MACHINING

Level-II

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Table of Contents

Acknowledgment **2**

Unit one: drawing requirements **8**

Drawing requirement **9**

1.1. Purpose, scope, information for drawing 9

1.1.1. Classifications of Drawing 10

1.2. Relevant Information to project. 16

1.3. Cad Equipment and software 18

Self-Check -1.1 ..... **25**

2, Key Features of CAD software **27**

2.1 Types of CAD software 27

2.1.1 AutoCAD 27

2.1.2 Inventor 28

2.1.3 CATIA 29

2.1.4 Solid Works 29

2.1.5 Pro Steel 30

2.1.6 X Steel 30

2.2 . 2-D drawings and 3D Modeling 30

Self check-2.1 ..... **34**

Operation Sheet ≠2.1 ..... **35**

Operation Sheet ≠2.2 ..... **36**

Operation Sheet ≠2.3 ..... **37**

LAP Test -2.1 ..... **38**

3: Create 2D drawings 40

2.3 Create drawings using the available software system. 40

2.4 Drawing entities link to database 47

2.5 Create views using various scales. 48

2.5.1 ISOMETRIC DRAWING 48

1.1.2 Viewing 3D Object 49

Self-Check-3.1 51

Operation Sheet ≠3.1 52

LAP Test -3.1 53

4.1. Filing and library system 55

4.1.1 Filing System for Drawings 55

4.1.2 Reproduction Room 55

4.1.3 Engineering Technical Library 55

4.2. Software templates 56

4.3. symbols, codes and standards 56

4.3.1. Introduction 56

Self-Check -4.1 60

5.1 CAD functions to basic drawing elements 63

5.2. Edited, transfer tools and methods 63

5.3. Dimensions, text and symbols 64

5.4. Import and export Files 64

5.5. Views and perspectives 65

Self-Check -5.1 67

Operation Sheet-5. 1 67

LAP Test -5.1 69

6: Complete CAD operations 71

6.1 File Drawing Elements. 71

6.1.1. Introduction 71
6.2. Print and evaluate drawing elements 72
6.2.1. Part and copy issuing drawing 72

Self-Check -6.1 75

List of Reference Materials 76

Acronym

- **(CAD) -Computer-aided design**
- **(CADD)-Computer Aided Design and Drafting systems**
- **(MCS)- Model Coordinate System**
- **(WCS) World Coordinate System**
- **(SCS)-Screen Coordinate System**

Introduction to the Module

In machining filed; the CAD Operation helps to know Confirm drawing requirements; to Identify key features of CAD software; to Create 2D drawings ;to Access software and set up for drawing work ;to Produce basic drawing elements and to Complete CAD operations.

This module is designed to meet the industry requirement under the machining occupational standard, particularly for the unit of competency: CAD Operation**.**

This module covers the units :

- ✓ drawing requirements
- ✓ key features of CAD software
- ✓ 2D drawings
- ✓ software and set up for drawing work
- ✓ basic drawing elements
- ✓ CAD operations

Learning Objective of the Module

- ✓ Confirm drawing requirements
- ✓ Identify key features of CAD software
- ✓ Create 2D drawings
- ✓ Access software and set up for drawing work
- ✓ Produ5tce basic drawing element
- ✓ Complete CAD operations

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: drawing requirements

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- purpose, scope, information for drawing
- Relevant information to project.
- Equipment and software.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

1.1. Confirm purpose, scope, information for drawing

1.2. Identify addressing available information. relevant to project.

1.3. Identify and compute equipment and software.

Drawing requirement

Engineering drawings need to communicate information that is legally binding by providing a specification. Engineering drawings therefore need to meet the following requirements:

Engineering drawings should be unambiguous and clear. For any part of a component there must be only one interpretation. If there is more than one interpretation or indeed there is doubt or fuzziness within the one interpretation, the drawing is incomplete because it will not be a true specification.

The drawing must be complete. The content of an engineering drawing must provide all the information for that stage of its manufacture. There may be several drawings for several phases of manufacture, e.g. raw shape, bent shape and heat-treated. Although each drawing should be complete in its own right, it may rely on other drawings for complete specification, e.g. detailed drawings and assembly drawings.

The drawing must be suitable for duplication. A drawing is a specification which needs to be communicated. The information may be communicated electronically or in a hard copy format. The drawing needs to be of a suitable scale for duplicating and of a sufficient scale such that if is micro-copied it can be suitable magnified without loss of quality.

Drawings must be language-independent. Engineering drawings should not be dependent on any language. Words on a drawing should only be used within the title block or where information of a non-graphical form needs to be given. Thus, there is a trend within ISO to use symbology in place of words.

Drawings need to conform to standards. The 'highest' standards are the ISO ones that are applicable worldwide. Alternatively standards applicable within countries may be used. Company standards are often produced for very specific industries.

1.1. Purpose, scope, information for drawing

Technical drawing is a universal language by means of which the form, size, finish, color, and construction of an object can be described accurately and clearly. Therefore it is the language used by engineers and architects to develop and record their ideas and to transmit them to those who are to execute their designs. There are two basic types of drawings: **artistic** and **technical**. The artistic drawings are used to express the feelings, beliefs, philosophies, or abstract ideas of

the artist. Technical drawing, on the other hand, is not subtle or abstract. Drawing is used by engineers, technicians, and skilled craftsmen. Whether this drawing is made freehand (sketching) or by the use of drawing instruments(mechanical drawing), it is needed to convey all the necessary information to the individual who will fabricate and assemble the object be it a building, ship, aircraft, or mechanical device.

Today, the mechanics of the drafting task have largely been automated and accelerated through the use of Computer Aided Design and Drafting systems(CADD). Computer-aided design is the use of computer technology to aid in the design and particularly the drafting of a part or product, including entire buildings.

The student of technical drawing should attain knowledge of fundamental principles presented in this Learning Guide and as much skill as possible in drawing. To become a finished draftsman, he must also acquire knowledge of the details of construction employed in the branch of engineering sciences.

1.1.1. Classifications of Drawing

1.1) Machine Drawing

It is pertaining to machine parts or components. It is presented through a number of orthographic views, so that the size and shape of the component is fully understood. Part drawings and assembly drawings belong to this classification. An example of a machine drawing is given in Fig. 1.1

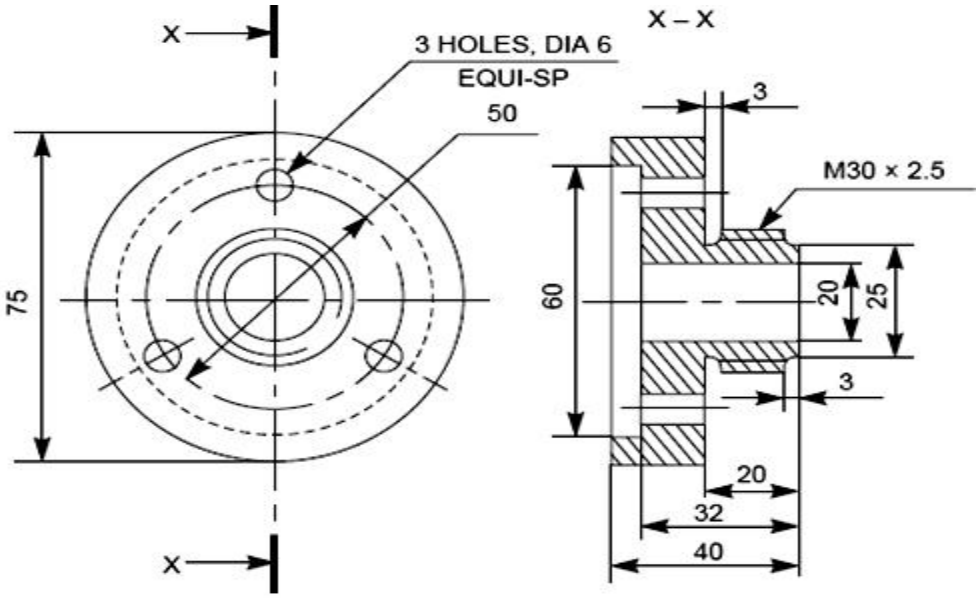


Figure 1.1. Machine Drawing

1.2) Production Drawing

A production drawing, also referred to as working drawing, should furnish all the dimensions, limits and special finishing processes such as heat treatment, honing, lapping, surface finish, etc., to guide the craftsman on the shop floor in producing the component. The title should also mention the material used for the product, number of parts required for the assembled unit, etc. Since a craftsman will ordinarily make one component at a time, it is advisable to prepare the production drawing of each component on a separate sheet. However, in some cases the drawings of related components may be given on the same sheet. Figure 1.2 represents an example of a production drawing.

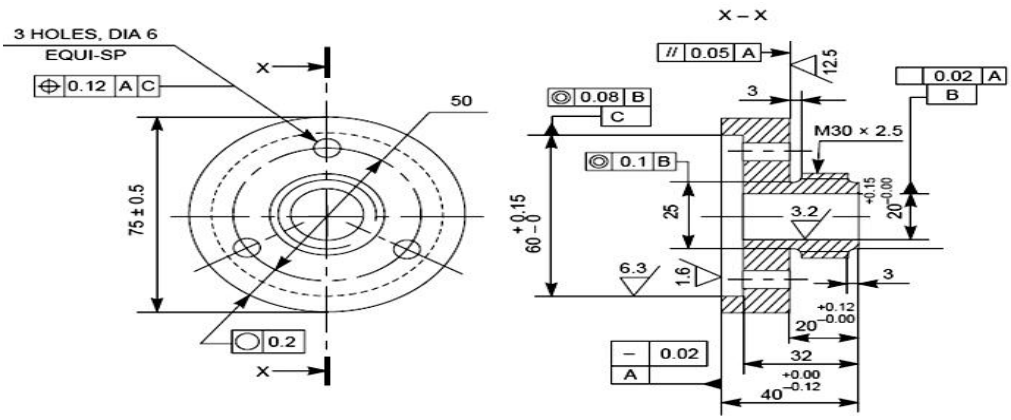
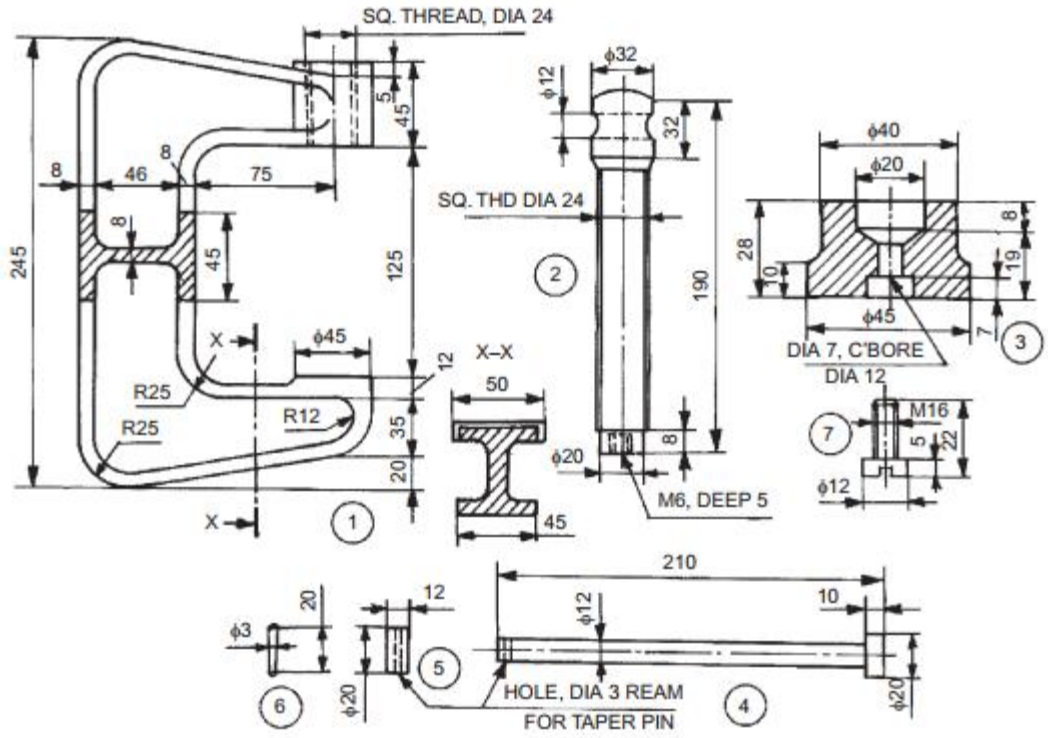


Figure 1.2. Production Drawing

1.3) Part Drawing

Component or part drawing is a detailed drawing of a component to facilitate its manufacture. All the principles of orthographic projection and the technique of graphic representation must be followed to communicate the details in a part drawing. A part drawing with production details are rightly called as a production drawing or working drawing.



Parts list

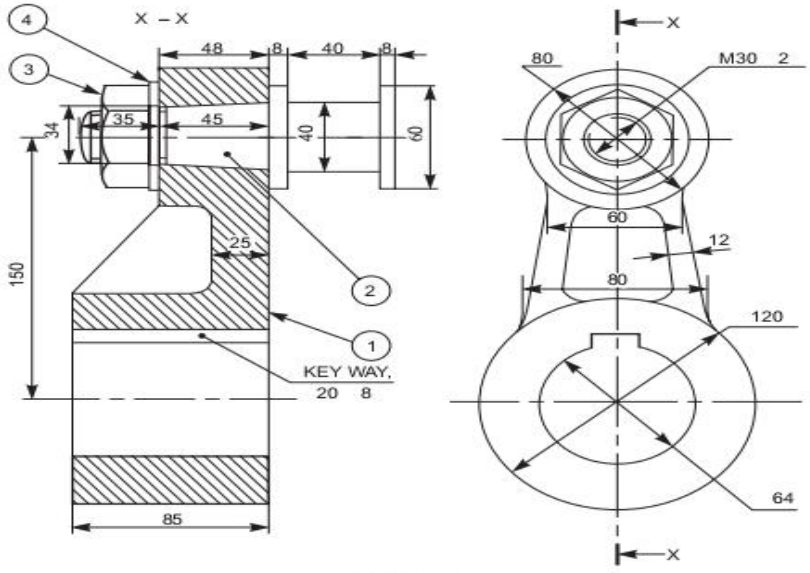
Sl. No.	Name	Matl.	Qty.
1	Frame	CI	1
2	Screw	MS	1
3	Pad	MS	1
4	Tommy bar	MS	1
5	Collar	MS	1
6	Pin	MS	1
7	Cap screw	MS	1

Figure 1.3 **Part Drawing**

1.4) Assembly Drawing

A drawing that shows the various parts of a machine in their correct working locations is an assembly drawing .There are several types of such drawings.

Design Assembly Drawing, Detailed Assembly Drawing, Sub - Assembly Drawing, Exploded Assembly Drawing



Parts List

Part No.	Name	Material	Qty
1	Crank	Forged Steel	1
2	Crank Pin	45C	1
3	Nut	MS	1
4	Washer	MS	1

Figure 1.4 Assembly Drawing

1.5) Sectional Drawing

- **Sectional View**

An engineering drawing has the function of showing shape and size of an object clearly and completely. In certain cases, however, the representation in views is not sufficient. Many objects have internal shapes which are so complicated in nature that it is virtually impossible to show their true shape without employing numerous confusing hidden lines

View (**a**) (b) Representation of the intersection

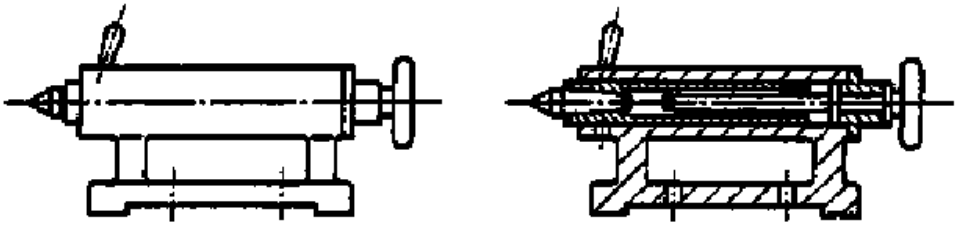


Figure 1.5. Sectional View

The solution of the problem is the use of one or more sectional views: One imagines the object cut by passing a cutting plane through it so that the internal shape is revealed. The purpose of a sectional view is to show the internal shape of an object. In this way, the dimensions of the internal shape can be applied to visible edges.

By passing a cutting plane (e.g. a saw or a knife) that portion of the object is removed which obstructs the view into the interior.

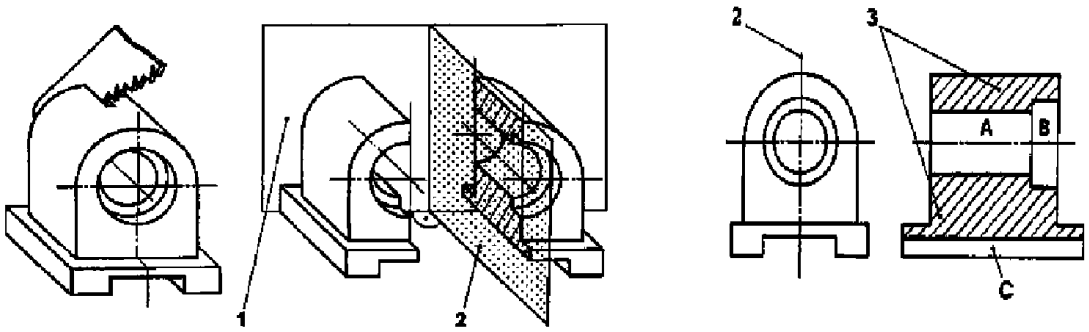


Figure 1.6. Drawing plane 2. Cutting plane 3. Shading

To produce a section view a cutting plane is passed through the part (figure a). The cutting plane is removed and the two halves are drawn apart (figure b) exposing the interior detail. A section view obtained by passing the cutting plane fully through the object is called a full section. In the front view the cutting plane appears as a line called a cutting-plane line. The arrows at the ends of the cutting-plane line indicate the direction of sight for the section view. To obtain the section view the right half of the front view is only imagined to be removed. The cross-hatched areas of the section view are those portions that are in actual contact with the cutting plane.

A correct front view and section view are shown in figure (a) and figure (b). All visible edges and contours behind the cutting plane should be shown. Section views are used primarily to replace hidden lines so as a rule hidden lines should be omitted in section views (figure d).

A section-lined area is always completely bounded by a visible outline, never by a hidden line as in figure (e).

Section lines in a section view must be parallel and at the same angle and direction (figure f).

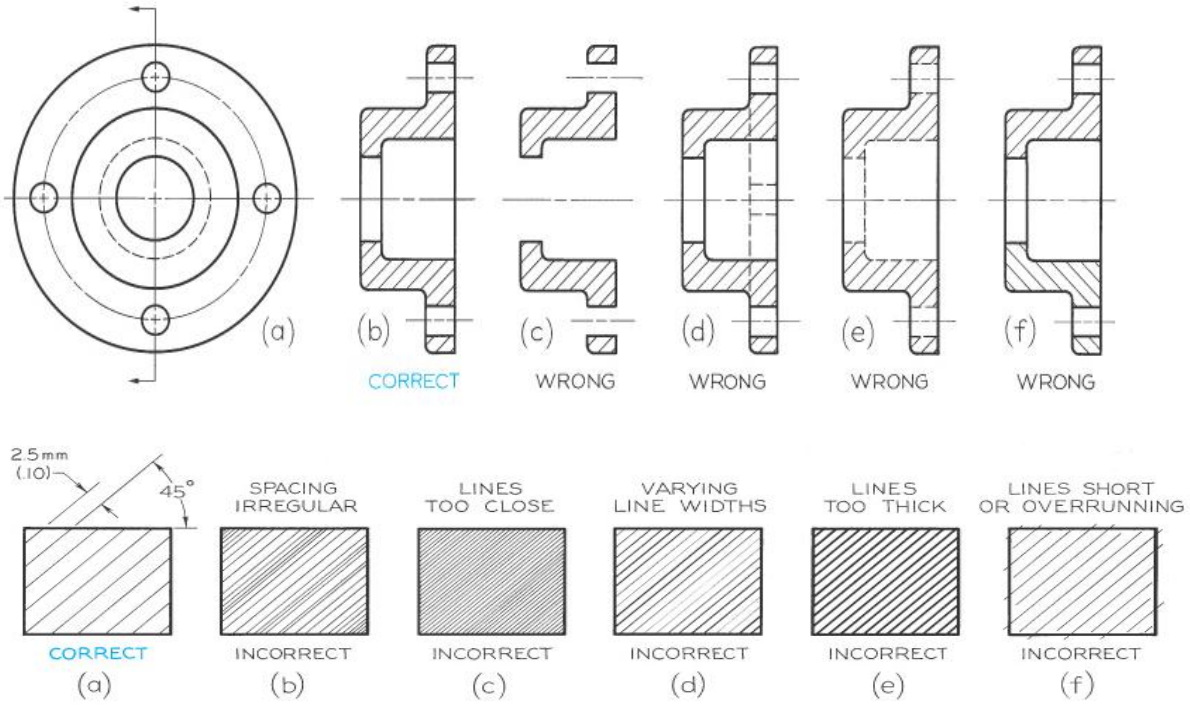


Figure 1.7. Shading with thin solid lines (Hatching)

Identifying the parts of a personal computer

The other basic requirement in learning Drawing using **CAD (Computer Aided Design)** is to differentiate the Software and Hardware and to know the parts of personal computers.

Hardware: - The physical parts that make up a computer(the central processing unit, input, output and memory)are called “hardware”.

Software: - Programs that tell a computer what to do are called “software”.

A **peripheral** device is defined as a **computer** device connects to a **computer** system to add functionality. Such as a keyboard or printer, that is not part of the essential **computer** (i.e., the memory and microprocessor). These auxiliary devices are intended to be connected to the **computer** and used.

There are many different models of personal computers. They include desktop personal computers (PC), notebooks and laptops but they all have the same basic hardware parts:

- ✓ a keyboard

- ✓ mouse/touch pad/trackball
- ✓ monitor (screen)
- ✓ System unit.

The diagram below shows a typical set up of a personal computer.

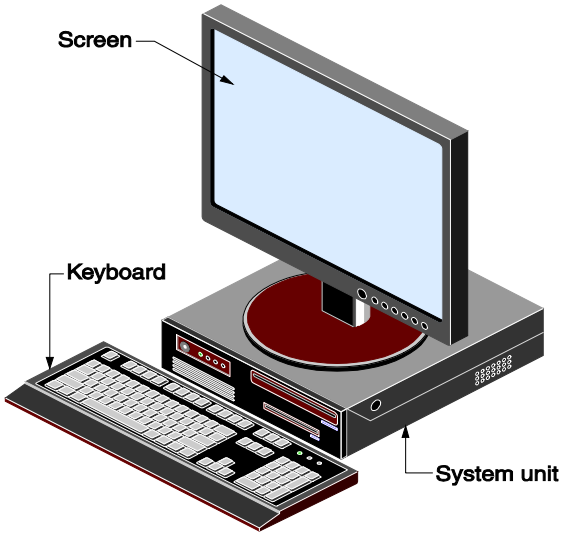


Figure 1.8.: The typical set up of a personal computer

1.2. Relevant Information to project.

Introduction

In a procurement context, a specification can be defined as a statement of needs. It defines what the procurer wants to buy and, consequently, what the supplier is required to provide. Specifications can be simple or complex depending on the need. The success of the procurement activity relies on the specification being a true and accurate statement of the buyer's requirements.

- **A good specification should**:

state the requirement clearly, concisely and logically in functional and performance terms unless specific technical requirements are needed for goods, state what the item will be used for

- against contain enough information for offers to decide and cost the goods or services they will offer and at what level of quality
- Permit offered goods or services to be evaluated against defined criteria by examination, trial, test or documentation

- state the criteria for acceptance of goods or services by examination, trial, test or documentation
- provide equal opportunity for all potential suppliers to offer goods or services which satisfies the needs of the user, including goods or services incorporating alternative solutions
- form the fundamental basis of the contract between buyer and seller • not over-specify requirements
- not contain features that directly or indirectly discriminate against people with disability, but allows optimal access and inclusion
- not contain features that directly or indirectly discriminate against Australian and New Zealand suppliers
- for procurements covered under either the Australia-United States or Australia-Chile Free Trade Agreements, contain features that directly or indirectly discriminate suppliers from a participating country or are otherwise contrary to the Agreements

✓ Specifications are agreed upon defined requirements for a product.
✓ Specifications are a type of Standard defined by a governing body.
✓ Specifications may have embedded drawings but may focus more on text.
✓ There are effectively two types of specifications;
✓ Design or Product Specifications (what is wanted).
✓ Application Specifications (how something is to be done in order to achieve a specific Goal)

- **Types of specifications"-** There are three types of specifications.

✓ **Functional specifications:** these are specifications that define the function, duty or role of the goods or services. It nominates what the goods or services are broadly required to do. Functional specifications define the task or desired result by focusing on what is to be achieved rather than how it is to be done. They do not describe the method of achieving the intended result. This enables suppliers to provide solutions to defined problems. For example, a specification for "an accessible device capable of conveying children from their school to their homes" does not limit responses to bus operators alone.

✓ **Performance specifications:**

These are specifications that define the purpose of the goods or services in terms of how effectively it will perform, that is, in capability or performance terms. Performance is a logical extension of function. Performance specifications define the task or desired result by focusing on what is to be achieved. They do not describe the method of achieving the desired result. This enables suppliers to provide solutions to defined problems. For example, a specification could be written: "An accessible device is required to convey at least 30 children every afternoon of the school week from their school in a safe manner to their homes within a radius of the school of 15 kilometers. The device shall be capable of achieving this within 1 hour. The device shall be capable of maintaining a comfortable environment for the children at an average temperature of 22 degrees Celsius in all types of

weather. The device should allow equitable access by all children". Such a specification does not limit offers to one type of transportation or one type of user

- ✓ **Technical specifications**:

These are specifications that define the technical and physical characteristics and/or measurements of a product, such as physical aspects (for example, dimensions, color, surface finish), design details, material properties, energy requirements, processes, maintenance requirements and operational requirements. They are used when functional and performance characteristics are insufficient to define the requirement.

- ✓ **Design or Product Specification**

A design or product specification describes the key points or requirements for a final design not how to achieve it.

- ✓ **Application Specification**

Application Specifications provide a sequential presentation of functions that need to be carried out in order to achieve a goal. The key difference between Performance and Application Specifications is that Performance specifications define a goal with no guidance on how this is achieved. Whereas Application Specifications define a step by step set of instructions which lead to a common goal.

1.3. Cad Equipment and software

1) Hardware

Conventional Vs CAD Hardware:

- **Input devices** may include alphanumeric and programmed function keyboard, digitizing tablets, trackballs, styluses, touch input devices.
- **Output devices** may include conventional plotters, hardcopy printers.

Graphic display terminals possess various local processors and controllers that can perform graphic functions(transformations, graphics generations) unlike conventional video terminals.

- **CAD Work station:** it is a visible part of the CAD system which provides interaction between the operator and the system.

It has a capacity to support major software packages, multitask capability, networking potential, availability and portability.

A typical CAD work station may consist of:

Visual Display Unit/Graphic screen, An Alpha- Numeric Display, a work station processor, An Electronic Command Table, a menu facility, Digitizer/ a cursor control device, a keyboard, printer/mini plotter devices.

2) CAD input devices

a)Locating input devices b) Digitizers c)Image- input devices

Locating input devices/Locators/cursor control device: - provide a position or location on the screen. These includes:

- ✓ Light pens
- ✓ Mouse
- ✓ Joystick, andTrackballs
- ✓ Touch Sensitive Screen

The key board

Light Pens: it is a picking device that enables to select the displayed item on the screen by directly touching the vicinity of the item. It detects light from the graphics items displayed on the screen and sends an interrupted signal to the computer to determine which item was seen by the pen.

Mouse:-this is of two types - Mechanical and Optical

Mechanical mouse has a ball rolling on the bottom in order to record the mouse motion in the x and y directions which is later encoded into digital values.

Optical mouse has a light source and a beam modulation and optical encoding techniques measuring the movements over the mouse pad.

Pushbuttons may be mounted on top of the mouse and programmed to various functions.

- **Joystick and trackballs:** are analogous to a mouse device, and operate on the same principle. These devices are applicable to control velocity or force in some simulation application where fast responses arerequired.
- **Touch Sensitive Screens:** This device is embedded in the monitor screens, usually, in the form of an overlay.The screen senses the physical contact ofthe user.
- **Keyboard:** the operator communicates with the system by typing commands on this input devices to tell the computer what to do. It consists of alphanumeric keys, function keys which are programmed to do a specific function for each application software, and communication keys (eg. Window key).
- **Digitizers: they are electro-mechanical**

vector graphic input devices that resemble a drafting board. It consists of 3 basic elements: a locator(puck or stylus), a tablet, and asoftware.

There are electrical wires embedded in orthogonal directions that receive and pass signals between the device and the computer. It is used to draw irregular shapes or copy a drawing.

2) **Image-input Devices:** Such as Scanners, which can copy a drawing or schematic with a camera and light beam assembly and convert it into a pictorial database.

There are four important parameters that measure

- **the performance of input devices:**

Resolution • Repeatability

Linearity • Accuracy

- **Resolution.** High resolution (or high res) refers to an image with a high level of detail. Resolution is determined by the number of **pixels** per unit area; pixels are the building blocks of an image, where smaller pixels mean there are more of them in a given space, which makes the final image more accurate. The term high resolution is used for digital images on TVs, cameras, printers, scanners and computer monitors

CAD output devices Soft devices:

Soft devices are display terminals, which display information on a screen,

Hard devices refer to hardcopy printers and plotters that provide permanent copies of the displayed information. The ICG(interactive computer graphics) display device can be classified in to two groups

Display device based on CRT principle

Flat screens (LCD & plasma screen)

3) Software:

System software is a general program written for the system, which provide the environment to facilitate the writing of application software. EX . Operating systems(windows 2000/XP/Vista, UNIX)

Application software is the set of program necessary to carry out operations for specified application.

Computer Programming Language

Towrite any software essentially a language is necessary

Data and instructions are communicated to the computer in binary form

Binary number system is used to represent any decimal no, letter, symbol

- **Three levels of computer ɯgramming Language**

✓ *Machine languages:*

Written in binary form(the binary coded instructions the CPU understands)

Machine specific (a program for one computer not run on other)

Programmer should be familiar with the specific computer system

Tedious, complicated, difficult and timeconsuming

✓ *Assembly/low-level languages:*

They are symbolic languages(English like mnemonic used for eachbinary each instructions)

Machine specific(so difficult for the programmer)

Most efficient in terms of fast execution of computer

✓ *High level languages:*

They are procedure oriented

They are not machine dependant (able to run on anymachine)

Use English like statements with standard mathematicalelements

Each statement is equivalent to instructions in machine language

- Must be converted into machine code by a special program called compiler.

- **Operating System:**

1. These are programs written by computer manufacturers, which are in-built and used to govern the control of the hardware of the computer such as processer, memory devices, and input/output devices e.g. MS-DOS, Windows NT , WindowsVista , etc

- **Application Soft Ware:** user written programs to perform specificjobs**.**

Some of the commercial CAD Applicationsoftware:

Geometric modeling software

e.g. CATIA, PROE, IDEAS, AMD, UNIGRAPHICS, AUTOCAD, SOLIDWORKS, etc Analysis software e.g. NASTRN, ANSYS, NISA, COSMOS Simulation software e.g. ADAMS, 3D max,WM3d

Points to be noticed for designing Graphics Software

- ✓ Simplicity - easy to use
- ✓ Consistency – predictable to user
- ✓ Completeness – full set of graphic functions
- ✓ Robustness – tolerating minor misuse
- ✓ Performance – fast speed of response
- ✓ Economy – not too expensive

- **Modules in a Graphics Package**

The graphics software can be divided into three modules according to a conceptual model. They are

- The graphics package
- ✓ User and graphics terminal
- ✓ User and the system
- ✓ It consists of input and output subroutines
- -The application program Is the central module
- Controls the storing data into and retrieving the data out of the application database.(Is driven by the user through graphics package) Is written by the user to do a specific job
- The application Database

- The graphics software can be divided into three modules according to a conceptual model. They are.

✓ Data base containing mathematical, numerical, and logical definitions of the application models, such as mechanical components in terms of alpha numerical data associated with the models like material ,mass and geometric properties

- **Functions of Graphics Package**

✓ **Generations of graphics element**

A 2- D basic image entities such as a dot, lines, circle, arcs, etc

A 3- D primitives such as sphere, cones, cylinder, orbox

There is a special hardware in graphics system for each graphic elements Users use both 2D and 3D elements as a building block to construct images

- **Transformations**

Modifying the generated objects,

e.g. copying, moving, scaling, rotating, mirroring etc of the object

- **Display control and windowing function**

Viewing the object from different directions

Hidden line removal (dividing the object into visible and invisible lines and removing the invisibles to make it more understandable.)

- **Segmenting functions**

Capability to selectively replace, remove, or modify portion of the object

- **User input functions**

It permits users to enter commands and data.

- **Database**

It is an organized collection of graphics and non-graphics data stored in the computer.

It is an art of storing data in computer. (Implementation of Data structure into computer)

- **Advantage**

✓ Eliminate redundancy

✓ Enforce standards

✓ Apply security restriction

✓ Maintain integrity

- ✓ Balancing conflicting requirements

- **Methodology of storing data:**

- ✓ Relational database (storing related data in the form of table)
- ✓ Hierarchical database(representing data by tree structure. Root is top of the tree, for complete object representation surface, edge/line, vertex, and coordinate system are required)
- ✓ Networking database (complex but permits modeling of many to many)
- ✓ Object oriented database(storing the object only not the individual records)
- ✓ Database Coordinate system
- ✓ Three types of coordinate system are needed in order to input, store and display model geometry and graphics:

- **Model Coordinate System(MCS):** It is the reference space w.r.t. which geometrical data of objects are stored. It is the Cartesian coordinate.
- **World Coordinate System(WCS):** It is used to explain inclined faces or objects.
- **Screen Coordinate System(SCS):** It is a two dimensional device dependant system whose origin is usually located at the lower left corner of the graphics display/screen. The physical dimension of a device determine the range and the measurement unit of SCS.

Self-Check -1.1	Written Test

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

1,_____is provide a sequential presentation of functions that need to be carried out in order to achieve a goal.

A, production specification B, application specification C, specification of lettering

2. _____ is specifications that define the purpose of the goods or services in terms of how effectively it will perform, that is, in capability or performance terms

A, Performance specifications B, Technical specifications C, Application Specification

3. _____is describes the key points or requirements for a final design not how to achieve it.

A Product Specification B, production specification C, application specification

4. One of the following is not the advantage of data base

A. Maintain integrity B. Enforce standards

C. Eliminate redundancy D. None

5. Binary number system is used to represent any decimal no, letter, symbol

A. Decimal no B. Letter C. Symbol D. All

Directions: II **Mach the following column "A" With column "B"**

Column "A"	**Column "B"**
1. Simplicity	A. tolerating minor misuse
2. Consistency	B. easy to use
3. Completeness	C. tolerating minor misuse
4. Robustness	D. predictable to user
5. Performance	E. full set of graphic functions

Directions: III **Give short Answer**

1. Explain the term "Machine Drawing"
2. Define the term "Production drawing
3. What is an assembly drawing?

Unit Two: key features of CAD software
This unit is developed to provide you the necessary information regarding the following content coverage and topics: 1. Types of CAD software ✓ AutoCAD ✓ Inventor ✓ CATIA ✓ Solid works ✓ Pro Steel ✓ X Steel 2. 2-D drawings, 3-D models This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: 2.1. Describe and use types of CAD software 2.2. Identify differences in CAD process to generate 2-D drawings, 3-D models.

2, Key Features of CAD software

2.1 Types of CAD software

There are a variety of engineering and design jobs that use **CAD (computer-aided design software).**

We often get asked what CAD software companies use. As a busy staffing agency for engineers, and designers we know it depends on the particular industry a company is in.

Different CAD systems are tailored towards certain industries, with crossover and competition between the various CAD software companies.

Interested in learning about the best CAD software for engineers, designers, and drafters? Keep reading. We list CAD software packages you should consider learning, some of their features, potential career paths, and the industries that create jobs for them.

Popular types of CAD software companies use include Solid Works, Inventor, Revit, AutoCAD, Civil 3D, Micro Station, CATIA, Creo, and Siemens NX.

2.1.1 AutoCAD

One of the oldest and most used CAD software for 2D / 3D drafting & design. It has the ability to create blueprints, equipment layouts, section planes, model documentation, and more. Learning AutoCAD and additional 3D CAD software is a recipe for success.

- **Some features including:**

✓ 2D drawing, drafting, and annotation
✓ Extended workflows
✓ X refs and block palettes
✓ Dynamic blocks
✓ 3D Mesh, solid and surface modeling

- **Jobs that use AutoCAD CAD software**

✓ Architects, Architectural designer, and drafter
✓ Electrical engineer, design and drafter
✓ Electronics engineer, design and drafter
✓ Plumbing designer, HVAC designer, MEP designer
✓ Interior designer

- ✓ Industrial engineer
- ✓ Manufacturing engineer
- ✓ Mechanical engineer, design and drafter
- ✓ Structural engineer, designer, and drafter

- **What industries use AutoCAD?**

- ✓ Aerospace & Aviation
- ✓ Consumer products
- ✓ Manufacturing
- ✓ Medical Device
- ✓ Industrial products
- ✓ Oil & Gas
- ✓ Civil, Structural, MEP

2.1.2 Inventor

A 3D modeling software and the main competitor of Solid Works, used in mechanical design, engineering, and product development.

- **Some features including:**

- ✓ Parametric modeling for 3D objects
- ✓ Product data management
- ✓ 3D Solid Modeling
- ✓ Simulation
- ✓ Visualization

- **Jobs that use Inventor CAD software**

- ✓ Mechanical engineer, designer, and drafter
- ✓ Manufacturing engineer
- ✓ Industrial engineer
- ✓ Product development engineer

- **What industries use Inventor?**

- ✓ Aerospace & Aviation
- ✓ Consumer products
- ✓ Manufacturing

- ✓ Medical Device
- ✓ Industrial products
- ✓ Oil & Gas equipment

2.1.3 CATIA

CAD software used by OEM's (original equipment manufacturers) for surface modeling, design, and visualization. Want an engineering or design job in the Automotive or Aerospace industries? Put this one on your list.

- **Some features including:**
- ✓ 3D Modeling
- ✓ Digital prototyping
- ✓ Highly detailed surface modeling and shape manipulation
- ✓ Virtually create and analyze products during development
- **Jobs that use CATIA CAD software**
- ✓ Mechanical engineer, designer, and drafter
- ✓ Electrical engineer, design and drafter
- ✓ Industrial designer
- ✓ Product development engineer
- **What Industries use CATIA?:**
- ✓ Aerospace & Aviation
- ✓ Automotive
- ✓ Shipbuilding

2.1.4 Solid Works

As a popular mechanical design software with a large community of users, employers are frequently seeking job seekers with Solid Works experience. This 3D modeling CAD software is used heavily in the mechanical engineering and design industries. It is the industry standard for product development.

- **Some features including:**
- ✓ Product design simulation
- ✓ 3D solid modeling

- ✓ Product data management
- ✓ Cost estimation, manufacturability checks
- ✓ Created with ease of use in mind
- ✓ Used by mechanical and electrical engineering departments

- **Jobs that use Solid Works CAD software**

- ✓ Mechanical engineer, designer, and drafter
- ✓ Manufacturing engineer
- ✓ Industrial engineer
- ✓ Electrical engineer, designer, and drafter
- ✓ Product development engineer

- **What Industries use Solid Works?**

- ✓ Aerospace & Aviation
- ✓ Consumer products
- ✓ Manufacturing
- ✓ Medical Device
- ✓ Industrial products
- ✓ Oil & Gas

2.1.5 Pro Steel

Pro Steel is comprehensive steel detailing and fabrication design software that helps you efficiently and accurately develop models and documentation for steel structures.

2.1.6 X Steel

X Steel is sophisticated 3D deigning software produced by the Tekla Corporation. The software has some unique features that are effective for flawless. The designing tool features model based architecture that can be used to create intelligent 3D simulated real world structural designs

2.2 . 2-D drawings and 3D Modeling

A. **2D modeling**

What is 2D drafting and drawing? 2D drafting and drawing is the process of creating and editing technical drawings, as well as annotating designs. Drafters use computer-aided design (CAD)

software to develop floor plans, building permit drawings, building inspection plans, and landscaping layouts Construction of 2D drawings using coordinate systems2D drawing can be drawn either one of the following four method

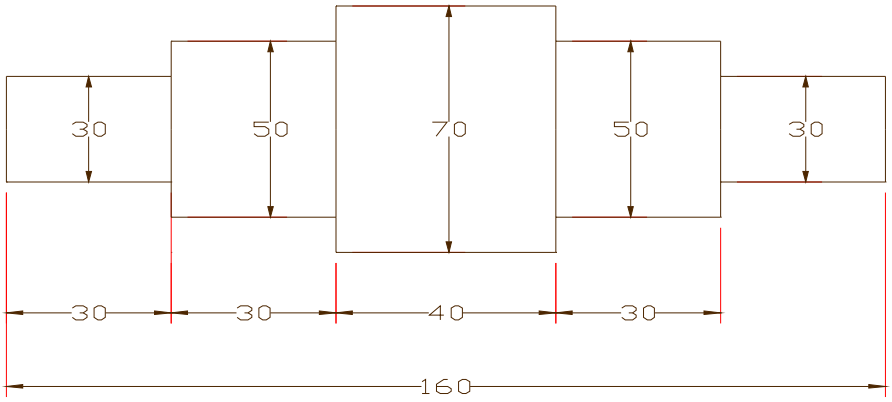
Direct Entry methods :-

- ✓ It is Used to draw only vertical and horizontal line .
- ✓ Give Distance (Length) of the line then show direction . Or distance + direction

Procedure :-

- ✓ Select Line From Draw Menu bar Or Draw Tool Bar
- ✓ Click At Any Point On The Graphic Window.
- ✓ Show The Direction And Write The Dimension . Then Enter finally.

Example:- .Practice to draw the figure given below with this method



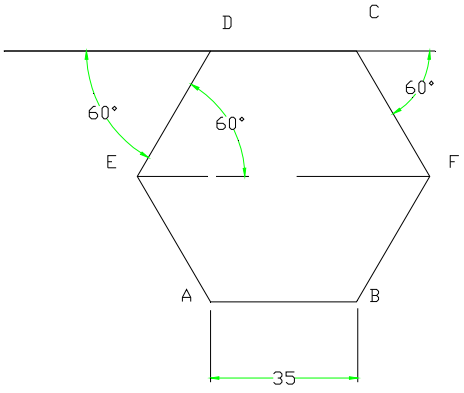
2.1Polar coordinate system:-

it is used to draw vertical , horizontal and inclined line.

It is length +angle

That is @ Length < angle

Exersice :- write the steps and Draw the figure given below .



To draw AB @ 35<0 enter key

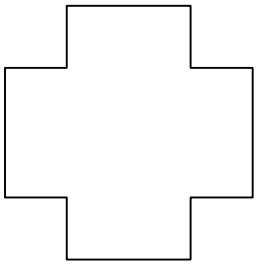
To draw BF @ 35 <60 enter key -

----------–

Figure.2.2.

To draw EA @ 35 <360 enter key

Rectangular or relative coordinate system :-



It Can be given by @x , y which means @and any number x and y

Exercise :- write the steps and Draw the figure given below using this method

To draw line AB @ 0,57 enter

Tto draw line BC@ 57,63 enter

To draw line CD @

To draw line EF @

To draw line FG @

To draw line GH @

Figure.2.3.

Absolute coordinate system

It is drawn by x,y co-ordinate system only that is (x,y)

TO draw AB use 0,106

TO draw BC use 106,49

TO draw CD use 106,0

TO draw DA use 0,0

close -ente

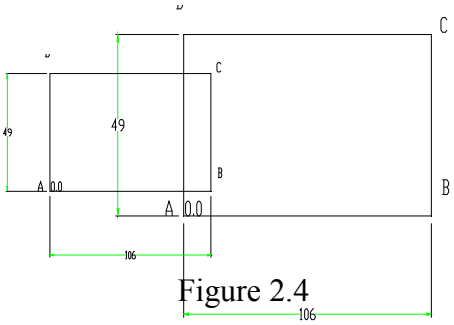


Figure 2.4

B. **3-D models**

Types of Modeling Within CAD, there are three main types of 3D modeling – solid, wireframe, and surface – and each has its own advantages and disadvantage

Various types of 3D modeling allow us to design various things, some better than others. Read on to see the best type of 3D modeling for you!

Isometric Drawing :-

To do this drawing apply the following .

Limit your drawing area first

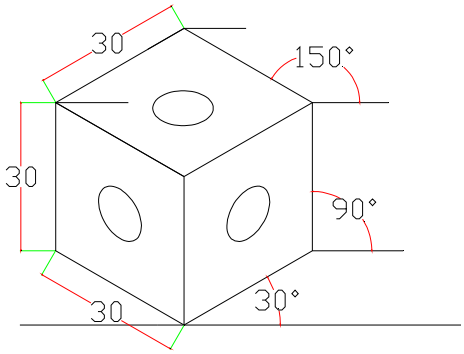
Right click on grid

Select setting

Select isometric snap Then ok .

Finally you will find the curser angle is changed .

In this type of drawing even inclined angle is drawn by 300, 1500, 2100 , 3300, and vertical line is drawn by 900 and 2700 degrees



To draw Isometric drawing

Select ellipsis

Type I and enter key

Specify center point

Specify the (side top/right /left) by function key (F5)

Specify the radius Look the example

Figure 2.5.

Self check-2.1	Written test

A. Multiple choice:

1. What method used to draw an object using distance and an angle?

a. Absolute coordinate system b. Relative coordinate system

b. Polar coordinate system d. distance method

2. What method used to draw an object using the value of X & Y from only one origin?

a. Absolute coordinate system b. Relative coordinate system

b. Polar coordinate system d. distance method

3. What AutoCAD command is used to cut a line?

a. Offset b. trim

c. Move d. copy

4. From the command given, @8,0 ↵, what type of coordinate system being used?

a. Absolute coordinate system b. Relative coordinate system

b. Polar coordinate system d. distance method

5. Which command is used to write a letter in the drawing area?

a. rotate b. extend

c. M text d. Move

B. Answer the following question

1. What Industries use CATIA?

1.----------

2.----------

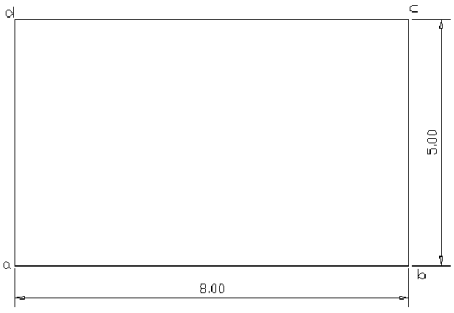
3.----------

2. What is 2D drafting and drawing?

Operation Sheet ≠2.1	Draw lines using absolute coordinate system

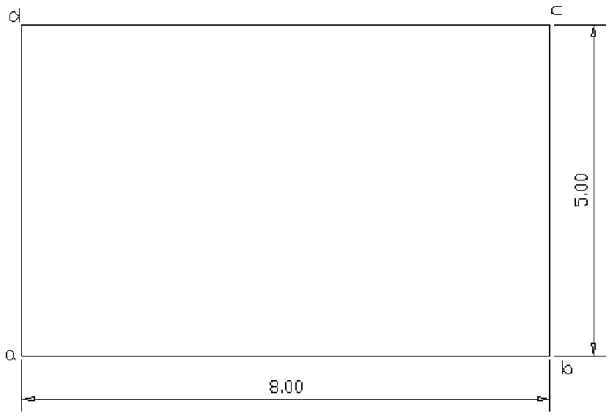
- **Operation title:** Procedures Draw absolute coordinate system lines using
- **Purpose:** To practice and demonstrate the knowledge and skill required in Drawing absolute coordinate system lines using.
- **Instruction:** Use the given figure below , the tools and equipment draw the given drawing. For this operation you have given 3Hour and you are expected to show the drawing on the given computer.
- **Tools and requirement:**
    1. This operation sheet
    2. computer
- **Quality Criteria:** the given geometrical shape is measured with 1mm accuracy
- **Precautions: :** check and save all activity
- **Procedures in doing the task**

1. From the command prompt: type L↵
2. At point a, Line specify first point; 0,0
3. Line ab, Specify next point or undo; 8,0 ↵
4. Line bc, Specify next point or undo; 8,5↵
5. Line cd, Specify next point or undo; 0,5 ↵
6. Line da, Specify next point or undo; 0,0↵↵



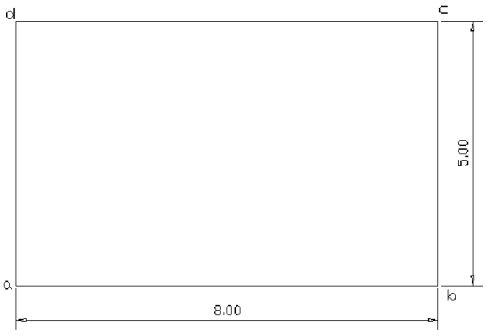
Operation Sheet ≠2.2	Draw lines using relative coordinate system

- **Operation title:** Procedures draw lines using relative coordinate system
- Purpose: To practice and demonstrate the knowledge and skill required in drawing lines using relative coordinate system
- **Instruction:** Use the given figure below , the tools and equipment draw the given drawing. For this operation you have given 3Hour and you are expected to show the drawing on the given computer.
- **Tools and requirement:**
  3. This operation sheet
  4. computer
- **Quality Criteria:** the given geometrical shape is measured with 1mm accuracy
- **Precautions: :** check and save all activity
- **Procedures in doing the task**
  1. From the command prompt; Type L⏎
  2. Line specify first point; click first point
  3. Line ab, Specify next point or undo; @ 8,0⏎
  4. Line bc, Specify next point or undo; @ 0,5⏎
  5. Line cd, Specify next point or undo; @-8,0⏎
  6. Line da, Specify next point or undo; @ 0,-5⏎⏎



Operation Sheet ≠2.3	Draw lines using polar coordinate system

- **Operation title:** Procedures draw lines using polar coordinate system
- Purpose: To practice and demonstrate the knowledge and skill required in drawing lines using polar coordinate system
- **Instruction:** Use the given figure below , the tools and equipment draw the given drawing. For this operation you have given 3Hour and you are expected to show the drawing on the given computer.
- **Tools and requirement:**
  5. This operation sheet
  6. computer
- **Quality Criteria:** the given geometrical shape is measured with 1mm accuracy
- **Precautions: :** check and save all activity
- **Procedures in doing the task**
  1. From the command prompt; Type L↵
  2. Line specify first point; click first point
  3. Line ab, Specify next point or undo; @ 8<0↵
  4. Line bc, Specify next point or undo; @ 5<90↵
  5. Line cd, Specify next point or undo; @ 8<180↵
  6. Line da, Specify next point or undo; @ 5<270↵↵



LAP Test -2.1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

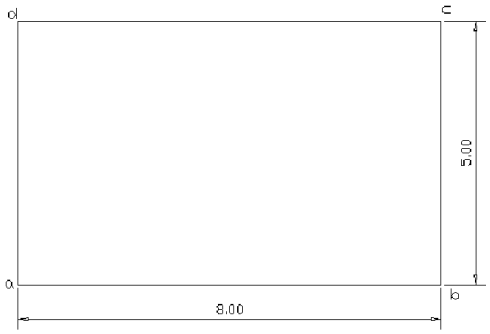
Instructions: Given necessary operation sheet and computer with requaried software you are required to perform the following tasks within 4 hours

Lap Test

Task-1: Draw lines using absolute coordinate system

Task-2: Draw lines using relative coordinate system

Task-3: Draw lines using polar coordinate system



Unit Three: Create 2D drawings
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • Create drawings using the available software system. • link to database • Create views This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: 3.1. Creating drawings using the full capability of the available software system. 3.2. Attributing drawing entities linking to database 3.3. Creating detailing views using various scales.

3: Create 2D drawings

2.3 Create drawings using the available software system.

- **Basic Toolbars**



Draw command

- **LINE COMMAND** :- it helps to draw any figure you like .

✓ TO activate line :- select line from draw tool bar

✓ Or Select line from draw menu bar

✓ Or write line on command line

- **CIRCLE COMAND** ;- help to draw any circle

TO activate circle :-

✓ Select circle from draw tool bar

✓ Or select circle from draw menu bar

✓ Or write circle on command line

✓ Specify centre point

✓ Write `d` or` r`` for diameter or radius you like to do

Specify diameter or radius circle eg 30

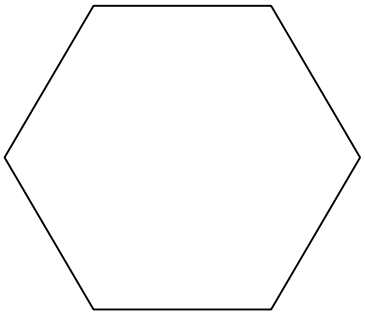


Figure 3.1.

Hexagon

- **POLYGON COMMAND**

✓ Select POLYGON from draw tool bar

✓ Or Select POLYGON from draw menu bar

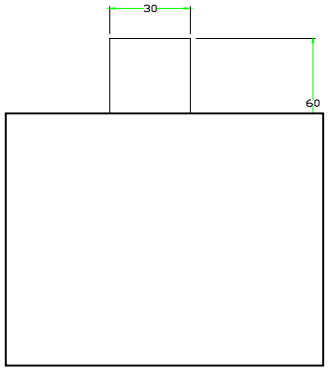
✓ Or write POL on command line

✓ Enter number of sides

✓ Specify centre of polygon

✓ Enter an option circumscribed about circle or inscribed in circle (I) enter Specify radius of circle eg 30 then right click or enter

- **RECTANGLE COMMAND**



✓ Select RECTANGLE from draw tool bar

✓ Or Select RECTANGLE from draw menu bar

✓ Or write REC on command line

✓ SPECIFY first point by click some where you like .

✓ Write ` dim ` for the value of dimension then right click or enter

✓ Specify the length rectangle eg 30mm

✓ Specify the width of the rectangle eg. 20mm

Figure 3.2.

- **Arc Command**

Rectangle

✓ Select arc fro draw menu bar

✓ Select one of the methods Example ,Start - Center -End then enter.

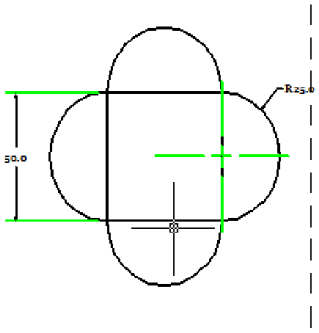


Figure. 3.3. Arc

- **Hatching command**

✓ Select section from modify menu or

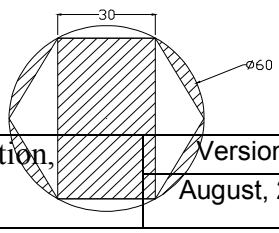
✓ Select section from tool bar menu or

✓ Type section on command line .-- enter key

✓ Select gradient from draw dialog box - Right click or enter key

✓ Specify pick point

✓ Locate (pick) the internal part

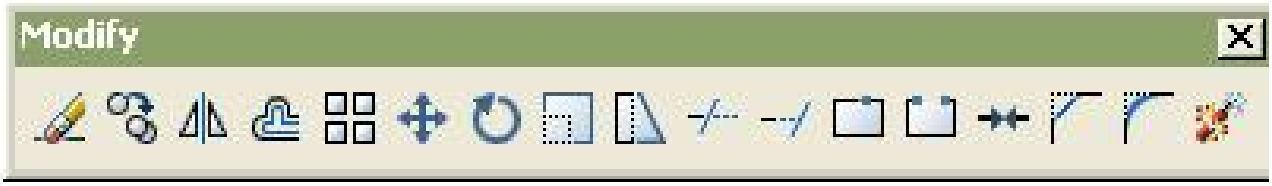


- ✓ Right click – enter then ok

Eg. Draw and hatch the given figure below

Figure 3.3. Hatching

Do one more exercise from



- Modify toolbars

- **Erase command :-**used to delete the object or line

Procedure:-

- ✓ Select the Erase command from tool bar menu or
- ✓ Select Erase from tool modify menu or
- ✓ Type Erase on command line --. Enter key
- ✓ Select the object or line to be clean

- **Then Right click or enter**
- Trim command

- ✓ Select trim from modify menu or
- ✓ Select trim from tool bar menu or
- ✓ Type trim on command line --. enter key
- ✓ Select the object (cutting plane).
- ✓ Right click or enter key
- ✓ Click on the line to be trim

Or

- ✓ Select trim command
- ✓ Select the whole object right click

✓ Click on the line to be trim

- Copy command

✓ Select copy from modify menu or
✓ Select copy from tool bar menu or
✓ Type copy on command line --. enter key
✓ Select the object
✓ Right click or enter key
✓ Specify base point
✓ Finally locate or give the distance enter key
✓ Do one more exercise

- Move command

✓ Select move from modify menu or
✓ Select move from tool bar menu or
✓ Type move on command line ----. enter key
✓ Select the object by widow box- Right click or enter key
✓ Specify base point
✓ Finally locate or give the distance enter key

- **Fillets command**

✓ Select fillet from modify menu or
✓ Select fillet from tool bar menu or
✓ Type fillet on command line --. enter key
✓ Specify radius of fillet ---R— then enter key.
✓ Type the number you need eg. 25 enter key
✓ Select the first line and then the second line

- **Rotate command**

Select rotate from modify menu or

Select rotate from tool bar menu or

Type rotate on command line ---. enter key

Select the object by widow box- Right click or enter key

Specify base point of the given figure

Specify angle of rotation ---- e g. 15 0 then enter key

N.B Practice the commands by drawing closed wrench given below

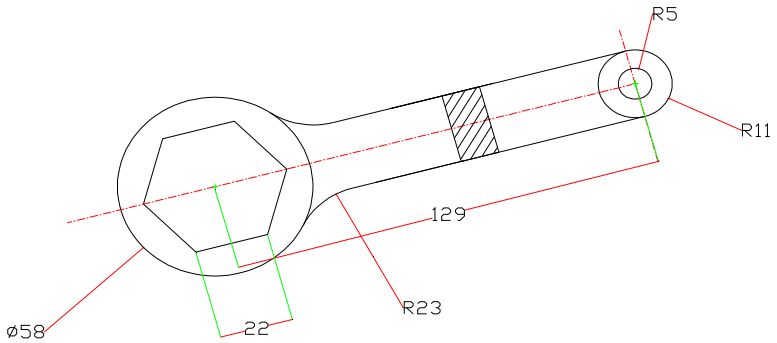


Figure 3.4. Rotate Wrench

- **Chamfer command**

Select chamfer from modify menu or

Select chamfer from tool bar menu or

Type chamfer on command line--- enter key .

Type A (angle) Right click or enter key

Specify length of chamfer ---- eg. 2.5 enter key

Specify chamfer angle ---- eg. 450 enter key

Eg. Draw and practice the given figure below (use rectangle command)

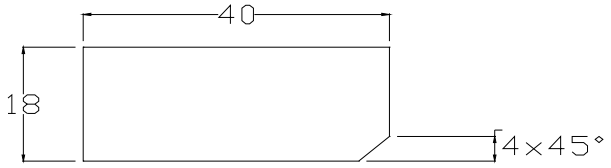


Figure 3.5. Rectangular chamfer

- **Mirror command**

Select mirror from modify menu or

Select mirror from tool bar menu or

Type mirror on command line .--- enter key

Select the object by widow box- Right click or enter key

Specify base point

Finally locate or give the distance enter key

E.g practice the given drawing below for Mirror command

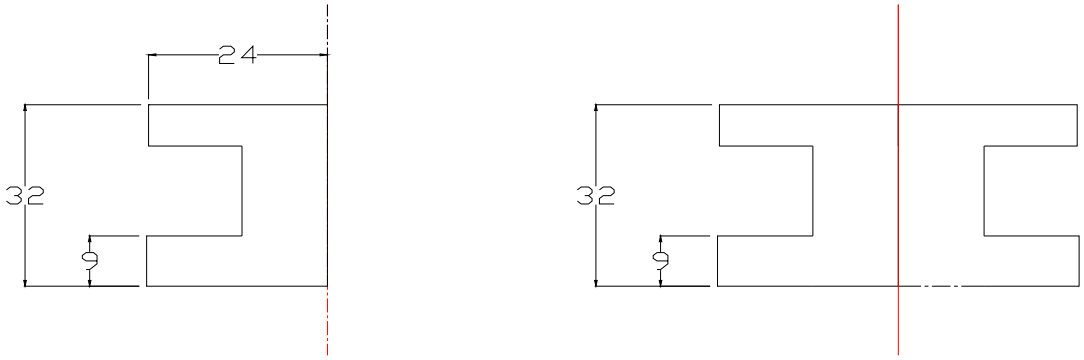


Figure 3.6. Before mirror

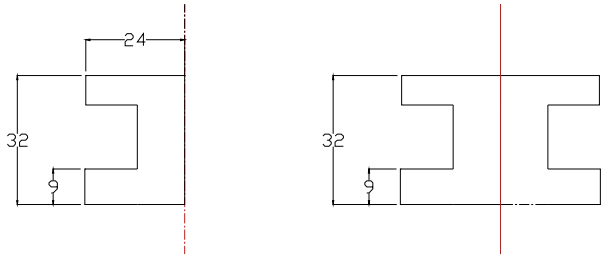


Figure 3.7. After mirror

Before mirror After mirror

- **Array command**

✓ Select Array from modify menu or

✓ Select Array from tool bar menu or

✓ Type Array on command line --. enter key

✓ Pick “polar array “ on plane box -- enter key

✓ Specify no of items—e.g. 4

✓ Select pick center point

✓ Locate center circles

- ✓ Click on select the object then ok

  Eg. Draw and practice the given figure below .

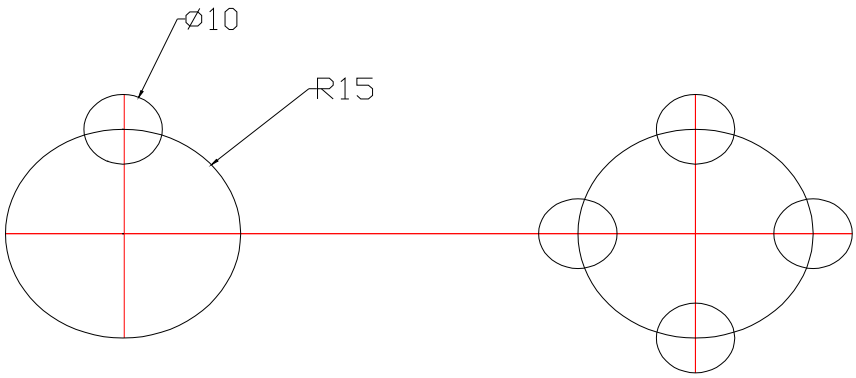


Figure 3.8. Array command

Dimension Command



First

specify the text height before any dimensioning is taken place

To do this click format ---text style ---give text height--- apply and close

- Linear dimensioning:-
- ✓ Help for vertical and horizontal line dimensioning
- ✓ Select leaner from dimensioned menu
- ✓ Or Select leaner from dimensioned tool bar
- ✓ Or Write linear on command line
- ✓ Specify first extension line (origin)
- ✓ Specify first extension line
- **Aligned dimensioning** :-
- ✓ Used only for inclined object

- ✓ Select Aligned from dimension menu
- ✓ Or Select Aligned from dimension tool bar
- ✓ Or Write Aligned on command line
- ✓ Specify first extension line (origin)
- ✓ Specify first extension line

- **Dimension editing**

- ✓ Select Dimension editing from dimension task bar
- ✓ Select the option(oblique, New, rotate ,home)
- ✓ Write new (N) – enter key
- ✓ Cancel (< >)from the dialog box – then OK
- ✓ Right click then enter key
- ✓ Object snap tool bar
- ✓ To set running object snaps
- ✓ Click Tools menu » Drafting Settings.
- ✓ In the Drafting Settings dialog box, Object Snap tab, select the object snaps you want to use.

Eg . Select all Click OK.



2.4 Drawing entities link to database

- **W Data Requirements Analysis**?

Though traditional requirements analysis centers on functional needs, data requirements analysis complements the functional requirements process and focuses on the information needs, providing a standard set of procedures for identifying, analyzing, and validating data requirements and quality for data-consuming applications. Data requirements analysis is a significant part of an enterprise data management program that is intended to help in:

Articulating a clear understanding of data needs of all consuming business processes,

Identifying relevant data quality dimensions associated with those data needs,

Assessing the quality and suitability of candidate data sources,

Aligning and standardizing the exchange of data across systems,

Implementing production procedures for monitoring the conformance to expectations and correcting data as early as possible in the production flow, and

Continually reviewing to identify improvement opportunities in relation to downstream data needs.

During this process, the data quality analyst needs to focus on identifying and capturing more than just a list of business questions that need to be answered. Analysis of system goals and objectives, along with the results of stakeholder interviews, should enable the analyst to also capture important business information characteristics that will help drive subsequent analysis and design activities: data and information requirements must be relevant, must add value, and must be subject to availability.

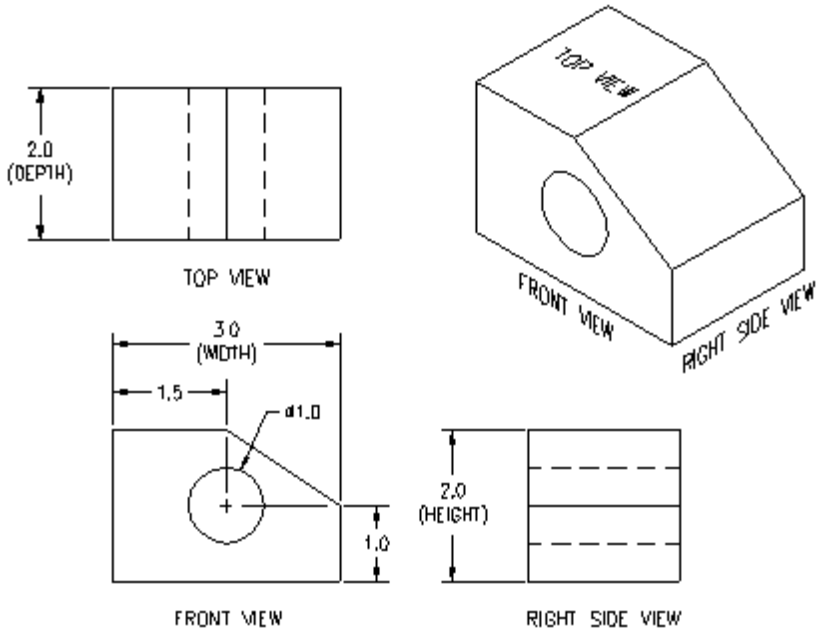
Data analysis with a good statistical program isn't really difficult. It does not require much knowledge of mathematics, and it doesn't require knowledge of the formulas that the program uses to do the analyses. It really only requires a few things:

- ✓ A "clean" spreadsheet that's analysis-ready
- ✓ A clear idea of what evaluation questions you want the data to answer
- ✓ Attention to detail
- ✓ A relaxed frame of mind.

2.5 Create views using various scales.

2.5.1 ISOMETRIC DRAWING

Using Isometric commands is one of the simplest ways to give a 3-D representation while using only 2-D commands. This has been the usual way of doing things before CAD allowed true 3-D work to be done. Many times an isometric drawing is used to compliment a 3 view orthographic drawing. See the sample below.



1.1.1 Figure 3.9. Isometric drawing

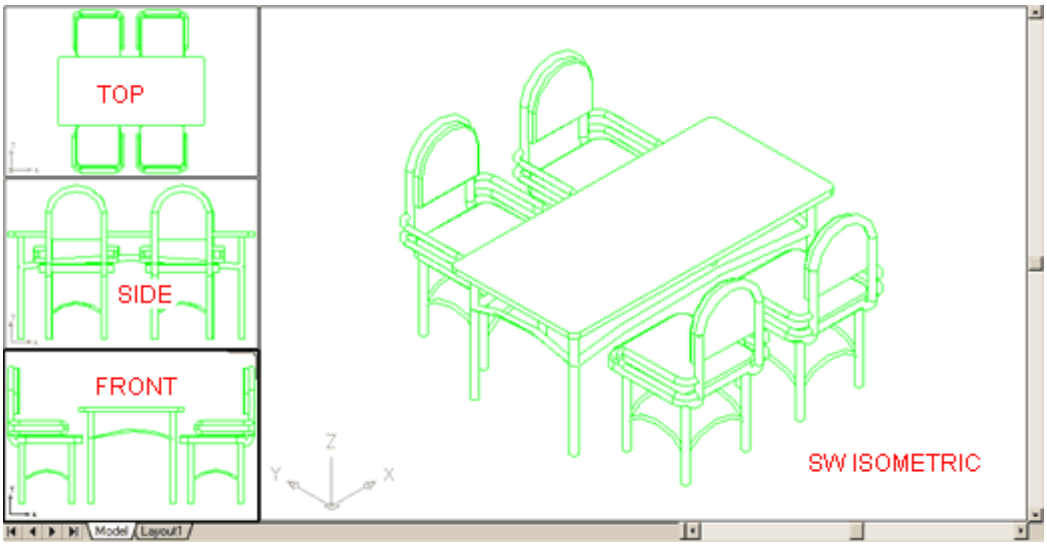
You can see that it is a very simple drawing. The basic isometric drawing of the object gives a very good idea of what it looks like. If this is all that is needed then isometric works well. Unfortunately, as soon as you change anything, like the block's height, you'll need to redraw all four views.

1.1.2 Viewing 3D Object

AutoCAD has a few ways for you to view an object other than the plan view that you have used for your 2-D drawings. For quick, easy views use the pull-down menu options. To do this choose **View > 3-D Viewpoint >** (then select one of the four bottom *isometric* options). Look at the drawing below to see the differences between four views. When doing basic drawings, it is a good idea to use only one view. This will keep you orientated a lot easier. It is most common to use the **Southwest** view, as this keeps your positive X and Y axes in a logical position. For most of your work in this course, stick with this view.

There will be times when you may need to see around to the other side of your object.

Then you can easily use the other preset views to see your model. You can also have more than one view on your screen at a time. See below:



1.1.1 Figure 3.10. Viewing 3D Object

To achieve this, use the **Tiled Viewports** option of the **View** pull-down menu. Then choose the New Viewports tab, and pick from several layouts. Any view or viewport configuration can be saved under a unique name. Later you can easily restore this view when needed. Here are the preset viewport configurations that you can use in model space.

Self-Check-3.1	Written Test

I. I. Multiple choice:

1. What alias or a short cut is used in the command line?

a. Li b. Ll

c. L d. Ln

2. What alias or a short cut is used in the command Circle?

a. C b. Cl

b. Cc d. Ce

3. What alias or a short cut is used in the command Trim?

a. Tm b. Tr

c. Ti d. T

4. What alias or a short cut is used in the command Move?

a. Mo b. Mv

c. Me d. M

5. What alias or a short cut is used in the command Copy?

a. Co b. C

c. Cp d. Cy

B. II. **Answer the following question**

1. Write the three basic command to make the drawing

A. ----------

B. ----------

C. ----------

2. Write what the data analysis need in drawing

A. ----------

B. ----------

C. ----------

D. ----------

Operation Sheet ≠3.1	Chamfer command

- **Operation title: Making chamfer**
- Purpose: To practice and demonstrate the knowledge and skill required in drawing **making chamfer** using **chamfer command**
- **Instruction:** Use the given figure below , the tools and equipment draw the given drawing. For this operation you have given 3Hour and you are expected to show the drawing on the given computer.
- **Tools and requirement:**
  7. This operation sheet
  8. computer
- **Quality Criteria:** the given geometrical shape is measured with 1mm accuracy
- **Precautions: :** check and save all activity

1. Select chamfer from modify menu or

2. Select chamfer from tool bar menu or

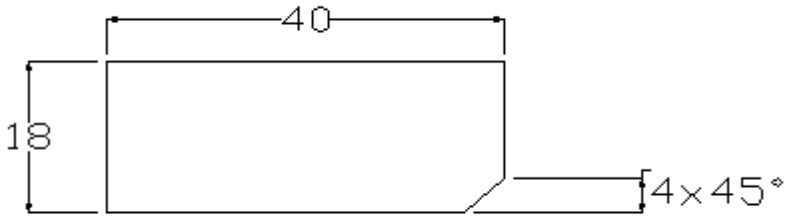
3. Type chamfer on command line--- enter key .

4. Type A (angle) Right click or enter key

5. Specify length of chamfer ---- eg. 2.5 enter key

6. Specify chamfer angle ---- eg. 450 enter key

- Eg. Draw and practice the given figure below (use rectangle command)



LAP Test -3.1	Practical Demonstration

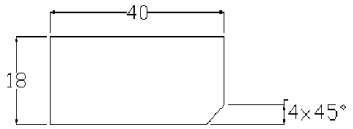
Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary operation sheet and computer with required software you are required to perform the following tasks within 40 min.

Lap Test

Task-1: Draw rectangle making chamfer



Unit Four: Access software and set up for drawing work
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • filing and library system. • software templates • symbols, codes and standards This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Opening software and navigating organizational filing and library system. • Identifying and determining organizational software templates • Identifying organizational symbols, codes and standards

4: Access software and set up for drawing work

4.1. Filing and library system

4.1.1 Filing System for Drawings

The filing system used for drawings should be the one you find to be most satisfactory-meaning ... Of concern to you is the engineering technical library.

The filing system used for drawings should be the one you find to be most satisfactory-meaning that there are no specific rules on the subject. For a discussion of recommending filing practices, you should review chapter 16 of the EA3 TRAMAN. An individual should be assigned daily to the task of logging in, card indexing, and filing any drawings or prints received. Tracings should be filed separately, and there should be a standing rule that tracings must never be removed from the file except with your approval as the supervising EA. About the only time removal is necessary is for reproduction purposes.

Any print issued to a constructor should be logged out by recording the date of issue and the name of the individual to whom it was issued. The purpose of this is to allow you to inform the constructors of any changes that must be made to prints used in the field

4.1.2 Reproduction Room

As you know well by now, ammonia vapors are highly toxic; therefore, for any room containing ammonia-vapor reproduction equipment, ventilation is of vital importance. Check with the battalion safety chief to see if the ventilation in your reproduction room is adequate.

In addition, the reproduction room should be kept as dust-free as possible. Air conditioning is helpful in this regard; however, it does not take the place of good housekeeping practices.

Before a new reproduction machine is operated even before it is installed-the potential operator must study the manufacturers handbook carefully. The instructions it contains (both for safe and efficient installation and for safe and efficient operation) must be carefully followed

As alluded to previously, light-sensitive materials must be stored in light tight spaces. The original containers of such materials are light tight; therefore, the materials should remain in these containers as long as possible

4.1.3 Engineering Technical Library

The overall battalion technical library contains reference publications related to construction and to subjects like ordnance, communications, military planning and training, medical and dental, professional development, and supply. Of concern to you is the engineering technical library. It should be consigned to the operations department on a sub custody basis by a designated central control office. That central control office may be the plans and training department, educational services office, or the supply department. Publications that are required in the engineering technical library, as well as the entire battalion library, are listed in Section 12 of the TOA. Some of the NAVFAC publications that must be in the engineering library are listed below

4.2. Software templates

The term template, when used in the context of word processing software, refers to a sample document that has already some details in place; those can (that is added/completed, removed or changed, differently from a fill-in-the-blank of the approach as in a form) either by hand or through an automated iterative process

A template is simply the layout and design the platform applies over your content. Sometimes referred to as a "skin," templates are interchangeable and affect website elements such as: Fonts. Colors.

4.3. symbols, codes and standards

4.3.1. Introduction

- Codes

The *MARC Code List for Organizations* contains short alphabetic codes used to represent names of libraries and other kinds of organizations that need to be identified in the bibliographic environment. This code list is an essential reference tool for those dealing with MARC records, for systems reporting library holdings, for many interlibrary loan systems, and for those who may be organizing cooperative projects on a regional, national, or international scale. There are a number of data elements in the MARC formats that call for institutional identifiers, the chief ones being those that identify the organization assigning the record control number, the agency responsible for creating or modifying a record, and the agency holding a copy of the item. In particular, it is a key to codes for holding institutions represented in the Library of Congress *National Union Catalog* (NUC) and other union list publications which contain holdings for reporting institutions.

This code list for organizations is the latest update to the list, previously published under the title *USMARC Code List for Organizations* (1996 edition). It includes new codes assigned since the last edition. A small number of existing codes have been changed or made obsolete. In all cases, previously valid codes are given as references. The large number of new codes can be attributed to continuing expansion of the use of standard identifiers, nationally by school libraries (particularly for statewide projects) and internationally as information is shared globally via the internet.

- **SYMBOLS**

The basic symbol is shown in Figure 4.1. The dimensions of surface texture symbols are shown in Figure 3.2. Sloping lines in the symbol are at 60□□to the horizontal

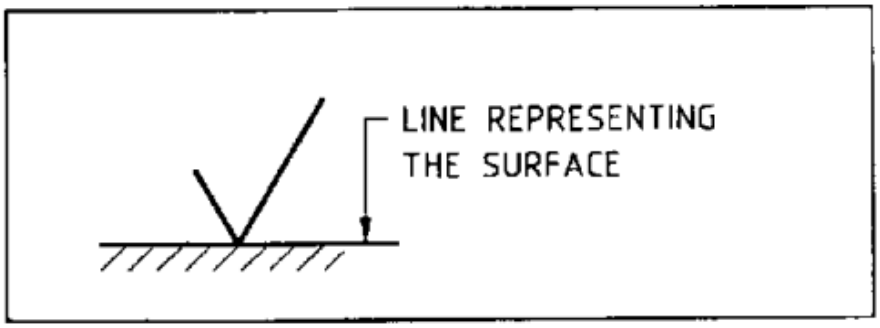


Figure 4.1.Basic Symbol

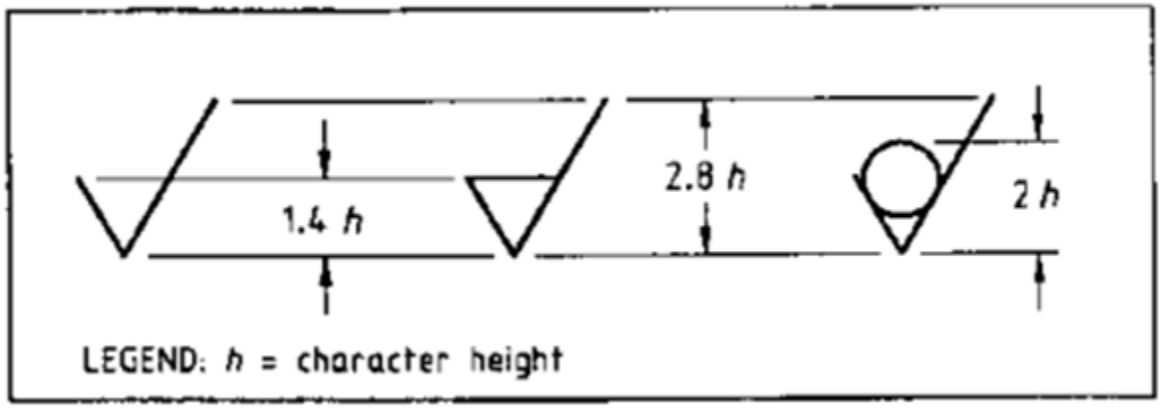


Figure 4.2. Shape and size of surface texture symbols

Table.4.1.Character height

h	1.4*h*	2*h*	2.8*h*
2.5	3.5	5.0	7.0
3.5	5.0	7.0	10
5.0	7.0	10	14
7.0	10	14	20
10	14	20	28
14	20	28	40
20	28	40	56

NOTE:=characterheight

- **Modification to basic symbol**

The following modifications may be made to the basic symbol:

a. The symbol to be used where machining is mandatory shall be the basic symbol with a bar added, as shown in Figure 4.3.

This symbol may be used alone to indicate that a surface is to be machined without defining either the surface texture or the process to be used.

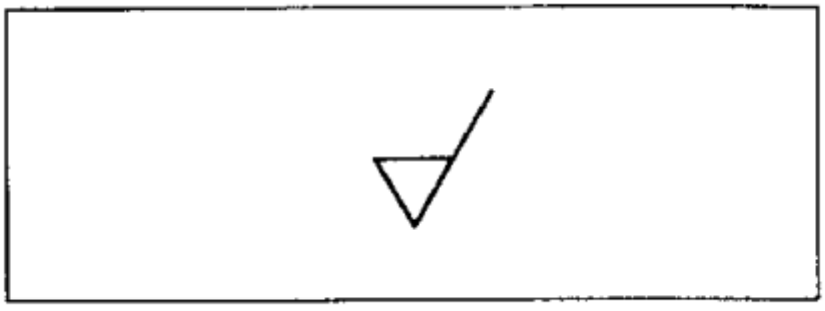


Figure 4.3.Symbol when machining is mandatory

(b) The symbol to be used when the removal of material is not permitted shall be the basic symbol with a circle added, as shown in Figure 3.4. This symbol may be used alone to indicate that a surface is to be left in the state resulting from a preceding manufacturing process.

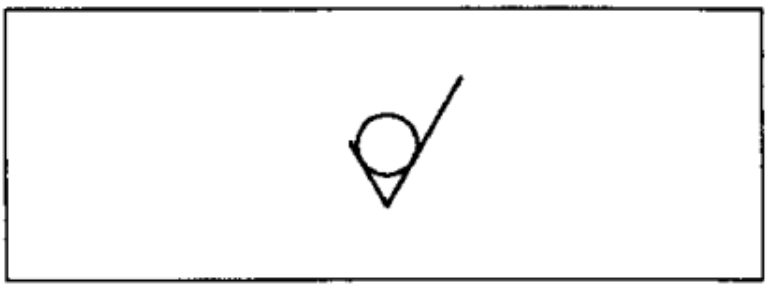


Figure 4.4. Symbol when material removal is not permitted

- **Extension of symbols** When special surface characteristics are to be indicated (see Clause 3.4), the symbols shown in Figures 4.2, 4.3 and 4.4 may be extended by adding a line of appropriate length to the long leg, as shown in Figure 4.6.

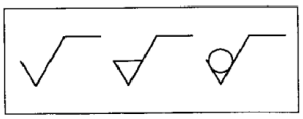


Figure 4.6. Extension for symbol for special surface characteristics

Self-Check -4.1	Written Test

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

1. _ The most common methods of arranging documents are
   A. Alphabetical B, Numerical C, Alphanumeric D, All of the above
2. Types of alphabetical filing
   A. Topical filing
   B. Classifiedfiling arranges related documents under a major subheading
   C. Filling based on a number
   D. A & B
   E. A & C
3. Advantages of numerical filing include
   A. quicker comprehension of numerical sequences over alphabetical
   B. ability to add new files without disturbing existing arrangement
   C. easy identification of misfiled or out-of-sequence numbers
   D. All of the above
4. Which one of the following is the modify tools

Line B. Circle C. Rectangle D. Move

5. One of the following is not the most basic types of Auto cad tools

Rotate B. Line C. Circle D. Rectangle

6. One of the following is true about files management
   A. It is the process of determining how files will be arranged
   B. It is the process of determining how files will be categorized
   C. It is the process of determining how files will be accessed
   D. It is the process of determining how files will be Stored
   E. All of the above

Directions: II. Write true or false

1.Templates are interchangeable and affect website elements such as: Fonts. Colors.

2. The filing system used for drawings should be the one you find to be most satisfactory-

Directions: III. Write down the correct answer

1.List what technical library contains

A.----------

B.----------

C.----------

D.----------

2. Draw the symbol when machining is mandatory

Unit Five: basic drawing elements
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • CAD functions to basic drawing elements • Edited, transfer tools and methods • Dimensions, text and symbols • Import and export Files • Views and perspectives This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Producing CAD functions to basic drawing elements • Using editing and transferring tools and methods • Applying dimensions, text and symbols • Importing and exporting Files • Generating different views and perspectives

5. Basic Drawing Elements

5.1 CAD functions to basic drawing elements

The vast majority of 2D drawings are comprised of three basic drawing elements: lines, circles, and arcs. The size, location, color, line width, and line type may vary. They may even be combined or joined together to create more complex objects. But most drawings can be broken down to these three basic elements

Purpose of CAD

Used by engineers, architects, and construction managers, CAD has replaced manual drafting. It helps users creating designs in either 2D or 3D so that they can visualize the construction

The functionality areas of CAD application can be grouped into categories. Explanation: The four categories are geometric modeling, engineering analysis, design review and evaluation and automated drafting. Explanation: The three primary color red, green and blue are combined to produce variety of colors

5.2. Edited, transfer tools and methods

- **Editing tool in cad**

The various AutoCAD tools present to assist in drawing a certain part/component, the most basic types used are: Line. Circle. Rectangle

AutoCAD provides a whole range of modify tools such as Move, Copy, Rotate and Mirror. As you can see, the command names are easily understandable. However, the way these commands work is not always obvious. This tutorial is designed to show you how all of the

- **Modify commands work**

CAD data exchange is a method of drawing data exchange used to translate between different Computer-aided design (CAD) authoring systems or between CAD and other downstream CAx systems. Many companies use different CAD systems and exchange CAD data file format with suppliers, customers, and subcontractors.

Computer-aided design (CAD) involves creating computer models defined by geometrical parameters. These models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by changing relevant parameters.

5.3. Dimensions, text and symbols

Select the dimension (or leader) style and click Modify. On the Text tab (or the Content tab for an m leader), set the desired text height

Select the dimension.

Open the Properties palette.

In the Text section, change Text height to the desired value

To Insert a Symbol or Text at a Specific Place in Dimension Text (AutoCAD Mechanical Toolset)

In the drawing area, select the dimensions you want to edit. ...

Click Power Dimensioning tab Edit panel Edit Dim Text . ...

Click in the position you want to insert the symbol or text.

To insert a symbol: ...

Press ESC

5.4. Import and export Files

AutoCAD File Formats: Only AutoCAD files in the DWG or DXF formats can be imported. Files in other formats will need to be converted before being imported. How the Information is Imported: The software only copies the information from the AutoCAD file

3D CAD Translation: Importing & Exporting The Right Format

Major CAD Software	Developer	Major Import/ Export CAD Files
SolidWorks	Dassault Systemes	ACIS, CATIA V5, DXF/DWG, IGES, Parasolid, PDF (export only), STEP, and STL.
Inventor	Autodesk	ACIS, CATIA V5, DWG, IGES, JT, Parasolid, STEP

You can import the geometry, fills, raster images, and TrueType text from a PDF file into the current drawing. The visual fidelity along with some properties such as PDF scale, layers, lineweights, and colors can be preserved.

PDF files are a common way of publishing and sharing design data for review and markup. AutoCAD supports creating PDF files as a publishing output for AutoCAD drawings, and importing PDF data into AutoCAD using either of two options:

PDF files can be attached to drawings as under lays, which can be used as a reference when collaborating on projects.

PDF data can be imported as objects, in part or entirely, which can be used a reference and also modified. If you import PDF data, you can choose to specify a page from a PDF file or you can convert all or part of an attached PDF underlay into AutoCAD objects

5.5. Views and perspectives

A. **PERSPECTIVE DRAWING**

Central projection is the other calling name.

It excels over all other types of projection in the pictorial representation of objects because it more closely approximates the view obtained by the human eye.

Terminology:

The station of the observer's eye is called *Station point* (SP).

The imaginary plane of projection is called *Picture plane* (PP).

The point where all projection lines converge is called *vanishing point* (VP).

A horizontal line in the front view representing an infinite horizontal is called *Horizon*.

The *three* basic types of perspectives are:

- One point – single vanishing point
- Two point – two vanishing point
- Three point – three vanishing point

✓ **ONE POINT PERSPECTIVE DRAWING**

Has one surface of the object parallel to the picture plane. However, other sides vanish to a single point. To draw one point perspective projection, we can develop from top and front views of an object.

When drawing any perspective, the station point should be placed far enough away from the object to permit the cone of vision to be less than 30^{o} to reduce distortion.

We can work one point perspective either by simply selecting a stationary point or by measuring points. The use of measuring point eliminates the need of placing top view above the front view

B. **MULTIVIEW DRAWING**

Multi view projection is a method by which the exact shape of an object can be represented by two or more separate views produced on projection planes that are at right angles to each other.The system of constructing multi view drawing is orthographic
projection. Orthographic views are two dimensional views of three dimensional objects.

Self-Check -5.1	Written Test

Directions: I **Mach the following column "A" With column "B"**

Column "A" **Column "B"**

1. Observer's eye A. *Picture plane*
2. Plane of projection . B. *Horizon*.
3. Projection lines . C. *Station point*
4. Infinite horizontal D. *vanishing point*

Directions: II Answer all the questions listed below.

1.Write the three basic types of perspectives

1.----------

2.----------

3.----------

2.Write at list four modify tools

1. ----------

2. ----------

3.----------

4.----------

Directions: Ill. Write true or false

1. Files in other formats will need to be converted before being imported

2. In the text section, it is impossible change text height to the desired value

Operation Sheet-5. 1	Indicating dimensions, notes and specifications

- **Operation title: Indicating dimensions, notes and specifications**
- **Purpose:** To practice and demonstrate the knowledge and skill required in **Indicating dimensions, notes and specifications**
- **Instruction:** Use the **Techniques for Indicating dimensions, notes and specifications**
  For this operation you have given 3Hour and you are expected to provide the answer on the given table.
- **Tools and requirement:**
  7. This operation sheet
  8. Computer
- **Quality Criteria:** the given geometrical shape is measured with 1mm accuracy
- **Precautions:** check and save all activity.
- **Procedures in doing the task**

Step 1. Identify method of dimensioning

Step 2. Dimensions should be placed outside the view.

Step 3 . Dimensions should be taken from visible outlines rather than from hidden lines.

Step 4. Dimensioning to a center line should be avoided except when the centre line passes through the center of a hole.

Step 5. Each feature should be dimensioned once only on a drawing.

Step 6 - Dimensions should be placed on the view or section that relates most clearly to the corresponding features.

Step 7 - Each drawing should use the same unit for all dimensions, but without showing the unit symbol.

Step 8 - No more dimensions than are necessary to define a part should be shown on a drawing.

Step 9 – Complete dimensioning

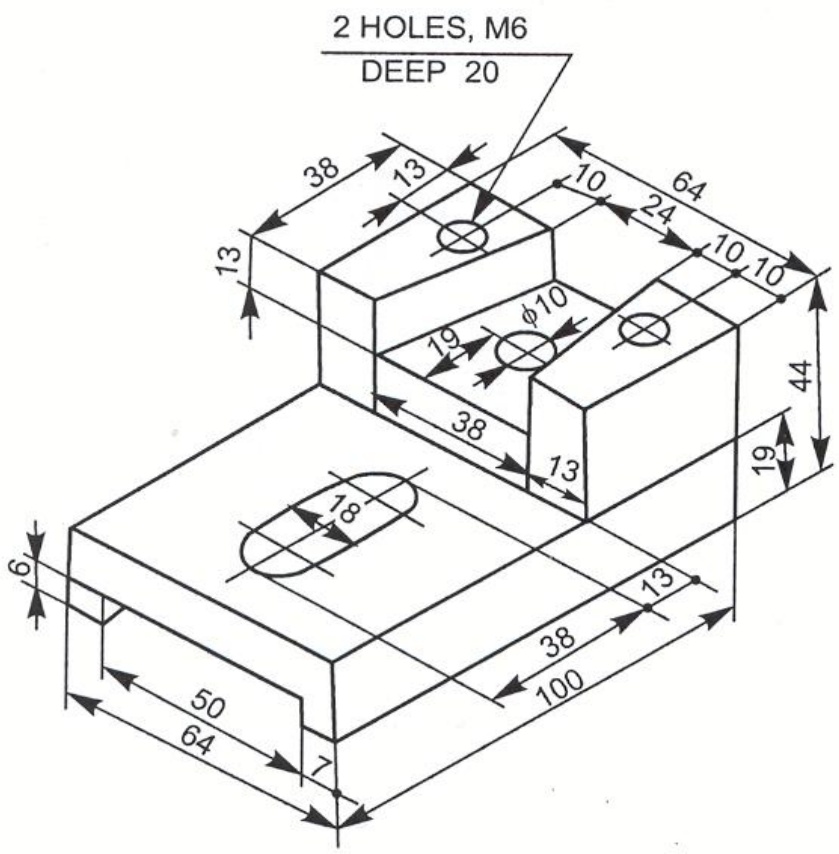
LAP Test -5.1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary operation sheet and computer with requaried software you are required to perform the following tasks within 4 hours.

1. Redraw the isometric drawing, the orthographic views and the complete dimensioning of the following object.



Unit six: Complete CAD operations
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • drawing elements. • Print and evaluate drawing elements This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Saving and filing drawing elements. • Printing and evaluating drawing elements

6: Complete CAD operations

6.1 File Drawing Elements.

6.1.1. Introduction

A complete, independent, and documented physical and functional inspection process to verify that prescribed production methods have produced an acceptable item as specified by engineering drawings, planning, purchase order, engineering specifications, and/or other applicable design documents

Three main sets of production drawings include the following:

Detail of each non-standard part on a drawing sheet, usually one part per sheet

Assembly drawing showing all parts on one sheet

A Bill of materials (BOM), essentially of each part

The basic elements of production drawings include:

Size and shape of component

Format of drawing sheet

Process sheet

Projection method

Limits, fits, and tolerances of size, form, and position

Production method

Indication of surface roughness and other heat treatments

Material specification and Shape such as Castings, Forgings, Plates, Rounds, etc.

Conventions used to represent certain machine components

Inspection and Testing Methods

Specification of Standard Components

- **Blueprinting**

In many ways, learning to read a drawing is the same as learning to read a language. Blueprint is the common name of the copies taken from an original drawing, usually drawn on a tracing paper. The copies may be obtained by way of reprographic processes, *viz*., blueprinting, ammonia printing, xerox copying, copy of a photo film, etc., but the colour of the print has nothing to do with the name “blueprint”.

For blueprint reading and understanding the drawing, one must have a thorough knowledge of the principles of drawing and orthographic projections. The knowledge of various manufacturing processes and the sequence of operations required to obtain the finished shape, intended by the designer, also helps in interpreting the drawings.

In this module, the examples chosen help providing guidelines to enable students to understand the shape and size of a component, in the case of component drawings, and also its location, in the case of assembly drawings. While reading the drawings, the details such as shape, size, through dimensions, notes and material to be used, and additional notes to the workman on machining, surface finish, tolerances, etc., are to be noted carefully.

6.2. Print and evaluate drawing elements

6.2.1. Part and copy issuing drawing

Files management is the process of determining how files will be

- ✓ Arranged,
- ✓ Categorized,
- ✓ Accessed, and
- ✓ Stored, whether in paper or electronic format.

Having good filing practices ensures that the right file can be retrieved quickly at the right time for the lowest possible cost.

Users of the system should be part of the planning process and trained on policies and procedures when the system is implemented.

Create a policy and procedure manual to distribute to staff members for easy reference.

- **Paper Filing Practices**

The most common methods of arranging documents are

- ✓ Alphabetical
- ✓ , numerical, or alphanumeric.

The file arrangement should be based on how the information will be retrieved.

- **Alphabetical Filing**

There are two types of alphabetical filing.

1) **Topical** filing arranges files in straight alphabetical order, such as subject correspondence arranged from A to Z, based on the name of the subject.

2) **Classified** filing arranges related documents under a major subheading, such as customer complaint correspondence filed under the general heading of customer relations.

- **Advantages of alphabetical filing include:**

✓ Avoiding the use of an index
✓ effective filing if adhered to
✓ ease of browsing through files

- **Disadvantages of alphabetical filing are:**

✓ the increased risk of misfiling versus numeric systems
✓ retrieval problems arising over name changes
✓ may be inefficient and cumbersome in large systems
✓ ease with which unauthorized persons can find records

- **Numerical Filing**

✓ by file number,
✓ by Social Security number,
✓ by date, or
✓ By patient or case number is common.

- **Advantages of numerical filing include:**

quicker comprehension of numerical sequences over alphabetical
ability to add new files without disturbing existing arrangement
easy identification of misfiled or out-of-sequence numbers

- **Disadvantages of numerical filing are:**

necessity of an index since it is an indirect arrangement
possibility of numbers being transposed when files are created

- **Alphanumeric Filing**

✓ An alphanumeric arrangement uses a combination of numeric digits and alphabets to create a flexible filing system.
✓ An index is required to use the system effectively.
✓ Subjects may be substituted by using alphabetical or numerical codes, such as
✓ ADM-001 (Administrative files, Director's Correspondence) and
✓ ADM-002 (Administrative files, Assistant Director's correspondence).

- **Advantages of alphanumerical filing include:**

eliminating the need for long titles through use of codes increased file security because users must understand the coding system

- **Disadvantages of alphanumerical filing include:**

the necessity of consulting an index in order to access the filesthe need to train users on the index

- **Indexes**

✓ An index is a listing used to determine file location.

✓ Alphanumeric systems require and numeric could require an index, but alphabetical does not.

✓ Most indexes have a heading and the subheading listed alphabetically.

✓ The heading is the main class or title of records and the subheading lists records that are derived or related to the main heading.

- **Disposal**

✓ A key part of filing-system maintenance involves controlling the growth of the system.

✓ Records should be reviewed regularly to purge and dispose of records that have expired based on Records Retention & Disposition Schedules.

✓ Documents containing confidential, personally identifying, or private information should be confidentially destroyed.

✓ A Certificate of Records Destruction must be submitted to the Archival and Records Management Services Division after records have been destroyed.

- **Audits**

✓ Regardless of the type used, filing systems should be audited periodically and updated as necessary to accommodate any changes in the records or needs of the users.

✓ Another aspect of the audit is determining if Records Retention & Disposition Schedules are being applied

Review retention schedules and compare with destruction certificates to see if records are being promptly destroyed when eligible.

Self-Check -6.1	Written Test

Directions: Answer all the questions listed below.

1. The most common methods of arranging documents are

   A, Alphabetical B, Numerical C, Alphanumeric D, All of the above

2. Types of alphabetical filing

   A, Topical filing

   B, Classified filing arranges related documents under a major subheading

   C, Filling based on a number

   D, A & B

   E, A & C

3. Advantages of numerical filing include

   A, quicker comprehension of numerical sequences over alphabetical

   B, ability to add new files without disturbing existing arrangement

   C, easy identification of misfiled or out-of-sequence numbers

   D, All of the above

4. Files management is the process of determining how files will be

   A. Arranged,

   B. Categorized,

   C. Accessed, and

   D. Stored, whether in paper or electronic format.

   E. All of the above

Directions: II. Write true or false

5. **Topical** filing arranges files in straight alphabetical order,

6. An index is a listing used to determine file location

Directions: III. Write down the correct answer

7. Write the advantages of alphabetical filing

   A.----------

   B.----------

   C.----------

List of Reference Materials

- ***E.,Technical Drawing,1958,4 thed.,The Macmillan Company***
- ***David L.Goetsch et al, Technical drawing,1994,3rd ed., Delmar Publishers Inc.***
- ***A text book of engineering drawing, B.Gupta. NasakaPashakar publisher***
- ***V.B. Sikka ,A course in civil engineering drawing ,1998,4 th ed.***
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