Surigao City Campus

Bachelor of Science in Electrical Engineering

SURIGAO STATE COLLEGE OF TECHNOLOGY

SSCT

"For Nation's Greater Heights"

I.8.17. multi-media/ courseware/ teachware;

Republic of the Philippines
SURIGAO STATE COLLEGE OF TECHNOLOGY
Narciso Street, Surigao City

Computer Aided Drafting

Courseware

TOPIC	Introduction to CAD Software

TIME FRAME: **7 hours**

INTRODUCTION:

In computer graphics we are generally concerned with images drawn on display screens. (Hard copies can then be made of these images if needed, using various types of plotting device.) There are several ways in which these images can be constructed and different types of display device use a range of imaging techniques to achieve acceptable visual representations.

In modem industry, the computer supports all the design and manufacturing functions. The concept of a common database has effectively integrated these engineering functions and requires the engineer to be aware of the ramifications of changes anywhere in the design and manufacturing process.

The link between the area of drawing and design and analysis is very strong. Computer aided design and drawing systems provide the means to generate 3D models with the computer and from those models generate drawings for manufacturing. Computer aided drawing is a technique to produce engineering drawings with the assistance of a computer.

OBJECTIVES/ INTENDED LEARNING OUTCOMES:

In this lesson, learners will be able to:

1. Define Computer-Aided Design;
2. explain the importance and the significance of CAD software in the professional development;
3. express the various advantages of CAD in the design versus conventional/manual drafting;
4. state the different types of CAD version and its complexes; and
5. test the CAD software in the computer

PRE-TEST:

I. Explanation

1. What is Computer-Aided Design (CAD)?

2. What are some of the different types of computer hardware platforms used for running CAD soft- ware? During what periods in history were each of these platforms in common usage?

II. Identification.

1. It is defines as the technology concerned with the use of computer systems to plan, manage, and control manufacturing operations.
2. This involves the creation of hard copy engineering drawings directly from CAD data base.
3. This is concerned with the computer compatible mathematical description of the geometry of an object
4. This is an interpreter or translator which allows the user to perform specific type of application or job related to CAD
5. This is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences

III. True or False. Write T is the statement is correct and write F if the statement is incorrect.

1. The use of CAD process provides enhanced graphics capabilities which allows any designer to conceptualize his ideas and modify the design very easily
2. The use of a CAD system provides better engineering drawings, more standardization in the drawing, perfect documentation of the design, no drawing errors and legibility.
3. Technical drawings remain an essential part of the construction industry and manufacturing industry regardless of product type.
4. The CAD software provides great tools for design professions that will help in carrying out design and analysis of a proposed design.

DISCUSSION/ LEARNING ACTIVITIES:

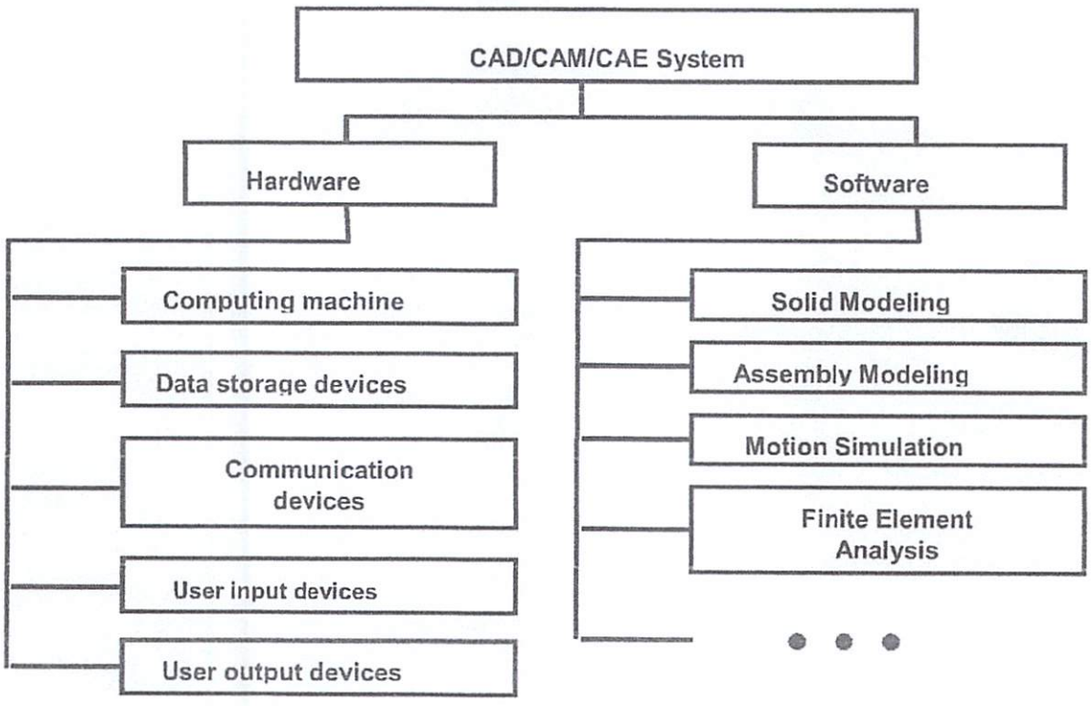
What is Computer-Aided Design (CAD)?

Computer Aided Drafting is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences. In the fields of mechanical or aeronautical engineering, the drawings of machine components and the layouts of them are prepared. In the field of civil engineering, plans and layouts of the buildings are prepared. In the field of electrical engineering, the layouts of power distribution system are prepared. In all fields of engineering use of computer is made for drawing and drafting.

Other definitions:

- Computer-Aided Design (CAD) is the technology concerned with the use of computer systems to assist in the creation, modification, analysis, and optimization of a design. [Groover and Zimmers, 1984]
- Computer-Aided Manufacturing (CAM) is the technology concerned with the use of computer systems to plan, manage, and control manufacturing operations.
- Computer-Aided Engineering (CAE) is the technology concerned with the use of computer systems to analyze CAD geometry, allowing the designer to simulate and study how the product will behave.

Components of CAD SYSTEMS



CAD system and Hardware

Computers are being used at an increasing rate for both engineering design and drawing purposes. There are many CAD systems on the market which are being continually developed and refined. There are three main types of computer: (a) the mainframe computer; (b) the minicomputer;(c) the microcomputer.

The workstation, which is similar in appearance to a personal computer, is generally of higher performance and typically four to five times more expensive. Computer-aided engineering software available for workstation platforms is normally capable of carrying out the more demanding numerical analysis required of sophisticated design systems with acceptable performance in speed. A mainframe computer system is capable of supporting the functional demands of complex software packages, and for CADD systems these are accessed and presented to the user via a graphics terminal. The mainframe performs the relevant mathematical modelling and sends the results in graphical form to the terminal, which has some computing power to interpret the data received, manipulate it and display it in graphical form.

Input Devices

The *input devices* are used for making selections from a *menu*, which is a layout of a variety of commands and functions required to operate the system. Sending these commands into the computer produces complete engineering drawings.

The choice of optional commands on the screen menu is made by indicating the required position with the cursor cross-hairs or by typing a required code. The movement of the cursor on the screen may be controlled by the following devices as shown in Figure 1.3:

(a) a *keyboard,* where the allocated keys control the required movements,
(b) *thumb wheels,* where one wheel controls horizontal movement and another wheel controls vertical movement.
(c) a *light pen,* where the required position is selected by pointing the pen directly at the scree n;
(d) a *joystick,* a vertical lever mounted in a box controls movements in any direction;
(e) a *mouse, a* small box which when pushed across a surface controls movements in the same direction;
(f) a *tracker ball,* its rolling in the mounting controls movements in any direction;
(g) a *puck* or (h) *stylus* in conjunction with the digitising tablet, can enter the complete drawing from a sketch or half-completed drawing by attaching it to the surface of the digitiser and indicating the important points on lines, curves, etc., and entering the relevant commands.

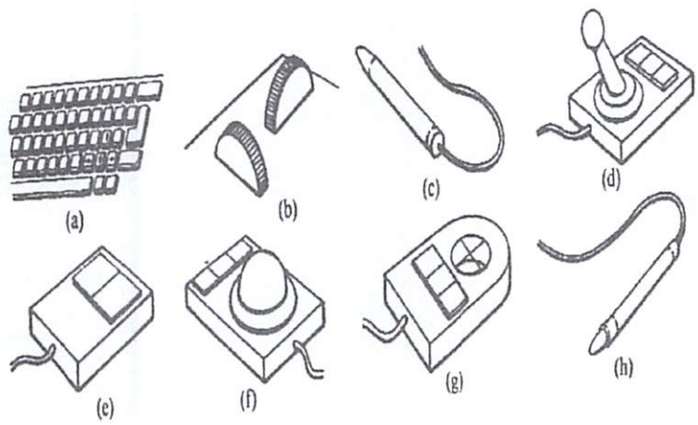


Figure 1. Input devices

Output Devices

The output devices receive data from the computer and provide an output, hard copy. There are two main types of output devices, namely printers and plotters. The printers may be impact, where images are formed by a striking action or non-impact:

(a) *impact printers* for drawing reproduction are of the *dot matrix* type and form shapes by the appropriate selection of small dots from the printhead;

(b) *non-impact printers* include electrostatic, ink-jet and laser printers, viz.:

i) *electrostatic printers* create shapes by burning away a thin metallic coating on the special printing paper;

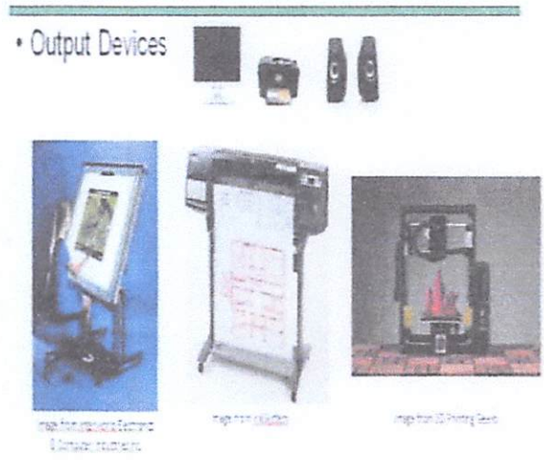
ii) the *ink-jet printers* use a printhead which directs a jet of ink at the paper to create the required shapes;

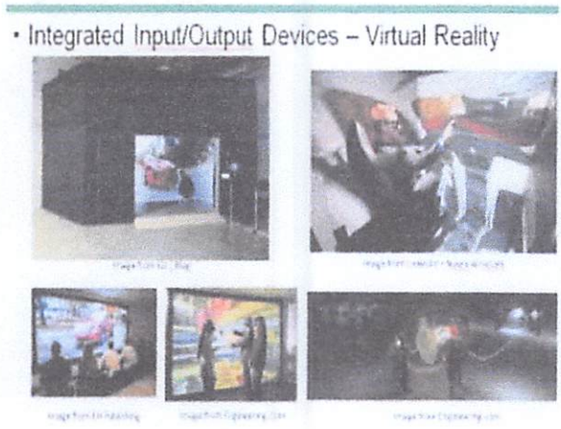
iii) the *laser printers* use a fine beam of laser light to create the required shapes.

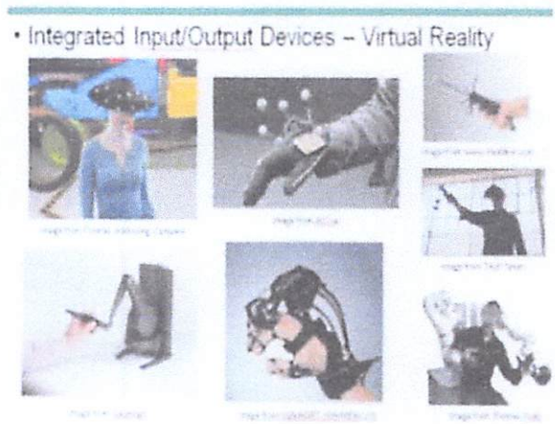
There are two basic types of plotter, i.e. flatbed and drum:

(a) *flatbed plotters* have a flat area on which the paper of any type and thickness is placed and the pens of various thicknesses and ink colours are free to move in any direction with plothead providing all the motion;

(b) *drum plotters* have a rotating drum over which the paper can move in two directions and pens are limited to move only across the drum and, with a combination of pen movement and drum rotation, provides the required motion. Drawings of longer length but sometimes of lower precision are produced when compared with flatbed plotters.







The use of CAD process provides enhanced graphics capabilities which allows any designer to

- Conceptualize his ideas
- Modify the design very easily
- Perform animation
- Make design calculations
- Use colors, fonts and other aesthetic features.

REASONS FOR IMPLEMENTING A CAD SYSTEM

1. **Increases the productivity of the designer.**

- CAD improves the productivity of the designer to visualize the product and its component, parts and reduces the time required in synthesizing, analyzing and documenting the design

2. **Improves the quality of the design.**

- CAD system improves the quality of the design. A CAD system permits a more detailed engineering analysis and a larger number of design alternatives can be investigated. The design errors are also reduced because of the greater accuracy provided by the system

3. **Improves communication-**

- It improves the communication in design. The use of a CAD system provides better engineering drawings, more standardization in the drawing, better documentation of the design, few drawing errors and legibility.

4. **Create data base for manufacturing**

- In the process of creating the documentation for these products, much of the required data base to manufacture the products is also created.

5. **Improves the efficiency of the design.**

- It improves the efficiency of the design process and the wastage at the design stage can be reduced.

APPLICATION OF CAD:

There are various processes which can be performed by use of computer in the drafting process.

1. **Automated drafting**: This involves the creation of hard copy engineering drawings directly from CAD data base. Drafting also includes features like automatic dimensioning, generation of cross – hatched areas, scaling of the drawing and the

capability to develop sectional views and enlarged views in detail. It has ability to perform transformations of images and prepare 3D drawings like isometric views, perspective views etc.,

2. **Geometric modeling**: concerned with the computer compatible mathematical description of the geometry of an object. The mathematical description allows the image of an object to be displayed and manipulated on a graphics terminal through signals from the CPU of the CAD system. The software that provides geometric modeling capabilities must be designed for efficient use both by computer and the human designer.

BENEFITS OF CAD:

The implementation of the CAD system provides variety of benefits to the industries in design and production as given below:

1. Improved productivity in drafiting
2. Shorter preparation time for drawing
3. Reduced man power requirement

4. Customer modifications in drawing are easier
5. More efficient operation in drafting
6. Low wastage in drafting
7. Minimized transcription errors in drawing
8. Improved accuracy of drawing
9. Assistance in preparation of documentation
10. Better designs can be evolved
11. Revisions are possible
12. Colours can be used to customize the product
13. Production of orthographic projections with dimensions and tolerances
14. Hatching of all sections with different filling patterns
15. Preparation of assembly or sub assembly drawings
16. Preparation of part list
17. Machining and tolerance symbols at the required surfaces
18. Hydraulic and pneumatic circuit diagrams with symbols
19. Printing can be done to any scale

LIMITATIONS OF CAD

1. 32 – bit word computer is necessary because of large amount of computer memory and time
2. The size of the software package is large
3. Skill and judgment are required to prepare the drawing
4. Huge investment

CAD SOFTWARES

The software is an interpreter or translator which allows the user to perform specific type of application or job related to CAD. The following softwares are available for drafting.

1. AUTOCAD
2. Pro – E
3. CATIA
4. MS OFFICE
5. PAINT
6. ANSYS
7. MSc.NASTRAN
8. IDEAS
9. SOLID WORKS
10. HYPERMESH
11. FLUENT – GAMBIT

The above software is used depending upon their application.

AUTO CAD

Auto CAD package is suitable for accurate and perfect drawings of engineering designs. The drawing of machine parts, isometric views and assembly drawings are possible in AutoCAD. The package is suitable for 2D and 3D drawings.

5 Advantages of Manual Drafting and CAD Drafting

In our olden days, engineers, designers and draftsmen were struggling to produce and submit engineering drawings in their scheduled times. It was mainly due to tremendous efforts they had taken to produce both new drawings or edited/updated drawings. Every lines, shapes, measurements, scaling of the drawings - all made them headache to the design / drafting field. All these difficulties and pressures over-ridden by Computer Aided Design Drafting (CAD Drafting) technology.

Technical drawings remain an essential part of the construction industry and manufacturing industry regardless of product type. The technology may have changed, but the techniques and the principles are essentially the same. Even with the advent of modern Computer Aided Design (CAD) Drafting and the prevalence of digitization tools in design and drafting, students and professionals alike see the significance of learning technical drawing skills by hand. There are both advantages and disadvantages in both manual drafting and CAD drafting. Earlier the only source for draftsmen was pencil, stencil and paper for drawing sketches. The CAD Drafting has many advantages over manual drafting because of the tools and automation the software offers.

Many times articulating your ideas might not be just enough, thus getting that idea designed with CADcan give a full picture of your concept. The traditional method of manual drafting is iterative and time consuming. After the advent of CAD, there has been a paradigm shift from traditional manual drafting to Computer Aided Design and Drafting. The clarity that can be achieved is easier to convey with the traditional drafting rather than the CAD drawing techniques. Manual drawings are necessarily created on paper, but the CAD drawings are environmental friendly and can be stored and used electronically without using paper. CAD Drafting has been a real breakthrough in the Architectural Engineering Construction industry by becoming the primary source of communicating design intent

Five major advantages of manual drafting:

1. **Work Done is Original**: In the past, drafters sat at drawing boards and used pencils, pens, compasses, protractors, triangles, and other drafting devices to prepare a drawing by hand. When doing manual drafting, most of the drafting work is done by technical people like the architect / engineer / diploma holders making their work to be genuine. The ability to bring creative style and expression to drawings is higher in manual drafting.
2. **Low Cost of Drawing Equipment:** In manual drafting, all you need is a drafting table or a drawing board, pencil/eraser, a straightedge, a t-square, triangles, French curves, a mini-drafter, and a compass. A drawing board, mini-drafter and pencils/eraser are much cheaper than a CAD package.
3. **No high-tech and Cutting Edge Technology Required:** Like in the CAD system, you do not need state of the art technology, systems engineer(s), IT engineer and expensive air conditions and AC technicians to maintain a pencil and paper. Whereas you have to have systems engineers, IT Engineers and AC technicians to keep the CAD system running.
4. **No Training Required:** Apart from the training that we get when we study, there is no need for the designers to be taught the CAD package being used. The Architects and Engineers would draw their sketches and later developed by assistants who are diploma holders or architectural and engineering draughtsmen in their respective trades. Even in the modern days Engineering, Architectural and Design majors are taught manual drafting techniques alongside digital software at most colleges.
5. **No Yearly Subscriptions:** Unlike the CAD systems, there are no software update costs or operator training. With the CAD systems, you would need yearly subscriptions for the CAD software, operating systems and other supporting software applications. Sometimes with yearly updates, the CAD operators would need additional training on the updated CAD software.

Five major advantages of CAD drafting:

1. **Better Quality Designs:** The CAD software provides great tools for design professions that will help in carrying out design and analysis of a proposed design. These tools also help in producing designs with high accuracy like in **Shop Drawings** and the scope for errors is much lower when compared to hand drawing. The higher accuracy will lead to better designs and these better designs helps in manufacturing faster. Manual design not only takes more time but the errors caused will delay the process in overall.
2. **Easy Saving and Sharing:** All the designs and drawings created with the help of CAD can be easily saved and preserved for future use and reference. These saved drawings can also be edited and printed whenever required. Some components from the drawing can also be standardized for future uses. Unlike the manual drafting, the CAD drawings require less space and can be stored in hard drive, USB pen drive or cloud and can be shared easily.
3. **Modify and Reproduce Faster:** Creating a digital blueprint with CAD has several advantages when compared to creating a traditional blueprint. Modifying the CAD geometry is easy with all the tools

available. Correcting any errors is much quicker when compared to using a pencil and paper. Earlier the draughtsmen used to take days to complete a drawing by manual drafting, and reproducing the drawing meant recreating the drawing from the scratch. But, in case of the CAD drafting, you can reproduce the drawing in no time and make as many copies as you want.

4. **Ability to Create 3D CAD Models:** CAD has the capability to transform an idea into a visible sketch in a matter of few minutes. With a rough draft, one can create something with the CAD software. Creating 3D CAD models manually is a very difficult and tiresome job. 3D CAD packages have many more powerful features for creating the 3D models easily. CAD models are logically connected, or in other words you cannot create a CAD model which is not possible practically. **Building Information Modeling** is the latest in CAD technology that helps in management of digital representations of physical and functional characteristics of a building.
5. **Template and Database Creation:** You can create any number of CAD templates with basic details that can be used and reused any number of times. These templates can save time by providing basic information. The CAD files can be used to create a database as well. Once created, the CAD templates and CAD database can be accessed through a wide area network. The drawings created by manual drafting can only be stored locally.

Computer Aided Design (CAD) drafting, and more recently, building information modeling (BIM) have changed the drafting techniques, in particular allowing modifications to be made with relative ease. Many companies and institutions will have scanned their hand drawn copies into computers and digitized these, and the original drawings will be kept in a locked drawing cabinet in an archive room that is secure.

HISTORY OF AUTOCAD

During 1980's the CAD (Computer Aided Drafting) software only runs on a mainframe computers or, minicomputers, in which each user's unit is connected to a graphic computer terminals.

December 1982 Autodesk, Inc. the largest design automation company in the world released the AutoCAD software. In the same year John Walker, Autodesk founder released Autodesk's Flagship named AutoCAD. March 1986 AutoCAD became the most ubiquitous microcomputer design program in the world, utilizing the functions of polylines and curve fitting. As of 1994 there had been 750 training centers established across the world for AutoCAD course. Below are the AutoCAD timeline by http://autodesk.blogs.com/between_the_lines/ACAD_R1.html:

- ✓ AutoCAD 1.0 December 1982 (Release 1)
- ✓ AutoCAD 1.2 (2) April 1983 (Release 2)
- ✓ AutoCAD 1.3 (3) August 1983 (Release 3)
- ✓ AutoCAD 1.4 (4) October 1983 (Release 4)
- ✓ AutoCAD 2.0 (5) October 1984 (Release 5)
- ✓ AutoCAD 2.1 (6) May 1985 (Release 6)
- ✓ AutoCAD 2.5 (7) June 1986 (Release 7)
- ✓ AutoCAD 2.6 (8) April 1987 (Release 8)
- ✓ AutoCAD R9 September 1987 codename White Album (Release 9)
- ✓ AutoCAD R10 October 1988 (Release 10)
- ✓ AutoCAD R11 October 1990 (Release 11)
- ✓ AutoCAD R12 June 1992 (Release 12)
- ✓ AutoCAD R13 November 1994 (Release 13)
- ✓ AutoCAD R14 February 1997 codename Sedona and Plnetop for 14.01 (Release 14)
- ✓ AutoCAD 2000 (15) March 1999 codename Tahoe (Release 15)
- ✓ AutoCAD 2000i (16) July 2000 codename Banff (Release 16)
- ✓ AutoCAD 2002 (17) June 2001 codename Kirkland (Release 17)
- ✓ AutoCAD 2004 (18) March 2003 codename Reddeer (Release 18)
- ✓ AutoCAD 2005 (19) March 2004 codename Neo (Release 19)
- ✓ AutoCAD 2006 (20) March 2005 codename Rio (Release 20)
- ✓ AutoCAD 2007 (21) March 2006 codename Postrio (Release 21)

- ✓ AutoCAD 2008 (22) March 2007 codename Spago (Release 22)
- ✓ AutoCAD 2009 (23) March 2008 codename Raptor (Release 23)
- ✓ AutoCAD 2010 (24) March 2009 codename Gator (Release 24)
- ✓ AutoCAD 2011 (25) March 2010 codename Hammer (Release 25)
- ✓ AutoCAD 2012 March 2011 codename Ironman (Release 26)
- ✓ AutoCAD 2013 March 2012 codename Jaws (Release 27)

Development and improvement of this software never stop until this present time and there are many other manufacturer of this software application such as Microsoft AutoCAD, MicroCAD, ZWCAD, etc.

Table 1. System Requirements

AutoCAD 2013	• Microsoft Windows 7 or XP SP 23
	• Processor
	  ○ 32-bit XP: Pentium 4 or AMD Athlon Dual Core, 1.6 GHz or greater with SSE2 technology
	  ○ 32-bit Vista or 7: Pentium 4 or AMD Athlon Dual Core, 3.0 GHz or greater with SSE2 technology
	  ○ 64-bit: Athlon 64 or Opteron with SSE2 technology or Xeon or Pentium 4 with EM64T support and SSE2 technology
	• 2 GB RAM
	• Disk space: 6.0 GB
	• 1024 x 768 display resolution with true color
	• Microsoft Internet Explorer 7.0 or later

AutoCAD 2012	• Microsoft Windows 7, Vista SP2 or XP SP 23
	• Processor
	  ○ 32-bit XP: Pentium 4 or AMD Athlon Dual Core, 1.6 GHz or greater with SSE2 technology
	  ○ 32-bit Vista or 7: Pentium 4 or AMD Athlon Dual Core, 3.0 GHz or greater with SSE2 technology
	  ○ 64-bit: Athlon 64 or Opteron with SSE2 technology or Xeon or Pentium 4 with EM64T support and SSE2 technology
	• 2 GB RAM
	• Disk space
	  ○ 32-bit: 2.0 GB
	  ○ 64-bit: 2.0 GB
	• 1024 x 768 display resolution with true color
	• Microsoft Internet Explorer 7.0 or later

AutoCAD 2011	• Microsoft Windows 7, Vista SP1 or XP SP 2
	• Processor
	  ○ 32-bit XP: Pentium 4 or AMD Athlon Dual Core, 1.6 GHz or greater with SSE2 technology
	  ○ 32-bit Vista or 7: Pentium 4 or AMD Athlon Dual Core, 3.0 GHz or greater with SSE2 technology
	  ○ 64-bit: Athlon 64 or Opteron with SSE2 technology or Xeon or Pentium 4 with EM64T support and SSE2 technology
	• 2 GB RAM
	• Disk space
	  ○ 32-bit: 1.8 GB
	  ○ 64-bit: 2.0 GB
	• 1024 x 768 display resolution with true color
	• Microsoft Internet Explorer 7.0 or later

AutoCAD 2010	• Microsoft Windows Vista SP1 or Windows XP SP 2
	• Processor
	  ○ 32-bit XP: Pentium 4 or AMD Athlon Dual Core, 1.6 GHz or greater with SSE2 technology
	  ○ 32-bit Vista: Pentium 4 or AMD Athlon Dual Core, 3.0 GHz or greater with SSE2 technology
	  ○ 64-bit: Athlon 64 or Opteron with SSE2 technology or Xeon or Pentium 4 with EM64T support and SSE2 technology
	• 2 GB RAM
	• Disk space
	  ○ 32-bit: 1 GB
	  ○ 64-bit: 1.5 GB
	• 1024 x 768 VGA with true color
	• Microsoft Internet Explorer 7.0 or later

AutoCAD 2009	• Microsoft Windows Vista or Windows XP SP 2 • Pentium 4 processor or AMD Athlon, 2.2 GHz or greater or Intel or AMD Dual Core processor, 1.6 GHz or greater • 1 GB RAM (Windows XP), 2 GB RAM (Windows Vista) • 750 MB free disk space • 1024 x 768 VGA with true color • Microsoft Internet Explorer 6.0 (SP1 or later)
AutoCAD 2008	• Microsoft Windows Vista, Windows XP Home and Professional (SP2), or Windows 2000 Professional (SP3) • Microsoft Internet Explorer 6.0 (SP1 or later) • Pentium 4 processor • 512 MB RAM • 750 MB free disk space • 1024 x 768 VGA with true color

Reference: http://www.designmaster.biz/products/AutoCADSystemRequirements.html

EVALUATION:

I. Explanation

Instruction: Answer the following questions briefly but concisely (10 pts. each)

1. Define CAD in your own words (minimum of 6 sentences).

2. Explain the importance and the significance of CAD software in the professional development.

3. Distinguish the differences between CAD and conventional/manual drawing.

4. State the different types of CAD versions and explain it complexes

5. List four different output devices used with CAD.

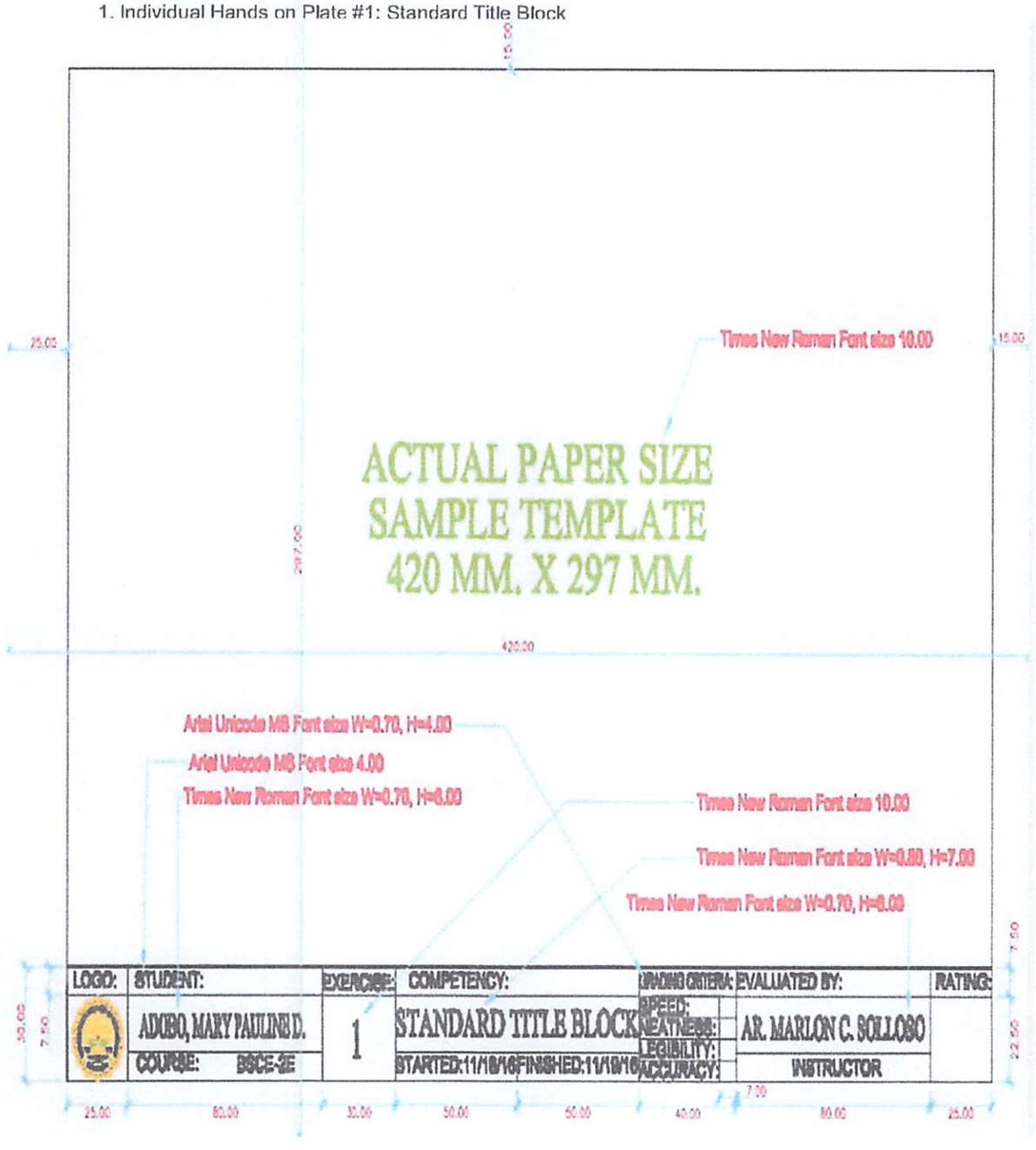
6. Name the primary parts of a CAD system.

7. List three types of storage media for CAD drawings.

8. List three types of input devices used with CAD systems

II. Hands-on Activity: Test the CAD software on the computer

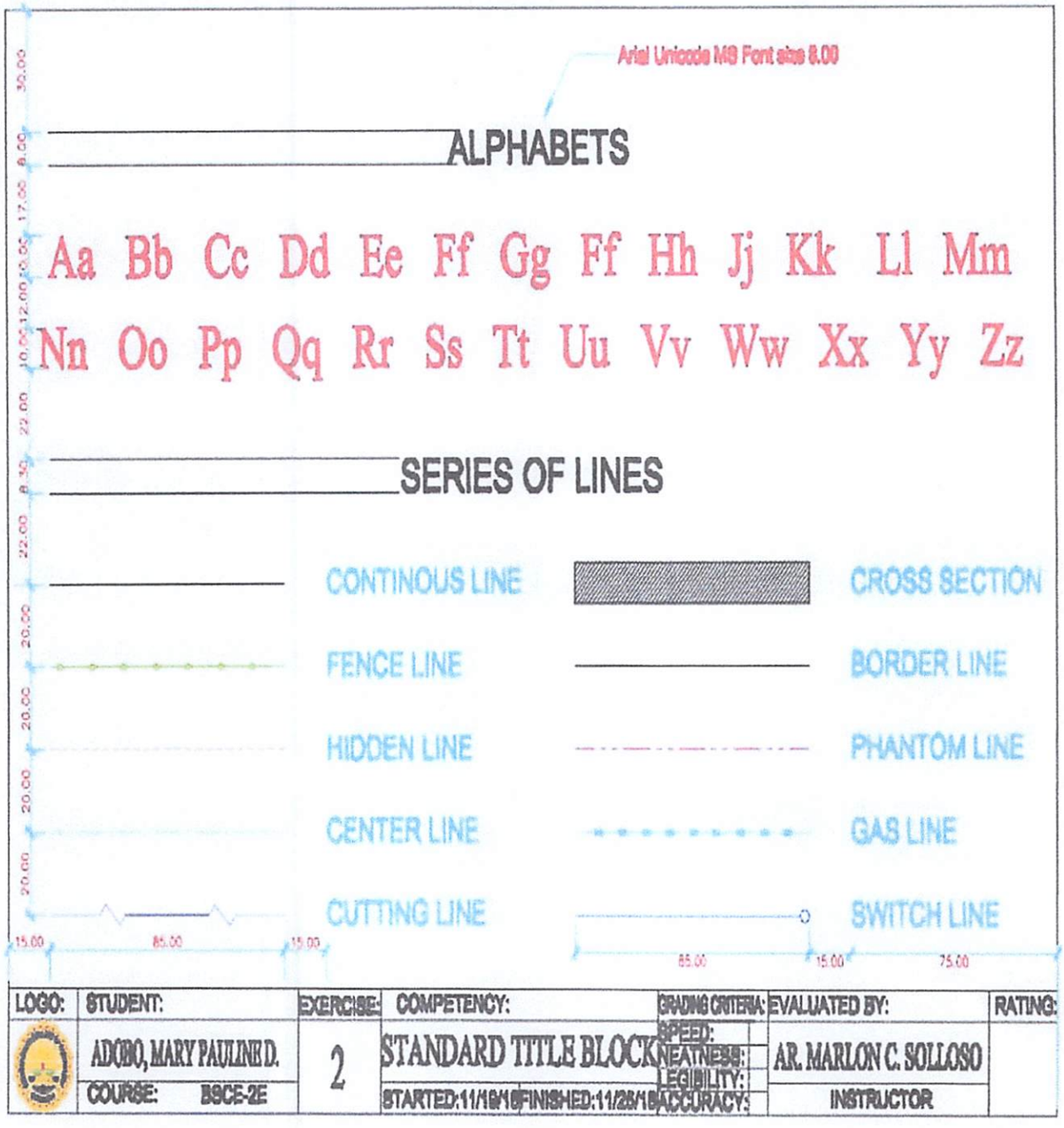
1. Individual Hands on Plate #1: Standard Title Block



Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

2. Individual Hands on Plate #2: Alphabets and Lines



LOGO:	STUDENT:	EXERCISE:	COMPETENCY:	GRADING CRITERIA:	EVALUATED BY:	RATING:
	ADOBO, MARY PAULINE D. COURSE: BSCE-2E	2	STANDARD TITLE BLOCK STARTED:11/18/18 FINISHED:11/25/18	SPEED: NEATNESS: LEGIBILITY: ACCURACY:	AR. MARLON C. SOLLOSO INSTRUCTOR	

Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

REVIEW OF CONCEPTS:

In this topic you learned that:

- CAD is the technology concerned with the use of computer systems to assist in the creation, modification, analysis, and optimization of a design.
- Development and improvement of this software never stop until this present time and there are many other manufacturer of this software application such as Microsoft AutoCAD, MicroCAD, ZWCAD, etc.
- Regardless of the industry, be it architecture, engineering, construction, manufacturing, fashion etc., they use CAD in some form. There are more uses of CAD drafting over manual drafting and that is why CAD is used widely rather than manual drafting. One of the main reasons why professional designers are comfortable with CAD drafting is because of its growing popularity. With various benefits over traditional manual drafting, it's a matter of time for CAD drafting to take over the world of planning and designing.

POST TEST:

I. Explanation

1. What is Computer-Aided Design (CAD)?

II. Identification.

6. It is defines as the technology concerned with the use of computer systems to plan, manage, and control manufacturing operations.
7. This involves the creation of hard copy engineering drawings directly from CAD data base.
8. This is concerned with the computer compatible mathematical description of the geometry of an object
9. This is an interpreter or translator which allows the user to perform specific type of application or job related to CAD
10. This is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences

III. True or False. Write T is the statement is correct and write F if the statement is incorrect.

5. The use of CAD process provides enhanced graphics capabilities which allows any designer to conceptualize his ideas and modify the design very easily
6. The use of a CAD system provides better engineering drawings, more standardization in the drawing, perfect documentation of the design, no drawing errors and legibility.
7. Technical drawings remain an essential part of the construction industry and manufacturing industry regardless of product type.
8. The CAD software provides great tools for design professions that will help in carrying out design and analysis of a proposed design.

REFERENCES:

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https://www.lopol.org/article/advantages-and-disadvantages-of-computer-aided-design-cad-over-manual-drafting

https://cadsourcing.com/how-cad-differs-from-manual-techniques/

http://www.designmaster.biz/products/AutoCADSystemRequirements.html

TOPIC	CAD DRAWING

TIME FRAME: 7 hours

INTRODUCTION:

Designers generally use *drawings* to represent the object which they are designing, and to communicate the design to others. Of course they will also use other forms of representation — symbolic and mathematical models, and perhaps three-dimensional physical models — but the drawing is arguably the most flexible and convenient of the forms of representation available. Drawings are useful above all, obviously, for representing the geometrical *form* of the designed object, and for representing its *appearance.* Hence the importance in computer-aided design (CAD) of the production of visual images by computer, that is computer graphics.

In the process of design, technical drawings are used. Drawings explain the design and also establish the link between design and manufacture. During the stage of design and detailing depend on the designers' skill and experience. Changes in previous designs take a long time because the drawings have to be produced again.

Computer-aided drawing is a technique where engineering drawings are produced with the assistance of a computer and, as with manual drawing, is only the graphical means of representing a design. Computer - aided design, however, is a technique where the attributes of the computer and those of the designer are blended together into a problem-solving team. When the term CAD is used to mean computer-aided design it normally refers to a graphical system where components and assemblies can be modelled in three dimensions. The term design, however, also covers those functions attributed to the areas of modelling and analysis. The acronym CADD is more commonly used nowadays and stands for computer-aided draughting and design; a CADD package is one which is able to provide all draughting facilities and some or all of those required for the design process.

Two-dimensional (2D) computer drawing is the representation of an object in the single-view format which shows two of the three object dimensions or the mutiview format where each view reveals two dimensions. In both cases, the database includes just two values for each represented coordinate of the object. It can also be a pictorial representation if the database contains X, *Y* coordinates only.

OBJECTIVES/ INTENDED LEARNING OUTCOMES:

In this lesson, learners will be able to:

1. Identify the concept of CAD, its environment, terminologies, general operating procedure and command techniques; and
2. compose series of parallel lines and grille design.

PRE-TEST:

I. TRUE OR FALSE. Write T if the statement is correct and write F is the statement is incorrect.

1. CAD systems may be considered as comprising a large number of functions for creating or manipulating the design model.
2. The graphics screen and the text screen are two different screens available in the drawing editor.
3. Controls the size of the cursor. The allowable range is from 1 to 100 percent of the total screen. At 100% the ends of the crosshair are never visible.
4. CAD uses four basic elements for preparation of any drawing: Line, curves, text, and Filling point.
5. Advanced computer aided drafting packages utilize four areas on the screen.

LEARNING CONTENT:

CADD Software Structure

The database for a CADD package contains data defining the two- or three-dimensional geometry of the drawing or design. It can be viewed as a mathematical model which is a precise geometrically accurate representation of the component or assembly. The input to this is the addition to and modification of the model by the designer or draughtsman and includes the addition of geometric and detail entities such as lines, curves, points, notes or dimensions and modification to correct errors and enhance productivity. These additions and modifications should immediately be seen on the graphical display, which is the main interactive output medium of the software and therefore needs to be very effective. In the case of draughting one needs to be able to add a drawn feature with as much or greater ease than one would be able to do on a drawing board.

The User Interface

CAD systems may be considered as comprising a large number of functions for creating or manipulating the design model. For example a function might create a line in the database parallel to another line at a given distance. The general sequence of operation of a CAD program is for the user to select the function to be applied, and the particular way it is to be operated, and then for the program to apply this function using data provided by the user. Traditionally, there are two ways in which this is achieved:

Command-based systems

Command-based systems operate by reading a command and its parameters entered by the user, carrying out the required actions, then waiting for the next command. The commands themselves may often comprise English-like words. The main commands are indicated by the permitted major words, and the options relating to the command by minor words. Many systems also allow commands to be abbreviated, either through the use of an alternative form (for example 'dimension' might be abbreviated by 'dim'), or by allowing the user to type only those characters of the command required for its unique identification . The command is itself sometimes followed by the name of an object on which to carry out the command. The general form of command may thus be summarized as: *command (optional parameters , target object)*

Menu-driven systems

The menu-driven approach contrasts markedly with the command approach. The basic principle is that the user is at any time presented with a list or menu of the functions that are available to be selected. The user selects from the list, and then perhaps from further lists of available sub -functions until the function is specified fully, at which point data is entered, or items selected for the operation. In many systems the menus may be regarded as forming an inverted tree, with the main command groupings at the first level (e.g. in a CAD context, construct, modify, delete, move), and more specific functions at lower levels.

There are a number of rules which should be adopted in designing a user interface the adherence to which should be investigated when choosing a software package for a particular task. The most important of these rules are:

- A clear, well presented screen layout.
- Easy function selection by a well-structured menu system.
- Meaningful function names.
- Meaningful and helpful prompts to the user.
- Easily accessible and clearly written help information.

AutoCAD – BASICS

1. STARTING WITH ACAD

CAD uses four basic elements for preparation of any drawing:

1. Line
2. Curves
3. Text
4. Filling point.

Computer Aided Drafting is done by the operator by placing the mouse pointer by placing the mouse pointer at the desired location and then executing the command to draw the graphic elements using different methods.

Advanced computer aided drafting packages utilize four areas on the screen.

1. Drawing Area
2. Command Area
3. Menu Area
4. Tool boxes.

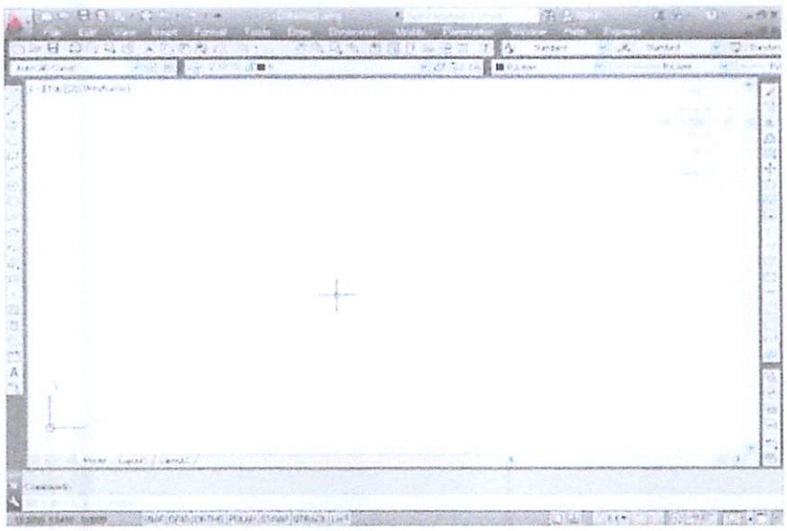


Figure.2. Startup Window

Startup Window

FOUR MAJOR COMPONENTS

1. OPEN a DRAWING
2. START from SCRATCH
3. USE a TEMPLATE
4. USE a WIZARD

Note: Open a drawing is the indication that there is an existing file to be modify, Start from the scratch will gives the user a choice to choose between the metric and imperial measurement system (Imperial is for feet and inches; Metric is for millimeter). The Template will show all the listed .dwt extension; and wizard will help the user to create a based on quick setup or the advanced setup wizard.

POINTERS: Setting this form using the command bar indicates that 0-OFF and 1-ON

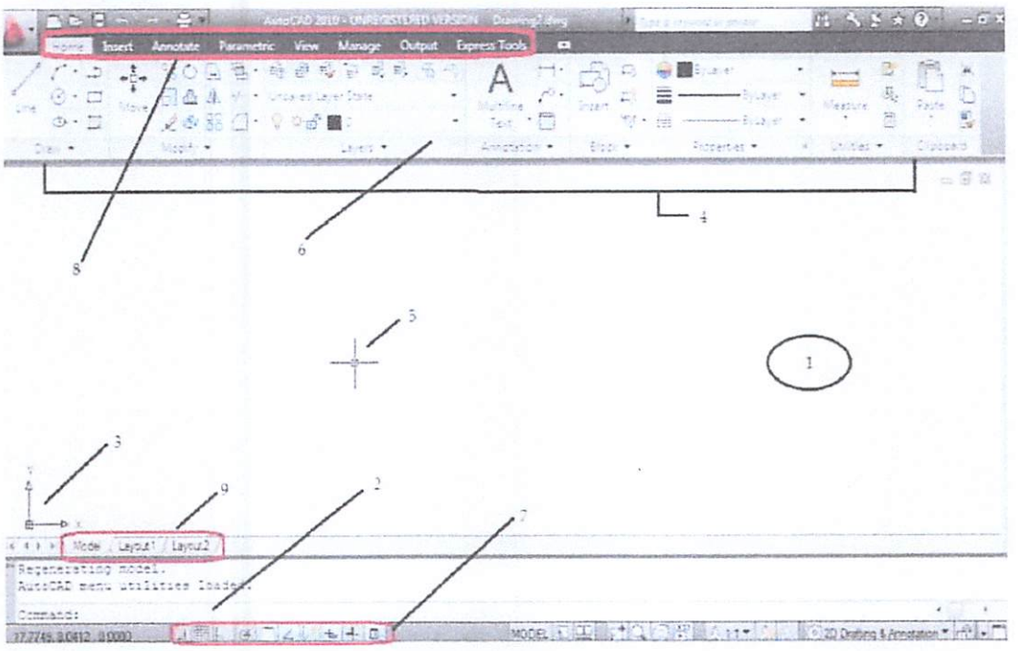


Figure 3. AutoCAD Drawing Editor

Table 1. Parts and Functions

PARTS	FUNCTIONS
1. Drawing area	It is a representation of Drawing 1 Template. This is the part of the AutoCAD software that handles all of the object to be created
2. Command line	It is the part of the AutoCAD software wherein the user can type the command to be executed.
3. UCS icon	It is a basic X-Y-Z (Z Is not visible) axis. In which it could be a Universal Coordinate System or World Coordinate System.
4. Toolbar	It contains all icon tools that can be useful on creating a design.
5. Crosshairs	The crosshairs serve as the pointer on giving a direction for every command specially for the direct distance entry.
6. Ribbon	It is a new way of interacting with AutoCad's commands.
7. Drawing tools/status bar	This is the part of the AutoCAD wherein the user can turn On or Off the tools that could help in creating a certain object.
8.Cascading Drop Down Menus	It is another way to access commands in AutoCad.
9. Model space tab/mode	A layout figure area wherein the user can identify the possible output of the object.

Note: There are other areas of AutoCAD environment that the coordinate system appear and because this is a free scaling system that can also use the annotation tools near the lock and clear screen icon buttons.

AUTOCAD SCREEN

1. **APLLICATION BUTTON** -This button displays commands for printing, saving, drawing utilities and other non-drawing tool.

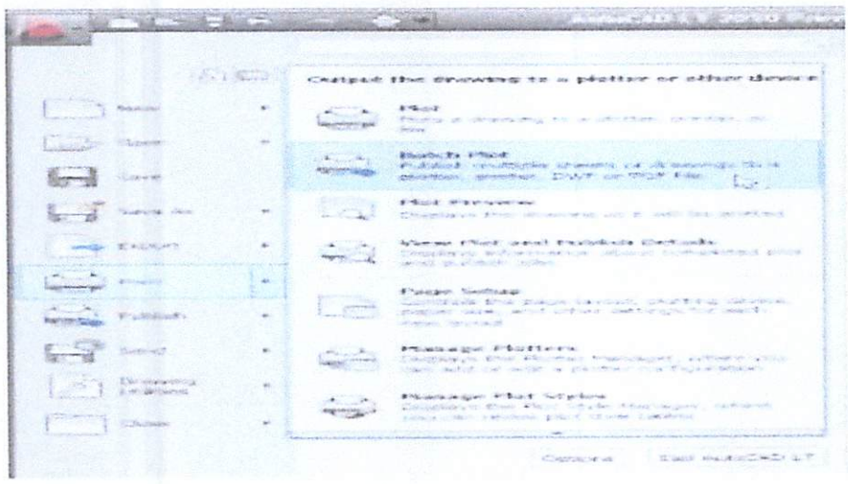


Figure 4. Application Button Window

2. **QUICK ACCESS TOOLBAR**- This is for quick access to common commands like New, Open, Save, Plot.

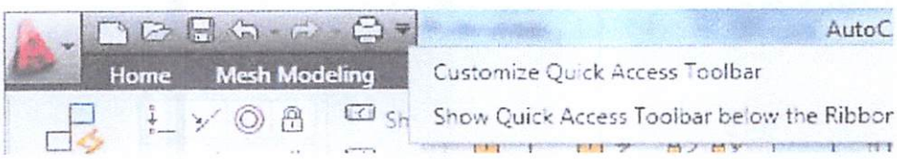


Figure 5. Quick Access Toolbar

3. **RIBBON** - The Ribbon has most of the commands/tools that can be use while working in AutoCAD Environment.

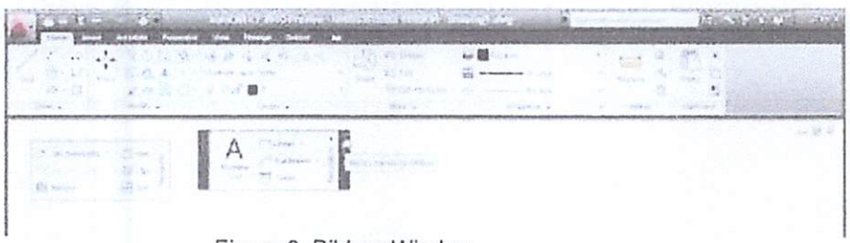


Figure 6. Ribbon Window

- **VERTICAL RIBBON-**Has been updated to show the tab names along the side.

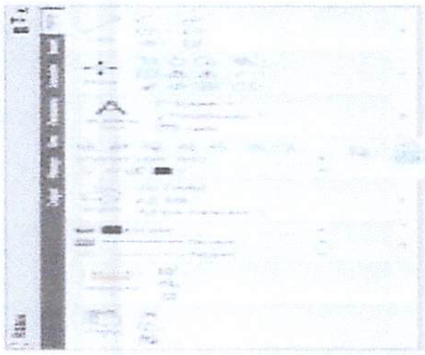


Figure 7. Vertical Ribbon Window

- **DASH BOARD PANELS-**Converted to new ribbon panels.

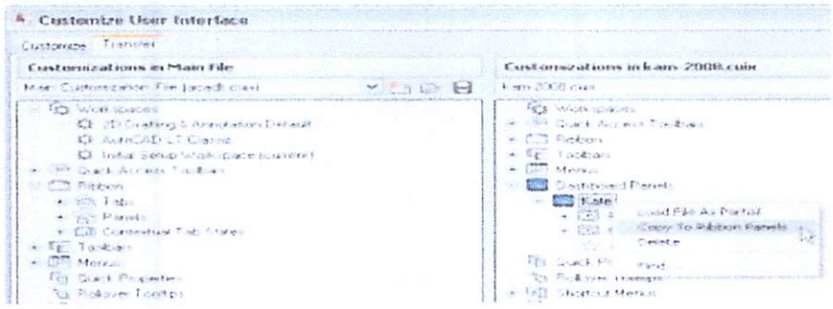


Figure 8. Dash Board Plane Window

- **COLOR SELECTION-** set layer colors and pick from the AutoCAD.

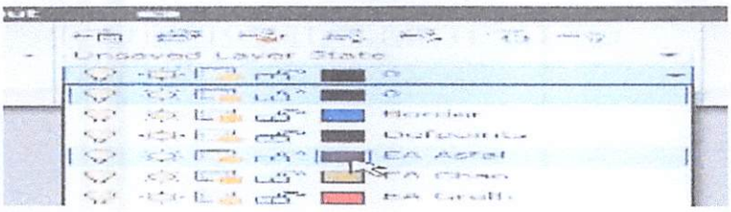


Figure 9. Color Section Window

- **DIMENSION TOOLS-**Command enables to measure the distance, radius, area, or volume of a selected object or a sequence of points.

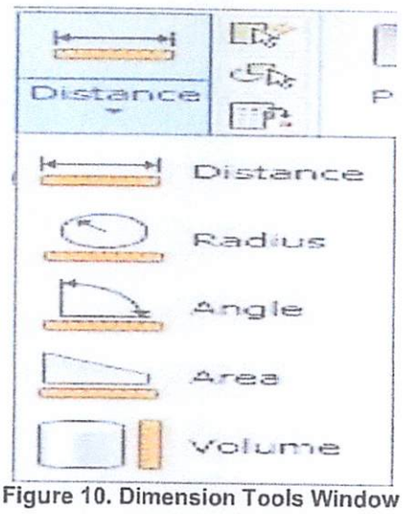


Figure 10. Dimension Tools Window

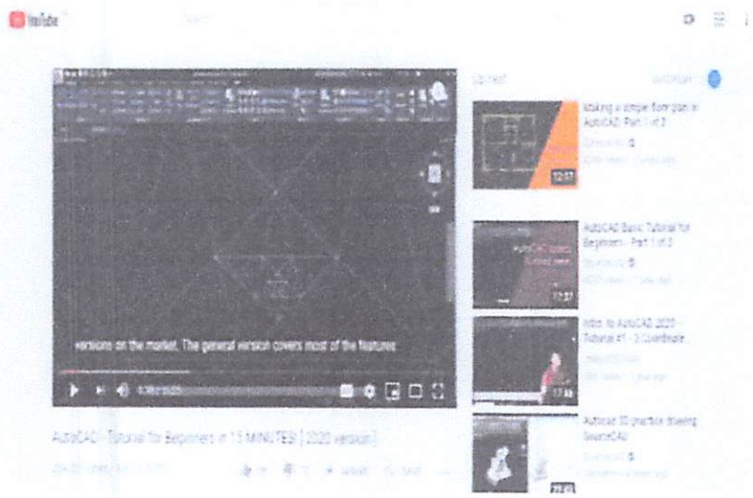
SHORTCUT KEYS

Table 2. Keyboard Function Keys

KEYS	FUNCTION
F1	Online Help
F2	Switch between Graphics Screen to Text Window Screen
F3	Turn ON/OFF Osnap (Object Snap)
F4	Turn ON/OFF Tablet
F5	Change Isometric Planes
F6	Turn ON/OFF Coordinates
F7	Turn ON/OFF Grids
F8	Turn ON/OFF Ortho mode
F9	Turn ON/OFF Snap
F10	Turn ON/OFF Polar Tracking
F11	Turn ON/OFF Osnap Tracking
F12	Turn ON/OFF Dynamic Input
ESC	Terminate the existing command

Table 3. Keyboard Control Keys

CONTROL KEYS	DESCRIPTIONS
CTR+A	Turn ON/OFF Group Selection
CTR+B	Turn ON/OFF Snap
CTR+C	Copy Object to Windows Clip Board
CTR+D	Turn ON/OFF Coordinates
CTR+E	Change Isometric Planes
CTR+F	Turn ON/OFF Osnap
CTR+G	Turn ON/OFF Grids
CTR+J	Execute the last command
CTR+K	Invoke the hyperlink command
CTR+L	Turn ON/OFF Ortho mode
CTR+M	Display DBConnect Manager Dialog Box
CTR+N	Create a new drawing file
CTR+O	Open an existing drawing file
CTR+P	Display the plot dialog box
CTR+Q	Save the content of the Text Window to a Log File
CTR+R	Switch Viewports
CTR+S	Save Current drawing
CTR+T	Turn ON/OFF Tablet
CTR+U	Turn ON/OFF Polar mode
CTR+W	Turn ON/OFF Object Snap Tracking
CTR+X	Cut a clip on a selected object
CTR+Y	Redo
CTR+\-	Cancel current command
CTR+[-	Cancel current command
CTR+1	Turn ON/OFF Property Dialog Box
CTR+2	Turn ON/OFF Design Center Dialog Box
CTR+6	Turn ON/OFF DBConnect Manager Dialog Box
CTR+0	Turn ON/OFF the Ribbon Plane
CTR+9	Turn ON/OFF the Command Line Window



Click this link https://www.youtube.com/watch?v=ONapRVyXn2E to view the video this AutoCAD tutorial video on YouTube.

List of Basic AutoCAD Terminology
Following is some basic terminology which is used in AutoCAD and one should review this before using AutoCAD:

1. **Absolute coordinates.** It is a way of inputting points which are based on AutoCAD's origin.
2. **Acad.dwt.** This is template which is default and due to default property it will automatically loads whenever you start a drawing session. It can be changed to meet your needs.
3. **Backup file.** AutoCAD had a feature of automatic backup of your drawing and it will save it. This is a safeguard in case your file gets corrupted. It is saved with a .BAK extension.
4. **Block.** This Block helps in saving time by using a pre-drawn image and it will make your file size smaller.
5. **Clean Screen.** It is display on which you draw your drawing and it is of full size.
6. **Crosshairs.** This terminology is used for your cursor which is used to move in your drawing area.
7. **Cursor.** The cursor will automatically changes according to function which is performing in program.
8. **Database.** It is basically, one large database containing all information which one needed to reproduce objects, when file is opened. Information for layers and line types are stored in this manner.
9. **Dialog box.** It uses a dialog box method to get information from user. You must know how to input information that is asks for.
10. **Drawing template file.** The preset values are used for frequently used settings. The file containing preset values has an extension of DWT.
11. **Extents.** It is outer boundaries of objects you have drawn.
12. **Grid.** This is pattern of dots displayed on screen to guide you.
13. **Grips.** Grips are used for small handles on objects which allow for quick editing.
14. **Layer.** All objects are drawn on a layer. You can group objects on a single layer and organize your drawing.
15. **Layer Tabs.** A space used for plotting your drawings.
16. **Limits(Grid).** It is a setting to make an artificial boundary on your drawing. When limits are turned on, it limits you to drawing in that area.
17. **Linetype.** There are various line types for each object. e.g solid, center, dashed etc.
18. **Model Space.** The space where user models their objects is called Model space.
19. **Modify.** To change anything in drawing area user use this tool.
20. **Object.** The any item which is present in database of AutoCAD is called object. The other name of object is entity.
21. **Origin.** (0, 0) point in your drawing is called origin of co-ordinate system.
22. **Ortho mode.** The mode which is used for vertical axis is called ortho mode.
23. **Orthographic Projection.** The method of showing 2 or more views of same part in drawing a term used is orthographic projection.
24. **Object Snap.** To precise points on an object, we used a method called snapping.
25. **Pan.** Pan is terminology used to move around drawing by dragging drawing area around your screen.
26. **Panel.** Panel is group of commands which are present on ribbon.
27. **Path.** It is specific folder where AutoCAD looks for, or saves files.
28. **Pick.** By left-clicking on object we can pick any object.
29. **Plot.** It is just like print because it is used to make hard-copy of files.
30. **Polar coordinates.** To input point based on distance and angle in your drawing.
31. **Property.** Any specific characteristics of an object such as layer, scale, line type, start point, etc.
32. **Ribbon.** The Ribbon is used to run across top of drawing space and contain panels – each panel consists a group of tools. We can switch to different panels just by clicking on tabs which are at top of ribbon.
33. **Relative coordinates.** A way of inputting points based on starting point.
34. **Section view.** The view which represent cross section of a part or assembly is called section view.
35. **Selection set.** The group of objects which are selected by user for their modification are called selection set.
36. **Snap.** This is drawing mode that allows you to snap your cursor to precise points laid out in a grid pattern.
37. **Styles.** By styles we mean different look of text and providing different dimensions to drawing.

38. **Units.** The basic drawing unit set for your drawing. For example, You can use inches or millimetres depending upon your need. You can set precision you want to be displayed.
39. **User Coordinate system.** Modification made to World Coordinate System (WCS) result in a User Coordinate System (UCS).
40. **View.** A particular area of your drawing.
41. **Viewport.** A separate window on your drawing. You may have more than one view-port visible to see different areas of your drawing at a same time.
42. **Wizard.** It is an instruction set which help user to set-up certain aspects of your drawing.
43. **World Coordinate System.** It is default X-Y coordinate system. By modifying it, it will become a User Coordinate System.
44. **Zoom.** It is used to view object precisely, for a smaller section of your drawing (zoom in) or a larger section (zoom out).

EVALUATION:

I. Identification

1. It is a way of inputting points which are based on AutoCAD's origin.
2. This is template which is default and due to default property it will automatically loads whenever you start a drawing session. It can be changed to meet your needs.
3. This will automatically changes according to function which is performing in program.
4. It is basically, one large database containing all information which one needed to reproduce objects, when file is opened. Information for layers and line types are stored in this manner.
5. It uses a dialog box method to get information from user. You must know how to input information that is asks for.
6. All objects are drawn on a layer. You can group objects on a single layer and organize your drawing.
7. Command enables to measure the distance, radius, area, or volume of a selected object or a sequence of points.
8. This is for quick access to common commands like New, Open, Save, Plot.
9. The Ribbon has most of the commands/tools that can be use while working in AutoCAD Environment.
10. It is a representation of Drawing 1 Template. This is the part of the AutoCAD software that handles all of the object to be created
11. It is the part of the AutoCAD software wherein the user can type the command to be executed.
12. It is a basic X-Y-Z (Z Is not visible) axis. In which it could be a Universal Coordinate System or World Coordinate System.
13. It contains all icon tools that can be useful on creating a design.
14. The crosshairs serve as the pointer on giving a direction for every command specially for the direct distance entry.
15. It is a new way of interacting with AutoCad's commands.
16. This is the part of the AutoCAD wherein the user can turn On or Off the tools that could help in creating a certain object.
17. It is another way to access commands in AutoCad.
18. A layout figure area wherein the user can identify the possible output of the object.
19. This button displays commands for printing, saving, drawing utilities and other non-drawing tool.
20. This is drawing mode that allows you to snap your cursor to precise points laid out in a grid pattern.

II. Enumeration.

1. Startup Window 4 major components

2. Advanced computer aided drafting packages utilize four areas on the screen.

3. List at least 10 control keys indicating their description.

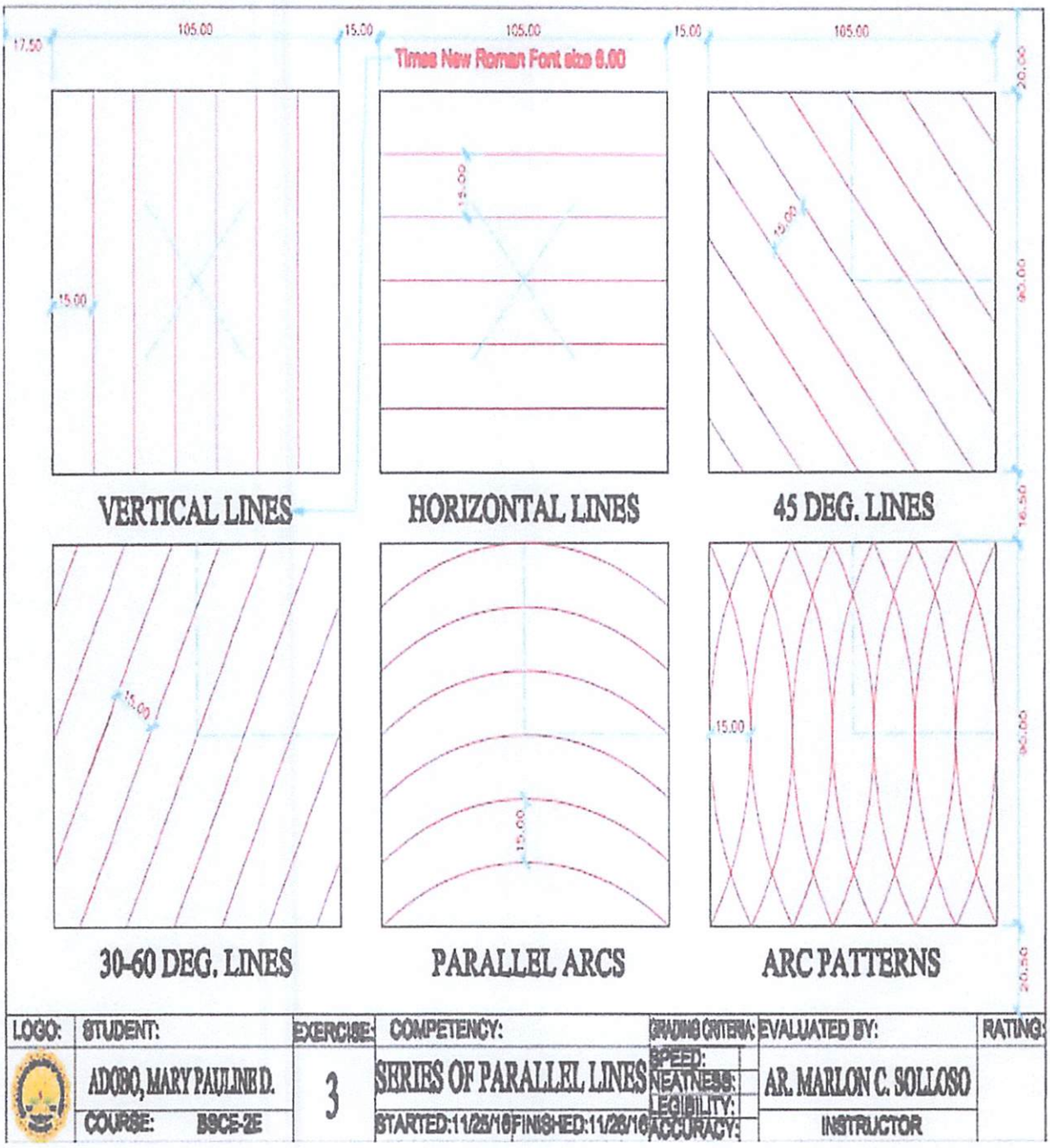
4. Outline at least 6 Keyboard Function Keys

III. Explanation. (10 points)

1. Imagine you have invited to talk in front of Senior high school students, prepare a minimum of 30 words explanation about the concept and background of CAD.

IV. Hands-on Activity: Test the CAD software on the computer

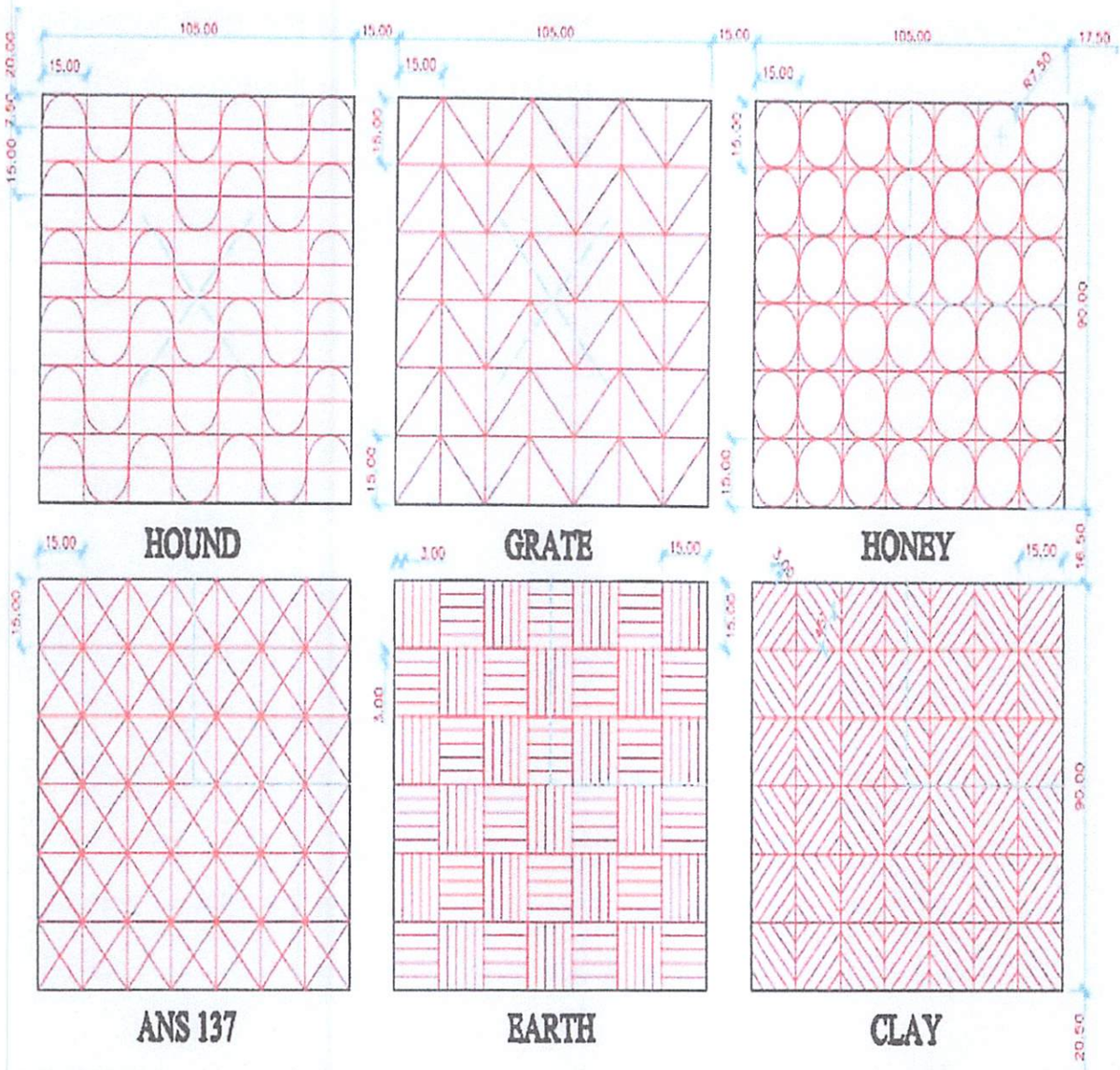
1. Plate # 3 Series of Parallel lines



Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

2. Plate # 4. Grille Design



LOGO:	STUDENT:	EXERCISE:	COMPETENCY:	GRADING CRITERIA:	EVALUATED BY:	RATING:
	ADORO, MARY PAULINE D.	4	ORNAMENTAL GRILLE DESIGN	SPEED: NEATNESS: LEGIBILITY:	AR. MARLON C. SOLLOSO	
	COURSE: BSCE-2E		STARTED:12/02/16 FINISHED:12/03/16	ACCURACY:	INSTRUCTOR	

Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

REVIEW OF CONCEPTS:

In this topic, you learned that:

- AutoCAD is Computer-Aided Design, which is used to design variety of drawings. It provides various kinds of tools with the help of which different kinds of drawings can be made and viewed easily.
- Application button displays commands for printing, saving, drawing utilities and other non-drawing tool.
- Quick access toolbar quick access to common commands like New, Open, Save, Plot.
- The Ribbon has most of the commands/tools that can be use while working in AutoCAD Environment.
- Dimension tools are the command enables to measure the distance, radius, area, or volume of a selected object or a sequence of points.
- Computer Aided Drafting is done by the operator by placing the mouse pointer by placing the mouse pointer at the desired location and then executing the command to draw the graphic elements using different methods.
- There are general operating procedure and command techniques of CAD

POST TEST:

I. TRUE OR FALSE. Write T if the statement is correct and write F is the statement is incorrect.

1. CAD systems may be considered as comprising a large number of functions for creating or manipulating the design model.
2. The graphics screen and the text screen are two different screens available in the drawing editor.
3. Controls the size of the cursor. The allowable range is from 1 to 100 percent of the total screen. At 100% the ends of the crosshair are never visible.
4. CAD uses four basic elements for preparation of any drawing: Line, curves, text, and Filling point.
5. Advanced computer aided drafting packages utilize four areas on the screen.

II. Explanation

1. How much memory is recommended for running AutoCAD ?

2. What is the most commonly used pointing device ? Why ?

3. What is the fundamental benefit to using CAD ?

4. List each option for starting AutoCAD ?

REFERENCES:

CAD Software User's Guide and Manual

www.tutorialbook.info AutoCAD 2018 For Architectural Design

https://www.geeksforgeeks.org/list-of-basic-autocad-terminology/

TOPIC	SNAPPING and CONSTRUCTION ELEMENTS

TIME FRAME: **8 hours**

INTRODUCTION:

Geometry refers to a shape of an object. It can be a point, line, circle, ellipse or a combination of these. This lesson will introduce and use the draw, coordinate system and object snap mode that available in AutoCAD which will be used in creating a geometrical drawing.

Making drawings precisely in AutoCAD is not possible without the use of object snaps. These options not only let you make drawings precisely but they also speed up the drawing workflow.

Objects snaps are indispensable tools and you can't make precise drawings without using them. Knowing about the object snaps will just make your drawing workflow much more efficient.

OBJECTIVES/ INTENDED LEARNING OUTCOMES:

In this lesson, learners will be able to:

1. Identify the basic commands of CAD;
2. apply the basic commands in the application of snapping construction elements on CAD drawings;
3. apply the Draw Command; line, construction line, polyline, polygon, rectangle, arc, circle and ellipse.
4. construct drawings using coordinate system;
5. apply Object Snap Mode with other Draw Command in sketching; and
6. compose compound figures.

PRE-TEST:

I. Identification

1) These are probably the most simple of AutoCAD objects. Using the this command, a line can be drawn between any two points picked within the drawing area.
2) This command creates a line of infinite length which passes through two picked points.
3) This command can be used to draw any regular polygon from 3 sides up to 1024 sides.
4) This command is used to draw a rectangle. The position and size of the rectangle are defined by picking two corners.
5) This command is probably one of the most frequently used and also one of the simplest.
6) This command allows you to draw an arc of a circle.
7) The command gives you a number of different creation options.
8) This command use to remove (deletes) unused any selected object(s) from the drawing.
9) This command allows you to mirror selected objects in your drawing by picking them and then defining the position of an imaginary mirror line using two points.
10) This command create copies of selected objects in a rectangular matrix (columns and rows) or a polar (circular) pattern

LEARNING CONTENT:

1. DRAWING OBJECT

The Draw commands can be used to create new objects such as lines and circles. Most AutoCAD drawings are composed purely and simply from these basic components. A good understanding of the Draw commands is fundamental to the efficient use of AutoCAD

The sections below cover the most frequently used Draw commands such as Line, Polygon, Square, Arc, Circle and ellipse. In common with most AutoCAD commands, the Draw commands can be started several numbers of ways. Command names or short-cuts can be entered at the keyboard, commands from the Draw pull-down menu, and command from the Draw toolbar. Don't worry too much about this; just use whatever method feels easiest or most convenient at the time. The Figure below, shows a draw toolbar used as a short cut to call the draw command.

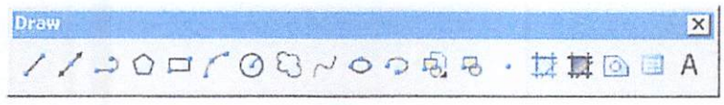


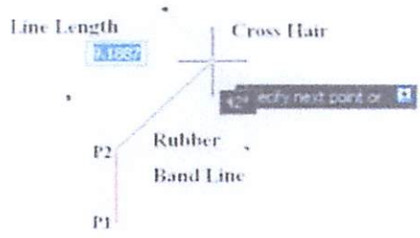
Figure 1. Draw Toolbar

1.1 Line

Lines are probably the most simple of AutoCAD objects. Using the Line command, a line can be drawn between any two points picked within the drawing area. Lines are usually the first objects you will want to draw when starting a new drawing because they can be used as "construction lines" upon which the rest of your drawing will be based.

The Line Command

Toolbar	Draw	
Pull-down	Draw	Line
Keyboard	LINE	**short-cut** L



With the Line command you can draw a simple line from one point to another. When you pick the first point and move the *cross-hairs* to the location of the second point you will see a *rubber band line* which shows you where the line will be drawn when the second point is picked. Line *objects* have two ends (the first point and the last point). You can continue picking points and AutoCAD will draw a straight line between each picked point and the previous point. Each line segment drawn is a separate *object* and can be moved or erased as required. To end this command, just hit the key on the keyboard.

Command Sequence

Command: LINE

Specify first point: (pick P1)

Specify next point or [Undo]: (pick P2)

Specify next point or [Undo]: (to end)

You can also draw lines by using something called direct distance entry or by entering the co-ordinates of their end points at the command prompt rather than picking their position from the screen.

Direct Distance Entry

A method to specify a second point by first moving the cursor to indicate direction and then entering a distance.

Command Sequence

Command: LINE

Specify first point: (pick P1)

Specify next point or [Undo]: (Put value after decide the direction)

Specify next point or [Undo]: (to end)

Specify next point or [Undo]: (to end)

Coordinate Entry

A method to specify next point by using coordinate system. (refer section 2.3 coordinate system)

Command Sequence

Command: LINE

Specify first point: (pick P1)

Specify next point or [Undo]: (Put value and press "," or "<". Then put another value)

Specify next point or [Undo]: (to end)

Specify next point or [Undo]: (to end)

1.2 Construction Line

The Construction Line command creates a line of infinite length which passes through two picked points. Construction lines are very useful for creating construction frameworks within which to design. Construction lines are not normally used as objects in finished drawings, it is usually, to draw all your construction lines on a separate *layer* which will be turned off or frozen prior to printing.

The Construction Line Command

Toolbar Draw

Pull-down Draw Construction Line

Keyboard XLINE **short-cut** XL

Command Sequence

```
Command: XLINE
Specify a point or [Hor/Ver/Ang/Bisect/Offset]: (pick a point)
Specify through point: (pick a second point)
Specify through point:    (to end)
```

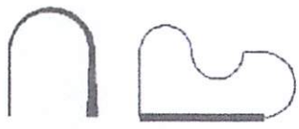
There are a number of options with this command. For example, the "Hor" and "Ver" options can be used to draw construction lines that are truly horizontal or vertical. In both cases, only a single pick point is required because the direction of the line is predetermined.

Command Sequence

```
Command: XLINE
Hor/Ver/Ang/Bisect/Offset/<From point>: H ↵
Through point: (pick a point to position the line)
Through point:    (to end or pick a point for another horizontal line)
```

1.3 Polyline

Polylines differ from lines in that they are more complex objects. A single polyline can be composed of a number of straight-line or arc *segments*. Polylines can also be given line widths to make them appear solid. The illustration below shows two examples of polyline to give you an idea of the flexibility of this type of line.



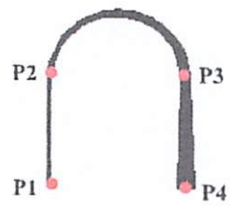
The Polyline Command

Toolbar Draw

Pull-down Draw Polyline

Keyboard PLINE **short-cut** PL

In practice the Polyline command works in the same way as the Line command allowing you to pick as many points as you like except that the resulting object may be composed of a number of segments which form a single *object*. Again, just hit to end. As with the Line command, you also have the option to automatically *close* a polyline end to end. To do this, type C to use the close option instead of hitting .



Command Sequence

Command: **PLINE**

Specify start point: (pick P1)

Current line-width is 0.0000

Specify next point or [Arc/Halfwidth/Length/Undo/Width]:

W ↵

Specify starting width: **1** ↵

Specify ending width: **1** ↵

Specify next point or [Arc/Halfwidth/Length/Undo/Width]:

(pick P2)

Specify next point or

[Arc/Close/Halfwidth/Length/Undo/Width]: **W** ↵

Specify starting width: **1** ↵

Specify ending width: **3** ↵

Specify next point or

[Arc/Close/Halfwidth/Length/Undo/Width]: **A** ↵

Specify endpoint of arc or

[Angle/CEnter/CLose/Direction/Halfwidth/Line/Radius/

Second pt/Undo/Width]: (pick P3)

Specify endpoint of arc or

[Angle/CEnter/CLose/Direction/Halfwidth/Line/Radius/

Second pt/Undo/Width]: **W** ↵

Specify starting width: **3** ↵

Specify ending width: **5** ↵

Specify endpoint of arc or

[Angle/CEnter/CLose/Direction/Halfwidth/Line/Radius/

Second pt/Undo/Width]: **L** ↵

Specify next point or [Arc/Halfwidth/Length/Undo/Width]:

(pick P4)

Specify next point or [Arc/Halfwidth/Length/Undo/Width]: ↵

(to end)

It is worth while taking some time to familiarise yourself with the Polyline command as it is an extremely useful command to know. Try experimenting with other options to get better understanding and knowledge of this Polyline. The Undo option is particularly useful. This allows you to unpick polyline vertices, one at a time so that you can easily correct mistakes.

1.4 Polygon

The Polygon command can be used to draw any regular polygon from 3 sides up to 1024 sides. This command requires four inputs from the user, the number of sides, a pick point for the centre of the polygon, *inscribed* or *circumscribed* polygon and a pick point with the orientation of the polygon or value for the radius of this imaginary circle.

The Polygon Command

Toolbar Draw

Pull-down Draw Polygon

Keyboard POLYGON **short-cut** POL

Command Sequence

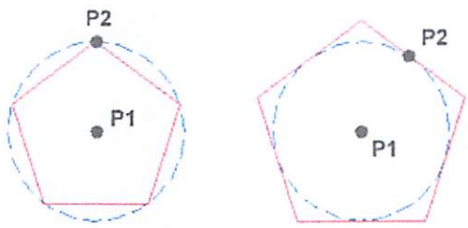
Command: **POLYGON**

Enter number of sides <4>: 5 ↵

Specify center of polygon or [Edge]: (pick P1)

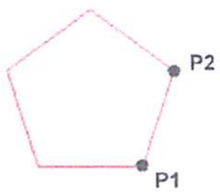
Enter an option [Inscribed in circle/Circumscribed about circle] <I>: (to accept the inscribed default or type **C** for circumscribed)

Specify radius of circle: (pick P2 or enter exact radius)



Inscribed **Circumscribed**

In the illustration above, the polygon on the left is inscribed (inside the circle) and the one in the right is circumscribed (outside the circle). Polygon command also allows you to define the polygon by entering the length of a side using the Edge option. Illustration below shows a polygon defined by the length of an edge.



Edge

Command Sequence

Command: POLYGON

Enter number of sides <4>: 5 ↵

Specify center of polygon or [Edge]: E ↵

Specify first endpoint of edge: (pick P1)

Specify second endpoint of edge: (pick P2 or enter length required)

1.5 Rectangle

The Rectangle command is used to draw a rectangle. The position and size of the rectangle are defined by picking two corners.

The Rectangle Command

Toolbar	Draw		
Pull-down	Draw	Rectangle	
Keyboard	RECTANGLE	**short-cuts**	REC, RECTANG

Command Sequence

Command: REC

Specify first corner point or

[Chamfer/Elevation/Fillet/Thickness/Width]: (pick P1)

Specify other corner point or [Dimensions]: (pick P2)

The Rectangle command also has a number of options. The Chamfer and Fillet options will make all the corner will chamfered or fillet with specify dimension. Notice that, instead of picking a second point to draw the rectangle, you have the option of entering dimensions. Say you wanted to draw a rectangle 40 drawing units long and 20 drawing units wide. The command sequence would look like this:

Command Sequence

Command: **RECTANG**

Specify first corner point or [Chamfer/Elevation/Fillet/Thickness/Width]: (pick P1)

Specify other corner point or [Dimensions]: **D** Specify length for rectangles <0.0000>: **40**

Specify width for rectangles <0.0000>: **20**

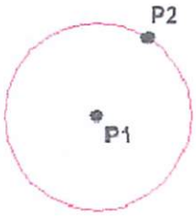
Specify other corner point or [Dimensions]: (pick a point to fix the orientation)

1.6 Circle

Circle command is probably one of the most frequently used and also one of the simplest. However, in common with the other commands in this section there are a number of options that can help you construct just the circle you need. The Circle command for example, offers 6 ways to create a circle. The default method is to pick the centre point and then to either pick a second point on the circumference of the circle or enter the circle radius at the keyboard

The Circle Command

Toolbar	Draw		
Pull-down	Draw	Circle	Center, Radius
Keyboard	CIRCLE	**short-cut**	C

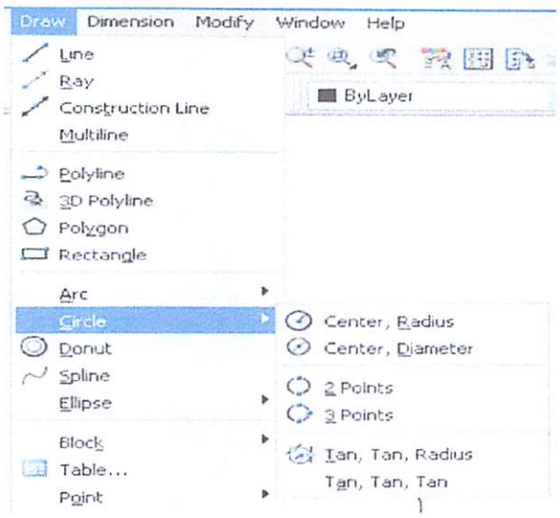


Command Sequence

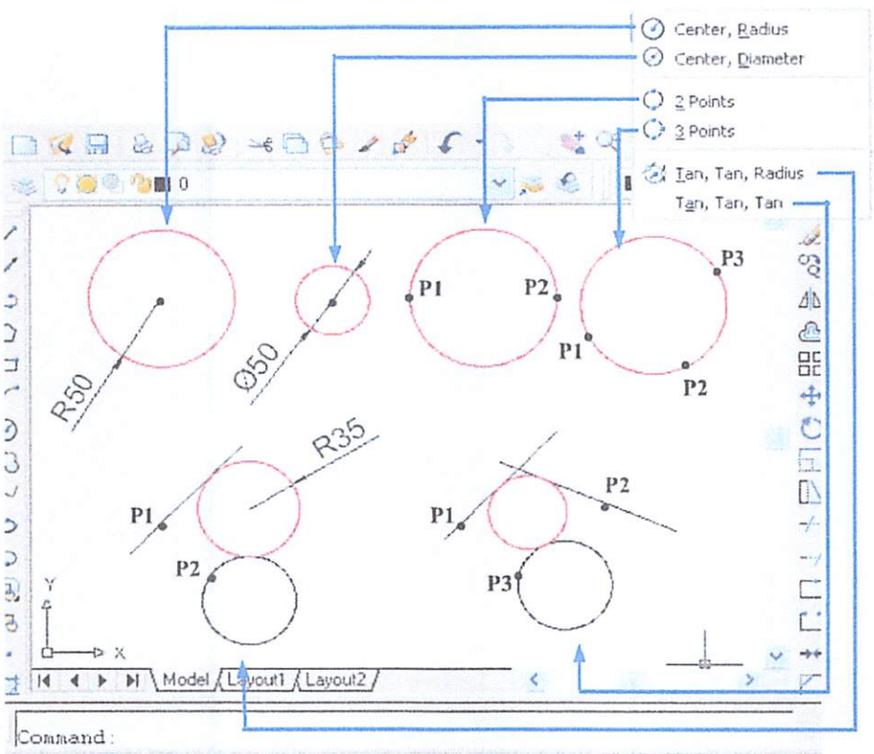
Command: **CIRCLE**

Specify center point for circle or [3P/2P/Ttr (tan tan radius)]: (pick P1)

Specify radius of circle or [Diameter] <50.0195>: (pick P2 or enter the exact radius)



As you can see from the Draw>Circle pull down menu above, there are six options to create a circle. "Center, radius" and "Center, Diameter" are circle command which is commonly use where user need to decide the center point of the circle and followed by the radius or diameter needed. "2P" option will create a circle by using two points on the circumference to form a diameter, while "3P" will use any three points on the circumference. Meanwhile "Ttr" which stands for Tangent Tangent Radius will create a circle with a specified radius tangent to two objects and "Tan, Tan, Tan" will create a circle based on tangent from 3 point of a object. Obviously the last two option can be used if there are more than one object which you can use as tangents to the circl



1.7 Arc

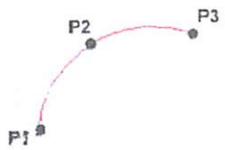
The Arc command allows you to draw an arc of a circle. There are numerous ways to define an arc, the default method uses three pick points, a start point, a second point and an end point. Using this method, the drawn arc will start at the first pick point, pass through the second point and end at the third point.

The Arc Command

Toolbar Draw

Pull-down Draw Arc 3 Points

Keyboard ARC **short-cut** A



Command Sequence

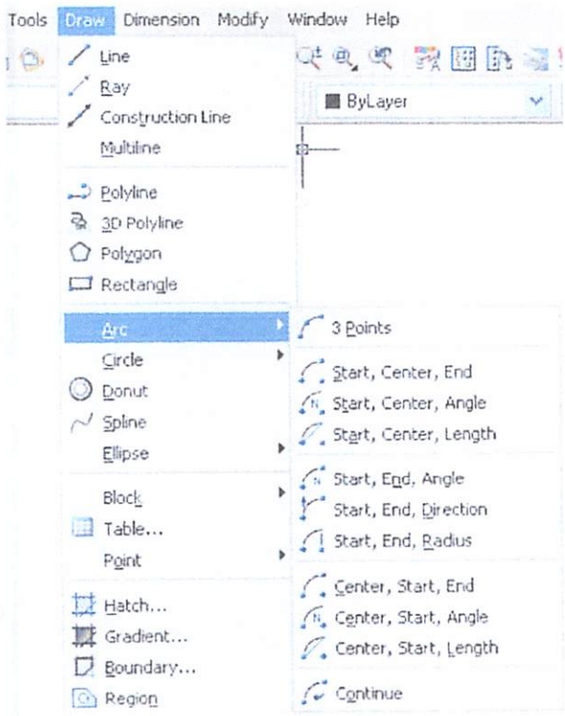
Command: **ARC**

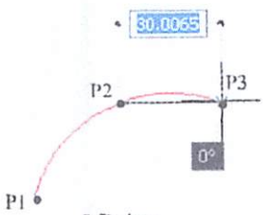
Specify start point of arc or [Center]: (pick P1)

Specify second point of arc or [Center/End]: (pick P2)

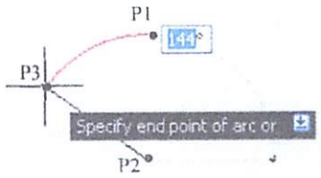
Specify end point of arc: (pick P3)

Arc command offers 10 different methods for drawing an arc. All of the Arc command options are available from the pull-down menu as shown in below figure.

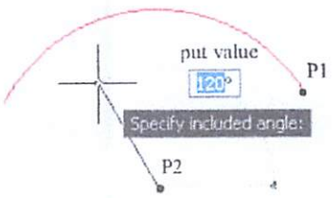




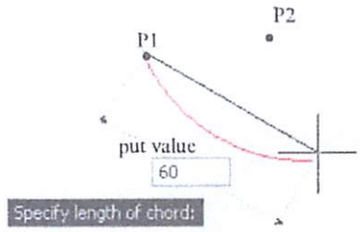
3 Points



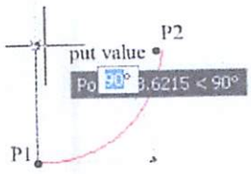
Start, Center, End



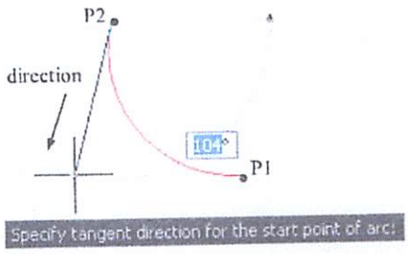
Start, Center, Angle



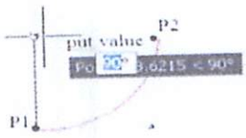
Start, Center, Length



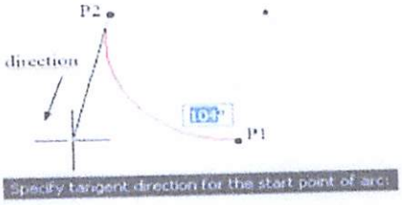
Start, End, Angle



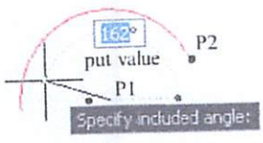
Start, End, Direction



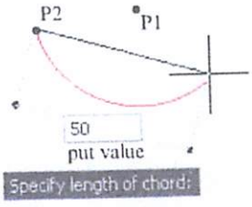
Start, End, Angle



Start, End, Direction



Center, Start, Angle



Center, Start, Length

1.8 Ellipse

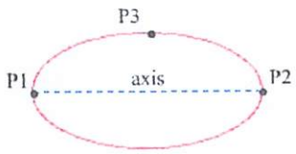
The shape of an ellipse is determined by two axes that define its length and width. The longer axis is called the major axis, and the shorter one is the minor axis. The Ellipse command gives you a number of different creation options. The default option is to pick the two end points of an axis and then a third point to define the eccentricity of the ellipse.

The Ellipse Command

Toolbar Draw

Pull-down Draw Ellipse Axis, End

Keyboard ELLIPSE **short-cut** EL



Command Sequence

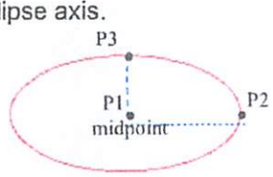
Command: **ELLIPSE**

Specify axis endpoint of ellipse or [Arc/Center]: (pick P1)

Specify other endpoint of axis: (pick P2 or put a specific distance)

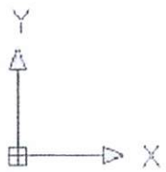
Specify distance to other axis or [Rotation]: (pick P3 or put a specific distance)

The other option is to pick the mid points of an axis and then define the two radius of the ellipse axis.



2. COORDINATE SYSTEM

A good understanding of how co-ordinates work in AutoCAD is absolutely crucial if you are to make the best use of the program. In the bottom left hand corner of the AutoCAD drawing window you will see a symbol like the one shown below. This is called the UCS (User Co-ordinate System) icon and it is there to remind you which is the X axis and which is the Y axis.

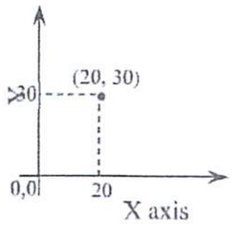


The UCS Icon

Co-ordinates fall into two types, namely Cartesian and Polar. A basic understanding of these co-ordinate types will help you to use AutoCAD to construct drawings more easily. They can be either Absolute or Relative. Knowing just when and where to use the various types and flavours of co- ordinate is the key to efficient drawing with AutoCAD.

2.1 Cartesian Co-ordinates

The Cartesian co-ordinate system is the standard co-ordinate system. The position of a point can be described by its distance from two axes, X and Y. This results in a simple point description using two numbers separated by a comma e.g. **20,30** as shown in below figure. In the example, the first value (**20**) is known as the X co-ordinate because it's value is measured along the X axis. The second value is known as the Y co-ordinate because it's value is measured along the Y axis.



The co-ordinate value of the origin point is always **0,0**. AutoCAD allows you to use co-ordinates to draw objects rather than using pick points. For example you could draw a line like this:

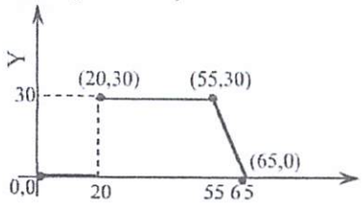
Command Sequence `Command:` **LINE** `From point:` **0,0**

`To point:` **20,30**

`To point:` **55,30**

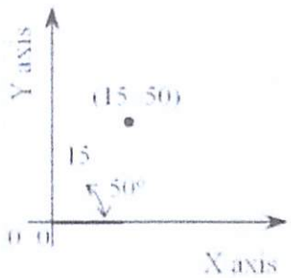
`To point:` **65,0**

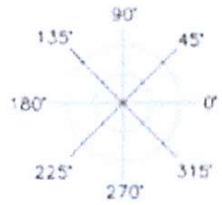
`To point:` (to end)



2.2 Polar Co-ordinates

Polar co-ordinates use one radial distance and one angle to describe the position of a point rather than the two distances in the Cartesian system. The radial distance and angle measurements are made relative to an origin. This results in a point description which looks like this **15<50** where the first figure is the radial distance and the second is the angle. To use polar coordinates, enter a radial distance and an angle separated by an angle bracket (<).



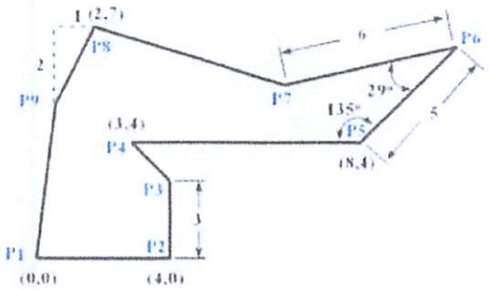


By default, angles increase in the counter clockwise direction as shown in the right figure above and decrease in the clockwise direction. To specify a clockwise direction, enter a negative value for the angle. For example, entering 10<315 locates the same point as entering 10<-45. It is not recommended to use this absolute polar coordinate in drawing because the distance is always refer to the origin point **0,0**. User can easily lost or confused with this coordinate. However in some cases, using a relative polar coordinate is very helpful and easier.

2.3 Absolute & Relative Co-ordinates

Both Cartesian and polar coordinates come in two flavours, absolute and relative. The only different is, absolute coordinate is always refer to origin point **0,0**, whilst relative coordinates relate to the current pick point. Absolute coordinates are typed exactly as in the examples previous. To specify relative coordinates, precede the coordinate values with an @ sign. Relative coordinates are based on the last point entered. Use relative coordinates when you know the location of a point in relation to the previous point. For example, entering @3,4 specifies a point 3 units along the X axis and 4 units along the Y axis from the last point specified.

Example of Drawing using various type of Coordinate System



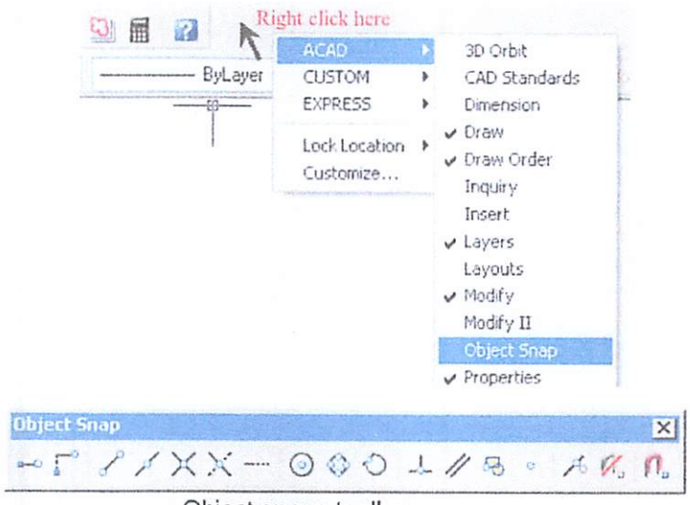
	Coordinate System			
	Absolute Cartesian	Relative Cartesian	Absolute Polar	Relative Polar
Command : LINE				
From point : (P1)	0,0	@0,0	0<0	@0<0
To point : (P2)	4,0	@4,0	4<0	@4<0
To point : (P3)	4,3	@0,3		@3<90
To point : (P4)	3,4	@-1,1		@1.41<135
To point : (P5)	8,4	@5,0		@5<0
To point : (P6)	11.54,7.54	@3.54,3.54		@5<45
To point : (P7)	5.77,5.88	@-5.77,-1.65		@6<196
To point : (P8)	2,7	@-3.77,1.12		@3.93<163.45
To point : (P9)	1,5	@-1,-2		@2.24<243.43
To point : (P1)	0,0	@-1,-5	0<0	@5.10<258.69

3. OBJECT SNAP MODE

The Object Snaps or Osnaps (short name) are used together with other commands to help user draw accurately. Object snaps allow user to *snap* onto a specific object location precisely when pick a point. For example, by using Osnaps, user can easily pick the exact end point of a line or the exact center of a circle. Therefore Osnaps in AutoCAD are so important that you cannot draw accurately without them.

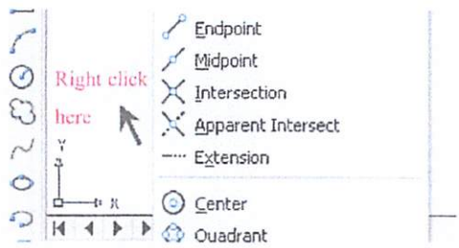
There are **three** basic methods of accessing the Osnaps:

- The Osnaps are available from Object Snap toolbar. If this toolbar is not already displayed, you can display it by right click the mouse button at empty space on the menubar to bring up the cursor menu. When the cursor menu appears, click "ACAD" option and then simply check the "Object Snap" item in the toolbars list.



Object snaps toolbar

- You can also access the Osnaps from the cursor menu. Hold the *Shift* key down on the keyboard and right-click the mouse at the screen to bring up the cursor menu. The menu appears at the current cursor position.



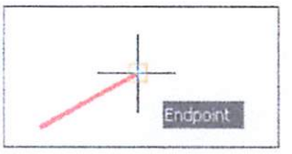
- Finally, you can also access the Osnaps from the keyboard by typing their shortened name.

There are 15 options of Object snaps which all of it are useful in certain situations. Users will probably find themselves using about half of them on a regular basis and another half in special circumstances. Not all the object snaps tool will be discuss here. Only the regular basis and important command will be discuss in next section. However, it's a good idea to get know as much of it so that you can plan you're drawing properly and use the provided tool optimally.

1. Endpoint

The Endpoint Osnap used to snaps the end points of lines, arcs and to polyline vertices. This is one of the most useful and commonly used Osnaps.

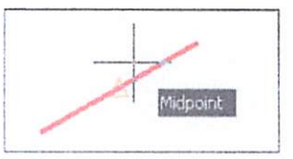
Toolbar	Object Snap	Pull-
down	Shift + Right Click **Endpoint**	
Keyboard	END (when picking)	



2. Midpoint

The Midpoint Osnap used to snaps the mid points of lines, arcs and to the mid point of polyline segments.

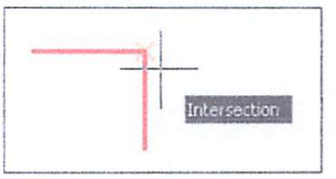
Toolbar	Object Snap	Pull-
down	Shift + Right Click **Midpoint**	
Keyboard	**MID** (when picking)	



3. Intersection

The Intersection Osnap used to snaps the physical intersection of any two drawing objects (i.e. where lines, arcs or circles etc. cross each other) and to Polyline vertices.

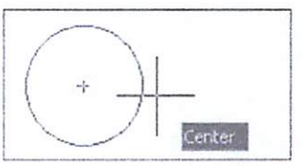
Toolbar	Object Snap	Pull-
down	Shift + Right Click **Intersection**	
Keyboard	**INT** (when picking)	



4. Center

The Center Osnap used to snaps the centre of a circle, arc or polyline arc segment. The cursor must pass over the circumference of the circle or the arc so that the centre can be found.

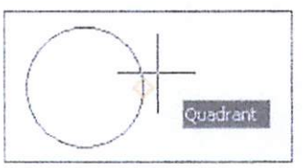
Toolbar	Object Snap	Pull-
down	Shift + Right Click **Center**	
Keyboard	**CEN** (when picking)	



5. Quadrant

The Quadrant Osnap used to snaps one of the four circle quadrant points located at noth, south, east and west which are 90, 270, 0 and 180 degrees respectively.

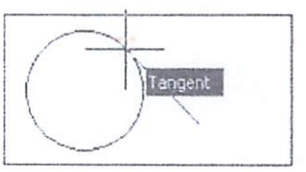
Toolbar	Object Snap	
Pull-down	Shift + Right Click	
Quadrant Keyboard	**QUA or**	
QUAD (when		
	picking)	



6. Tangent

The Tangent Osnap used to snaps a tangent point on a circle.

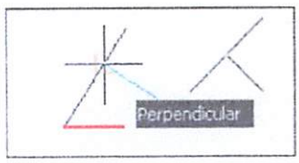
Toolbar	Object Snap	Pull-
down	Shift + Right Click **Tangent**	
Keyboard	**TAN** (when picking)	



7. Perpendicular

The Perpendicular Osnap used to snaps a point which forms a perpendicular (90 degree) with the selected object.

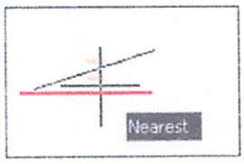
Toolbar	Object Snap
Pull-down	Shift + Right Click **Perpendicular**
Keyboard	**PER** or **PERP** (when picking)



8. Nearest

The Nearest Osnap used to snaps the nearest point on a drawing object. This Osnap is useful if you want to make sure that a pick point lies on a drawing object but you don't necessarily mind exactly where it is located

Toolbar	Object Snap
Pull-down	Shift + Right Click **Nearest**
Keyboard	**NEA** or **NEAR** (when picking)



EVALUATION:

I. Answer the following questions.

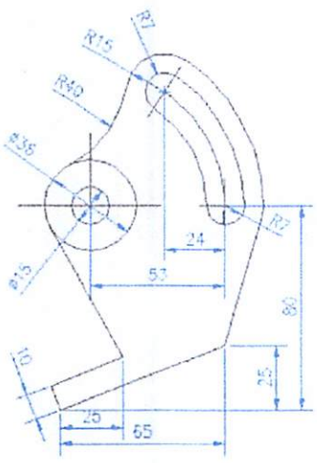
1) State the different methods for drawing an arc

2) Enumerate the object snap tools and explain each.

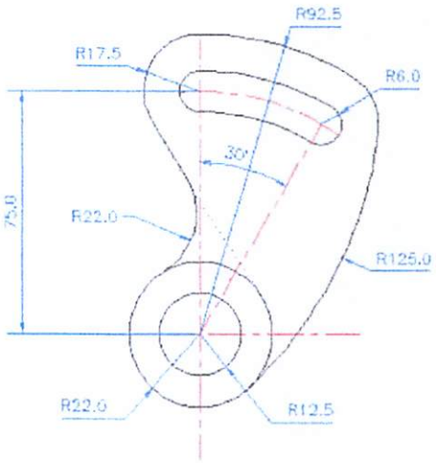
3) What are the types of Co-ordinates and explain each.

II.

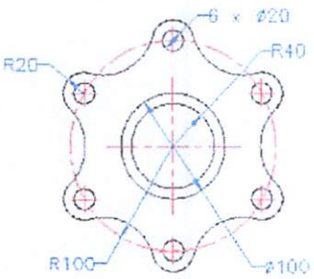
1.


R3
R15
R40
Ø35
Ø15
24
53
R7
85
52
10
25
55

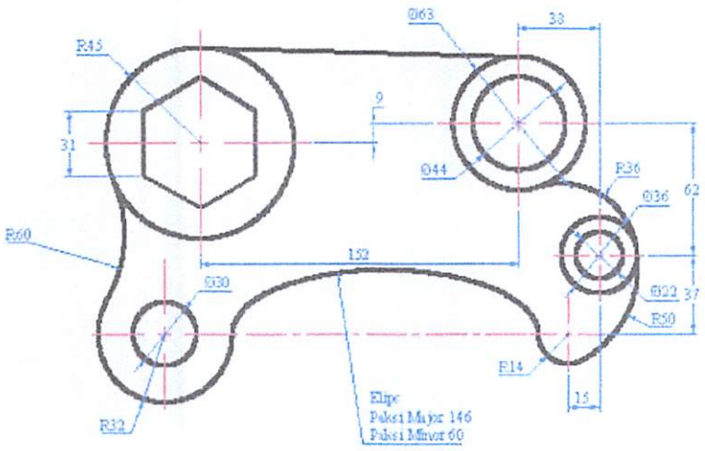
2.


R92.5
R17.5
R6.0
30°
75.0
R22.0
R125.0
R22.0
R12.5

3.

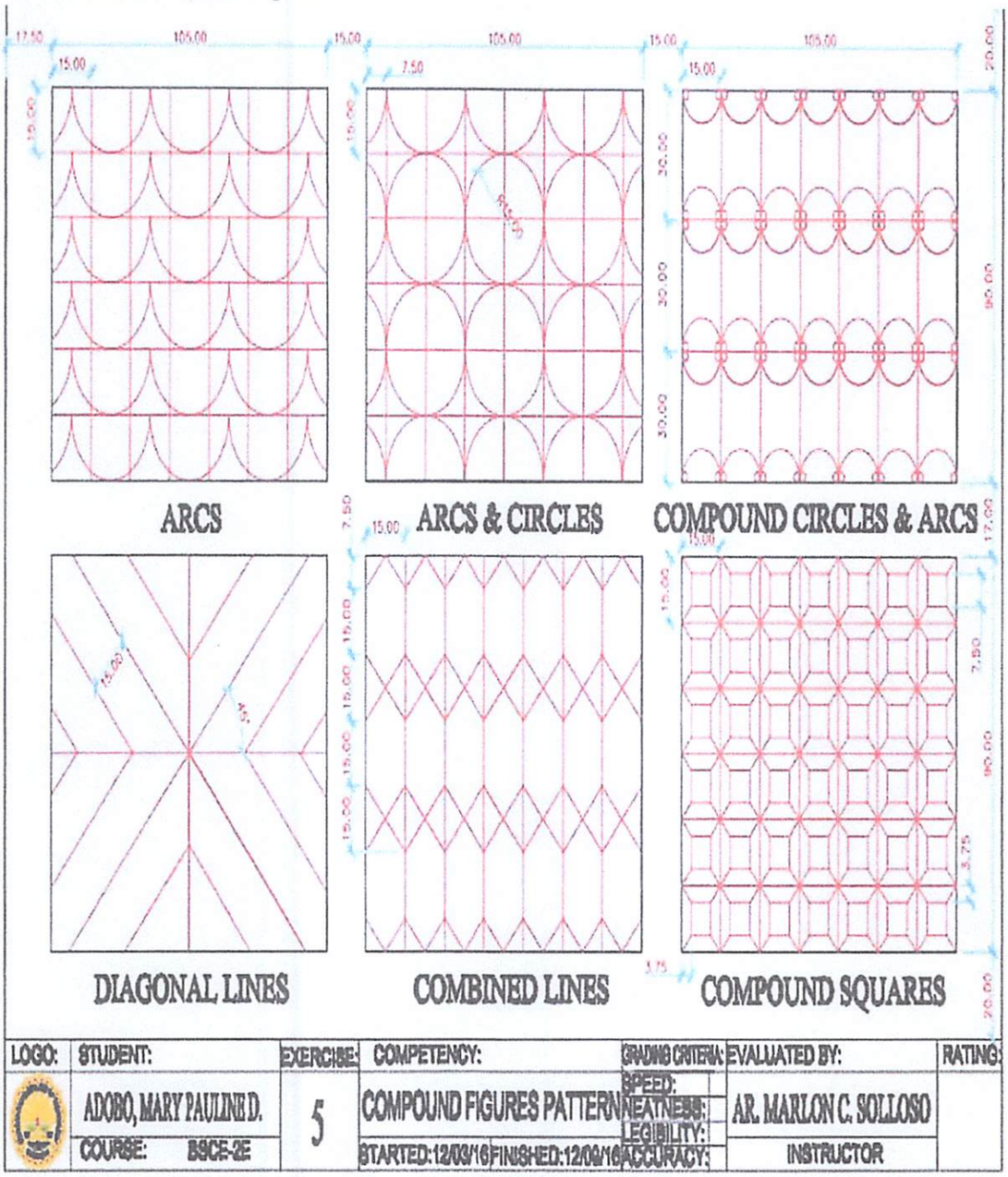

6 x Ø20
R20
R40
R100
Ø100

4.


Ø63
38
R45
9
31
Ø44
R36
Ø36
62
R60
152
Ø30
Ø22
37
R50
R14
15
R32
Elips
Paksi Major 146
Paksi Minor 60

II. Hands-on Activity. Compose Compound Figures

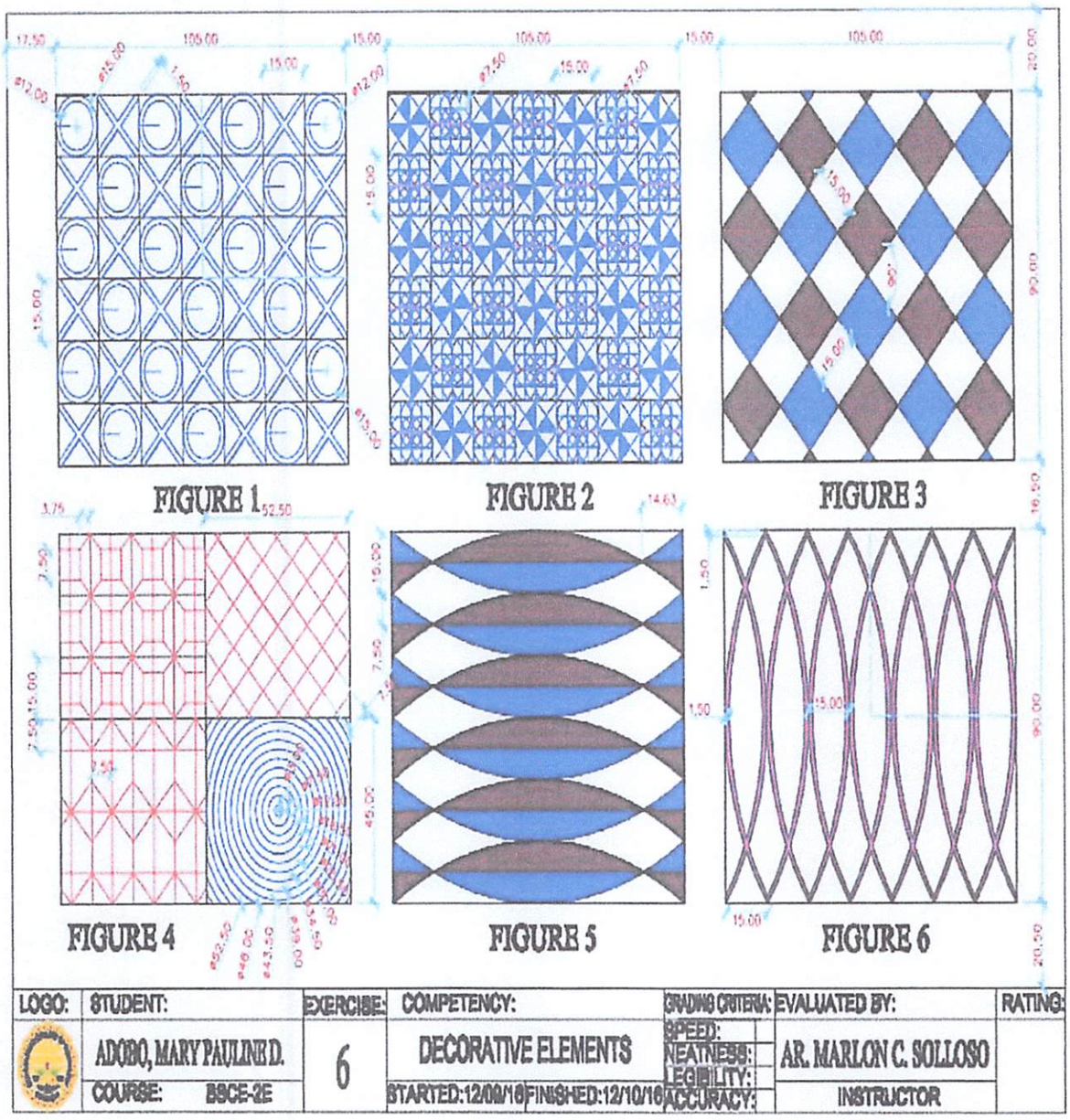
1. Plate No. 5. Compound Figures



Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

2. Plate No. 6. Decorative Elements



Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

REVIEW OF CONCEPTS:

In this topic, you have learned that:

- Different basic commands of CAD
- The Draw commands can be used to create new objects such as lines and circles.
- The Object Snaps or Osnaps (short name) are used together with other commands to help user draw accurately.
- A good understanding of how co-ordinates work in AutoCAD is absolutely crucial if you are to make the best use of the program. In th

POST TEST:

I. Identification

1) These are probably the most simple of AutoCAD objects. Using the this command, a line can be drawn between any two points picked within the drawing area.
2) This command creates a line of infinite length which passes through two picked points.
3) This command can be used to draw any regular polygon from 3 sides up to 1024 sides.
4) This command is used to draw a rectangle. The position and size of the rectangle are defined by picking two corners.
5) This command is probably one of the most frequently used and also one of the simplest.
6) This command allows you to draw an arc of a circle.
7) The command gives you a number of different creation options.
8) This command use to remove (deletes) unused any selected object(s) from the drawing.
9) This command allows you to mirror selected objects in your drawing by picking them and then defining the position of an imaginary mirror line using two points.
10) This command create copies of selected objects in a rectangular matrix (columns and rows) or a polar (circular) pattern

REFERENCES:

Onstot , S., AutoCAD® 2017 and AutoCAD LT ® 2017, Wiley, USA

Mark Dix, Discovering AutoCAD® 2017, Pearson, USA

CAD Software User's Guide and Manual

www.tutorialbook.info AutoCAD 2018 For Architectural Design

TOPIC	DIMENSIONING

TIME FRAME: 13 hours

INTRODUCTION:

Dimensioning is important in materializing a technical drawing into a product. There are several types of dimensioning including linear dimensioning, circle and arc dimensioning, and angle dimensioning. This chapter will describe on dimensioning technique for technical drawing and other guidelines in dimensioning. We will also see how dimensioning can be done in AutoCAD software.

OBJECTIVES/ INTENDED LEARNING OUTCOMES:

In this lesson, learners will be able to:

1. Identify the basic principles of dimensioning and scaling relative to the presentation of drawing techniques'
2. enumerate the type of dimensioning;
3. outline the dimensioning guidelines;
4. apply the basic tools on the set-up of commands on dimensioning or dimension-style;
5. apply basic guidelines in drawing dimensioning; and
6. produce a dimensioned drawing using AutoCAD

PRE-TEST:

I. True or False. Read each statement very carefully. Write T if the statement is correct and write F if the statement if incorrect. Place your answers on the space before the number.

1. Angle dimensioning is used to show inclination of a line with a reference to other line.
2. Basically there are three types of dimensioning; linear, circle and arc, and angle
3. Linear dimension is used to show length of a linear line
4. Dimension of a circle or arc must be constructed together with the centre-line of the circle or arc.
5. As AutoCAD is computer software, dimensioning process should be expected to be easier and more accurate.
6. A build in command for dimensioning make it even easier for the AutoCAD user Dimensioning of a technical drawing must be done according to the existing standard such as BS308, ANSI and ISO.
7. There are several guidelines that must be followed in dimensioning.
8. We can standardize our dimension according to the existing standard by clicking on the Dimension Style on the Dimension Toolbar.
9. As dimensioning is one of the most important component in providing the actual size of a product, tolerance also play an important role in providing the permitted error in manufacturing of a product.
10. To produce a dimension with tolerance, one must setup the parameter .

LEARNING CONTENT:

1. TYPE OF DIMENSIONING

Basically there are three types of dimensioning; linear, circle and arc, and angle. To choose the right style, one should consider the easiest and most complete way for the reader to determine the size and the shape of the object.

1.1 Linear Dimensioning

Linear dimension is used to show length of a linear line. Figure 1 shows several style of linear dimension.

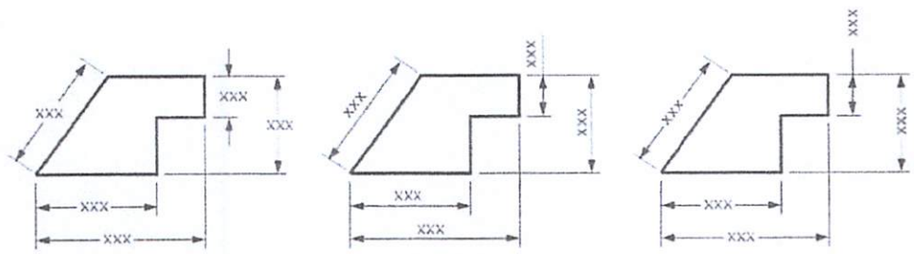


Figure 1: Several Types of Linear Dimensioning

1.2 Circle and Arc Dimensioning

Circle and arc dimension is used to show diameter or radius of a circle or arc. Dimension of a circle or arc must be constructed together with the centre-line of the circle or arc. Figure 2 shows several style of circle and arc dimension.

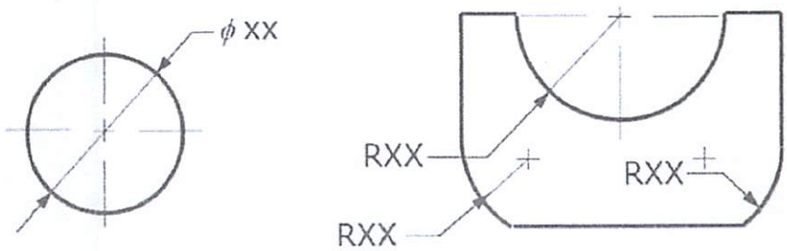


Figure 2: Several Types of Circle and Arc Dimensioning

1.3 Angle Dimensioning

Angle dimensioning is used to show inclination of a line with a reference to other line. Figure 3 shows some example on angle dimensioning.

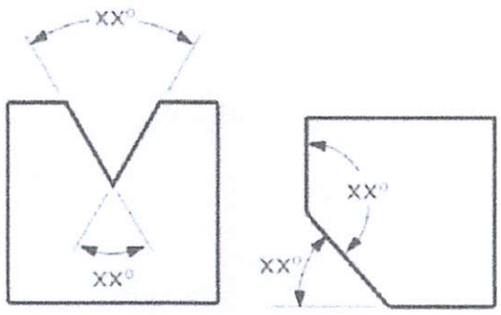


Figure 3: Several Types of Angle Dimensioning

2. DIMENSIONING GUIDELINES

Dimensioning of a technical drawing must be done according to the existing standard such as BS308, ANSI and ISO. Figure 4 shows an example of a drawing with dimension.

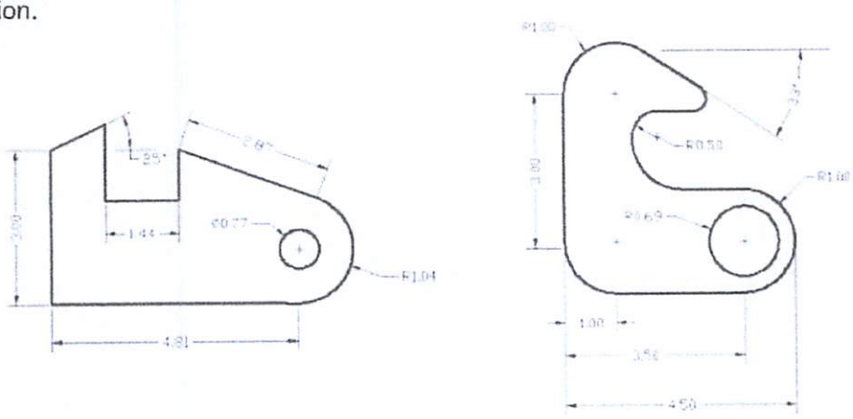


***Figure 4.**: Example of a Drawing with Dimension*

There are several guidelines that must be followed in dimensioning as shown in Figure 5. Description of the figure is given below:

a) arrow size of 3 mm (i)
b) texts height of 3 mm (ii)
c) projection line exceeding 1.5 mm from arrow (iii)
d) gap between object and projection line at 1.5 mm (iv)
e) distance between dimension and object line at 15 mm (v)
f) distance between dimensions at 10 mm.(vi)

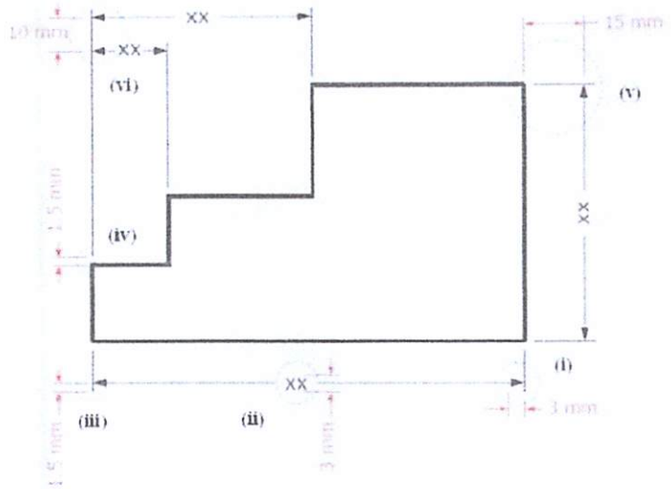


Figure 5: Guidelines for Dimensioning

Given below are list of error used to be made in dimensioning (Figure 4.6):

a) distance between projection and object line is too far (i)
b) crossing between projection and dimension line (ii)
c) break on projection line through the object line (iii)
d) dimension text size exceeding or below 3 mm (iv)
e) arrow size exceeding or below 3 mm (v)
f) dimension without projection line (vi)
g) crossing of two dimension line (vii)
h) no gap between the projection and object line (viii)
i) no projection line for the other side (ix)
j) gap between the dimension and object is too small (x)
k) inappropriate weighting of the dimension line (xi)
l) no gap between the centre line and the projection line (xii)

Figure 7 shows the corrected version of the same object dimension as Figure 6.

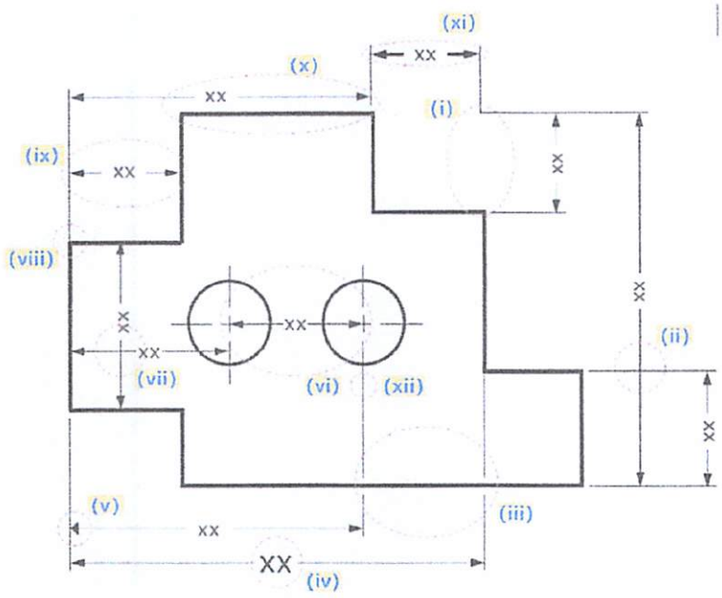


Figure 6: Typical Error Made in Dimensioning

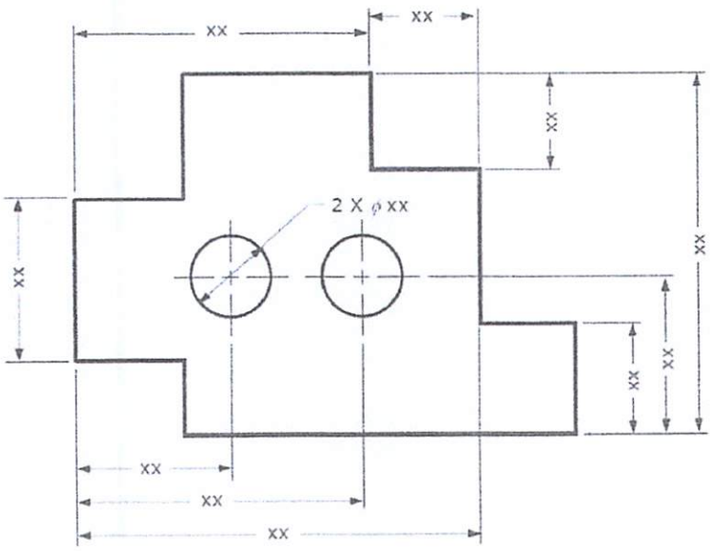


Figure 7: Corrected Version of Figure 6.

3. DIMENSIONING IN AUTOCAD

As AutoCAD is computer software, dimensioning process should be expected to be easier and more accurate. A build in command for dimensioning make it even easier for the AutoCAD user. This section will describe more on dimensioning technique and style in AutoCAD

3. 1 Dimension Toolbar

Just like what we have done in section 1.2.3, we will now add in dimension toolbar to our screen view. This toolbar can be added by right click on the existing toolbar and choose the dimension category (Figure 8). The toolbar contain of dimensioning icon that will be used later on in the next section.

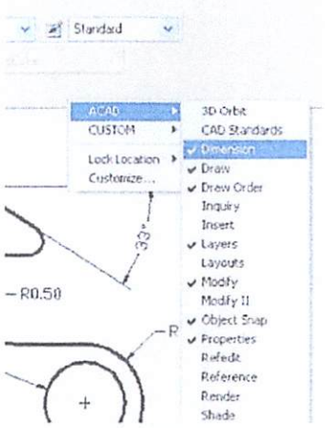


Figure 4.8: Enabling Dimension Toolbar

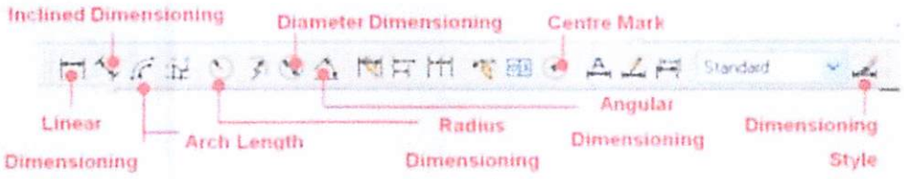


Figure 9: Dimension Toolbar

3.2Standardizing Dimension

As been discussed above, we can standardize our dimension according to the existing standard by clicking on the *Dimension Style* on the *Dimension Toolbar* (Figure 9). A new window of *Dimension Style Manager* will appear as shown in Figure 10.

We will now set a new dimensioning style named ISO (Figure 10). After renaming the *New Style Name*, click on *Continue* command (Figure 10) and *New Dimension Style Window* will appear (Figure11).. Setting of other parameters is shown in Figure 12–14.

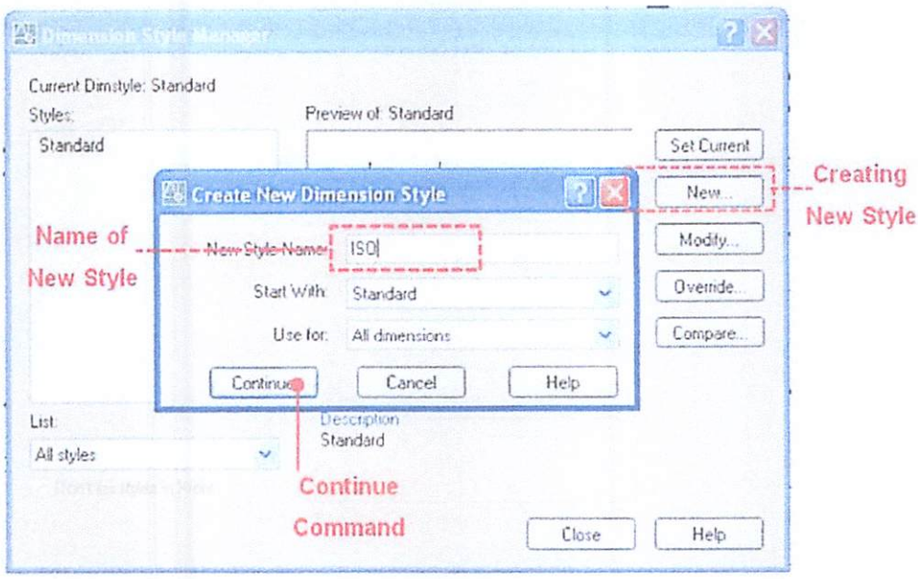


Figure 10: Dimension Style Manager Window

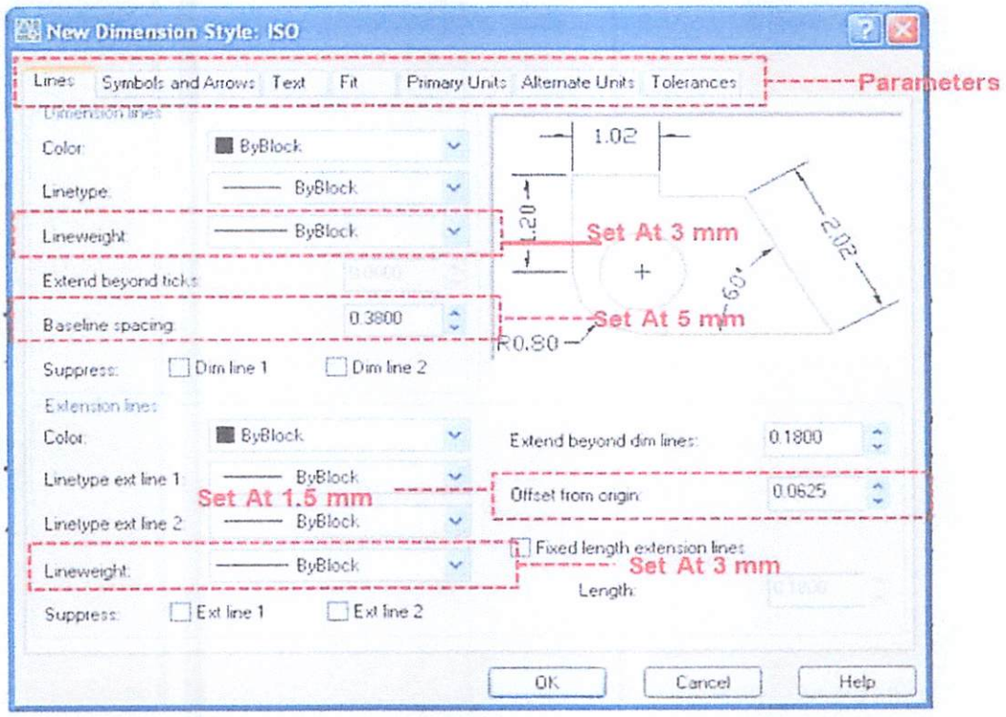


Figure 11: New Dimension Style Manager Window

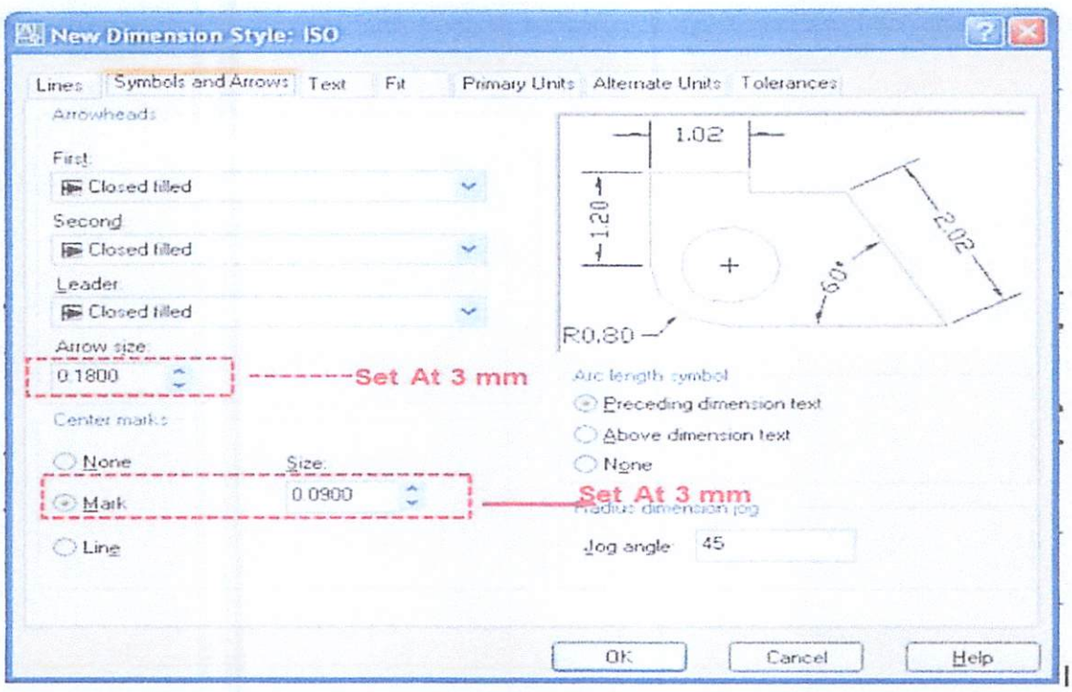


Figure 12: Setting of Symbols and Arrows

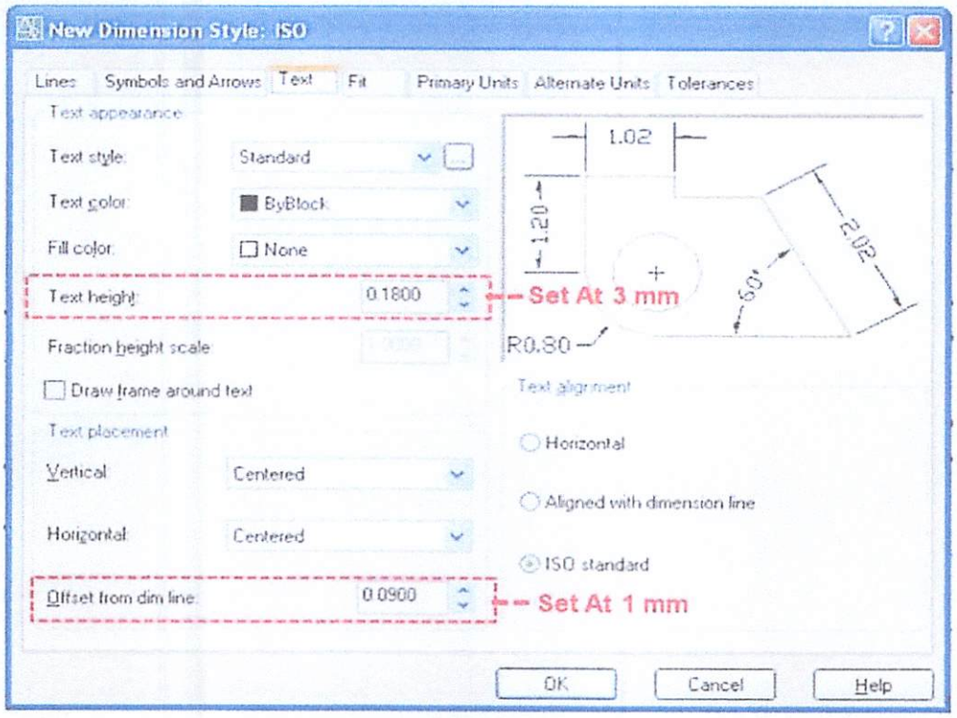


Figure 13: Setting of Text

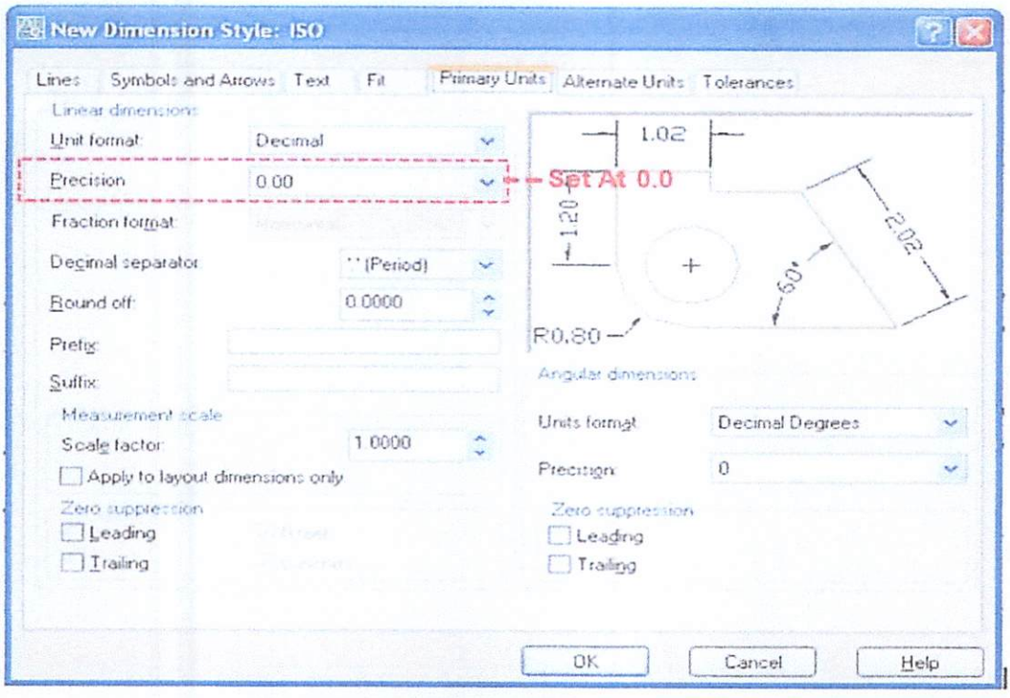


Figure 14: Setting of Primary Units

4. Tolerances

As dimensioning is one of the most important component in providing the actual size of a product, tolerance also play an important role in providing the permitted error in manufacturing of a product. Tolerance defines as the total amount by which a specific dimension is permitted to vary. The tolerance is the difference between the maximum and minimum limits allowed during the manufacturing process. Figure 15 shows example of dimensioning with tolerance.

To produce a dimension with tolerance, one must setup the parameter as we have done in section 3.2. Figure 16 shows the setting of tolerance parameter. Tolerance is important so that the production of a product is conducted within a given limits. Producing parts within the given range will enable the assembly process to be carried out easily. Usually, the overall tolerance of a product will be given in the Title Block (Figure 16)

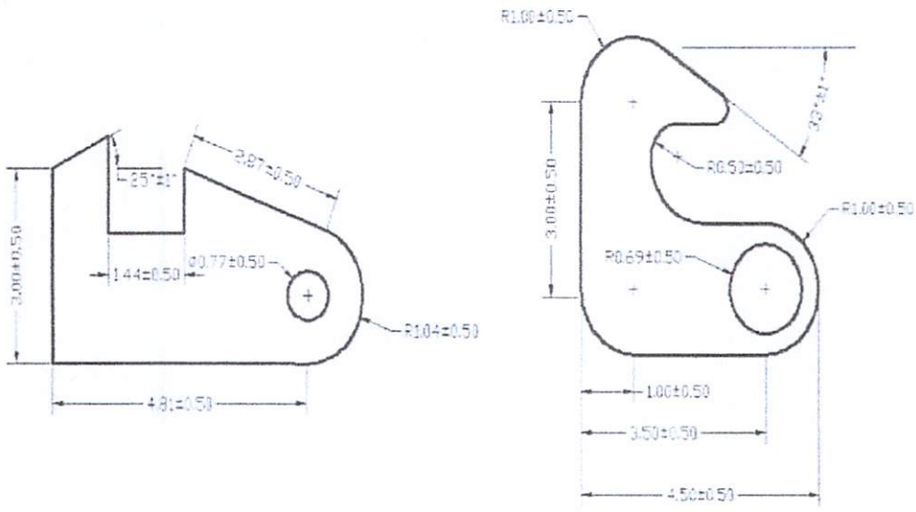


Figure 15: Example of Dimensioning with Tolerance

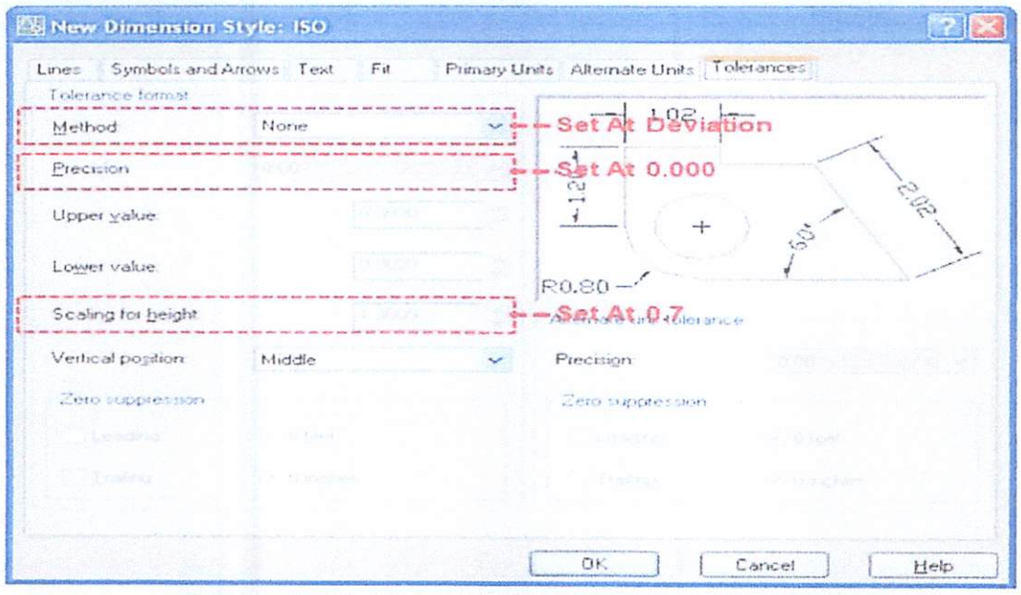


Figure 16: Setting of Tolerances for critical part

EVALUATION:

I. Answer the following questions: (10 points each)

1) What are the basic principles of dimensioning?

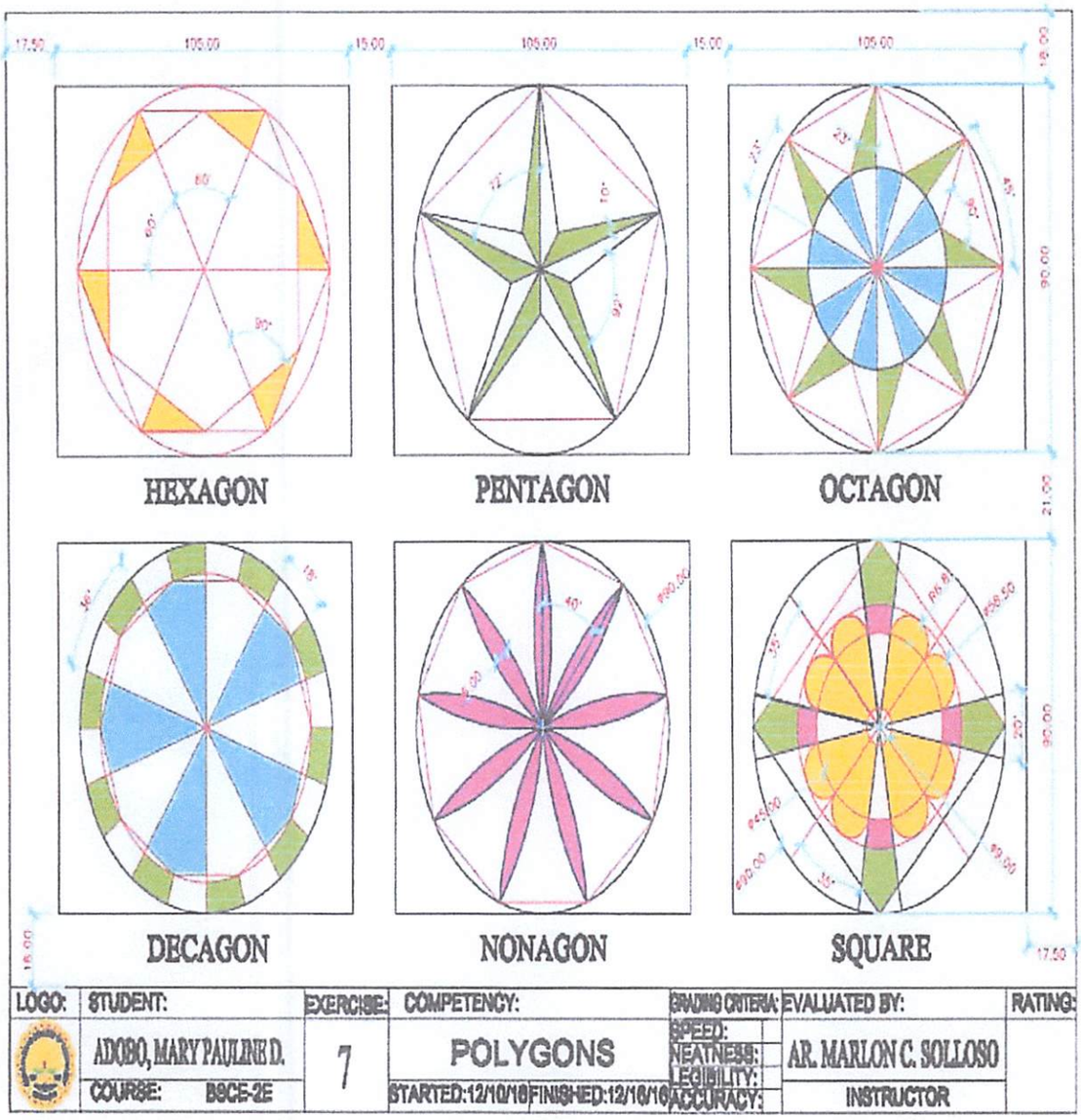
2) Enumerate the types of dimensioning. Explain each.

3) State the dimensioning guidelines.

4) What is Tolerance? How it is related with dimensioning?

II. Hands-on activity.

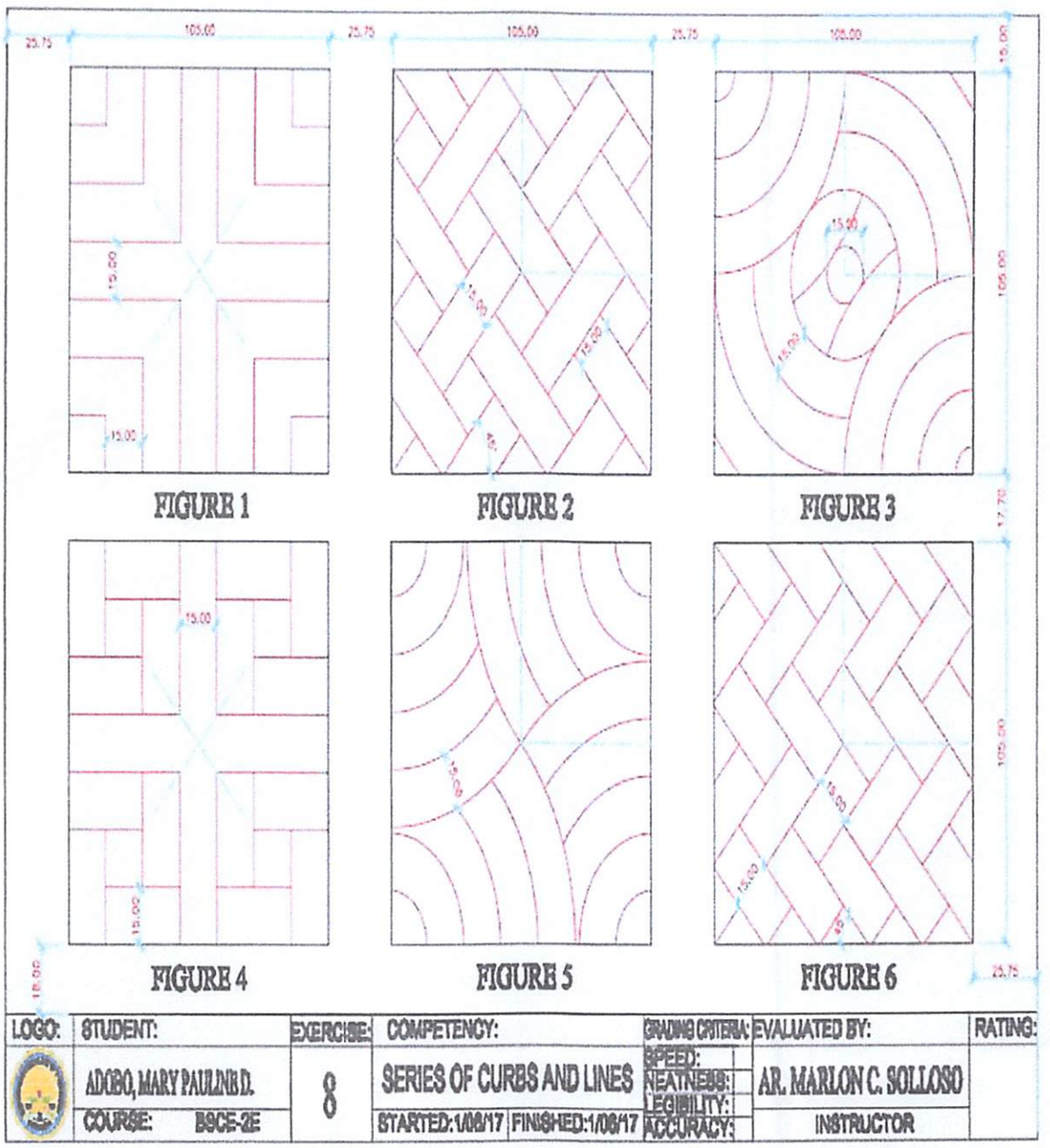
1. Plate no. 7



Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

2. Plate no. 8. Series of Curves and Lines

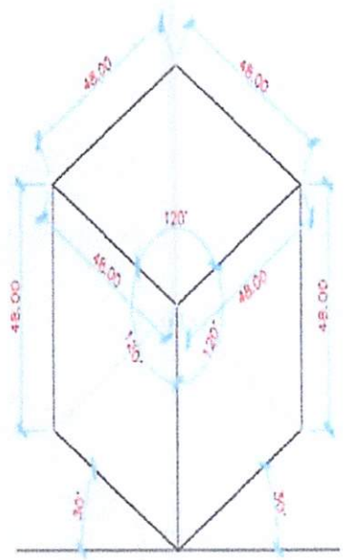


Scoring Rubric:

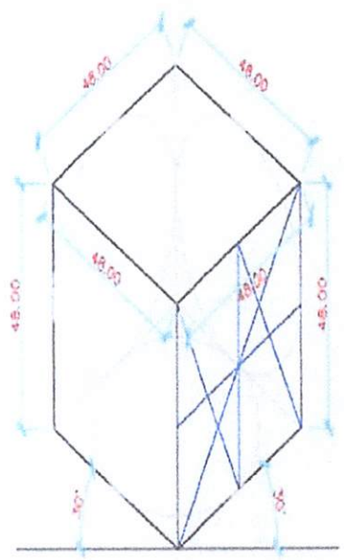
Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

3. Plate no. Isometric Drawing of Cube

A. Isometric drawing of a cube



B. Isometric circles on the three isometric



1. There are three axes, a vertical line, a line 30 to the left and a line 30 to the right.
2. These three lines are 120 apart and form a set of isometric lines.
3. When isometric lines are used as axes from which measurement are made, they are called isometric coordinate axes.
4. Vertical lines on the object appear vertical in the drawing.
5. Horizontal lines forming right angles (90) on the object are drawn at 30 to the horizontal.
6. Circles appear as ellipses.

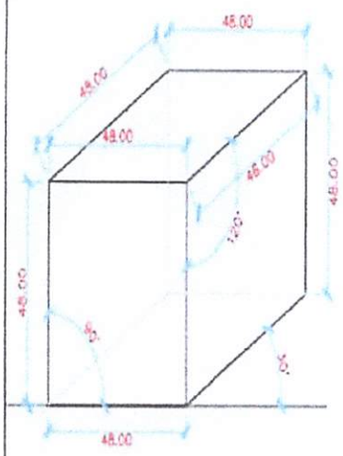
LOGO:	STUDENT:	EXERCISE:	COMPETENCY:		GRADING CRITERIA:	EVALUATED BY:	RATING:
	ADOBO, MARY PAULINE D.	9	ISOMETRIC DRAWING (CUBE)		SPEED: NEATNESS: LEGIBILITY:	AR. MARLON C. SOLLOSO	
	COURSE: BSCE-2E		STARTED:1/07/17	FINISHED:1/07/17	ACCURACY:	INSTRUCTOR	

Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

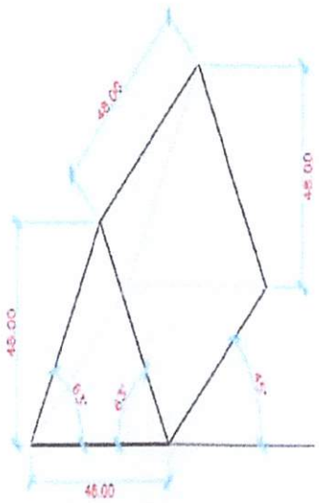
4. Plate no. 10 Isometric Oblique Drawing

A. 30 oblique drawing of a cube.



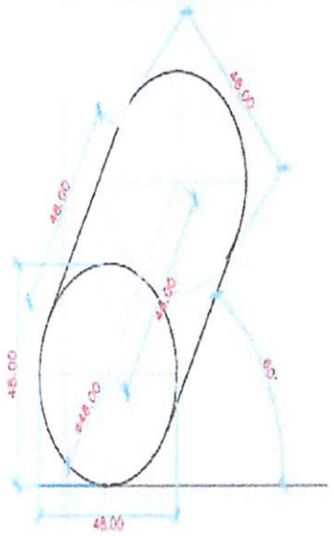
1. The axes consist of a horizontal line, a vertical line and line going back at any angle, but the most common angles are 30, 45 and 60.

B. 45 drawing of a triangular solid.



2. Circles, arcs and inclined lines normal thus avoiding drawing of ellipse.

C. 60 oblique drawing of cylinder.



3. Thickness or length is clearly seen and can be dimensioned.

LOGO:	STUDENT:	EXERCISE:	COMPETENCY:		GRADING CRITERIA:	EVALUATED BY:	RATING:
	ADOBO, MARY PAULINE D.	10	ISOMETRIC OBLIQUE DRAWING		SPEED: NEATNESS: LEGIBILITY:	AR. MARLON C. SOLLOSO	
	COURSE: BSCE-2E		STARTED:1/07/17	FINISHED:1/07/17	ACCURACY:	INSTRUCTOR	

Scoring Rubric:

Component	Points
Creativity	30
Craftsmanship	30
Perseverance	20
Design	20
Total	100

REVIEW OF CONCEPTS:

In this topic, you have learned that:

- Dimensioning is important in materializing a technical drawing into a product.
- There are three types of dimensioning; linear, circle and arc, and angle.
- There are dimensioning guidelines to be followed

POST TEST:

I. True or False. Read each statement very carefully. Write T if the statement is correct and write F if the statement if incorrect. Place your answers on the space before the number.

1. Angle dimensioning is used to show inclination of a line with a reference to other line.
2. Basically there are three types of dimensioning; linear, circle and arc, and angle
3. Linear dimension is used to show length of a linear line
4. Dimension of a circle or arc must be constructed together with the centre-line of the circle or arc.
5. As AutoCAD is computer software, dimensioning process should be expected to be easier and more accurate.
6. A build in command for dimensioning make it even easier for the AutoCAD user Dimensioning of a technical drawing must be done according to the existing standard such as BS308, ANSI and ISO.
7. There are several guidelines that must be followed in dimensioning.
8. We can standardize our dimension according to the existing standard by clicking on the Dimension Style on the Dimension Toolbar.
9. As dimensioning is one of the most important component in providing the actual size of a product, tolerance also play an important role in providing the permitted error in manufacturing of a product.
10. To produce a dimension with tolerance, one must setup the parameter .

REFERENCES:

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Mark Dix, Discovering AutoCAD® 2017, Pearson, USA

CAD Software User's Guide and Manual

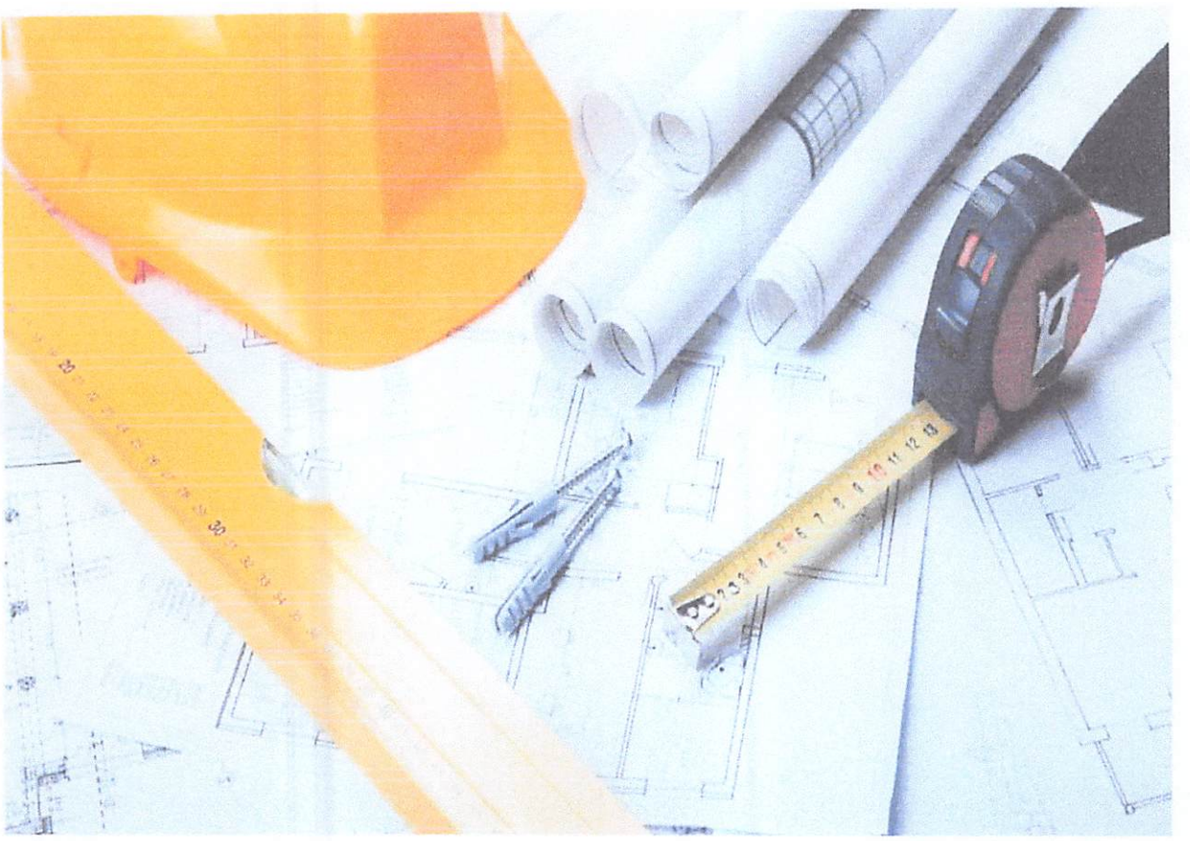
www.tutorialbook.info AutoCAD 2018 For Architectural Design

"For Nation's Greater Heights"

Republic of the Philippines
SURIGAO STATE COLLEGE OF TECHNOLOGY
Narciso Street, Surigao City

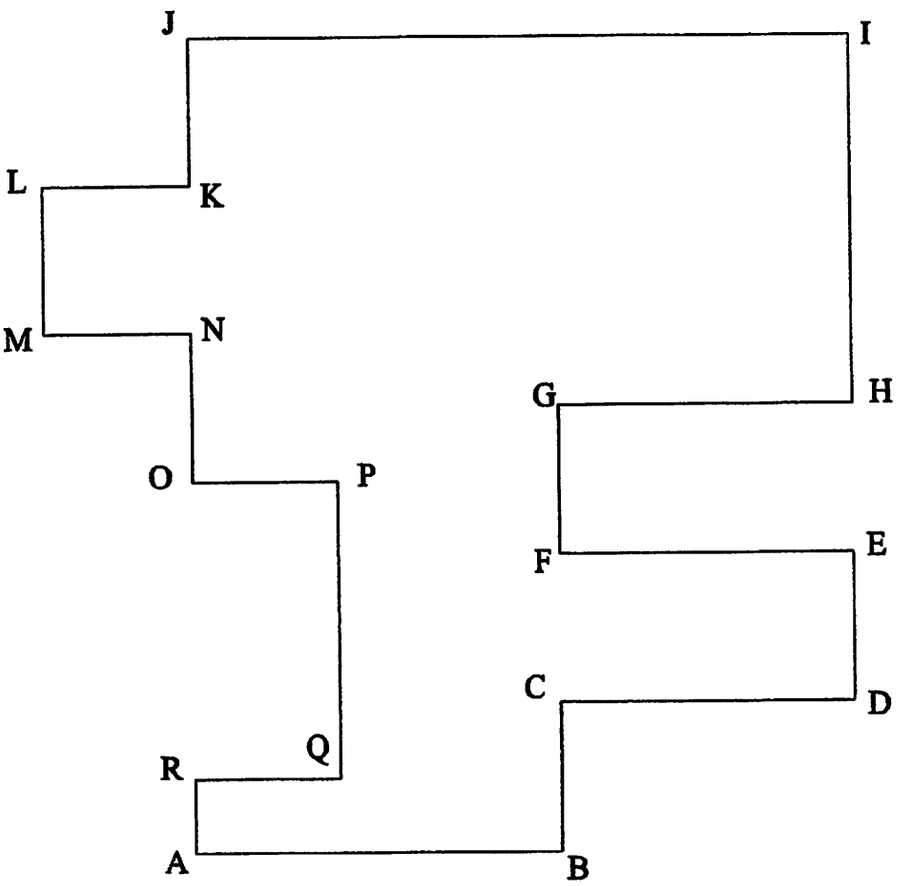
CERTIFICATE NUMBER: AJA19-0225

CAD
Learning Activities



ARCH. MARLON C. SOLLOSO – ASST. PROF. III (*ES 133- Computer Aided Drafting Instructor)*

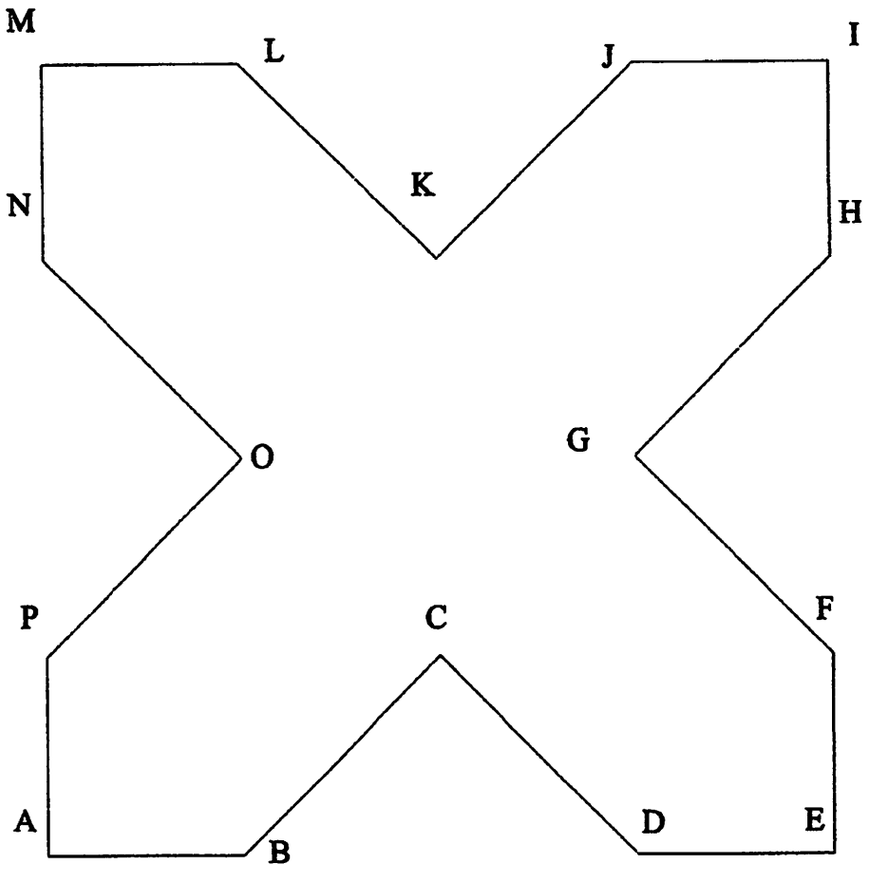
Exercise 1



Coordinates:
A= (100,100), B= (105,100), C= (105,102), D= (109,102), E= (109,104),
F= (105,104), G= (105,106), H= (109,106), I= (109,111), J= (100,111),
k= (100,109), L= (98,109), M= (98,107), N= (100,107),
O=(100,105), P= (102,105), Q=(102,101), R=(100,101).

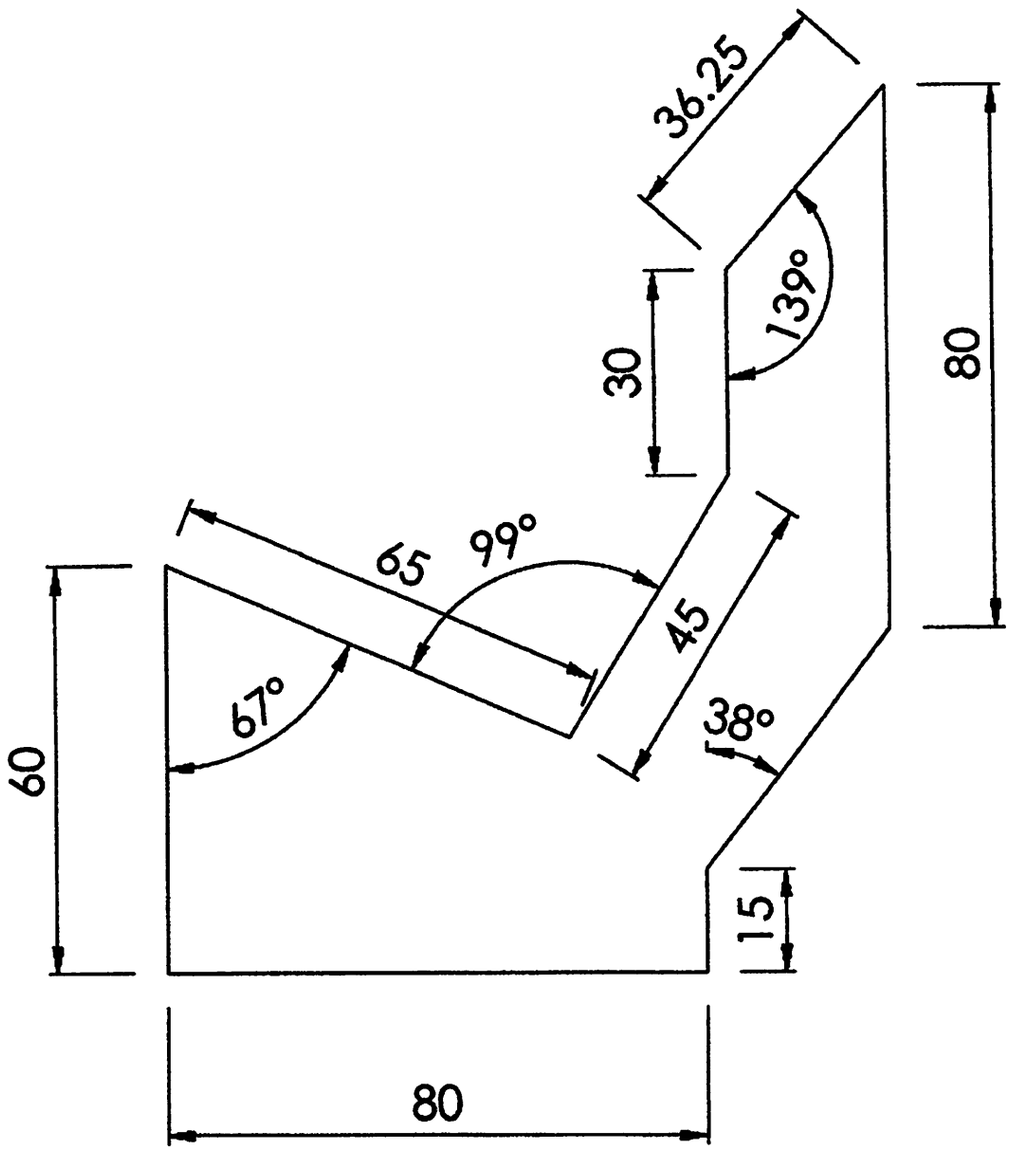
Exercises 1 and 2 are based on the concept of coordinates. You are expected to draw these figures using entirely the coordinate system and the command windows.

Exercise 2

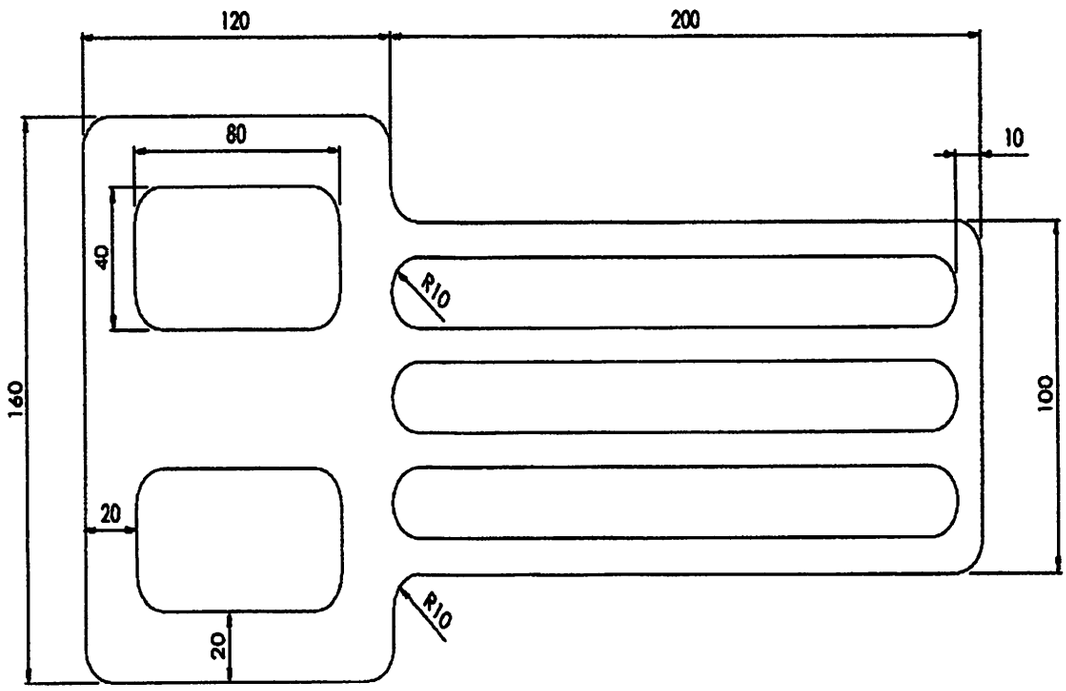


Coordinates:
A= (290,100), B= (340,100), C=(390,150),
D= (440,100), E= (490,100), F=(490,150), G=(440,200),
H= (490,250), I= (490,300), J=(440,300), k=(390,250),
L= (340,300), M= (290,300), N=(290,250),
O=(340,200), P= (290,150).

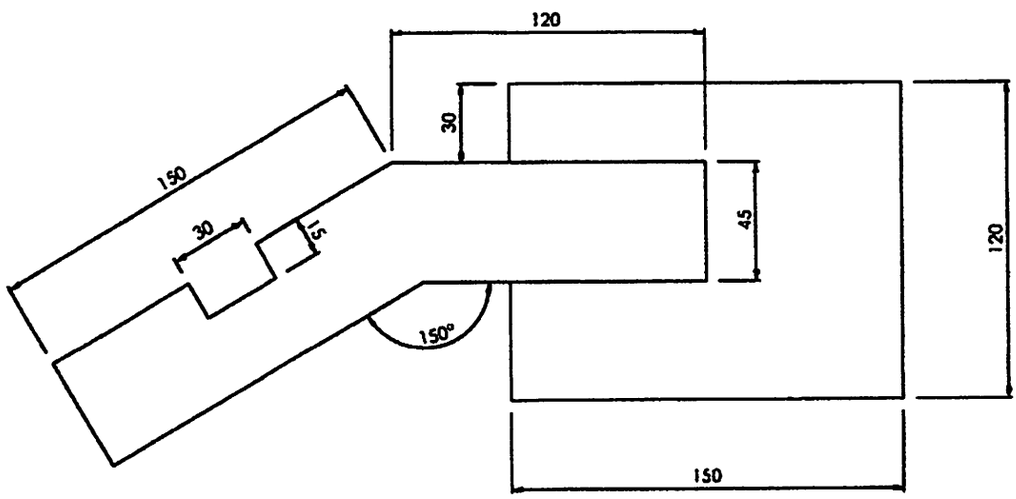
Exercise 3



Exercise 4



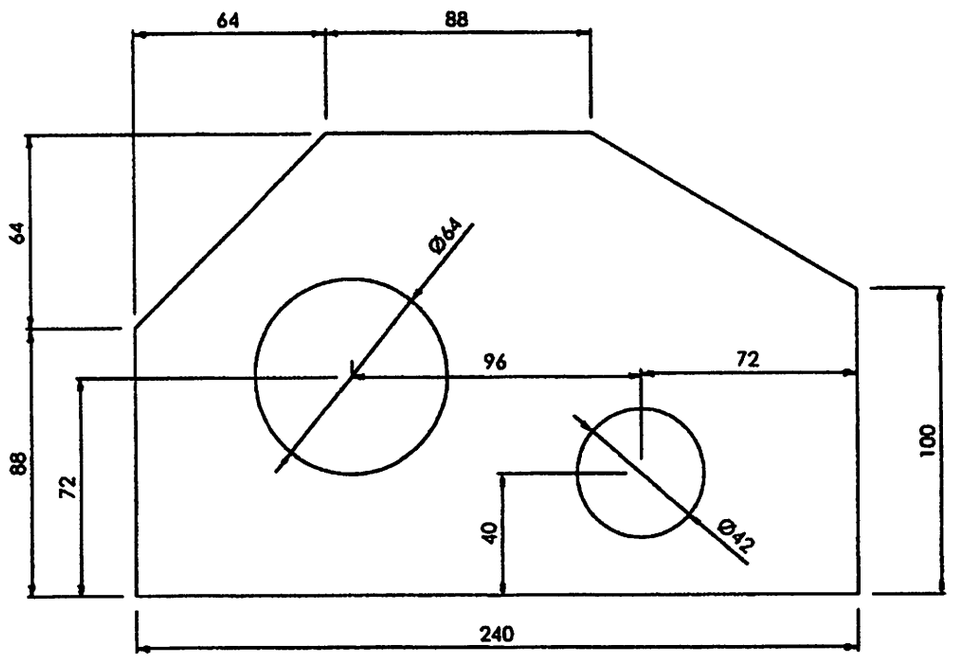
Exercise 5



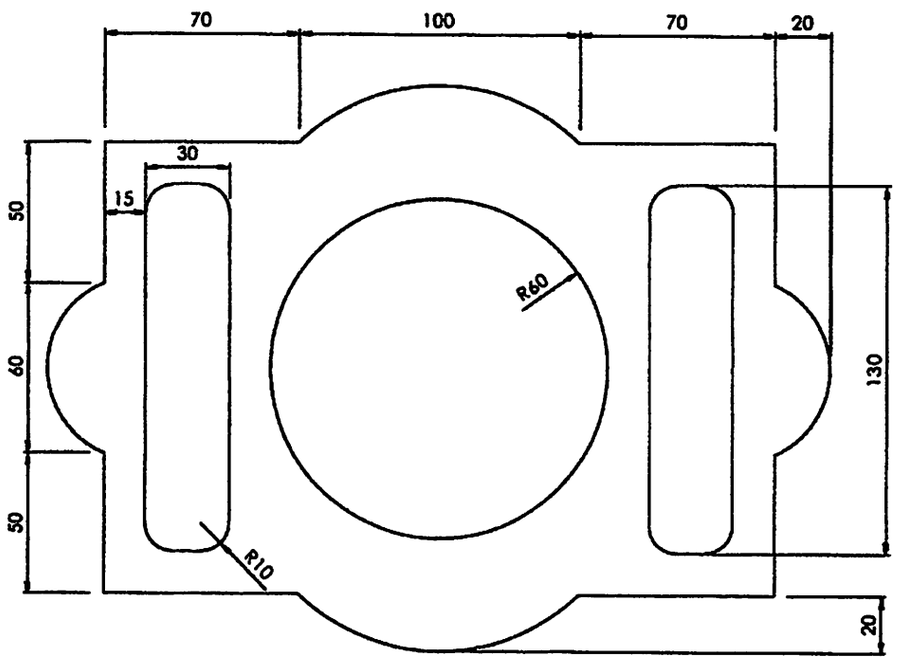
HINT:

Draw the line of length 150 straight (with 0 degree to the ground) before rotating it when you are done with it.
You can easily rotate it using the ROTATE command. How about the angle?

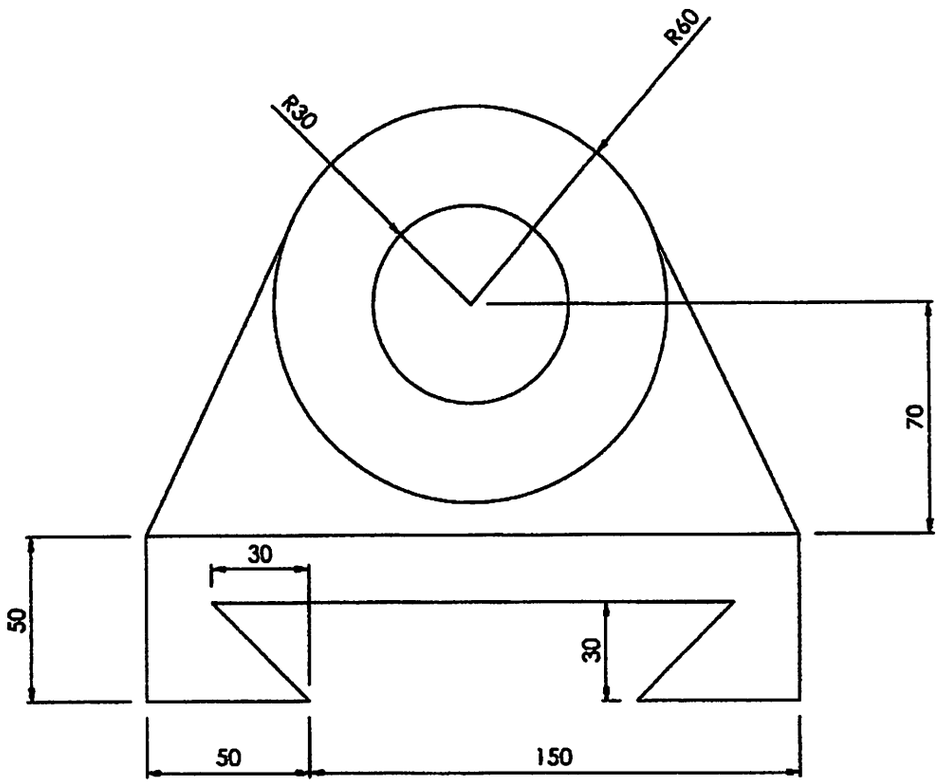
Exercise 6



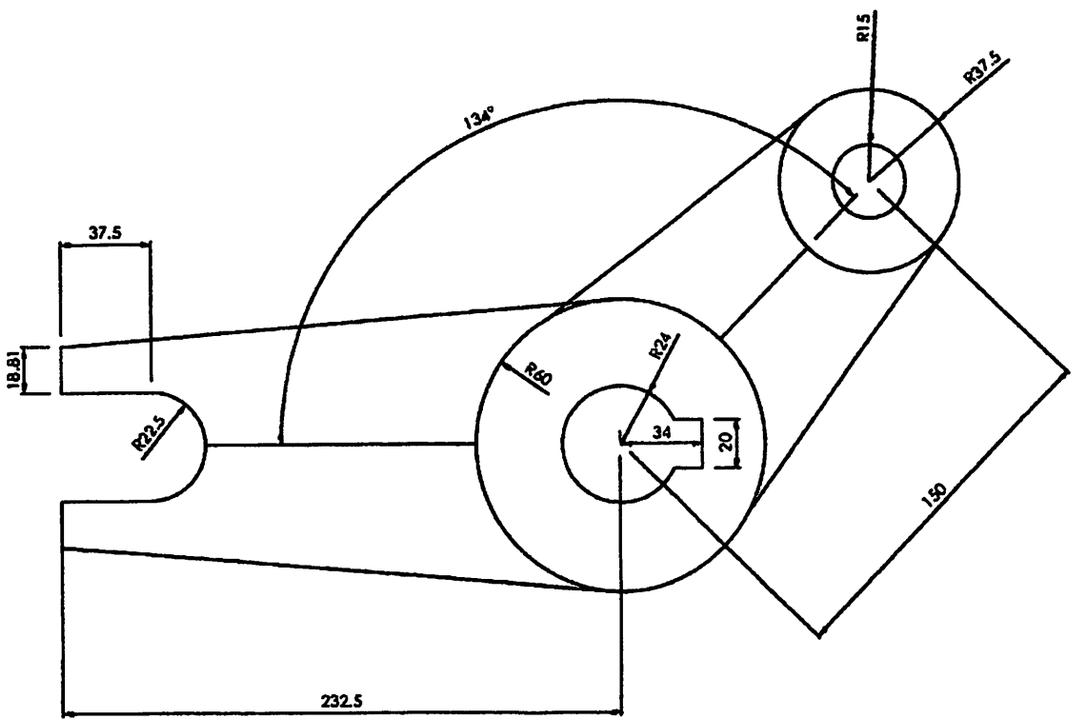
Exercise 7



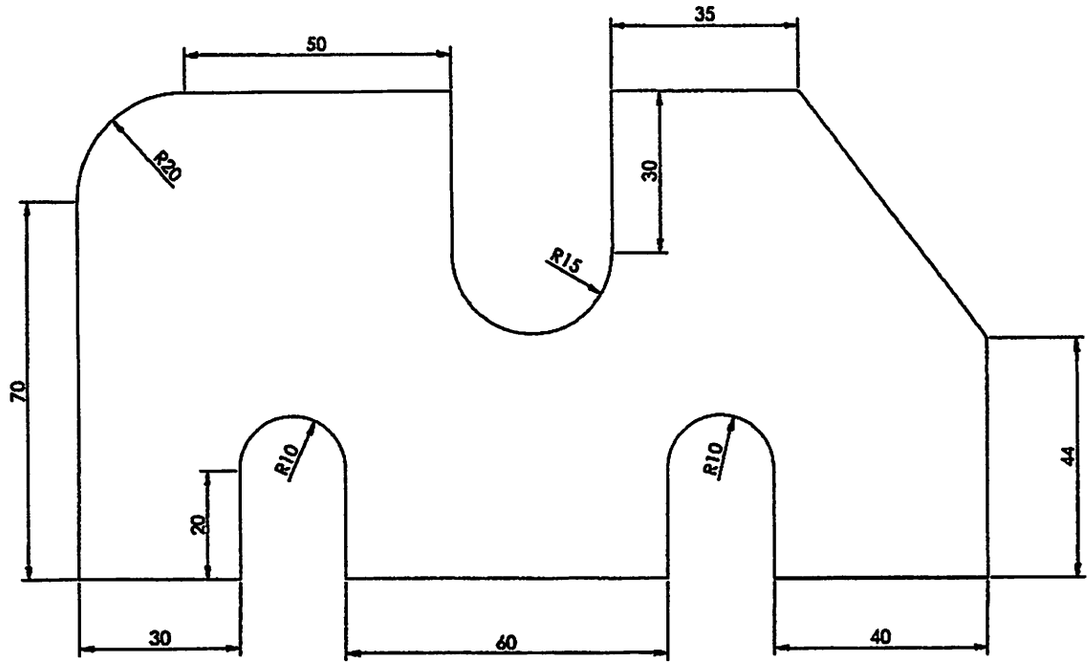
Exercise 8



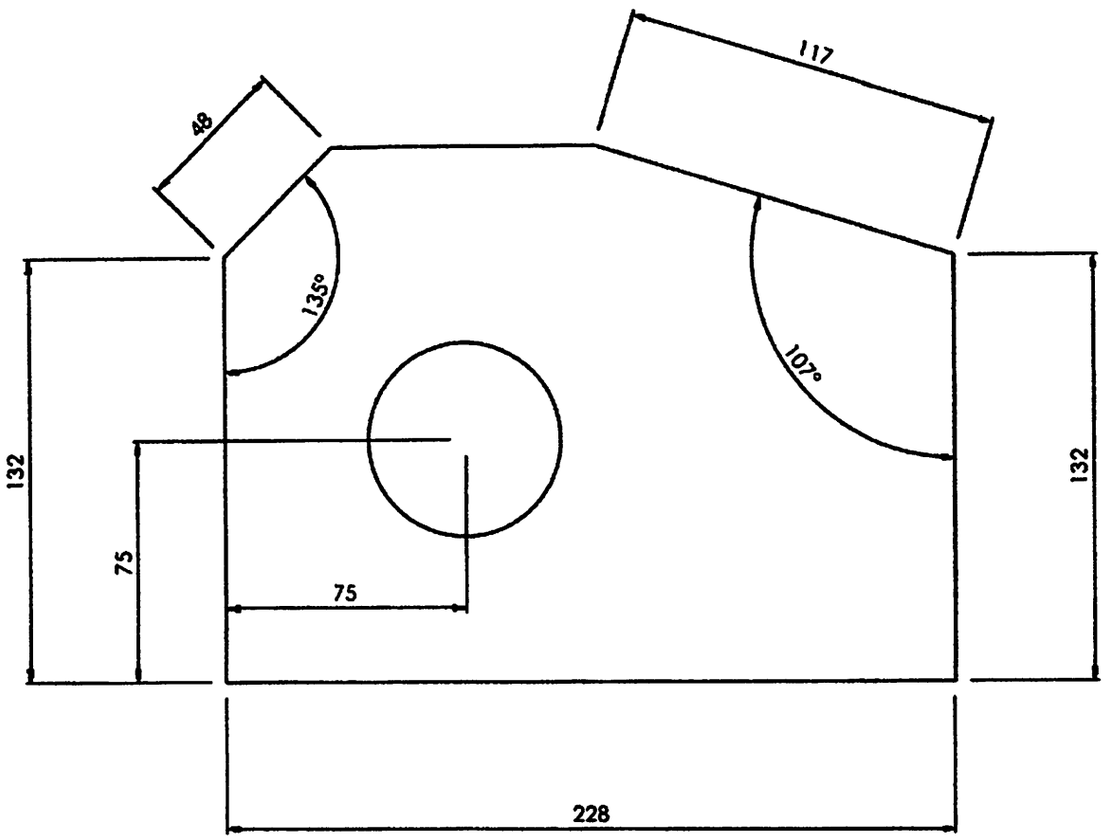
Exercise 9



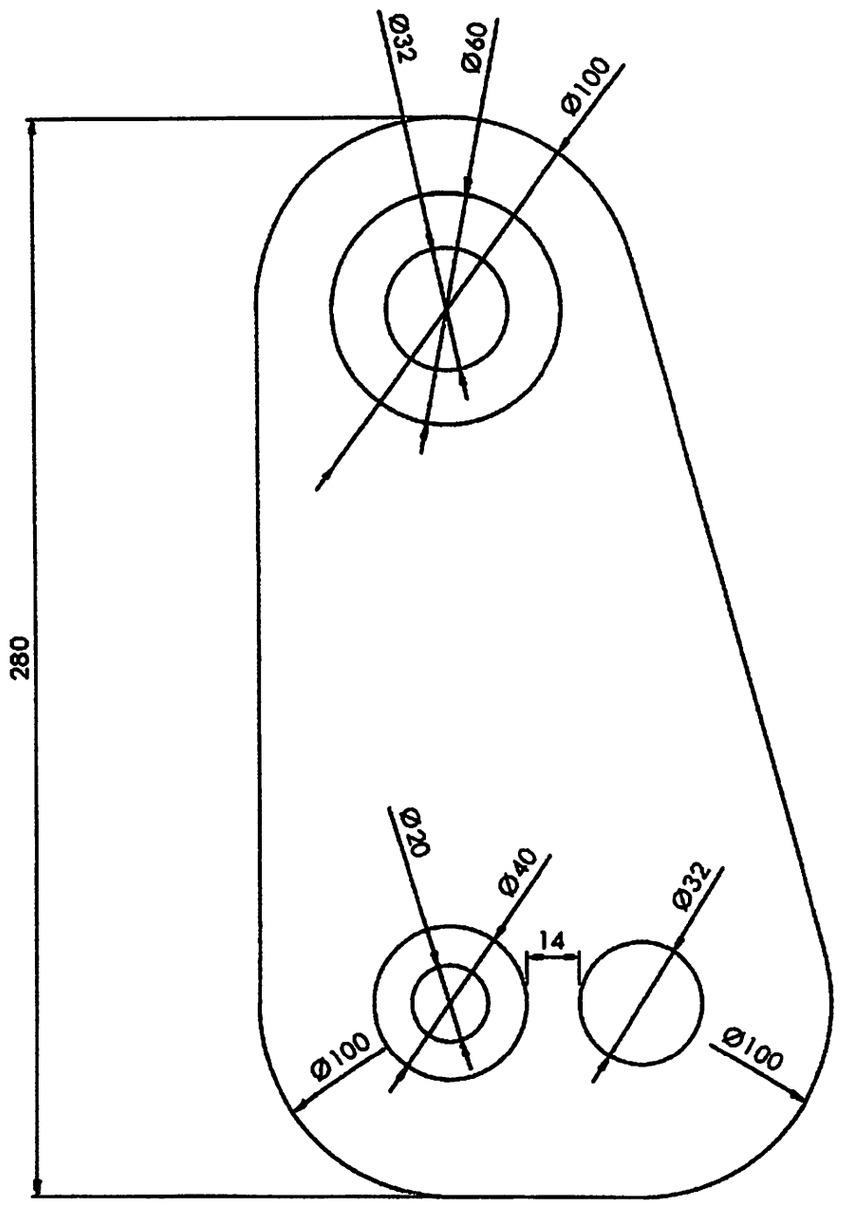
Exercise 10



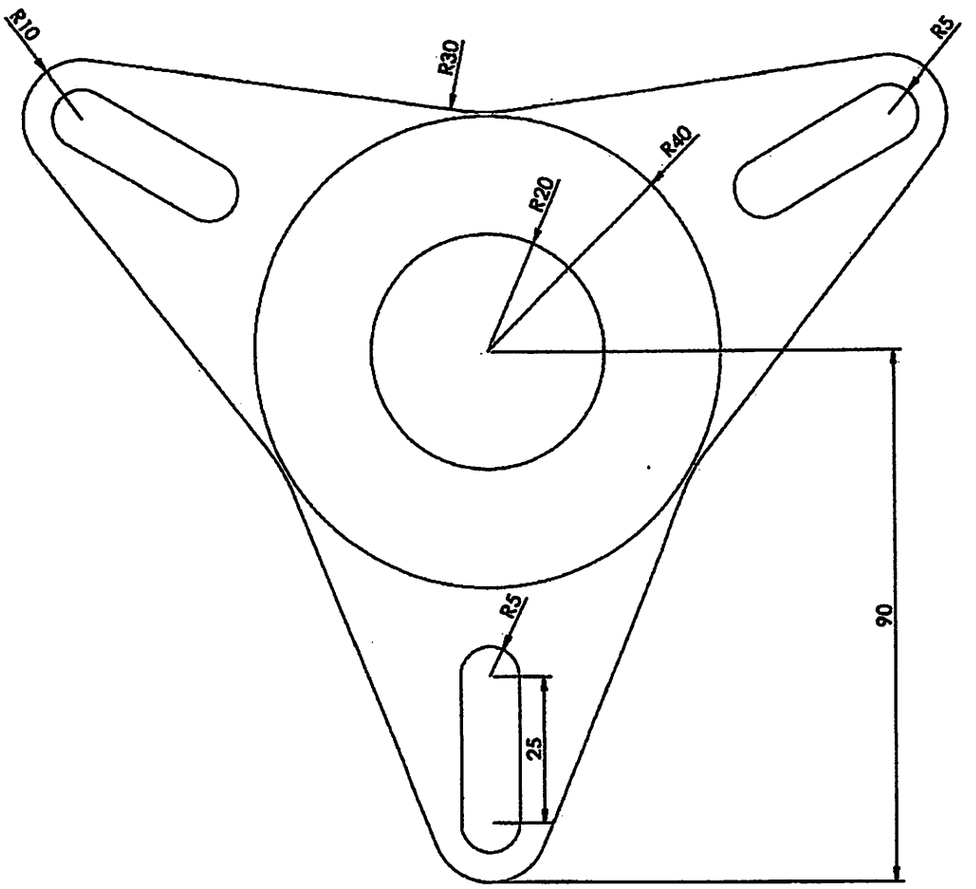
Exercise 11



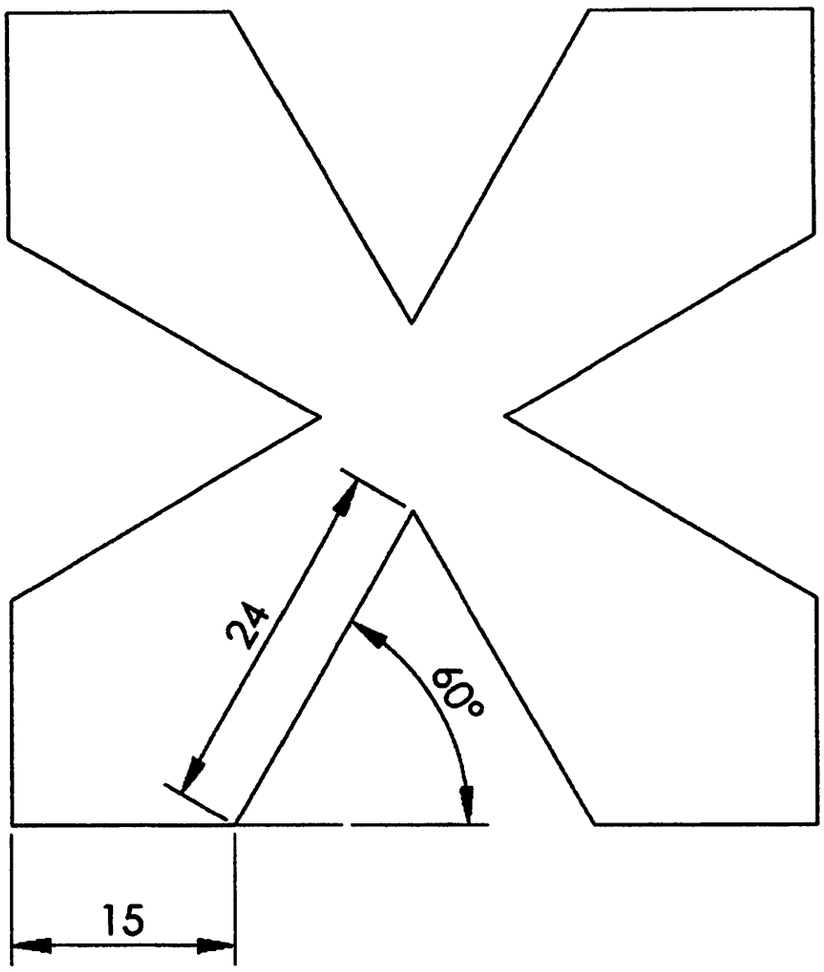
Exercise 12



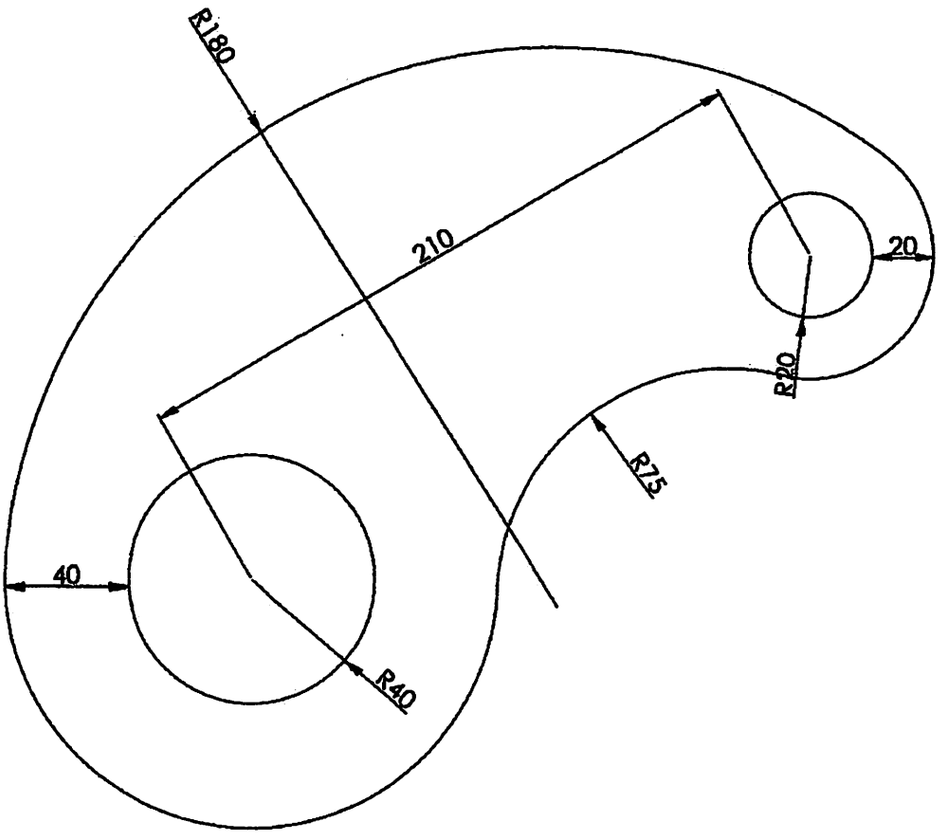
Exercise 13



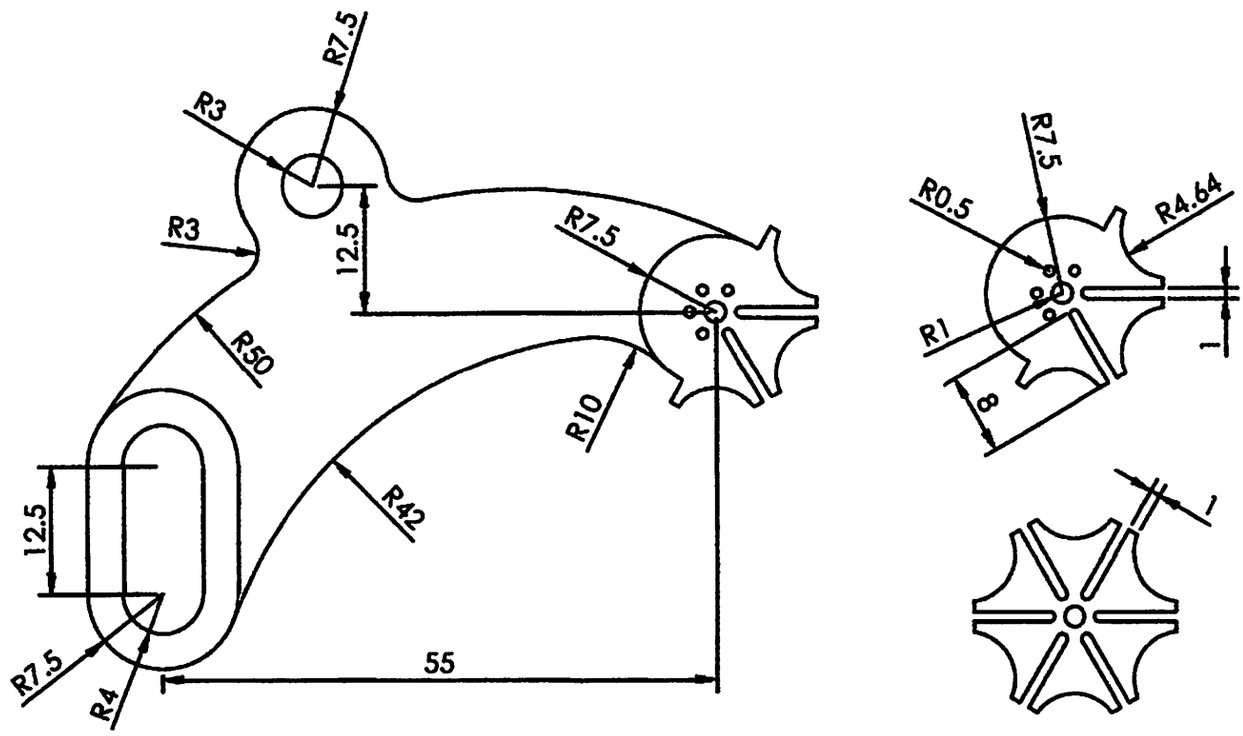
Exercise 14



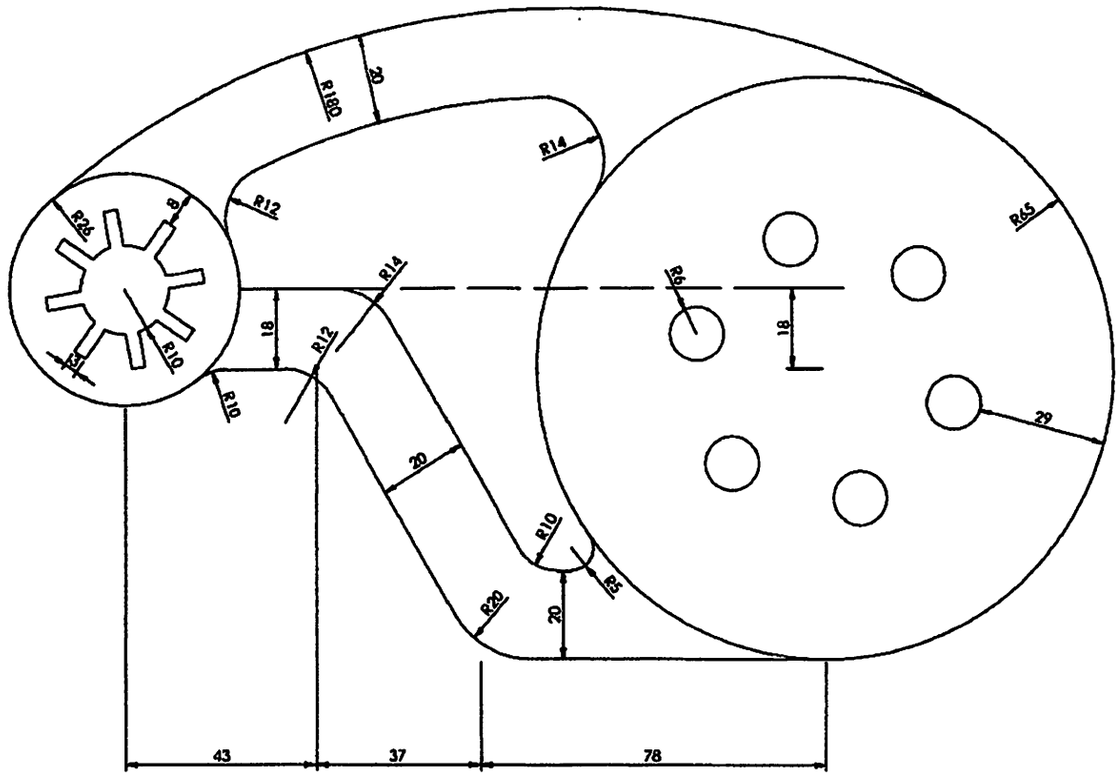
Exercise 15



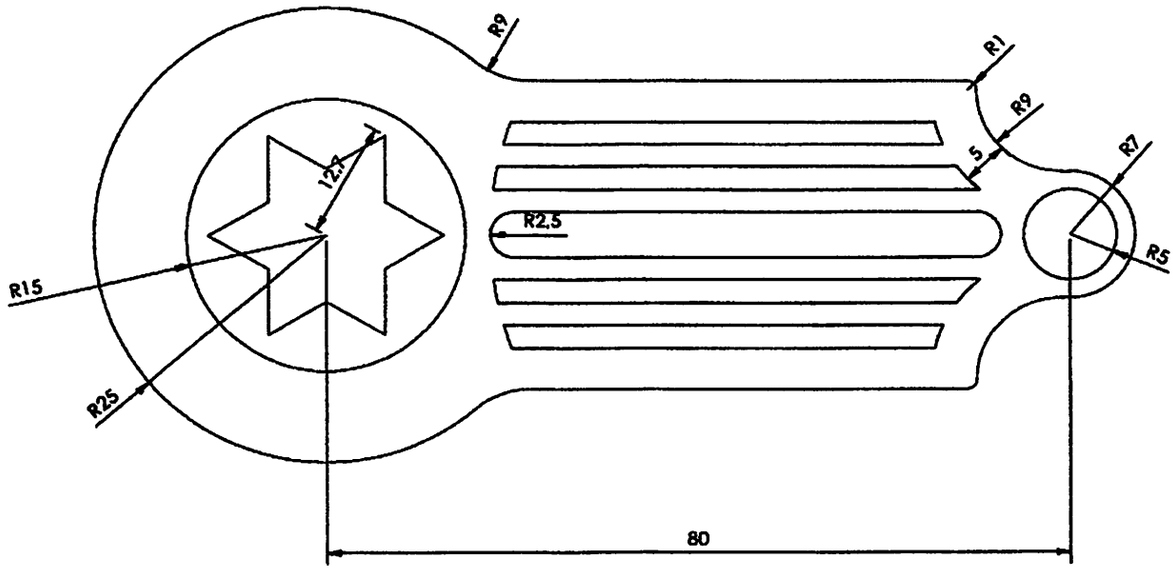
Exercise 16

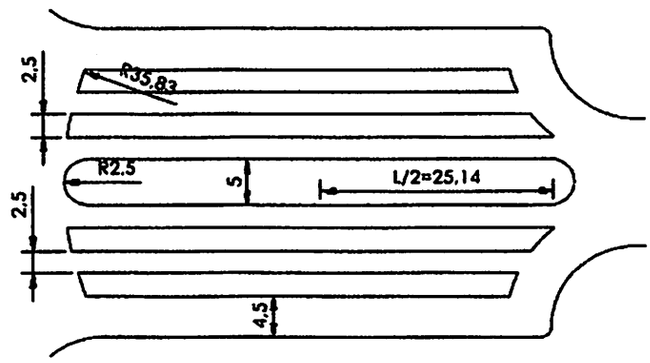


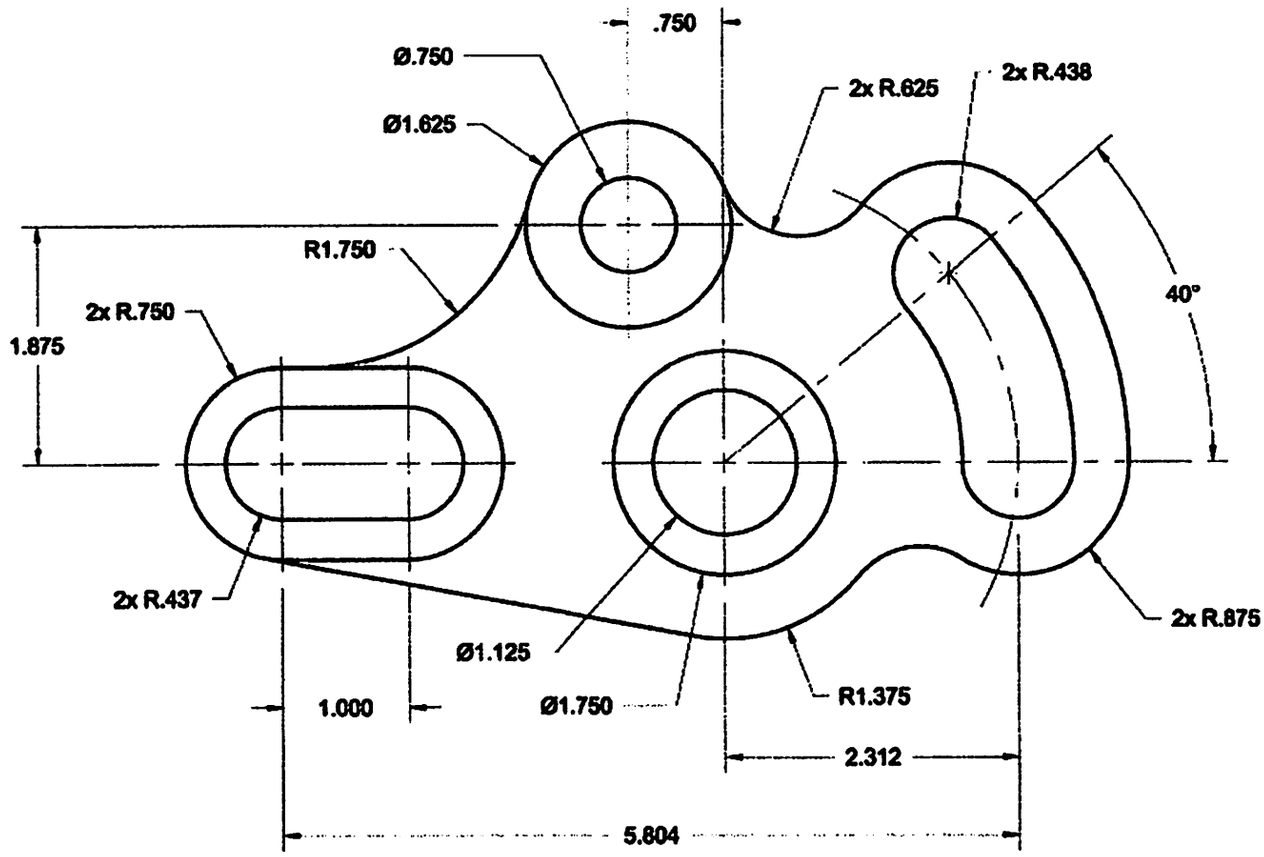
Exercise 17


R180
20
R14
R12
R24
8
R14
R6
R45
18
18
R12
R10
R10
29
20
R10
R5
R20
20
43
37
78

Exercise 18

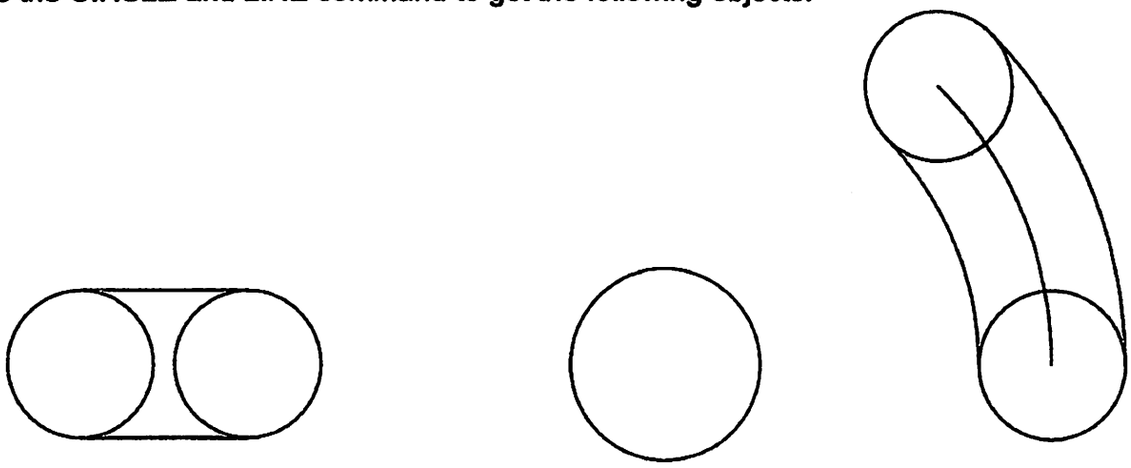




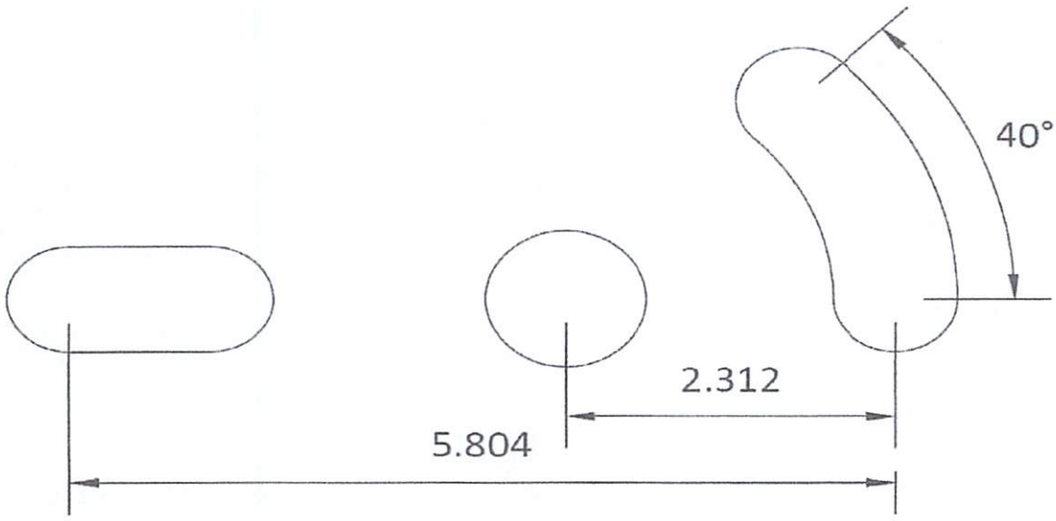


Hint:

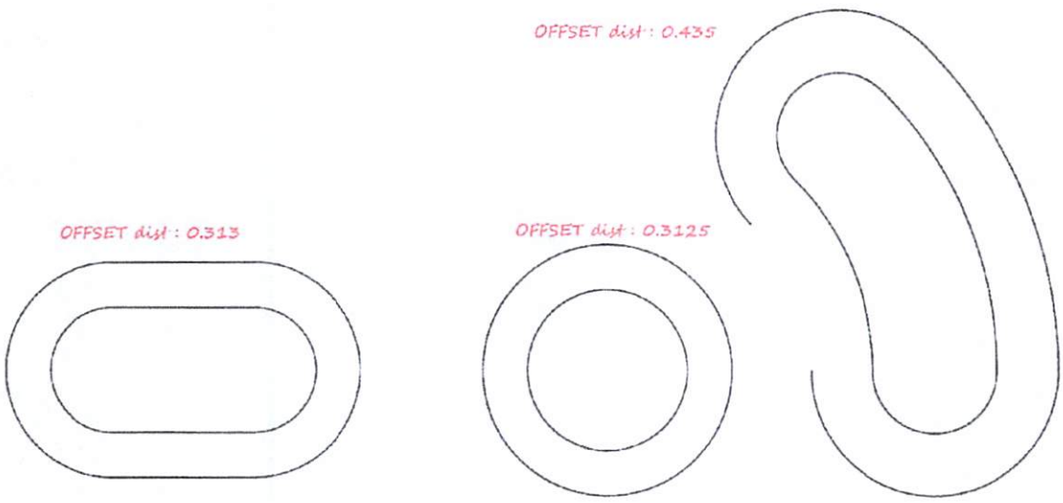
Use the CIRCLE and LINE command to get the following objects.



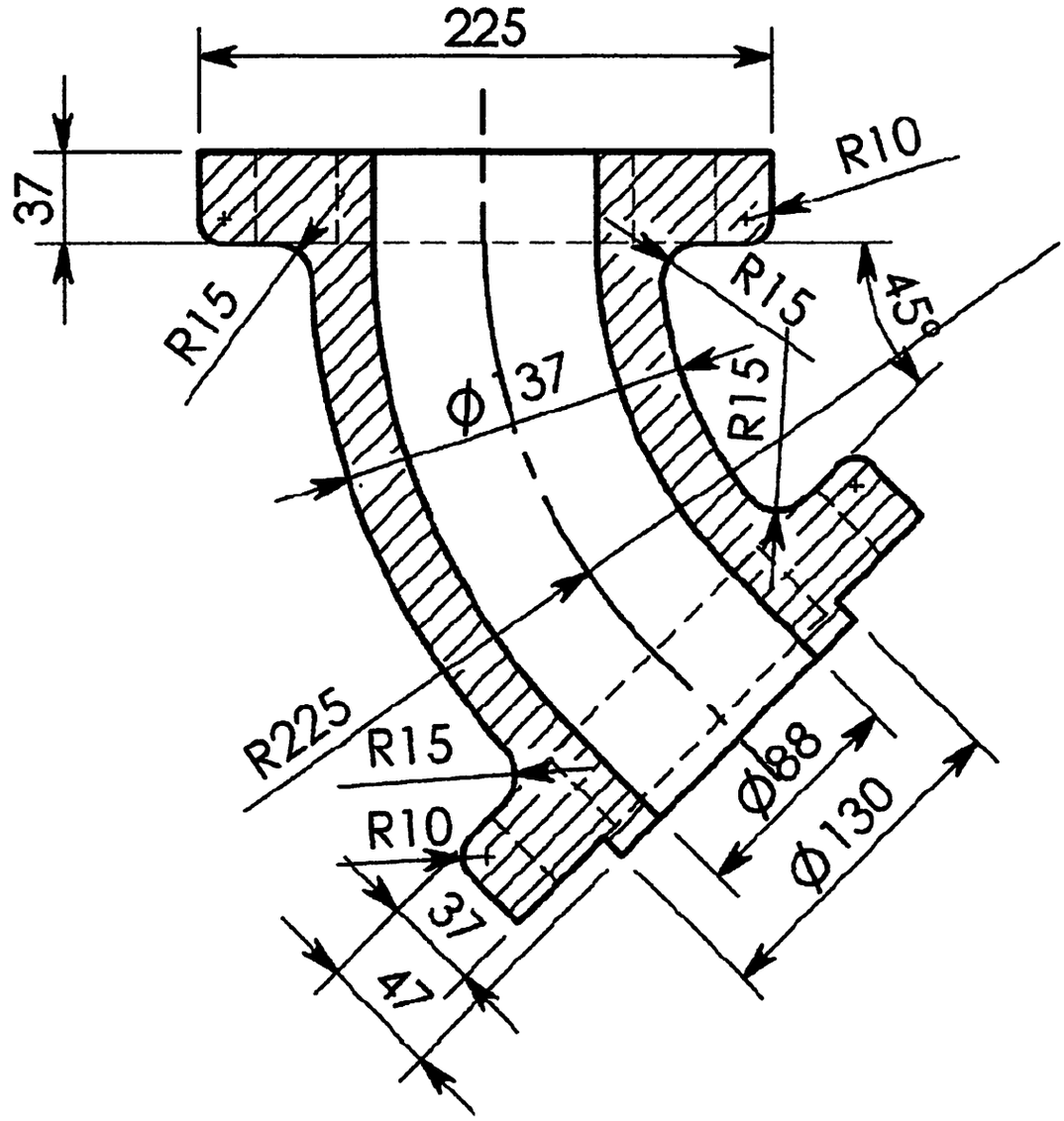
Clean it up using the TRIM command, you should have this



Use the OFFSET command to get the outer image of each block. You will need to find the appropriate OFFSET dimension for each block.



Today we have this "bent pipe joint" in 2D to draw as an exercise in AutoCAD. You can go ahead a use the HATCH command at the end of the design, nonetheless the more important in this exercise is to use a little bit of thinking and all techniques we have learned to get the curve right. All dimensions from your design should coincide with the one in the exercise.



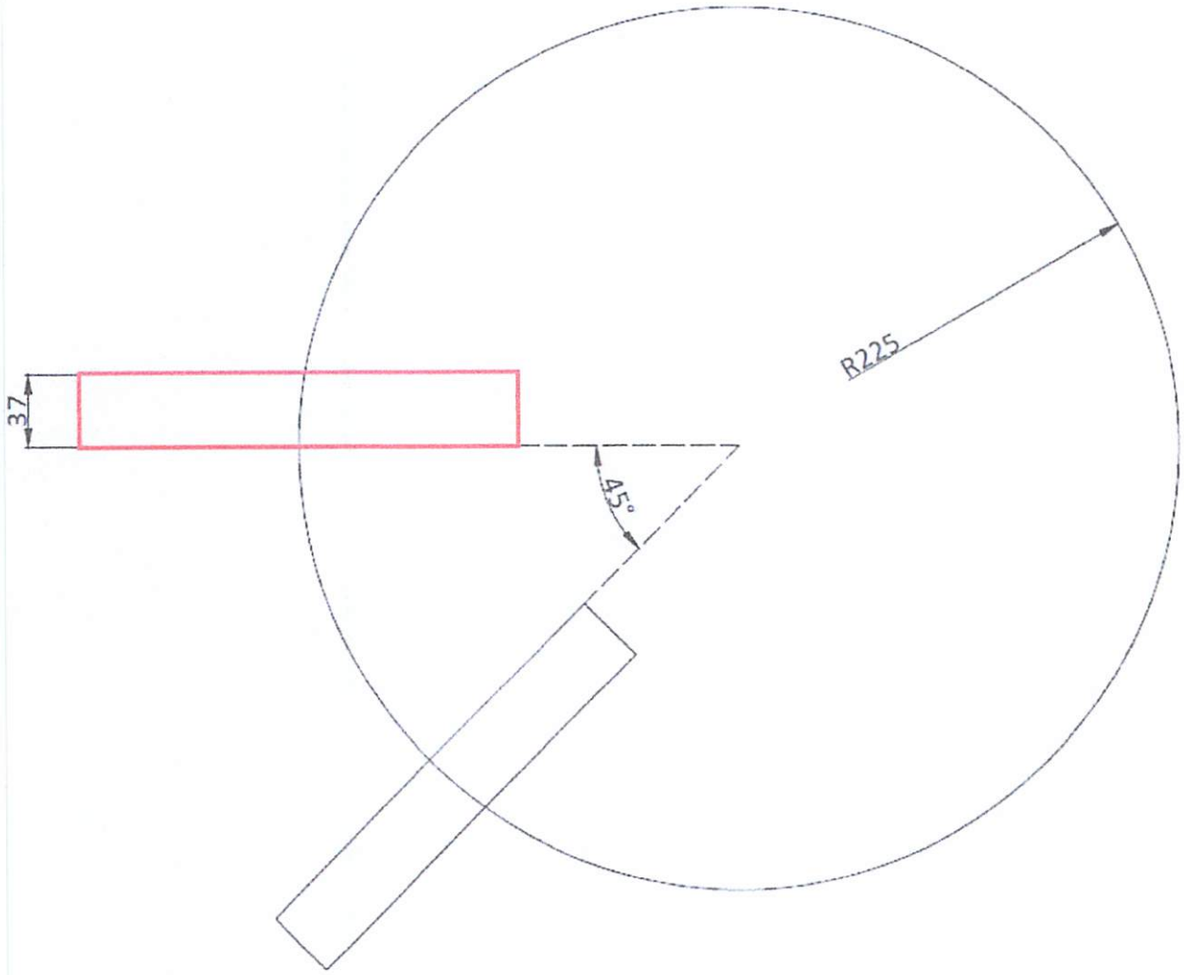
Hint:

The most tricky part in the exercise in my opinion is to get the curve shape right, and to place the two ends at their right positions.

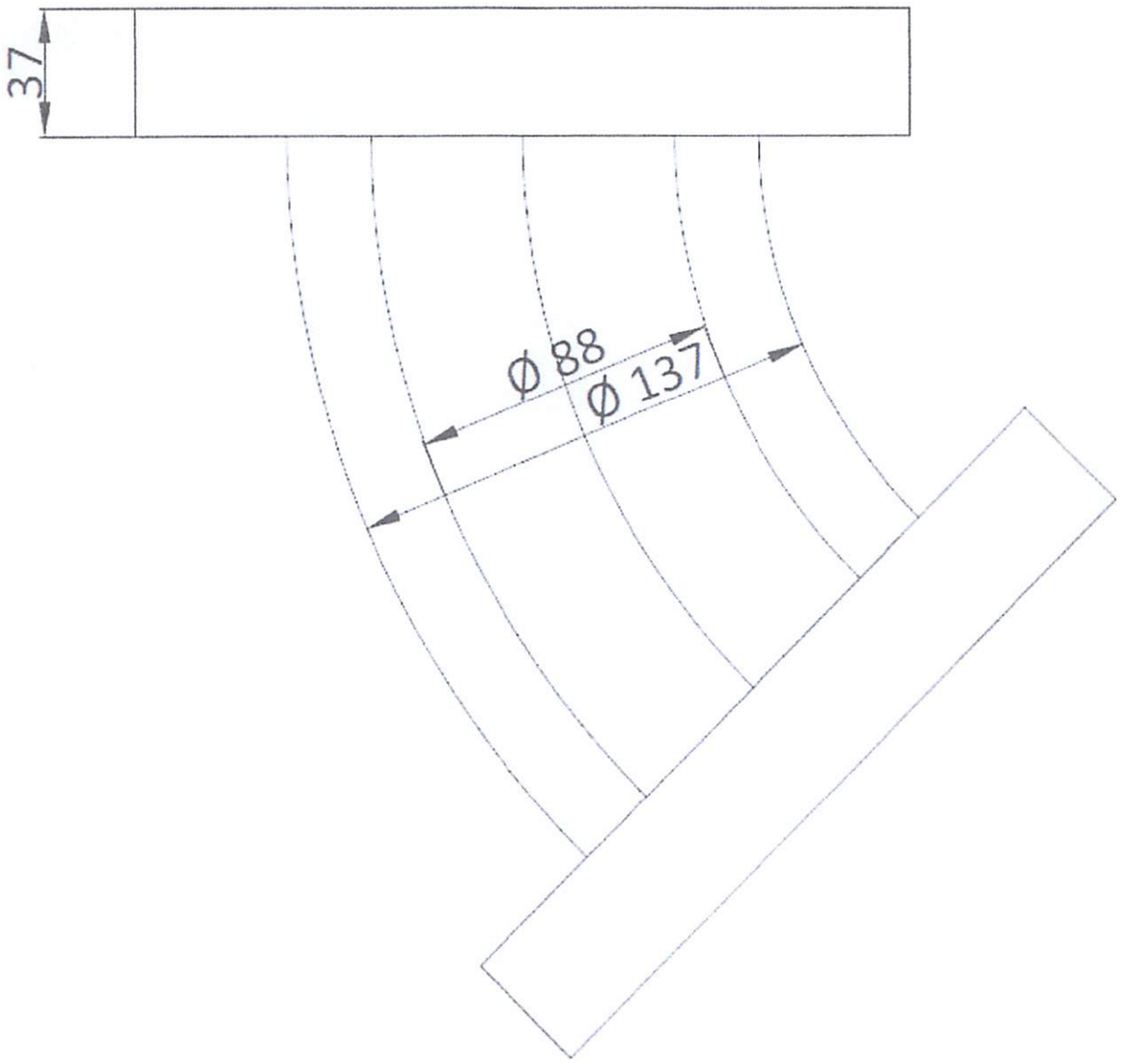
To achieve this. Use the trick shown below.

Draw the rectangle 37 x 225 and rotate is around the R225 circle with an angle of 45 degrees. And use the R225 circle to obtain the curve of the bent.

The circle intersect the rectangle at the center of the lower side.



Use the OFFSET COMMAND to get outer lines from the one left by the R225 circle. You can easily find the OFFSET distances using the inner and outer diameter of the pipe.



All hard parts have been done. You will need to use the FILLET command to get those rounded corners.