INSTALLATION CONSTRUCTION WORKS

Level - I

Learning Guide –1

Unit of Competence:- Carry out Measurements and Simple Calculations

Module Title: - Carring out Measurements and Simple Calculations

LG Code: CON ICW1 M07 LO1-LG-07

TTLM Code: CON ICW1 TTLM 05 19v1

LO No 1: Select measuring instruments

Instruction Sheet	Learning Guide #-

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Identifying object or component to be measured
- Classifying and interpreting geometric shape
- Selecting measuring instruments
- Obtaining correct specifications
- Using alternative measuring instruments

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Identify object or component to be measured
- Classify and interpret geometric shape
- Select measuring instruments
- Obtain correct specifications
- Use alternative measuring instruments

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1" **in page -.**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Identifying object or component to be measured

1.1 Concept of measurement

Measurement is the assignment of a number to a characteristic of an object or event, which can be compared with other objects or events. The scope and application of a measurement is dependent on the context and discipline. Measurement is a cornerstone of trade, science, technology, and quantitative research in many disciplines.

Historically, many measurement systems existed for the varied fields of human existence to facilitate comparisons in these fields. Often these were achieved by local agreements between trading partners or collaborators. As developments progressed towards unifying, widely accepted standards that resulted in the modern International System of Units (SI). This system reduces all physical measurements to a mathematical combination of seven base units.

1.2 Methodology of measurement

The measurement of a property may be categorized by the following criteria: **type, magnitude, unit**, and **uncertainty**. They enable unambiguous comparisons between measurements.

- The **type or level** of measurement is taxonomy for the methodological character of a comparison. For example, two states of a property may be compared by ratio, difference, or ordinal preference. The type is commonly not explicitly expressed, but implicit in the definition of a measurement procedure.
- The **magnitude** is the numerical value of the characterization, usually obtained with a suitably chosen measuring instrument.
- A **unit** assigns a mathematical weighting factor to the magnitude that is derived as a ratio to the property of an artifact used as standard or a natural physical quantity.
- An **uncertainty** represents the random and systemic errors of the measurement procedure; it indicates a confidence level in the measurement. Errors are evaluated by methodically repeating measurements and considering the accuracy and precision of the measuring instrument.

1.3. Standardization of measurement units

The international metric system of units or dimensions, commonly called SI, is used in electricity. The abbreviation SI stands for system international. The seven base units of SI are **length, mass, time, electric current, thermodynamic temperature, light intensity, and amount of substance**. Units of measurement are generally defined on a scientific basis, overseen by governmental or independent agencies, and established in international treaties

Base Units of the International Metric System

quantity	**Base Unit**	**Symbol**
Length	meter	m
Mass	kilogram	Kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Light intensity	Candela	cd
Amount of substance	mole	Mol

Supplementary SI Units

quantity	Base Unit	symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Other common units can be derived from the base and supplementary units. For example, the unit of charge is the coulomb, which is derived from the base units of second and ampere. Most of the units that are used in electricity are derived ones

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1.The SI unit of mass, time and current respectively

a. Ampere, kg and second c. volt, mole and ampere

b. Kilogram, second and Ampere, d. kilogram ampere and second

2. The numerical value of the characterization, usually obtained with a suitably chosen measuring instrument is -------

a. type b. uncertainty c. unit d. magnitude

3. The international agreed metric system of units or dimensions is a. SI b. .ms c. bs d. met

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = ___________
Rating: ____________

Name: _________________________ Date: _______________

Information Sheet-2	Classifying and interpreting geometric shape

A **geometric shape** is the geometric information which remains when location, scale, orientation and reflection are removed from the description of a geometric object. That is, the result of moving a shape around, enlarging it, rotating it, or reflecting it in a mirror is the same shape as the original, and not a distinct shape

Objects that have the same shape as each other are said to be similar. If they also have the same scale as each other, they are said to be congruent.

Many two-dimensional geometric shapes can be defined by a set of points or vertices and lines connecting the points in a closed chain, as well as the resulting interior points. Such shapes are called polygons and include triangles, squares, and pentagons. Other shapes may be bounded by curves such as the circle or the ellipse

Many three-dimensional geometric shapes can be defined by a set of vertices, lines connecting the vertices, and two-dimensional faces enclosed by those lines, as well as the resulting interior points. Such shapes are called polyhedrons and include cubes as well as pyramids such as tetrahedrons. Other three-dimensional shapes may be bounded by curved surfaces, such as the ellipsoid and the sphere

A shape is said to be convex if all of the points on a line segment between any two of its points are also part of the shape.

Different geometrical shapes

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Objects that have the same shape and scale is --------
   a. Congruent   b. similar   c. triangle   d. ellipse
2. Many two-dimensional geometric shapes are said to be
   a. Polygons   b. mono   c. a&b   d.none

Note: **Satisfactory rating - 3 points   Unsatisfactory - below 3 points**

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________   Date: _______________

Short Answer Questions

Information Sheet-3	Selecting measuring instruments

Measuring Instrument

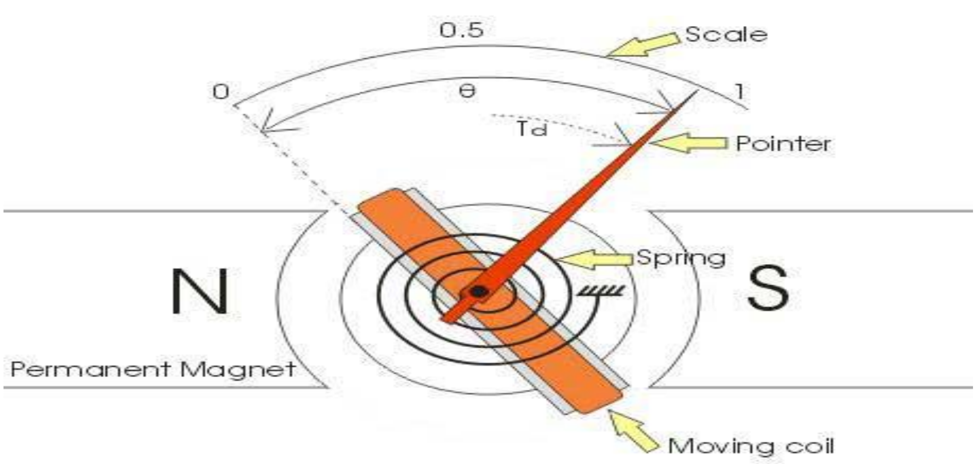
1.1 introduction

A **measuring instrument:-** is a device used for measuring a physical quantity. **Electrical instruments** measure the various electrical quantities like electrical power electrical energy, voltage , current and resistance etc. Ammeters, voltmeters, ohmmeters, wattmeter, and watt-hour meters are instruments used for measuring current, voltage, resistance, power, and electrical energy respectively.
The simplest instruments commonly used to measure voltage and current are the electromechanical direct-current (dc) and the alternating-current (ac) meters.

1.2. Types of electrical measuring instrument

- Multimeter;- combines the functions of ammeter, voltmeter and ohmmeter as a minimum. Electrical meters may be analogue or digital .

- Analogue **electrical instruments** use mechanical system for the measurement of various electrical quantities but as we know the all mechanical system has some inertia therefore electrical instruments have a limited time response. In these **types of instruments**, pointer of the **electrical measuring instrument** deflects to measure the quantity. The value of the quantity can be measured by measuring the net deflection of the pointer from its initial position. In order to understand these types of instruments let us take an example of deflection type permanent magnet moving coil ammeter which is shown



The diagram shown above has two permanent magnets which are called the stationary part of the instrument and the moving part which is between the two permanent magnets that consists of pointer. The deflection of the moving coil is directly proportion to the current. The pointer deflects between the two opposite forces produced by the spring and the magnets. And the resulting direction of the pointer is in the direction of the resultant force. The value of current is measured by the deflection angle θ, and the value of K

1. Volt reading=pointer reading x range/scale

2. Amper=pointer reading x range

3. Ohm=pointer reading x range

DIGITAL METERS A digital voltmeter (DVM) is an instrument that displays a measured dc/ac voltage in discrete numerals,. A decimal-point placement is included so that the exact value is evident. In some models, a plus or minus sign appears to the left of the numbers to indicate the polarity of the voltage being measured. The conventional meter with a pointer is an analog meter because its deflection corresponds directly to the measured quantity. Digital readout has several advantages over analog display: There are no observational errors such as parallax and estimation; there are fewer range scales; and it allows faster reading of numerical values, greater accuracy, and capability of feeding output directly to recorders for processing by digital computers

- **AMMETERS:-** An ammeter measures electric current. Its scale may be calibrated in amperes, milliamperes, or microamperes. To measure current, an ammeter is inserted in series with the circuit being tested . The addition of the ammeter increases the resistance of the circuit by an amount equal to the internal resistance of the meter RM. -
- **VOLTMETERS:-** measures the voltage in the circuit or device and it is connected in parallel in the circuit. Voltmeter Loading Effect When a voltmeter is connected to a circuit, the voltmeter draws current from the circuit. This current produces a voltage drop across the resistance of the coil, which is subtracted from the voltage being measured. This reduction in voltage is called the loading efect.
- **OHMMETERS:-** An instrument to determine resistance is the ohmmeter. The ohmmeter consists of a battery, a meter movement calibrated to read ohms, and a resistor. Ro is a current-limiting resistance and includes the meter resistance RM. Ro is shown as an adjustable resistor for zeroing and for correcting the aging of the battery. R, is the unknown resistance to be measured. Zeroing is done by first short-circuiting the ohmmeter terminals and adjusting Ro to produce full-scale deflection.. Thus, the ohmmeter can be used to test for continuity. This test should be conducted on the lowest ohms range. A break in the wire will give a reading of infinite resistance, indicating an open circuit and closed wire show same amount of resistance OR sound.
- **MULTIMETERS:-** is a single instrument capable of measuring voltage, resistance, and current. The volt-ohm-milliammeter (VOM) is the most common multimeter. One meter movement is used to measure milliamperes, dc voltage, ac voltage, and ohms.

- **Wattmeter**;- is an instrument that measures dc power or real ac power. The wattmeter uses fixed coils to indicate current in the circuit, while the movable coil indicates voltage.. Then the current in the fixed coils is proportional to I, while the current in the movable coil is proportional to V. The deflection of the pointer then is proportional to the VI product, which is power.

- **Watthour Meter:-** When the power being dissipated in a load is calculated in terms of time, the amount of energy consumed by the load can be found. The unit commonly used for electric energy calculation is the kilowatthour (kWh). It is the product of kilowatts and hours. For example, 1 kWh = 1000W x 1 h = 200W X 5h = 1 W x 1OOOh = 500W x 2h The most common energy-measuring device is the watthour meter . The speed of the rotating aluminum disk (rotor of an ac motor) is determined by the magnetic fields set up by the current and voltage coils. The greater the power passing through the meter, the faster the disk turns. The number of turns is a measure of the energy consumed by the load. The shaft on which the disk is mounted is geared to a group of indicators with clocklike faces. By reading the values on their faces at different times, you can determine how much energy passed through the meter during the interval between readings.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1.A measuring instrument that measures electrical energy used is----

1. watt meter b. ammeter c. watt hour meter d.ohm meter

2. Which instrument is used to measure continuity?

a. ammeter b. ohm meter c. volt meter d. watt meter

3. An instrument that displays a measured value in discrete numerals is -----

a. analogue b. multi meter c. digital d. a and b

Note: **Satisfactory rating - 5 points Unsatisfactory - below 5 points**

Answer Sheet

Score = ___________

Rating: ____________

Name: ___________________________ Date: _______________

Short Answer Questions

Information Sheet-4	Obtain correct specifications

Specification

A **specification** often refers to a set of documented requirements to be satisfied by a material, design, product, or service. A specification is often a type of technical standard.

There are different types of technical or engineering specifications (specs), and the term is used differently in different technical contexts. They often refer to particular documents, and/or particular information within them. The word *specification* is broadly defined as "to state explicitly or in detail" or "to be specific".

A specification may refer to a standard which is often referenced by a contract or procurement document, or an otherwise agreed upon set of requirements (though still often used in the singular). In any case, it provides the necessary details about the specific requirements.

Standards for specifications may be provided by government agencies, standards organizations.), trade associations, corporations, and others.

A **requirement specification** is a documented requirement, or set of documented requirements, to be satisfied by a given material, design, product, service, etc..

In engineering, manufacturing, and business, it is vital for suppliers, purchasers, and users of materials, products, or services to understand and agree upon all requirements.[3]

Metrology-Introduction

Engineering metrology is defined as the measurement of dimensions: length, thickness, diameter, taper, angle, flatness, profiles and others. An important aspect of metrology in manufacturing processes is dimensional tolerances. That is, the permissible variation in the dimensions of a part. Tolerances are important not only for proper functioning's of products, they also have a major economic impact on manufacturing costs.

The reading of the measured value of instruments vary in accordance with type and correctness of that instrument. The measuring instrument can be chosen by the following criteria's.

1.Accuracy:-It is desirable quality in measurement. It is defined as the degree of the closeness with which instrument reading approaches the true value of the quantity being measured. Accuracy can be expressed in three ways

1. Point accuracy
2. Accuracy as the percentage of scale of range
3. Accuracy as percentage of true value.

2. **Sensitivity**:-It is also desirable quality in the measurement. It is defined as the ratio of the magnitude response of the output signal to the magnitude response of the input signal.
3. **Reproducibility**:-It is again a desirable quality. It is defined as the degree of the closeness with which a given quantity may be repeatedly measure

Self-Check -4	Written Test

Match

A	B
1. Accuracy	A. the degree of the closeness to a repeatedly measured quantity
2. Reproducibility	B. the ratio of the magnitude
3. Sensitivity	C. the degree of the closeness to the true value

Information Sheet-5	Use alternative measuring instruments

Alternative measuring instruments

Some measuring instruments are substituted by other types of measuring instruments to get the same value/magnitude.

The Wattmeter that measures dc power or real ac power uses fixed coils to indicate current in the circuit and the movable coil indicates voltage, can be substitute by ammeter which measures current and volt meter that measures voltage since power is the product of current and voltage. The current also can be obtained from the result of volt meter and ohmmeter in the circuit.

Many alternative measuring instruments can be used by applying simple arithmetical operations.

Self-Check -5	Written Test

Write the alternative measuring instruments of the following

1. Wattmeter

2. Volt meter

3.Ammeter

3.steel rule

Operation Sheet 1	Selecting measuring instruments

Techniques of measuring length

1. Select/identify/ the type of measuring instrument you use
2. Prepare different size of steel and/or pvc conduits.
3. Measure 0.25m of conduit
4. Convert the measured unit in to cm
5. Mark the measured size.
6. Report your work and conclusion to your trainer

Operation Sheet-N	CONTENT-N

Techniques for---------------------:

Step 1-

Step 2-

Step 3-

Step N

.

LAP Test	Practical Demonstration

Name: ______________________________ Date: ________________

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 30 min.

Task 1. Measure 0.5m of pipe

Task 2. Measure 30cm of PVC conduit

NSTALLATION CONSTRUCTION WORKS

Level - I

Learning Guide –2

Unit of Competence:- Carry out Measurements and Simple Calculations

Module Title: - Carring out Measurements and Simple Calculations

LG Code: CON ICW1 M07 LO2-LG-07

TTLM Code: CON ICW1 TTLM 05 19v1

LO No 2: Carry out measurements and calculations

Instruction Sheet	Learning Guide #-

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Obtaining accurate Measurements and calculation
- Checking numerical computation
- Reading instruments
- unit conversion
- Measuring work pieces.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Obtain accurate Measurements and calculation
- Check numerical computation
- Read instruments
- Convert units
- Measure work pieces.

Learning Instructions:

8. Read the specific objectives of this Learning Guide.
9. Follow the instructions described in number 3 to 20.
10. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them.
11. Accomplish the "Self-check 1" **in page -.**
12. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
13. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
14. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Obtaining accurate Measurements and calculation

Measurements and calculation

2.1 RATIO AND PROPORTION

RATIO:-is a comparison of two or more quantities. The ratio of two quantities is the quotient of two quantities that tells the numerical relationship of the two quantities usually written as fractions. Ratios are expressed by the symbol (:) placed between the two numbers being compared or in the forms of fractions.Eg.2/4,2:4,1:2. This means If the total quantity (student) is 90,30students are girls and 60 students are boys.

Example

1. State the ratio between 40cm and 2m.

2mx100=200cm

40cm/200cm=1/5cm or 1:5

Calculate the followings

1. Two speeds are in the ratio 2:5 if the first speed is 60km/hr, what is the second speed? 2. IF360 birr is divided among three people in the ratio of 3:4:5, find the share of each people. 3. The height of chaltu to chala is in the ratio of 5:7.If chala's height is 1.75m , what is chaltu's height?

PROPORTION:-is an equality of two quantities or ratios. When two ratios are equal the four terms taken in order are called proportional's and the ratios are said to be in proportion.eg a/b: c/d, ratio a:b is proportional to c:d.That means ad(extremes)=bc (means).

Example.

1.Find the unknown terms in each of the following proportions.

a).5:15=Y:6

15xY=5x6

Y=5x6/15=2,Y=2

b).2:Z=4:12

Zx4=2x12

Z= 2x12/4=6, Z=6

EX. Are the following numbers taken in order of proportion?

a)3,6,7,12 b).2,5,8.20 c)6,12,12.24

DIRECT PROPORTIONALITY

Y is said to be directly proportional to X (Y∞X) if ther is a constant k , such that Y=kX .k is called the constant of proportionality.

EXAMPLE

If the connected load/resistance/ in the circuit is constant 5o ohm with 1A , see the following table

Current in amps (X)	1A	2A	3A	4A
Voltage in volts (Y)	50v	100v	150v	200v

Y is directly proportional to X because as X increases Y also increase as a factor of 50 x .Observe the table carefully that 50=50/1=100/2=150/3=200/4 is the constant of proportionality is k=50 ohm.

INVERSE PROPORTIONALITY

Y is said to be inversely proportional to X (Y ∞ 1/X) if there is a constant k such that Y=K.1/X or Y.X=K

Compare the proportionality of current and resistance in a simple dc circuit of constant voltage 200v per one ampere

Current in Amps (X)	1A	2A	3A	4A
Resistance in ohms(Y)	200	100	66.67	50

Remember that as the current (X) increase, the resistance of the circuit(Y) decrease but Y.X is constant=200

PERCENT

The word percent means "for every hundred". When we speak of a certain percent of something, we mean that it is that portion of 100 units. Percent is designated by %.

For example, 20% is read as 20 percent, it means 20 out of every hundred and is equivalent to 20/100.

To express a given decimal fraction or common fraction as a percent , we multiply the decimal fractions or the common fraction by 100/100.

Eg. a).0.05=0.05 x 100/100=5/100=5%

b). ½ =1/2 x100/100=50/100=50%

To express a percent as a common fraction, omit the percent sign and write the percent as the numerator of a fraction whose denominator is 100 then reduce this fraction to its lowest term.

Example

a).35%=35/100=7/20=0.35

AREA AND VOLUME

Area is the space/surface of an object

1. The area of a square $A = b^2$

1.The area of a rectangle A=bh (base x height)

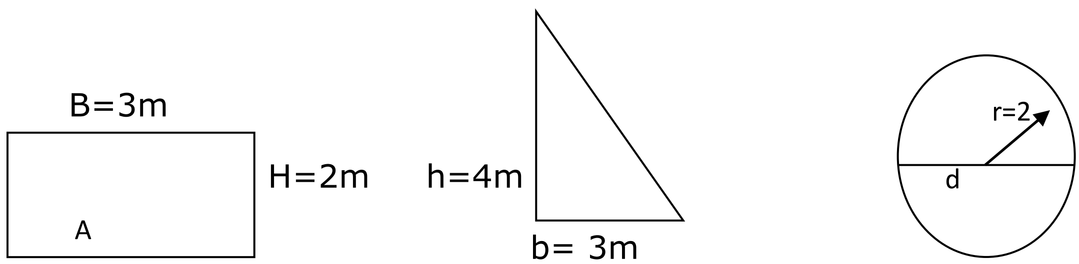
2. The area of a triangle A=1/2bh (base x height)

3. The area of a parallelogram A=bh (base x height)

4. The area of a circle $A=\prod r^2$ or $A=\prod d^2/4$

5. Circumference of a circle $C=2\prod r$ or $c=\prod d$

Example.



$A=B.H=3.2=6m^2$ $A=1/2bh=1/2.3.4=6m^2$ $A=\prod r2=3.14x2^2=12.56m^2$

The diameter of the circle is 2r ie d=2x2=4

Therefore the circumference of the circle $C=\prod d=3.14x4=12.56$

The size any wire can be known by measuring the diameter of the wire using micrometer or venire caliper.

A wire with a core diameter of 1.38 mm would have a cross-sectional area of:

$$A = \frac{d \times d \times 3.14}{4}$$

$$A = \frac{1.38 \times 1.38 \times 3.14}{4}$$

$$A = \underline{1.5 \text{ square mm}}$$

$$A = d \times d \times 0.785$$

$$A = 1.38 \times 1.38 \times 0.785$$

$$A = \underline{1.5 \text{ square mm}}$$

Or a wire with a core diameter of 2.76 mm would have a cross-sectional area of:

$$A = \frac{d \times d \times 3.14}{4}$$

$$A = \frac{2.76 \times 2.76 \times 3.14}{4}$$

$$A = \underline{6 \text{ square mm}}$$

$$A = d \times d \times 0.785$$

$$A = 2.76 \times 2.76 \times 0.785$$

$$A = \underline{6 \text{ square mm}}$$

VOLUME

The volume of prisms with length (L), width (w) and height (h) is the products of length, width and height (V=l.w.h), V=AH(A=l.w)

Eg. Find the volume of a rectangular prism of 2cm length,3cm width and 5cm height?

$V= l.w.h=2x3x5=30cm^3$

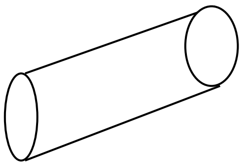
The volume of a cylinder is also calculated in the same way as prisms. Multiply the area of the base by the altitude/height/.

$V=A.h$ or $V=\prod r^{2.}$ h   h $A=\prod r^2$

Eg. Find the volume of a cylinder with 6cm diameter and 3.5cm high.

$V=A.h$

$V=\prod r^{2.}$ h



r=d/2=6/2=3cm

$V=22/7 \times (3cm)^2 \times 7/2cm = 11 \times 9\ cm^3 = 99cm^3$

TRIGONOMETRIC FUNCTIONS

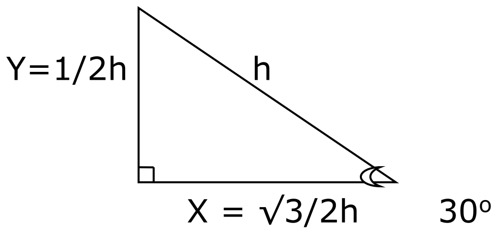
The three trigonometrial functions are SINE, COSINE AND TANGENT.

The Sine function is the set of ordered pairs Y axis and p coordinate point

The cosine function is the set of ordered pairs X axis and p coordinate point

The Tangent function is the set of ordered pairs Y/X axis and p coordinate point.

Eg.



Sine=1/2 or y/h

Cosine=√3/2 or x/h

Tan=sine/cosine=1/2 / √3/2=√3/3

Study the value of sine and cosine from numerical table at various degrees.

Eg. Sine 30^o=0.5 or 1/2, cosine 30^o=√3/2 or 0.866, tan30o=√3/3=0.577

Self-Check -5	Written Test

1. Change in to percentage ¼

2. Find the area of a square whose sides are 5m?

3.Calculate the cross sectional area of 1.38mm wire

Information Sheet-2	Check numerical computation

Numbers and symbols

The expression of numerical quantities is something we tend to take for granted. This is both a good and a bad thing in the study of electrical/electronics. It is good, in that we're accustomed to the use and manipulation of numbers for the many calculations used in analyzing electrical/electronic circuits. On the other hand, the particular system of notation we've been taught from grade school onward is *not* the system used internally in modern electronic computing devices, and learning any different system of notation requires some re-examination of deeply ingrained assumptions.

First, we have to distinguish the difference between numbers and the symbols we use to represent numbers. A *number* is a mathematical quantity, usually correlated in electrical/electronics to a physical quantity such as voltage, current, or resistance. There are many different types of numbers. Here are just a few types, for example:

WHOLE NUMBERS:

1, 2, 3, 4, 5, 6, 7, 8, 9 . . .

INTEGERS:

-4, -3, -2, -1, 0, 1, 2, 3, 4 . . .

IRRATIONAL NUMBERS:

π (approx. 3.1415927), *e* (approx. 2.718281828),

square root of any prime number.

REAL NUMBERS:

(All one-dimensional numerical values, negative and positive,

including zero, whole, integer, and irrational numbers)

COMPLEX NUMBERS:

3 - j4 , 34.5 ∠ 20°

BINARY ARITHMETICS

People and computers do not normally speak the same language. Methods of translating information in to forms that is understandable and useable to both are necessary. Humans generally speak in words and numbers expressed in the decimal number system, while computers understand coded electronic pulses that represent digital information. These pulses are defined in the simplest possible number system, which is the binary or base 2 system. The binary system uses only two symbols (0 & 1).

System:	Hash Marks	Roman	Decimal	Binary
-------	----------	-----	-------	------
Zero	n/a	n/a	0	0
One	|	I	1	1
Two	||	II	2	10
Three	|||	III	3	11
Four	||||	IV	4	100
Five	/|||/	V	5	101
Six	/|||/ |	VI	6	110
Seven	/|||/ ||	VII	7	111
Eight	/|||/ |||	VIII	8	1000
Nine	/|||/ ||||	IX	9	1001
Ten	/|||/ /|||/	X	10	1010
Eleven	/|||/ /|||/ |	XI	11	1011
Twelve	/|||/ /|||/ ||	XII	12	1100
Thirteen	/|||/ /|||/ |||	XIII	13	1101
Fourteen	/|||/ /|||/ ||||	XIV	14	1110

Fifteen	/|||/ /|||/ /|||/	XV	15	1111
Sixteen	/|||/ /|||/ /|||/ |	XVI	16	10000
Seventeen	/|||/ /|||/ /|||/ ||	XVII	17	10001
Eighteen	/|||/ /|||/ /|||/ |||	XVIII	18	10010
Nineteen	/|||/ /|||/ /|||/ ||||	XIX	19	10011
Twenty	/|||/ /|||/ /|||/ /|||/	XX	20	10100

Neither hash marks nor the Roman system are very practical for symbolizing large numbers. Obviously, place-weighted systems such as decimal and binary are more efficient for the task. Notice, though, how much shorter decimal notation is over binary notation, for the same number of quantities? What takes five bits in binary notation only takes two digits in decimal notation.

Self-Check -5	Written Test

1. Change the followings in to decimal numbers
   a.(100)2 b. (111)2 c. (1001) d.(1111)
2. The representation of binary number “1” in the circuit is----
   a. OFF b. ON

Information Sheet-3	unit conversion

Unit conversion

Over 90 % of all countries in the world are presently using the Metric System. But there are still some countries using the Inch System (e.g. United States, Canada and England). With the reality of global manufacturing continually expanding, the need for technicians in both systems of measurement will continue to grow.

3.1 Metric System

The metric system uses the meter and linear units based on the meter as its standards of measure. At the General Conference on Weights and Measures in October, 1983, the meter defined as the distance traveled by light in a vacuum during *11299.792.458* of a second was approved as a world standard. All multiplies and subdivisions of the meter are directly related to the meter by a factor of ten. This makes it easy to use the decimal system for calculations involving metric units.

Kilometer= km	1 km =1.000 m
Meter= m	1 m=10dm =100cm =1.000mm
Decimeter= dm	1 dm= 10 cm =100 mm
Centimeter =cm	1 cm =10mm
Millimeter= mm	1 mm =1,000 µm
Micrometer= µm	1 µm=10^{-6} m

3.1.1 Exercises -Metric System

Change into smaller unit5

1m =10 dm =100 cm =1,000 mm

25 m =--- dm = ----cm=---- mm

0.9m =----dm =-----cm =-----mm

0.2 m =---- dm=----- cm=----- mm

0.1 m =----- dm=----- cm=------ mm

Change into larger unit5

100 mm= 10cm= I dm =0.1 m

25 mm=-----cm=---- dm=--- m
12000mm=---- cm=--- dm =---m
9mm =----cm =----dm =-----m
386 mm=---- cm =------dm =------m

Mixed Operations

1m + 37 mm +5dm + 40cm= 193.7 cm
1.47 m +37mm +1.8dm + 36.5 cm=-------mm
40 cm +1200mm + 1.5m +85dm=------m

Conversion from Metric to Inch or opposite
1 millimeter 0.0394 inch ,1 inch 25.4 millimeters
1 centimeter 0.3937 inch ,I inch 2.54 centimeters I
meter 39.37 inches ,1 foot 0.3048 meter

3.2 Inch System

Unlike the Metric System., within the Inch System there is no relationship of other linear units to the base inch unit. The values of yard., rod., mile., etc. have to be studied and kept in memory in order to use them. The inch can be divide in halves (1/2)., quarters (1/4)., eighths (1/8)., sixteenth (1/16), thirty-seconds (1/32)., sixty-fourth (1/64), tenth.. hundreds., thousandth., ten-thousands etc

Self-Check -5	Written Test

1. Change the following units

   a. 12000mm=---- cm=--- dm =---m

   b. 0.2 m =---- dm=----- cm=----- mm

   c. 10inch=------cm

Operation Sheet 2	Measurement and calculation

Procedures for measurement and unit conversation of wire size for socket outlet

1. Identify the type of measuring instrument you use
2. Select wire size for socket outlet
3. Insert the measured wires inside the caliper/micrometer
4. Read the caliper/micrometer and list the result.
5. Convert the measured unit in to centimeter and inch

6.Report your work and conclusion to your trainer

LAP Test	Practical Demonstration

Name: ______________________________ Date: ________________

Time started: _________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 30 min.

Task 1. Measure the size of wire for socket outlet

Task 2. Convert the result in to cm and m