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Engineering Workshop Practice

Engineering Workshop is a small establishment where manufacturing or handicrafts are carried out.

* A workshop department can be identified in a factory.
* Why do we teach Engineering practice in higher institution?.

Types of Engineering Workshops.

1. Manufacturing Workshop
2. Maintenance "

Manufacturing Workshop.

- General purpose Workshop
- Special " "

* We classify workshop in form of Ownership.
- Independent workshop
- Captive workshop

Each workshop Organization is headed by a foreman that report to the directors. A foreman is a Supervisor.

Engineering Workshop is also a place where students acquire knowledge on the Operation of various processes involved in manufacturing and production. An ideal engineering workshop is a place, where all categories of engineering workers, use the basic hand tools, equipment and machines, to fashion out an assembly or product from the raw material stage, to its finished or functional stage. It must be definitely equipped with good lighting System, proper Cross Ventilation, easily accessible doors for smooth withdrawal in case of any emergency.

Workshop is distinct (different) from a factory. Factories are associated with batch (Quantity) and mass production. Also, workshop requires skilled staff for successful Operation while factory can Operate effectively with largely Semi-skilled staff due to the special production machines available.

Workshop practice provides the basic working knowledge required for the production of various engineering products. It also explains the Construction, function, use and application of different working tools, equipment, machines as well as the technique of manufacturing a product from its raw materials.

Types Of Engineering Workshop.

- General purpose workshops :→ are manufacturing workshop with a wide range of production capability that may cover such as metal casting, forging, pressing, welding, heat treating, surface finishing etc. Example of this type of workshop are machine builders, tool maker etc.
- Special purpose workshops :→ are manufacturing workshop where the main manufacturing process for a particular product is carried out. These workshops usually act as suppliers of parts to other manufacturers.

Engineering workshop are generally divided into different sections. There are divided according to nature of work. They are:

- Machine Shop :→ This is a place where metal parts are cut, fabricated and finished to the required size to form a mechanical units or machines. Machine shops are used in the creation of new parts as well as repairs of existing equipment and automobile parts. Equipment/machines that can be found in the machine shop are lathe machine, milling machine, multi drilling machine, drilling machine/drill press, grinding machine and welding machine.
- Forging Workshop :→ is a type of workshop where metal is shaped by application of "pressure" from hammer or press after heating to its plastic deformation range either by forging, bending, twisting, drawing etc. In order to bring it to its final shape. A forging shop is a blacksmith shop. Equipment/machine that can be found in the forging workshop are forge furnace, surface grinder, electric drilling machine.
- Fitting Shop :→ is a place where fitting or assembling is carried out. Fitting is the process of assembling of parts after bringing the dimension or shape to required size or form in order to secure the necessary fit. The operations of fitting are carried out on the workbench.
- Foundry Shop :→ is workshop where metal casting is done. That is a desired shape of a metal is obtained by heating up to its molten state (liquid state) and pouring into a moulded cavity to obtain the desired shape. The molten metal is allowed to cool and solidify.

- Heat treatment Shop :→ for hearing of metals.
- Welding/fabrication Shop :→ is a workshop where two metals are fused together at the temperature of about 3200°c. Hence it is a workshop for welding and fabrication. The most common types of welding are. Electric Arc Welding, Gas welding (Oxy Acetylene Welding), Resistance Welding, forge or fire Welding.
- Woodwork/pattern Shops → where students are to work on wooden jobs by using various hand tools and machines.
- Maintenance Workshop :→ where essentially repairs are carried out. E.g are automobile mechanic workshop, electric mower Workshop etc.

Classification of Workshop by form of Ownership.

- Independent Workshop :→ are workshop legally register to do business as an independent entity like any other company.
- Captive Workshop :→ are workshop which are more departments in an Organisation which serve the following functions

* To serve as a maintenance workshop to the Company.
* To serve as a training workshop as found in higher institution of learning.
* To serve as a production workshop for some particular components needed in the assembly of a product in the company.

Workshop Equipment.

1. Measuring Tools → these include Steel rule, Vernier Callipers, Combination set, depth gauges Outside Callipers, micro-meter screw gauge, micro-meter depth gauge etc.
2. Hand or bench tools :- hammers, pliers, screw drivers, bench vise, files, scribers, chisels, hacksaws, Centre punches, marking out tables etc.
3. Safety equipment :→ these include Overalls, helmets, goggles, Safety boots, first aid box etc.
4. Automobile mechanic's equipment :→ hydraulic screw jacks, battery charging and testing equipment, axle stand, air compressor, battery charging and testing equipment, tyre repair equipment etc.
5. Foundry equipment :→ include patterns, flasks, furnaces, Crucibles,

ladders, tongs, and mullers and sand testing equipments.

6 Welding equipment and consumables: include gas welding equipment, filler rods, fluxes, welding gas lighters, nozzles and mixers, metal-arc welding equipment, electrodes, solders and brazing rods.

A workshop foreman is the manager/supervisor in a workshop.

- The foreman assigns duties and responsible for the monitoring and progress of a project.
- He keeps records of a project on track from time and budgetary standpoint.
- The foreman gives instruction to the workers working under each given production section.
- He ensures that workers are qualified and knowledgeable about their roles and assignments according to skills sets.

Workshop arrangement :- engineering workshops are arranged such that the highest productivity and quality production are obtained. For efficient operations, the following arrangement should be observed.

- The workshop should be free of unnecessary items, hence, it should always be tidy.
- Each item should be placed in its due location.
- Drawing of parts, process charts and jobs slips/ route or function should be displayed on a special post at the workshop
- Splashes, oil, grease should be wiped off the floor.
- A clear path between machines must be kept clear for easy passage.
- Finished work pieces should not be kept carelessly around the workshop rather they should be stacked in the containers intended for transportation.

Workshop Hazard, Safety and Signs (code)

Hazard is any condition which causes actual or potential loss or damage or Undesirable effect on people and property (plant/equipment, raw materials, products, or environment). These hazards could occur at some specific places known as hazard points.

Hazard points are those points within the physical and operating environment that could cause injuries such as moving parts of machinery, working at heights, slippery surfaces and contact with electrical energy, excessive noise, toxic substances, and lifting of heavy objects among several other sources.

Workplace hazards :> are particularly domicile in the work environment. These could be as a result of human inefficiency, machine malfunction, inclement weather disrupts weather change and/or accidental occurrences. Workplace hazard has both short term (Safety implications) and long term (health implications) effects when not put under checks.

Risk, is defined as the probability/chance that exposure to a hazard will lead to negative effect or consequences.

Some Workshop hazard

* Lack of adequate Ventilation & temperature
* Lack of guard (keep watch over) or screens of equipment or around dangerous areas
* Chemical substances in an Uncharted containers
* Incorrect tools use for task
* No Safety Signs, Outdated Safety Signs and broken Safety Signs
* Chemical Splashes
* Electric shocks, burns or fires
* Machinery left Unattended while in use.

Causes of Hazard:

1 Safety hazard refers to circumstances that can cause immediate injury to a worker. Safety injuries are commonly associated with the physical environment. Physical environments that could cause Safety hazards include but are not limited to the following:

1 Machine/Machinery such as

(a) Point of Operation:

(b) Rotary and reciprocating movements
(c) In-running nip point (pinch points) etc.
2. Kick backs from the machine due to sudden impact loading, sudden blow from workload etc.
3. Flying chips, thrown objects etc. Such as flying stone propelled by mower blade etc.
4. Sharp protections from tool edges eg anvil edge, projecting object in load vehicles etc.
5. Fire and explosion hazards.
6. Electric shock, stunning, burn or electrocution as a result of contact with exposed or uninsulated live wire.

2. Health hazards:- are situations associated with long term exposure to certain substances or exposure to excessive noise levels or vibrations. Health hazards can cause both immediate (acute) and long term (chronic) health conditions. Health issues are commonly associated with the operating environment.

Operating environments that could cause health hazards include:

1. Excessive noise
2. Vibration
3. Wood dust
4. Harmful chemicals

Types of Workshop Hazard

1. Physical hazards:- are environmental factors that can harm an individual without necessarily touching them. They include slippery floors, objects walkways, unsafe or misuse machinery...
2. Chemical hazard:- these involved substances which can cause injury or death by being reactive, inflammable, toxic or corrosive such as gases, dust, fumes, vapours and liquids.
3. Ergonomic hazard:- are hazards associated with adverse body condition which results due to poor positioning of the body in relation to the task being performed. These include poor design of equipment, workstation design, fatigue etc.
4. Biological hazard:- involve micro-organism which can cause diseases such as bacterial, fungi and virus.

5. Psychosocial hazard → include bullying/ staff relationship, workload, dealing with public, threat of danger, shift work.
6. Mechanical hazard → include hazards caused by machinery such as vibration, cuts etc.

The following steps are taken to control workshop hazards:-

1. Identify the hazards by carrying out workshop risk assessment
2. Determine how employees may be at risk.
3. Evaluate the risk
4. Record and review hazards at least annually.

Workshop Safety and Signs (CODE)

Safety can be defined as the method of working without harm/injury/damage/danger.

General workshop safety rules.

1. Always remember "Safety and health first" in all you do in the workshop. This is the motto of every students working in the workshop.
2. Always bear in mind if the process is not safe for you, it is not safe for others, so avoid it.
3. Always listen carefully to the teacher and follow instructions.
4. Do not run in the workshop because you could bump into another and cause an accident
5. Always put on appropriate safety wears in the workshop (such as Overalls, helmet, goggles etc.)
6. Always use the correct work method for a process.
7. Do not operate a machine that you are not familiar with unless you have been trained
8. Report any damage to machines/equipment as this could cause an accident.
9. Keep hands away from moving/rotating machinery.
10. Bags should not be brought into a workshop as people can trap over them.
11. Always be patient, never rush in the workshop.
12. Smoking is usually prohibited in the workplace.
13. The workshop floor must be kept clean, all unwanted objects

must be put in their proper places.

14 Isolate machinery that is powered by electricity or compressed air when not in use etc.

Safety Signs and colours.

colours play an essential safety role in giving information for use in the prevention of accidents, for warning of health hazards, identification and safety use of cables and components in electronic and electrical installations as well as the correct use of fire-fighting equipment.

N.B The purpose of a system of safety colours and safety signs is to draw attention to objects and situation which affects or could affect health and safety.

	Safety colour	Meaning	Examples of use
*	Red with white background colour with black symbols	Stop/prohibition (Don't do)	- Stop Signs - emergence stops - Prohibition Signs.
*	Red with white symbols and text	Fire equipment	- Position of fire equipment. - alarms, extinguishers etc
*	Yellow with, black symbols and text	Hazards (risk, danger)	- Indication of hazards (chemical, explosive, radiation, chemical, Vehicle etc - Warning of threshold, low passage, Obstacles
*	Green with white symbols and text	Safe condition (the safe way)	- Escape routes - Emergency exist - Emergency showers - First aid and rescue stations
*	Blue white symbols and text.	Mandatory action (Must do).	- Obligation - to wear personal safety equipment.

⇒ Diagrams ⇒ Pdf.

First Aid in Accidents

First aid is an immediate treatment given to an accident victim, using the facilities or materials available at the time before proper medical attention maybe provided

First Aid Box: The contents of the first aid box should include the following items: Cotton wool, iodine, pair of scissor, forceps, clinical thermometer, band for dressing, bandage, plaster, splints, embrocation, Ointment, Safety pin etc.

First aid treatment for Cut and Bruises.

1. Wash the wound generously with clean water in order to remove foreign matter.
2. Clean the wound with diluted antiseptic solution or a tincture of iodine.
3. Give the injured part of the body as much rest as possible.
4. If the cut or bruises is severe and internal organs are affected, the victim must be carefully placed on a stretcher or bed after loosening or removing all tight cloth and send for the doctor immediately.

First aid treatment for Burns

1. Immediately get the person away from the heat source to stop the burning.
2. cool the burn with cool or lukewarm running water or place a Sodium bicarbonate per glass of water on the burn. Don't use ice, iced water or any creams or greasy substances.
3. If a person catches fire, quickly smother the burning clothes by covering the victim, with some thick clothing. Example blanket which has to be pressed against the body in order to extinguish the fire.
4. Douse the victim and the clothing with lukewarm water
5. Send to a doctor.

First Aid Treatment for Carbon monoxide poisoning

1 Remove the victim from the contaminated area into fresh air.
2 Make the victim smell some ammonium hydroxide
3 If breathing is irregular/sore/ has stopped completely, apply artificial respiration continue it for a long time until the doctor takes over.

First Aid Treatment for fractured bone

1. Place the victim on a Stretcher Or on the ground and bandage the fracture with Splints made of boards. This will prevent the ends of the fractured bone from shifting and it will ease the pain
2. Broken arms should be treated the same day but there is no need to put the victim in a Stretcher.
3. Immediately, Seek medical attention.

First Aid Treatment for Electric Shocks: Shocks through touching a bare electric wire my Cause Cramps in the arms and inability to let go of the wire. Severe Shocks may result loss of consciousness, weak pulse and Shallow breathing which Sometimes may even cease completely. The following actions should be taken when Someone has Suffered an electric Shocks.

1. Firstly, Cut off the Current either with the Switch or by cutting the electric wires with a dry wooden-handled or a plastic handled tool Such as an axe, insulated pliers machete etc.
2. If the victim is Unconscious, place him/her on his back, loosen all his clothes, Open all the doors and windows and Send for the doctor immediately.
3. While waiting for the doctor's arrival, apply artificial respiration to the victim whether he/she shows Sign of life or not.

Protective Wears in the Workshop.

1. Overalls
2. Safety Shoes Or boots
3. Helmet
4. Goggles
5. Earmuffs
6. Hand gloves
7. Respirators are devices worn over the nose and mouth to allow breathing in a polluted atmosphere. Such as dust, Smoke, Carbon-monoxide, etc.
8. Safety belts: belts worn when working at heights on ladders Scaffold etc. Such that if Slip is made while working, to prevent falling from Such height.

* Casting is the oldest form of manufacturing.
* How to prepare/design a mould for investment casting.
Extrusion machine — PVC
Injection moulding process - hanger.
? Welding
- Electrical energy → Arc welding
- Chemical energy — Gas welding.

Introduction to Basic Manufacturing Processes.

Manufacturing includes taking raw materials to finished product which can be used for various purpose. While manufacturing processes are steps or sequences of operations through which raw materials are transformed into a final products by using human effort or machines. Manufacturing process can also be described as that part of the production process which is directly concerned with the change of form or dimensions of the part being produced.

The process of manufacturing begins with product design and material specification from which products are made.

Manufacturing processes are broadly classified into five namely

- Casting
- Metal forming (forming process)
- Machining (Material removal)
- Joining
- Moulding

Casting process:- Casting is a manufacturing process in which a liquid metal is usually poured into a mould which contains a hollow cavity of the desired shape and then allowed to solidify. The solidified part is known as casting. These shapes can be used in a wide range of applications including automotive components, aerospace parts, electronics, mechanical devices and construction supplies. The workplace where castings are produced is called a foundry workshop. Casting processes are classified as follows:-

- Sand Casting
- Die Casting
- Centrifugal Casting

- Investment Casting:

Sand Casting :- is a Casting process that involves the use of furnace, metal pattern and Sand mould. The metal is melted in the furnace and then ladled and poured into the cavity of the Sand mould which is formed by the pattern. It is done with adequate proportion of clay (as a binder material) to keep the Sand grains together. Surface of the Sand castings is normally rough with surface impurities for which a machining allowance is included.

Die Casting :- Involve pouring molten metal into a steel/metal mould called die. The mould also known as tool or dies, which is specially designed for each project. It can produce complex metal parts.

Centrifugal casting :- Can also be called rotocasting. It is a metal casting process in which a molten metal is poured into a mould while it is rotating about an axis at a high speed thereby using centrifugal force to form cylindrical parts. Here, the molten metal is poured into a preheated spinning die.

Investment Casting :- is one of the oldest manufacturing processes that is used to produce castings of any intricate shape with very fine surface finish and accuracy. It is a casting process in which molten metal is poured into an expendable ceramic mould. The mould used for investment casting is formed using a "wax pattern". The wax pattern is coated with refractory ceramic material.

Metal forming Manufacturing process :- is a manufacturing process in which metal is deformed (undergo plastic deformation) into required shape by application of suitable stresses. Some of the commonly used forming process in the manufacturing industry are:

* Forging
* Rolling
* Extrusion
* Explosive forming etc

Machining manufacturing Process :- Machining is a metal removal process in which cutting tool removes unwanted material from a work piece to produce the desired shape. Machining processes

include turning, drilling, shaping, grinding, etc.

Joining process: Joining is a process whereby two or more parts are brought together either permanently or temporally in order to give desired shape or act for a particular function. Joining of any two components together can be done with the help of the following operations: Welding, brazing, soldering, adhesive joining, fastening etc.

Note that welding, brazing, soldering and adhesive joining can produce permanent joints while fastening generally produce semi-permanent or temporary joints.

Moulding process:→ moulding is a manufacturing process of non-metallic materials in which a machining operation is not required. Example, household plastic components such as bottles, toys, water, tanks, buckets etc. Different moulding processes are:

* Injection moulding: Wall hanger, bottle caps, plates etc.
* Blow moulding: → used in producing bottles
* Compression moulding: → car tyres, boat hull
* Rotational moulding: → Shipping drums, storage tanks, (hollow shaped objects)
* Extrusion moulding: pipes for plumbing work.

Bench work and fitting

Bench work denotes the production of an article (i.e components) by hand on the bench. Generally it can be defined as the work performed on the bench. While, Fitting is the assembling together of metal parts through removal of metal to secure the necessary fit or to obtain the required fit. The two types of work require the use of a large number of hand tools and other devices or equipment. The operations of fitting are usually carried out on the bench. Also the person working in fitting shop is called FITTER.

Bench work and fittings tools.

1. * Holding tools: → also known as work holding devices in the bench work/fitting workshop. They are used to hold all types of components between jaws (fixed jaws and movable jaws). Various work holding devices or tools are:

- Work bench :-> is a sturdy table at which manual work is done. It is used to hold various components on its surface. Also, it gives support to human while performing various operations.
- Bench Vice :-> is a tool used to hold a workpiece rigidly. It can also said to be a device which is used to hold the specimen or workpiece between the two jaws.
- Pipe Vice :-> is used for holding circular/cylindrical component such as tubes, pipes etc.
- Hand Vice :-> is designed to hold/grip workpiece in between the jaws of the bench vice. It is basically used for gripping workpiece which are to be conveniently held in the bench vice.
- Tool Maker's Vice :-> is used for holding small work which requires filing or drilling.

* Marking Out tools :- are tools used to mark the given measurements on the surface of the workpiece. Types of marking out tools are :

- Scriber :-> is a steel tool used to scribe or mark lines on metal workpiece. It can be used in conjunction with a try square.
- Punch :-> is used for marking out work locating centres. There are various types of punch used in fitting workshop. These are:
  - Dot punch :-> is used to specify the path of cutting. Marked path with a scriber and with the help of Dot punch, the path is hitted by hammer.
  - Prick punch :->is used to make small punch marks on layout lines in order to make the mark last longer.
  - Centre punch :-> is mostly used only to make the prick punch larger at the centres of holes that are to be drilled.

* Measuring tools :- are tools used to measure any component with respect to the dimensions. Measuring tools used in the fitting workshop are as follows:

- Steel rule and measuring tape.
- Surface plate
- Try Square
- Inside Calliper
- Divider
- Outside Calliper

done.
- Odd leg Callipers
- Vernier Callipers
- Micrometers Screw gauge.

Diagrams :-> Pdf.

Units of measurement

* Metric System (C.G.S) -> Centimetre - grams - Seconds
Length is measured in Centimetre (cm)
Mass is measured in grams (g)
Time is measured in Seconds (s)
* S.I System (M.K.S) -> metre - Kilogram - Seconds.
Length is measured in metre (m)
Mass is measured in Kilogram (kg)
time is measured in Seconds (s)

- Steel rule and measuring tape :-> is an instrument, in geometry which is used to measure the length, breadth and height of the given workpiece. Measuring tape is the flexible form of ruler that is calibrated in mm, cm and inches.
- Surface plate :-> is used for testing the flatness of workpiece. It is used as the main horizontal reference plane for precision inspection marking out etc. It is more precise than the marking table.
- Try Square :-> It is used for marking and checking right angles (flatness and squares) of given workpiece.
- Inside Calliper :-> It is to measure the internal size of an object.
- Outside Calliper :-> is used measure the external size of an object.
- Divider :-> is tool used for marking circles, arcs, laying out perpendicular lines bisecting lines etc. On a given workpiece/specimen.
- Odd-leg Calliper :-> is used for marking parallel lines from a finished edge and also for locating the centre of round bars.
- Vernier Calliper :-> is an instrument used for measuring both inside and outside diameters of a workpiece. It measures internal dimension, outside dimension and depth.
- Micrometres :-> is used to measure dimensions like diameters only. That is it is used to measure the diameter of the given specimen only. It is not used to measure the depth of an object which can be done by Vernier depth.

4. * Cutting tools :-> are tools used to cut the given specimen / workpiece with respect to the given dimension. The cutting tools used in fitting workshop are:
- Hacksaw :-> is used for cutting metal
- Chisels :-> are used for removing surplus metals and cutting thin sheet. Also, chisels can be used for cleaning corners of a workpiece and cutting small holes.
- Twist drill :-> is used for making holes in a metal.
- Tap (Taps wrenches) :-> is used to cut threads on the inside of a hole of bolt and nuts (i.e. to cut internal threads in cylindrical holes).

5. * Finishing tools :-> are tools used to remove the material from the surface of the workpiece in order to get a high surface finish. Examples of finishing tools are:
- Files :-> they are used to remove the material by rubbing on the metal (workpiece) to get a good surface finish. Files can also be used to cut, smooth or fit metal parts.
- Striking tools :-> are tools used to strike or hit the workpiece by application of external force. Example is hammer.

Various Operation commonly performed in bench work and fitting workshop are:
* Chipping
* Filing
* Scrapping
* Sawing
* Marking
* Drilling
* Reaming
* Tapping etc.

Safe Practice in Bench work and Fitting Shop.
1. Keep hands and tools clean and free of dirt, oil and grease.
2. Do not carry sharp tools inside the pockets.
3. Wear leather shoes and not sandals.
4. Don't wear loose clothes
5. Do not keep working tools at the edge of the table.
6. Position the workpiece such that the cut to be made is close

to the Vice. This prevents Springing, Saw breakage and personal injury.
7. Apply force only on the forward (cutting) stroke and relieve the force on the return stroke while Sawing and filing.
8. Do not hold the workpiece with hand while cutting.
9. Use the file with a properly fixed tight handle.
10. After filing, remove the burrs from the edges of the work, to prevent cuts to the fingers.
11. Do not use Vice as an anvil.
12. While Sawing, keep the blade straight; Otherwise, it will break.
13. Do not use a file without handle.
14. Clean the Vice after use.

Machining

Machining is a term used to describe a variety of material removal processes in which cutting tool removes unwanted material from a workpiece to produce the desired shape. Machining can be used to create a variety of features including:→

- Holes
- Slots
- Flat Surfaces
- Complex Surface Contours.

Lathe Machine and Lathe Machine Operations

Lathe machine is single point cutting tool machine which removes the metal from a rotating piece of work to generate the required cylindrical and desired shape and size. This machine is mostly used in performing work such as metal working, metal spinning, thermal spraying, glass working and parts reclamation.

Types of Lathe machine.

* Engine/Centre lathe machine: This is the most common form of lathe machine.
* Bench lathe machine.
* Speed lathe machine.
* Tool room lathe machine.
* Capstan and turret lathe machine
* Automatic lathe machine (computer controlled lathe machine).

Diagram:→ Lathe machine Operations.

Some major parts of lathe machine.

* Bed :→ is the base on which all other parts of lathe machine are mounted.
* Headstock :→ transmit power to the different parts of lathe machine. The headstock contains the high precision bearing which hold the horizontal axle known as spindle.
* Tail stock :→ is used to apply support to the longitudinal rotary axis of a workpiece as it is being machined.
* Carriage :→ is located between headstock and tailstock and it holds the tool in both cross and longitudinal directions. Also, Carriage contains some other parts of lathe machine such as apron, cross slide, compound rest and tool post.

Chip pan :→ this collect the metal chips while operation is going on.

* Spindle :→ is a hollow horizontal axle with interior and exterior thread by which workpiece can be mounted on.
* Legs :→ is used in holding the lathe machine and in elevating the lathe bed to working height.
* Feed rod :→ is a power transmission mechanism which provide precise longitudinal movement of the carriage.
* Lead screw :→ is found just between the feed rod. It also provide precise longitudinal movement to the carriage. It engage in thread cutting operation.
* Tool post :→ is used to hold the tool on correct position.

Chuck :→ is used to hold the workpiece.

Various lathe Machine Operation.

* Facing :→ is a process of making a flat surface on a lathe machine.
* Turning :→ is the operation of lathe machine which can be of many kinds such as rough turning, shoulder turning, taper turning, eccentric turning etc. Generally, it is operation that removal of metal takes place from the surface of the cylindrical workpiece. It removes metal from the outer diameter of a rotating cylindrical workpiece.

1.
2.
3.
4.
5.

Straight turning :→ can be called cylindrical turning is the process of reducing workpiece diameter to a specific dimension as the carriage of the lathe machine moves the tool along the workpiece.

- Step turning :-> is a process where excess material is removed from workpiece to obtain various steps of different diameter and shapes.
* Chamfering :-> is operation of giving a bevelled (i.e. Surface that slopes away from horizontal or vertical) Surface on the edge of a cylindrical workpiece. This operation is done in terms of both end shafts end.
* Grooving :-> is the process of reducing the diameter of a workpiece over a very narrow surface.
* Knurling :-> is a lathe machine operation used to obtain a diamond shape on a work use for gripping purpose.
* Threading cutting :-> is an operation performed on lathe machine to produce a helix (spirally) shape grooved workpiece.
* Drilling :-> is an operation of producing a cylindrical hole in a workpiece. It is done by a rotating tool, the rotating side of the cutter known as drilling drill (making holes in the workpiece with the help of drill tool(s)).
* Boring :-> is an operation of enlarging the hole which is already drilled, punched or forged.

Principle of Metal joining

The term joining in manufacturing includes various processes such as:

1. Welding
2. Brazing
3. Soldering
4. Mechanical fastening :-> metal parts joined together by making holes on them and fasteners are inserted through them.
5. Adhesive bonding :-> is a method in which filler materials in form of liquid called adhesive are used to hold two or more closely packed parts together by surface attachment.

Classification Of metal joining methods.

1. Permanent joints:-> Examples are joints made by welding, brazing, soldering, riveting, adhesive bonding etc.
2. Detachable joints
   (a) Detachable rigid joints which include joints made by screw, thread, keys, cotters, pins etc.
   (b) Detachable flexible joints:-> examples are knuckle joints, flexible couple, Universal joints etc.

Metal joining methods mostly used in industries are generally grouped under the following four categories:

* Welding
* Joining by metal deposition i.e brazing and soldering.
* Mechanical fastening
* Adhesive bonding.

Welding

Welding is the method of joining metals/materials by application of heat with or without the use of solder or any other metal or alloy having a lower melting point than the metal being joined (the base metal)

Welding produces coalescence (union) of metals by heating them to the welding temperature, with or without the application of pressure or by application of pressure alone and with or without the use of filler.

Welding can be explained as a process of joining together pieces of metal by bringing them into intimate proximity and heating the places of contact to a state of fusion or plasticity.

Welding process are broadly classified into two groups.

(a) Fusion Welding
(b) Solid state/pressure Welding

Fusion Welding

This is a type of welding in which the welding area of a metal or material to be joined together is heated by concentrated source of heat to a molten state and filler metal is usually added to the weld. The concentrated source of heat during fusion welding aids the coalescence of the metal to produce a solidification.

The source of heat in fusion welding is either electrical or chemical energy. Based on source of heat, fusion welding is grouped into:
(a) Arc welding
(b) Gas welding.

Fusion welding using electric energy are formally called electric arc welding and they are grouped based on the mode of operation and application of heat. They include
1. Shielded metal arc welding (SMAW)
2. Submerged arc welding (SAW)
3. Gas metal arc welding (GMAW)
4. Gas tungsten Arc welding (GTAW)
5. Flux cored arc welding (FCAW)

Fusion welding using chemical energy are called gas welding and those which are popular use in industries are
1. Oxy-acetylene welding (OAW)
2. Air-acetylene welding (AAW)
3. Oxy-hydrogen welding (OHW)

Arc welding :-> is a fusion welding process where coalescence of workpiece is produced by melting the surface to be joined with heat energy (electric energy) obtained from alternating current (A.C) or direct current (D.C), flux or inert gas (e.g Argon, CO_2, helium) etc. Electric arc struck between the workpiece and electrode (consumable or non-consumable) with or without the addition of filler metal and with or without the application of pressure. Among the types of arc-welding, shielded metal arc welding is the most widely used welding process.
Diagrams :-> Pdf

Shielded metal arc welding (SMAW) :-> employs the heat of the arc to melt the base metal and the tip of a consumable covered electrode. Here, the circuit begins with the electrode power source either from transformer or generator and includes the welding cables, an electric holder, a workpiece connection, the workpiece and an arc welding electrode. One of the two cables from the power source is attached to the work. The other is attached to the electrode holder. Welding commences when an electric arc is struck between the tip of the electrode and workpiece. The intense heat of the arc

melts the tip of the electrode and surface of the work close to the arc producing the joint, hence a joint weld is produce.

Gas Welding :- is a method of fusion welding processes that uses the heat produced by gas flame (combustion of gas) for melting the base metal and filler metal is employed in the process of welding the workpiece together. The gas flame which is acetylene or hydrogen and oxygen are mixed in proportion in the gas torch and delivered to the welding torch tip where they are ignited and flame formed is used to melt the base metal and the filler metal.

Principle of Operation of Oxy-acetylene Welding, the ignition of Oxygen and acetylene gases mixed in a blow pipe fitted with a nozzle of suitable diameter. This flame is applied to the edges of the joint and to a wire filler of the appropriate metal which is thereby melted and run into joint. When the acetylene is burned in an atmosphere of Oxygen, an intense hot flame with a temperature of about 3300°C is produced.

Solid State Pressure Welding :- Solid state welding involve heating of metallic parts only to plastic or slightly fused state and forcing them together with external pressure. Solid state welding processes are applied to metals which are capable of being brought to plastic deformation state by heating or due to the action of external forces.

The popular welding processes coming under the solid state welding are as follows:

1. Resistance Spot Welding (RSW)
2. Resistance Seam Welding (RSEW) (commonly used in industries for joining sheet metal parts)
3. Projection Welding (PW)
4. Flash Welding (FW)
5. Upset Welding (UW)

Resistance Welding :- is a group of solid state welding processes in which joint is produced at the contacting surface by the heat generated due to the resistance of the applied force during and after the application of current to confine the weld contact area at the faying surfaces.

Two resistance welding that are commonly used in

industries are
1. Resistance Spot Welding
2. Resistance Seam "

Resistance Spot Welding: (Principle of Operation)

In RSW, two sheet metal pieces are kept one over the other and joined in one or more spots by the heat generated due to resistance to flow of electrical current through the workpieces. The sheet metal pieces are held together in contact under force by round electrodes. The contacting surface in the region of current concentration are heated by short time pulse of low-voltage, high amperage current to form a fused region of weld metal. The interface between the two sheets offers maximum resistance to the flow of current, the interface melts and consequently solidifies under pressure of the two electrodes, thereby joining the two sheets of a spot that was under two electrodes.

Resistance Spot welding has.

(a) High speed welding process
(b) Adaptable for automation in large rate production of sheet metal assemblies
(c) It is economical in job shop operation
(d) Less operator skill is required e.t.c

Resistance Seam Welding - Principle of Operation:

This is modification of resistance spot welding. In resistance seam welding process, the cylindrical electrodes of spot welding are replaced by electrically conducting wheel or roller electrode and continuous A.C low voltage power supply to produce overlapping spot weld. Here, series of spot welds in a row with a seam welding machine are made without removing the electrode force between welds.

Resistance seam welding uses rotating wheel electrodes which roll the overlapping components between them. The welding current passes intermittently through the electrodes, forming a series of welds that overlap one another.

Seam welds are typically used to produce gas or liquid-tight joint in sheet assemblies such as automotive gasoline tanks. Leak-proof or air tight vessels components are joined by

resistance Seam welding process.

Nuggets is a molten metal that quickly cools and solidifies into a sound joint formed from the welding of overlapping pieces of metal or small joints by application of pressure and electric current.

Old welding processes

These are welding processes which are coming under either fusion or solid state welding but at the same time not very commonly used in industries. They include:

1. Forge welding
2. Carbon arc welding
3. Atomic hydrogen welding
4. Thermite welding
5. Electron slag welding
6. Stud welding
7. Bare metal arc welding.

Modern welding processes

Modern methods which are recently discovered and applied generally for special purposes are called modern welding processes. They include:

1. Electron beam welding
2. Plasma arc welding
3. Laser beam welding
4. High frequency welding
5. Percussion welding
6. Electron gas welding
7. Friction welding
8. Cold welding
9. Diffusion welding
10. Explosion welding
11. Ultrasonic welding.

Note, each of them differ according to the way they produce coalescence of material through method they obtain heat and material contact.

Brazing processes

Brazing is a metal deposition joining method that uses brass as joining medium. It is a metal joining process in which joint or coalescence is produced by heating the component to a suitable temperature above 450°C and below the solidus of the base metal, and inserting a filler metal (brazing alloy) at the joint which has a melting point below that of the base metal. The filler metal is distributed between the closely fitted surface of the joint in a molten state by capillary attraction.

Brazing procedure:- the process of brazing is carried as follows.

The surface to be joined are thoroughly clean. Then a paste made of flux and spelter (the brass used in making the joint) is kept in the joint, the joint being held in position by suitable clamp and jogs. The flame is directed over the joint held on fire brick piece. The flux and spelter will melt and fill the recess between the joints. The liquid is spread uniformly over the joint either with a pointed wire piece or by moving the jet or flame circular over the joint. The work is removed from the clamp after it is cooled

OR

The surface to be joined are thoroughly cleaned first with either solvent cleaning, vapour degreasing, alkaline emulsion etc. the type of the cleaning reagent depends on the type of coating or scale of surface. The surface to be brazed and the surrounding areas are coated with flux (flux is a chemical reagent for cleaning metal prior to soldering or welding. The aim of flux is to remove oxides from the base material and to prevent oxidation during heating process).

The fluxed parts are preheated almost nearer to the brazing temperature. The brazing filler metal is added in the joint gap and heated to melt at the brazing temperature, when the filler metal is converted to liquid form, it fills the joint by wetting then which it will later allow to solidify to form a joint. After solidification, the flux grains are removed by washing vigorously in hot water.

Brazing is used where a ductile joint is required which will not have only good strength but are able to withstand higher service temperature than soft soldered joints. In brazing process, metallic parts are joined by a non-ferrous filler metal alloy.

Advantages

1. The process of brazing is economical for complex assembling of components.
2. The method is a simple way to join parts with large joint areas
3. Excellent stress and heat distribution is obtained
4. Dissimilar material or non-metals can be joined by brazing etc.

Soldering processes.

Soldering is an operation of joining two or more parts together by molten metal. It is a group of joining processes that produce joint of materials by heating them to the soldering temperature and by using a filler metal (solder) having a liquidus temperature not exceeding 450°C and below the solidus of the base metal. Soldering is extensively used to make electrical connections, joining of lead pipe and copper tubing repair works.

It is a quick method of making joints in light articles made from steel, copper and brass and for fine joints. Soldering should not be used where joint will be subjected to vibration or heat as solder is comparatively weak and has a low melting point.

Soldering procedure.

1. Pre-clean the surface of workpiece, remove all traces of grease, oil, wax etc.
2. Coat the surface with appropriate flux sufficiently in the soldering area.
3. Take a blob of solder on the bit of the hot soldering iron and allow to run down the filling the recess of the joints for light work. Bring the molten solder in contact with the soldering region and heat the joint thoroughly to 55°C to 80°C above the melting point of the solder alloy so that the solder flows to the joining by capillary action.
4. Wipe off excess of solder with a piece of felt or cotton waste.
5. Leave the joint to cool to room temperature without disturbing the alignment.

Soldering method.

1. Soldering iron method.
2. Torch soldering method.

3 Dip Soldering method
4 Furnace Soldering method
5 Resistance soldering method
6 Inducting soldering method etc.

Advantages.

1 It has a low temperature process, hence, has minimum effect on the base metal.
2 High joint reliability can be obtained with carefully controlled procedures
3 The process is economical and less investment is required.
4 The low temperature for joining requires little energy input etc.

Auto-mobile 13/10/22.

What is Automobile?

Auto → movement
mobile → Self propell

Automobile is a machine or device that is Self-propelled through internal combustion engine (IC) that is used to move passenger or goods from one place to another on ground.

Types of Automobile

* Car
* Tricycle
* Motorcycle.
* Tractor
* Bus
* Truck.
* Trailer
* Jeep
* Scooter
* Tractor

Automobile engineering is a branch of engineering that uses internal combustion Engine through spark ignition, mixture of fuel and air through Self propelled,

Branches Of automobile:

* Machine part
* Carriage part (body part)

Engine is the power source of Vehicle. The power is transmitted from the clutch to the shaft.

Parts of Vehicle:

1. Steering
2. Ignition System
3. Steering rack/beam
4. Clutch
5. Brake (middle)
6. Accelerator (right)
7. Emission
8. Radiator
9. Engine block
10. Battery
11. Alternator
12. Exhaust
13. Shaft head – ball joint, knuckle joint, Shaft head
14. Gear box

In an engine, there is what we call the full System, also the ignition System, the lubricating Unit, cooling Unit.

Ignition timing simply means to maximize the power of the engine.

Assignment.

Exam: What are the factors affecting ignition timing?

What is a full System?

A full System is a process where there is a spark (ignition) and an air/fuel mixture which causes pressure or torque that causes the pistons to move.

Lubricating Unit.

A lubricating Unit is present to avoid part failure. It reduces wear and tear, thereby increasing the efficiency. It also increases the life expectancy of that device/product.

Lubrication is the use of Oil to reduce the friction between the components in order to increase efficiency.

The cooling Unit/Systems.

The radiator is a component of the cooling Unit.

Exam => List 5 components that may cause Overheating

1. No water in radiator
2. Cooling fan not working/functioning
3. The pulley System failing.
   The pulley System is failing.
4. Water pump failure.
5. When the Oil level is low

Factors affecting ignition timing:

- Compression ratio
- Engine speed and load
- Quality of fuel used
- Mixture Strength.

- Cylinder Stroke
- Engine temperature.

Exam ⇒ What are the factors affecting ignition time.

Assignment

Form a term paper

Topic :-> Wood (What is Wood?)

Name :->

Mat no :->

Course lecturer

Abstract :->

1-1 Introduction (definition, history, types etc)
1.2 Classification
1.3 Advantage or disadvantages
1.4 Uses/Applications
1.5 how it is Salvaged (how to mitigate errors)
1.6 Conclusion
1.7 Reference.

Exam ⇒ How can lubricating increase Efficiency

Factors affecting ignition timing.

1 The timing of the intake valve(s) or fuel injector(s)
2 The type of ignition System Used
3 The type and condition of the spark plugs,
4 The contents and impurities of the fuel
5 Fuel temperature and pressure
6 Engine Speed and load
7 Air and engine temperature
8 Turbo boost pressure.
9 Intake air pressure.
10 The components Used in the ignition System
11 The settings of the ignition System components.

Components that may Cause Overheating.

1 Damaged radiator
2 Bad hoses
3 Low or Contaminated Coolant
4 A damaged Water pump

15. A Malfunctioning thermostat

Lubricating increases the efficiency of a machine by reducing the friction between the moving parts so the energy that is lost as heat due to friction is reduced.

3.

Maintenance. 19/10/22.

A maintenance is the process of putting the factory or the machine or equipment into a Serviceable condition.

Why do we maintain equipment, machine or automobile?

When there is a breakdown in production, it is called idle time or downtime (i.e the time at which machine is not functioning).

We maintain so as to give durability to the equipment (prolong the life expectancy). Also to avoid breakdown.

Types of maintenance.

1. Corrective maintenance (Breakdown maintenance)
2. Preventive maintenance
3. Predictive maintenance (Forecasting maintenance, Prognostic maintenance)

Corrective maintenance:→ is the process where the equipment have broken down completely. It is an Unplanned ambition of maintaining our equipment (bringing it in a Serviceable Condition)

Preventive maintenance:→ is a measure put in place to correct any Unforeseen problem in your device/machine. It means putting down the equipment in right proportion before any problem should occur.

⇒ Who Carry Out maintenance work?

The most competent, skilled and experienced (Knowledgeable) person should do it

Predictive maintenance:→ means you are predicting (Forecasting) if proper maintenance is not Carried Out, the equipment will breakdown. It discusses the Operational parameters that will lead to the failure of the machine

Operational parameters that can lead to the failure of the equipment

1. Temperature
2. Pressure

3. Vibration.

Corrective maintenance :→ simply means fix it. Varieties.

* Maintenance is an act of inspection.

When and when should we carry out maintenance?

1. Break period
2. Public holiday.

Why :→ They want to maximize profit, instead of stoping work (No cash inflow).

3. Free (leisure) period.

Why we carry out maintenance:

Course
In the ~~case~~ of design of the machine or the course of the production, there is a design error, it is advisable to carry out a routine check.

* Why do we consider ~~temperature during~~ when designing an ~~eq~~ equipment.

Environmental factor

At what condition should we carry out maintenance.

1. When the performance of the machine is not efficient.
2. We should carry out maintenance periodically (from time to time)
   - We carry out maintenance so as to maximize efficiency.

A Corrective maintenance is fix it variety (there is failure) while preventive maintenance is not fix it variety (there is no failure).

Reasons why we should carry out maintenance.

1. For the equipment to be in a serviceable condition
2. To reduce production loss
3. To reduce fixed asset of the organization.

When a generator is ~~jerking~~ jerking.

* Check the oil level
* Carburetor (as a result of impurities).
* Bad or contaminated fuel
* Blockage of fuel hose.

Factors affecting ignition timing

* Compression ratio :- is the ratio between the Volume of the Cylinder and combustion chamber in an Internal Combustion engine at their maximum and minimum Values. The increase in Compression ratio develops the flame speed due to increased temperature of Cylinder gases which results in retarded maximum brake torque (MBT) ignition timing.
* Engine speed and load :- As the engine speed (RPM) increases, the time available to burn the mixture decreases but the burning itself proceeds at the same speed, it needs to be started increasingly earlier to complete in time. Poor Volumetric efficiency at higher engine speeds also required increased advancement of ignition time.
* Quality of fuel used :- In using higher grade of Octane in an engine with lower Creatinine, the ignition delay will be longer and the speed of the flame will be shorter causing reduction in total power output. Hence, future testing of fuels with low Research Octane number (combustibility of engine fuel at low speeds and temperatures) rating for this type of lower engine design may give better performance output.
* Mixture strength :- refers to the ratio of air to fuel. The air-fuel mixture will have less burn time, resulting in Unburned fuel being ~~ej~~ ejected into the exhaust. This effect becomes more pronounced as the cam timing is retarded more and more to the point where the spark will no longer ignite the mixture.
* ~~Cylinder~~ Cylinder tube :- In a reciprocating engine, the cylinder is the space in which a piston travels, propelled to the energy generated from the combustion of the air/fuel mixture in the combustion. It is pressure-tight, air tight and can conduct heat, thereby maximizing the ignition timing.
* Engine temperature :- If the air and fuel mixture is ignited too soon in the combustion process, the heat generated will increase. This can damage different parts of the engine due to overheating. Also ignition timing that is retarded too far can results in the spark plug igniting the mixture too late, this is as a result of low powers.

⇒ In Quality of fuel used :- the contents and impurities of the fuel

affect the ignition timing.

* The condition of the components used in the ignition system:
The basic components in the ignition system are storage battery, an induction coil, a device to produce timed high voltage discharges from the induction coil, a distributor, and a set of spark plugs, this components affect the ignition timing.

Automobile

The modern automobile, in general, is essentially a transportation equipment unit. It consists of a "frame" supporting the "body" and certain "power developing and transmitting Units" which are further supported by "tyres" and "wheels" through "springs and axles".

An engine supplies the power, which is delivered by the "transmission systems" to the wheels through the clutch or fluid coupling.

Machine part/portion:- Every automobile irrespective of its country of manufacture or model consists of the following three basic Units.

(i) The chassis and transmission
(ii) The IC engine
(iii) The electrical equipment.

Chassis: This part of the automobile supports its body, engine and transmission system.

The automotive chassis includes the following:

i) The frame
ii) Springs and shock absorbers.
iii) Brakes
iv) Tyres and wheels.

Transmission:

This Unit transmits the power from the engine to the wheels.

It consists of the following:

1. Clutch
2. Gear box
3. Universal joint
4. Final drive
5. Axles and differential.

The Engine :- An engine is an automobile is the source of power. A petrol engine consists of the following five basic System:

i) Fill System :- This System mixes petrol with air in the right proportion to give a mixture which when burnt produces pressure. This pressure is then used to move the pistons.

ii) Ignition System :- This System of the engine provides regular sparks to set fire to the mixture coming from the fuel System.

iii) Lubricating System :- This System lubricate the moving parts of the engine so that they can work smoothly.

iv) Cooling System :- This System with the help of water cools the engine and prevents it from getting hot.

Refrigeration

26/10/22.

Refrigeration is the absence (removal) of heat from a surrounding or an area.

⇒ Oliver Evans :- designed the first blueprint of Refrigeration System in 1802 while in 1834 Jacob Perkins (remodified) and by 1913, the one that are safe to use at home were invented.

Heat is a form of energy by virtue of difference in temperature, it can be created and it can also be destroyed and heat travels in one direction.

Cold :-

This is the lack of heat in an environment or a state where heat has been removed from a substance, object etc.

Mechanical refrigeration is the utilization of mechanical components arranged in a refrigeration System for the purpose of transferring heat.

In a refrigerating component we have; the compressor, the refrigerant, the condenser and they come in form of a high pressurized vapours. The evaporation Units are the collector tubes which transfers air. The refrigerating components are Suction pipe, Water collector, Freon or refrigerant charging point, condensing Unit, Vaccum application point, Capillary tube, evaporator or collector Unit and the Accumulator which is usually in copper/aluminium.

N.B Copper has more heat transfer coefficient but is heavier and more expensive compared to aluminium which is lighter.

Air Conditioning is the treatment of air simultaneously so as to control its temperature, moisture content, cleanliness, odour and circulation, as required by occupants, a process or product in the space.

It was discovered by Willis Haviland Carrier in 1902 and the purpose was to both cool a room and reduce humidity though originally created to keep moist air in a printing plant from shrinking magazine pages.

The working principle of an air conditioner is the same with the refrigerator.

Refrigerant are chemical compound that are compressed and condensed into a liquid and then permitted to expand into vapour or gas as they are pumped through the mechanical refrigeration system to cycle.

Refrigerant evaporate and boil at low temperature, even lower than water which permit them to extract heat at a more rapid and save than water.

The refrigeration cycle is based on the long known physical principle that a liquid expanding into a gas extracts heat from the surrounding substance or room.

⇒ leakages that occur in refrigerator system are caused by clogging

Strange noises from the refrigerator can be as a result of stoppage of the refrigerator fan.

Maintenance.

Maintenance is required in factories to

i) Keep plant in a serviceable condition so that stock of the appropriate quality is produced.
ii) Preserve the fixed assets in a satisfactory condition.
iii) Reduce the cost of lost production due to plant breakdown.

The work of the maintenance department ranges from major overhauls and replacement of faulty parts to routine servicing and cleaning.

Terotechnology is concerned with the complete responsibility for physical assets from installation to replacement, including those aspects of equipment design that affect durability and maintenance. Diagram of Terotechnology Concept → Pdf.

Economically the goal of any well run maintenance organisation is to have the lowest cost of the two quantities, that is;

a) Maintenance labour and material, and
b) Production loss cost resulting from an inadequate maintenance programme.

Diagram of Maintenance Optimisation — Pdf

The primary functions of maintenance include:

1 Maintenance of existing plant equipment.
2 Maintenance of existing plant building and ground (land)
3 Equipment: Statutory inspection and lubrication.
4 Utilities generation and distribution.
5 Modification of existing equipment and buildings.

The Secondary functions include:

1. Stock keeping
2. Plant protection including fire,
3. Waste disposal.
4. Insurance administration.
5. Property accounting,
6. Pollution and noise abatement.
7. Any other services delegated to maintenance by plant management.

Maintenance policies.

Preventive maintenance is usually considerably more expensive to operate than breakdown maintenance; however, this additional expense must be set against the savings resulting from minimising the random breakdown of plant. There are overriding considerations of safety, such as in aircraft maintenance, preventive maintenance should be performed only when there is a total annual saving to the company.

Types of maintenance.

1. Corrective maintenance (Breakdown maintenance) :→ It is the first it variety. This is when the equipment is run until it fails and is then repaired. Maintenance becomes repair work. Unplanned breakdown often pyramid into additional breakdowns with resultant higher cost.
2. Preventive maintenance :→ An attempt is made to avoid breakdown by anticipating failure or wear and making a timely examination, replacement or adjustment. Most of these factories, there is little information available even concerning the number of hours individual machines have worked. As a result, Preventive maintenance schedules have to be compiled on a calendar, rather than on a running-time basis.

Preventive maintenance should be considered when.

i) The failure rate of the equipment starts to increase rapidly after a period during which it has been low.
ii) The cost of preventive maintenance attention is less than the repair cost, both costs to include that of any lost production.
iii) Equipment failure is likely to disrupt subsequent production operations or cause customer dissatisfaction.
iv) Injury could result from equipment breakdown.

Preventive maintenance consists of:

i) Proper design and installation of equipment.
ii) Periodic inspection of plant and equipment to prevent breakdown
iii) Repetitive servicing, up-keep and overall of equipment.
iv) Adequate and appropriate lubrication, cleaning and painting of equipment and building.

The key to a good preventive maintenance programme is inspection.

3. Predictive maintenance (prognostic maintenance).

The policy factors to bear in mind when designing a new preventive maintenance programme include:

1. At the start of the programme, people must be released to design and implement the programme. The most competent persons in the Organisation should be used.
2. Preventive maintenance tasks will increase maintenance costs when firstly initiated, until the beneficial effect of the preventive maintenance task has time to take effect because at initiation you have both the preventive maintenance costs as well as breakdown maintenance costs simultaneously running.
3. A preventive maintenance programme may permanently increase costs, if its author(s) do/do not have enough about maintenance skills.
4. Maintenance costs should be optimised with production loss cost.
5. Preventive maintenance cost should be optimised with breakdown maintenance cost.
6. The degree of preventive maintenance should be related to equipment criticality.

Implementation of preventive maintenance programme Guidelines.

1. Assign the most competent persons to design the preventive maintenance programme.
2. Start with the most critical equipment and schedule the instruction writing and implementation task.
3. The implementation rate should be designed to give time for the instructions to reap its benefit in reduced labour, material and production loss cost.
4. Concerted efforts should be made to optimise production loss costs with maintenance costs.

Features of a well Organised Preventive maintenance programme.

1) Proper identification of all items to be included in the programme.
2) Adequate records (taking volume of works, cost, activity time (log), failure records, etc.

3. Inspection on a definite schedule for withstanding Orders on specific assignments
4. Use of checklist by inspectors.
5. An inspection frequency schedule - which may vary from hourly to annual checks based on criticality.
6. Well qualified inspectors should have craftmen familiar with the items being inspected and capable of making simple repairs once trouble is observed or anticipated.
7. Use of repair budgets for major items of equipment.
8. Administrative procedures that provide necessary fulfillment and follow up on the programme.

Inspection Decisions.

Equipment is inspected to determine whether further maintenance attention is required. Once the depth and the type of inspection have been decided upon the best frequency must be determined.

It is assumed that downtime due to inspection is proportional to the inspection frequency and downtime due to breakdown is inversely proportional to inspection frequency and downtime due to breakdown is inversely proportional to inspection frequency. The total downtime in unit time D_T is given by

$$D_T = D_I N + D_B \frac{K}{N}$$

D_I → downtime per inspection

D_B → downtime per breakdown

N = Number of inspections per unit time

K = Constant.

The Old law of maintenance attributed to Confucius states that "If it works don't mess with it".

* Overheating is a phenomenon of rising temperatures (excess heat) in a device or machine which can lead to fire, explosion and injury.

Part Of Vehicle

* Hub
* Steering rack
— Steering Seal
* Steering fluid.
⇒ Lubricating oil enter through the Power Steering Pump.
The white part of the hub is called the brake disc.
* Alternator
* Speedometer → (AKA dashboard of a Car → rpm)
The electrical Part contain the Control panel
Battery (Signal, colour) = green → in good condition.
red/yellow → drained.
* Pulley → driver and driven, combined with the belt
* The chain belt is advantageous than the rubber belt because to notify the owner before it cut
How does your battery discharge.

Assignment: → Factors affecting Lubrication System.
⇒ Why do you reboard the engine block and Engine Cylinder
⇒ Reboard means that you are retheading to the performance
You reboard the engine block because the car is knocking
What are the Common Indication Signal in a Vehicle
* Traffic lights
* Headlight
* Horn
* Backlight
* Turn Signals.
* Hazard light

1.
2.
3.
4.

Factors affecting lubrication System.

1. Dirty Environment :- Heavy dirt and dust-filled environments can weigh profoundly on a lubricant due to the high risk of particle contamination, which is the primary cause of equipment failures. This type of contamination most frequently takes place when airborne or stagnant particles gain access to the lubrication system through open ports and hatches, especially in systems with negative pressure. Studies have found that half of a bearing's loss of usefulness can be attributed to mechanical wear. This wear occurs through surface abrasion, fatigue and adhesion, is often the result of particle contamination.

2. Elevated temperatures :- Viscosity is the most important physical property of a lubricant. It can be defined as a lubricant's resistance to flow and shear, and is typically influenced by a combination of temperature, moisture and contaminants. Of these factors, temperature frequently has the greatest impact. Remember the Arrhenius rate rule, which states that once a lubricant has exceeded its base activation temperature, it will degrade twice as fast for every 10 degrees C (18°F) it increases in temperature.

3. Wet condition :- Equipment that is subjected to wet conditions can also experience lubrication-related failures. When moisture appears in lubricants, it can take three different forms: emulsified, dissolved and free. The specific form will depend on the amount of moisture, the lubricant and the application. Over time, moisture can affect oxidation, lubricant film strength and load-carrying ability, among other parameters.

4. Excess Vibration and Other Harsh environment :- Excess Vibration, low temperatures and Other harsh environments can impair lubrication as well. However, it would be in your best interest to focus initially on keeping your equipment clean, cool and dry by addressing machines in dusty areas, at elevated temperatures and with the likelihood of moisture ingression.

5. Bearing load :- The main purpose of lubrication in bearings is to separate metal surfaces, support loads, and eliminates to minimize wear. By developing a layer of oil between the rollers and raceways, oil actually can separate the moving components, fully supporting the bearing loads and preventing wear.

* For plane bearing applications, researchers found that 0.8% of shaft misalignment doubled the effective load and reduced the hydrodynamic lubricating film thickness by 75%
* Viscosity of the thickness of the oil is important because it determines the lubricant's film strength and efficiency in preventing friction between moving parts.

State with higher temperature and pressure thus completing the heat transfer cycle.

Theoretically, after the cycle the amount of refrigerant will remain contained in the system. When leakage occurs in the closed circuit the efficiency of the refrigerator will gradually diminish till it stops cooling. By then it requires servicing to be done by a qualified technician to locate its leakage or parts that are not functioning properly.

Diagram :> Pdf.

1. Compressor or Heat pump.
2. Suction pipe or low pressure side with non-return valve.
3. Liquid exit going to condensing unit with non-return valve.
4. Water collector during defrosting process which gradually dries out.
5. Freon or refrigerant charging point.
6. Condensing unit usually in the form of serpentine tube.
7. Vacuum application point to remove impurities and humidity prior to refrigerant charging.
8. Capillary tube act as an orifice. An alternative for capillary is expansion valve for large refrigeration.
9. Evaporator or collector unit usually in serpentine tube, tube is in aluminium or copper. Copper has more heat transfer coefficient but its heavier and more expensive compared to aluminium.
10. Accumulator.

Air Conditioning.

This refers to the treatment of air so as to simultaneously control its temperature, moisture content, cleanliness, odour and circulation, as required by occupants, a process or product in the space.

Brief History.

Willis Haviland Carrier an American Engineer invented the first electrical air conditioning unit in 1902 and the purpose was to both cool a room and reduce humidity though originally created to keep moist air in a printing plant from wrinkling magazine pages.

Diagram :> Pdf.

Principles Of air Conditioning.

Air Conditioning systems utilizes a specific chemical called refrigerant to undergo the phase conversion. The refrigerant is pulled into the system's compressor in the form of a warm vapors after the evaporator coil. The compressor increases the density of the incoming refrigerant vapour causing it to increase in pressure and temperature. This is normally accomplished using a centrifugal system, where a series of spinning blades rapidly forces the vapour which then travels to the air conditioner condensers.

Basic definitions and Terminologies.

1. Heat :- is a form of energy transferred by virtue of a difference in temperature.
2. Cold :- This refers to lack of heat in an object, substance or area.
3. Refrigeration :- is the removal of unwanted heat from a selected object, substance or space.
4. Mechanical Refrigeration :- is the utilization of mechanical component arranged in a refrigeration system for the purpose of transferring heat.
5. Refrigerants :- are chemical compounds that are thermally compressed and condensed into a liquid and then permitted to expand into a vapour or gas.

Troubleshooting your refrigeration system.

Common problems.

1. Continuous water leakage
   - Drain hose gets clogged with food particles, vegetable leaves and other litters and scraps.
   - Water supply line freezes and splashes.
2. Strange noises from the refrigerator.
   - Condenser motor fan stops working due to blockage.
3. Temperature not cold enough.
   - Condenser fan is clogged. This can be solved by the removal of evaporator cabinet and replace the fan.
4. Freezing of food at the bottom.
   - Inadequate food compared to the amount of the air inside.
   - Temperature regulating point are not set correctly.
5. Ice building up inside the refrigerator.
   - loose door joints and careless closure of doors. let the external

air accumulate inside and cause the building of excessive ice. Ice buildup can lead to clogging inside the chambers and imbalance in humidity to be maintained inside.

Best methods for refrigerant leak detection.

1. Soap bubbles/Visible method
2. Flourescent Dye/Visible method :-> a special UV light is required
3. Electronic leak detectors :-> the most popular method. It must be checked regularly against a calibrated reference leak to ensure accuracy.
4. Ultrasonic :-> uses sound amplification.
5. Visual inspection
6. Gas pressure detection :-> By using the pressure difference between interior and exterior of the system.
7. Halogen lamp Detection
8. Nitrogen tester detection

5. Bearing load :> The main purpose of lubrication in bearings is to separate metal surfaces, support loads, and eliminates or minimize wear. By developing a layer of oil between the rollers and raceways, oil actually can separate the moving components, fully supporting the bearing loads and preventing wear.

* For optimal bearing applications, researchers found that 0.5° of misalignment doubled the effective load and reduced the hydrodynamic lubricating film thickness by 75%
* Viscosity, or the thickness of the oil, is important because it determines the lubricant's film strength and efficiency in preventing friction between moving parts.

Refrigeration and Air condition.

Refrigeration may be defined as the process of reducing and maintaining temperature of a space or material below that of the surroundings.

This simply means the cooling of or removal of heat from a system.

Brief History

Oliver Evans, an American inventor in 1805 designed a blueprint for the first refrigeration machine but it wasn't until 1834 that Jacob Perkins first built a practical refrigerating machine. The first commercial ice-making machine was invented in 1854. In 1913, refrigerators for home use were invented.

Before the advent of mechanical refrigeration, water were kept cool by ancient Iranians in Yakchals a form of large evaporative cooler. (Yakchals are ancient type of ice house that functions as an evaporative cooler. The structure had a domed shape above ground and a subterranean storage space) In modern time, before the invention of electric refrigerator, ice

holders and ice boxes were used to provide cool storage for most of the year.

The Romans carried packed trains of snow from Alps to Rome for cooling the Emperor's drink. Water was also kept cool by storing it in Semi-porous jugs so that the water could seep through and evaporate. These methods of cooling, all make use of natural phenomenon, they were used to maintain a lower temperature in a space or product.

The main function of the refrigeration cycle is to absorb heat from indoor air and dispel it outdoors.

Principles of Refrigeration.

This was named after two scientists James Prescot Joule and William Thompson and the procedure is called a throttling process or Joule-Thomson. It applies to all systems whether its the smallest water cooler to largest walk in freezer. The process where a gas or liquid change its temperature when it is forced through an expansion valve or capillary tube in an insulated system where no ambient heat transfer occurs at STP (Standard Temperature and Pressure), all gases cool up expansion by the Joule-Thomson process with the exception helium, neon and hydrogen gases.

Freon gas or the refrigerant absorbs heat inside the area to be cooled in the evaporator Unit and transfers the heat to the refrigerator's Condenser or exterior.

Refrigeration basic principle is that with the aid of a heat pump, the refrigerant is being compressed to the Condenser and Capillary tube thus increasing its temperature (50-60°C) and pressure (750 KPa) in the refrigerator being cooled down by the condensing Unit to 30°C depending the existing ambient temperature upon entering the evaporator Unit the gas expanded and vaporized due to sudden enlargement of the evaporator tube cross section eventually dropping its pressure to almost atmospheric Valve (120 KPa) and temperature from 30°C to -24°C. Heat absorption takes place from the evaporator and bring transferred from cool vapour to liquid