CHAPTER

WORKSHOP ENGINEERING AND SAFETY PRECAUTIONS

O LEARNING OBJECTIVES

To know about Machinist, Industries, Industrial Safety Precaution, Accidents, Concept of 5S, First Aid and First Aid Materials, Waste Management, Environmental Management System (EMS)

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1.1 INTRODUCTION

- Now a day's technological revolution shows modern machineries in industries. New techniques lead to dramatic development in new machines. In order to cater to the needs of our daily life, new machines are developed in places of house, office, commercial complex and industry etc., Machines became a part of ourlife. We can see our daily life begins and ends with machines like water heater, grinder, mixer, refrigerator etc.
- In order to satisfy the rising demands of the mankind, such machines are manufactured in large number. Machinists involve themselves in the process of mass production and avert any shortfall in the demand, special trainings required to be given to machinist to make them aware of modern manufacturing techniques and special skill developing abilities.
- A machine tool is a machine which is used in manufacturing process. An industry or a factory may have many machine tools such as lathes, drilling machines, shaping machines, milling machines and grinding machines etc. It may also have several types of hand tools and cutting tools involved in the production process.



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1.2 INDUSTRIES

An industry is an economic activity concerned with the processing of raw materials and manufacture of goods from raw materials. All such industries need especially skilled machinist in achieving their target in production.

TYPES

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According to the range of investments and production, industries can be classified in to

- 1. Small scale industry
- 2. Medium scale industry
- **3.** Large scale industry.

1.2 MACHINIST

A machinist can be defined as a person who has a complete knowledge of operation of various machine tools and handling of different hand tools. He makes the components or machine parts of required size and shape from various materials.



Figure 1 Machinist working on a lathe

DUTIES OF MACHINIST

• A machinist should have a complete and thorough knowledge of operating different machine tools.

- He should know how to handle various hand tools and instruments.
- He should have a complete knowledge of reading production drawings. He should understand the various notes given in the drawing and different symbols marked in the drawing. He will then analyse about the size and shape of the component or assembly, the materials used for manufacturing and method of production.
- He should operate the machine tools in a proper manner providing periodical maintenance.
- He should be able to provide appropriate cutting speed, feed and depth of cut according to the rigidity of the machine, nature of the materials used for manufacturing and the type of cutting tool used.
- He should provide wholesome support to the overall development of the industry.

1.4 ACCIDENTS

Accidents can be called as an unexpected event which takes place suddenly causing damages to human lives and materialistic loss. Accidents may occur to every- one in factories, workplace, on roads and at home. The main reason of accidents can be attributed to carelessness and not correcting some minor faults or deficiencies.

CAUSE OF ACCIDENT

In industries accidents can be avoided by placing proper attention on the activities that takes place there. Some important causes for accidents are:

• Unnecessary conversation and lack of attention on the work.

• Lack of adequate rest or sleep.

- Not possessing adequate experience in the task to be done.
- Showing sense of urgency in the work.
- Desire of making quick time money.
- Working with poor health.
- Improper handling of hand tools.
- Improper environment
- Inadequate facilities in the workplace.
- Wearing improper dress.
- Improper holding of work pieces and tools in machines.

1.5 SAFETY

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Safety can be defined as an attitude to keep away damages or accidents. Industrial safety refers to the management of all operations and events within an industry in order to protect its employees and assets by minimizing hazards, risks, accidents, and near misses.

In order to prevent the loss of human lives, safety should be enforced at all costs. Safety is an attitude and working safely is a state of mind. A machinist should follow the safe working habits are important for himself and for working places.





Safety in a workshop can be classified as follows:

- 1. Safety precautions in Workshop.
- 2. Safety precautions for Hand tools.
- 3. Safety precautions for Machine tools.
- **4.** Safety precautions for Machine operator.
- 5. Fire Safety

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1.5.1 Safety Precautions in Workshop

- Round and cylindrical objects, sharp articles and tools should not be found in pathways, it may cause injuries to the workers.
- The layout of machines, lighting and ventilation in the workshop should be done properly.
- Workshop floor has to be dry and free from Oil, water and grease.
- Inflammable materials should be kept in safe places with proper precautions.
- Hot object should be kept separately, where in messages like "HOT", "DO NOT TOUCH" are displayed.
- First aid box containing proper medicine and emergency instruments should be kept ready in a workshop.

1.5.2 Safety Precaution for Hand tools

- Files, hammers and screw drivers with proper handles alone should be put into use.
- When hammers, chisels and punches are put into use, should be taken that any oil, grease or metal chips present on their heads are cleaned completely.

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- After use measuring instruments should be kept safely in their respective covers (or) places.
- Measuring instruments should be handled properly to increase their durability.
- The hand tools should be used for the specific purpose for which they are intended. They should not be placed near machine tool when their usage is not necessary.
- Marking and measuring should not be done on rotating and moving parts.
- Tools having cutting edges like files, and scrapes should not be grouped with other hand tool when storing.

1.5.3 Safety Precaution for Machine Tool

- Proper packing pieces should be used while lifting or shifting machine tools.
- Operators should work on machines which they are familiar with. When they choose to work on unfamiliar machines, accident may take place.
- The operation parameters like feed, cutting speed and depth of cut should be selected according to the strength and rigidity of the machine tools.
- Sudden failures and defects in the machines should not be corrected or attended by the operator himself. Proper technicians should be called for repair works.
- The machines should be stopped immediately if any abnormal sound comes from them.

- Notice board plate showing the message "The Machine Out Of Order" should be placed near the machines, which are breakdown or under repair.
- The operator should not change the speed (or) lubricates when the machine is still functioning.
- The machine tools should be maintained properly. It should be monitored regularly for scheduled maintenance.

1.5.4 Safety Precaution for Machine Operator

- Operator should not wear ties and bows while working.
- Operator should not wear small towel or clothes around his neck or on shoulders.
- Operators should not rest his body on the machines during the operating time.
- Operator should wear tight clothes and avoid wearing loose dresses
- While operations like grinding, welding and chiseling, the operator should wear safety goggles.
- The operator should wear gloves while handling hot and sharp articles.
- Operators should wear only leather shoes.
- The operator should not touch unsafe and un-insulated electrical wires.





- operator should seek the help of others while handling heavy and fragile materials.
- Safety plates and equipment should be installed before the machine.
- Strict code of discipline should be followed in the workshop. Running, playing and chatting with others are to be avoided in the workshop.
- The operator should wear earplug, helmet and mask while performing the machining operations.

• The operator should know about the "FIRST AID"

1.5.5 Fire Safety

Fire safety is the set of practices intended to reduce the destruction caused by fire. Fire safety measures include those that are intended to prevent ignition of an uncontrolled fire, and those that are used to limit the development and effects of a fire after it starts.

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Fire extinguisher is a portable device that discharges a jet of water, foam, gas, or other material to extinguish a fire.

Class A fire extinguishers: Class A fire extinguishers are used for ordinary combustibles, such as paper, wood, cloth, and some types of plastic. These extinguishers typically use water or certain types of dry chemicals to either absorb heat or coat the fire.

Class B fire extinguishers: Fires that originate from flammable liquids and gas can be extinguished by a class B fire extinguisher. This is the type of extinguisher you want to use on a fire caused by oil or fuel.





Class C fire extinguishers: Class C fire extinguishers are effective against electrical fires from live wires, panels, and circuit breakers. The extinguisher works by releasing materials that stop the conduction of electricity.

Class D fire extinguishers: Class D fire extinguishers are used on combustible metals. These include magnesium, sodium, aluminium, and titanium.



Figure 5 How to use a Fire Extinguisher

1.6 CONCEPT OF 5S

5S system is one of the Lean Manufacturing tools for organizing workplace that results in a clean, uncluttered and safe working environment. 5S helps to reduce waste, reduce accident and to optimize productivity. 5S originated as a part of Toyota Production System (TPS).

Focus of 5S:

5S system focuses on giving a place for everything and putting everything in its place. Simply,

"A Place for Everything and Everything in its Place"

Need for 5S:

Practicing the 5S system keeps the workplace clean and well organized which makes it easier for people to do their jobs with minimal effort without wasting time and without injury.

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If the workplace is not clean and organized, achieving good results consistently will become difficult in long term.

5S Steps:

Step Number	Step Name in English Meaning of 'S'
15	Sort
25	Set in order
35	Shine
4S	Standardize
5S	Sustain



Step 1S: Sort

Sort involves looking through all the available items and then separate what is needed and not needed. Keep the needed items for further action and dispose the not needed items accordingly. The available items may be tools, equipment, materials, manuals etc.

To do the "Sort" step easier we can ask these questions:

- a. What is the purpose of this item?
- b. Are we using this item frequently?
- c. Who uses this item?

- d. When we had used this item last?
- e. What is the need for the item to be placed here?

Answers for the above questions will give the clear purpose of each item. Now we exactly know which items are needed here and those not needed items can be disposed accordingly.

Step 2S: Set in order

As we had executed the "Sort" step, we now have needed items only.

Now organize the needed items in an order related to process, people, frequency of usage, weight of item, size and shape of item etc.

To do "Set in order" easily, we can ask these questions,

- a. Which items are used most frequently?
- b. Who uses these items?
- c. When the items are used?
- d. Any grouping of items are required?
- e. Any process sequence to be followed?
- f. Any need for storage containers? If yes, what will be the quantity?
- g. Is there any containers required? Mention size of the containers

Answers for the above questions will give us the optimized arrangement order which covers tasks, frequency of tasks, people movement path, height of storage, weight of item etc.

At the end of second step, the necessary items alone are stored in a well- organized manner that makes us to identify the item and pick the item easily for use with minimum effort.

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Step 3S: Shine

This step of 5S focuses on cleaning the work area on regular basis (daily) before starting the work. This includes cleaning of tools, equipment, machines, worktables, computers, printers, sweeping of shop floor etc.

While doing this regularly, the items will be always clean and in addition to that it will help us identify and correct any abnormalities like loosened nut, damaged electric wire, cracks etc. which will reduce the accidents.

Step 4S: Standardize

In this step, what are all changes done in the sort, set in order and shine steps will be added to the Standard Operating Procedure (SOP). By doing so, it is made compulsory to follow the defined steps on regular basis.

Standardize systemizes everything happened earlier and converts one time effort in to a routine duty.

Step 5S: Sustain

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Sustain is about making 5S a part of organization's culture. It will form a habit of following sort, set in order, shine and standardize steps regularly.

Sustain ensures that everyone in the organization from top management to bottom line management is involved in following 5S steps, so that company will start producing continuous positive results. Sustain assigns responsibility to each and every person and tracks the progress on continuous basis.

Benefits of 5S:

- a. Safe work environment
- b. Lesser efforts and fatigue to people
- c. Increased production
- d. Lower rejection
- e. Reduced costs
- f. Higher equipment availability
- g. Improved employee morale
- h. Increased customer satisfaction

Note

Actually 5S originated in the automobile manufacturing industry (Toyota). On realizing the benefits of practicing 5S, other manufacturing industries like health care, educational institutions, offices, kitchens etc. started to follow 5S concept.

1.7 FIRST AID

So far, we have discussed about various factors to enforce safety and avoid accidents. At some times, the focus on safety may be missing due to some reason. In such circumstances, accidents may be happen causing liabilities to the industry as well as the operator.

Accidents may happen at any time in a workshop. The affected or injured person should be provided with immediate medical attention before he is taken to a hospital. This treatment which is given on the spot is known as first aid.

Every industry (or) a workshop should be equipped with a doctor or a first aid assistant. Apart from this, all the operators should be given proper training in first aid.

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Figure 5 First Aid

These measures will avoid heavy losses of lives. Every workshop should have a first aid box. Which contains with proper medicine and instruments.

1.7.1 Materials to be found in a First aid box

- 1. Iodine
- 2. Tincture of Benzene
- 3. Dettol
- 4. Burnol
- 5. Boric Powder
- 6. Meshed Cloth
- 7. Cotton
- 8. Plaster
- 9. Small Scissor
- 10. Knife
- 11. Small Wooden Stripes
- 12. Basin for Washing Eyes
- 13. Broad Based Beaker for Mixing Medicine





1.8 WASTE MANAGEMENT

Waste is anything that is left out after any process.

Example:

- a. Tea powder will be left out after making tea.
- b. Metal chips will be left out after machining.
- c. Contaminated water will be left out after washing a vehicle with water.
- d. Polythene covers will be left out after consuming the packed contents.

Management

Management is the art and science of managing resources. Simply it is the process of dealing with anything (Peoples, materials, tools, equipment, machines etc.).

Waste management

Waste management is the art and science of managing wastes. Simply it is the process of dealing with wastes from its beginning point to its final disposal without contaminating environment.

Contamination

Contamination is the presence of unnatural substances at varying levels or concentrations.

Pollution

If the contamination causes harm to anything (human beings, other organisms, materials, structures etc.), then it is called as pollution.

For better understanding, All contaminations are not pollutions; but all pollutions have contaminations at higher levels/concentrations.

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Hierarchy of wastes:

Generally referred as 3R,

Reduce, Reuse, Recycle.



Reduce: Designing a product and processes in order to reduce the waste generation during manufacturing. Reduce also includes reduction of usage.

Reuse: Reusing anything for its intended original purpose (refilling etc.) or for a different purpose.

Recycle: Recycling involves converting waste in to any useful thing by processing.

Biodegradable waste: It is defined as a waste that can be decomposed by natural agents and will not create pollution.

Example: left out vegetables, fruits, papers etc.

Non-biodegradable waste: It is defined as a waste that cannot be decomposed by natural agents.

Example: Plastic items, polythene carry bags etc.

Hazardous waste: It is defined as a waste that are having dangerous properties and will be harmful for the living beings (humans, animal etc.)

Example: Nuclear & Chemical wastes, Leather industries wastes Paint thinners, diapers etc.

Non Hazardous waste: If the waste is not harmful for the living beings, then it is called as Non-hazardous waste.

Example: glass, cardboard etc.



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Note

In addition to the above, wastes can be further classified in to solid waste, liquid waste, gaseous waste, dry waste and wet waste.

Colour code:

Colour coding system is followed to collect and process the different type of wastes.

Colour Code	Bin	Used to Collect
Red		Non-biodegradable waste and hazardous waste
Green		Biodegradable wastes.
Yellow	e	Glass etc.
Black	.	E-Wastes
Blue	3	Metal etc.

1.9 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

All industries have started following Environmental management System (EMS) in order to reduce contamination and pollution caused as a result of their operations. ISO 14001 is the standard of EMS. Current edition is 2015. So, we can call as Environmental Management System (EMS) or ISO 14001:2015 standard. ISO stands for International Organization for Standardisation.

The purpose of this ISO 14001:2015 standard is to provide organisations with framework that can protect the environment and to respond to changing environmental conditions. It follows PDCA model. P stands for Plan, D stands for Do, C stands for Check and A stands for Act.

PDCA Model

This model can be applied to EMS and each of its individual elements.



Plan: Create Environmental Policy. Identify the aspects that affects environment. Fix objectives and targets to process further.

Do: Execute and Implement the planned process.

Check: Monitor, Measure, Check and Review what is done. Compare results in line with planned objectives and targets.

Act: Take necessary action continuously to reduce the environment pollution.

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Note

Environmental Policy of a government or non-government organisation is nothing but the commitment by an organisation to strictly follow the environmental laws, policies and regulations without any deviation. It will differ from one organisation to another based on their processes.

Glossary

- 1. Revolution புரட்சி
- 2. Technique நுட்பம்
- 3. Modern நவீன
- 4. Accident விபத்து
- 5. Safety பாதுகாப்பு
- 6. First Aid முதலுதவி
- 9. Environment

7. Workshop

- Environment
- 10. Precautions

உற்பத்தி

– பணிமனை

8. Gross Domestic Product (GDP) – உள்நாட்டு மொத்த

- சுற்றுச்சூழல்
- முன்னெச்சரிக்கை

Activities

- 1. Make the First Aid Box.
- 2. How do you give First Aid for burning accident? Explain and give the report.
- **3.** Follow 5S steps daily in your school bag. Your daily periods will be a combination of theory and practical that follows a specific sequence every day. So you need to follow that period sequence for the day to organize the textbooks, note books, pencil box etc. Keep the schoolbag clean and well organized by following 5S.

QUESTIONS



PART A

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I. Choose the correct option

- 1. The person who manufactures different parts is
 - a. Supervisor
 - b. Machinist
 - c. Manager
 - d. Foreman

- 2. What kind of safety rule while the operator rest his body on the running of the machine
 - a. Workshop safety precaution
 - b. Safety precaution for hand tools
 - c. Safety precaution for machine tools
 - d. Safety precaution for operators

- **3.** First Aid is
 - a. A manufacturing process.
 - b. Safety regarding operators.
 - c. Immediate treatment given at the spot of accidents.
 - d. Breakdown of machines.
- **4.** The packing pieces are used at the time of
 - a. Running of the machine.
 - b. While stopping the machine.
 - c. While lifting (or) shifting machine tools.
 - d. While fitting the machine tools.

PART B

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II. Answer the following questions in one or two sentences:

- 5. How Industries are classified?
- 6. Who is Machinist?
- 7. What is safety?
- 8. What is the classification of safety Precautions?
- 9. What is known as First Aid?
- **10.** List out the Materials in a First Aid box?
- **11.** Define 5S and focus of 5S.
- **12.** Define Contamination and Pollution
- **13.** List the hierarchy of wastes and explain.
- 14. Define waste and waste management.
- **15.** Expand EMS and state the ISO standard for EMS.

PART C

III Answer the following questions in about a page

- **16.** What are the main causes for accident?
- **17.** List out the safety Precautions regarding hand tools.
- **18.** What are the safety Precautions for machines?
- **19.** List out the safety Precautions for operators.
- **20.** List the 5S steps.
- **21.** List the different coloured bins for collection of waste and their uses.
- **22.** Define PDCA model.

PART D

IV. Answer the following questions in detail:

- Explain the duties and important role in development of country of a machinist.
- 24. List the 5S steps in English language and explain each steps.
- **25.** Explain Sources of waste with flowchart.