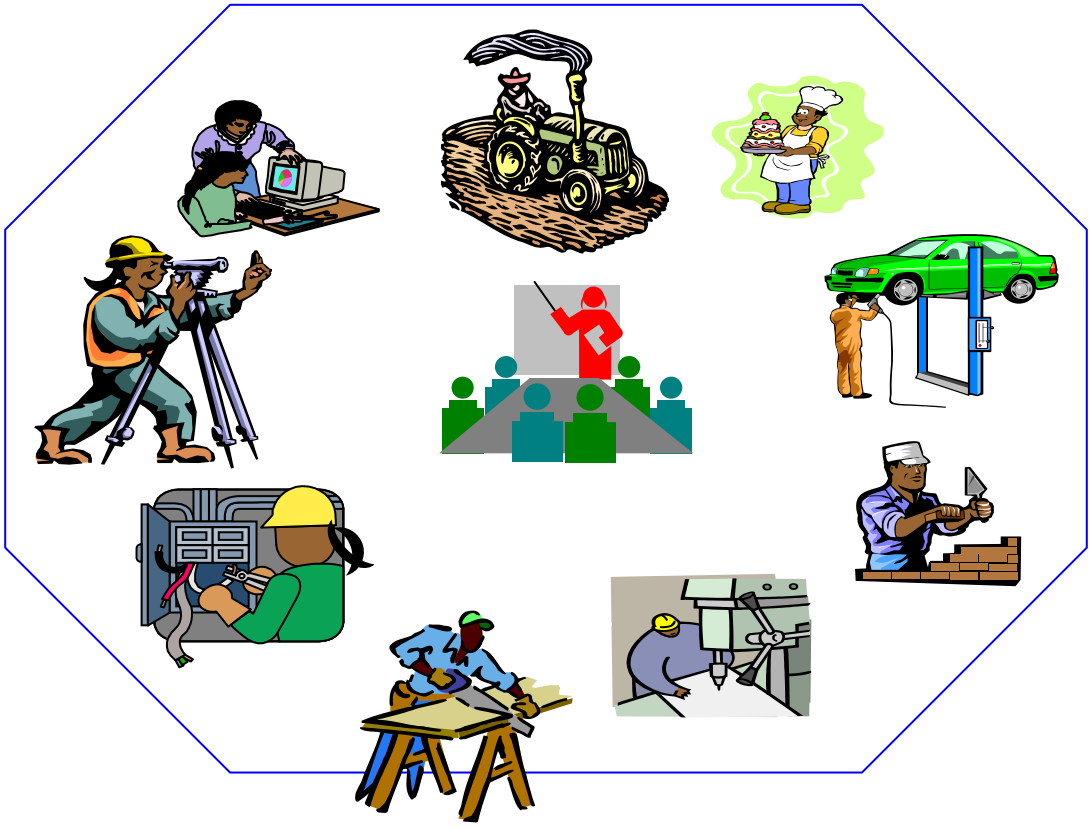
FURNITURE MAKING OPERATION MANAGEMENT LEVEL IV V1

Based on September, 2012, Version 2 Occupational standards (OS)

LEARNING GUIDE -40-42



Module Title: Developing Prototype According to Design

LG Code: IND FOM4 M10 LO (1-3)LG (40-42)

TTLM Code: IND FOM4 TTLM 0221 V1

February 2021
Adama, Ethiopia

Table of Contents page

LG #31	LO #1- Determine job requirements

Instruction sheet

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

- Identifying requirements from design program and brief.
- Interpreting drawings instructions and specifications
- Selecting to meet appropriate material specifications
- Considering available resources program requirements
- Referencing the actual context.
- Preparing detail specifications.

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

- Identify requirements from design program and brief.
- Interpreted drawings instructions and specifications
- Selected to meet appropriate material specifications
- Considered available resources program requirements
- Reference the actual context.
- Prepare detail specifications.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering If you earned a satisfactory evaluation proceed to "Operation sheets
6. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	Identifying requirements from design program and brief..

Identifying requirements from design program

Product design strategies Design for Environment, Design for Assembly and Design for Dis - assembly aim to reduce the environmental impact of products and increase the recycle ability level of products throughout the product life cycle. However, there is one drawback. If only one environmental issue is focused on, it can negatively influence other issues so that the environmental impacts of the product may be increased. all product life-cycle approaches should be considered together in choosing product design strategies .

Design for Environment

Design for Environment (def.) includes any design process whose goal is to reduce the environmental impact of products during their life cycle. Many Def. methodologies have been developed and many companies have establishing their own processes in applying these methodologies to their products. Generally, these methodologies have been focused on the life cycle of parts or products and their function during this cycle aimed at applying them in the design process

DfE consideration in product design and manufacturing process can be ordered as following First understanding the relationship between furniture product and environment Developing an initial product design Apply DfE strategies to the product

Design for Environment strategies are aimed at:

- Reducing the material content and energy required in the manufacturing process”
- Increasing the use of recycled parts”
- Increasing the number of reused parts”.

DfE studies are mainly associated with End-of-Life Stages because of waste handling problems. Some of Design for Environment strategies based on minimizing End of Life impacts are remanufacturing and reusing product should be also design in terms of cost effective remanufacturing and landfill waste reduction. Also, a set of Design for Environment rules are suggested below which summarized the guidelines in various Design for Environment methods and tools .

- Do not use toxic substances”

- Minimize energy use and material consumption in manufacturing and transportation”
- minimize energy and resource consumption in product use” Promote maintenance”
- Provide long life”
- Use structural features and high quality materials to minimize weight”
- Use better materials, surface treatments or structural arrangements to protect products from dirt, corrosion and wear”
- Arrange in advance for upgrading, repair and recycling, through good access, labeling, modules and breakpoints, and provide good manuals”
- Promote upgrading, repair and recycle by using few, simple, recycled, unblended materials, and do not use alloys”
- Use minimum joining elements possible, using screw, adhesives, welding, snap fits, geometric locking etc. according to Life Cycle Analysis”.

These suggestions may be summarized under the following three focus points:

Focus on the disposal of the products: Waste is an important problem in landfills so that disposal of products comes into prominence. The product should be disposed of according to the following waste disposal hierarchy reuse, recycle, remanufacture and incinerate to decrease landfill disposal

Focus on the use of certain materials in the product life cycle: This point focuses on the use of renewable and biodegradable materials bio-degradable wooden furniture .there are environmental problems associated with their production and use. Composite materials have drawbacks because they can seldom be recycled into useful products .Also, the chemicals they contain increase their environmental impact. However, using wood composite materials in furniture give more opportunities to produce easy to assemble and disassemble furniture.

Focus on product life: Durability, remanufacturing and prolongation of product life is based on the material content of the products. The goal is to extend the product life provides using fewer materials for producing new products and reducing environmental impact of these products

Design for Disassembly

The aim of Design for Dis assembly (DfD) (derived from DfE) is to design products that readily can be disassembled at the end of their service lives in such a manner that the residual parts and materials can be reused, recycled, remanufactured into new products .

In the design process, designers must anticipate and prepare for the potential uses of components of products salvaged from worn-out products at the ends of their normal service lives so that these components and parts are recycled and incorporated into new products rather than wastefully

disposing of them in landfills According to Bogie (2007, page 287), there are three critical factors that must be considered if a product is to satisfy the above criteria for successful .

- Selection and use of material”
- Design of products”
- Selection of joinery, connectors and fasteners”

Designing products for efficient dis assembly improves ease of product repair along with material and part reuse and recycle ability. However, designers and companies must first be aware of the options that are available to them that can be used in the production of such furniture

- Factors affecting the dis assembly process Guides to improve dis assembly
- Product structure Create a modular design
- Minimize the component count
- Optimize component standardization
- Minimize product variants
- Materials Minimize the use of different materials
- Use recyclable materials
- Eliminate toxic or hazardous materials
- Fastener, joints and connection
- Minimize the number of joints and connections
- Make joints visible and accessible, eliminate hidden joints
- Use joints that are easy to dis assembly
- Mark non-obvious joints
- Use fasteners rather than adhesives
- Characteristic of components for dis assembly
- Good accessibility
- Low weight
- Robust, minimize fragile parts
- Non hazardous
- Preferably unpainted conditions Design for automated dis assembly
- Eliminate the need for specialized dis assembly procedure
- DfD with simple and standard tools

Prototypes of traditional architectures, such as Brunelleschi's work are similar to the prototypes of mechanical designs described in the previous section. The architects of the era are actually such experts like artists, scientists, mathematicians and carpenters. However, due to the division and specialization of fields in architecture, it becomes difficult to accurately estimate productivities considering manufacturing processes and materials in the stage of architectural design. Thus, it is difficult to expect holistic performances like traditional designs in the stage of architectural design. Therefore, the prototype of the current architectural design remains only as a result of the technical implementation of the architect and the completion of the result. The use of prototypes for testing is often delegated to other experts. While the failures and solutions recorded during the testing process will play a decisive role in technology development, architects have no choice, but to focus more on the way they describe others than experience based on failure and resolution. Architects, for example, inevitably spend a significant amount of time creating reports that summarize their skills and achievements or visual presentations that are as good as 3D images.

For the future building designs, differentiated prototyping processes are required according to the aforementioned cases. New forms and technological application are required to respond to the changes in the climate environment and the users 'needs. Designs based on cutting-edge technologies refer to application processes or high-performance materials that are not well known in conventional building designs. For example, there is a large amount of complex new materials that are not utilized for the general construction process. Despite the many advantages of these new materials over other construction materials in terms of performance, firms use the existing materials, due to the risks posed by the new materials. The main reason that the new materials are not used is that their prices are not reasonable. In addition, there are few experts who understand how these new materials should be used, and there are also no domestic design standards or specifications related to such materials . Therefore, new prototyping methods are needed to support numerous tests about new materials/technologies in the design phase. Rather than making guesses about unknown performances or just exploring individual design performances, design processes need to be facilitated to identify and supplement the inherent risks in the design.

Self-Check -1	Written Test

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

1. ----are arranged based on the sequence of operations required to produce a product or provide a service
2. **----------** are created for primitive processes and some higher level processes on a data flow diagram

Part two short answer

3. What are the two general forms for Process specifications? Given an example

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Interpreting drawings instructions and specifications.

Product design – the process of defining all of the company's product characteristics

- Product design must support product manufacturability (the ease with which a product can be made)
- Product design defines a product's characteristics of:
  - ✓ appearance,
  - ✓ materials,
  - ✓ dimensions,
  - ✓ tolerances, and performance standards

Process Selection – the development of the process necessary to produce the designed product.

The Product Design Process

Idea development: all products begin with an idea whether from:

- customers,
- competitors or
- suppliers

Reverse engineering: buying a competitor's product

- Idea developments selection affects
  - ✓ Product quality
  - ✓ Product cost
  - ✓ Customer satisfaction
  - ✓ Overall **manufacturability** – the ease with which the product can be made

Step 1 - Idea Development - Someone thinks of a need and a product/service design to satisfy it: customers, marketing, engineering, competitors, benchmarking, reverse engineering

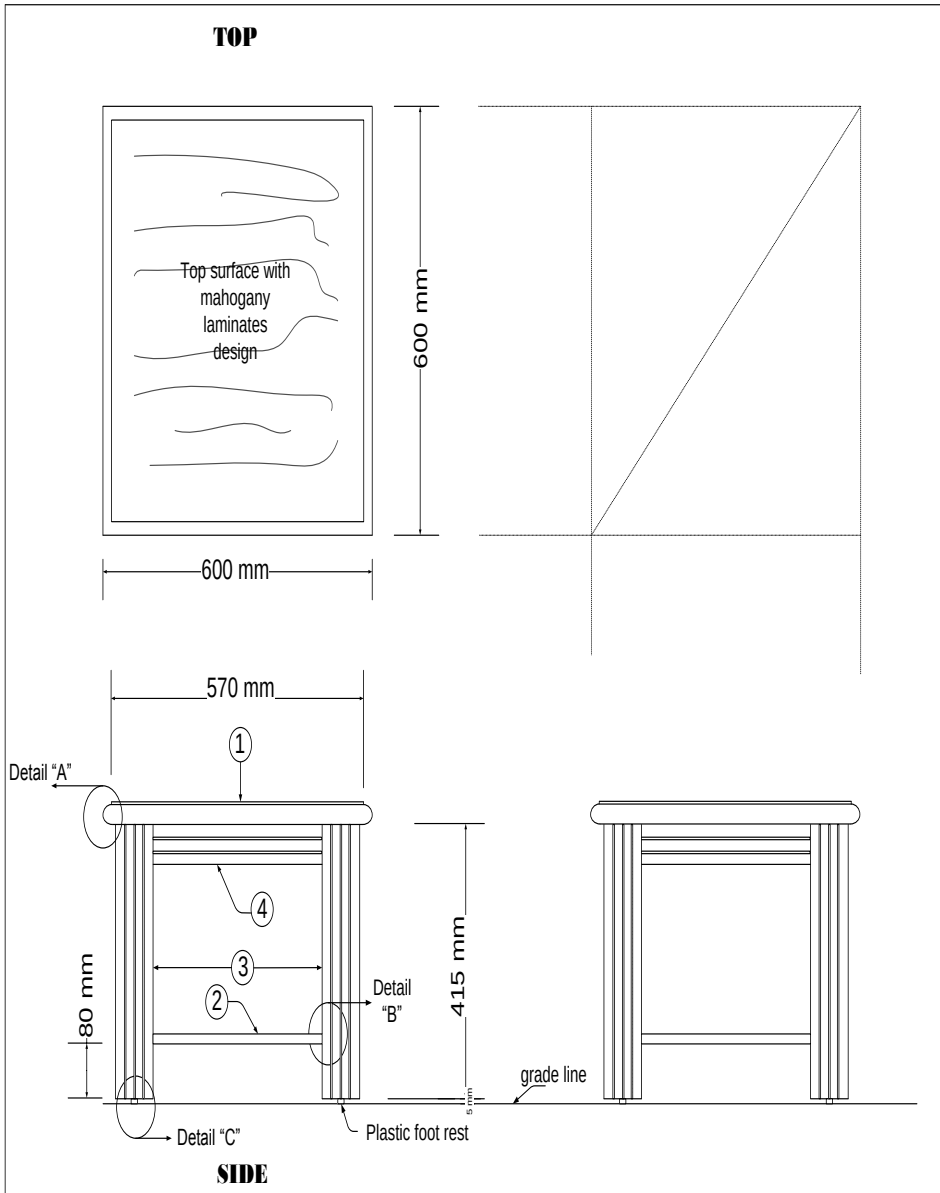
Step 2 - Product Screening - Every business needs a formal/structured evaluation process: fit with facility and labor skills, size of market, contribution margin, break-even analysis, return on sales

Step 3 – Preliminary Design and Testing - Technical specifications are developed, prototypes built, testing starts

Step 4 – Final Design - Final design based on test results, facility, equipment, material, & labor skills defined, suppliers identified

Design for Manufacturing (DFM)

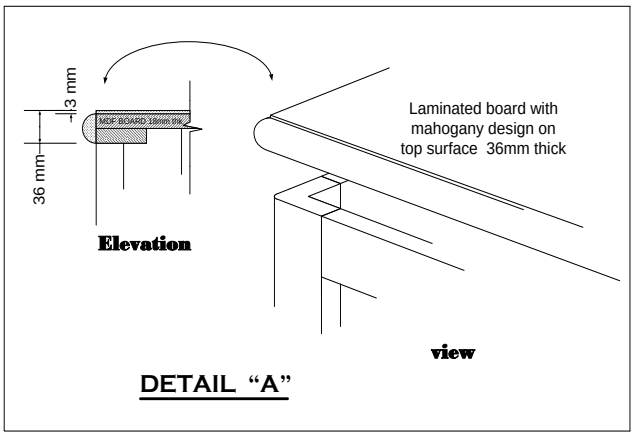
- **Guidelines to produce a product easily and profitably**
  - ✓ **Simplification - Minimize parts**
  - ✓ **Standardization**
- **Design parts for multiply applications**
  - ✓ **Use modular design**
  - ✓ **Simplify operations**



PICTORIAL

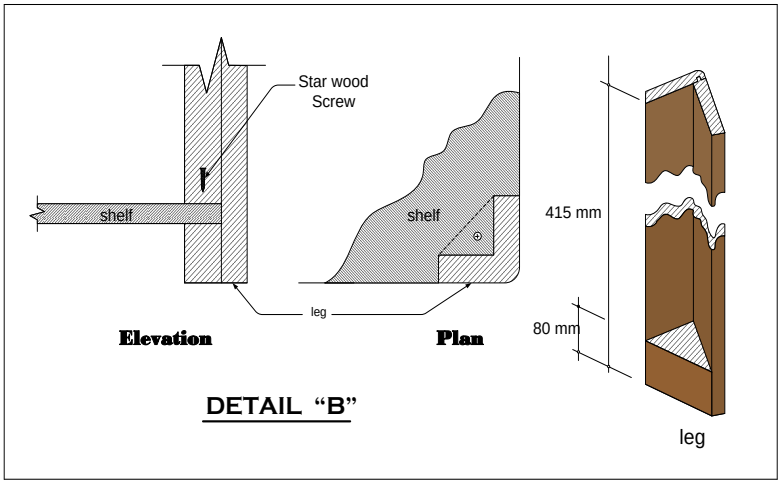
LEGEND:

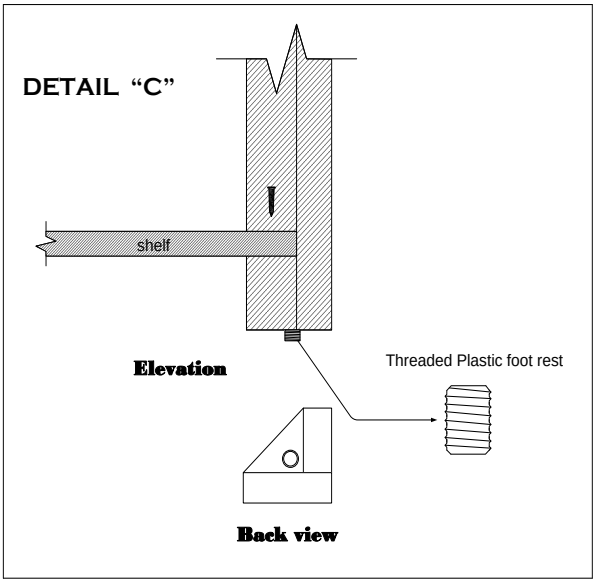
1 Top surface with mahogany laminates design
2 Legs
3 Side support
4 Shelve

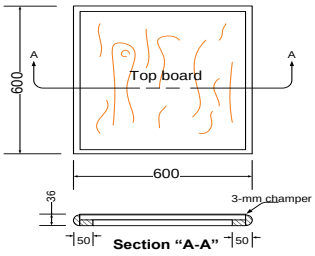


Note:

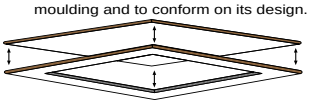
* Side moulding is concave designed
* The legs are attached to side support through mortise and tennon joints and with dowel on the top board
* Shelf is attached with wood screw
* Plastic foot rest (12 mm diameter) is made of threaded hard plastic designed like a bolt to hold balance of the project

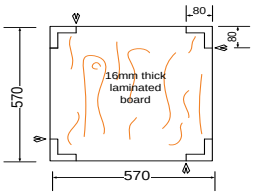




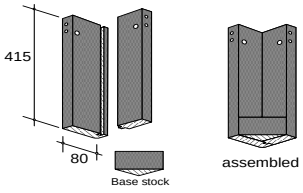


1. Prepare laminated top board with mahogany designed of 18mm thick. Cut it according to its specifications and prepare solid wood for moulding. Attach each component with glue using clamp and wood presser. Allow the glue to harden in a minimum time of 4 hours. Use shaping machine or router with concave bit for moulding and to conform on its design.

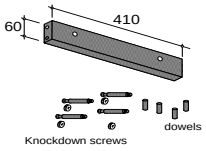




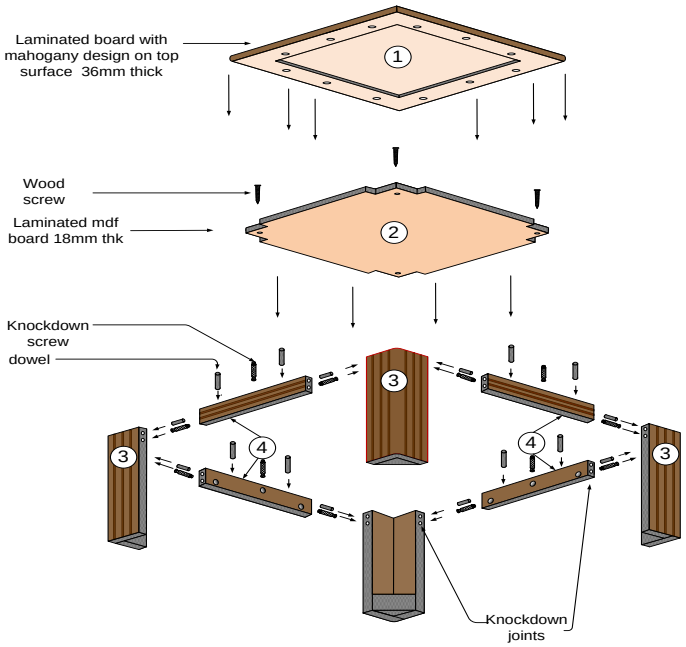
2. In making a shelf of the project, prepare laminated board according to a given specifications. Perform markings and cut it until you will get the desired result.



3. Select solid wood a mahogany natural design for 4 pieces legs with 20mm thick. Using circular machine perform grove joints according to specifications. Carefully assemble the joints with glue. Make base stock and glued it on the adjacent side. Provide holes for knockdown screws and dowels



4. Prepare solid wood for support. Measure and cut according to specifications. Provide holes for knockdown screws and dowels. Use drill machine in making holes with specified drill bits enough for screw and nut. These would give strong joints between top board and the frame.

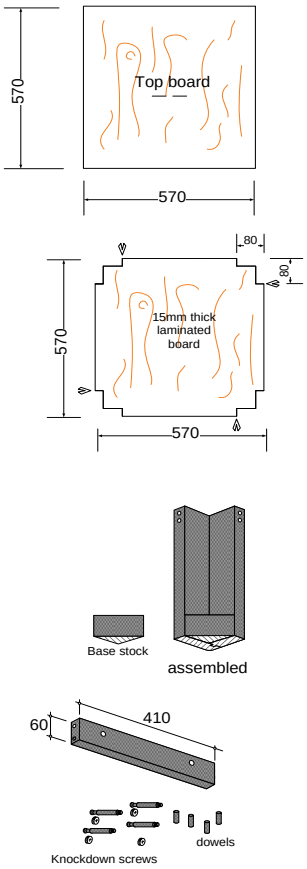


LEGEND:

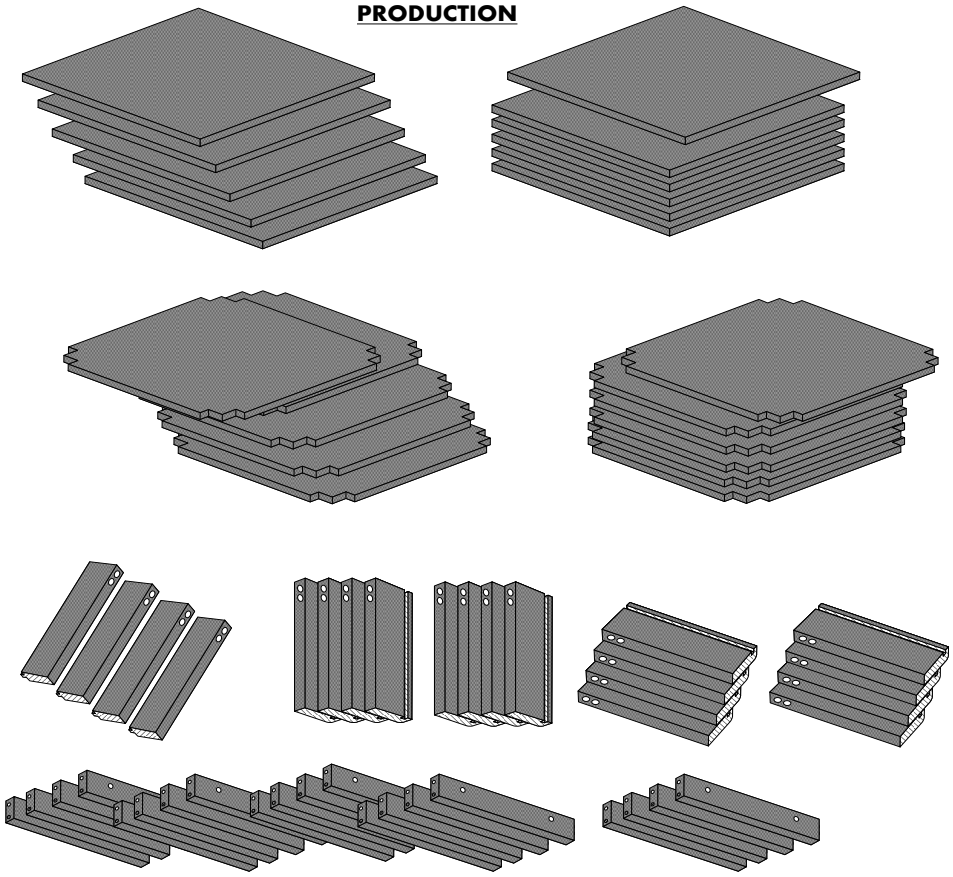
Cutting list

1. Top surface with mahogany laminates design ---------- 1 piece
2. Shelf ---------- 1 piece
3. legs ---------- 4 pieces
4. Side support ---------- 4 pieces

JIGS



MASS PRODUCTION



Self-Check -2	Written Test

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

1. Write the product design process
2. Write design for manufacturing

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Product Screening Tool – Break-Even Analysis con't

- Break-even analysis considers two functions of Q
  - ✓ Total cost – sum of fixed and variable cost

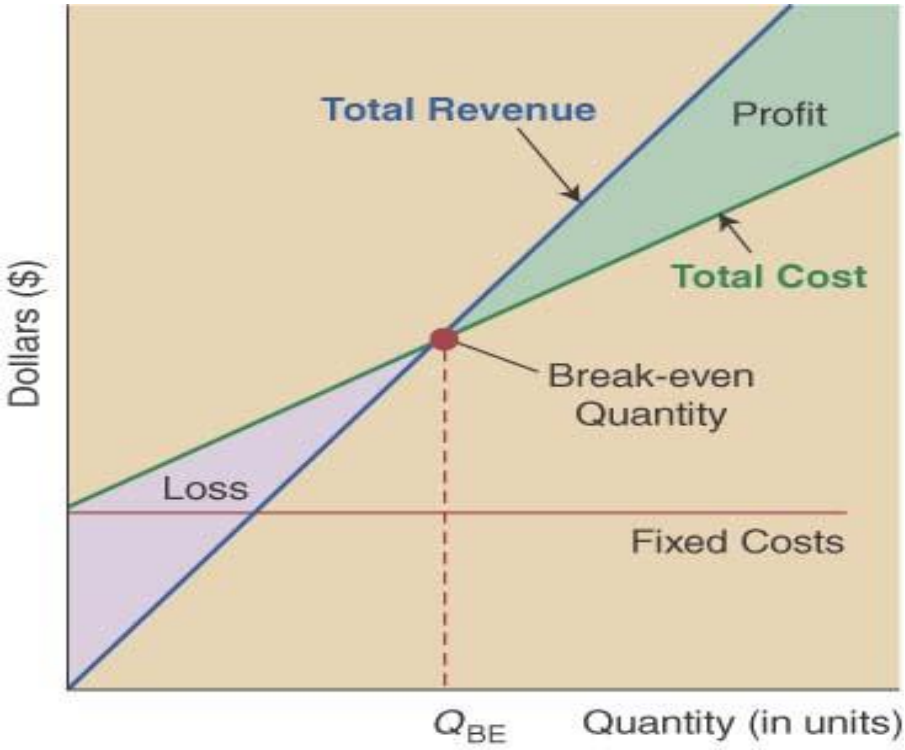
    Total cost = F + (VC)*Q
  - ✓ Revenue – amount of money brought in from sales

    Revenue = (SP) * Q

    Q = number of units sold

Break-Even Analysis: Graphical Approach

- ✓ Compute quantity of goods that must be sold to break-even
- ✓ Compute total revenue at an assumed selling price
- ✓ Compute fixed cost and variable cost for several quantities
- ✓ Plot the total revenue line and the total cost line
- ✓ Intersection is break-even
- ✓ Sensitivity analysis can be done to examine changes in all of the assumptions made



Product Screening Tool – Break-Even Analysis

- Computes the quantity of goods company needs to sell to cover its costs

$$Q_{BE} = F/ (SP - VC)$$

  - ✓ Q_{BE} – Break even quantity
  - ✓ F – Fixed costs
  - ✓ SP – selling price/unit
  - ✓ VC – Variable cost

Break-Even Example:

A company is planning to establish a chain of movie theaters. It estimates that each new theater will cost approximately $1 Million. The theaters will hold 500 people and will have 4 showings each day with average ticket prices at $8. They estimate that concession sales will average $2 per patron. The variable costs in labor and material are estimated to be $6 per patron. They will be open 300 days each year. What must average occupancy be to break-even?

Break-Even Example Calculations

Break-Even Point

Total revenues = Total costs @ break-even point Q

Selling price*Q = Fixed cost + variable cost*Q

($8+$2)Q= $1,000,000 + $6*Q

Q = **250,000 patrons (42% occupancy)**

What is the gross profit if they sell 300,000 tickets

Profit = Total Revenue – Total Costs

P = $10*300,000 – (1,000,000 + $6*300,000)

P = **$200,000**

If concessions only average $.50/patron, what is break-even Q now? (sensitivity analysis)

($8.50)Q = 1,000,000 - $6*Q

Q = **400,000 patrons (67% occupancy)**

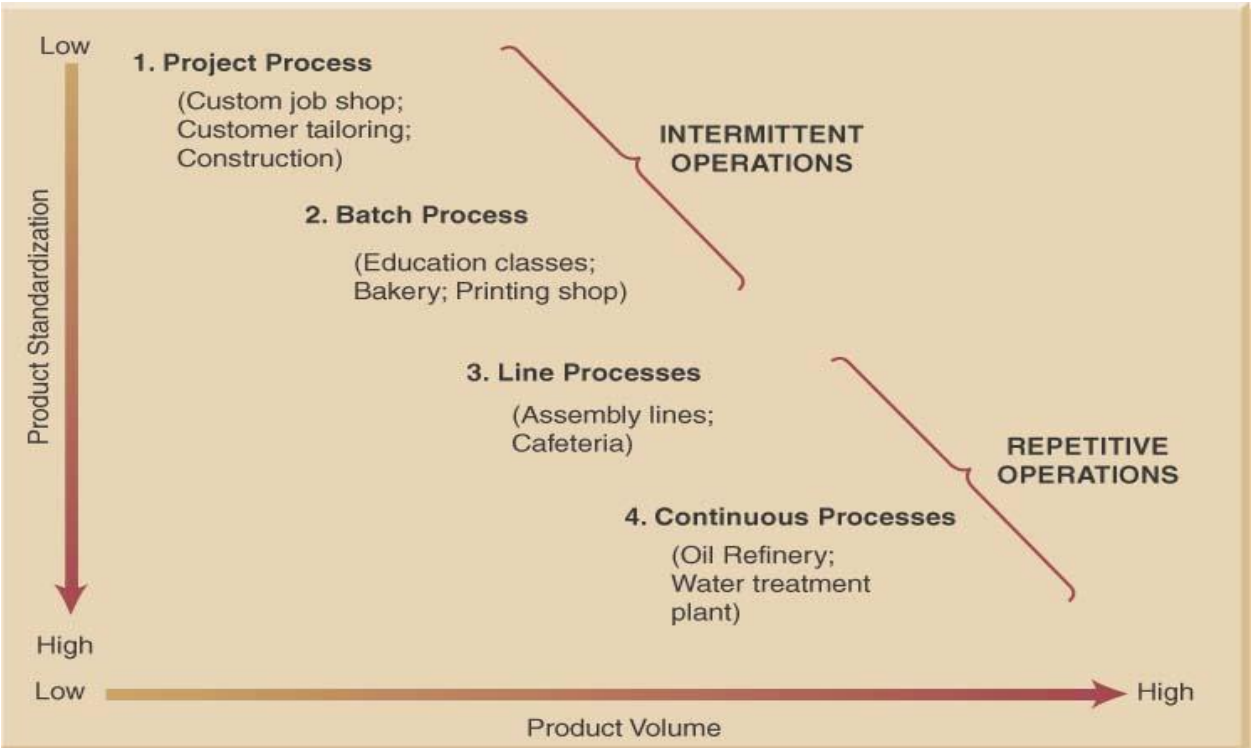
Is Breakeven Analysis really in use?

http://www.businessweek.com/magazine/content/06_44/b4007026.htm?chan=search

Process Selection

- Product design considerations must include the process
- Intermittent processes:
    - Processes used to produce a variety of products with different processing requirements in lower volumes. (such as healthcare facility)
- Repetitive processes:
    - Processes used to produce one or a few standardized products in high volume. (such as a cafeteria, or car wash)

Product-Process Grid



Process Types

- Process types can be:
    - ✓ Project process – make a one-at-a-time product exactly to customer specifications
    - ✓ Batch process – small quantities of product in groups or batches based on customer orders or specifications
    - ✓ Line process – large quantities of a standard product
    - ✓ Continuous process – very high volumes of a fully standard product

Process types exist on a continuum

Self-Check -3	Written test

Directions: Write correct answer

1. Write types of Product Process? (2 point)
2. What are the Process Selection? (5 point)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1……..

2……..

3…….

Information Sheet-4	Considering available resources program requirements . .

In relation to furniture design one or more of the following problems may prevail and one's design should avoid them.

1. Inability to meet functional requirements

   The furniture may not be convenient to:-

   - the type of job to be done on the furniture
   - the type of people who work on the furniture

   This may be due to:-

   - standard dimensions may not be followed
   - operable parts may overlap when they are open
   - metal fitting may be noisy (e.g. in libraries)
   - glass fittings may reflect

2. May not be suitable to the space requirement
   - The type of design may not allow to use the furniture in a limited space
3. The furniture may not be durable. This may be due to:-
   - The design didn't consider method of construction which leads to in accurate fitting
   - production techniques and appropriate material is not specified in the design

Task 2: Identifying Problem Situations on the Market

Furniture is first conceived and designed and then produced and finally marketed.

In relation to marketing, furniture designer should:-

- Understand the need of the market
  - ✓ What items are needed best?
  - ✓ What woods are the most desirable?
  - ✓ What are the most popular finishes?

  E.g. In construction areas (expansion sub cities of Addis) it is good to produce doors, windows and partitions than furniture.
- Design the furniture to the required standard.
- Design the furniture to be cost effective without the sacrifice of quality and standard. This may be achieved by:-
  - ✓ Material selection – using cheaply available but reasonably strong and attractive material
  - ✓ Selecting cheaper and taster production method again with good level of quality

- ✓ Specifying cost effective finishes that can harmonize to the required service

Task 3: Identifying the Design Task

The design task is a process of identifying the problem and giving appropriate solution

The design tasks are:-

- **State the need**

E.g. Writing surface – not a desk

Define the problem by asking questions about

- the use or function of furniture?
  - ✓ What to do on it?
  - ✓ How to do on it?
- the user
  - ✓ how high?
  - ✓ how long?
- the environment
  - ✓ What condition will attack the furniture?
  - ✓ What situation will be the worst?
- About the technical data
  - ✓ how to manufacture or to produce?
  - ✓ from what materials?
- **Conduct Research**

Single tests, measurements or experiments can be conducted to obtain design data like:-

- ✓ size of the user
- ✓ environment
- ✓ material

Propose Solution

As many as possible solutions should be proposed and recorded for later evaluation and in the form of single sketches or draining.

Evaluate the proposed solutions and select the best

Self-Check -4	Written test

Directions: Write correct answer

1. Write Understand the need of the market? (2 point)
2. Write single tests, measurements or experiments can be conducted? (3 point)
3. Define the problem by asking questions? (5 point)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1……..

2……..

3…….

Information Sheet-5	Referencing the actual context

DEVELOPING FUNDAMENTALS OF GOOD DESIGN

The fundamentals of good design include purpose or function, appearance, materials and construction.

Task 1: Developing Function of Design

A product is well designed only if it meets the need for which it is intended.

For Example

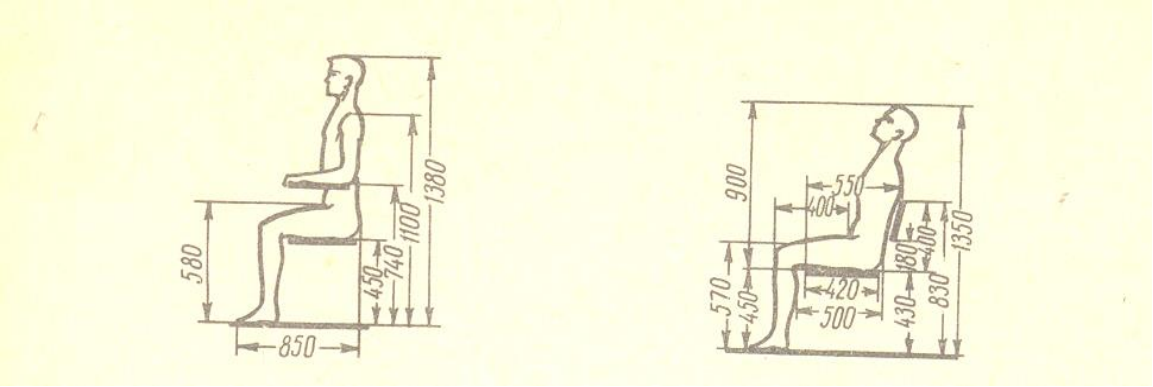
- A table must be the right height for its particular use
- A chair must be comfortable to seat both in seat height, depth and back angle

Concerning functional requirement of furniture it may be divided into two groups:-

I. Furniture which in its service is directly connected with human being and his stature. Such furniture includes tables, chairs, bed, sofas, desks, etc.

II. Furniture which in its service is connected with materials clothes, utensils, etc. This group includes cupboards, dresses, shelves, etc.

In designing furniture of the first group, the sizes are influenced by size of human beings. The designer makes a careful study of the human body to determine man's furniture needs.



a) b)

Fig 1 Sizes of a sitting man

a) Vertical b) inclined

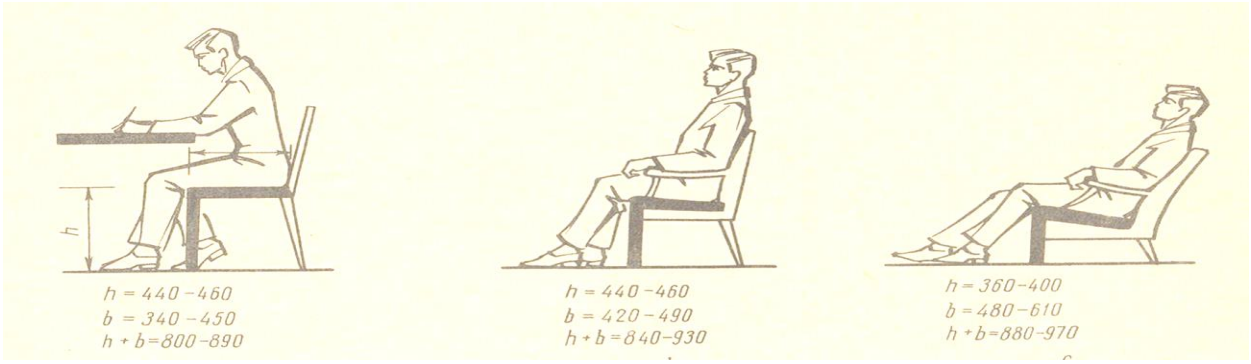


Fig. 2 Height and depth of seat

a) Ordinary chairs b) chairs with arm rest c) easy and club chairs

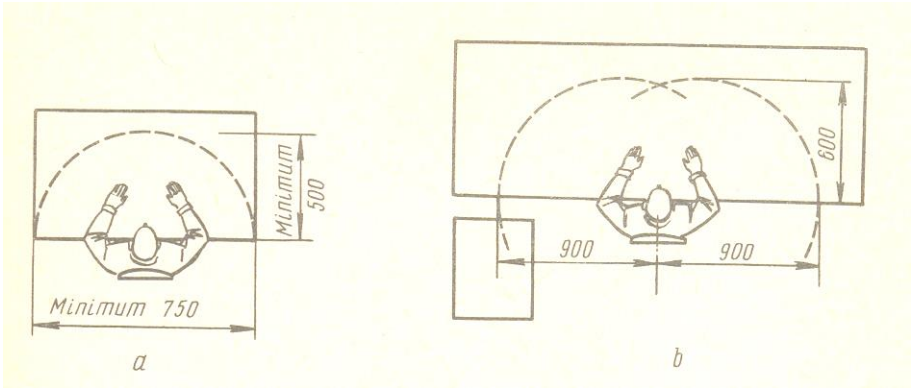
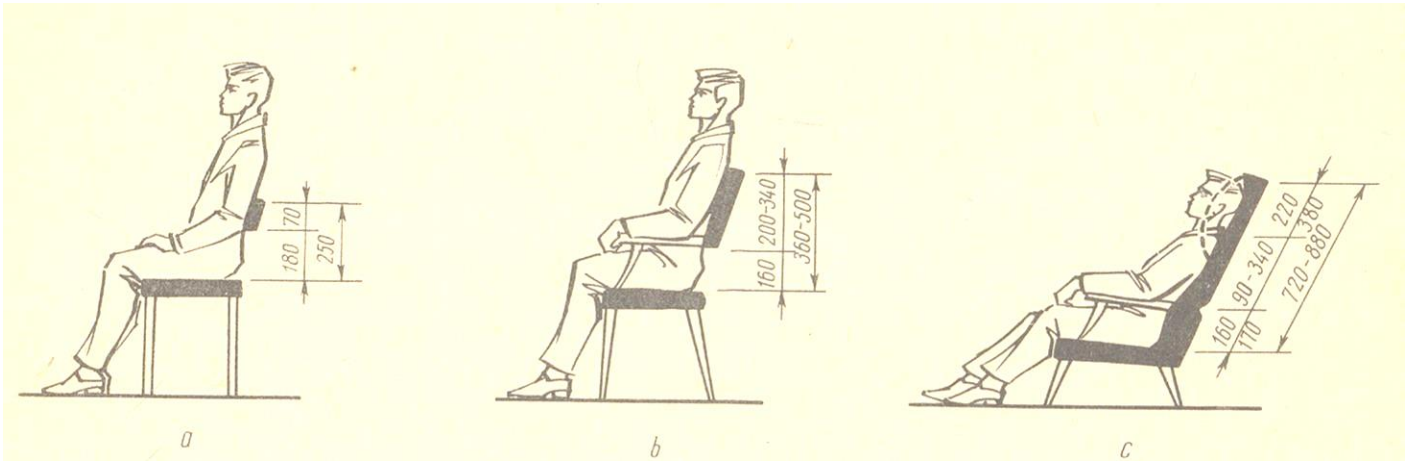


Fig.3 Useful area when working at a desk

a) Minimum area b) Reach out area



a) lumber Chair b) ordinary chair c) easy and club chair

Fig.4 Shape and height of chair backs

A furniture in the second group must be designed with due consideration of the quantity and size of the articles to be kept in it. However, even furniture of this group must be matched in dimension with human height.

In designing furniture the principal Motto is “MAN IS THE MEASURE OF ALL THINGS”

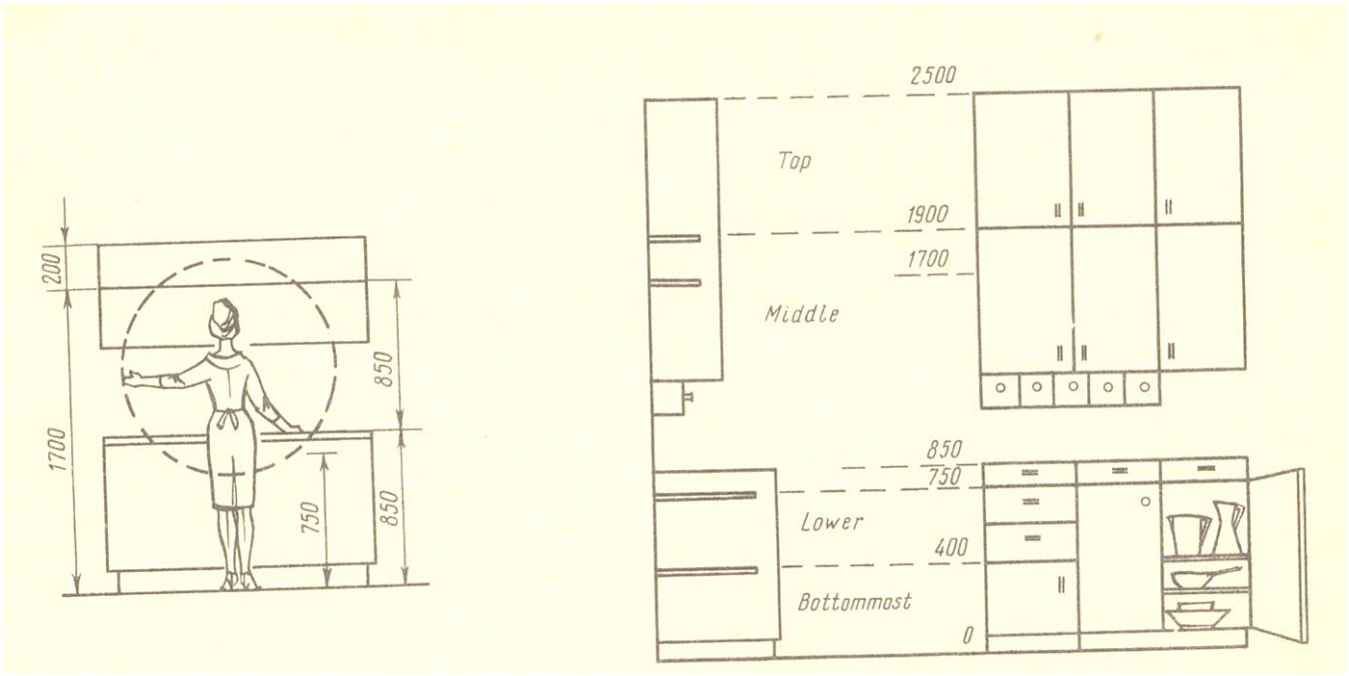


Fig.5 Functional height of work table with accessibility zone

Task 2: Developing Appearance of a Design

The furniture piece must be pleasing to the user.

The furniture must be suited to the personality

E.G.: Two chests may be equally efficient for storage but one may have greater attraction because of its appearance.

. In this aspect people have strong preference to different styles of furniture. Furniture and cabinets that are true to their own particular style are attractive and in most cases represent the principles of good design

Fig.6 – American colonial group

Fig.7 – French provincial

Task 3: Developing Materials of Design

The furniture being designed should display simple, direct and practical use of the substance of which it is made. Materials selected must be appropriate. Certain kinds of furniture woods possess excellent qualities of beauty and durability. Other materials are satisfactory only for the internal parts of furniture.

Moreover, materials selected for furniture must be right for both use and style. Certainly the fine hard woods possess great beauty and durability but it must be remembered that well designed furniture also makes use of plywood. Fine hard wood ply woods are ideal for the large flat surfaces of chests, tables, and cabinets. Veneer is another material for furniture. Quality furniture today also makes use of many non – wood materials such as plastic laminates, ceramics, tile, metal, glass, and textiles.

The designer should achieve maximum benefit from a minimum amount of material. A duty object does not guarantee beauty or strength.

TASK 4: DEVELOPING THE CONSTRUCTION OF FURNITURE DURING DESIGN

Furniture must be constructed on a basis of sound structure.

- Good joinery should be the rule throughout the product
- Unstable construction in itself is poor design
- A table should not wobble or a chair should not tip otherwise it is useless
- If glue joints don't hold, the product is worthless

Quality furniture construction means building to last a long time with minimum maintenance.

Furniture intended for hard use, as in motels or in homes with small children is often made with plastic laminates for the tops of chests, desk, and tables. Frequently these materials closely match the grain of fine wood veneer.

Self-Check -5	Written test

Directions: Write correct answer

1. Write types of specification? (2 point)
2. Date of last effective revision and revision designation ? (3 point)
3. What are the benefits of detailed specifications? (5 point)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1……..

2……..

3…….

Information Sheet-6	Preparing detail specifications

DEVELOPING THE PRINCIPLE OF DESIGN

When you are designing furniture, there are certain principles that you must pay attention to: But before we start studying those principles, first let us see how to form a design.

Forming the Design

In forming the design there are the so called "building blocks" of all design. The building blocks of design are called elements.

While we see, all furniture appears different in design and beauty, but they have elements of design in common. These elements of design are:-

a. line
b. shape
c. volume/mass
d. tone and texture
e. color
f. space

a. Lines

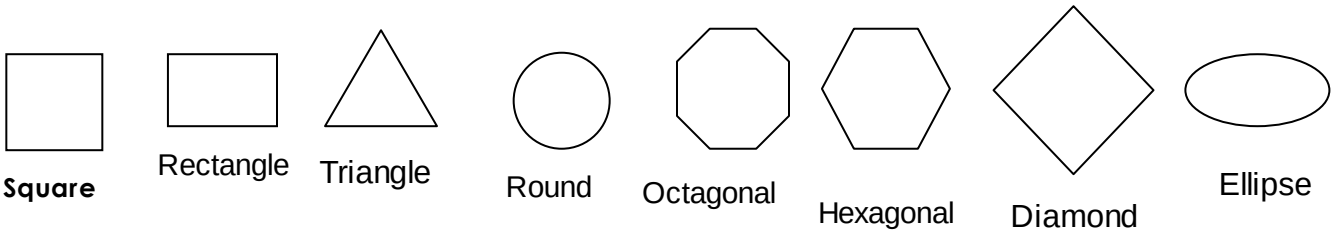
In design, lines are what the designer must put on a piece of paper in order to instruct what you have in mind. The line of design is made up of the edges of the different shapes in the design. Lines can be straight, curved, S-shaped, circular. Lines can give a feeling of action or motion. They also give shape to a product.

Straight Curved s-shaped circular

Much contemporary and modern furniture are made up of straight lines where as traditional early American and French provincial have many curves.

b. Shape

Lines make up the shape of a product. An understanding of shape is the basic furniture design. The common shapes are square, rectangular, round, triangular, diamond, elliptical, hexagonal and octagonal.



We see these shapes in furniture. For example

- Table the unusual hexagonal to the unusual hexagonal
- Many drawer pulls are circular

C – Volume or Mass

Line and shape make up mass or the three dimensional appearance of an object. This indicates the amount of material in it. All furniture has height, depth, and width or length to form mass. Basic construction materials come in many shapes.

E.g.

- Rectangular piece of wood
- Round dowel rode
- Oval or rectangular drawer pulls

In planning the mass of the furniture piece, the designer thinks more in terms of form than of solid shape. The form may be open as for a table or chair, or closed as for a chest, cabinets or storage unit.

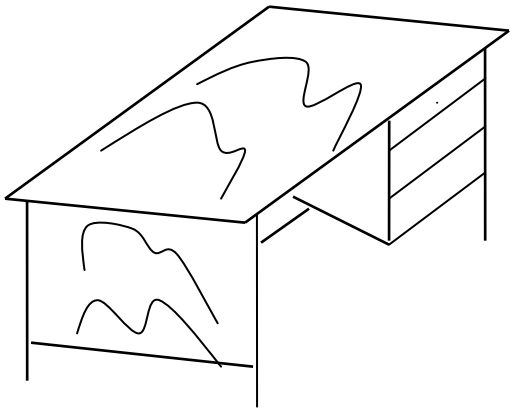


Fig.8 Office desks

Less massive More massive

d. Tone and Texture

Tone is a contrast between light and dark or shadow or brightness on a surface. Texture is the way a surface feels to touch and how it reflects.

Every kind of wood has its own tone and texture. The tone on the wood is its natural color or colors and the texture is what it makes like generally and how it feels when you touch it. Finishing materials are used to show the tone and texture of the wood clearly and to prevent them getting spoiled. Every material has a natural texture. Texture can also be added to a surface applying paints and finishes. Texture is woods can also be achieved by sand blasting the surface. Sometimes, natural defects like knots, holes and other irregularities add interest to woo texture.

e. Color

Color creates mood or atmosphere and is a most important element of furniture design. It can be natural or applied. Colors can be added to wood and are also used in upholstery, hardware and other furnishings. In wood work, we can choose woods that have pleasant, colors, or we can put stain, paint, or enamel.

f. Space

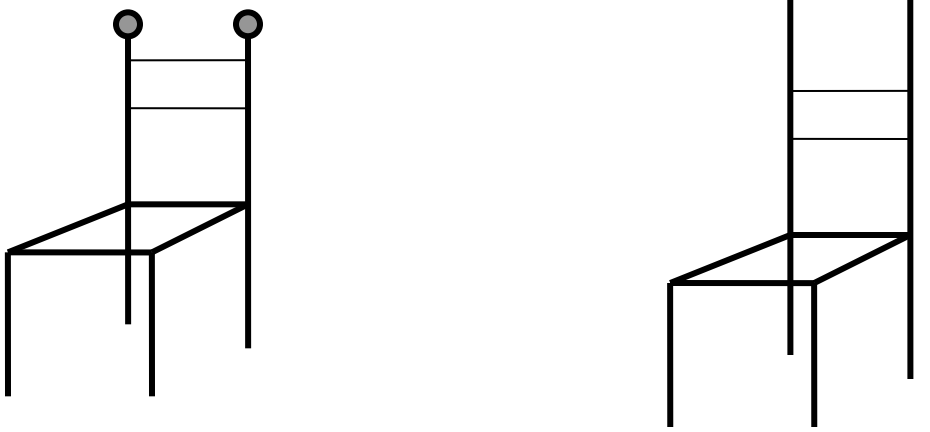
When you are planning your design, you must always think about the amount of space that the object will take up. It must be the right size and shape for the place where it will be and for the purpose people will use it for.

Proportioning the Design

Proportion is the relationship of the parts of an object to each other and to the total product. A rectangle often has better proportion than a square because the exact relationship between its height and width or width and depth is not easy to see. Many designers consider the golden mean rectangle to have perfect proportion -the ratio of the longer to the shorter is 5 to 8.

If we have proportion in our design, the thing we make will not look too wide, too tall, too thin, too square, etc. It will look just right to our eyes, and it will be just right for the use we have for it.

A relation of 1 to 3 or 2 to 3 is also superior to perfect square in many instances.



Proportional Fig. 9 Chairs Not proportional

Balancing the Design

Something seems balanced when the parts on different sides of it is some way equal to each other.

Example

A man looks balanced because he has an arm on each side; two eyes each the same distance from his nose etc.

Generally, we do not like to see something which has parts that are not balanced. Balance is achieved when the object equals to have equal weight on either side.

There are two kinds of balance:-

1. **Formal**: Formal balance is when the two sides of an object are exactly the same.

   E.g. If parts are symmetrical, the result is formal balance

2. **Informal:** Informal balance is when they seem equal or similar because one group of parts balances on other group.

   E.g. If two small boys are on one side of a sec-saw and one large boy is on the other.

If the parts are not symmetrical but still the piece has the appearance of being at rest this is called informal balance.

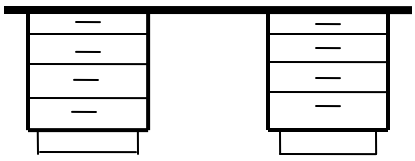


Fig. 10 a table with formal balance

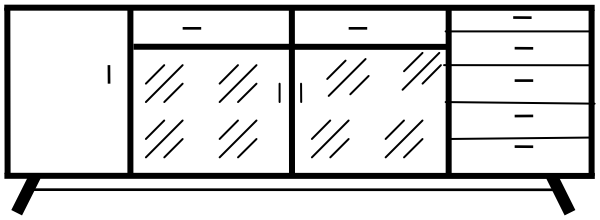


Fig. 11 a buffet with informal balance

Harmonizing the Design

Many times different materials are combined, or different shapes are put together. When the parts, colors, shapes and textures of an object go well together, we say that the object has harmony. A piece of modern furniture is made of many different materials but they are put together in such a way that they have a certain unity. But there is no harmony, for example, in a table that has a smooth, thin top with a beautiful finish and thick rough metal legs.

Applying Emphasis to the Design

Each furniture piece needs points of emphasis. It means a point that is especially interesting that attracts the attention in that direction. This may be the overall appearance of the piece itself, the fine finish a simple piece of hardware, or some point in its construction. For example, in a desk, it may be a beautiful piece of metal work, the fine finish of the wood, or as interesting grain in the wood at a cupboard or a drawer.

Maintaining Rhythm to the Design

Rhythm in design is marked by the occurrence of certain distinct features or elements at regular intervals. This causes eye movement much the same as musical rhythm often causes foot movement. A feeling of rhythm in a design is obtained by repetition of forms, lines, shapes or color to give a distinct character to an object.

Self-Check -6	Written test

Directions: Write correct answer

1. Write elements of design? (2 point)
2. Date of last effective revision and revision designation ? (3 point)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1……..

2……..

3…….

Lap test -1	Written test

Name: _____ Date: _____

Time started: _____ Time finished: _____

INSTRUCTION:-

- You are asked to find work place and collect the necessary tools and equipments to accomplish you work.

You are required to perform any of the following:

1.1 Check all parts of the jointer machine and adjust or make ready for work.

1.2 Cut the stock to the necessary dimension.

- Use measuring tools.
- Use eye protection.
- Check the table against the fence.

1.3 Lubricate the revolving parts.

- Clean the dust using compressor.
- Clean with rag
- Apply lubricants

Precautions: know the location of the ofswich and/or emergency disconnect!!!1

Quality criteria:

- Wise use of tools
- Applying the right procedure
- Wise use of materials
- Apply jointer machine safety during your work.

LG #41	LO #2- Layout model

Instruction sheet

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

- Using quality applicable finishing processes.
- Calculating to establish model parameters.
- According with specifications jigs and fixtures manufactured

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

- Use quality applicable finishing processes.
- Calculate to establish model parameters.
- Accorded with specifications jigs and fixtures manufactured

Learning Instructions:

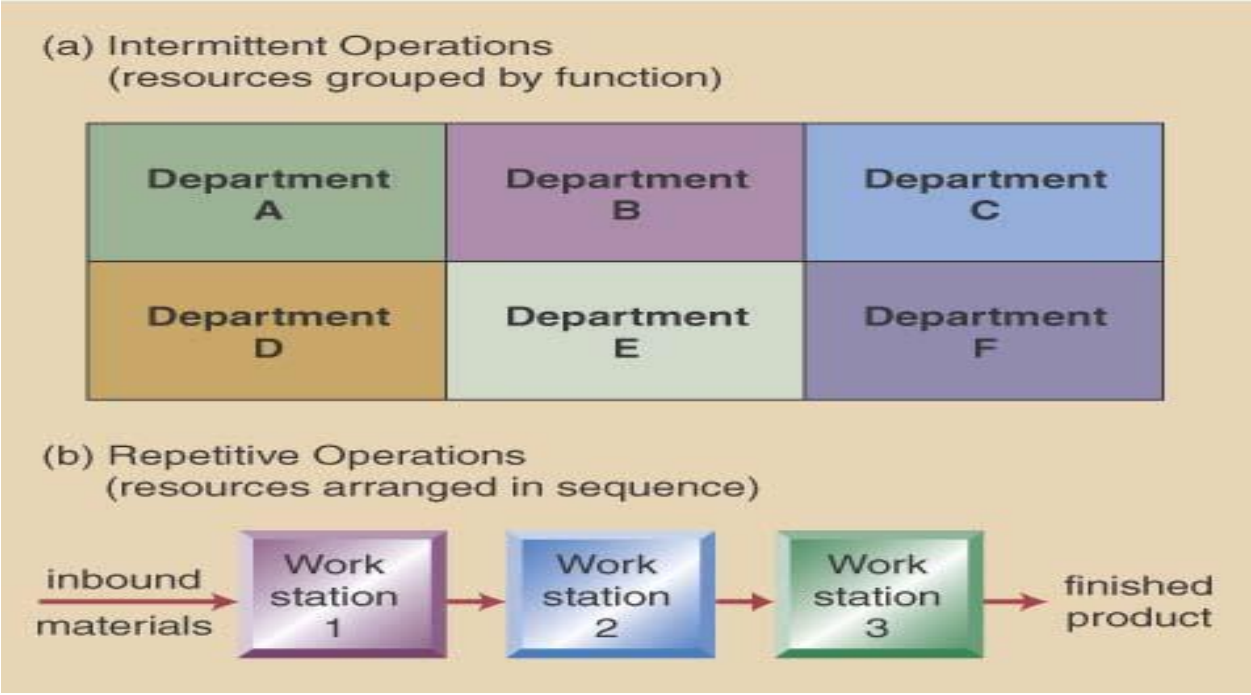
1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	Using quality applicable finishing processes**.**

Using quality applicable finishing processes

French provincial is the most popular of the fine line of furniture which take their inspiration from the old world using the woods at hand, craftsmen worked out simple imitations of the more elaboration court designs. As main features:

Intermittent VS. Repetitive Facility Layouts



Process Selection Considerations

- **Process selection is based on five principal considerations**
  1. Product-Process Grid
  2. Degree of vertical integration
  3. Flexibility of resources
  4. Mix between capital & human resources
  5. Degree of customer contact

Process Decisions-Vertical Integration & Make or Buy

- **<u>Vertical integration</u> refers to the degree a firm chooses to do processes itself- raw material to sales**
    - Backward Integration means moving closer to primary operations
    - Forward Integration means moving closer to customers
- **A firm's *Make-or-Buy* choices should be based on the following considerations:**
    - ✓ Strategic impact
    - ✓ Available capacity
    - ✓ Expertise
    - ✓ Quality considerations
    - ✓ Speed
    - ✓ Cost (fixed cost + variable cost)make = Cost (fixed cost + Variable cost)buy **[see Ch 4]**
- **Business are trending toward less ***<u>backward integration</u>*, more ***<u>outsourcing</u>***

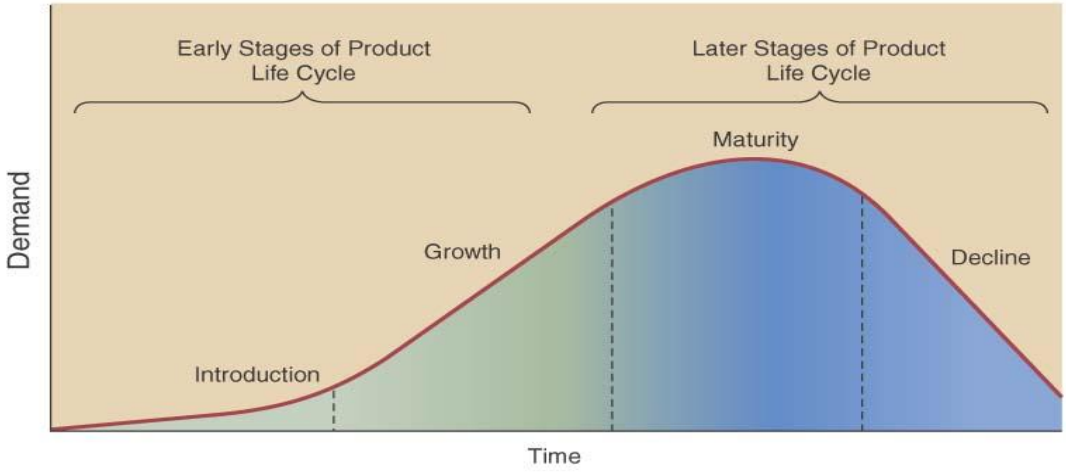
Product Life Cycle also affects decisions

- **Product life cycle – series of changing product demand**
- **Consider product**

life cycle stages

- **Introduction**
- **Growth**
- **Maturity**
- **Decline**

Facility & process investment depends on life cycle



Flowchart Symbols for Process Design

Self-Check -1	Written test

Directions: Write correct answer

1. Write Product Life Cycle also affects decisions? (3 point)
2. Write Process Selection Considerations? (3 point)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1……..

2……..

3…….

Information Sheet-2	Calculating to establish model parameters

styling the furniture design

Ever since people begun to use house hold furnishings, there have been trends in furniture design. The history of furniture includes hundreds of different styles. Note many years ago, there were only three main classifications, Early American, traditional, and modern. However, now there are a great many mixtures which combine the good features of former styles with other features that impart a style at their own. Nevertheless, popular furniture styles fall generally into three major groups.

- Modern
- Provincial
- Traditional

Styling the Modern Design

In considering modern furniture, it should be remembered that modern cannot be defined and delineated as a historical period. On the other hand, modern is a style still developing and it promises to remain in a state of transition for many years to come.

Several different types of modern have appeared. Some have already been discarded such as the "waterfall front" commercial styles of the 1930's and the angular geometric forms of the late 1920's. Other like the pre – worldwide ll "classical modern" and "Swedish modern" based on updating of classic forms, seemed to influence contemporary and future modern furniture.

The main concern in the design of modern furniture is the mass production methods of present factories. For this reason clean, simple straight lines and the elimination of unnecessary ornament have made modern furniture quite practical for mass production.

General Features

- The design is influenced by clean, simple lines.
- Flat surfaces and straight lines are combined with graceful curves.
- No deep carving as it collects dust.
- Applied decoration is avoided.
- Knobs and pulls are functional harmonizing with design.
- Legs are smooth, undecorated, square, tapered or round or sometimes of metal.

Fig. 12 Furniture in modern style

Styling in Provincial Design

The main ones in this style are the French provincial and Italian provincial.

French provincial is the most popular of the fine line of furniture which take their inspiration from the old world using the woods at hand, craftsmen worked out simple imitations of the more elaboration court designs. As main features:

- Cabriole leg was almost universally used
- Some scroll work, carving and fluting was also used
- The popular finish is white or black point trimmed in gold

Fig. 13 provincial style

Fig. 14 Provincial Style

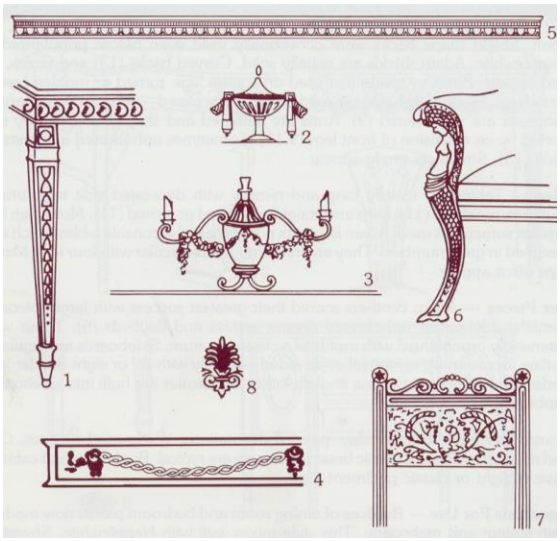
Italian provincial gets its inspiration from furniture developed by craftsman of the Italian provinces in the 18th and 19th centuries. A characteristic of much Italian provincial is the use of straight lines.

- Many chairs, tables, and cabinets have straight, tapered legs on four sides often with graceful recess just below the rails.
- Makes use of cornices and fluted bands.
- You also find well proportional paneling framed with modeling to create interesting patterns.
- Fine in lay, overlay, and fluting are found on legs to enhance the design equality.

Styling Traditional Design

Traditional furniture traces its history to the 18th century, the age of Chippendale, Hepplewhite, Sheraton, and the Adams Brothers.

- Made use of the handsomely carved cabriole leg in addition to simple, straight legs.
- Applied much delicate fretwork (lattice work) inspired by Chinese artisans
- Made use of ball and cow foot



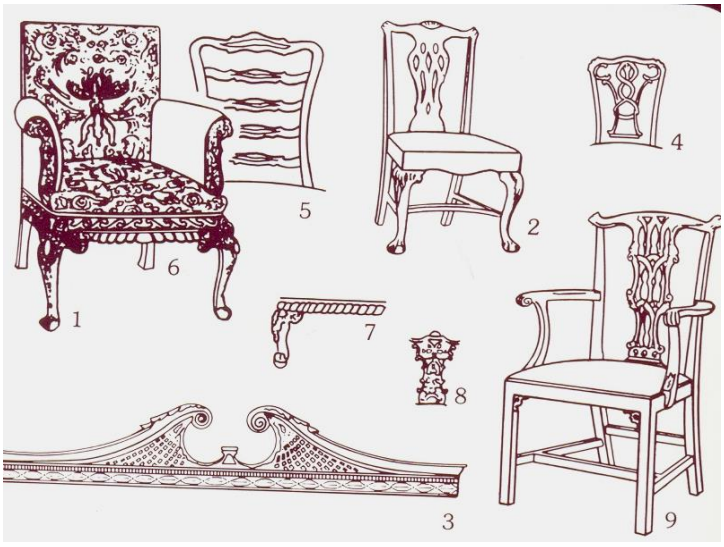


Fig.15 Traditional styles and their features

Self-Check -2	Written Test

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

1. Write elaboration court designs. As main features

.

Part two short answer

2. List Common Priorities Rules
3. How to Use Priority Rules

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet-3	According with specifications jigs and fixtures manufactured .

Developing steps in designing furniture

Steps to be followed in designing furniture

1. Determine need
2. Develop alternative sketches
3. Select the best idea/sketch
4. Conduct research/model
5. Develop working drawing
6. Prepare bill of materials/cost

Determining the need during design

It is known that in order to design furniture there must exist a need. The need may arise from customers based on the function of the furniture. On the other hand you may be required to develop the need based on the actual situation in which that furniture is going to be used.

For example you may be asked to design furniture after observing a blank finished assembly hall. In this case you must study the actual situation during the service life of the hall and list the required functions that can be served by furniture.

As a check list you may ask

1. What activities are going to be performed? e.g. – seating, writing
2. Who will be using?
3. How may activities?
4. How will be the arrangement of activities?

Developing Several Sketches

- The designer draws his dreams on a paper. After the need for furniture design is arisen, you start to develop ideas for the proper solution several sketches representing various alternative ideas for the solutions are made. In developing several sketches the fundamental requirements of design (i.e. function, appearance, material, and construction) and the principles of design (i.e. proposition, balance, Rhythm etc) should always be remembered. Moreover furniture style is the third guide that should be considered at this stage.

The sketches developed at this stage are rough ide3as that guide to the solution and only overall dimensions and only the sizes of special features are known. Detail dimensions and only the sizes

of special features are known. Detail dimensions and materials of construction as well as construction methods are not thoroughly understood at this stage.

For example in order to design a garden seat different alternatives can be suggested using sketches. The sketches may show.

- Seats that may be of cement
- Seat of normal bench
- Seats of anchored chairs
- Seats of swinging chairs that can be hung from trees

Developing Model

In design the ideas developed in the above stage may be so fancy that it can not be practically produced or it may not serve its function properly. For example some movable parts may not properly function as per our ideal design. In order to prove the well functioning of the unit and/or its prod liability models are prepared before the whole laborious design and then production is started.

There are three types of models

- Prototype models –those prepared or produced to the same size as the actual product
- Diminished models – those prepared to diminished scale of the actual object
- Enlarged models – those prepared to enlarged scale f the actual object

A model provides an opportunity to study the piece with possible revision.

Developing Sketch and Model into final Drawings

In designing furniture engineering drawing is the language of communication. Here final drawing implies working drawing and it in formal documents include

- 3D- object drawings
- principal views of the object
- sectional views as much as appropriate in number
- details includes
  - ✓ joint detail
  - ✓ element detail

In case of bar element furniture such as chairs working drawings may be the composition of

- ✓ principal views
- ✓ exploded view of the object

Producing exploded view of the object enables us to visualize the joint.

See the exploded view of service on next page

In developing the sketch into final or working drawing detail understanding of the elements and joints is required. It is at this level that every part and element is dimensioned and propositioned. Every aspect f material and method of construction is also decided.

In producing working drawing a good visualization of your sketch is mandatory. Every joint and element is decided and shown clearly on the drawing.

First the principal view of the object is drawn using the gab site dimensions shown on the sketch. Every form is indicated on the respective view. If there are problems in the dimensions scaled drawings will enable us to see that and correct at this stage. Then at each intersection of the elements propose the appropriate joint considering strength and appearance. Moreover, the internal dimensions and appearances are developed by taking sections at appropriate place and direction. This internal features are drawn with due consideration of conversional sectional views.

Self-Check -3	Written Test

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

1. write as a check list you may ask.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

LG #42	LO #3- Manufacture model

Instruction sheet

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

- Establishing datum's mark out of model
- Selecting mode shape/produce Processes
- Modeling fine fashion/manufacture Procedures
- Checking specifications including measuring and machine required
- Operating procedures standard

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

- Establish datum's mark out of model
- Selected mode shape/produce Processes
- Model fine fashion/manufacture Procedures
- Check specifications including measuring and machine required
- Operate procedures standard

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
10. If your performance is satisfactory proceed to the next learning guide,
11. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	Establishing datum's mark out of model

Bill of materials, cost calculations and plan of procedure

1. Bill of materials

A bill of materials is a list of the things a worker needs when he makes an object.

After you have the furniture design or working drawing at hand you must prepare

- The materials and parts list
- The bill of materials tells the worker exactly what he needs to make the object.

The dimensions of the pieces or parts should be put in the following order:

Thick ness* Width*Length

It is a good idea first to give specification number or name to the parts of an object so that they can be perfectly referred. Then rough dimensions are calculated by adding machining allowances to the finished sizes of the parts (indicated on the drawing). Usually 3 to 5 mm is added to the thickness about 6 to 10mm to the width and about 10 to 15mm to the length.

Once the dimension of the part is determined (both rough and finished) it is necessary to select the type of lumber or material required. In addition to the lumber material other materials such as Formica, plywood, hardboard, Chip wood, metal fittings, fastening devices, finishing materials and others must be included.

Here is an example of a bill of material for service tray.

Part name	quantity	Kind of wood[material]	Rough dimension[mm]			Finished dimension[mm]		
			T	W	L	T	W	L
Sides	2	Kerero	12	70	277	8	60	260
Front &Back	2	Kerero	12	70	465	8	60	450
bottom	1	Plywood	4	254	444	4	254	444

2. Cost calculation

Furniture costs are composed of four main factors. These are:

- Material costs
- Labor Costs
- Overhead costs
- Profit

Material costs are quite easily established, provided there is no excessive amount of waste. In calculating material cost, the list of materials the furniture and its quantity is taken from the bill of material.

A cost of machine able materials is calculated based on the rough dimension. If the processing or machining by product of that material is valuable enough however, one can consider the value from the furniture cost.

S.N	Material	Qty	Unit price	Total price	Remark

Labor costs are carefully anal sized. In most workshops labor unit is set so that the cost of furniture is calculated based on the number of days elapsed to complete it. On the other hand others have hourly rate that can be use for cost calculation. In usual practice some percentage of the material cost is also taken as labor cost.

Overhead refers to the fixed cost of running the factory overhead expenses include building and equipment depreciation cost power consumed telephone and other expenses.

In addition to these items, management must do its best to make sure that a profit will be made on the items that are manufactured.

An analysis must be made to the total cost and how it can be reduced through careful planning or through minor design changes.

To calculate the costs of furniture follow the following procedures

i. Know the quantities of materials used to construct the project by type
ii. Know the unit price for each material
iii. Then calculate the cost of material used to construct the project
   Add 25% wastage for wood
   5% for plywood, chip wood, hardboard, furniture
iv. Add labor cost of 20% of the total material cost or have recorded hours that are spent to construct the project. If the payment
v. Add overhead cost of 15-20% of the total materials cost
vi. Add materials cost + overhead cost. This will be cost price of the project.
vii. By adding profit 20-25% of the cost price , we will get the selling price.

3. Plan of Procedure

A plan of procedure is a list of steps a worker has to follow when he is making or constructing an article

The plan of procedure describes the required.

- Processes
- Tools
- Machines

Working drawing helps to make the plan of procedure i.e. the drawing of the project is analyzed so that a clear understanding of all constructional details is achieved.

In making a plan of procedure

- A breakdown of the project into the smallest parts is made.

e.g. If the project is bed side cabinet it may be broken-down into

- ✓ Leg or base
- ✓ Side, top, bottom, partition (if any)
- ✓ Door (if any)
- ✓ Drawer (if any)

- The steps that are necessary to make each part are listed in order

A general guide of plan of procedure is

- ✓ Read drawing
- ✓ Select material (wood)
- ✓ Cutting stock into rough size

- ✓ Ripping into rough size
- ✓ Joint one face and one edge as a datum
- ✓ Plane the other face & edge in thicknesses
- ✓ Cutting to final length
- ✓ Prepare joins
- ✓ Check the details based on drawing before assembling
- ✓ Assemble units separately
- ✓ Assemble the article
- ✓ Prepare the article for finishing
- ✓ Apply finishing
- ✓ Quality control [check]

- After all the individual parts have been made, a careful check of the assembly (working drawing) is done for the exact dimensions.

Self-Check -1	Written Test

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

1. Write Furniture costs are composed of four main factors
2. Write A general guide of plan of procedure t.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Selecting mode shape/produce Processes .

Elements of Design

While all appear different in design and beauty, they have certain things in common. These are the elements of design that you or the furniture designer must use in designing of piece of furniture.

Lines

In design lines are what you must put on a piece of paper in order to illustrate what you have in mind. Lines can be straight, curved, s – shaped, circular, or spiral.

Shapes

The common shapes are square, rectangular, round, triangular, diamond, elliptical, hexagonal and octagonal. All of these shapes can be represented in fine furniture.

Mass (Solids) and Form

Lines and shape make up mass and form which give and object the three dimensional appearance.

Color

Color creates a mood or atmosphere and is a most important element of furniture design. It can be natural or applied.

Tone and Texture

Tone is a contrast between light and dark, or shadows and brightness on a surface. Texture is the way a surface feels to the touch and how it reflects color. Every material has a natural texture. Texture can also be added to a surface by carving or by applying paints, finishes, or overlay materials.

Principles of Design.

- ✓ *The part must be in balance –*

Balance is achieved when the object appears to have equal weighty on either side. When parts are symmetrical, the result is ***formal*** the piece has the appearance of being at rest this is called ***informal balance***.

- ✓ *The article must be in good proportion –*
- ✓ *The parts must be in harmony with one another –*

This means the finished article must appear to be made up of parts that belong together naturally.

- ✓ *Each furniture piece needs a point of emphasis* –

This may be the overall appearance of the piece itself, the fine finish, and a simple piece of hardware or some point in its construction.

Common Mistakes in Design

The most common mistakes made in furniture design are:

- ✓ *A definite style of furniture is not selected* –
- Too often an individual will design a piece that represents no style but is rather a combination of many styles.
- ✓ *A basic principle of design is ignored* –
- If a part is out off balance or proportion the total effect is spoiled.
- ✓ *Poor selection of material is made* –
- It is difficult to make quality furniture from cheaper woods. Only good furniture woods should be chosen
- ✓ *The beginner often over decorates* –
- Most modern pieces have little or no surface decoration, but depend upon the natural beauty or the wood.
- ✓ *The finish is often poor* –
- A smooth, even finish is a characteristic of good furniture.

Designing a Product

The 1st question that comes to mind is "what style of furniture should I build?" Too much of what is made by the beginning craftsman has no style, design, or character. Strangely enough it is just as easily to build good, high quality furniture as it is to make junk.

The craftsman must first decide on the style or period. The architectural style of a home will influence the decision about the style of furnishings for the home.

The second question that comes to mind is "what should I build?" Items that can be built may be grouped as follows:

- Accessories – these include trays, lamps, small shelves, clocks, curved ornaments, shadow boxes.

- Tables – Including coffee or cocktail, end, game, lamp, snack, dining.
- Stools, benches and chairs
- Bookcases.
- Cabinets, including dish, radio, television, storage, and all purpose.
- Chest and desks.

Another question often asked is, "Should I design my own furniture?" when making your 1st pieces, it is probably better to follow some existing design in some cases making small changes or adoptions to fit particular needs. The size may be changed slightly, for example provides that the change does not upset· the proportion of the piece. For more advanced crafts man, the answer to that question would be to design your own furniture. With close attention to the principles of good design you can achieve very satisfying and individual results.

Self-Check -2	Written Test

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

1. What are the elements of design in designing of piece of furniture?
2. write the principles of design.
3. Explain the most common mistakes made in furniture design.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Indicative Mood

It uses the passive voice with the use of the word *shall* in nearly every sentence. Sometimes this can create unnecessary wordiness and monotony.

Examples: Two coats of paint *shall* be applied to each exposed surface.

Streamlined Writing

This technique uses a colon (:) to mean *shall* or *shall be*. Streamlined specifications are very concise and clear to read. The subject before the colon is helpful when scanning the specifications for keywords.

Examples: Adhesive: Spread with notched trowel.

Words to Avoid

Typically the articles a, an, and the; are not necessary and can be deleted where clarity is not diminished. Avoid making an article or pronoun out of the following words; *such*, *said*, and *same*. The use of the word *all* is usually unnecessary.

Avoid: Install *the* equipment plumb and level.

1.1. Essential Requirements of Specifications

The Following are some of the essential requirements of good specification writing.

1. **Subject matter**

   The subject matter of specifications should relate to the information required after the contract is given to a particular contractor. The requirements which are to be enforced should only be included in the specifications.

2. **Grammar**

   All sentences of the specifications should comply with the rules of grammar. The style and tense should remain the same throughout.

   Proper sentence construction means that the subject and verb must agree, that sentences have parallel construction for both parts of compound subject or predicate, and that the style for nouns, adverbs, or prepositional phrases are identical.

3. **Selection of works**

   While writing specifications, only suitable works with desired meaning should be used. Unfamiliar works of works having more than one meaning should never be used in the specifications.

4. **Accuracy**

   The information given in the specifications should be complete and correct, otherwise the contractor may claim for any extra cost due to damage occurred to him by the misleading information supplied by the specifications.

5. **Practical limits and commercial sizes**

   The specifications should be framed keeping in view the practical limitations of materials and workmanship and they should not specify practical impossibilities. Also, the specifications should specify use of commercial sizes and patterns of the material.

6. **Fairness**

   The specifications should be fair and they should not be framed in such a way as to throw all the risks on the shoulders of the contractor.

7. **Brevity**

   The sentences of the specifications should be short, simple, clear, correct, complete, and concise. This is essential as the main purpose of the specifications is to give directions to the contractor and the supervising staff in carrying out the construction work.

Points to be Included in the Specifications

In the case of Civil Engineering Works, the specifications shall contain the following points.

1. Quality of materials to be used with strength/size requirements,
2. Quantity of materials to be used and the methods of measurements to be followed.
3. Method of mixing when different materials are used.
4. Construction methods to be followed mentioning the equipment and machinery to be used.
5. Dimensions of works such as breadth, thickness etc.,
6. Methods of measurements of works for payments.

A. Steps in writing a specification

The steps to write specification are:

Plan; research; outline; write; edit; review; and obtain approval.

Advice that applies in particular to specifications is:

1. Be positive. Omit statements that indicate lack of knowledge or uncertainty.
2. Exclude requirements that cannot be enforced.
3. Give direction, not suggestions.
4. Give specific numerical data: values, maximum and minimum tolerances.

5. Don't be vague with the use of such phrases as 'Good workmanship', 'easily cleaned', 'readily accessible' .
6. Specify the contractor's responsibilities to subcontractors and third parties.
7. Check and re-check alpha-numeric references to specifications and standards quoted.
8. Be realistic and do not specify the unattainable.
9. Write in the imperative style: 'Conduct the following tests ... etc.' in preference to the passive 'The following tests shall be conducted ... etc.'
10. Be precise in the use of language and avoid:

- Vague adjectives: good, fine, smooth, rough, high, low, large, small.
- Adjectival strings: 'main circuit control switch', which could mean 'Control switch in the main circuit'; 'Main switch in the control circuit'; or 'A switch in the main control circuit.'

The steps to write specification are:

Assess General Considerations

Decide if the specification will be open or closed.

Determine requirements. Evaluate all specifications to determine if they are necessary to the product or assembly.

Ascertain your writing style.

Develop your table of contents. Order the contents such that general requirements about the product or assembly are presented first, followed by more specific subsection or subassembly specifications.

Self-Check -3	Written Test

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

1. Write essential Requirements of Specifications
2. Write Advice that applies in particular to specifications.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet-4	Checking specifications including measuring and machine required**.**

specifications

Specification is defined as the designation or statement by which written instructions are given distinguishing and/or limiting and describing the particular trade of work to be executed. In short specification is a statement of particular instructions of how to execute some task. Specification is one of the contract documents.

Specifications are written based on the prepared design, drawings, general and scientific trends of workmanship, quality expected, equipment involved and materials to be used for the particular trade of work. The specifications should clearly specify: -

- Design and drawing
- Labour employment
- Materials to be used
- Construction method

Equipment's used

Specifications should be clear, concise, and brief descriptions of what is required to execute the proposed trade of work. The information that is needed for building construction is usually conveyed by two basic communication lines. They are:

The drawings (pictorial) and The specifications (written)

In so doing the methods of communication should complement each other and neither should overlap or duplicate the other. Specifications are devices for organizing the information depicted on the drawings and they are written descriptions of the legal and technical requirements forming the contract documents.

Their difference is that the drawings should generally show the following:

- Dimensions, extents, size, shape, and location of component parts
- Location of materials, machineries, and fixtures
- Interaction of furniture, equipments and space
- Schedules of finishes, windows and doors
- Specifications generally describe the following: -
- Type and quality of materials, equipments, labor or workmanship
- Methods of fabrication, installation and erection
- Standards, codes and tests

- Allowance, submittals and substitutions
- Cost included, insurance and bonds
- Project records and site facilities.

Self-Check -4	Written Test

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

1. specifications should clearly specify

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Examples of Detailed Specifications of Materials

Detailed Specification for sand for mortar

The Sand used for mortar shall be clean, sharp, heavy and gritty. It should be free from clay, salt, mica and organic impurities. It shall not contain harmful chemicals in any form. Medium and fine sand are to be used in mortars. Coarse sand shall be sifted through 600 micron sieve and used in mortars for plastering works.

The following provisions are made in the detailed specifications.

- The GENERAL CONDITIONS and
- The TECHNICAL SECTIONS.

A. General provisions/ General Conditions

Describe briefly and in detail the scope of work of the Technical Section concerned and makes reference to the Contract Documents as being part of the requirements of that section of work. Each section is numbered according to the order of the technical description.

These are also known as conditions of contract and they apply to the work as a whole. In this document, the conditions governing the contract are written.

The following groups of conditions of contract are generally accommodated under the general provisions.

- Conditions a relating to documents
- Conditions relating to the general obligations of the contractor:
- Conditions a relating to labor and personnel:
- Conditions a relating to the execution of the work
- Conditions a relating to measurements and payments
- Conditions a relating to default and non-completion
- Conditions a relating to settlement of dispute

B. Technical Provisions/ Technical Section

It is a unit of work consisting of carefully worded description of materials and explains the method of construction or application, method of fabrication and testing requirements and other technical details. These specifications describe the technical requirements of each type of constructions. The technical provisions contain detailed instructions regarding the desired quality of the final product.

The technical provisions are of three types.

- Specifications for materials and workmanship Specifications for performance
- Specifications for proprietary commodities Commercial products which are standardized or patented are called proprietary commodities.

All specifications fall into seven (7) types:

1. Performance Specification (result system)
2. Descriptive/Prescription Specification (method system)
3. Brand Name Specification
4. Proprietary Specifications
5. Reference Specification
6. Combination Specification
7. Standards
8. Process

A. PERFORMANCE SPECIFICATION

The results of the product rather than the product itself are specified.

Under this method the required end results are specified along with the criteria by which the performance will be judged and the method by which it can be verified. The contractor is free to choose the materials and methods that comply with the performance specification. They are generally used to encourage the use of new and innovative techniques that may lead to more economical construction. They are also used to supplement other specification methods.

B. DESCRIPTIVE SPECIFICATIONS

As the name implies, a descriptive specification gives a description of the product.

Under this method of specifying the exact properties of the materials and methods of installation are described in detail without using proprietary or manufacturer's names. Descriptive specifications are commonly used for products for which no standards exist, on projects where using proprietary names is restricted, and in situations where the Architect/Engineer want to exercise tight control over the specified work.

C. BRAND NAME SPECIFICATION

The desired product is specified by the name given by the manufacturer or manufacturer's name and model number.

D. Proprietary Specifications

Under this method the actual brand names, model numbers and other proprietary information is specified. They are primarily used for private commercial projects where the Owner knows what products they want.

There are two types of proprietary specifications, closed and open. The primary difference between the two types concerns substitutions.

CLOSED SPECIFICATION:-Closed specifications generally prohibit substitutions. One or more products are specified, and no substitutions will be considered.

Closed specifications are usually brand-name specifications. This is used basically where material is required to match existing material.

A closed specification describes not only required performances, but also tools, technologies or subassemblies that must be used in the design of a product or assembly to meet the specification. For example, a lifting assembly specification may require that hydraulic power be used by the product or assembly that is to meet the specification.

OPEN SPECIFICATION:- An open specification describes required performances without mandating how those performances are to be achieved. An open specification leaves a great deal of freedom to the entity that creates a product or assembly to satisfy the specifications. Open specifications permit substitutions. One or more products are specified, but other manufacturers will be considered. It is necessary to specify the process and criteria the alternate manufacturers will be judged by.

For example, a computer memory storage specification may not specify the exact medium used to store the data in order to meet the requirement.

E. Reference Standard Specification

The item desired is referred to by a number corresponding to a number in a published specification. It makes reference to a standard that has been established (like a guild or organization who can vouch for the quality of material or work).

Under this method reference is made to an established standard defined by associations very knowledgeable about a certain part or phase of construction. Reference standard specifications are used for "commodity" products in the marketplace, where brand names are not important.

F. . COMBINATION SPECIFICATION

- It may be desirable to use a combination of the performance, descriptive and reference types of specifications.

- These specifications include both design and functional features. Characteristics of both are used as prerequisites and as limiting factors in developing the specification.

G. STANDARDS

Standards are specifications in a category of their own. They are written by national and international bodies (the ASME *Boiler and Pressure Vessel Code* is used internationally), by industries, and even by large corporations.

There are many examples of standards as specifications. The U.S. Military Specifications, the Canadian Federal Department of Works Master Construction Specification, and Ontario Power's extensive welding standards fall into this category. Standards, however, can be one of three types:

- To provide specific requirements for products such as material, fasteners and fittings that, among various suppliers, are interchangeable.
- Specify product material requirements as in the first type, but suppliers are permitted some latitude to meet the standards. In this case, however, the products from different suppliers are not interchangeable.
- To cover processes and practices not specific to a product or item. Standards of this type can be recognized in titles such as Codes of Practice, General Requirements, Guide, Test Methods, and Quality Assurance.

H. PROCESS

Process specifications describe the technical processes that will be used in the manufacture of a product, or construction of a building or system. These processes include the heat treatment of foundry castings, rules for pre-stressing concrete beams, bolt torques on bridge anchors, seismic measurements, and specific chemical processes to name a few.

In many ways, process specifications are specified procedures and are often regarded as procedures as opposed to specifications. For example, the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code contains specifications that include process procedures.

4. Writing specification

Any specification that is indefinite, indeterminate, ambiguous or useless will involve uncertainties and result in the addition of certain sums by the bidder. Any specifications, therefore, which are arbitrary, unfair or unnecessary severe, give a bad impression of the interior designer, attorney and principals and usually involved either a refusal to bid on the work or additions to the price bid to offset the unwarranted treatment to be expected under such specifications.

a. Specification Language and Writing Style

Specification language should be precise. Vague and ambiguous text can be open to multiple interpretations.

1. Avoid using "it" or "which", and clearly specify what is being referred to in the text.
2. Define the jargon and abbreviations that are common within the industry. To clearly define industry terms, add a definition section at the beginning of the specification.
3. Short, direct and simple sentences are easier to read and understand.

Style also means passive or active voice. Active voice is when the subject of the sentence acts, but if the subject is acted on, the voice is passive. Passive voice nearly always takes more words and is less direct. Active voice takes fewer words and is more direct. Active voice is preferred in most cases, but is not always appropriate.

Vocabulary (Terminology):

Use terms with precise meanings and avoid jargon and ambiguous terms.

Avoid the use of abbreviations unless they are well-known industry standards or are defined in the specification.

Avoid the use of symbols. Use numerals consistently and set particular rules for capitalization.

Avoid the use of unnecessary words and the excessive use of prepositional phrases.

Sentence Structure

Imperative Mood

It puts the verb that defines the action as the first word in the sentence. It is the recommended method for specifications covering installation of products and equipment. It is easily understandable and concise.

Examples: *Apply* two coats of paint to each exposed surface.

Self-Check -5	Written Test

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

1. Write types of specification? (2 point)
2. Date of last effective revision and revision designation ? (3 point)
3. What are the benefits of detailed specifications? (5 point)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

List of Reference

1. Clin Chem Westgard JO, Burnett RW, Bowers GN. Quality Management Science in Clinical Chemistry: A dynamic framework for Continuous Improvement of Quality. Clin Chem 1990;36:1712-6.
2. Arlbjorn, J. S., & Freytag, P. V. (2012). Public procurement vs private purchasing. International Journal of Public Sector Management, 25(3), 203-220.
3. Larson, P.D. (2009), "Public vs private sector perspectives on supply chain management", Journal of PublicProcurement, Vol. 9 No. 2, pp. 222-47.
4. Okello , B., & Richu , S. (2016). Does Tendering Processing Enhance Organizational Performance? Analysis of Kenya Wildlife Service . The International Journal of Business & Management , 4(4), 167-174.
5. Quayle, M. (1998), "The impact of strategic procurement in the UK government sector", International Journal of Public Sector Management, Vol. 11 No. 5, pp. 397-413.
6. Trent, J. R., & Monczka, M. R. (2003). International Purchasing and Global Sourcing — What are the Differences? The Journal of Supply Chain Management, 26-36.

Books

1. **Benton**, W. C., Purchasing and Supply Chain Management, 3rd ed., 2013 Tata McGraw Hill, New Delhi
2. Dobler D.W., Lee L., Burt D.N., Purchasing and Materials Management – Text and Cases, 4th edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
3. Gopalakrishnan P., Purchasing and Materials Management, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
4. Khana, R., Production and Operation Management, PHI Learning Private Limited, New Delhi.

Web links

1. http://www.finmin.nic.in/the_ministry/dept_expenditure/gfrs/mpproc4progod.pdf
   http://www.ceeri.res.in/purchase/Uploads/Purchase_Manual.pdf
2. http://www.transparencyindia.org/pdf
   http://www.legislation.gov.uk/uksi/2015/102/pdfs/uksi_20150102_en.pdf
3. http://www.diva-portal.org/smash/get/diva2:627148/FULLTEXT01.pdf
4. http://www.diva-portal.org/smash/get/diva2:318924/fulltext01

The trainers who develop *this outcome based* curriculum

No	Name	Region	Level	/Proffession/ Qualification	TVET College	Email & Phone No
01	ASHEBIR ATNAFU	SNNP	A	Construction management	Hossana	Geji1993@gmail.com 0911821805
02	BOGALE YILMA	SNNP	A	Construction management	Butajira	0910411083
03	HUSSIEN MOHAMMED	B/G	A	Wood Technology Management	Asossa	0913837021 Hussenmoha856@gmail.com
04	IBRAHIM HASHM	D/D	B	Wood Tecknology	D/D P/Tevt	0921442756 Ibrahimhashim2756@gmail.com

Adviser during developing this *outcome based* curriculum

No	***Name***	***Profession***	***Mob. No***	***College***	***Email***
01					

This out Come Based Curriculum was developed on Jan, 2021 G.C at Adama, Ethiopia