drawing; • Perform Oblique drawing of an object with its principle; • Explain the terms of perspective drawing; • Identify the best location of station point, picture plane and vanishing point, • Show the location of	isometric • Offset location measurement 7.2.6 Isometric construction • box method • the center line layout method **7.3 Oblique projection** *(5 periods)* 7.3.1 Types of oblique drawing 7.3.2 position of axis in oblique drawing 7.3.3 oblique drawing construction 7.3.4 Circles in oblique drawing 7.3.5 Advantage of oblique drawing **7.4 Perspective projection** *(5 periods)* 7.4.1 definition of basic terms	• Discuss and demonstrate offset location measurement in isometric drawing by giving different example. • Student should understand the two construction method of Isometric drawing and they perform practically both methods. • Students should understand the principle and the types of oblique projection. • Discussion and demonstrate about Oblique drawing with different objects including Oblique axes and lines and the choice position of objects in oblique drawing. • hold class discussion on the advantage of oblique drawing and show the construction method of circle and arcs in oblique drawing and give some practical activities. • Students should explain the definition of basic elements, show the location of picture plane, station point, vanishing point and ground & horizon line • Hold class discussion on the principle and the types of perspective drawing and show the

Competence	*Contents*	*Suggested activities*
ground line and Horizon line; • Identify the three types of perspective drawing; • Apply the procedure of construction of objects in perspective; • Draw circles and arcs in perspective drawing; • Perform perspective drawings with its principle.	7.4.2 Location of picture plane & station point 7.4.3 Types of perspective drawing 7.4.4 construction of perspective drawing	construction method and applications of: - One point perspective (parallel perspective) - Two point perspective (Angular perspective) - Three point perspective. (oblique perspective) • Student should have some understanding about the method of construction of Circle and arcs in perspective drawing • Allow students to practice only on one point & some on two point perspective drawing, by assignment and class activities level.

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 types of projection system and its constituting elements, State the types of pictorial drawing and axonometric projection, Choose appropriate position of isometric axis to describe the shape of an object, Describe the procedure which angles are located in Isometric drawing, Draw circle, arcs and irregular curves in Isometric, Apply offset location measurement in Isometric drawing, Construct the isometric drawing using box method and center line layout methods, Perform isometric drawing of an object using its principle, State the types of oblique drawing, Explain about axis and position of objects in oblique drawing, Draw circles and arcs in oblique drawing, Construct oblique drawing of an object with its principle, Describe the advantage of oblique drawing from others, Explain the terms and best location of station and vanishing point, ground and horizon line, and picture plane, Describe the main purpose and three types of perspective drawing, State the procedure of construction of objects in perspective drawing, and Perform perspective drawing of objects with its principle.

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.

Basic Technical Drawing
for
Grade 12

Grade 12 Basic Technical drawing Outcome

The 12th 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***
Students will able to: • describe the use and application of free- hand sketching;	***1. Sketching and Visualization*** **1.1 Introduction** *(2 periods)*	• Students should understand the use, application of sketching , advantage of sketching and general concept of sketching techniques
• Identify free-hand sketching materials;	1.2 Sketching materials.	• Discuss and demonstrate the types and use of sketching materials used in free-hand sketching by illustration.
• use free hand sketching material properly; • prepare a sketch of line in free hand;	1.3 Sketching lines	
• Sketch different types of lines, areas, angles, circles, and arcs by applying sketching techniques;	1.4 Dividing lines and areas equally 1.5 Sketching angles. 1. 6 Sketching circles and Arcs.	• Show and demonstrate the sketching techniques of lines, area, angles, circles, arcs and objects and give practical exercises. • Students should acquire sketching layout in a proper proportion. • Show how to use sketching proportion layout and give practical exercise.
• Lay out a sketch using proportion; • sketch multi-view drawing of 3D objects;	1.7 sketching techniques of Objects *(3 periods)* 1.7.1 proportion of large objects 1.7.2 Multi-view sketching	• Discuss and demonstrate the sketching techniques of different multi-view drawing of 3D objects. • Students should understand the sketching techniques of pictorial drawing and perform free hand drawing of isometric, oblique and perspective drawings.
• prepare a free-hand sketch of any 3D objects in three types of pictorial drawing.	1.7.3 pictorial sketching - oblique - Axonometric - perspective	• 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

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.

Competence	*Contents*	*Suggested activities*
Students will be able to : • Explain the use of auxiliary views; • show the possible position of inclined surface may occur;	***2. Auxiliary Views*** **2.1 Introduction** *(1 periods)*	• Discuss and demonstrate by explaining the purpose of auxiliary views and possible position that inclined surface may occur
• Describe the basic concept of orthographic projection; • Use reference or folding lines when creating auxiliary view; • Find the projection of a point, a line and a plane in space;	**2.2 Over view of Orthographic drawing** *(2 periods)* • Position of reference line 2.2.1 Projection of a point in space 2.2.2 Projection of a line	• Discuss and demonstrate the basic concept of orthographic drawing and show projection of a point, line and plane in space. • students should able to draw reference line in appropriate position
• Identify the three classification of surfaces; • Describe normal view of a line and a plane, inclined surface, and the edge view of a plane; • Construct normal view of a line and a plane, inclined surface, and the edge view of a plane;	2.2.3 Projection of a plane *(3 periods)* • Types of plane surface • Principle of projection of plane • Edge view of a plane • Normal (true shape) view of plane	• Discuss and demonstrate the three classification surfaces. • show the normal view of a line, inclined surfaces and edge view of a plane. • give some practical work of inclined objects
• Explain the position of auxiliary projection plane;	**2.3 Auxiliary projection of objects** *(2 periods)*	• Discuss and demonstrate the position of auxiliary projection plane. • Students should understand the construction steps of auxiliary views. • Give some activities to master the skill

Competence	*Contents*	*Suggested activities*
• Identify the steps in drawing of auxiliary projection; • Identify the types of auxiliary views; • Describe the different between primary and secondary auxiliary views; • Draw the primary and secondary auxiliary views; • Describe the advantage of partial and complete auxiliary views; • Draw circular features in auxiliary projection; • Describe the advantage of half auxiliary view; • Perform the type of auxiliary view of an object.	2.3.1 Auxiliary planes 2.3.2 Construction of Auxiliary views **2.4** Types of Auxiliary views *(5 periods)* 2.4.1 Primary Auxiliary views • Front auxiliary • Top auxiliary • Side auxiliary 2.4.2 Secondary auxiliary views 2.4.3 Other features in Auxiliary • Partial and complete Auxiliary views • Circular features in auxiliary • Half auxiliary view	• Students should know the two types of auxiliary views and identify the advantage and disadvantage of them • show and discuss by drawing the principle of primary and secondary auxiliary views. • Discuss and demonstrate the advantage of other auxiliary views like partial and complete and half auxiliary. • show the general steps how circular features are projected in auxiliary. • Give some practical work on primary and secondary auxiliary views. • Allow students to practice more on auxiliary views if the time allow.

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.

Competence	***Contents***	***Suggested Activities***
Students will able to: • Define the concept of sectional views; • Describe the use of sectional views;	***2. Sectional view*** **3.1 Introduction** *(1 period)*	• Ask students the purpose of section in different condition what they know before • 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.
• Describe the location of cutting plane to create sectional view; • Select the location of cutting plane line; • Identify the different types of section lining symbols; • Make different types of section lining;	3.2 Cutting plane and Section lining	• Discuss and demonstrate by showing the location of cutting plane line, section line symbols and how to apply them.
• Visualize the sectional view of an object;	3.3 Visualizing sectional view	• Discuss and demonstrate how student visualize sectional views from different objects.
• Identify the types of sectional views; • Compare and contrast the advantage of all types of sectional views; • Select the appropriate type of section to the given object; • Perform the sectional view of an object with preferable type of section;	**3.4 Types of sectional view** *(8 periods)* 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	• Students should name and differentiate the types of section • Discuss and demonstrate the advantage of each types of section by comparing. • Student should select and draw section of an object in appropriate section type. • Give enough examples and practical activities about section. • show the use and application of Full section, Half section, and Offset-section in special consideration

Competence	*Contents*	*Suggested Activities*
• Identify other sectional view representation , using conventional practices;	**3.5 Other sectional view representation** *(2 periods)* 3.5.1 Aligned section 3.5.2 Auxiliary section	• Students should understand and use other sectional view representation in different application • Give examples about aligned and auxiliary section
• identify the conventional representation of section; • apply conventional representation of section in technical drawing.	**3.6 Conventional representation in sectioning** *(1 periods)*	• Students should understand the conventional representation in sectioning and apply in working drawing • Allow students to practice on mentioned topic specially on full, half and off-set section by class work or assignment level

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.

Competence	***Contents***	***Suggested Activities***
Students will be able to: • Explain the use of dimensioning;	***4. Dimensioning*** **4.1 Introduction** *(1 period)*	• students should understand the use and where to apply dimensioning
• Identify the basic symbols, forms and elements of dimensioning;	**4.2 Lines and symbols**	• discuss and demonstrate the two basic dimension forms, including Dimension lines, Arrow heads, extension line, leaders, finished marks and others elements of dimensioning
• Identify the two system in reading direction of figures;	**4.3 Reading direction of figures**	• discuss and demonstrate the two system in reading direction of dimensioning figures by giving different examples
• Differentiate size and location dimensioning; • Apply size and location dimension on different drawing; • Select convenient dimensions properly to describe a feature of an object; • Identify the relationship between scale of drawing and dimension figures;	**4.4 Theory of dimensioning** *(2 periods)* 4.4 1 Size dimensioning 4.4.2 Location dimensioning 4.4.3 Selection of dimensions 4.4.4 Scale of the drawing	• Discuss and demonstrate the techniques of size and location dimensioning and student should apply in different drawings • Give examples and practical exercise • Student should select convenient dimension properly to describe the features of an object • Student should consider the relation between the scale of drawing and dimensioning figures
• Identify the two arrangement of dimensions;	**4.5 Arrangement and indication of dimensions** *(2 periods)*	• Discuss and demonstrate the two arrangement of dimensions such as datum and chain dimensioning and give practical exercise

Competence	***Contents***	***Suggested Activities***
• Select the appropriate arrangement of dimensions; • Use the two basic arrangement of dimensions alternately on drawing; • Identify the methods of dimensioning on standard features	4.5.1 Datum dimensioning 4.5.2 Chain dimensioning 4.5.3 Dimensioning standard features	• Students should understand methods of dimensioning on standard features like dimensioning of diameters, arcs, hole sizes, chamfers, screw threads and others
• Identify the placement of dimensions on views, on limited space and pictorial drawing; • Apply dimension on views, on limited space rule and pictorial drawing; • select dimensions to reduce the number of dimension lines; • perform different types of dimensioning techniques for any shapes of objects; • prepare dimensions of different views and objects.	**4.6 Placement of dimensions** *(2 periods)* 4.6.1 Dimensioning views 4.6.2 Dimensioning in limited space 4.6.3 Dimensioning pictorial drawing	• Students should understand the conventions of placement of dimensioning like on - Views - pictorial drawing - limited spaces etc. • Give examples and practical exercises • Give some practical work on dimensioning to apply the techniques for any shape of objects.

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.

Competence	*Contents*	*Suggested Activities*
Students will be able to: • Describe the use of surface development; • Identify the different types of surfaces and solids; • Identify the type of hems and joints used in sheet metal drawing;	***5. Development and Intersection*** **5.1 Introduction** *(1 period)*	• Allow students to discuss in group the application of surface development what they know before • Students should understand the advantage of surface development. • Discuss and demonstrate the different types of surfaces, solids, Hems and joints of sheet metal work and others
• Identify the principles of surface development;	**5.2 Principles of development**	• Student should understand the principle and types of surface development. Use enough illustration to this point.
• Identify the rules and steps to use parallel-line development; • Perform the development of prism using parallel-line development; • Perform the development of cylinder using parallel-line development;	5.2.1 Parallel- line development*(6 periods)* • Development of prism (full and truncated) • Development of cylinder (full and truncated)	• Discuss and demonstrate by showing the rules and steps in parallel-line development • Students should perform the full and truncated prism and cylinder. • allow students to perform different exercises on parallel line development
• Identify the rules and steps to use radial-line development; • Apply the rule of true	5.2.2 Radial-line development *(6 periods)* • True length by triangulation	• discuss and demonstrate by showing the rules and steps in Radial-line development • Student should know how to find the true length by triangulation. • Students should perform the full and truncated pyramid development.

Competence	***Contents***	***Suggested Activities***
length by triangulation; • Prepare the development of Pyramid using radial-line development; • Prepare the development of Cone using radial-line development;	• Development of pyramid (full and truncated) • Development of Cone (full and truncated)	• Students should perform the full and truncated Cone development. • allow students to perform different exercises on radial line development
• Identify piercing point, visible and hidden line of intersection; • use the two methods of finding point of intersection alternatively; • Determine the line of intersection of two solids, such as prisms and cylinders; • Construct the development of two intersected regular solids such as, prisms and cylinders.	**5.3 Intersection between geometrical solids** *(8 periods)* 5.3.1 Piercing point, visible and hidden line of intersection 5.3.2 Methods of locating point of intersection - Cutting plane method - End view method 5.3.3 Intersection of two regular prism and their development 5.3.4 Intersection of two cylinder and their development	• 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. • Students should describe about Piercing point and visible and hidden line of intersection. • Discuss and demonstrate by showing line of intersection of solids and construction method of development of two intersected regular solids • allow students to do some practice on the mentioned topic by assignment level • - Allow students to visit metal workshop factory

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