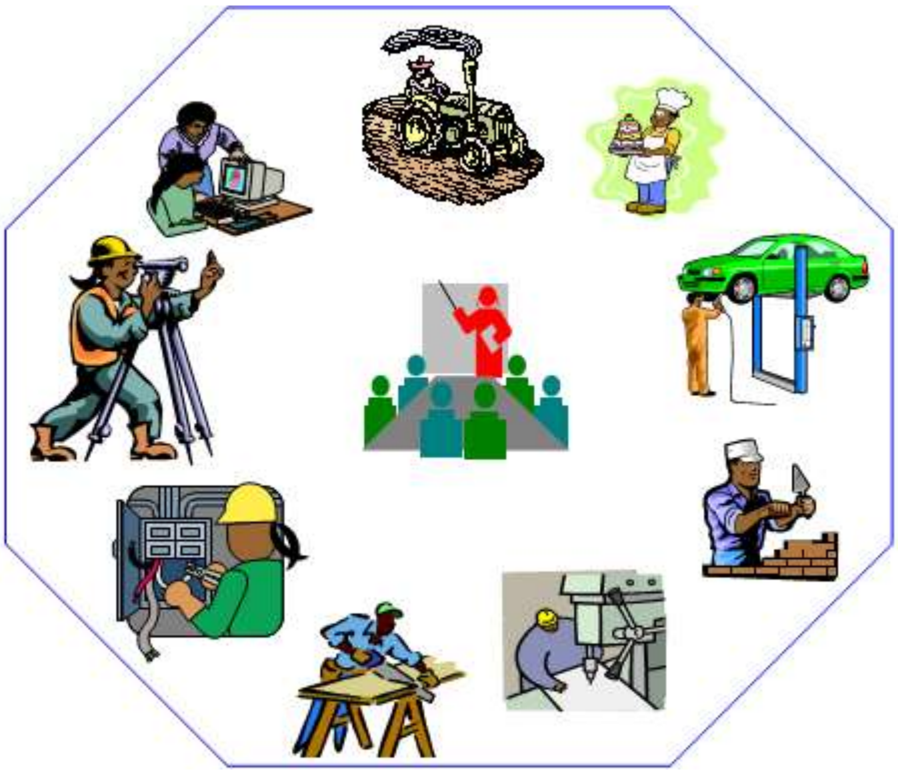
Welding
Level-IV

Based on May 2017, Version 1 Occupational standard



Module Title: - Developing Models

LG Code: IND WLD4 M06 (1-4) LG (28-31)
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LG #28	LO #1- : Determine work 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 and understanding drawings, instructions and specifications.
- Selecting materials to meet specifications.
- Preparing time schedule.
- Studying functional and formal relationships.
- Determining detail specifications.

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

- Identify requirements from design program and brief.
- Interpret and understanding drawings, instructions and specifications.
- Select materials to meet specifications.
- Prepare time schedule.
- Study functional and formal relationships.
- Determine 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 the Self-checks).

6. If you earned a satisfactory evaluation proceed
7. Perform “the Learning activity performance test”
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions

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

1.1. Introduction of design program

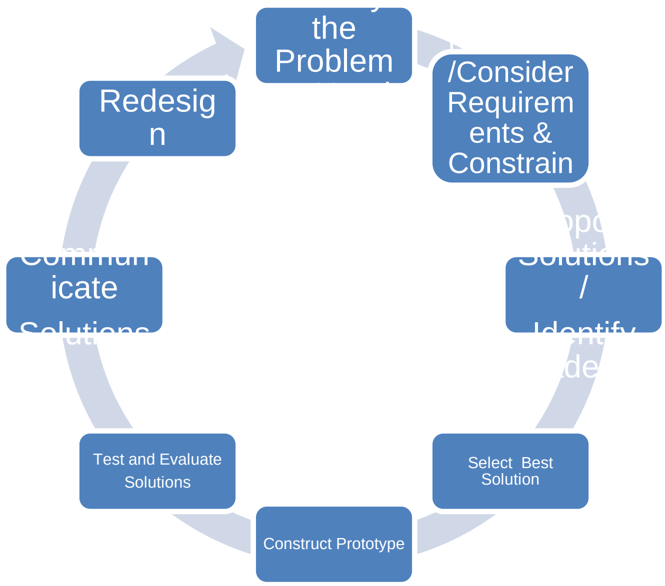
Design Many elements around us are designed Communities, buildings, landscapes, road systems, information systems, web pages, web sites, lectures…

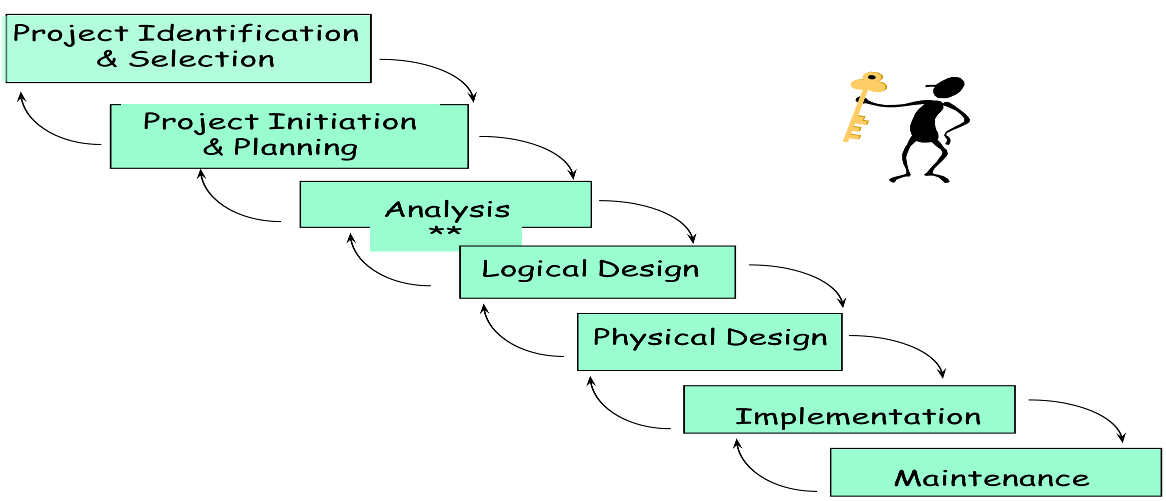
The word design can be a noun (check out my design) or a verb (I need to design my web site) . Design is about creating something with a purpose."

"Design is that area of human experience, skill and knowledge which is concerned with man's ability to mold his environment to suit his material and spiritual needs."

"Design is more than just technology; it is a problem-solving process in which the form of the final product must occupy a function. "Engineering design is the communication of a set of rational decisions obtained with creative problem solving for accomplishing certain stated objectives within prescribed constraints. Engineering design is the systematic, intelligent generation and evaluation of specifications for artifacts whose form and function achieve stated objectives and satisfy specified constraints.Engineering design is the organized, thoughtful development and testing of characteristics of new objects that have a particular configuration or perform some desired function(s) that meets our aims without violating any specified limitation.The design of an embedded microcontroller system requires an integrated use of hardware and software.Hardware and software provide a natural division of the view of the system. Embedded systems require well designed interaction between these two divisions. The software design needs to follow established methodologies.The software of the system is typically called a Software Program.A software program is software compiled and assembled into executable code for the target machine.

Requirement from design





Two essential views of the current and replacement information systems. Both are describing the same system, but in a different way.

Process view: The sequence of data movement & handling operations within the system

- Data flow diagrams

- Data: The inherent structure of data independent of how or when it is processed
- Entity-relation diagrams

Who will you get information from?

- User Stakeholders,
- Managers,
- Client Stakeholders,
- Technical Stakeholders

Traditional Methods for Determining System Requirements.

Administering questionnaires,Interviewing and listening,Interviewing groups,Directly observing users,Analyzing procedures & other documents

Administering Questionnaires Advantages & Disadvantages.

Strengths**,**Weaknesses

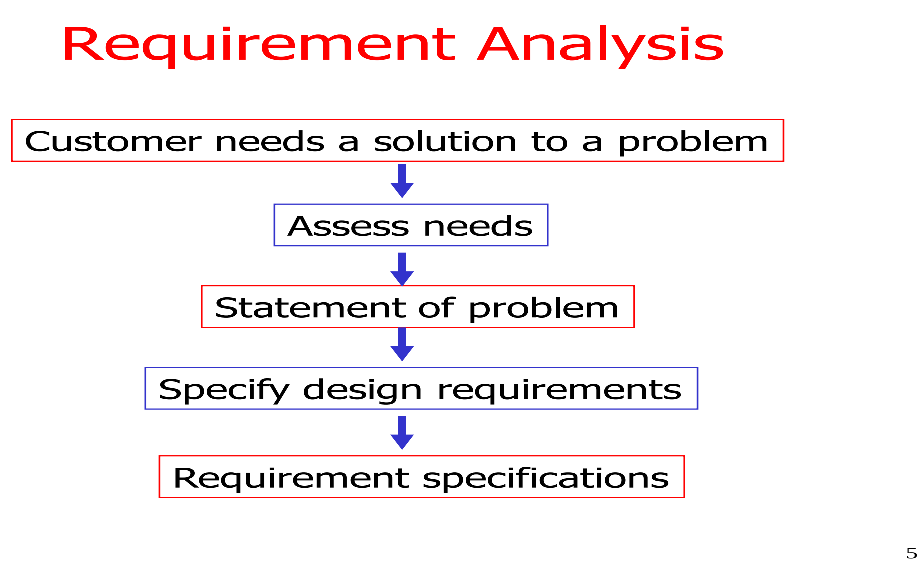
Interviewing & Listening.

Before,During the interview,Afterwards

During the Interview.

Beginning,Introduction, open-ended questions, interest & attention Middle,Open & close-ended questions, f-u questions, active listening, provide feedback, limit note-taking,End.

Summarize, request feedback and/or f-u, ask for corrections



How to assess needs?

Question the customer. To define the design problem,To understand budget and schedule constraints,Reliability and maintenance constraints

Explore resources

Expertise (knowledge and experience),Technical literature (books, journals,www),Measurement and testing equipments (equipment suppliers) ,Similar designs (competitors, patent search)

Search legal and regulatory restrictions.Environmental impacts ,Safety

Manufacturability issues

What is a requirement?

It may range from a high-level abstract statement of a service or of a system constraint to a detailed mathematical functional specification.

This is inevitable as requirements may serve a dual function

May be the basis for a bid for a contract - therefore must be open to interpretation;

May be the basis for the contract itself - therefore must be defined in detail;

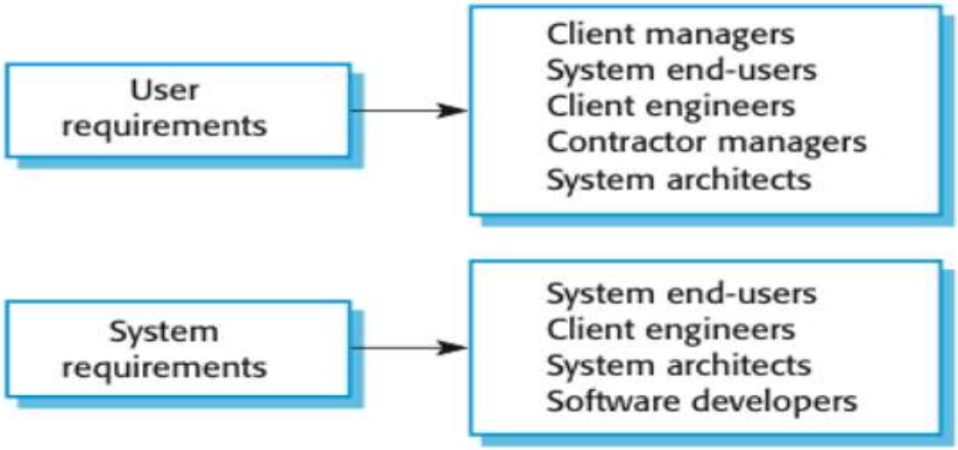
Both these statements may be called requirements.

Types of requirement

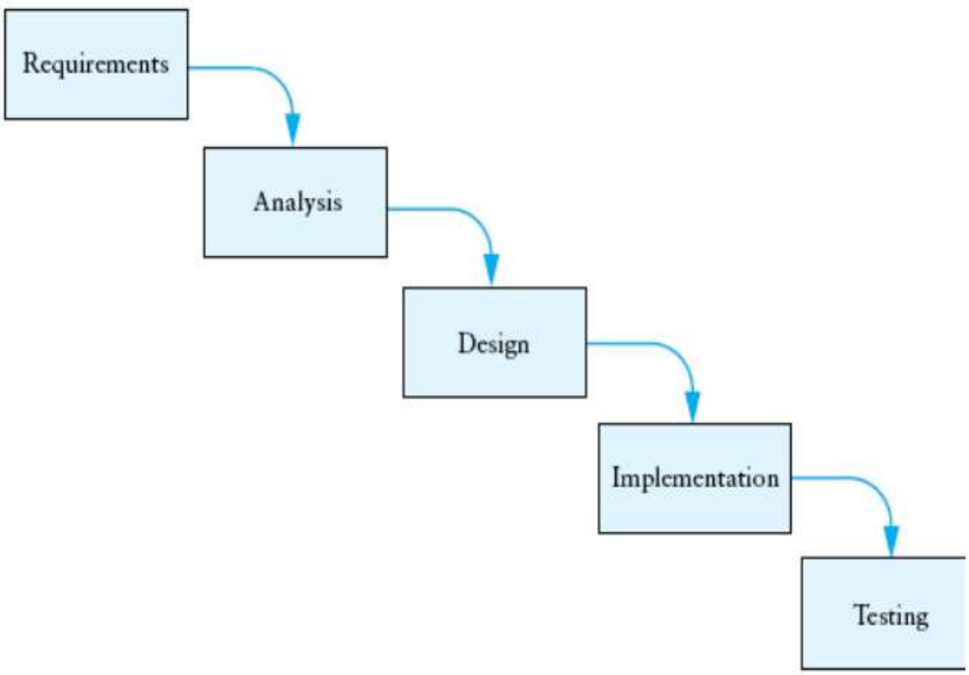
User requirements

Statements in natural language plus diagrams of the services the system provides and its operational constraints. Written for customers.

System requirements – A structured document setting out detailed descriptions of the system's functions, services and operational constraints. Defines what should be implemented so may be part of a contract between client and contractor.



Sequence of water fall requerment



Software Life Cycle Activities

Activities essential for successful development:

- Requirements specification
- Architectural, component, & detailed designs
- Implementation
- Unit, integration, and acceptance testing
- Installation and maintenance

Software Life Cycle Activities (more)

- Requirements Specification
- System analyst works with users to clarify the detailed system requirements
- Questions include format of input data, desired form of any output screens, and data validation

Design

- Top-down: brake system into smaller subsystems
- Object-oriented: identify objects and their interactions
- UML diagrams: tool to show interactions between:
- Classes (inside the system)
- Classes and external entities

Analysis

- Make sure you completely understand the problem before starting the design or program a solution
- Evaluate different approaches to the design Software Design Software Life Cycle Activities (continued)

Table -1 software life cycle activites

1. Requirements specification	The requirements for the software product are determined and documented.
2. Architectural design	The architecture of the solution is determined. This breaks the solution into different components, which are allocated to one or more processing resources.
3. Component design	For each component, classes are identified, with specified roles and responsibilities.
4. Detailed design	Methods and data fields are defined for classes. Detailed algorithms for the methods are defined.
5. Implementation	The individual methods are coded in the target programming language.
6. Unit test	Each class and its methods are tested individually.
7. Integration test	Groups of classes are tested together to verify that they work together and meet the requirements.
8. Acceptance test	The product as a whole is tested against its requirements to demonstrate that the product meets its requirements.
9. Installation	The product is installed in its end-use (production) environment.
10. Maintenance	Based upon experience with the software, enhancements and corrections are made to the product.

A prototype is a “first or primitive form” and the word comes from the Greek word proto types which is a compound of the word **proto** “first” and **typos** “impression”
The word has been used in many different contexts and disciplines and is used within design for various purposes. It is commonly believed that prototyping benefits the design process and output. Prototypes can identify problems early to save money.

Prototypes are said to be especially important when the design space is complex and fuzzy (unclear) since clients and other stakeholders might have a hard time understanding the progression and usefulness of different activities in the design process without them.

Tangible things, such as scenarios, visualizations and other representations provide security for stakeholders; and facilitate communication.In short, having some external representation provides a common reference point that allows stakeholders to collaborate and evaluate design suggestions.

The purpose of prototyping is a perspective dealing with the reason for prototyping and what aspects to represent. When designers need to be aware during every step of the prototyping process of what they are actually prototyping they were addressing the issue of purpose in prototyping.

The purpose should nevertheless be a highly prioritized perspective, since it inevitably dictates the terms of how prototypes are constructed. The purpose also changes with design disciplines, i.e., motivations behind industrial design prototypes are presumably (most probably) different from interaction design prototypes and it also changes depending on what the prototyping culture looks like.

Why Do We Prototype?

- Get feedback on our design faster
  - saves money
- Experiment with alternative designs
- Fix problems before code is written
- Keep the design centered on the user

1.2. Prototype Design

This design should exhibit the basic form, fit, and function of the final product

It will not necessarily be identical to the production model

What is a prototype?

In other design fields a prototype is a small-scale model:

- a miniature car
- a miniature building or town

Why prototype?

Evaluation and feedback are central to interaction design

Stakeholders can see, hold, interact with a prototype more easily than a document or a drawing.Team members can communicate effectively.You can test out ideas for yourself

It encourages reflection: very important aspect of design .Prototypes answer questions, and support designers in choosing between alternative

What to prototype?

Technical issues

Work flow, task design

Screen layouts and information display

Difficult, controversial, critical areas

Low-fidelity Prototyping

- Uses a medium which is unlike the final medium, e.g., paper, cardboard
- Is quick, cheap and easily changed
- Examples:
- sketches of screens, task sequences, etc
- 'Post-it' notes
- Storyboards
- 'Wizard-of-Oz'

Storyboards

Often used with scenarios, bringing more detail, and a chance to role play

It is a series of sketches showing how a user might progress through a task using the device, Used early in design

Sketching

Sketching is important to low-fidelity prototyping

Don't be inhibited about drawing ability. Practice simple symbols

High-fidelity prototyping

Uses materials that you would expect to be in the final product.

Prototype looks more like the final system than a low-fidelity version.

For a high-fidelity software prototype common environment include Macromedia Director, Visual Basic, and Smalltalk.

Danger that users think they have a full system see compromises

Compromises in prototyping

All prototypes involve compromises

For software-based prototyping maybe there is a slow response? sketchy icons? limited functionality?

Two common types of compromise

'horizontal': provide a wide range of functions, but with little detail

'vertical': provide a lot of detail for only a few functions

Compromises in prototypes mustn't be ignored. Product needs engineering

Construction

Taking the prototypes (or learning from them) and creating a whole

Quality must be attended to: usability (of course), reliability, robustness, maintainability, integrity, portability, efficiency, etc

Product must be engineered

Evolutionary prototyping

'Throw-away' prototyping

Performance Testing of Prototype

Performance testing and redesign of the prototype continues until this design-test-redesign process produces a satisfactorily performing prototype

Design of Production Model

The initial design of the production model will not be the final design; the model will evolve

Prototyping

Prototyping is an information-gathering technique

Prototypes are useful in seeking user reactions, suggestions, innovations, and revision plans Prototyping may be used as an alternative to the systems development life cycle

Four Kinds of Prototypes

There are four conceptions of prototypes:

- Patched-up prototype
- Non-operational scale model
- First full-scale model
- Prototype which contains only some of the essential system features

Patched-up Prototype

This is a working model with all the features but is inefficient

Users can interact with the system

Storage and retrieval of data may be inefficient

Workable but inefficient

May contain only basic features

Nonoperational Scale Models

A nonoperational scale mode is one which is not operational, except for certain features to be tested

Prototype input and output

First Full-Scale Models

Create a pilot system

An operation models

Useful when many installations of the same information system are planned

An example is a system to be installed in one location, tested and modified as necessary, and later implemented in other locations

Selected Features Prototype

An operational model that includes some, but not all, of the final system features

With the acceptance of these features, later essential features are added

Some menu items are available

System is built in modules

These are part of the actual system

Prototype Development Guidelines

Guidelines for developing a prototype are

- Work in manageable modules
- Build the prototype rapidly
- Modify the prototype in successive iterations
- Stress the user interface

1.3. Prototype Advantages and Disadvantages

Prototype Advantages

Potential for changing the system early in its development

Opportunity to stop development on an unworkable system

Possibility of developing a system that closely addresses users' needs and expectations

Prototype Disadvantages

Managing the prototyping process is difficult because of its rapid, iterative nature

Requires feedback on the prototype

Incomplete prototypes may be regarded as complete systems

1.4. Prototype Evaluation

Systems analysts must work systematically to elicit and evaluate users' reactions to the prototype

Three ways the user is involved

- Experimenting with the prototype
- Giving open reactions to the prototype
- Use a prototype evaluation form

Suggesting additions to and/or deletions from the prototype

Self-Check -1	Written Test

Directions: choose the best answer for the following question

1. Software Life Cycle Activities essential for successful development**?**
   - A. Requirements specification
   - B. Unit, integration, and acceptance testing
   - C. Installation and maintenance
   - D. all
2. one of the following is NOT user requirement?
   - A. client manager
   - B. software developer
   - C. Contractor manager
   - D. Engineer managers
3. what are the four conceptions of prototypes?
   - A. Patched-up prototype
   - B. Non-operational scale model
   - C. First full-scale model
   - D. All
4. ____________is the communication of a set of rational decisions obtained with creative problem solving for accomplishing certain stated objectives within prescribed constraints.
   - A. Sketching
   - B. Engineering Design
   - C. Software
   - D. prototype

***Note:* Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet-2	Interpreting and understanding drawings, instructions and specifications

2.1. drawing

A drawing is one method of presenting technical communication. Technical communication is an advanced form of communication whereby people of the same trade (profession) can convey messages to one another more accurately and precisely. To achieve this, a technical language (and jargon), which is well standardized, is needed (e.g., botanical names in Horticology and Latin for medical terminology, etc.). Drawings have been used since the beginning of history for planning and producing art objects, architectural designs and engineering works. Since the Industrial Revolution a system for creating architectural and engineering drawings has evolved. While the pens, pencils, tools and papers for creating drawings have changed, the basic forms for presenting information have stayed the same. People producing technical drawings need to be familiar with the standard ways of presenting design information.

Engineering drawing is completely different from artistic drawing, which are used to express aesthetic, philosophical, and abstract ideas.Drawing is important for all branches of engineering.Graphical representation of an object – **Drawing.**Engineering drawing – A drawing of an object that contains all informationlike **actual shape**, accurate size, **manufacturing methods,** etc., required for its construction.No construction/manufacturing of any (man -made) engineering objects is possible without engineering drawing.

What will you learn in this course?

You will learn - How industry communicates technical information.

Visualization – the ability to mentally control visual information.

Graphics theory – geometry and projection techniques.

Standards – set of rules that govern how parts are made and technical drawings are represented.

Conventions – commonly accepted practices and methods used for technical drawings.

Tools – devices used to create technical drawings and models.

Applications – the various uses for technical drawings.

2.2. Drawings, instructions and specifications should be interpreted and understood before starting any production on prototype

Conceptual design requirements to design

Transform user requirements/needs into a conceptual model

"A description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"

Don't move to a solution too quickly.

Consider alternatives prototyping

Is there a suitable metaphor (symbol or image)?

Interface metaphors combine familiar knowledge with new knowledge in a way that will help the user understand the product.

Three steps:

understand functionality,

identify potential problem areas,

generate metaphors

Evaluate metaphors:

How much structure does it provide?

How much is relevant to the problem?

Is it easy to represent?

Will the audience understand it?

How extensible is it?

Expanding the conceptual model

What functions will the product perform?

What will the product do and what will the human do (task allocation)?

How are the functions related to each other?

What information needs to be available?

What data is required to perform the task?

How is this data to be transformed by the system?

Using scenarios (situations) in conceptual design

Express proposed or imagined situations

Used throughout design in various ways scripts for user evaluation of prototypes concrete examples of tasks as a means of co-operation across professional boundaries

Plus, and minus scenarios to explore extreme cases

Generate storyboard from scenario

2.3. Types of Specification

Design specs(critria) : provide basis for evaluating the design

Functional specs: what the thing must do?

Input-output relations

Black boxes and transparent boxes

Performance specs: tells us how well the design is

Metrics : Tools for testing and measuring the performance

Items required for drawing

- Drawing board
- Drawing sheet
- Mini-drafter/drafting machine/ T- square
- Instrument box containing compass, divider, etc.
- Scales
- Protractor
- French curves
- Drawing pencils
- Eraser
- Drawing clip/pin/adhesive tape
- Sharpener
- Duster

The technical drawing, on the other hand, is not subtle, or abstract. It does not require an understanding of its creator, only an understanding of technical drawings. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications. (See figure 1.2)

Fig

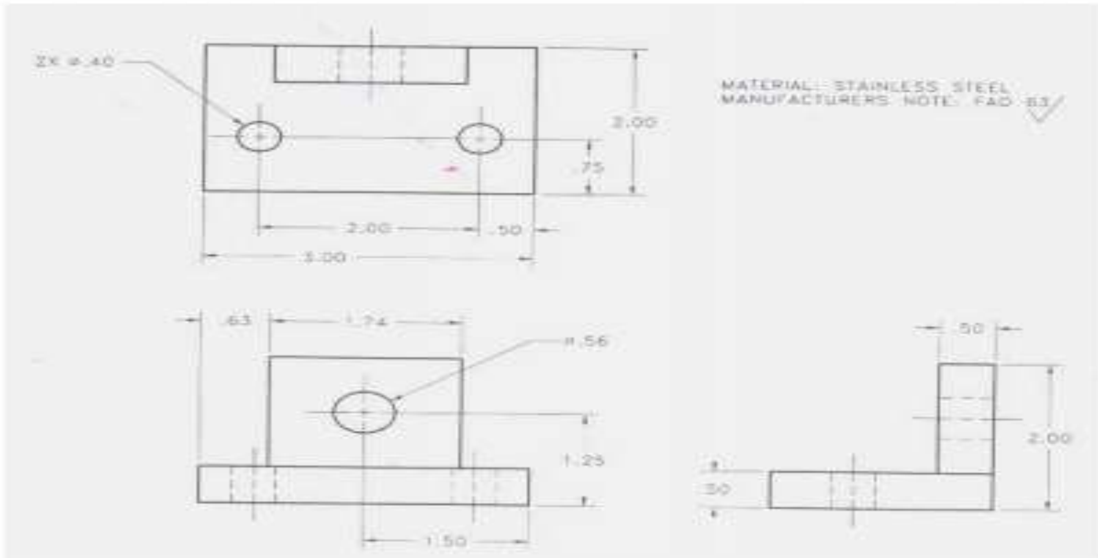


Fig -1 technical drawing

Types of Technical Drawings

Technical drawings are based on the fundamental principles of projections. A projection is a drawing or representation of an entity on an imaginary plane or planes. This projection planes serves the same purpose in technical drawing as is served by the movie screen. A projection involves four components

- The actual object that the drawing or projection represents
- The eye of the viewer looking at the object
- The imaginary projection planes
- Imaginary lines of sight called Projectors

Self-Check -2	Written Test

Instruction: Choose the best answer.

1. ___________________is one method of presenting technical communication. Technical communication is an advanced form of communication whereby people of the same trade (profession) can convey messages to one another more accurately and precisely. Transformer
   A. Iinstruction
   B. Specification
   C. Drawing
   D. all
2. which are NOT the following Items required for drawing
   A. Drawing board
   B. Drawing sheet
   C. Scales
   D. None

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

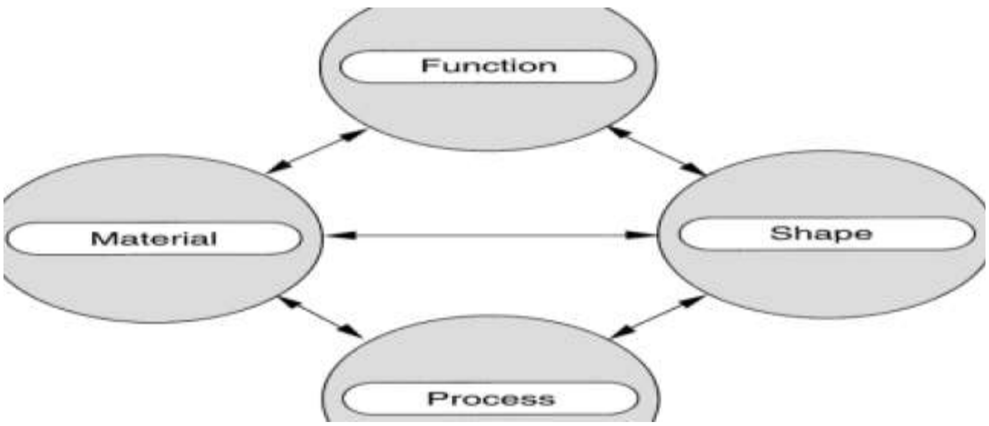
Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

3.1. Appropriate materials

Mechanical components have mass, they carry loads, they conduct heat and electricity, they are exposed to wear and to corrosion, they are made of one or more materials; they have shape; and they must be manufactured. We need to understand how these activities are related.

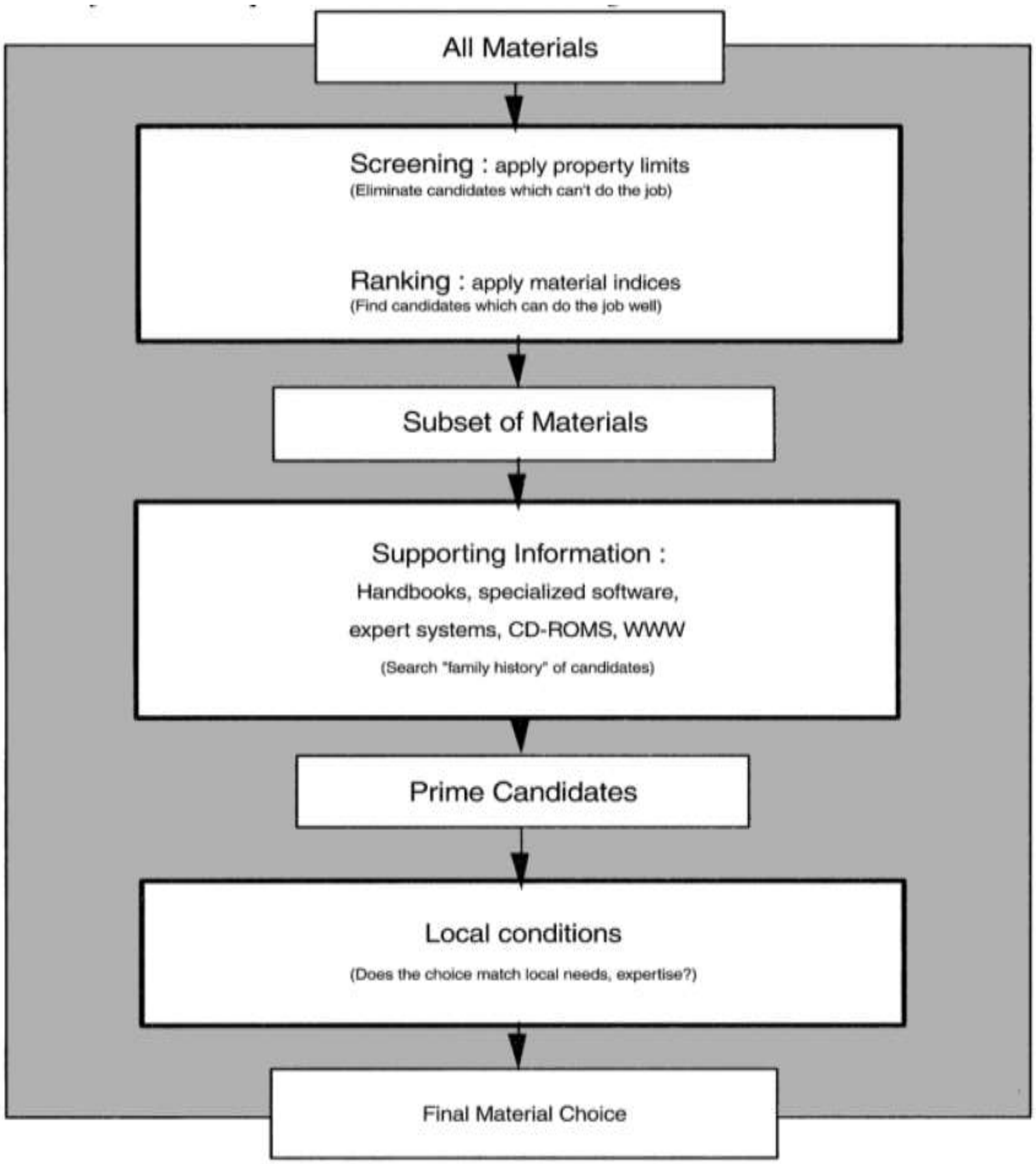


Materials have limited design. But right now materials and the processes to shape them are developing faster than at any time in history; the challenges and opportunities are therefore greater than ever before

Normally the choice of material is dictated (ordered) by the design, but sometimes it is the other way around, the development of a new material changes the way something is designed.

The process for the selection of the material depends on the stage of the design, with initial design suggesting the consideration of a wide range of material, but final design requiring more accurate information to choose between a few materials and to make the final accurate design.

The choice cannot be made independently of the forming and finishing processes for the materials for these significantly impact on properties and cost



3.2. selection of a proper material

Metal material

iron. In terms of mass, **iron** is the most abundant element on Earth, since it is found in the Earth's surface and core. ...

Copper. **Copper** is notorious for its color and its chemical properties. ...

Aluminum. **Aluminum** is a soft, ductile metal that has a distinct bright silver colour to it. Steel.

The selection of a proper material, for engineering purposes, is one of the most difficult problem for the designer. The best material is one which serve the desired objective at the minimum cost. The following factors should be considered while selecting the material:

- Availability of the materials,
- Suitability of the materials for the working conditions in service, and
- The cost of the materials.

The important properties, which determine the utility of the material are physical, chemical and mechanical properties. We shall now discuss the physical and mechanical properties of the material in the following articles.

Fig-2 valuable metals

3.3.1. Physical Properties of Metals

The physical properties of the metals include luster, color, size and shape, density, electric and thermal conductivity, and melting point. The following table shows the important physical properties of some pure metals.

Table -2 phyical properties of metal

Metal	*Density* (*kg/m³*)	*Melting point* (*°C*)	*Thermal conductivity* (*W/m°C*)	*Coefficient of linear expansion at 20°C (μm/m/°C)*
Aluminium	2700	660	220	23.0
Brass	8450	950	130	16.7
Bronze	8730	1040	67	17.3
Cast iron	7250	1300	54.5	9.0
Copper	8900	1083	393.5	16.7
Lead	11 400	327	33.5	29.1
Monel metal	8600	1350	25.2	14.0
Nickel	8900	1453	63.2	12.8
Silver	10 500	960	420	18.9
Steel	7850	1510	50.2	11.1
Tin	7400	232	67	21.4
Tungsten	19 300	3410	201	4.5
Zinc	7200	419	113	33.0
Cobalt	8850	1490	69.2	12.4
Molybdenum	10 200	2650	13	4.8
Vanadium	6000	1750	—	7.75

3.3.2. Mechanical Properties of Metals

The mechanical properties of the metals are those which are associated with the ability of the material to resist mechanical forces and load. These mechanical properties of the metal include strength, stiffness, elasticity, plasticity, ductility, brittleness, malleability, toughness, resilience, creep and hardness. We shall now discuss these properties as follows:

1. **Strength**. It is the ability of a material to resist the externally applied forces without breaking or yielding. The internal resistance offered by a part to an externally applied force is called *stress.

2. **Stiffness.** It is the ability of a material to resist deformation under stress. The modulus of elasticity is the measure of stiffness.

3. **Elasticity.** It is the property of a material to regain its original shape after deformation when the external forces are removed. This property is desirable for materials used in tools and machines. It may be noted that steel is more elastic than rubber.

4. **Plasticity.** It is property of a material which retains the deformation produced under load permanently. This property of the material is necessary for forgings, in stamping images on coins and in ornamental work.

5**. Ductility**. It is the property of a material enabling it to be drawn into wire with the application of a tensile force. A ductile material must be both strong and plastic. The ductility is usually measured by the terms, percentage elongation and percentage reduction in area. The ductile material commonly used in engineering practice (in order of diminishing ductility) are mild steel, copper, aluminium, nickel, zinc, tin and lead.

Note: The ductility of a material is commonly measured by means of percentage elongation and percentage reduction in area in a tensile test.

6. **Brittleness**. It is the property of a material opposite to ductility. It is the property of breaking of a material with little permanent distortion. Brittle materials when subjected to tensile loads, snap off without giving any sensible elongation. Cast iron is a brittle material.

7. **Malleability**. It is a special case of ductility which permits materials to be rolled or hammered into thin sheets. A malleable material should be plastic but it is not essential to be so strong. The malleable materials commonly used in engineering practice (in order of diminishing malleability) are lead, soft steel, wrought iron, copper and aluminium.

8**. Toughness**. It is the property of a material to resist fracture due to high impact loads like hammer blows. The toughness of the material decreases when it is heated. It is measured by the amount of energy that a unit volume of the material has absorbed after being stressed upto the point of fracture. This property is desirable in parts subjected to shock and impact loads.

9**. Machinability**. It is the property of a material which refers to a relative case with which a material can be cut. The machinability of a material can be measured in a number of ways such as comparing the tool life for cutting different materials or thrust required to remove the material at some given rate or the energy required to remove a unit volume of the material. It may be noted that brass can be easily machined than steel.

10**. Resilience**. It is the property of a material to absorb energy and to resist shock and impact loads. It is measured by the amount of energy absorbed per unit volume within elastic limit. This property is essential for spring materials.

11. **Creep**. When a part is subjected to a constant stress at high temperature for a long period of time, it will undergo a slow and permanent deformation called creep. This property is considered in designing internal combustion engines, boilers and turbines.

12**. Fatigue**. When a material is subjected to repeated stresses, it fails at stresses below the yield point stresses. Such type of failure of a material is known as *fatigue. The failure is caused by means of a progressive crack formation which are usually fine and of microscopic size. This property is considered in designing shafts, connecting rods, springs, gears, etc.

13. Hardness. It is a very important property of the metals and has a wide variety of meanings. It embraces many different properties such as resistance to wear, scratching, deformation and machinability etc. It also means the ability of a metal to cut another metal. The hardness is usually

3.3.3. Properties of Timber and Wood.

1. Color and Odor. Most trees are characterized by a typical color and odor. ...
2. **Specific Gravity**. Wood is a very light material, its **specific gravity** being always less than 1 (that of **water**). ...
3. Moisture Content. All woods are porous to some extent. ...
4. Grain. ...
5. Shrinkage and Swelling. ...
6. **Strength**.

Different Types of Industrial Timber

Following are the different form of industrial timber:

Veneers

Veneers are nothing but thin layers of wood which are obtained by cutting the wood with sharp knife in rotary cutter.

In rotary cutter, the wood log is rotated against the sharp knife or saw and cuts it into thin sheets. These thin sheets are dried in kilns and finally veneers are obtained

Veneers are used to manufacture different wood products like plywood, block boards etc.

Fig -3 veneers

Plywood

ply means thin. Plywood is a board obtained by adding thin layers of wood or veneers on one above each other. The joining of successive layers is done by suitable adhesives.

The layers are glued and pressed with some pressure either in hot or cold condition. In hot conditions 150 to 200oC temperature is marinated and hydraulic press is used to press the layers. In cold conditions, room temperature is maintained and 0.7 to 1.4 N/mm2 pressure is applied.

Plywood has so many uses. It is used for doors, partition walls, ceilings, paneling walls, formwork for concrete etc.

Due to its decorative appearance, it is used for buildings like theaters, auditoriums, temples, churches, restaurants etc. in architectural purpose.

Fig- 4 ply wood

Fiber boards

Fiber boards are made of wood fibers, vegetable fibers etc. They are rigid boards and called as reconstructed wood.

The collected fibers are boiled in hot water and then transferred into closed vessel. Steam with low pressure is pumped into the vessel and pressure increased suddenly.

Due to sudden increment of pressure, the wood fibers explode and natural adhesive gets separated from the fibers. Then they are cleaned and spread on wire screen in the form of loose sheets. This matter is pressed in between steel plates and finally fiber boards are obtained.

Fiber boards are used for several purposes in construction industry such as for wall paneling, ceilings, partitions, flush doors, flooring material etc. They are also used as sound insulating material.

Fig- 5 fiber board

Impreg timbers

Impreg timber is a timber covered fully or partly with resin. Thin layers of wood or veneers are taken and dipped in resin solution. Generally used resin is phenol formaldehyde.

The resin solution fills up the voids in the wood and consolidated mass occurs. Then it is heated at 150 to 160oC and finally impreg timber develops. This is available in market with different names such as sungloss, sunmica, Formica etc.

Impreg timber has good resistance against moisture, weathering, acids and electricity. It is strong, durable and provides beautiful appearance. It is used form making wood molds, furniture, decorative products etc.

Fig- 6 Impreg timbers

Compreg timbers

It is similar to impreg timber but in this case, the timber is cured under pressure conditions. So, it is more strengthened than impreg timber. Its specific gravity lies from 1.30 to 1.35.

Fig- 7 Compreg timbers

Hard boards

Hard board is usually 3 mm thick and made from wood pulp. Wood pulp is compressed with some pressure and made into solid boards. The top surface of board is smooth and hard while the bottom surface is rough. Hard boards are generally classified as three types as follows:

Types	Density (kg/m³)	Available thickness (mm)
Medium	480 – 800	6,8,10,12
Normal	800-1200	3.4.5.6.9.12
Tempered	>1200	3,4,5,6,9,12

Fig – 8 hard board

Glulam

Glulam means glued and laminated wood. Solid wood veneers are glued to form sheets and then laminated with suitable resins.

This type of sheet is very much suitable in the construction of chemical factories, long span roofs in sports stadium, indoor swimming pools etc. Curved wood structures can also be constructed using glulam sheets.

Fig -9 glulam

Chip board

Chip boards are another type of industrial timber which are made of wood particles or rice husk ash or bagasse. These are dissolved in resins for some time and heated. After then it is pressed with some pressure and boards are made. These are also called particle boards.

Fig- 10 chip board

Block board

Block board is a board containing core made of wood strips. The wood strips are generally obtained from the leftovers from solid timber conversion etc. These strips are glued and made into solid form.

Veneers are used as faces to cover this solid core. The width of core should not exceed 25mm. If the width of core is less than 7mm then it is called as lamin board.

Block boards are generally used for partitions, paneling, marine and river crafts, railway carriages etc.

Fig- 11 block bord

Flush door shutters

Flush door shutters made in factories are widely using nowadays. They are generally available with 25mm, 30mm or 35mm thicknesses. Factory made flush board shutters are of different types such as cellular core, hollow core, block board core etc.

Fig -12 Flush door shutters

Plastic

The composition, structure, and properties of plastics

Properties and applications of commercially important plastics

low-density **polyethylene** (**LDPE**)	8–30	100–650
polypropylene (**PP**)	30–40	100–600
polystyrene (PS)	35–50	1–2
acrylonitrile-butadiene-styrene (ABS)	15–55	30–100

Polyethylene terephthalate (PETE or PET):

PET is the most widely produced plastic in the world. It is used predominantly as a fiber (known by the trade name “polyester”) and for bottling or packaging. For example, PET is the plastic used for bottled water and is highly recyclable.

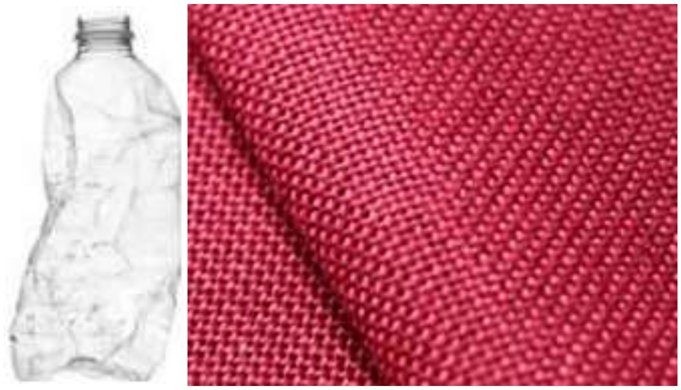


Fig -13 plastic

Three words or short phrases to describe the major benefits of Polyethylene relative to other plastics and materials would be:

Wide applications as a fiber ("polyester")

Extremely effective moisture barrier

Shatterproof

Polyethylene (PE):

There are a number of different variants of polyethylene. Low- and high-density polyethylene (LDPE and HDPE respectively) are the two most common and the material properties vary across the different variants

Fig -14 Polyethylene (PE):

LDPE: LDPE is the plastic used for plastic bags in grocery stores. It has high ductility but low tensile strength.

HDPE: A stiff plastic used for more robust plastic packaging like laundry detergent containers as well as for construction applications or trash bins.

UHMW: Extremely strong plastic that can rival or even exceed steel in strength and is used is for applications like medical devices (e.g. artificial hips).

Polyvinyl Chloride (PVC):

Polyvinyl Chloride is perhaps most well-known for its use in residential and commercial property construction applications. Different types of PVC are used for plumbing, insulation of electrical wires, and “vinyl” siding. In the construction business PVC pipe is often referred to by the term “schedule 40” which indicates the thickness of the pipe relative to its length

Fig – 15 Polyvinyl Chloride (PVC):

Three words or short phrases to describe the major benefits of PVC relative to other plastics and materials would be:

- Brittle
- Rigid (although different PVC variants are actually designed to be very flexible)
- Strong

Polypropylene (PP):

Polypropylene is used in a variety of applications to include packaging for consumer products, plastic parts for the automotive industry, special devices like living hinges, and textiles. It is semi-transparent, has a low-friction surface, doesn’t react well with liquids, is easily repaired from damage and has good electrical resistance (i.e. it is a good electrical insulator). Perhaps most importantly, polypropylene is adaptable to a variety of manufacturing techniques which makes it one of the most commonly produced and highly demanded plastics on the market

Fig -16 Polypropylene (PP):

Two short phrases to describe the major benefits of Polypropylene relative to other plastics and materials would be:

Unique Use for Living Hinges

Simple To Manufacture

Polystyrene (PS):

Polystyrene is used widely in packaging under the trade name "styrofoam." It is also available as a naturally transparent solid commonly used for consumer products like soft drink lids or medical devices like test tubes or petri dishes.

Fig -17 Polystyrene (PS):

One short phrase to describe the major benefits of Polystyrene relative to other plastics and materials would be:

Foam Application

Polylactic Acid (PLA):

Polylactic Acid is unique in relation to the other plastics on this list in that it is derived from biomass rather than petroleum. Accordingly it biodegrades much quicker than traditional plastic materials

Fig – 19 Polylactic Acid (PLA

Two words or short phrases to describe the major benefits of Polylactic Acid relative to other plastics and materials would be:

- Biodegradable
- DIY 3D Printing (compare PLA to ABS**)**

Polycarbonate (PC):

Polycarbonate is a transparent material known for its particularly high impact strength relative to other plastics. It is used in greenhouses where high transmissivity and high strength are both required or in riot gear for police.

Fig -20 **Polycarbonate (PC):**

Two words or short phrases to describe the major benefits of Polycarbonate relative to other plastics and materials would be:

- Transparent
- High Strength

Acrylic (PMMA):

Acrylic is best known for its use in optical devices. It is extremely transparent, scratch resistant, and much less susceptible to damaging human skin or eye tissue if it fails (e.g. shatters) in close proximity to sensitive tissue.

Fig – 21 Acrylic (PMMA):

Two words or short phrases to describe the major benefits of Acrylic relative to other plastics and materials would be:

- Transparent
- Scratch Resistant

Acetal (Polyoxymethylene, POM):

Acetal is a very high tensile strength plastic with significant creep resistant properties that bridge the material properties gap between most plastics and metals. It is known for high resistance to heat, abrasion, water, and chemical compounds. Additionally, Acetal has a particularly low coefficient of friction which combined with its other characteristics makes it very useful for applications that utilize gears

Fig – 22 Acetal (Polyoxymethylene, POM):

One short phrase to describe the major benefits of Acetal relative to other plastics and materials would be:

- Low Friction

Nylon (PA):

Nylon is used for a variety of applications to include clothing, reinforcement in rubber material like car tires, for use as a rope or thread, and for a number of injection molded parts for vehicles and mechanical equipment. It is often used as a substitute for low strength metals in applications like car engines because of its high strength (relative to other plastics), high temperature resilience, and high chemical compatibility.

Fig – 23 Nylon (PA):

Two short phrases to describe the major benefits of Nylon relative to other plastics and materials would be:

- High Strength
- Temperature Resistant

Fiberglass is an immensely versatile material due to its lightweight, inherent strength, weather-resistant finish and variety of surface textures.

The development of fiber-reinforced plastic for commercial use was extensively researched in the 1930s. It was of particular interest to the aviation industry. A means of mass production of glass strands was accidentally discovered in 1932 when a researcher at Owens-Illinois directed a jet of compressed air at a stream of molten glass and produced fibers. After Owens merged with the Corning company in 1935, Owens Corning adapted the method to produce its patented "Fiberglas" (one "s"). A suitable resin for combining the "Fiberglas" with a plastic was developed in 1936 by du Pont. The first ancestor of modern polyester resins is Cyanamid's of 1942. Peroxide curing systems were used by then.

3.3.4. Types of Fiberglass Based on Their Properties

A-Glass Fiber. A-glass is also known as alkali glass or soda-lime glass. ...

C-Glass Fiber. C-glass or chemical glass shows the highest resistance to chemical impact. ...

- D-Glass Fiber. ...
- E-Glass Fiber. ...
- Advantix Glass Fiber. ...
- ECR Glass Fiber. ...
- AR-Glass Fiber. ...
- R-Glass, S-Glass, or T-Glass Fiber

composite materials are created from individual materials. These individual materials are known as constituent materials, and there are two main categories of it. One is the matrix (binder) and the other reinforcement.[43] A portion of each kind is needed at least. The reinforcement receives support from the matrix as the matrix surrounds the reinforcement and maintains its relative positions. The properties of the matrix are improved as the reinforcements impart their exceptional physical and mechanical properties. The mechanical properties become unavailable from the individual constituent materials by synergism. At the same time, the designer of the product or structure receives options to choose an optimum combination from the variety of matrix and strengthening materials.

Natural the most used ones because of **their** lightness and excellent mechanical **properties**, are **composite materials** of polymeric matrix with fiber reinforcements.

Long fiber-reinforced composite materials

- Glass fibers.
- Carbon fibers.
- Boron fibers.
- Ceramic fibers.
- Metal fibers.
- Aramid fibers.
- Natural fibers: sisal, hemp, flax, etc
- fibers: sisal, hemp, flax, etc

3.3. The Procedure of Performance Indices

A performance index is a group of material properties which governs some aspect of the performance of a component.

<u>First Step</u>: Translation

"Express design requirements as constraints and objectives" Using design requirements, analyze four items:

- Function**:**

What does the component do? Do not limit options by specifying implementation with in function

- Objective:

What essential conditions must be met? In what manner should implementation?

- Constraints:

What is to be maximized or minimized? Differentiate between binding and soft constraints

- Free variables**:**

Which design variables are free?

Which can be modified?

Which are desirable?

<u>Second Step</u>: Screening

"Eliminate materials that cannot do the job"

- Need effective way of evaluating large range of material classes and properties

<u>Third Step</u>: **Ranking**

"Find the materials that do the job best"

- ✓ What if multiple materials are selected after screening?
- ✓ Which one is best?
- ✓ What if there are multiple material parameters for evaluat

- **Use Material Index**

Self-Check -3	Written Test

Instruction: choose the best answer for the following question

1. Which one factors should be considered while selecting the material(2 point)
   A. Availability of the materials,
   B. Suitability of the materials for the working conditions in service, and
   C. The cost of the materials
   D. All
2. Which of The following are not Properties of Timber and Wood (2point)
   A. Color and Odor
   B. Specific Gravity
   C. Dryer
   D. Moisture Content
3. ____________ is an immensely versatile material due to its lightweight, inherent strength, weather-resistant finish and variety of surface textures.(2 point)
   A. Composite
   B. Fiber glass
   C. Metal
   D. Plastic

Note: **Satisfactory rating - 6points** **Unsatisfactory - below 6 points**

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _____________

Information Sheet-4	Preparing time schedule

Time schedule of specific work to be performed is prepared considering available resources based on the program requirements to be under taken.

4.1. Time Management

Step 1: Create a Weekly Schedule for your typical week.

Step 2: Identify major responsibilities for each Schedule

Step 3: Create timelines for each major responsibility.

Step 4: Create weekly plans, integrating activities of each timeline into the weekly activities plan.

Step 5: On a daily basis, plan your time to achieve specific outcomes for each activity.

Step 6: At the end of each day and each week, match your actual activities with your plan to see how well you stayed on track.

4.2. The Importance of Scheduling

Scheduling is the art of planning your activities so that you can achieve your goals and priorities in the time you have available. When it's done effectively, it helps you:

- Understand what you can realistically achieve with your time.
- Make sure you have enough time for essential tasks.
- Add contingency time for "the unexpected."
- Avoid taking on more than you can handle.
- Work steadily toward your personal and career goals.
- Have enough time for family and friends, exercise and hobbies.
- Achieve a good work-life balance.

Time is the one resource that we can't buy, but we often waste it or use it ineffectively. Scheduling helps you think about what you want to achieve in a day, week or month, and it keeps you on track to accomplish your goals.

Step 1: **Identify Available Time**

Start by establishing the time you want to make available for your work.

How much time you spend at work should reflect the design of your job and your personal goals in life.

For example, if you're pushing for promotion, it might be prudent to work beyond normal hours each day to show your dedication. If, on the other hand, you want to have plenty of time for out-of-work activities, you might decide to do your allocated hours and no more.

Step 2: **Schedule Essential Actions**

Next, block in the actions you absolutely must take to do a good job. These will often be the things you are assessed against.

For example, if you manage people, make sure that you have enough time available to deal with team members' personal issues, coaching, and supervision needs. Also, allow time to communicate with your boss and key people around you.

Step 3: **Schedule High-Priority Activities**

Review your To-Do List, and schedule in high-priority and urgent activities, as well as essential maintenance tasks that cannot be delegated or avoided.

Try to arrange these for the times of day when you are most productive – for example, some people are at their most energized and efficient in the morning, while others focus more effectively in the afternoon or evening. (Our article "Is This a Morning Task?" can help you identify your best times of day.)

Step 4: Schedule Contingency Time

Next, schedule some extra time to cope with contingencies and emergencies. Experience will tell you how much to allow – in general, the more unpredictable your job, the more contingency time you'll need. (If you don't schedule this time in, emergencies will still happen and you'll end up working late.)

Step 5: Schedule Discretionary Time

The space you have left in your planner is "discretionary time": time that is available to deliver your priorities and achieve your goals. Review your prioritized To-Do List and personal goals, evaluate the time you need to achieve them, and schedule them in.

Step 6: Analyze Your Activities

If, by the time you reach step five, you find that you have little or no discretionary time available, you need to go back through steps two, three and four, and question whether all of the tasks you've entered are absolutely necessary. It may be that some things can be delegated or tackled in a more time-efficient way.

One of the most important ways that you can build success is by maximizing the leverage you can achieve with your time. Increase the amount of work you can complete by delegating to other people, outsourcing key tasks, or using technology to automate as much of your work as possible. This will free you up to achieve your goals.

If you find that your discretionary time is still limited, then you may need to renegotiate your workload or ask for help. Use your newly prepared schedule as evidence of your heavy commitments. This demonstrates to your boss how well-organized you are, and might make him or her more receptive to your request!

Scheduling is the process by which you plan how you'll use your time. Doing it well can maximize your effectiveness and reduce your stress levels.

Follow this six-step process to prepare your schedule:

- Identify the time you have available.
- Block in the essential tasks you must carry out to succeed in your job.
- Schedule high-priority urgent tasks and vital "housekeeping" activities.
- Block in appropriate contingency time to handle unpredictable events and interruptions.
- Schedule the activities that address your priorities and personal goals in the time that remains.
- Analyze your activities to identify tasks that can be delegated, outsourced or cut altogether.

It's important that your schedule makes time for your professional and personal goals. If you have little or no discretionary time left when you reach step five, revisit your tasks to see if you can do them differently – otherwise, your work-life balance will suffer.

Designing a Work System

Designing a work system is part of developing an operations strategy

Effective operations strategy provides structure for company productivity

The work system includes:

- Job design
- Work measurements
- Worker compensation

Job Design specifies work activities of an individual or group

Jobs are designed by answering questions like:

What is the job's description?

What is the purpose of the job?

Where is the job done?

Who does the job?

What background, training, or skills are required to do the job?

A project is a collection of tasks that must be completed in minimum time or at minimal cost.

4.3. Objectives of Project Scheduling

- Completing the project as early as possible by determining the earliest start and finish of each activity.
- Calculating the likelihood, a project will be completed within a certain time period.
- Finding the minimum cost schedule needed to complete the project by a certain date.

To determine optimal schedules, we need to

- Identify all the project's activities.
- Determine the precedence relations among activities.

Based on this information we can develop managerial tools for project control

Self-Check -4	Written Test

Instruction: choose the best answer for the following question .

1. The work system are:
   A. Job design
   B. Work measurements
   C. Worker compensation
   D. all
2. The Importance of Scheduling?
   A. . Achieve a good work-life balance
   B. Avoid taking on more than you can handle.
   C. Work steadily toward your personal and career goals
   D. all
3. ________________is a collection of tasks that must be completed in minimum time or at minimal cost
   A. project
   B. Objectives of project scheduling
   C. Time management
   D. Work produres

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

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

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: _______________

5.1. standard work procedure

standard work procedure is the result of organizing tasks in the best sequence of steps to make the best use of people, equipment, tooling and materials. ... A standard work procedure is the best way to ensure performance consistency

Detail specification**s** are prepared and functional and formal relationships should be studied with reference to the actual context.

Formal Specification

A formal software specification is a statement expressed in a language whose vocabulary,

syntax, and semantics are formally defined. The need for a formal semantic definition means that the specification languages cannot be based on natural language; it must be based on mathematics.

The advantages of a formal language are:

- The development of a formal specification provides insights and understanding of the software requirements and the software design.
- Given a formal system specification and a complete formal programming language

definition, it may be possible to prove that a program conforms to its specifications.

- Formal specification may be automatically processed. Software tools can be built to assist with their development, understanding, and debugging.

Depending on the formal specification language being used, it may be possible to animate a formal system specification to provide a prototype system.

- Formal specifications are mathematical entities and may be studied and analyzed

using mathematical methods.

- Formal specifications may be used as a guide to the tester of a component in identifying appropriate test cases.

Formal specifications sometimes are not used

because:

- Software management is conservative and unwilling to adopt new techniques whose

payoff is not immediately obvious.

- Most software engineers have not been trained in formal specification techniques.
- Some classes of systems are difficult to specify using existing specification techniques. Interactive and interrupt driven

Relational and State-Oriented Notations

Relational notations are used based on the concept of entities and attributes. Entities are elements in a system; the names are chosen to denote the nature of the elements (e.g., stacks, queues). Attributes are specified by applying functions and relations to the named entities. Attributes specify permitted operations on entities, relationships among entities, and data flow between entities.

Relational notations include implicit equations, recurrence relations, and algebraic axioms.State-oriented specifications use the current state of the system and the current stimuli presented to the system to show the next state of the system. The execution history by which the current state was attained does not influence the next state; it is dependent only on the current state and the current stimuli.

State-oriented notations include decision tables, event tables, transition tables, and finite-state tables.

5.2. Specification Principles

Principle 1: Separate functionality from implementation.

A specification is a statement of what is desired, not how it is to be realized. Specifications can take two general forms. The first form is that of mathematical functions: Given some set of inputs, produce a particular set of outputs. The general form of such specifications is finding

All result such that input, where P represents an arbitrary predicate. In such specifications, the result to be obtained has been entirely expressed in a “what”, rather than a “how” form, mainly because the result is a mathematical function of the input (the operation has well-defined starting and stopping points) and is unaffected by any surrounding environment.

Principle 2: A process-oriented systems specification language is sometimes required. If the environment is dynamic and its changes affect the behavior of some entity interacting with that environment (as in an embedded computer system), its behavior cannot be expressed as a mathematical function of its input. Rather a process-oriented description must be employed, in which the "what" specification is achieved by specifying a model of the desired behavior in terms of functional responses to various stimuli from the environment.

Principle 3: The specification must provide the implementor all of the information he/she needs to complete the program, and no more. In particular, no information about the structure of the calling program should be conveyed.

Principle 4: The specification should be sufficiently formal that it can conceivably be tested for consistency, correctness, and other desirable properties.

Principle 5: The specification should discuss the program in terms normally used by the user and implementor alike.

Operations/Production Process

5.3. Process Mapping

Rationale:

Step-by-step mapping of your operations or manufacturing is a useful way to visualize the whole process. Called a flow diagram, this instrument facilitates the identification of bottlenecks, inefficiencies, and information-sharing problems within your social enterprise, which ultimately eat into your profits.

The diagramming also helps you determine operating and production costs and skill and labor requirements for each stage.

The flow diagrams for three purposes

- .Assessing process,
- . productivity, and
- Capacity. This exercise begins with the mapping of each stage of your operations and production process (manufacturing businesses).

Diagramming the Operations Process

Step 1: Operations Stages

- Map the process—make a flow diagram—depicting each stage of operations.
- The flow diagram and corresponding Operations Stages should answer the following questions:

What are the different stages?

Who is responsible for each stage of operations?

How does work get transferred from one stage to another?

Is any part of your operations outsourced (contracted to another business or individual)?

Step 2: Production Steps

- ✓ Map the production steps respond to the same questions as for operations stages above.
- ✓ If your processes vary dramatically among products (e.g., manufacturing is different for peanut butter and jam), draw a map for each product.

☞ **Outsource**—to contract to another company or individual a business function such as assembly, distribution, sales, etc.

Self-Check -5	Written Test

Instruction: choose the best.

1. ____________is the result of organizing tasks in the best sequence of steps to make the best use of people, equipment, tooling and materials. ... A standard work: (2point)
   A. standard work procedure Work
   B. specification
   C. procedure
   D. all
2. Which one of the following are **NOT** Principles Specification?(2 point)
   A. the implementor all of the information he/she needs to complete the program,
   B. A process-oriented systems specification language is sometimes required.
   C. Relational and State-Oriented Notations
   D. Separate functionality from implementation
3. _________________is a collection of tasks that must be completed in minimum time or at minimal cost
   A. project
   B. Objectivesofproject scheduling
   C. Time management
   D. Workprodures

Note: **Satisfactory rating - 3 points** **Unsatisfactory -3 below 6points**

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: ______________

6.1. Determinine the Scope of Work

Defining the scope of work is one of the most important steps to writing an SOW. This document describes the services that will be performed to complete the project and the extent to which they can be changed, according to the Oregon Department of Transportation. It typically includes the types of services requested, as well as the expected outcome. You may also use this section to define technical terms, list relevant documents and address the specific tasks and limitations that must be considered when planning the project.

If, say, you work for a creative agency and you're asked to create a one-page website for a local event, you may start by writing a statement of work. The document will list and describe your services along with the software required to get the job done, among other aspects. This section represents the scope of work.

For example, you can specify that your services include domain name registration, hosting, web design, testing and copywriting plus two rounds of edits at no extra charge. This kind of job may require a content management system, widgets, plugins and other free or paid tools, which will be listed in the scope of work.

Depending on your industry and project requirements, you may be able to find a scope of work example online. The United Nations Development Programme, for instance, provides an example of a project focused on the rehabilitation of its air conditioning systems in Vietnam. In this case, the scope of work includes HVAC activities, such as air conditioning installation and testing.

Detail Specifications For The Basic Office Ergonomic Chair

Fig – 6.1 Ergonomic Chair

Design

Ergonomically assessed and certified by approved Ergonomists

Warranty

5 to 7 years (Five years /8/ day to seven years/ 8 hrs/day)

Scope of work

Standardization in the field of ergonomics, in particular, general ergonomics principles, anthropometry and biomechanics, ergonomics of human system interaction and ergonomics of the physical environment, addressing human characteristics and performance, and methods for specifying, designing and evaluating products, systems, services, environments and facilities.

Certification / Standarisation

- Approved and meets the valid standard of Ergonomics.
- Quality Office-certification as per ISO 9001:2000 standards
- Environment certification of the company as per ISO 14001.

Mechanism

- Seat and backrest follow the movements of the user synchronously thus ensuring the correct seated posture.
- Infinite adjustment of the backrest counter pressure by means of side tension control, for body weight of approximately 125kg.
- The synchronise movement can be locked in five positions.
- Seat depth adjustment (5.0cm) by means of sliding seat (can be locked in five positions) Seat tilt adjustment (-1 or -4 degrees)

Armrests

- (155) T-Armrests, height adjustable (10cm) and width adjustable (2.5cm) without the use of tools armrest pads made of soft polyurethane (PU).
- Optional: (175) T-Armrests, 4F Multifunctional, height adjustable (10cm) width adjustable (7cm) without the use of tools by means of an eccentric closure. Depth adjustable (6cm) 30°radially adjustable to both sides. Armrest pads made of soft polyurethane (PU).

Ecology

All materials should be environmentally sound, easily separable and recyclable.

- Over 50% of all the materials used should be recycled.
- It should contain no hazardous substances (no PVC, chrome VI, lead or mercury).
- All expendable parts must be replaceable so as to greatly increase the life cycle of the product. .
- The powder coatings used should be free from volatile (explosion), organic compounds and heavy metals.
- Changeable upholstery and cushions to increase the product life cycle.
- All components should be replaceable and some of them can be retrofitted.

Seat

- Ergonomically moulded upholstery, foam thickness: 4.0cm with range of 10cm thickness.
- Breathable polyurethane (PU) moulded foam, CFC and CHC free foamed. Foam thickness55kgs/m3
- Premium seat with straight, upholstery outline, changeable.

Backrest

- High backrest, breathable, dampness regulative mesh material made of 100% Polyester.
- Web A, black (0465) or white (0466)/Grey optional
- Ergonomically formed, flexible plastic backrest frame
- Optionally against surcharge: Lumbar support cushion to provide additional support and protection to the back vertebrae

Upholstery Covers

Seat cover not glued, mesh backrest.

Plastic Components

Standard: black (RAL 9011)

All plastic components are genuine PVC free and recyclable

Base

Standard: type F aluminium die cast 70cm black (RAL 9011) or optionally against surcharge, Type F, polished aluminium die cast 70cm.

Safety Gas Unit

Standard: seat height 40-52cm (tube: black) Optional: seat height 40-52cm with mechanical bounce spring (chromed tube)

Castors(small wheels under the chair):

Load dependent blocked twin wheel castors (6.5cm)

Standard: hard castors for soft floors, example carpeted, floors.

Optionally: soft castors for hard floors, example parquet or stone floors.

Glides for soft floors, e.g. carpeted floors.

The Cost Estimate process provides:

- Documented assumptions and basis of estimate that provide further project definition;
- The activity quantities that make up the scope of work;
- The cost element data (labor and non-labor) needed to complete the products/deliverables;
- The estimated resource hours and non-labor values that make up the work;

- The component elements (labor, materials, equipment, etc.) required to complete activities and work packages; and
- Additional WBS elements mined during the detailed take-off.

Fig -6.2 Cost Estimating process model

Self-Check -6	Written Test

Instruction: choose the best answer for the following question

1. Which one of followings are Not The Cost Estimate process provides:
   A. The activity quantities that make up the scope of work;
   B. The estimated resource hours and non-labor values that make up the work;
   C. The cost element data (labor and non-labor) needed to complete the products/deliverables;
   D. Standard: hard castors for soft floors, example carpeted, floors.
2. ___________________is one of the most important steps to writing an SOW
   A. Goal
   B. Scope of work
   C. Project work
   D. Design
3. Most cost estimates have common characteristics, regardless of whether the technical scope
   A. .traditional (capital funded,
   B. construction,
   C. .equipment
   D..all

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

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

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: _______________

LG #29	**LO #2-** Layout model

Instruction sheet

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

- Conceptualizing and planning finished model design
- Accomplishing estimate cost calculation for models.
- Designing and manufacturing datum boards, jigs and fixtures
- Calculating contractions allowances, clearances, tapers

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

- Conceptualize and planning finished model design
- Accomplishine estimate cost calculation for models.
- Design and manufacturing datum boards, jigs and fixtures
- Calculate contractions allowances, clearances, tapers

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- Conceptualizing and planning finished model design

1.1. Conceptualize and plan Finished model design

Finished model design is conceptualized and planned with reference to customer's specifications (written or verbal) for finish, quality and form, using applicable processes.

When trying to make knowledge explicit, the conceptualization and terminology is important.With new design disciplines that challenge the borders of design practice and inquiry (investigation) comes new possibilities for prototyping techniques and approaches. The basis for such an evolution is a firm understanding of the existing knowledge generated in design and the challenges posed by new design disciplines, such as service design.

Definitions of “prototype” and “prototyping” vary of course, not the least since it means different things in different design domains such as architecture, graphic design and fashion. Some consensus can however be identified in a number of central constituents that recur in the literature. Most definitions, be they formal or informal, mention prototypes as representations, embodiments or manifestations.

What they represent is commonly said to be ideas, described as hypotheses or assumptions about the future. A third element of most definitions is that it must be possible to test the ideas that the prototype represent, i.e. to evaluate the degree to which the prototype succeeds to meet specified criteria.

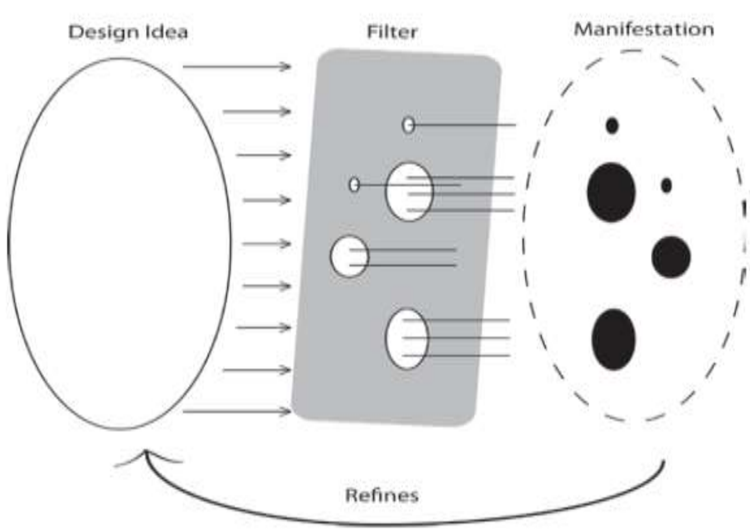


Figure-2 .1 Prototype dimensions in relation to design idea

2.1.1. Various processes requiring models.

There are many different reasons to develop a process model. These include:

- increase fundamental understanding of a process
- assist in scale-up 4
- design of experiments
- evaluation of experimental results
- quantifying property measurement
- online process control and optimization
- technology transfer

2.2.1. Conceptualizing and determining type of model.

All process models can be classified according to their empirical versus mechanistic basis. A fully-empirical model is created by performing a curve-fitting procedure on the results of a statistical study with no attempt to understand the reasons for the relationships. This type of model is well-suited for online applications, because the resulting equations are very fast to solve, and robust, avoiding numerical difficulties. However, they usually become very inaccurate if extrapolated beyond the specific range of processing conditions for which they were developed. A fully-mechanistic, or phenomenological, model solves equations based solely on the fundamental laws which govern natural phenomena. These laws include the differential equations governing the conservation and transport of mass, momentum, mechanical force, electromagnetic force and energy, in addition to thermodynamics, phase equilibria, kinetics, and other relations. Experimental data are incorporated in their most fundamental form, through the material properties. A mechanistic process model can be extended to understand and solve problems with a given process, without knowing the problem particulars prior to development of the model. In practice, all models lie somewhere between these two extremes. No model comes close to being a complete, fully-mechanistic process model, despite the claims of some modelers. In reality, it is possible at best to model mechanistically only a tiny fraction of the actual phenomena present in a real process. This is because real industrial processes contain staggering complexities in phenomena at the mechanistic level. The continuous casting process, for example, is governed in part by the following phenomena: - fully-turbulent, transient fluid motion in a complex geometry (inlet nozzle and strand liquid pool), affected by argon gas bubbles, thermal and solutal buoyancies –

- thermodynamic reactions within and between the powder and steel phases –
- flow and heat transport within the liquid and solid flux layers, which float on the top surface of the steel
- dynamic motion of the free liquid surfaces and interfaces, including the effects of surface tension, oscillation and gravity
- induced waves, and flow in several phases
- transport of superheat through the turbulent molten steel
- transport of solute (including intermixing during a grade change)
- transport of complex-geometry inclusions through the liquid, including the effects of buoyancy, turbulent interactions, and possible entrapment of the inclusions on nozzle walls, gas bubbles, solidifying steel walls, and the top surface
- thermal, fluid, and mechanical interactions in the meniscus region between the solidifying meniscus, solid slag rim, infiltrating molten flux, liquid steel, powder layers, and inclusion particles.
- heat transport through the solidifying steel shell, the interface between shell and mold, (which contains powder layers and growing air gaps) and the copper mold. - mass transport of powder down the gap between shell and mold - distortion and wear of the mold walls and support rolls –

nucleation of solid crystals, both in the melt and against mold walls

- solidification of the steel shell, including the growth of grains and microstructures, phase transformations, precipitate formation, and microsegregation
- shrinkage of the solidifying steel shell, due to thermal contraction, phase transformations, and internal stresses
- stress generation within the solidifying steel shell, due to external forces, (mold friction, bulging between the support rolls, withdrawal, gravity) thermal strains, creep, and plasticity (which varies with temperature, grade, and cooling rate)
- crack formation - coupled segregation, on both microscopic and macroscopic scales

Categorizations of prototype were;

- Representation, describing what kind of prototype and what form
- Precision, referring to the level of detail in the prototype’s representation
- Interactivity, describing the level of interactivity available to users, and
- Evolution, that looks at the whole expected life cycle of the prototype.

Self check -1 written test

Instruction: describe the following question

1. **Explain the Categorizations of prototype** design (3 point)
2. What it is meant for Finished model design?(2 point)

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

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

Answer Sheet

Score = ____________

Rating: _____________

Name: ____________________________ Date: _______________

Information Sheet - 2 Accomplishing estimate cost calculation for models

2.1 Models

A process model is a system of mathematical equations and constants that are usually solved on a computer to make quantitative predictions about some aspect(s) of a real process. The specific variables required as input data and generated as output predictions are important features of the model. The equations often stem from a numerical solution to one or more differential equations and their boundary conditions.

A model has been "implemented" only after the modeling exercise has led to some tangible change in the process, which ultimately benefits the industry. To understand this definition, it must be recognized that the principal aim of industry is to make a profit. In materials-processing based industries, two possible ways to help do this is are to improve product quality and to reduce production cost. One way to improve quality is to eliminate defects. Thus, a reasonable objective for a process model could be to eliminate some defect by specifying achievable changes in the process. Note the two key terms: "eliminate" the defect and "achievable" changes. Many process modeling efforts aim to predict the occurrence of some kind of defect, such as segregation or impurities in the product. These models may provide valuable insight into the phenomena that underlie the formation of the defect. Before it is truly useful, however, this phenomenological understanding, which is often gained only by the modeller, must be translated into beneficial process changes, such as actually eliminating the defect. The second point is that process changes need to be achievable. Thus, models should first identify input and output variables that can be changed in the plant. Another pitfall to avoid is running the model for conditions which are infeasible to achieve in practice. If the model is too complex for anyone else to rerun, then the potential implementation has been lost.

Food processing equipment is an umbrella term referring to the components, processing machines, and systems used to handle, prepare, cook, store, and package food and food products. Although this equipment is primarily aimed toward the transformation—i.e., increasing the palatability, consumability, and digestibility—or preservation—i.e., extending the *shelf life*—of food, some pieces of equipment are also employed to perform preliminary or auxiliary functions, such as handling, preparation, and packaging

A cost calculation model Nissen, Petsch, Termer, Möhring

Licence model	Cost driver	Provision of the software license costs
Primarily user-based models	for example, the number of users	- Number of user licenses - price
primarily time-based models	for example, the duration of use	- Time - costs per unit of time
primarily value-oriented models	for example, number of models	- Number of models cost - cost per model
Primarily infrastructure-related models	for example, the extent of use of the infrastructure	- solicitation of quotations

Preparation equipment

As indicated previously, within the food processing production cycle, initial preparatory operations focus on preparing the raw food material for subsequent processes—typically mechanical or chemical processing—by separating the desirable material from the low quality, substandard, or undesirable material. In doing so, manufacturers are better able to ensure the production of uniform and high-quality food and food products, as well as remove foreign matter and contaminants which may degrade or damage the food material or equipment.

Fig – 2.2 Preparation equipment

Mechanical Processing Equipment Mechanical processing operations are employed (without the application of heat or chemicals) to reduce, enlarge, homogenize, or otherwise change the physical form of solid, semi-solid, and liquid food matter. By altering the form and size of the food matter, manufacturers can facilitate and increase the efficiency and effectiveness of subsequent processes, improve the overall quality and edibility, and allow for a greater range of food products to be produced.

Fig- 2.3 Mechanical Processing Equipment

Heat Processing Equipment (Preservation by the Application of Heat)

Depending on whether the application (and the specific unit operation) is aimed towards heating or cooling the food material, heat transfer equipment can be used to direct heat towards or away from the material, respectively. This section of the article will focus primarily on the applications and equipment aimed towards heating food products, while the following section—*Preservation Equipment*—will touch on the applications and equipment aimed towards cooling food products, as well as those intended to preserve and extend the shelf life of food products. Heat processing equipment—i.e., equipment which heats food—can cause not only physical changes in the food material, but chemical, biochemical, and biological changes as well. These changes can transform and affect the overall quality of the resulting food products—such as by altering the chemical structure or enhancing the flavor—and serve as a preservation method by inhibiting or destroying the microorganisms or enzymes which cause spoilage.

Fig- 2.4 Heat Processing Equipment (Preservation by the Application of Heat)

Preservation Equipment

As indicated above, many of the heat processing operations used in the food processing industry demonstrate preservative qualities. Although there is significant overlap between heat processing equipment and preservation equipment, the previous section already covers the former category—i.e., preservation methods (and their respective equipment) which apply heat. Therefore, this section will focus on other preservation methods, processes, and equipment.

The preservation stage of the food processing production cycle ultimately aims to prevent or inhibit the *spoilage* and increase the shelf life of food products. There is a wide range of preservation methods available ranging from refrigeration to irradiation, each of which acts to destroy microorganisms and enzymes within the food material or, at the very least, limit and depress their activity.

Fig- 2.5 Preservation Equipment

Packaging

Following the preparation and processing stages, food material generally undergoes one or more post-processing operations, which help to produce the final food product and complete the food processing production cycle. While there are several post-processing operations involved with the production cycle, this section will focus on packaging operations and equipment

Food packaging can serve several functions, including:

- **Containment**: Holds (i.e., contains) food contents until they are used
- **Protection and Preservation**: Creates a physical barrier between processed food products and physical, chemical, microbial, and macrobial variables during storage, transportation, and distribution which can cause spoilage, contamination, or loss of quality
- **Convenience**: Enables food products to be portioned out (by weight or volume) for easier consumer use, and stored, transported, and distributed
- **Communication**: Helps identify the food contents and indicate handling, storage, and use instructions, as well as allows for an opportunity for branding and marketing

Fig-2-6 Packaging

Agricultural equipment,

Fig-2.7.1 Agricultural equipment

Production unit

defines a "**production unit**" as: "a process, line, method, activity, or technique, or a combination or series thereof, used to produce a product (or family of products)." A **production unit** is not the process or the product. It is the combination of the process and the products produced by that process. a shaped cavity used to give a definite form to fluid or plastic material

a frame on which something may be constructed.to make in a mould
to shape or form, as by using a mould to influence or direct*to mould opinion*

ress die is a special tool for forming metallic material, which uses the up-and-down movement of **press** machine. ... The material can be formed by shearing (blanking, punching), bending and drawing, using **press dies**, and the desired shape of the product can be achieved through the combination of these forming way

Fig 2.8. press tool die 5000/kg

Packaging / Packing

- Box Cutters and Safety Knives.
- Heat Sealing & Shrink Wrapping.
- Industrial Scales.
- **Packing** Dispensers, Stands and Air Pillows.
- **Packing** Tapes & Dispensers.
- Staple Guns.
- Strapping **Equipment**.
- Stretch Wrap Dispensers.

The gearbox is a mechanical device used to increase the output torque or to change the speed (RPM) of a motor. The shaft of the motor is connected to one end of the gearbox and through the internal configuration of gears of a gearbox, provides a given output torque and speed determined by the gear ratio.

The following information is required to select a gear coupling.

- Horsepower or torque
- Running rpm.
- Application or type of equipment to be connected
- pump, drive to conveyor, etc.).
- Shaft diameters.
- Shaft gaps.
- Physical space limitations
- Special bore or finish information and type of fit

Main gear box

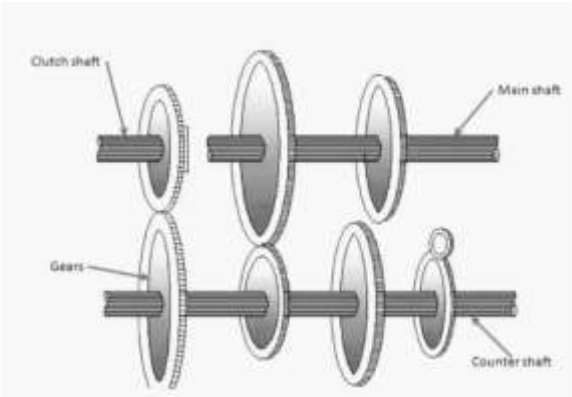


fig -9 main gear box

Parts of gear box

PUMPS. Velocity pumps and positive-displacement pumps are the two categories of pumps commonly used in water supply operations. Velocity pumps, which include centrifugal and vertical turbine pumps, are used for most distribution system applications. Positive-displacement pumps, which include rotary and reciprocating pumps, are most commonly used in water treatment plants for chemical metering and pumping sludge. Detailed descriptions of the pump types commonly used in water supply systems, along with applications, operating characteristics, and a listing of general advantages and disadvantage

Self-Check -2	Written Test

Instruction: choose the best answer for the following question .

1. the combination of the process and the products produced by that process.
   :
   A. Production unit
   B. Measurement
   C. packaging
   D. prototype
2. required to select a gear coupling?
   A. . Horsepower or torque
   B. Running rpm.
   C. pump, drive to conveyor
   D. all

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = ___________

Rating: ____________

3.1. model parameters due to standards pattern

Model is based on good science

Accepted principles, theory, results

- From peer reviewed sources
- Prestige of developer or lab

Up-to-date

- Concepts and theory
- Algorithms, computational methods
- Empirical findings

Appropriate data are available or feasible to acquire

- Estimates for model parameters
- Data for model calibration

Gets the Correct Result for the Right Reason

Model accurately represents the real system

- Comprehensive
- Variables
  - ✓ Inputs, outputs
  - ✓ Exogenous, endogenous
- Relationships
  - ✓ Functional
  - ✓ Cause-effect
- Statistical Circumstances
  - ✓ Input changes
  - ✓ Assumption relaxation
- Resolutions
  - ✓ Temporal
  - ✓ Spatia

Model is seen to be appropriate for the specific system

- Application is within model limitations

- ✓ Resolution
- ✓ Parameter values
- ✓ Special system characteristics (for example, special weather characteristics or soil chemistry)

- Inputs available for the specific system
  - ✓ Parameter estimates
  - ✓ Calibration data

Pattern allowances:

There are some allowances which are responsible for the difference in the dimensions of the casting and the pattern. These allowances are considered when a pattern is designed for casting. In this article we will discuss those allowances –

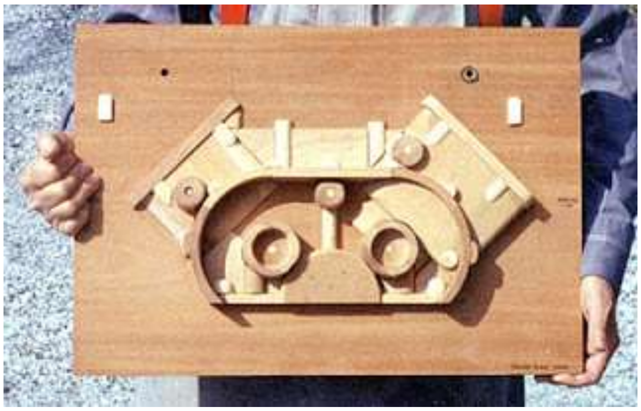


Fig -3.1 pattern

Contraction(shrinkage) allowance:

After solidification of the metal from further cooling (room temp.) dimensions of the patterns increases. So pattern size is bigger than that of the finished cast products. This is known as shrinkage allowance.

It depends on:

- Dimensions of casting
- Design and intricacy of casting
- Resistance of mol to shrinkage
- Molding materials used
- Method of molding used

- Pouring temp of the molten metal

Draft or taper allowance:

Pattern draft is the taper placed on the pattern surfaces that are parallel to the direction in which the pattern is withdrawn from the mould (that is perpendicular to the parting plane), to allow removal of the pattern without damaging the mould cavity.

It depends on:

- the method of molding
- the sand mixture used
- the design (shape and length of the vertical side of the pattern)
- economic restrictions imposed on the casting
- intricacy of the pattern

distortion allowance:

This allowance is taken into consideration when casting products of irregular shapes. When these are cooled they are distorted due to metal shrinkage.

Finishing or machining allowance:

Machining allowance or finish allowance indicates how much larger the rough casting should be over the finished casting to allow sufficient material to insure that machining will "clean up" the surfaces.

This machining allowance is added to all surfaces that are to be machined. Machining allowance is larger for hand molding as compared to machine molding.

It depends on:

- Machining operation
- Characteristics of metal
- Methods of castings
- Size, shapes and volumes of castings
- Degree of finish required in castings
- configuration of the casting

Shaking or rapping allowance:

To take the pattern out of the mould cavity it is slightly rapped to detach it from the mould cavity. So the cavity is increased a little.

Clearance is defined as the hypothetical volume of body fluids containing drug from which the drug is removed or cleared completely in a specific period of time.

Self-Check -3	Written Test

Instruction: choose the best answer for the following question .

1. machining allowance is added to all surfaces that are to be machined. Machining allowance is larger for hand molding as compared to machine molding.

   It depends on.

   A. Machining operation
   B. Characteristics of metal
   C. Methods of castings
   D. all

2. Model accurately represents the real systems are:-

   A. configuration of the casting
   B. Comprehensive
   C. Machine operation
   D. Molding materials used

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = ____________

Rating: _____________

Information Sheet-4	Calculating contractions allowances, clearances, tapers .

4.1. Manufacture using special tools based on design

Jigs and fixtures

Jigs and fixtures are production tools used to accurately manufacture duplicate and interchangeable parts. Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components.

Jigs

It is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation. Jigs are usually fitted with hardened steel bushings for guiding or other cutting tools. a jig is a type of tool used to control the location and/or motion of another tool. A jig's primary purpose is to provide repeatability, accuracy, and interchangeability in the manufacturing of products. A device that does both functions (holding the work and guiding a tool) is called a jig.

Fixtures

It is a work holding device that holds, supports and locates the workpiece for a specific operation but does not guide the cutting tool. It provides only a reference surface or a device. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in some cases hold a workpiece during either a machining operation or some other industrial process. A jig differs from a fixture in that a it guides the tool to its correct position in addition to locating and supporting the workpiece. Examples: Vises, chucks

Student should Ask yourself by the following question

- How is the part going to be made?
- Have standardized sizes and parts Have standardized sizes and parts been used where applicable?

- What are the important/critical dimensions of the part?
- How accurate does the par t nee d to be (Tolerances)?
- What material does the part need to be made of to satisfy g the desi gn requirements (Environment, strength, cost)?
- Is the part optimized for the manufacturing methods to be manufacturing methods to be employed?

4.2. Rotor design

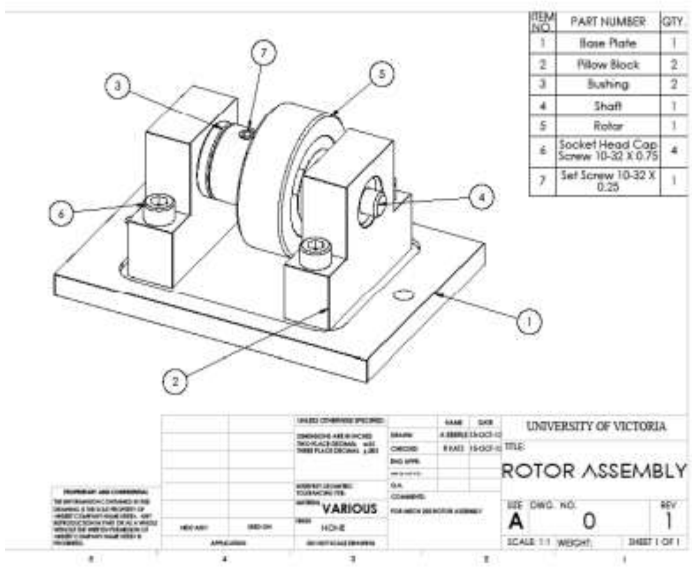


Fig – 3.2 rotor assembly

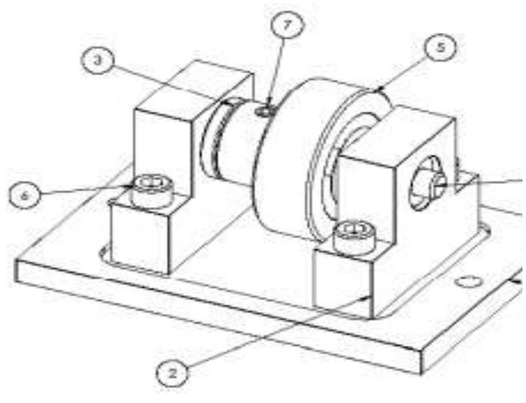
Self-Check -4	Written Test

Instruction: choose the best answer for the following question .

1. Explain how to used Jigs and fixtures ?

2. List and Explain rooter for the part

3.



Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = ___________

Rating: ____________

LG #30	**LO #3-** Manufacture model

Instruction sheet

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

- Determining sequence of manufacture.
- Selecting machines and machining processes.
- Selecting and using hand- and hand-held power tools.
- Undertaking measurement/calculations to check specifications.
- Assembling components

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

- Determinine sequence of manufacture.
- Selecte machines and machining processes.
- Selecte and using hand- and hand-held power tools.
- Undertake measurement/calculations to check specifications.
- Assemble components

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”.

2.3. Determine Sequence of manufacturing

- Sequence of manufacture, including build-up on datum board, establishing datum's mark out of model and areas to be machined, are determined

Requirements - general requirements necessary to carry out routine tasks, such as:

- Dedicated tools and equipment
- Materials and parts
- Workpcedures
- Completion time
- Safety measures and equipment

Requirements and instructions are supplied verbally or on familiar standard forms, such as on job sheets. Instructions are carried out under supervision and in accordance with established procedures.

Plan a complete activity

Performance criteria

- Identify activity requirements
- Activity outcomes and objectives are identified and clarified with appropriate persons.
- Activity requirements, including resources, overall timeframe, quality requirements and criteria for acceptable completion are identified and clarified.

Relevant specifications and procedures are obtained and clarified

A datum reference or just datum is some important part of an object—such as a point, line, plane, hole, ... In carpentry, an alternative, more common name is "face side" and **"**face edge". ... An engineering datum used in geometric dimensioning and tolerancing is a feature on an object used to create a reference system for

Self check 1 **written test**

Instruction: choose the best answer for the following question

1. general requirements necessary to carry out routine task of the manufacture:
    A. Workpcedures
    B. Completion time
    C. Safety measures and equipment
    D. All
2. __________________ datum is some important part of an object—such as a point, line, plane, hole, ... In carpentry, an alternative, more common name is "face side
    A. Limitation
    B. Datum
    C. Clirance
    D. Fit

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

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

Answer Sheet

Score = ____________
Rating: _____________

Name: ___________________________ Date: _______________

Information Sheet 2- Selecting machines and machining processes

Appropriate machines and machining processes are selected to shape/produce model to specifications.

To select appropriate machines and machining processes we have to have Master production scheduling

What Is Machining?

The term “machining” refers to a collection of machine-based manufacturing processes that involve the controlled removal of material from a workpiece for the purpose of changing its size and/or shape. With machining, manufacturing companies use a machine to remove material from a workpiece until they achieve the desired size and shape.

A manufacturing worker who specializes in machining is known as a machinist. Machinist are well-trained, and often certified, to use one or more machines. As a result, they have the skills and knowledge necessary to perform machining processes on workpieces.

Alters a material’s shape, physical properties, or appearance in order to add value

Three categories of processing operations:

- **Shaping operations** - alter the geometry of the starting work material
- **Property-enhancing operations** - improve physical properties without changing shape
- **Surface processing operations** - clean, treat, coat, or deposit material on surface of work

shaper is a stationary power tool that is used for shaping edges, making moldings, and cutting joints. Main parts of a shaper include an on/off switch, spindle height adjustment wheel, miter gauge groove, spindle, cutter guard, and adjustable fence. The spindle holds the cutter. The adjustable fence is used as a guide for straight cuts.

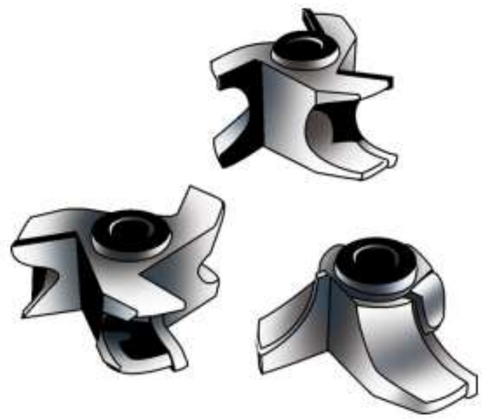


Fig -2.1 tool cutter

Self-Check – 2	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Explain the following processing operations in detail ?(3 point)

    Shaping operations

    Property-enhancing operations

    Surface processing operations

Test II: Write true if the statement is correct and false if the statement is incorrect

1. shaper is a stationary power tool that is used for shaping edges, making moldings, and cutting joints (2pts)

2. removel of material from a workpiece by machine until they achieve the desired size and shape. (2pts)

Note: Satisfactory rating - 7points Unsatisfactory - below 7points

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

Score = ___________

Rating: ____________

Answer sheet

Test I

1.____

Test II

1.____

Information Sheet 3- Selecting and using hand- and hand-held power tools.

3.1. Select and use A range of hand and hand held power tools

Handheld power tools are tools that are not stationary and are either cordless (battery powered) or corded (powered from an AC outlet). I personally prefer to use cordless tools because it is easier to use them without having to worry about dragging cords around. However, cordless tools are generally more expensive to purchase and replacement batteries can be quite expensive. BUT, they are great to take to the tournament because you don't have to worry about finding a power outlet should you need to use your tools.

Drill

- A drill is one of the most important tools that a DI team can have. It is used for boring (drilling) holes in various materials by using a drill bit. It can also be used for installing screws. The drill bit is held in place with a "chuck". I recommend teams use a cordless drill with what is called a "keyless" chuck. Some drills require the use of a small "key" to tighten drill bits into the chuck. A "keyless" chuck is much quicker and easier to use. See the link below for more information about accessories for drills.

Fig 2.3 portable drile machine

A range of hand and hand held power tools is selected and used utilizing acceptable techniques and procedures to fashion/manufacture model to fine tolerances according to specifications, ensuring that surface finish is appropriate to the type of model.

3.2. Common Causes of Accidents

Typical causes of hand and power tool accidents include the following:

- using the wrong tool for the job
- tools falling from overhead
- sharp tools carried in pockets
- using cheaters on tool handles
- excessive vibration
- using tools with mushroomed heads
- failure to support or clamp work in position
- •carrying tools by hand up or down ladders
- using damaged electrical cords or end connectors
- failure to use ground fault circuit interrupters (GFCIs), especially outdoors.

Safe Practices

Basic hazard awareness and common sense can prevent serious injuries with hand and power tools. As a general rule follow the safe practices listed below.

- Always wear eye protection. There is always the risk of flying particles and dust with hand and power tools. Appropriate eye protection is essential and must be worn by the user and others nearby. For eye protection see the Personal Protective Equipment chapter in this manual.
- Use the right tool for the job. Using a screwdriver as a chisel, using a cheater on a wrench handle, or using pliers instead of a proper wrench are typical

examples of the mistakes which commonly lead to accidents and injuries.

- Use tools as recommended by the manufacturer. For example, don't use cheaters on handles. This will exert greater forces on the tool than it was designed for and is likely to cause breakage and possible injury.
- Damaged or broken tools should be removed from service. Chisels with mushroomed heads, hammers with cracked or loose handles, wrenches with worn jaws, damaged extension cords, and ungrounded tools are all unsafe and should be removed from service and be either repaired or destroyed.
- Maintain tools in safe operating condition. Prevent mushrooming. Tools which are struck by hammers, such as chisels or punches, should have the head ground periodically to prevent mushrooming

Keep handles secure and safe.

Don't rely on friction tape to secure split handles or to prevent handles from splitting. Check wedges and handles frequently. Be sure heads are wedged tightly on handles. Keep handles smooth and free of rough or jagged surfaces. Replace handles that are split, chipped, or that cannot be refitted securely. **Keep hand tool cutting edges sharp**. Sharp tools make work easier, improve the accuracy of your work, save time, require less effort, and are safer than dull tools.

- **Never climb ladders with tools in your hand**. Tool holders and pouches (Figure 21.2) free the hands while workers are climbing or working on ladders, scaffolding, and other areas where access may be difficult. When carrying tools up or down from elevated places, put them in substantial bags or boxes and raise and lower them with strong rope

The following are general safety procedures for working in a shop area. Safety precautions for specific tools are discussed later in this lesson.

- Adhere to instructions.
- Read labels and warnings on containers and tools.
- Follow the manufacturer's recommendations for use and maintenance of a specific tool.
- Pay attention to signs posted in the work area.

- Follow the instructor’s directions.
- Wear safety glasses at all times in the shop.
- Wear protective gear such as gloves, earplugs, and safety shoes if appropriate.
- Do not wear loose-fitting clothing that could get caught in a moving part.
- Wear a hair net to prevent long hair from getting caught in a tool.
- Keep work areas clean and free of clutter.

Self-Check – 3	Written test

Name…………………………………………… ID……………………….. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Mention at least three Common Causes of Accidents (3 point)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. a Sharp tools make work easier, improve the accuracy of your work, save time (2pts)

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

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

Score = ___________
Rating: ____________

Answer sheet

Test I

1.____

2. ____

Test II

1.____

2.____

Information Sheet 4- Undertaking measurement/calculations to check specifications

Different Types of Machining Operations and the Machining Process

During the manufacturing of a part, a variety of machining operations and processes are needed to remove excess material. These operations are usually mechanical and involve cutting tools, abrasive wheels, and discs, etc. Machining operations may be performed on stock mill shapes such as bars and flats or they may be executed upon parts made by previous manufacturing methods such as casting or welding. With the recent advancement of additive manufacturing, machining has of late been labeled as a "subtractive" process to describe its taking material away to make a finished part.

Different Types of Machining Operations

Two primary machining processes are turning and milling – descried below. Other processes sometimes dovetail onto these processes or are performed with standalone equipment. A drill bit, for instance, may be installed on a lathe used for turning or chucked in a drill press. At one time, a distinction could be made between turning, where the part rotates, and milling, where the tool rotates. This has blurred somewhat with the advent of machining centers and turning centers that are capable of performing all the operations of the individual machines in a single machine.

Precision machining is what produces a huge number of both large and small objects that we use in daily life. Each intricate piece which makes up an object requires one level or another of a machinist's skills. Likewise, a tool or machine that has been worn down will often require machine tool calibration, welding or grooving by a precision machinist. From the production of aircraft aluminum alloys to surgical bone drilling devices and custom automotive tools, precision machining reaches into every technology and industry. In other words, if an object contains parts, it required precision machining.

Self-Check – 4	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1.List the Different Types of Machining Operations (3 point)

Test II: Write true if the statement is correct and false if the statement is incorrect

1.machinining operations are usually mechanical and it involve cutting tools, abrasive wheels, (2pts)

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

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

Score = ___________

Rating: ____________

Answer sheet

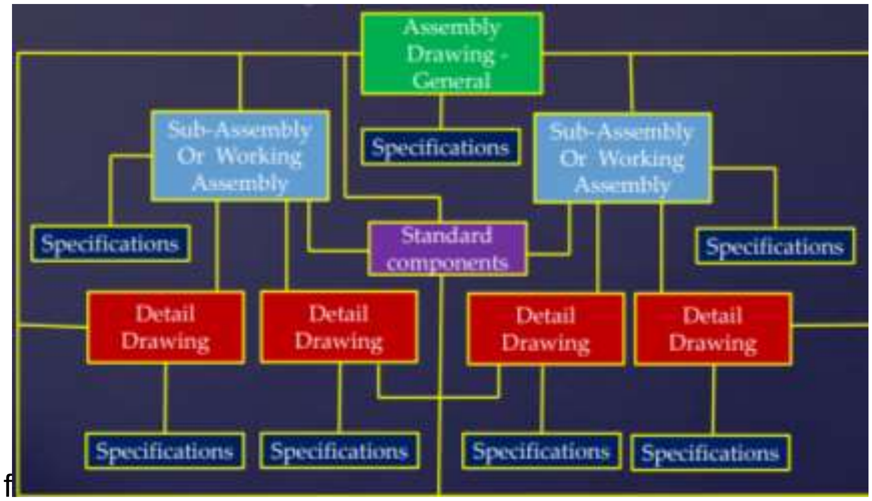
Test I

1.____

Test II

1.____

Information Sheet 5- assembling components



f

fig -5.1 drawing component

Assembly Drawings must provide sufficient information to enable the assembly of a component.

• Assembly Drawings must have a number of views to show how parts fit together.

• Section views to show how parts fit and to eliminate hidden detail.

• Dimensions to indicate range of motion or overall size of assembly for reference purposes.

• Individual components identified with balloons and leader lines.

• Parts list (or BOM – Bill of Materials) relates to balloon numbers on drawing.

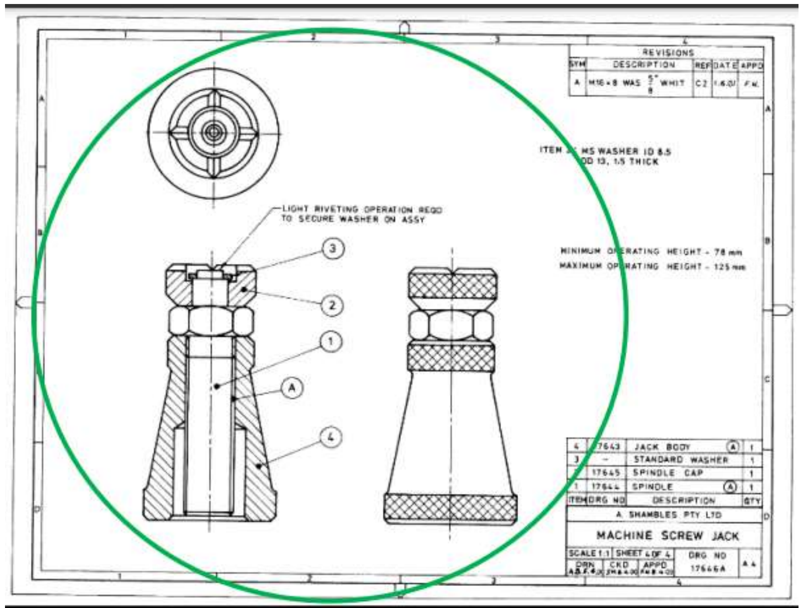


Fig 5-2 Enough equally spaced views are needed in order to demonstrate to the reader of the drawing how the assembly fits togethe

Dimenssion

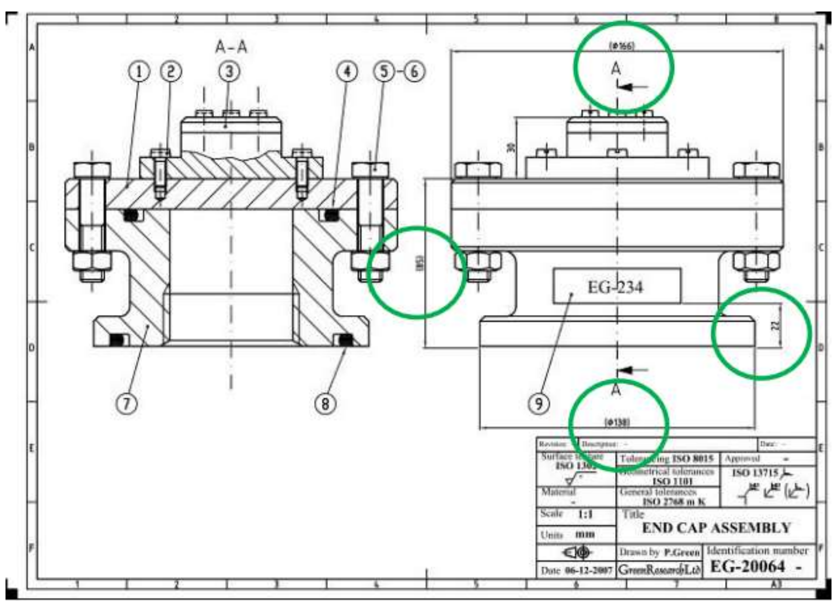


fig- 5-3 Dimension

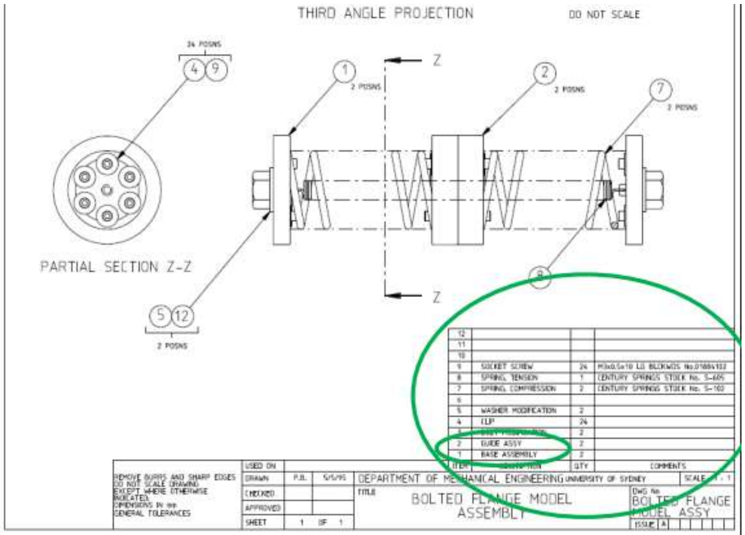


Fig- 5.4 In the assembly drawing above notice the arrangement of the numbering of the individual sub assemblies, component and standared hared ware. They are numbered from the bottom of the parts list up wareds. The relevant quanties and material (missing) should also be stated

Sub assembly drawings

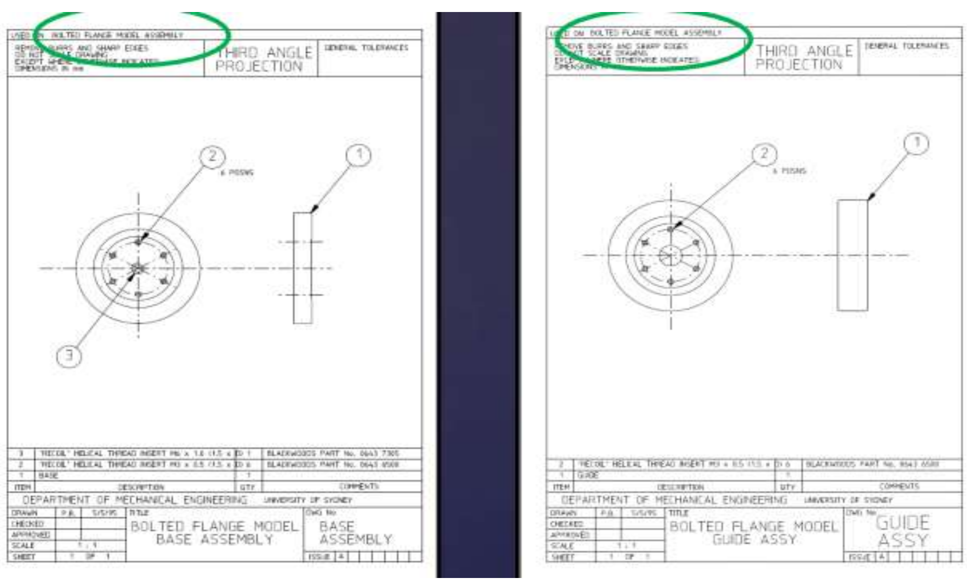


Fig- 5.5 Sub assembly drawings

Detail drawings from sub assembly

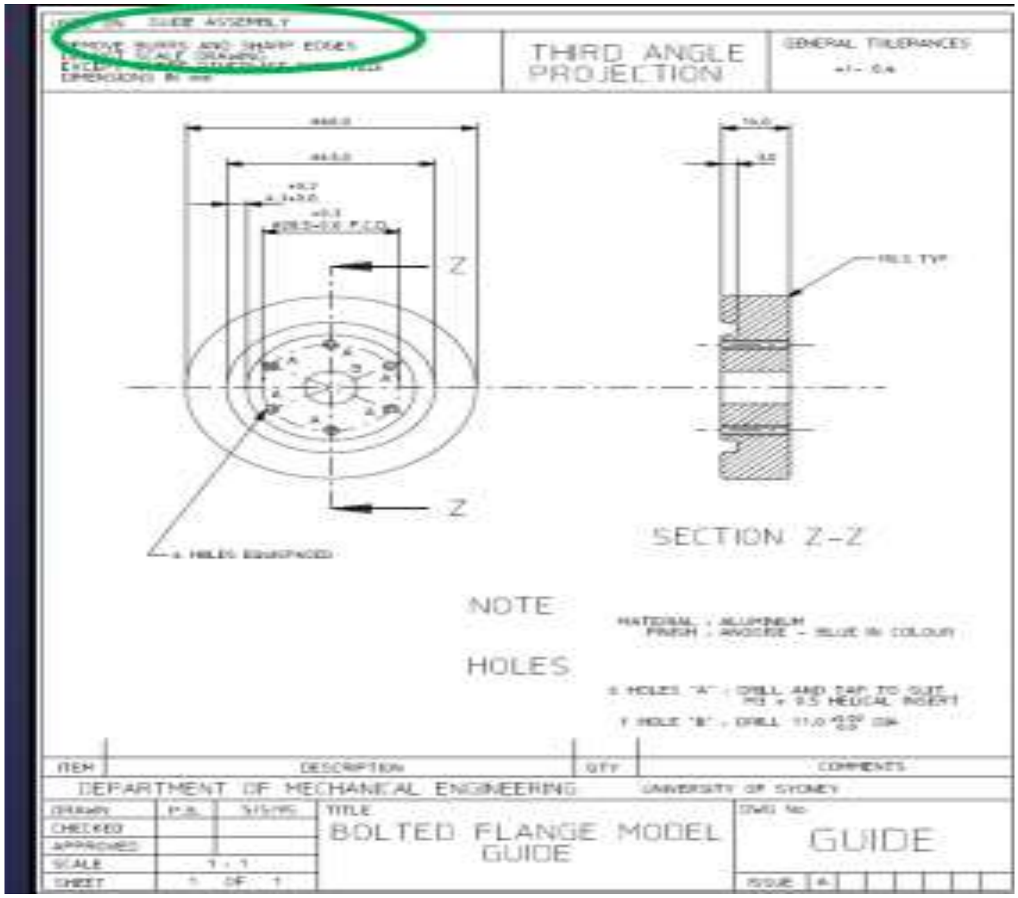
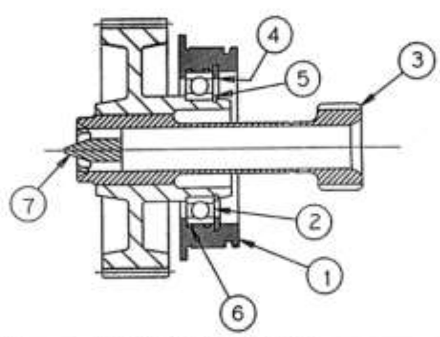


Fig-5.6 Detail drawings from sub assembly

Assembly drawing



1		1689-207	BUTTON, SPLINE LUBRICATION		7
2		M83248/1-034	O-RING	MIL-R-83248, TYPE 1	6
1	80756	RS137	RING, RETAINING	CARBON STEEL (SPIROLOX)	5
1	89462	N5002-218	RING, RETAINING	CARBON STEEL (TRUARC)	4
1		1689-294	SHAFT ASSY, INPUT		3
1		MRC 1907-5	BEARING		2
1		1689-276	INSERT, BEARING		1

Fig -5-7 Assembly drawing

Assembly drawings demonstrate how a number of separate subassembly drawings, detail parts standared components and specifications come together in a unified assembly

Self-Check – 5	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Explain what it meant Assembly drawings (3 point)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Assembly Drawings must provide sufficient information to enable the assembly of a component (2pts)

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

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

Score = ___________

Rating: ____________

Answer sheet

Test I

1.____

Test II

1.____

LG #31	LO #4- : Assure Quality

Instruction sheet

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

- Testing functionality of model.
- Recording and reporting deviations or modifications.
- Compiling model documentation.

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

- Test functionality of model.
- Record and reporting deviations or modifications.
- Compile model documentation

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 Testing functionality of model.

Functional Testingbesed on the model with in standared prodcedure

Functional Testing is a type of software testing that validates the software system against the functional requirements/specifications. The purpose of Functional tests is to test each function of the software application, by providing appropriate input, verifying the output against the Functional requirements.

Functional testing mainly involves black box testing and it is not concerned about the source code of the application. This testing checks User Interface, APIs, Database, Security, Client/Server communication and other functionality of the Application Under Test. The testing can be done either manually or using automation.

What do you test in Functional Testing?

The prime objective of Functional testing is checking the functionalities of the software system. It mainly concentrates on -

- **Mainline functions**: Testing the main functions of an application
- **Basic Usability**: It involves basic usability testing of the system. It checks whether a user can freely navigate through the screens without any difficulties.
- **Accessibility**: Checks the accessibility of the system for the user
- **Error Conditions**: Usage of testing techniques to check for error conditions. It checks whether suitable error messages are displayed.

How to do Functional Testing

Following is a step by step process on :

- Understand the Functional Requirements
- Identify test input or test data based on requirements
- Compute the expected outcomes with selected test input values

- Execute test cases
- Compare actual and computed expected results

Examples of Functional testing are

- Unit Testing
- Smoke Testing
- Sanity Testing
- Integration Testing
- White box testing
- Black Box testing
- User Acceptance testing
- Regression Testing

.

Self-Check – 1	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

2. Mention at least three things by functional testing (3 point)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Functional Testing is a type of software testing that validates the software system against the functional requirements/specifications (2pts)
2. The prime objective of Functional testing is checking the functionalities of the software system(2pts)

Note: Satisfactory rating - 7points Unsatisfactory - below 7points

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

Score = ___________

Rating: ____________

Answer sheet

Test I

1.____

Test II

1.____

Information Sheet 2- Recording and reporting deviations or modifications.

Quality records

- non-conformances
- CAPAs o internal inspection reports
- change control

Standard Operating Procedures

Test Methods

Training Documentation

Validation Documents (IQs, OQs and PQs)

Work Instructions

Product and Sample Labels

reporting/record-keeping timeliness

- information is recorded contemporaneously
- real-time record keeping including date stamps (e.g., automated time-stamping)
- prevents errors from memory-issues and prevents editing of original data

Categories of Documents

1. Primary records such as those obtained from the master formula, manufacturing and packaging instructions.
2. Supporting procedures such as instructions on how to perform a manufacturing step or test methodology.
3. Subsidiary records which support the process as it is being carried out, such as environmental monitoring or preventive maintenance/calibration on process or lab equipment.
4. Quality control records include all lab testing results for the process or products and al investigative reports and records.

Generally speaking, when signing your name to a GMP document, you:

1. Confirm your unique identity.

2. State that you have the authorization to perform, verify, check, review or approve the activity associated with your name.

3. Recognize that your signature and initials cannot be taken back; once signed, you are personally, professionally and legally responsible for the action taken.

Controlling Your Signature

It is imperative that you maintain strict control over the use of your signature and initials. Sign and initial only for yourself. Never allow someone else to sign or initial for you unless that person is authorized in writing to do so and according to procedure.

Self-Check – 2	Written test

Name…………………………………………… ID……………………….. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What types of documents require following Good Documentation Practices? (3 point)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. data accuracy is one of documentation standards :(2pts)
   Is that non-conformances is get Quality records (2pts)

Note: Satisfactory rating - 7points Unsatisfactory - below 7points

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

Score = ___________

Rating: ____________

Answer sheet

Test I

1.____

Test II

1.____

Information Sheet - 3	Compiling model documentation .

documentation standards relate to:

data accuracy

- recorded *accurately*
- cross-checked for errors
- not intentionally misleading (prevents fraudulent entries, editable entries)

data integrity/validation

- genuine, true data
- validated and supported/witnessed; vs intentionally falsified
- relevant to the reporting requirement
- not changeable after original record-keeping entry (extensively tracked changes)

legibility

- clarity
- legible (readable by anyone, removing guesswork)
- readily accessible

identifiable

- clear records that can *identify the person* who actually records the data
- Blockchain is increasingly being discussed as part of Pharma 4.0 innovations
- watch for other new technology adaptations for GDocP as systems evolve

What types of documents require following Good Documentation Practices? Some examples include:

- Analytical Methods
- Batch Records
- Bills of Materials (BOMs)

- Certificate of Analyses (CoA)
- Certificate of Compliance (CoC)
- Laboratory Notebooks
- Logbooks
- Policies
- Protocols

Operation Sheet 1– Testing functionality of model.

Objectives Testing functionality of model;

- To know all models or pattern should properly made .
- To know models make prepared concerned to the right manufacture of the product produce regarding to concern maintainace

Procedures to ensure the job gets done safely and without delay

1. Select, fit and use personal protective clothing and/or equipment
2. Testing functionality
3. inspecting vidualliy and NDTwith all the dimension, proper alignment and accuracy
4. check and make sure all the dimension proper material the right machinery use to proceduraly as required to take process and related equipment off-line in preparation for cleaning and/or maintenance within level of responsibility.
5. Seat the right place and operational.
6. Make record and report to your supervisors

LAP TEST - 1	Performance Test

Name………………………………. ID………….. Date………………………………

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task

Preform successful show and assure all the system activities are exactly represented the produced a product particularly elbow

Reference Materials

Book:

1. HERBERTSON, J. AND AUSTIN, P. “The Application of Mathematical Models for Optimization of Continuous Casting”, Modeling of Casting, Welding, and Advanced Solidification Processes - VI, Palm Coast, FL, TMS, Warrendale, PA, 689-700, (1993).
2. Advanced Physical Chemistry for Process Metallurgy, M. Maeda editor, Academic Press, 1997. pp. 253-279. ISBN 0-12-618920
3. Wolff, F.: Ökonomie multiperspektivischer Unternehmensmodellierung. ITControlling für modell-basiertes Wissensmanagement. Gabler, Wiesbaden 2008.
4. Jeyapoovan, Engineering Drawing with autocad 2000, Vikas publishing

WEB ADDRESSES

1. http://ccc.illinois.edu/PDF%20Files/Publications/97_Proc_model_16fulpag2.pdf
2. http://www.ddegjust.ac.in/2017/Uploads/11/POM-326.pdf

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The trainers who developed this learning guide