SUPPORT MATERIAL

MULTI SKILL FOUNDATION COURSE

SUBJECT CODE – 416
QP CODE – MLT/Q0001

FOR CLASS IX

CONTENTS

UNIT 1

WORKSHOP & ENGINEERING TECHNIQUES

SESSION 1: INTRODUCTION AND SAFE PRACTICE OF TOOLS IN ENGINEERING WORKSHOP

In the engineering division, various types of tools, devices, machinery need to be used for different jobs while undertaking multi-skill training of fabrication, carpentry, construction, plumbing etc. It is essential to get familiar with them before beginning the job. One should be aware of the precautionary and safety measures while using the tools and devices for appropriate jobs by correct methods. One must use the appropriate tool/device only for a certain job. If an inappropriate tool/equipment is used, it will not only get damaged but also spoils that job.

1. **Screw Driver -** Its design is as shown in the image. This is used to fix or to remove a screw. Handle of a screw driver is made of wood, hard plastic or cellulose acet ate.

Fig 1- Screw Driver

Blade – It is made of steel or carbon steel. The pointed head which is used to remove the screw is called as a 'Tip'.

Safe Practice –

1) According to the screw head's groove, select the screw driver having appropriate tip.
2) Select small screw driver for a small job while big screw driver for a big job.
3) Do not apply oil, grease to the handle of screw driver.
4) After completion of work, clean it and keep it at designated place.
5) Don't use it for drilling or to remove any object like nail.

Hammer –

Hammer is used for fitting job, hitting in an engineering workshop. Hammers are available in different sizes and weights for different jobs (e.g. punching, bending, chipping, forging, riveting, etc.). Hammer is made of carbon steel. Handle of the hammer is made of wood so that it can easily sustain the vibrations generated during the process of hammering. Types of hammer are known according to hammer head (pin), face, weight or shape.

1) Ball Pin Hammer
2) Straight Pin Hammer
   .
3) Cross Pin Hammer
4) Claw Hammer

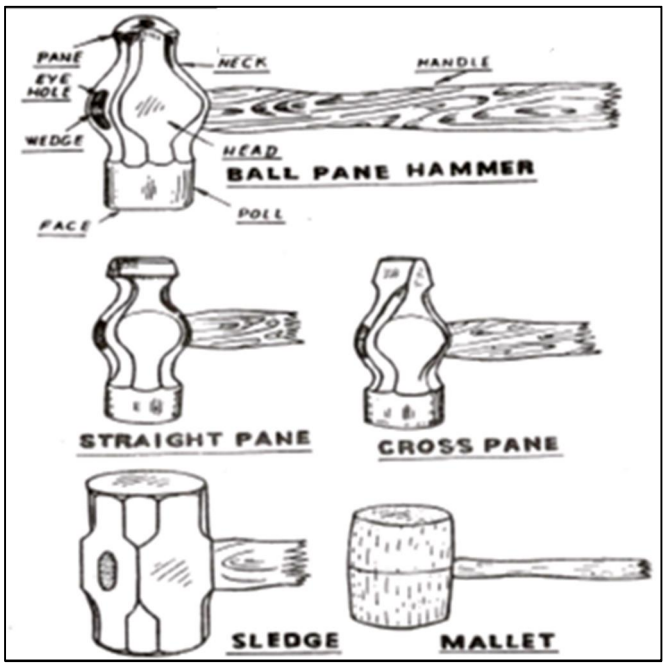


Fig 2 - Hammer

Safe Practice –

1) Before using the hammer, ensure that the handle is tight and intact.
2) Use the appropriate type of hammer only, according to the job.
3) Ensure that oil and grease is not applied to the head (pin) and face of the hammer.
4) During use, hold hammer at the end of handle.
5) Do not use a cracked and/or damaged hammer.

Chisel – Chisel is made of high carbon steel. In the workshop chisel is used to cut any rough material or to break it into small pieces. Chisel is used in various types of job like cutting, chipping, cutting of edges, making key holes. Based on the nature of job, there are various types of chisel. Also, there are different chisels for hot and cold jobs.

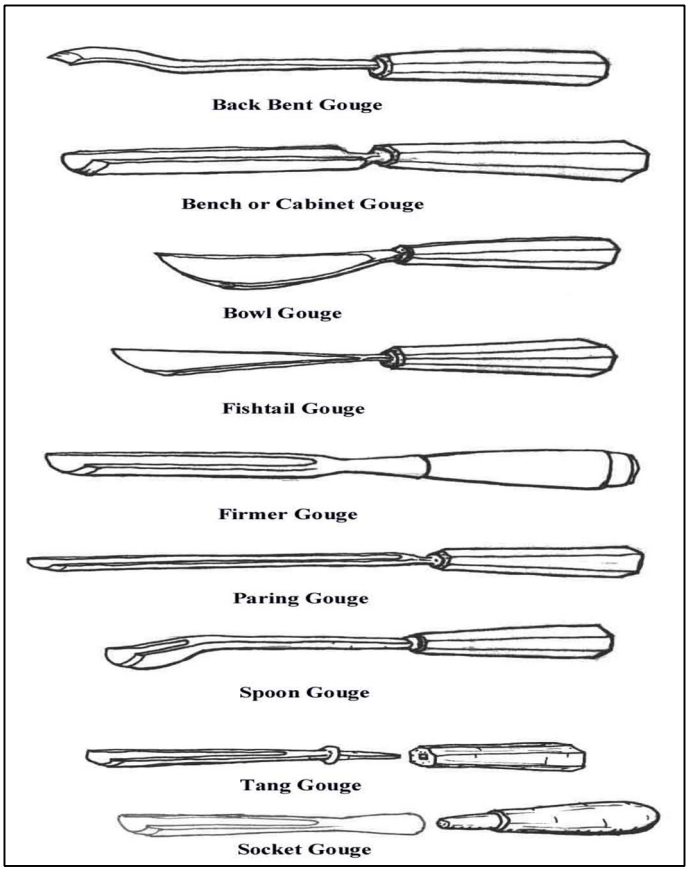


Fig 3 - Chisel

Safe Practice –

1) Don't use a chisel having broken head or blade.
2) While using chisel, focus should be on the cutting area and process; and not on the head of hammer.
3) Ensure that cut/scrap material doesn't harm the body during chipping, cutting.
4) Use safety goggle during chipping.
5) Ensure that oil, grease is not applied to the head of chisel.
6) If the chisel blade becomes hot during job, then immerse it in oil repeatedly to cool it off.

File – A file is used for filing or rasping of a job, to file a rough, uneven surface of a job so that its surface becomes uniform and for soft filing. A file can be described based on its length, grade (no. of teeth in specific square area), teeth configuration (cut and shape). (Files are present in various shapes like flat, rectangular/Mill file, square, round, half round, and triangular/three square.)

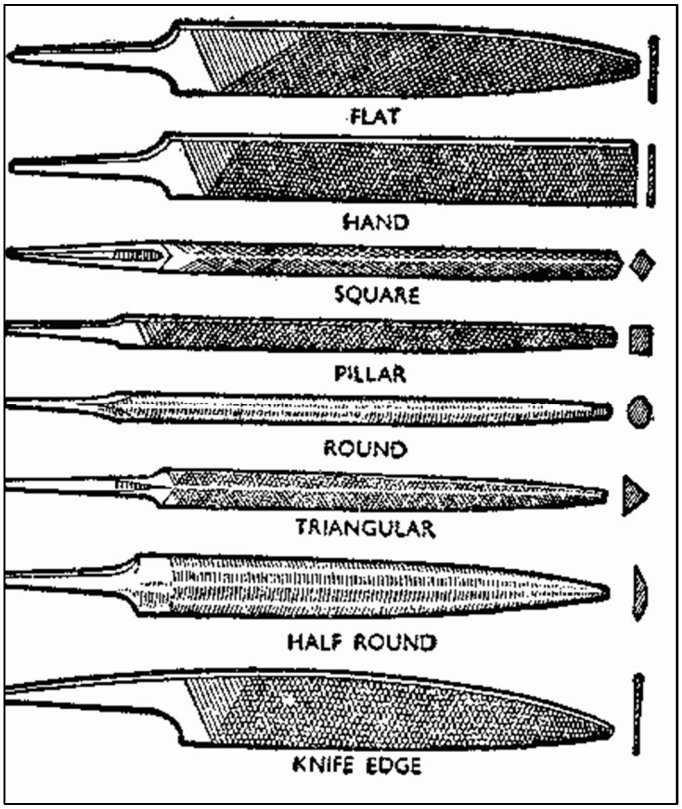


Fig 4 - Types of File

Safe Practice –

1) Don't use a file that doesn't have a handle.
2) Based on the nature of job, select a file having appropriate grade and shape.
3) Don't hit hammer on the handle of a file.
4) Never heat a file and avoid exposing it to extreme temperature.
5) Remove any metal particles trapped in between file teeth.
6) Don't apply oil or grease to a file.
7) Use entire surface of file during filing or rasping.

3) Hacksaw – While working in workshop, a hacksaw is used to cut material of various metals in desired shapes and dimensions. Hacksaw frame is made of mild steel while blade is made of high speed carbon steel or alloy steel. Handle is made of wood, plastic or iron. Hacksaw is available in either solid hacksaw frame (standard length blade) or adjustable hacksaw frame. Length of blade is typically 250 mm or 300 mm.

a. **Frame:** Useful in holding cutting blade firmly.
b. **Blade:** This unit actually performs the cutting job. Blade is made of high speed steel.

Safe Practice –

Based on the type of job, select the grade of blade and tighten the blade such that its teeth are facing towards front side.

1) Use entire blade during cutting.
2) Use coolant to keep the blade cool during cutting.
3) Don't move the job during cutting as a moving job may break the blade.
4) Don't apply excessive pressure during cutting.

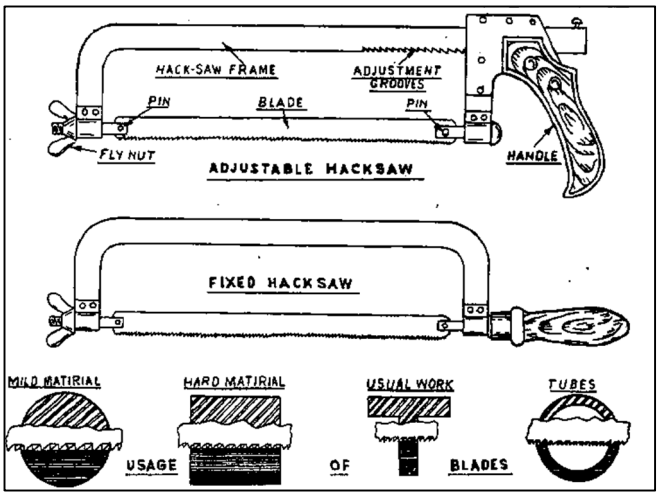


Fig 5- Hacksaw

5) Apply force during forward cutting and release force during backward motion.
6) At the time of actual work, fix the blade firmly to the frame using wing nut present on the frame.
7) While fixing the blade to frame, ensure that its teeth are facing towards front side.

4) Spanner – Different spanners are needed to assemble and dissemble appliances. Spanners are available in different sizes and types based on the usage of nut bolts. These are made of carbon steel.

- Single ended spanner
- Double ended spanner
- Ring spanner
- Adjustable spanner
- Box spanner

Fig 6 - Spanner

Safe Practice –

1) Select an appropriate spanner based on the size of nut bolts.
2) Don't use spanner as if it is a hammer.
3) Damaged head of nut bolts damages spanner.
4) Clean the spanner and keep it in rack appropriately post its use.
5) If spanners are not to be used for a prolonged period, then apply oil to them.
6) Don't apply excessive force during its application.

5) **Plier –** Plier is a hand tool used to hold objects firmly. Rubber or celluloid insulation coating is applied on both handles of a plier to be used in electric work. This enables to carry out electric repair work without power shut down. Pliers of different sizes are used based on various types of work. The size of plier means length of jaw from its tip. Pliers are made of steel alloys. They are available in sizes ranging from 100 mm to 300 mm. Pliers are available in types mentioned below:

Combination Plier: This plier is primarily used to hold nut bolt etc. Also it is used to bend/twist wires and snip wires and nails. As this plier performs multiple tasks, it is called as a 'Combination Plier'. These pliers are available in market in sizes of 150 mm, 200 mm, 250 mm and 300 mm length.

Fig 7- Combination Plier

a) **Long Nose Plier:** Jaw of this plier is narrow and has horizontal parallel threads for better grip. This is used to bend small sized wires, twist wires and reaching into small areas that are unreachable w ith fingers or other means. An insulated nose plier of 200 mm length is broadly used.

Fig 8 - Long Nose Plier

b) **Flat Nose Plier:** Front tip of this plier is flat. This plier is used to fix small nuts, give specific shape to wires etc. Generally these pliers of 150 mm and 200 mm length are used in electric wiring.

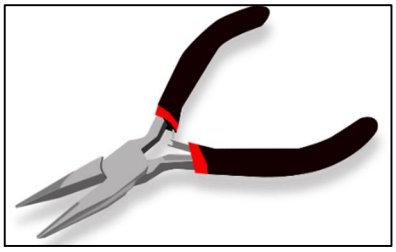


Fig 9 - Flat Nose Plier

c) **Side-Cutting Plier:** This plier is used to snip wire tips, remove insulation located at areas unreachable with fingers or other m eans. These pliers are available in market in sizes of 150 mm and 200 mm length.

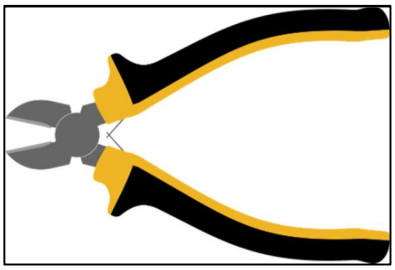


Fig 10 - Side Cutting Plier

➢ **Keeping and Caring of Plier:**

a) Don't use a plier as if it is a hammer.
b) Take precaution of insulation coating on handle grip of plier.
c) If plier is not to be used for a prolonged period, then apply oil to rivet and grease to jaw.

6) **Poker –** Poker is designed by fixing a wooden or plastic handle at the end of a tapered rod. Poker is used to

identify and mark the location where a screw is to be fixed.

Fig 11- Poker

7) Try Square: It has two parts. Its blade is made of high carbon steel and is typically thin but broad as compared to its stock. It has graduations for measurement. Stock or handle is another part of try square which is made of hardened steel or cast iron. Blade and stock are firmly riveted at right angle. This is used to fix switches or other appliances at right angle on wooden, plastic or sun mica boards.

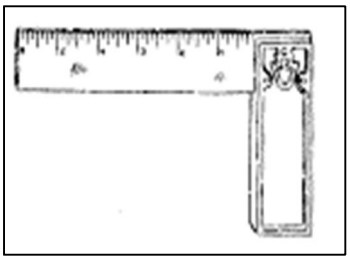


Fig 12 - Try Square

Precautions & care while handling:

a) Be cautious to retain graduations on blade meant for measurement.
b) Don't use this for knockdown job.
c) Be cautious to retain the right angle between blade and stock.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Hammer is used for fitting job, hitting in an _____workshop (engineering)
2. Chisel is made of high _____steel (carbon)
3. A file is used for _____of a job (filing)
4. A _____is used to cut material of various metals in desired shapes and dimensions (hacksaw)
5. _____is a hand tool used to hold objects firmly (Plier)
6. Poker is used to identify and mark the location where a _____is to be fixed (screw)

Subjective Questions

1) What are different types of screw driver?
2) Mention application of hammer based on its types.
3) Describe precautionary measures to be taken during application of chisel.
4) File a square shaped M.S. plate using a file and bring it in right angle.
5) Describe application of hacksaw.
6) Mention types of plier and describe precautionary measures to be taken during its usage.

What Have You Learnt?
On completion of this session, are you able to: • Recognize basic workshop tools and equipment and demonstrate their safe use.

SESSION 2: MEASUREMENT – MEASURING VARIOUS PHYSICAL QUANTITIES

While studying basic technology, students will be introduced to various skills. While acquiring multi skills, every time it will be necessary to conduct measurements. Earlier body parts, rope, utensils; etc. were used for the sake of benchmark or comparison during measurements. E.g. the length of an object used to be measured in terms of no. of hands, amount of grains used to be measured in terms of no. of utensils; etc. However, such an approximate comparison doesn't yield accurate measurement. 'It rained more this year as compared to last year.' provides descriptive information. 'Last year, the rainfall was 130 mm and this year's rainfall is 170 mm.' provides quantitative information. Quantitative information is more beneficial than descriptive information. Science is always based on quantitative information. The process of quantification to generate quantitative information is known as 'Measurement'. Mass, distance, temperature, time, volume, area; etc. need to be measured frequently. They are called as 'Quantities'. The standards used for measurement are called as 'Units'.

Basic Quantities and Derived Quantities –

1) **Basic Quantities:** Mass, distance, time, temperature; etc. are basic quantities. Their units are called as 'Basic Units'.
2) **Derived Quantities:** As the name suggests, derived quantities are derived from basic quantities. E.g. Area, Volume; etc. The units of derived quantities are derived from basis units. They are known as 'Derived Units'.

Types of Measurement Methods:

1) British Method
2) Metric Method
3) International (S. I.) Method

1) **British Method:** In this method, foot or inch is used to measure length, pound is used to measure weight, second is used to measure time. Though this method is currently not used in India, per tradition, few units are still used in day to day activities. E.g. Timber is measured in the unit of cubic metre.

2) **Metric Method:** In this method, there are two methods: M.K.S. and C.G.S.

Sr. No.	Quantity	M.K.S. Method Unit	C.G.S. Method Unit
1	Distance/length measurement	Metre (M)	Centimeter (C)
2	Mass measurement	Kilogram (K)	Gram (G)
3	Time measurement	Second (S)	Second (S)

This is a currently prevailing method. Small, large units are available in the multiple of 1, 10 and 100 which is convenient for calculation.

3) **International (S.I.) Method:** SI (System of International) is used to bring uniformity and consistency in the measurement methods used worldwide and largely used in the research activities. Units in this method are similar to that of M.K.S. units in metric method. This is the method used extensively.

Some important quantities and units:

Sr. No.	Basic Quantity	Unit	Derived Quantity	Unit
1	Distance/length	Metre	Area	Square Metre
2	Mass	Kilogram	Volume	Cubic Metre
3	Time	Second	Speed	Metre/Second
4	Temperature	Degree Celsius	Density	Kilogram/m^3
5	Electric Current	Ampere	Weight	Newton (N)

Speed is a derived quantity because we measure distance and time and calculate speed by formula:

$$\textbf{Speed} = \frac{\text{Distance}}{\text{Time}}$$

The way the correlation between unit of derived quantity and basic quantity is written (e.g. kg/m^3) is known as measure of that unit.

Quantity	Unit
Density	kg/m^3
Acceleration	m/sec^2

This is quite useful while converting one unit into another. While documenting measurements, quantity is mentioned instead of units.

Such as:

Area = Length * Breadth

Area = L^2

Density = Mass / Volume

Density = M ÷ L^3

Measurement Accuracy: The amount of accuracy in measurement depends upon the purpose of measurement. Based on the objective, appropriate measuring device is used for measurement. Thanks to advanced technology, nowadays devices are available to measure even minute measurements of quantities like mass, distance and time accurately.

Measuring Devices –

1) **Measuring Scale:** Measuring scale is used to measure length, breadth, thickness, diameter, height. Based on the task, measuring scale is available in different material and size.

Fig 13 - Measuring Scale

Steel Rule – Used in fabrication workshop
Wooden Rule – Used in carpentry and electric work
Brass Rule – Used in welding and smithy

These scales are available in 150 mm, 300 mm, 600 mm and 1000 mm length. One can measure a minute measurement equal to 0.5 mm or 1 mm.

Precautionary Measures:

1) Keep the measuring scale hanging to a support near the job site.
2) Don't keep it amidst metal cutting or marking tools.
3) Don't use it as if it is a screw driver.
4) Apply oil when not in use.

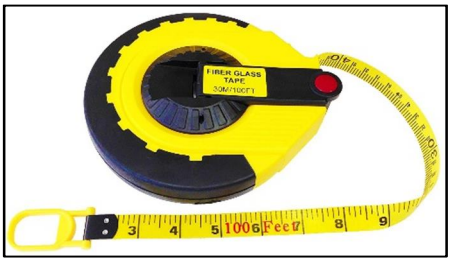


Fig 14- Measuring Tape

2) **Measuring Tape:** Measuring tapes are made of steel, cotton or plastic. This type of tape is used in cases where higher degree of elasticity and flexibility is required. These are used in various tasks like tailoring, construction, land measurement, fabrication, carpentry,
3) Agriculture. These tapes are available in 1.5 metre, 3 metre, 5 metre, 10 metre, 15 metre and 30 metre length.

Safe Practice –

1) Stretch the measuring tape, during measurement. Do not hold it loose.
2) Post task completion, immediately wind it up neatly and keep at a safe place.
3) Apply oil to steel tape when not in use.
4) Don't store it amidst heavy material. It may damage the tape.
5) Hang it at a suitable, convenient location.

Fig 15 - Kitchen Balance

4) **Balance:** Based on the nature of work, various types of balances are available in market to weight different objects. E.g. precision weighing machine used by goldsmith, Double-Pan balance used in market, hanging spring balance used to weigh milk, grain sacks/bags, electronic balance, kitchen balance, table balance used to weigh agricultural products, road way balance; etc. All these balances should be certified by government's 'Department of Weights and Measures'.

5) **Clock/Watch:** To measure time parameter, analog and digital clocks/watches are available. Clocks/ watches measuring 100th part of a second are also available.

6) **Thermometer:** Thermometer i s used to measure temperature of various things like substances, climate, water, furnace and body. Based on the type of measurement, it is available in different types and design.

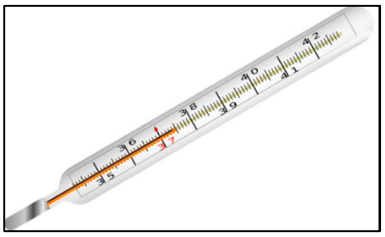


Fig 16 - Thermometer

7) **Vernier Caliper:** While working in a workshop, it is required to record very minute measurements (also called as micro measurements). Vernier Caliper is used to record micro measurements like length, breadth, thickness, depth, inner diameter, outer diameter; etc.

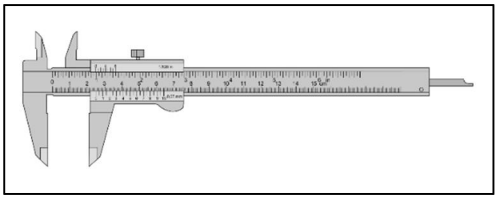


Fig 17 - Vernier Caliper

CHECK YOUR PROGRESS

Fill in the Blanks

1. Quantitative information is more beneficial than _____information (descriptive)
2. The process of quantification to generate quantitative information is known as _____ ('Measurement')
3. _____is used to bring uniformity and consistency in the measurement methods used worldwide (SI)
4. The amount of _____in measurement depends upon the purpose of measurement (accuracy)
5. _____is used to measure temperature of various things like substances, climate, water etc. (Thermometer)

Subjective Questions

1) What are the two methods of metric measurement system?
2) Which measurement system is used to bring uniformity and consistency in the measurement system used worldwide?
3) Which type of quantity area and volume are?
4) Where do we use Vernier Caliper?
5) Measure a distance of 1 meter ground using a measuring tape.
6) What different types of balances are available in market based on the nature of task?

What Have You Learnt?

On completion of this session, are you able to:

- Carry out measurement using instruments such as meter tape, Vernier Calliper, and screw gauge.
- Select proper measuring Instrument for given task.

SESSION 3: CARPENTRY

Tools Used During Carpentry:

1) **Steel Rule:** Steel rule is used to measure an object's length and breadth. These are made of carb on steel or stainless steel and are available in 15 cm, 30 cm and 60 cm length. It has graduations of mm and inches marked on opposite sides.

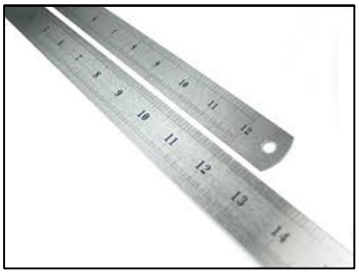


Fig 18 - Steel Rule

2) **Divider:** Divider is used to draw arcs or circles on the metal surface and to measure the distance between two points by steel rule. Dividers are of two types: plain dividers and spring dividers. The tips of dividers legs are made of steel and are pointed.

Fig 19 - Divider

3) **Scriber:** Scriber is a hand tool used to mark lines on the metal surface. Scriber is made of steel. Length of a scriber is 15 cm and 20 cm and the point is sharpened to an angle of 10˚ to 15˚.

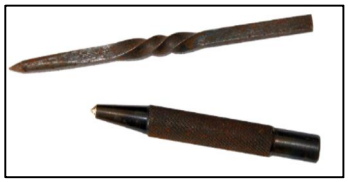


Fig 20 - Scriber

4) **Punch:** To make the markings made on the metal surface distinctly visible, small pits are made on it using punch. Punch is made of high carbon steel. Knurling i s made on the surface of punch to provide better hand grip.

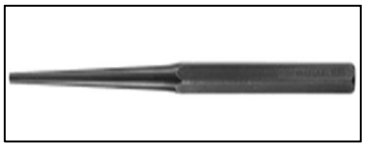


Fig 21 - Punch

5) **Chisel:** Chisel is used to cut any rough material or to break it into small pieces.

6) **Hammer:** Hammer is used to bend or straighten a job.

7) **Hacksaw:** Hacksaw is used to cut metal.

8) **File:** A file is used to remove unwanted, excess metal present on the job by filing/rasping so that its surface becomes uniform.

File Types: 1) Flat File 2) Half Round File 3) Round File 4) Triangular/Three Square File

9) **Bench Vice:** Bench vice is used to hold the job firmly during filing, cutting, chiseling (using a chisel). It has two jaws: a fixed jaw and a movable jaw. The gap between two jaws can be adjusted using handle. Bench vice is made of cast iron. The thickness of its jaw represents its size.

Fig 22-Bench Vice

10) **C-clamp:** As its name suggests, its shape is of English letter – 'C'. To prevent any movement of job during any operation on it, C-clamp is effectively use d to retain it fixed at the same position and location. C-clamp is especially used in cases where it is difficult to hold and operate the job using a bench vice. C-clamp has

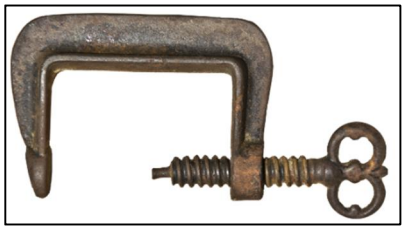


Fig 23- C clamp

Advantages as mentioned below:

1) Easy to operate in remote locations (typically where bench vice is of no use)
2) To hold jobs of various sizes
3) Convenient to hold two parts of the job easily

11) **Plane Tools:**

1) **Wooden Plane:** Wooden plane means a plane made of timber. This is made of high quality seasoned timber like Teak, Acacia or Rosewood.

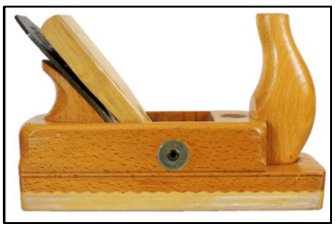


Fig 24 - Wooden Plane

2) **Iron Plane:** Iron plane means a plane made of iron. This type of plane is generally used in all carpentry workshops. The stock of this plane is made of cast iron. It is beneficial to use an iron plane as compared to a wooden plane because of points mentioned below:

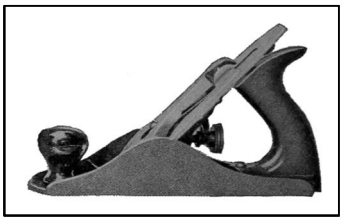


Fig 25 - Iron Plane

1) One can mount and remove blade in the plane quickly.
2) Wood shavings passes immediately through the mouth opening.
3) This type of plane can be assembled quickly and conveniently that saves time.

- **Parting Tools:**

1) **Firmer Chisel:** This is used to remove extra timber before plane job and to create slots on the timber. The width of blade represents its size. This chisel is available in 3 mm to 35 mm size.

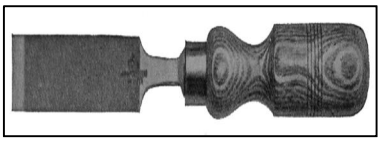


Fig 26 - Firmer Chisel

2) **Mortise Chisel:** Blade of this chisel is different than other chisels and is relatively thick. This chisel is used to create rectangular holes or mortises for wooden joint purpose.

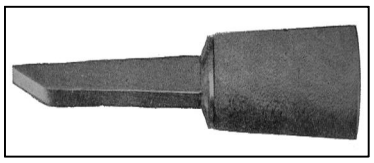


Fig 27 - Mortise Chisel

3) **Paring Chisel:** Blade of this chisel is relatively narrow and long. This is used to clean the corners of blocks, slots, slits and slabs. This chisel is used by hammering/knockdown by hand. It should have good sharpness. Mallet is not used while using this chisel.

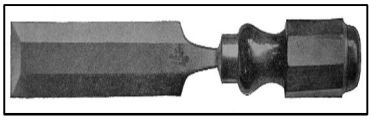


Fig 28 - Paring Chisel

4) **Bevel Chisel:** This chisel is similar to paring chisel and its use is also same. The only difference lies in the shape of the blade. The blade of bevel chisel is relatively thick and short. This chisel is also used by hammering/knockdown by hand.

5) **Gouge chisel:** This chisel is used for chiseling of concave and convex part of the job. The shape of its blade is curved and corrugated.

Fig 29 - Gouge chisel

- **Hand Drill:** Hand drill machine is used to drill (making holes in the job) quickly. This machine is operated by hand. Drills of different diameter are used to drill holes of different sizes.

  This machine is used to drill holes on a wooden job quickly. It has parts like machine chuck, pinion, crank and main handle. Drilling is done by locking drill bit in chuck. A drill of size ranging from 6 mm to 12 mm can be done with this machine. Marking should be done with a punch at the designated drill location. It is advisable to place a wooden piece below the desired wooden job to avoid any damage to drill bit.

Fig 30 - Hand Drill

- **Auger bit (Girmit):**

  Auger bit (Girmit) is made of steel and used to drill deep and large holes in a wooden job. The steel shaft of Girmit has a twisted form and its lower tip is sharpened for deep and effective drilling. This is operated by hand.

- **Gimlet:**

  This tool is prepared by attaching a horizontal wooden handle to a steel rod. The steel rod consists of a screw like sharp point and wooden handle is attached to another end. This is used to drill hole before fitting a small screw in a wooden job.

Fig 31- Gimlet

- **Dolomite:**

  This is used to drill at a remote area. A hole can be drilled by fixing a desired blade on the chuck and rotating the handle by pressing head of Dolomite. However, note that this can be rotated in a single direction. Drill bit of size 6 mm to 12 mm can be used in a Dolomite.

Precaution and care while handling:

a) Before beginning drilling job, ensure that the drill bit is of appropriate size.
b) Check whether the drill bit has adequate and appropriate sharpness.
c) During drilling, hold the drill machine, Dolomite etc. at a right angle to the surface of wooden job.
d) Ensure that other metal objects don't create any hindrance during drilling job.
e) Detach the drill bit after drilling job is accomplished.

- **Sawing Tools:**

Saw: The tool used to cut wood is known as 'Saw'. It is used right from the retrieving wood from tree trunks till finishing of a wooden product. It is also known as '*Aari*'. Its blade is made of high quality steel. Following types of saws are used in carpentry.

Fig 32 - Hand Saw

This type of saw is used for general cutting. Its blade is narrow towards top and broad towards heel (near handle). The straight edge of the blade consists of V-shaped teeth.

Based on the type of teeth, there are two types of saw:

a) **Rip Saw:** This is used to cut the wood vertically (i.e. longitudinal section).
b) **Cross Cut Saw:** This is used to cut the wood horizontally (i.e. transverse section).

Tenon Saw: This type of saw has thin blade. The width of its blade is equal (unlike hand saw, where the width of blade diminishes towards top). An iron strip is fitted at th e top to retain the blade stiff. This iron strip prevents bending of blade. It is used for making deep, accurate cuts in furniture joinery. It makes straight, fast cuts without bending.

Fig 33 - Tenon Saw

Relevant Subject Knowledge

Trees are natural resources and these resources are available to human being since ages. Trees provide human being with numerous benefits. Many essential commodities can be retrieved from trees. Among that, the trunk of tree is used as timber in carpentry. The tree takes its form after cultivation of a seed. Tree grows gradually.

Trunk of the tree provides necessary support to the tree. So as to provide strength to the trunk of tree, the cellulose fibers are bonded with each other by

means of lignin. Human being has used this structure creatively for his own benefit.

Based on the type of growth, there are two types of trees:

1) Internal Growing Trees – e.g. Bamboo, Palm, Betel Nut, Coconut, etc.
2) External Growing Trees – e.g. Teak, Deodar, Mango, Tamarind, Acacia, etc.
   Timber of only these trees is used in carpentry.

1) Advantages of using timber in carpentry:

1) Timber doesn't rust or decay.
2) Timber has considerable strength and stiffness compared to its weight.
3) Timber is bad conductor of heat. Hence, it doesn't become too hot or too cold.
4) Attractive articles can be crafted from timber and also wood-crafting can be done on it.
5) It is convenient to craft any shape from timber
6) Any amount of timber can be generated by cultivating trees.

2) Disadvantages:

1) Based on the volume available, timber needs to be used by forging joints.
2) With increase in volume/size, the price of timber increases substantially
3) Timber is flammable and hence may catch fire
4) Timber may get damaged by termite.
5) Timber may swell or shrink depending on humidity in climate.
6) Being a natural resource, it tends to show variation and hence lacks exact uniformity.

3) Different types of timber being used in carpentry:

Based on the quality and characteristics of timber, there are two types of timber:

- Soft Wood
- Hard Wood

1) Teak:

Characteristics – Dense, straight and beautiful body, yellowish golden or brownish colour. However, easy to craft and durable

Usage – Premium quality furniture, building construction, train bogie & ship construction

2) Rosewood:

Characteristics – Dense body, firm, durable and heavyweight, brownish purple colour

Usage – To craft stock of wooden plane, handles and stems (rods) of tools, expensive furniture, skeleton of boats

3) Acacia:

Characteristics – Dense body, auburn colour, extremely strong, hard, firm and tough

Usage – To craft agriculture tools, tools' handle, bullock carts, pegs of tents etc.

4) **Mango:**
Characteristics – Hard body, auburn colour, medium strong
Usage – To craft cheap furniture, fruit crates, toys etc.

5) **Lime:**
Characteristics – Dense and deformed body, tough, auburn colour, intense odor
Usage – Useful in cheap furniture, building construction
Along with timber types mentioned above; tamarind, khair, Eucalyptus (*Nilgiri*), Diospyros peregrina (*Tembhurni*), gular, ashoka, deodar, jackfruit timber are also used in carpentry.

- **Artificial Timber:** Recently, artificial timber is being used extensively as an alternative to teak wood and other types of timber. This timber is used in building construction and furniture work to maximum extent.

- **Advantages of Artificial Timber:**
  1) Faults present in natural wood are not observed in artificial wood
  2) These timbers are available in large size
  3) These timbers are strong and attractive
  4) These timbers can be cut in required size and creative shape
  5) Time and money is saved during wood crafting
  6) Cracks don't open up after hitting screw or nail in this type of timber

- **Artificial Timber has following types:**
  Plywood, particle board, block board, laminated board

1) **Plywood:** Ply means layers. Thin planks are formed from wooden logs. Their vertical and horizontal layers are joined together leading to plywood. These layers of thin planks are aligned at right angle to each other; glue is applied between the thin planks and pressed together using high pressure machine. These press-fitted sheets are cut in required dimensions to form plywood. While creating plywood, odd number (like 3, 5, 7, 9) of thin planks are joined together. Plywood is available in various thicknesses ranging between 3 mm to 24 mm (like 3 mm, 6 mm, 15 mm, 18 mm, and 24 mm).
2) **Particle Board:** Tiny wooden particles are steamed at high temperature and a pulp is formed. Adhesive like glue or resin is mixed in this pulp as a binder. These sheets are cold compressed to get desired shape. Later on these sheets are dried to form particle board. One can get desired thickness and texture of particle board as per need.
3) **Block Board:** Block board is formed by sticking square wooden thin planks together and sticking thin sheets to both surfaces of this union.
4) **Laminated Board:** This artificial timber is created like a board. Only difference is the wooden planks are rectangular instead of square.

- **Protecting Timber:** Protecting timber means avoiding decaying or any deterioration due to external factors. Herbicides are sprayed over timber so as to form a thin, protective layer on it to prevent any impact of termite, weed on timber, and protect it from decaying and to enhance overall life of timber. These sprays or chemicals are termed as protectors. Following types of protection is used to protect wooden objects from termite, dust present in surrounding area and after-effects of frequent handling of wooden objects.

1) **Polishing:** Polish is used to enhance the beauty of wooden products and also as a protection. This is readily available in market. Initially, the desired wooden surface needs to be rubbed and scrapped with a sand paper to make it clean. Later on polish of desired colour or shade should be applied on the wooden surface. Any water soluble paint gets absorbed by wooden surface leading to a uniform shade to the surface. Polish work should be begun only after this paint is dried thoroughly. A clean and dry piece of cotton cloth should be used to apply polish on the wooden surface. Keep polishing until the texture of surface shows up prominently. Let the polish dry completely. Later on, rub the surface further using a sand paper. Remove the husk or bran formed on the surface due to scrubbing. As done earlier, apply second coat of polish using a cotton cloth and let the polish dry completely. Again, apply third coat of polish as done earlier and see the effect: Polish will be shiny and majestic...!!!

2) **Painting:** Paint having oil mixed in it; is called as 'Oil Paint' in English. This kind of painting can be done by two ways: either by brush or by spray. A coat of paint changes the original colour of an object and gives it a desired shade as per the paint. Doors and windows of houses are painted with oil paint. This prevents any adverse effect of climatic humidity on it and protects the timber from termite.

3) **Varnishing:** Varnishing prevents any impact of air on the wooden object. Its mixture is readily available in market. After scrubbing the wooden surface with a sand paper, apply a uniform base (first) coat of varnish using a brush along the length of surface and let the coat dry completely. Apply top (second) coat horizontal to the surface. Apply third coat, if necessary.

- **Protection from Termite:** If wooden objects are kept in or exposed to humid climate; insects like ants, termite start decaying them. These insects form a tunnel like passage on the wooden surface. This state of deterioration is knows as effect of termite. Termite reduces strength of timber. Remedies are as below:
  1) Apply tar
  2) Apply tar + kerosene
  3) Apply tar + lime
  4) Apply chemicals – zinc naphthenate, chlorodyne, etc.

- **Seasoning:** At the time of cutting the tree, naturally a considerable amount of water /moisture traces is present in the timber. It reduces its strength and may get affected by fungus. To avoid this deterioration of timber, it needs to be dried. However, at times, it contracts from one side leading to bends, deformation and affects its look. Hence, it needs to be dried gradually. This process of drying of timber is called as 'Seasoning'. To avoid impact of termite and fungus during seasoning, timber needs to be processed chemically before drying.

- **Do you know this?**

1) As timber with higher width is rare and expensive, plywood is used. Layers of tree trunk are pasted together leading to plywood. Generally plywood of size ranging from 6 mm to 18 mm is extensively used. Waterproof plywood is also available in market.
2) Sunmica is prepared by coating a layer of plastic resin on a printed paper (that may have designs or plain finish). This plastic resin coating makes it smooth and washable. Sometimes, Formica is used instead of Sunmica. Formica is thicker than Sunmica. Apart from that its surface has roughness, too.
3) Hand saw is used where deep cutting is required.
4) Hammer is made of wrought iron while tools like pincer, plier are made of cast iron.
5) Pincer is used to remove nails.
6) Plane is used in carpentry to level wooden surface. Plane is made of either wood or iron. The main parts of plane are stock, blade and wedge.

Types of Hinges:

1) Butt Hinge: Butt hinge means two rectangular strips of equal size, connected face to face with each other. This type hinge is commonly used in almost every job where a hinge is needed. These hinges are available in 25 mm to 150 m m size. The length of strip represents size of the hinge. This hinge is also known as '*Takkari* Hinge'.

Fig 34 - Butt Hinge

2) Rising Butt Hinges: After opening this hinge, one of the strips (flaps) gets lifted upwards and hence this is known as 'Rising Butt Hinge'. This hinge is used to lift the door slightly upwards to avoid its direct contact with the underlying carpet or rug. This helps to protect carpet or rug from wear and tear due to direct contact/friction with door.

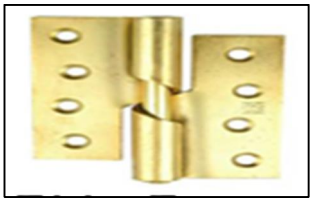
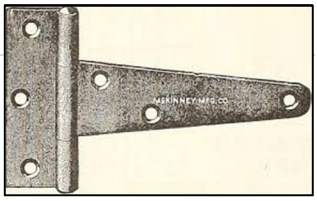


Fig 35 - Rising Butt Hinges



3) **T-Hinge:** Shape of this hinge is of English letter – 'T'. One strip of this hinge is like butt hinge and another strip is like strap hinge. This hinge is used to provide extended support to flaps of heavy doors for a broad region around joint.

Fig 36 - T Hinge

4) **Strap Hinge:** Strap hinge is a hinge formed by joining two 'V' shaped strips. This is used for joints of large doors of shops or horse stable. These are available in 3 to 4.5 inch length. This length is measured with respect to a single strip (flap).

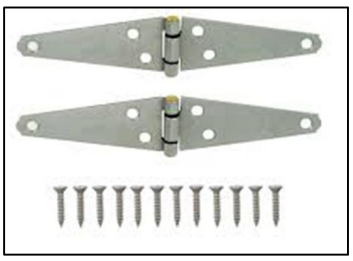


Fig 37 - Strap Hinge

5) **Parliament Hinge:** This type of hinge is used where the doors or windows open in outward direction. Due to this hinge, door and wall remain in same plane and hence it prevents any obstruction or inconvenience of doors to human movement around it.

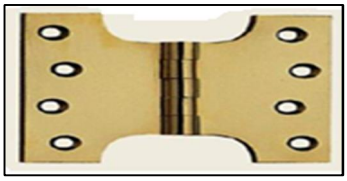


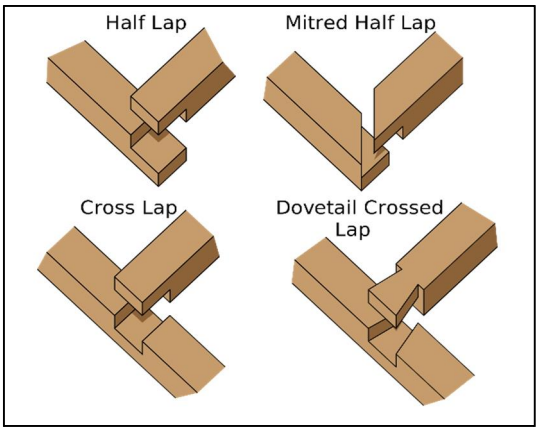
Fig 38 - Parliament Hinge

6) **Piano Hinge:** This hinge is used for the piano shutter. Hence, it is known as 'Piano Hinge'. It is narrow, long and delicate in nature. This is also used for the shutters/panels of concealed wall cupboards. This is used to craft wooden articles by joining multiple wooden objects with each other. The connection of two parts of an object to yield strength, durability, elegance and neatness is known as 'Joint'.

Fig 39 - Piano Hinge

Main joints being used in carpentry are as below –

1) **Lap Joints –** By creating slit in the timber and fixing them in each other, lap joints are created. Screw and nails should be used in lap joint. Types of lap joints are as below:



a) **Simple Lap Joints –** These are created to increase length of timber. Screws and nails are used during lap joint fitting.

b) **Corner Lap Joints –** This joint is a type of frame joint. This is used in frames and furniture joints. This is useful in providing joints at the corners.

Fig 40 - Types of Carpentry joints

c) **Cross Lap Joints –** This joint also comes under frame joint category. This is used wherever two strips or planks need to be joined at right angle to each other. Screws and nails are used during lap joint fitting.
d) **Half Lap Joints –** This joint is used is very common and simple joining job. Screws and nails are used during lap joint fitting.
e) **Tenon & Mortis Joints –** In general, Tenon & Mortis joint is extensively used in framing joint. It consists of two pieces. One is called 'Tenon' or 'Gouge' and the other is termed as 'Mortis' or 'hole'. The thickness of Tenon is 1/3rd of timber's thickness and it is fitted into the Mortis at right angle.

Fitting of Hinges –

Introduction – Various wooden articles are crafted in carpentry. E.g. Wooden boxes, doors, windows, etc. It is necessary to fix hinges so as to allow free movement of these articles. This year, we will study the skill of fixing hinges.

Selection of Activity – Select one of the following jobs useful to school:

1) Fitting hinges to window and door of school.
2) Fitting hinges to a box.
3) Fitting hinges to shutters (panels) of cupboards in school/town
4) Fitting hinges to switchboard
5) Prepare a folding table

Preparation of the activity –

1) Once the activity is finalized, assemble the material needed for the activity
2) Purchase the desired type of hinges and relevant screws
3) Ensure that adequate devices and tools required for the demonstration are available. E.g. drill machine, screw driver, nut – bolt, plane, chisel, pencil, drill bit, mallet, etc.
4) Ensure that wooden plank or plywood is available
5) Arrange all the material, devices and tools on demonstration table

Desired Skills –

a) Tightening of a screw using a screw driver
b) Ability to identify different types of hinges and describe them
c) Handling of drill machine
d) Fixing hinges
e) Job handling by adhering to safety rules and regulations

Procedure –

1) Based on the size of wooden plank, decide the size, quantity and type of hinge.
2) Place the hinges at the desired location of fixing and complete the marking using pencil or marker
3) Create slots at the marked location as per the thickness of hinges.
4) Again place the hinges on the marked location and now, mark the location using a pen where screw needs to be fixed.

5) Drill holes at location marked for screw fitting
6) Again place the hinges on the marked location and fit the screws

Precautionary measures to be taken during hinge fitting –

1) While marking location of hinges on the plank, ensure to keep hinge joint outside the plank.
2) While marking location of screws, do not disturb hinges. It may misalign hole position
3) Ensure that the drill size is less than screw size
4) Do not fix the screw in skewed or tilted direction. Fix it straight into the job.
5) Do not knockdown the screw. Instead, fix it by gradual and uniform rotation
6) Once the screw is fitted into the job up to its length, do not rotate it further.
7) Ensure that the head of screw doesn't come out of flap of hinges.

Fitting of Sunmica –

During carpentry, in order to increase the durability of wooden articles, it is vital to protect them. Sunmica needs to be applied on top of timber or plywood so that it is protected from termite, decaying, deterioration and to prolong its life. This also adds to the beauty of wooden article, making it clean, chiseled and attractive. In this chapter, we will learn the skill of applying Sunmica.

Selection of Activity – Select one of the following jobs useful to school:
To apply Sunmica for items mentioned below:

1) Low Stool
2) Square Stool
3) Table
4) Pad
5) Switchboard
6) Traditional Indian Chopping Board
7) School furniture

Preparation of the activity –

1) Assemble the necessary material for demonstration like: Sunmica, plywood, Fevicol, tack nails
2) Ensue that required devices and tools are in good shape and available. E.g. Pencil, centre punch, tape, Sunmica cutter, hand saw, hammer, plane, pincer (plier), etc.
3) Arrange all the material, devices and tools on demonstration table
4) Keep some heavy objects readily available. This can be used as a load to be kept on top of the surface after application of Sunmica on it.

Desired Skills –

a) Cutting of plywood as per designated dimension
b) Cutting of Sunmica as per designated dimension and ability to apply (paste) it

c) Levelling of wooden surface using a plane
d) Applying Fevicol and fixing tack nails

Procedure –

1) As per given measurements, draw markings of right angles on plywood
2) Cut the plywood using hand saw
3) Depending on the dimension of plywood, draw markings on Sunmica using a pencil
4) Draw lines 3 to 4 times repeatedly on the Sunmica using centre punch
5) Hold the Sunmica against the plywood such that the location where lines have been drawn (in step 4 above) is at the edge of plywood. Gently press the Sunmica downwards. The Sunmica will break automatically at the location of lines.
6) Fix the tuck nails on the edge of plywood at a distance of 3 cm from each other such that half part of tuck nails goes inside plywood
7) Apply Fevicol on the entire surface of upper part of plywood and lower part of Sunmica.
8) Keep the Sunmica on one side of plywood and press it firmly.
9) Gradually, keep pressing Sunmica on plywood on entire surface area
10) Bend the tuck nails/nails placed on the edge of plywood such that they create pressure on Sunmica
11) Keep weight on all over the plywood
12) Remove the weight approximately after 12 hours
13) Remove the tuck nails placed on the edge of plywood
14) Smoothen all edges of plywood using plane

Precautionary measures to be taken during application/pasting of Sunmica –

1) Place a tall block below plywood during cutting job
2) Ensure that Sunmica is slightly larger than plywood
3) Ensure that while drawing lines 3 to 4 times repeatedly on the Sunmica using centre punch, all lines fall on each other to create a deep marking at exactly same location. Multiple lines adjacent to each other won't serve the purpose of deep marking.
4) Ensure that the centre punch has sharp tip.
5) While breaking Sunmica at the deep marking, hold its part on plywood firmly to avoid unexpected breaking at a different location
6) Apply/paste Sunmica on the plywood immediately after applying Fevicol on the plywood surface while Fevicol is wet.
7) Ensure that there aren't any air bubbles or vacuum retained between Sunmica and plywood. It may affect the grip and holding capacity of Fevicol adversely.

Crafting of a Book Shelf –

Expected Skill Acquisition and Development –

a) Cutting of timber
b) Levelling of wooden surface by plane

c) Making slots
d) Fixing sides into planks
e) Assembly of rack

Material – Wooden planks, yellow clay, French polish, screw, etc.

Devices and Tools – Support base, vice, ruler, try square, drill machine, diary, saw, plane, chisel, Mortis chisel, hammer, drill bit, screw driver, Marpha file, polish paper, etc.

Procedure –

1) Collect information in relation to devices and tools needed for the demonstration.
2) Hold the wooden planks in vice and cut it as per specified measurement using saw.
3) Place the wooden planks on support base and smoothen/level the surface of planks using plane.
4) Draw markings on both sides of wooden planks for the rectangular slots.
5) Create rectangular slots with the help of chisel and Mortis chisel.
6) Create pegs at the end of wooden planks so that they can be fitted in the shelf sides.
7) Cut the pegs using saw.
8) Insert the pegs in rectangular slots and form a joint.
9) Fix the pegs in rectangular slots with the help of screws so that pegs don't get out of rectangular slots.
10) File the additional part of peg that is poking out of rectangular slots with the help of Marpha file.
11) Scrub and polish all surfaces of planks using sand paper.
12) Apply yellow clay on all surfaces.
13) Again, scrub and polish all surfaces of planks using sand paper and finally, apply 2-3 coats of French polish on all surfaces.

Precautionary measures to be taken during crafting of book shelf –

1) Stretch the plane to maximum extent covering entire wooden surface/edge for uniform levelling.
2) While creating slots, ensure that slots are in a right angle for perfect joint.
3) Ensure that the plank doesn't break while creating slots
4) Create the pegs slightly longer than the depth of rectangular slots. Later on, file the additional part of peg that is poking out of slots with the help of Marpha file.
5) Wood, being a natural resource, is rough. Use sand paper to smoothen it.
6) Ensure that the job doesn't come in contact with dust during polishing as it affects the effectiveness of polish drastically.

Other General Information in Carpentry –

1) A two feet long, foldable measuring tape is used in carpentry. It can be folded into four parts. Hence, it is convenient to carry in pocket.
2) A support base is used to provide firm support to timber during surface levelling & smoothening using a plane.
3) A scriber is used to draw parallel lines along the length of timber.
4) In carpentry, generally chisel is used for cutting while Mortis chisel is used for creating slots.
5) Once desired shape is given to the wooden job, a Marpha file is used to file and clean the wooden craft.
6) Various joints need to be formed to join the wooden parts of the job. Joints formed by joining two adjacent (side on) timber are known as 'Butt Joints' while joint formed by joining two timber one on one are known as 'Lap Joints'.
7) French polish protects timber from climate effectively. Also, the timber becomes durable and looks decorative.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____is used to measure an object's length and breadth (Steel rule)
2. _____is used to mark lines at right angle on the job and to check the surface level (Try Square)
3. _____is used to draw arcs or circles on the metal surface and to measure the distance between two points by steel rule (Divider)
4. Scriber is made of _____ (steel)
5. Knurling is made on the surface of punch to provide better _____ (hand grip)
6. Hacksaw is used to _____metal (cut)
7. _____plane means a plane made of iron (Iron)

Subjective Questions

1) Why is it needed to sharpen the tools?
2) Why do tools become blunt?
3) Mention names of tools that are sharpened and used for drilling for carpentry.
4) Which tools are used for drilling job?
5) Describe characteristics and usage of teak, Acacia and lime tree.
6) Mention advantages and disadvantages of timber.
7) Mention advantages of artificial timber.
8) Describe particle and laminated board.
9) What is meant by protector? What are methods to protect timber?
10) What is meant by 'Varnishing'?
11) What measures are taken to protect timber from termite?
12) What is the purpose of applying Sunmica on timber or plywood?

13) What precautionary measures need to be taken during application of Sunmica on plywood?
14) What is the motive behind protecting timber?
15) What is the process of preparing Sunmica? Explain the reason behind smoothness of Sunmica.
16) What types of saw are used during carpentry?
17) Which tool is used to remove nails?
18) What is the application of hinge?
19) Mention types of hinges.
20) Which metals are used to make hinges?
21) Why T-Hinge is used for shutters (panels) of heavyweight doors? Distinguish between Strap Hinge and T-Hinge.

What Have You Learnt?

On completion of this session, are you able to:

- Prepare a simple wooden object like pad for writing/ newspaper holder, display board, stool, electric board etc
- Fix sunmica on plywood surface
- Demonstrate Finishing and polishing of wooden surface.
- Demonstrate the use of carpentry tools and equipment.
- Identify and select timber, board, laminated sheet and other wooden materials for carpentry work.
- Demonstrate the use of wooden materials for basic carpentry.

SESSION 4: SOLDERING AND FABRICATION (MAKING JOBS FROM SHEET METAL)

In modern era, human being has made significant progress. He created, invented novelty objects. People are using gas stove, burner stove and electric appliances. Also they use a stove that operates on a liquid fuel called kerosene which is a natural resource. After few days, these stoves catch rust and become non-operational. Soldering is required for repairing purpose. If we acquire soldering skill, then we can repair stove and other metal items cheaply. Hence, let's study the demonstration of soldering. Soldering is done to join two parts of same metal. Solder is an alloy of tin and lead. Solder contains 60% tin while 40% lead. Soldering is a temporary joint. Similarly, unwanted joined parts can be separated by application of heat to the affected area. Solder melts at relatively low temperature. Soldering is done on thin sheets. Various utility articles can be created using thin sheets. Different metal sheets are used in this regard. These metal components are known as 'Sheets'. These sheets are available in 30, 28, 26, 24, 22, 20, 18, 16 and 14 gauge (i.e. thickness).

Generally, following joints are used during sheet metal work –

1) **Soldering:** Metals having melting point up to 300˚C are used for soldering. The point of joining is heated but not melted. The alloy used for soldering purpose is known as 'Solder'. Soldering iron (also called as soldering gun) is used to perform soldering. The soldering iron consists of a triangular, hollow copper bit at the start of iron. Inside this hollow copper bit, an iron rod is placed which is connected to a wooden handle at the other end of iron (gun). If flux is applied at the soldering (application) area, it prevents any contact of air with the soldering joint. Thus, it creates a layer of burnt impure compounds on the soldering joint.

2) **Solder:** a) Soft solder b) Hard solder. Melting point of soft solder is below 450˚C and melting point of hard solder is above 450˚C.

Heating Appliances: The device used to perform soldering is known as 'Soldering Iron'. Heat is supplied to a soldering iron as follows:

1) via electricity
2) with the help of a blow lamp
3) via coal furnace

1) Soldering Method:

a) By means of this method, two or more parts of a metal can be joined together. This is also known as 'Soft Soldering'. To avoid breaking of joint, this type of soldering is not used wherever extreme heat is involved.

b) By means of this method, too, two or more parts of a metal can be joined together. However, this type of joint can sustain relatively more heat. This is further divided into two sub-types:

   1) Silver Soldering: This has more amount of silver.

   2) Brazing: This has more amount of brass.

- **Brazing:** This process is conducted with the help of gas welding. (This is not possible using a soldering iron.) And a filler rod of brass (an alloy of zinc and copper) is used. This requires a high temperature of 600˚C. This method is used to join cast iron, steel and fill up damaged area of these metals.

➢ **Difference between soldering, brazing and welding:**

Sr. No	Soldering	Brazing	Welding
1.	This involves **lead** and **tin**.	This involves **copper** and **zinc**.	**Mild Steel** rod is used.
2.	Melts at **300˚C**	Melts at **500˚C** to **700˚C**	Melts above **3000˚C**
3.	Done by heating soldering iron.	This is processed by heating up to red hot condition on a blower.	Electrically heated up to 80 V to 100 V voltage.
4.	Joint is **not completely potent** (relatively weak).	Joint is **potent** (relatively stronger than soldering) but not as strong as a weld.	Joint is **strong**.
5.	**Ammonium chloride** is used as flux.	**Borax** is used as flux.	Flux is present as a **coat on electric (welding) rod** itself.
6.	Joint can be opened (broken) at **700˚C.**	Cannot be opened (broken) at any severe temperature.	Cannot be opened (broken).
7.	An **expert** workman can do this.	An **expert** workman can do this.	A **trained** workman can do this.
8.	All metals except aluminum antimony can be soldered.	If melted above **700˚C**, joint can be applied on all metals.	Gas and arc is used to join various metals.

G. I. Sheets: Galvanized Iron (G.I.) sheet is primarily a black sheet of Mild Steel (M.S.). However, it is coated with a layer of zinc to protect it from rusting and to enhance its utility.

Scriber: It is used to draw accurate lines for marking on metal sheets.

Mallet Hammer: During sheet metal work, along with regular hammer; wooden or plastic or rubber hammer is used. As they have lesser impact, the metal sheet doesn't get damaged. These hammers are known as 'Mallet' or 'Mallet Hammer'.

Bench Stake: During sheet metal work, stake is placed below metal sheet and knocked down with hammer or mallet. Depending on the purpose, various types of bench stokes are available. (Stake is a device used in sheet metal work that provides support to the job. Stake is firmly fitted in the vice and job is placed on the

stake. Now the job is knocked down by hammer or mallet to provide it with desired shape.)

Spin: This is used to cut thin metal sheets of 20 gauge and 22 gauge. These are available in 15 to 30 cm length.

Shiers: A metal cutter having blade longer than 30 cm is known as 'Shiers'.

- **Sheet Metal Work Method:**

1) Spreading: Spread is the total amount of space or shape that a certain job can occupy after it is fully opened during the actual making of the job. A job cannot be done without spread drawing.

2) Joints in Sheet Metal Work: 1) Mechanical Joint 2) Metallic Joint

1) **Mechanical Joint –** In this type of joint, the edges of sheets are bent in such a way that they fit into each other at the joint easily. In this case, marginally more sheet is needed for the overlap and interlocking. This is known as 'Allowance'. Such joints don't need soldering.
2) **Metallic Joint –** In this type of joint, joints are performed by means of a medium without interlocking edges of the sheets. Joint is performed by soldering, brazing or welding.

3) Soldering – A joint is performed using a soldering material to join two to more than two metal sheets. The process of joining by metals having lower melting point than that of metal sheet is known as 'Soldering'.

4) Solder Material – The alloy formed by mixing lead and tin is known as 'Solder Material'.

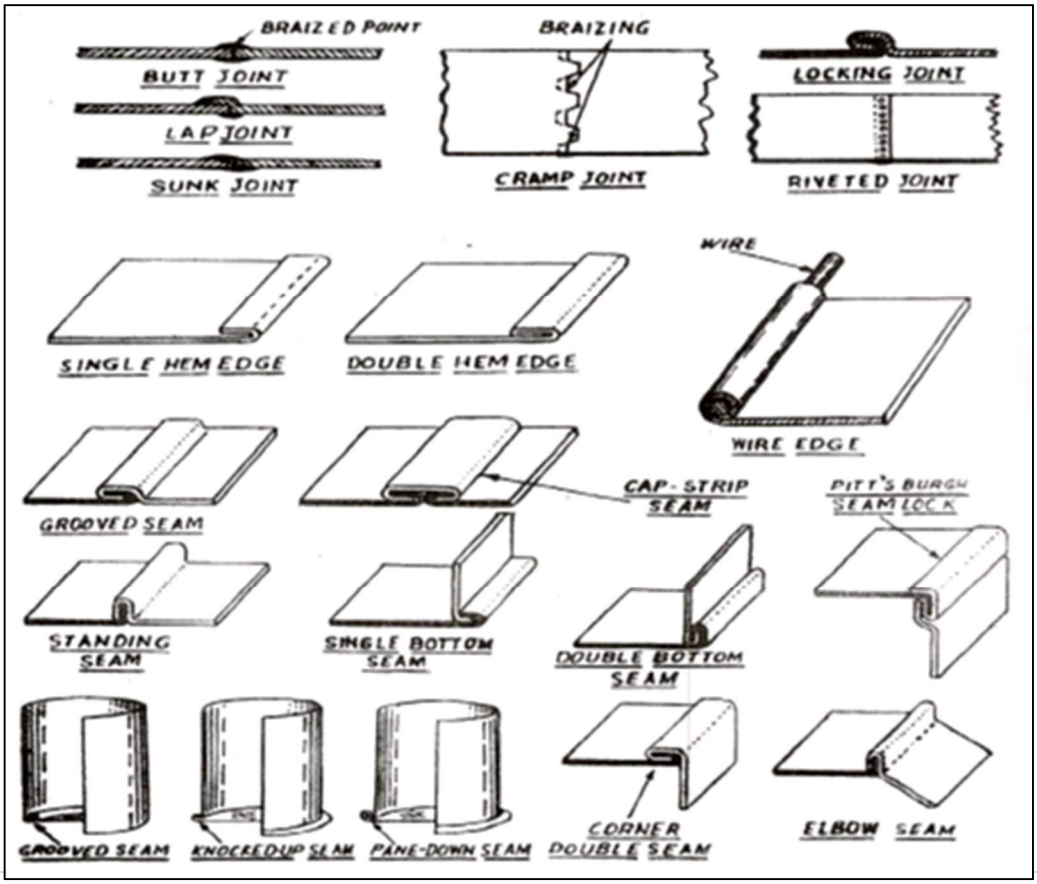


Fig 41 - Metal Joint

Soldering Process –

Objective: Join two pieces of metal with each other using soldering. Cleansing of job using flux. Solder is an alloy of tin and lead. Solder contains 60% tin and 40% lead.
The metal for which joint is intended should have higher melting point than that of solder (soldering material). It is expected/essential that the solder should have fluidic nature.

Joining and Soldering of G. I. Sheet –
Objective: To learn making a box using soldering technique.

Material:
1) Card sheet 2) G. I. Sheet 3) Hydrochloric acid
4) Zinc pieces 5) Kerosene 6) Match Box 7) Solder plate

Devices:
1) Measuring Scale/Ruler 2) Soldering iron 3) Blow lamp
4) Straight cutter 5) Stake 6) Flux vessel

Tools:
1) Marker 2) Sniper 3) Mallet 4) File5) Plier 6) Stove Pin

Preparation of the activity –
1) Arrange the material required for soldering on table: Solder, Flux, Solder lamp, Soldering iron, etc.
2) Arrange other material like G. I. Sheet, cutter, mallet, etc.
3) Verify whether the blow lamp is in working condition. Keep it ON.
4) Material and devices required for soldering – Hydrochloric acid, flux, solder, card sheet, measuring scale/ruler, stake, marker, mallet, soldering iron, sniper, file, plier, etc.
5) Instructor should demonstrate the process of soldering to students.
6) Instruct students to practice cutting and folding using card sheet.
7) Instruct students to plot measurements on G. I. sheet and perform cutting accordingly. Also, demonstrate how to fold the sheet and join its both ends.

Desired Skills –
a) Ability to cut G. I. sheet as per measurement.
b) Blow and operate blower lamp.
c) Ability to fold sheet and join its ends correctly forming a joint. Ability to perform soldering.
d) Cleansing of the joint using flux.

Procedure –

1) To begin with, cut the card sheet and fold as per measurement.
2) Fold two card sheets and join their ends with each other.
3) Perform marking on the G. I. sheet as per diagram and fold the sheets.
4) Perform filing at the location of joint using a file and cleanse the location with hydrochloric acid.
5) Apply flux at the location of joint.
6) Hold the soldering iron on the flame of blower lamp till its tip becomes red hot.
7) Dip the hot soldering iron in zinc chloride.
8) Touch the soldering iron with solder so that some solder is applied to the tip of soldering iron.
9) Dip the soldering iron in ammonium chloride so that the solder on the soldering iron spreads uniformly all over the tip.
10) Hold the sheet joint firmly in a plier and rest the soldering iron on the joint.
11) Once the joint is heated, move the soldering iron over the edge of joint so that soldering material is applied all over the joint.
12) Let the joint cool off. Later on, cleanse and dry it.

Precautionary measures to be taken during soldering –

1) If sheet bends during folding, knock it down with mallet and make it plain (i.e. bring it to original form).
2) Ensure that dust, oiliness and rust is not present at the location of joint.
3) Ensure that while applying hydrochloric acid, it doesn't spill on body or clothes.
4) Rub the tip of soldering iron with file before use.
5) While igniting the blower lamp, keep its mouth towards wall (i.e. away from body).
6) Don't heat soldering iron more than necessary.
7) Cleanse the soldering iron and ensure that it is adequately and appropriately heated.
8) Place a wet cloth adjacent to the site of job so that it doesn't become hot due to soldering activity.
9) Don't place the soldering iron on the table or bench or below bench. It may accidentally come in contact with body.
10) In the end, ensure that uniform soldering is done all over the joint.

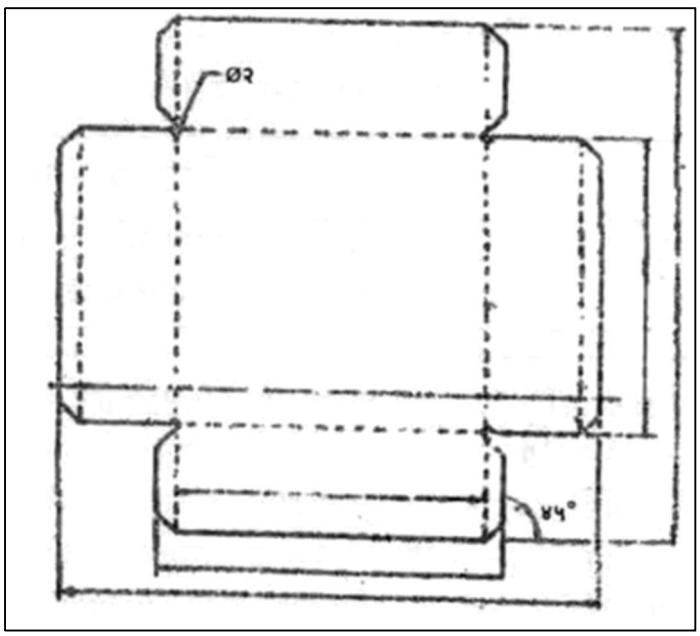


Fig 42 - Sheet metal job drawling

Like all the above procedures and other demonstrations, safety rules should be adhered to and precautions and care should be taken during all the demonstrations of sheet metal work of G. I. sheet and soldering.

Do you know this?

1) Cutter (Sniper) is used to cut the metal sheet. Based on the shape, sniper (soldering cutter) has 3 types: Straight, Universal and Pipe.
2) Stake is used to bend metal sheet. Based on the convenience of bending, stakes come in different shapes.
3) Mallet is made of soft metal, fiber or wood. Based on the type of job, mallet comes in different shapes.
4) Joining of two parts of a metal with a soldering material having lower melting point than that of the metal is known as 'Soldering'.
5) Soldering is used to join thin metal sheets, electric wires, and to stop leakage.
6) For general purpose soldering, a soldering material of an alloy of tin and lead is used where both are present in the ratio: 50:50 or 60:40, respectively.
7) Flux is applied on the joint to prevent oxidation of metal due to heat generated during soldering process. Flux leads to quick melting of solder and helps to spread it across the joint.
8) For general purpose soldering, zinc chloride, ammonium chloride or resin is used as flux.
9) It is also necessary to cleanse the surface of joint chemically to ensure a robust joint.
10) Soldering iron of copper is used to melt soldering material. (Simple soldering iron, electric soldering iron/gun)
11) Simple soldering iron is heated on blower lamp while electric soldering iron/gun is heated via electricity.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Metals having melting point up to _____˚C are used for soldering (300)
2. The alloy used for soldering purpose is known as _____ ('Solder')
3. To avoid breaking of joint, _____ soldering is not used wherever extreme heat is involved (soft)
4. _____is conducted with the help of gas welding (Brazing)
5. In GI sheets, GI stands for _____ (Galvanized Iron)

Subjective Questions

1) What is meant by soldering?
2) Describe the principle of soldering.
3) What is the role of flux?
4) What is the proportion of tin and lead in the soldering material?
5) Which material is used as flux?
6) Which material is used to prepare soldering iron?

7) What precaution should be taken while igniting blower lamp?
8) Mention the advantages of soldering.
9) How to assess the quality of soldering?
10) Which device is used to bend metal sheets?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate the use of soldering gun and fabrication.
- Demonstrate making of an article from G.I. sheet according to given dimension (funnel, box)

SESSION 5: DRILLING, TAPPING AND THREADING

In the engineering division, various objects are created using processes like drilling, tapping and filing. We should understand and be familiar with application and safe practice of relevant devices and tools.

- **Drilling –**

  This is a cutting tool that enables creating space in a solid metal object. Also, it enables to enhance the already existing space. Creation of hole in an object using a machine is known as 'Drilling'. Various types of drilling machines are used for drilling purpose. In the bench drill machine, shaft is rotated in vertical direction using an electric motor and drill chuck is connected to the other end of shaft. Drill bit is fixed in this drill and drilling is performed. Drilling can be done in iron, wood, and fiber, plastic and other metals in desired size.

Fig 43 - Drill Machine

- **Drilling Machine –**

  Drilling is to perform a hole across a surface in a solid job using drill. In order to do this, drill needs to be rotated at high speed. The device or machine used to hold and rotate a drill at high speed is known as a 'Drilling Machine'.

  In the machine era, drilling machine was invented immediately after the invention of lathe machine. With changing times, revolutionary modifications were observed in the prevailing technique of drilling using this drilling machine. Not only this; based on the type of job and specific processes, drilling machines were designed in different ways as per customized needs. Even today, convenient and appropriate modifications are being made. Based on the type of job and power supplied to it and time interval required by machine to deliver designated output; drilling machines are divided into following types:

1) **Hand Drilling Machine:** This type of drilling machine is approximately 300 mm in length. Its lower portion consists of a wheel having three jaws. Drill is mounted and fixed in it. Upper portion of drill machine is fitted with a wooden handle. It is used to apply pressure on the drill during drilling. Handle is rotated by right hand. Speed is transitioned from handle to wheel through bevel gear. This machine is used in carpentry, wireman, electrician and sheet metal work divisions for drilling on sheets and timber.

2) **Chest Brace:** This machine is similar to hand drilling machine except that there is an adjustable strip instead of a wooden handle. Thus, additional and stable pressure can be applied on the drill. Generally, there are two variant of speed in this type of drilling machine. Rest design and function is same as hand drilling machine.

3) **Ratchet Brace:** Large size holes can be drilled with the help of this machine. A ratchet is fitted in this machine. This machine is handy to operate in remote area where any mechanical or electric power is not available. A strong fixture is fitted in it. This fixture is mounted with ratchet. The ratchet is fitted with drill and feed nut. Ratchet is rotated using handle. By rotating feed nut slowly and rhythmically, drill progresses with cutting the material.

All of above three machines are operated by manual power. Drill machines operated by mechanical or electric power are as follows:

- **Portable Electrical Hand Drilling Machine:**

  In a portable hand drilling machine, entire driving mechanism and electric motor are fitted in a compact space. Speed of this machine is relatively more than other machines and hence it is best suited for drilling small holes. This machine is available in two categories: light duty and heavy duty. This machine is available in pneumatic power as well.

- **Bench Type Drilling Machine:**

  This is a small sized drilling machine mounted on work bench. An electric motor and main spindle is fitted to a low height pillar. A drilling wheel is fitted on the spindle. A feed handle is attached to it. The job is held on a work table of square, rectangular or round shape. This machine can drill up to a maximum depth of 12 mm.

Fig 44 - Bench Type Drilling machine

- **Drill Bit:**

  This is made of high carbon steel. Based on the objective and application of drilling, drill bits are available in different sizes, different types and desired angles.

Fig 45 - Drill bit

- **Precautionary measures to be taken during drilling –**

1) It is recommended to use cutting oil during drilling.
2) Hold the job firmly in machine vice during drilling.
3) Don't knock down (hit hard on) drill check.
4) Always use safety goggle during drilling.
5) Use a wire brush to remove scrap / bur (iron powder) generated from drilled hole during drilling.
6) Drill bit has size mentioned on it. Use drill bit of appropriate size only.

- **Threading:** The process of creating threads on the outer / inner side of a pipe is called 'Threading'.

- **Taping:** The process of drilling a metal and creating threads on the inner side of the job is called as 'Taping'. Tap Wrench and Taps are available in different sizes and different types. Drill needs to be done on the job slightly of an appropriately smaller size than the desired size of taping. Taps are available as first tap, second tap and third tap. Taping needs to be done using 1, 2, 3 taps in the same sequence.

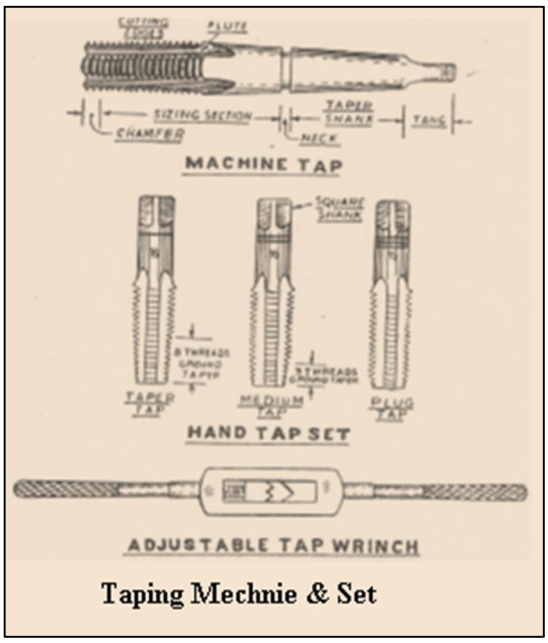


Fig 46 - Taping Machine & set

- **Taping and Hand Taps:** The process of creating threads on the inner side of the object using taps after the drilling up to core diameter is called 'Taping'. This process can be done manually (by hand) or by machine. While taping with hands, hold the tap in tap wrench and initially hold the taper (first) tap from the tap set and rotate it clockwise. This will enable to tap to enter the job and then rotate it slightly in anti-clockwise direction for a quarter turn and again, rotate it clockwise.

  Once the tab enters a specific length inside the job, remove it by rotating in reverse direction and continue taping with medium and third (or bottom) tap in same sequence, to complete taping process.

  Parts of tap – body and shank
  Body had standard threads and flutes. Taper is placed at the mouth of body. Size of tap is mentioned on shank. One end of tap is in square shape. It can be held in the tap wrench.

Precautionary measures to be taken during drilling –

1) Prior taping, ensure the drill is of desired size only.
2) Fit the job on the vice in correct level to avoid misaligned threading/taping. Use tap and tap wrench of appropriate size.
3) While taping, keep moving the tap for half turn in forward and backward direction rhythmically.
4) While taping, do not rotate the tap with jerks. It may damage the taping.
5) Use cutting oil during tapping.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Creation of hole in an object using a machine is known as _____ (Drilling)
2. A small sized drilling machine mounted on work bench is known as _____(Batch type drilling machine)
3. The process of creating threads on the outer / inner side of a pipe is called _____ (Threading)
4. The process of drilling a metal and creating threads on the inner side of the job is called as _____ ('Taping')

Subjective Questions

1) What is meant by threading?
2) What is meant by taping?
3) What precaution should be taken during threading and taping?
4) Prepare a flow chart depicting activities performed during a taping job.
5) Distinguish between threading and taping.

What Have You Learnt?

On completion of this session, are you able to:

- Carry out drilling on MS flat, Threading and tapping on a MS rod.
- Understand the difference between Threading & Tapping
- Demonstrate the use of drilling machine, Bench wise with proper safety precautions.

SESSION 6: WELDING

In welding division, while joining two parts/pieces of same metal, the two metal parts are kept adjacent to each other and their connecting edges are melted by means of heat using welding electrodes and joined with each other. This process is known as 'Welding'. Parts/pieces of an alloy or two different metals can also be joined with each other using welding.
(Students are expected to observe the practical; Demonstration should be given only by teacher)

Types of welding are as follows -

a) **Arc Welding**
b) **Gas Welding**
c) **Forge Welding**

a) **Arc Welding –** This is an important type of welding used in fabrication. In general, fabrication is done by this type of welding. In this type of welding, electric current is used to create an arc. Electric current is controlled via a transformer and current is supplied to holder via welding cable. Welding electrode in the holder is used to create arc wherein arc is created between tips of electrodes. In this process, the intended job (to be welded) needs to be connected to the other cable coming from welding machine for earthing purpose. If this is not done, then the arc is not generated. When we bring the welding electrode in contact with the job to which earthing is done, the arc is generated at the contact point and the heat generated due to this arc melts the metal parts and filler metal in the electrode, and the metal parts are joined with each other. This is known as 'Arc Welding'.

- **Welding Machine –** Step down transformer is used in welding machine. This transformer decreases the voltage (from primary winding to secondary winding of transformer) and supplies more current to the welding rod. E.g. If input voltage to a machine is 230 V, then it is decreased to 60 V and a current of 200 Amp is supplied. Passage of such a large amount of current through welding rod generates heat leading to melting of welding rod and welding is accomplished. Read and understand the information mentioned on the welding machine being used in your school.

b) **Gas Welding –** When a welding is done by means of a flame generated by burning a mixture of a combustible gas and an oxidizing agent (i.e. a gas that helps combustion) in an appropriate proportion; it is known as 'Gas Welding'. For this purpose, mainly acetylene and LPG are used as combustible gases while oxygen is used as an oxidizing agent. Both gases are high pressure gases and a flame is generated using a blow pipe by combination of these gases. Due to the tremendous temperature of 3100˚C to 3300˚C, the welding of all metals is

accomplished satisfactorily. In gas welding, the edges of metal parts and filler metal rod melt due to flame and form a strong cohesive bond. In gas welding, the distance between angle of flame and job is kept 3 mm to 5 mm. Gases are filled in cylinders at high pressure. Hence, they are called as 'High Pressure Oxy-Acetylene Plant'. Regulator is used to supply oxygen and acetylene at optimum pressure. Later on, the combination of gas is supplied through blow pipe and flame is generated as per requirement. Edges of metal melt due to heat of flame. A standard glass (safety) goggle, asbestos apron and hand (safety) gloves are used during gas welding.

- **Gases used during gas welding (Use of common gas in welding) –**
  The way electricity is converted into heat and used during arc welding, gas is used wherever electricity supply is not available.

Two types of gases are used during welding –

1) Combustible gas
2) Oxidizing agent

1) Combustible Gas – The gas that burns itself is known as a combustible Gas.

E. g.

1. Acetylene gas
2. Hydrogen gas
3. Coal gas
4. Burshane gas
5. Mineral gas – A gas that is extracted from mines is called a mineral gas. This category consists of gases like Propane, Butane.

2) Oxidizing Agent – The gas that helps the combustible gas to burn with more intensity is known as an oxidizing agent. (I.e. it increases the temperature of the flame.)

- **Welding Blow Pipe (Torch) –** Major parts of a blow pipe are as below:

1) Body – This is made of brass. This is used as a handle. This is used to give direction and angle to flame.

2) Mixing Chamber – An appropriate and optimum mixing of oxygen and acetylene is done in mixing chamber.

3) Valve – This is used to regulate the inflow of gas from mixing chamber.

4) Tip – This is made of copper alloy. This is used to propel the flame in the welding zone. Tips are available in different sizes. Size of tip depends on the type of welding and the thickness of metal under weld.

- **Welding Tip Maintenance:** During gas welding, it is possible that melted metal may lead to sparkles and spread in the surrounding area in the form of tiny particles and the tiny metal particles enter welding tip. It affects performance of

flame. While cleaning welding tip, do not use any normal wire; instead use welding tip cleaner only. A welding tip cleaner consists of various specially designed wires similar to broaching (i.e. a mechanism to remove material from object using a toothed tool.)

Adhere to following guidelines for effective welding tip maintenance:

2) While tightening tip, use special purpose box spanner. User appropriate plier wherever needed.
3) Do not remove the tip from pipe while it is hot. Let it cool off.
4) Do not attach a cold (normal temperature) tip to a hot pipe.
5) Do not use welding tip like a hammer to knock down job or any other object. Do not rub or braze the welding tip on the welded area.

Oxygen and Acetylene Welding – Amongst all the known gas welding methods, oxy-acetylene is the most conventional and popular method. When acetylene gas was invented, it was burnt with oxygen and it was observed that oxy-acetylene gas has the highest amount of characteristics required for a gas welding flame.

- **Characteristics essential for gas welding (oxy-acetylene) flame –**

1) Different flames for different types of metal
2) Flames of different temperature
3) Characteristics needed to sustain original properties of metal
4) Ability to weld soft metals without burning them substantially
5) Ability to weld same or different metals (and alloys), and a guarantee not to alter the carbon proportion present in the metal
6) Ability to protect the metal from oxidization
7) This type of welding leads to good quality cutting

All these characteristics are observed in this flame only. Hence, this type of gas welding has become very conventional and popular. For oxygen and acetylene welding, oxygen and acetylene gas cylinders or acetylene gas generator is required.

c) Forge Welding – When two metals are heated till they melt, joined with each other and welded after they are cooled off is known as 'Forge Welding'.

Types of welding joint are as follows-

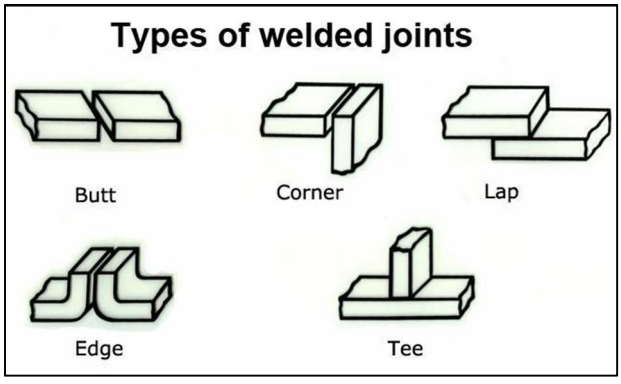


Fig 47 - Welding joints

- **Filler Rods and Fluxes:**
  Flame – This leads to melting of the metal as well as the filler rod.
  Filler Rod – This provides the additional metal needed to form a joint via welding. The filler rod should be selected according to the metal under weld.
  Flux – This is a medium to cleanse and retain molten metal clean. This leads to removal of impure elements from the metal under weld and gives strength to the weld by protecting it from atmospheric contamination.

- **Welding Electrode (Rods) and Flux –**
  Welding electrode is used to generate an arc and to add material to the weld (iron). As a convention during welding; electrode is chosen of same metal as that of the metal under weld.
  Welding rods are used during welding to weld two part of a metal. The rod is chosen of same metal as that of the metal under weld. The rod is melted at the joint by generating required amount of flame using gas. This rod is known as 'Welding Rod' or 'Welding Electrode'. This welding is used to weld spare parts of a machine or fabrication work like welding of cupboards, etc. Joints done by means of welding become proper, good quality and strong. Hence, welding rods are used for jobs that are heavy and need strong bonds.

- **There are two types of electrode:** 1) Bare Electrode; 2) Coated Electrode
  Flux coating enables deeper arc penetration and also quick generation of arc. Electricity is supplied to job and welding rod through welding machine. If both are connected to each other and immediately electrode is lifted 3 mm to 6 mm apart from job; a tremendous amount of electric resistance is generated between job and electric rod. It results into conversion of electric energy into heat energy in the form of an arc. The temperature of this arc is almost 4000˚C and it is sufficient to melt the metal of job and welding electrode.

- **Advantages of Welding:**
  1) Neatness is observed
  2) It's 100% strong and robust
  3) This is cost effective
  4) Metal is not wasted
  5) Metals of same or different types can be welded
  6) Needs lesser amount of time
  7) Welding can be accomplished in any form or condition
  8) Convenient to weld thin as well as thick metal sheets
  9) Weld becomes homogenous and flawless
  10) Maximum penetration is achieved
  11) Maximum efficiency is achieved
  12) Welding can be done manually (by hand) as well as machine.

- **Safety Rules –**
  1) Always use hand screen and goggle during welding.

2) Always use grinding goggle during chipping.
3) Do not bend welding rod once it is attached to holder.
4) Do not connect earthing and holder to each other while the machine is operational.
5) Do not change (amount of) current while the machine is operational.
6) Initially, perform strike welding and later on, perform run welding.

➢ **Safety rules to be obeyed during arc welding –**

1) Do not handle any electrical appliance without sound knowledge about it. It (body) should be always connected to earth (through earthing mechanism).
2) Avoid contact of welding machine with water.
3) Always use of apron, hand screen, safety boots, hand gloves, safety goggle for self-protection.
4) 30 V – 35 V voltage and 60 Amp to 200 amp current is used during welding depending on size of job and rod.
5) Use chipping hammer to remove slag formed on the job. Do not use body of welding appliance or electrode for this purpose. This may damage the holder/electrode and the job, too.
6) Always use chipping goggle while removing slag to avoid slag particles entering into eyes.
7) Keep hot job and rod at a safe and remote place to avoid their accidental contact of anyone's body.

➢ **Precautionary measures to be taken during arc welding –**

1) After switching ON the main switch, ensure that the current is not flowing through the welding machine using a tester.
2) While switching ON the machine, ensure that earthing and electrode holder are not connected to each other.
3) Maintain the angle of electrode equal to 60˚ to 70˚ during welding.
4) Do not alter the current during welding (i.e. while the welding machine is operational).
5) Ensure that the welding doesn't remain hollow.
6) Always use plier to hold hot job.
7) After chipping if it is observed that the quality of welding is not as expected, perform welding again.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Creation of hole in an object using a machine is known as _____ (Drilling)
2. A small sized drilling machine mounted on work bench is known as _____(Batch type drilling machine)

3. The process of creating threads on the outer / inner side of a pipe is called _____ (Threading)
4. The process of drilling a metal and creating threads on the inner side of the job is called as _____ ('Taping')

Subjective Questions

1) What is meant by welding?
2) Draw a flow diagram of a welded job.
3) Describe the precautionary measures to be taken during welding.
4) Which precautionary measures would you take while performing job by arc welding method?
5) How many methods of welding are present? What are those methods?
6) Mention safety rules to be obeyed during arc welding.
7) What is the use of chipping hammer?
8) Why chipping should not be done on a hot job?

What Have You Learnt?
On completion of this session, are you able to: • Understand welding techniques & its use. • Understand different types of welding joints (- T-fillet, open corner, single V, butt joint)

SESSION 7: STUDY OF CONSTRUCTION MATERIAL

Building construction has notable significance in human civilization. Since thousands of years, kings and monarchs ordered the sculptors of their *darbars* to build huge monuments to perpetuate their name. 5000 years ago, pyramids were built in memory of Pharaoh Kings in Egypt after their death. The height of pyramid used to be about 300 feet and they were built using 5 to 6 feet sized rectangular stones. These sculptors demonstrated their immense talent and skill in building such huge monuments with precision. Even today, thousands of travelers and tourists visit Egypt to see this skill and are stuck in awe. Kailas Temple in Verul, India (also known as Elora is carved in such huge stones. Its height is 120 feet. In recent history, everyone is aware of the famous Taj Mahal built by King Shah Jahan in the memory of his beloved wife Mumtaz. During ancient times, human being used to express creativity and skill through civil construction. Even today, whenever we visit any town or city, and see the beautiful homes and good town planning; we tend to say that the town or city is beautiful.

The sculptors from ancient times used all of their skills to the best of their ability while designing and building ceiling of a building. In ancient times, after building stone walls; horizontal, broad stones were used to build ceiling. Even today in old temples, we can see the beams made by stones on the columns formed by stones. The buildings build by Greek people 2000 to 2500 years ago were of this type only. In this type of construction, the pillars were arranged close to each other. It didn't allow constructing huge shrines or sanctuary. Till this time, stones and bricks were the only prominent building material. They had weak tensile strength. Hence, they couldn't be used as beam.

Later on, when man learnt to build arch by arranging stones, he made substantial progress in his construction techniques and skills. Roman people used best of their skills to build round ceiling applying this method. Later on, Arabs used this same technique and skill while building maszids and dargahs. Nowadays, the arches of temples and precinct are constructed by this method only. 600 to 700 years ago in Europe, the sculptors started building cylindrical arches instead of round arches.

Beams start bending at centre due to its weight. Therefore, the distance between two columns needs to be limited. In case of round arches, the stress of weights spreads uniformly and hence the distance between two columns can be relatively increased. In case of cylindrical arches, this distance can be further increased and the dome can be built in stone.

When use of timber and iron started in construction; frame (skeleton) method became a prominent technique of construction. As timber and iron can sustain stress and strain better than stone, construction using frame (skeleton) become easier and possible.

The sculptors identified the salient features of triangular structure in frame (skeleton) method. They constructed triangular, rectangular and pentagon shaped frames (skeletons). Out of them, triangular frame is the strongest of all. Those sculptors started constructing triangles of different size and joined them with each other to form truss for the roofs of small houses.

By arranging horizontal and vertical supports on this truss, it became a practice to place roof tiles of different types between them and complete the ceiling structure.

This further lead to the use of iron/tin or cement sheets for such kind of ceiling. Nowadays, plastic sheets are also being used for ceiling.

In any construction, appropriate devices are utmost essential for measurements. In construction, it is important to draw perpendicular and horizontal parallel lines precisely. Earlier masons had knowledge of plumb bob to assess perpendicular direction. Plumb bob and try square were used for horizontal lines. Later on, level bottle and level tube were used to assess levelling.

The knowledge acquired 5000 years ago is still being used during construction of each and every building worldwide. Today's sculptors have the availability of latest construction material like cement, iron, steel etc. during construction of skyscrapers, huge bridges, etc. Sculptors of ancient times didn't have these material and facilities. Still they built jaw-dropping monuments using a handful of basic materials like lime, stone and clay. This is a testimonial of their skill, grit and creativity!

Structure for Strength –

In nature, all big animals have skeletons of bone. Had there been no such skeletons, their body would have succumbed due to the burden of their own weight. Trunks of trees are fibrous in nature. Lignin is generated in the cell membrane so that the trunk can remain stiff and straight to bear its own weight firmly. This structural characteristic makes timber a strong material compared to its weight.

By understanding this structure gifted by nature, man has also used it to his benefit. There are two concepts in this regard.

1) **Frame (Skeleton) Method –** The skeleton in the body of animals gives apt support to rest of the flexible but delicate organs of the body. Similarly, man creates frame (skeleton) of strong material to lend support to other weak materials. E.g. By using truss, frames, beams; etc. of timber or iron/steel in roofing; weaker materials like roof tiles or grass rooftops are supported. Iron/steel skeletons become even stronger after (cement) concrete is reinforced into it.

2) **Fiber Method –** Though the fibrous materials are probably delicate and flexible; they have good tensile strength. To give them stiffness, if cement is mixed such that these fibrous material bind with each other; then it gives them strength. Similarly, if fibrous material is mixed with brittle material, brittleness can be reduced to a certain extent. E.g. cement is brittle in nature. If asbestos is mixed with cement, asbestos cement sheets can be prepared having good strength. Plastic is easily breakable. However, if tiny glass particles are mixed with plastic, it leads to strong fiber glass. Mortar is also brittle and easily breakable. If chicken-mesh of thin wires is mixed with mortar, it leads to robust Ferro cement. If fibrous paper is mixed with tar, it leads to tough ceiling/roof sheets. As mentioned above, the fibrous material in trees leads to strong timber. It is not necessary to bring two or more different materials together to yield strength. By changing the composition or structure of a material, its strength can be enhanced.

- **Basalt Stones:** Stones are formed from lava. During cooling off, the ingredients of lava acquire crystalline shape. Crystal of every ingredient has a specific form/shape

and while breaking a stone, it breaks as per the crystalline form only. Hence, the stonemason or the person who breaks stones, judges the stone based on sound. As the crystals of this stone are of medium size, in a single stroke he can break the flat side of the stone. This stone is formed by compact basalt rock.

- **Bricks:** Natural caves was the basic and first of its kind residential place for man in primitive ages. He had to utilize timber, stones and clay only to build a house as per his wish. He used to break and reshape the available stones, rocks and give them a structural shape and arrange them in layers to build a wall. Later on, he used to cover up the intermediate gaps and cavities using mud. This might have given him the idea of bricks.

- **Unburnt/Raw Clay Bricks:** These are formed by filling and pressing mud in molds. The clay used for these bricks should be appropriate. It means that the proportion of china clay (finer and granular: 0 – 0.02 mm) and sand (0.05 – 2 mm) should be appropriate. If the proportion of china clay becomes more than crack are developed during drying of bricks while more proportion of sand makes it weaker in strength. These unburnt clay bricks are dried in shadow (not in direct sunlight). To create stronger bricks, initially cut grass is mixed in the mud and kept for decomposition for 10-15 days and then this mud is used for brick formation. These unburnt clay bricks sustain a pressure of 18 kg/cm^2. However, moistness and humidity reduces this strength to 10 kg/cm^2.
  Another method of preparing clay bricks uses a hand machine. Here, water is used in lesser amount (12 -15%). It is made sure that the filtered clay doesn't stick to hand after adding of water; however, it is ensured that the clay becomes homogenous after pressing it with hand machine. It is recommended that these bricks should be dried in shadow for 28 days before their use.

- **Clay and Cement Bricks:** These bricks are used the way unburnt/raw clay bricks are used. However, 3-7% cement is added to clay before formation of mud. Excess water makes them weaker. More the density, higher is the strength of the bricks. Their strength is more than the pure raw clay bricks.

- **Burnt/Fired Clay Bricks:** After drying and burning them in kiln, clay bricks become light and porous but strong in nature. Even if they are soaked in water, their strength doesn't reduce to the extent of unburnt clay bricks. For the sake of convenience during burning them in kiln, their size is kept marginally smaller than the unburnt clay bricks. They have two types. One is local or country bricks what are handmade while another is table molded using iron/steel molds. Burnt/fired bricks are stronger and uniform in shape as compared to unburnt clay bricks. Generally, their size is: 23 cm * 11 cm * 7 cm.

- **Cement Block:** Due to inflated fuel and operational costs, burnt/fired clay bricks are becoming expensive. Hence, hollow cement blocks are being used. Here, mortar

is pressed in a mould using a machine and the block is kept hollow at its centre. They are very strong and bad conductor of heat due to hollowness. They are heat resistant. They need lesser amount of plaster. Also, external painting can also be done with minimal expenses. Generally, their size is: 30 cm * 20 cm * 10 cm.

- **Ash Bricks:** Fly ash, (a polluting solid waste of thermal power plant) is used to make these bricks. This ash is compressed at 28mPa (272atm) pressure and cured for 24 hours. In steam at 66^0 C then toughened with an air entrainment agent. Use of this bricks saves energy in manufacturing, reduces pollution and 20% brick cost.

- **Cement –** Cement is prepared by the reaction of following elements: Calcium, Aluminum, Magnesium and Silicon, with Oxygen and Hydrogen. Out of these, oxides of Calcium, Magnesium, Aluminum and Silicon are abundantly available in nature. The combination of these mixtures is deeply heated in kiln. During the heating process, water present in the mixture evaporates and it attains melted state and thus, forms a compound. After sufficient cooling, it is converted into fine powder form. It is called as 'Portland Cement'. When it is mixed with water, its different molecules form bonds with water molecules. Due to this chemical bond, cement gains strength. However, cement is always used to join different items with each other. The mixing of cement with sand and gravel leads to formation of concrete. Though the cement portion in this mixture is relatively low, due to its bonding ability, the entire concrete hardens like a stone. If already hardened cement is mixed with water, it doesn't provide any strength. So, always ensure that cement is not exposed to the moisture in air that may lead to its hardening. Therefore, before actual use, cement should be stored in a dry area above ground (away from wet surface).

- **Mortar and Concrete –** Cement is used to bond different stone particles together. The cavity between stone particles needs to be filled with cement. To reduce the cost of cement (by means of reduction in quantity), different sized particles (sand, gravel) are combined together. The mixture of cement and sand is called as 'Mortar' while the mixture of cement, sand and gravel is called as 'Concrete'. As concrete consists of bonded pieces of stone, it becomes very strong.

  Characteristics –

  1) Post chemical reaction, cement becomes hard and it remains as is in water.
  2) Cement does not deteriorate or rust in normal climate condition.
  3) The cement concrete is strong in handling stress, but it is weak in handling strain. The structural part that is supposed to have tensile strength or sustain load, iron/steel frames/mesh are used along with concrete as a support. It is called as R.C.C. (Reinforced Cement Concrete).
  4) Cement concrete is neither affected by normal heat nor gets burnt. However, it may burst due to major fire.

5) Cement is bad conductor of electricity or heat.
6) If water content in the cement mortar is high; then after curing, cavities are formed leading to weakening of cement.
7) Higher the cement density, stronger it becomes.

- **Curing and Drying –** Cement powder becomes hard due to its reaction with water. If there isn't enough water for this process where cement is used, this process of hardening doesn't attain its desired completion level and there is no hardening of cement. So, for the first 28 days, cement should always be kept wet and this is called 'Curing'. At the same time, if there is too much water with cement, then take the precaution to maintain the moisture content of the cement construction. Cement consumes water for the hardening process, but it gets dry due to outside air. So, it is necessary to supply enough water.

Curing becomes faster in hot temperature. Strength increases in proportion to curing.

Time required for curing	**Strength of Concrete**
0 days	50 %
1 day	61 %
7 days	85 %
14 days	92 %
28 days	100 %

Required proportion of mortar / concrete in different types of work –

Nature of Work	**Proportion of Cement : Sand : Gravel**
To construct water tank	1 : 3
Making of bricks (Fired/Burnt)	1 : 6
Making of steps (of stones)	1 : 7
Finishing	1 : 2 (or cement water)
Construction of wall	1 : 3
Foundation	1 : 3 : 6 or 1 : 3 : 5
R.C.C. column or beam	1 : 2 : 4
Hand pump foundation	1 : 2 : 4

A) Stretcher Bond – Layer of horizontal bricks in 4 inch wide construction

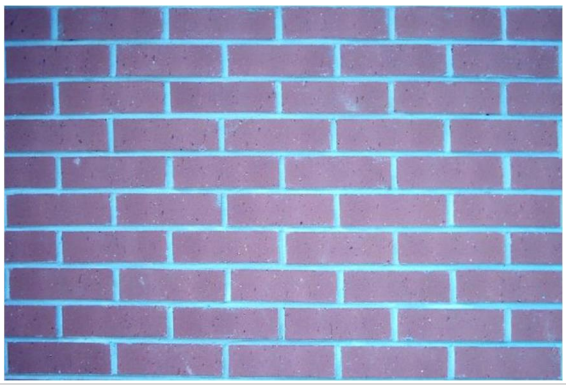


Fig 48 - Stretcher Bond

B) Header Bond – Layer of vertical bricks in 9 inch wide construction

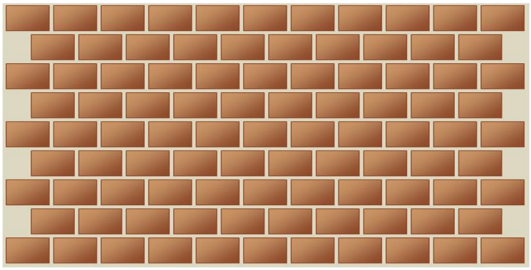


Fig 49- Header Bond

C) – First layer of horizontal bricks (stretcher), second layer of vertical bricks (header) in 9 inch wide construction

D) Flemish Bond – First layer of two horizontal bricks (stretcher) and second layer of vertical bricks (header) in 9 inch construction

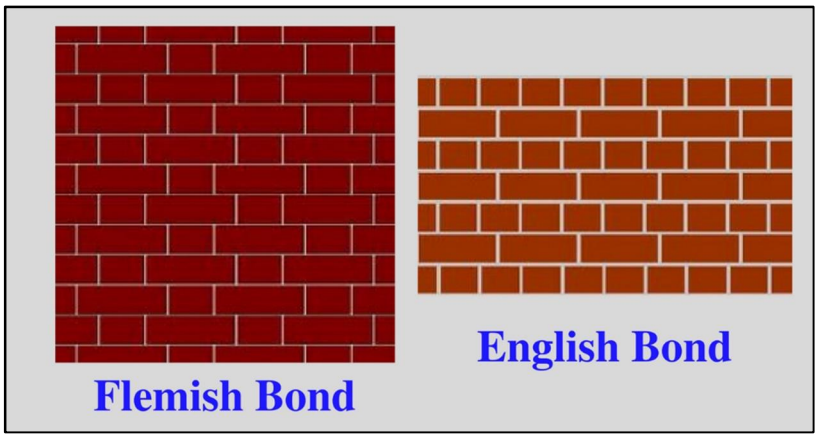


Fig 50 - Flemish bond & English bond

- **Precautionary Measures –**

1) Measure the right angle of the mapping using T-Square.
2) Sprinkle water on the application area before spreading the mortar.
3) Maintain a gap of ½ inch between two adjacent bricks.
4) Ensure that the outer side of the brick layer is properly aligned (i.e. it is in one line) using a rope for each layer.
5) Using a level tube, check if all the bricks of a particular layer are at the same level.
6) Check the right angle of the two walls using the T-Square intermittently.
7) Break the structure of bricks at the location of right angles.
8) While applying a layer of mortar on the brick layer, press and fill the mortar in gaps between bricks using the trowel.
9) Check the right angle between wall & floors / slabs two walls using a plumb bob intermittently.
10) After the work is finished scratch and remove some mortar between the layers of bricks using trowel (Raking).

➢ **Remember this –**

1) Method of Cement Storage – Keep the cement is an air-tight area. Spread a plastic paper or plywood on the floor before keeping cement on the floor. Do not rest the cement bag to wall vertically. Always, pile up cement bags horizontally one above another. Cement storage location should be always dry.
2) Precaution to be taken during landing a nd lifting of cement from the vehicle – Do not use hook to a cement bag while landing the cement from the vehicle. Use safety goggle, hand gloves, face mask and cap on head while landing and lifting the cement.
3) Methods to assess the quality of cement –

- Take a glass full of water. Add 2-3 spoons of cement in it. If cement gets fully mixed with water then it is good quality cement and if the cement sinks to the bottom of glass, then it is poor quality cement.
- When the cement is held firmly in a fist, if it forms a roll or ball, then it is poor quality cement and if it spread on the palms after opening up the fist, then it is good quality cement.

4) Method of Sand/Gravel Storage – Make a heap of sand/gravel. Keep the bricks and bags of sand/gravel around it and form a ring around it to avoid its spreading all over the place.

Fig 51 - Helmet for construction use

5) Method of Bricks Storage – Pile the bricks one above another vertically and horizontally and sprinkle water on them once in 15-20 days.
6) Concrete – The mixture of cement, sand, water and gravel is called as concrete. Devices/Tools: Spade, Mortar Pan, Trowel
7) Mortar: The mixture of cement, water and sand is called as mortar.
8) Types of helmets according to its colour and which coloured helmets are used by whom?
   1) Red – Fire fighter
   2) Yellow – Labor workers
   3) Green – Security department
   4) White – Engineer, Supervisor
   5) Blue – Electrician

9) Machineries, tools and material used in construction –
Machineries – Crane Machine, Trolley, Mixer, Vibrator, Cutter, Grinder, Drill Machine
Devices/Tools – Trowel, Spade, Plumb Bob, Concrete Trolley, Lever, Spirit Level, Level Tube, T Square

Material – Sand, Gravel, Cement, Bricks, Cement Block

10) Which devices/tools are used during plastering?
Trowel, Plainer, Wooden Plane/Float

11) Types of wall (based on types of brick bonds) –
1) Stretcher Bond
2) Header Bond
3) Flemish Bond
4) English Bond

12) Measurement of bricks –

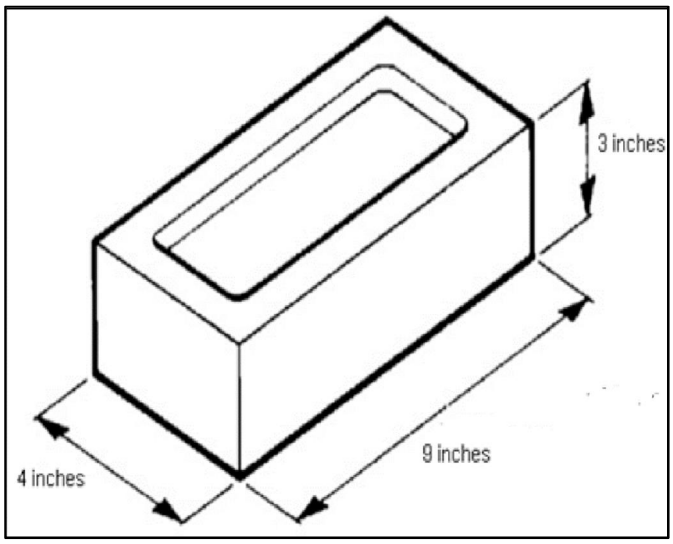


Fig 52 - Bricks

13) R.C.C. Column – The construction done using torsion bars frames is called as R.C.C. construction. Concrete is strong in handling stress/pressure and weak in handing strain. Hence, the column made by using torsion bars is called as R.C.C. column.

14) Why rubber hand gloves are used during construction?
During construction, the hands are exposed to water frequently. The skin of our hands gets damaged due to sustained contact with water and construction material. Sometimes the skin of our hands gets pilled off and cracks develop on palms due to cement. So, to protect the hands from these ill-effects, rubber hand gloves are used during construction.

15) What is gap filling?

Gap filling is pressing mortar between two continuous bricks. The gap between two bricks should be ½ inch.

16) What are the benefits of using gumboots?
Gumboots are up to knee length. They are used to protect legs from cement and water.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____construction has notable significance in human civilization (Building)
2. 5000 years ago, pyramids were built in memory of _____in Egypt after their death (Pharaoh Kings)
3. In any construction, appropriate devices are utmost essential for _____ (measurements)
4. Stones are formed from lava known as _____(Basalt stones)
5. Gap filling is pressing mortar between two _____bricks(continuous)
6. Gumboots are up to _____length (knee)
7. To protect the hands from ill-effects, _____hand gloves are used during construction (rubber)
8. The column made by using torsion bars is called as_____ column (R.C.C)

Subjective Questions

1) Write the information for frame (skeleton) and fibre method.
2) Write a note on unburnt/raw clay bricks.
3) Explain characteristics of cement.
4) What is curing?
5) Mention the names of different bonds in brickwork.
6) Why brick should be soaked in water prior to its use in construction?
7) Mention the types of brickwork.
8) Describe the principle of level tube.
9) What is use of spirit level?
10) What are the necessary precautionary measures to be taken during construction?

What Have You Learnt?

On completion of this session, are you able to:

- Identify building materials, types of walls, types of mortar and types of bonds.
- Demonstrate building different brickwork bonds up to 1 meter.
- Use of plumb-bob & level tube.

SESSION 8: PIPING AND PLUMBING (SIMPLE PIPELINE WORK)

Plumbing connection is a very essential thing to provide water supply in daily life. There are various types of plumbing as per usage and pipe structure and hence plumbing should be done in a scientific method. A skilled, trained person can provide the service of plumbing as per the need of your locality. Also, if plumbing is done in a scientific way; it would lead to optimum use of water resulting into cost reduction.

While undertaking pipeline work at home, tasks like pipe joining, turning the pipes in 90° angle, connecting the different equipments to pipeline, etc. need to be accomplished. Different types of pipes and various relevant couplings need to be used during this work. Hence, it is necessary for the plumbing technician or plumber to know all types of pipe and coupling being used in plumbing/pipeline work.

Types of pipe are decided according to the material used for pipe, size and shape of pipe and sustainable pressure on the pipe (thickness of the pipe wall).

To make the pipe, metals like Lead, Cast Iron, Steel, G. I. (Galvanized Iron - Zinc Coated Wrought Iron) etc. and non-metals like PVC, Plastic, Ceramic, Reinforced Cement Concrete (R.C.C.), Asbestos Cement etc. are used. Lead pipes are used for low pressure pipeline; e.g. urinal, washbasin, flush tank etc. Cast Iron pipes are used for main water supply pipeline and sewage and drainage line. Steel pipes are used for high pressure pipeline; e.g. water pipeline while G. I. pipes are used for domestic pipeline. PVC and plastic pipes are used for domestic pipeline and sewage/drainage pipeline. Ceramic pipes are used for sewage and drainage pipeline. R.C.C. pipes are used for main discharge line while Asbestos Cement pipes are used for sewage and drainage pipeline and to discharge septic gases of toilet high in the air.
Although there are such a different types of material used for the making of pipes; G. I. or rigid PVC pipes are extensively used for domestic plumbing work. These pipes are available in diameter starting from 10 millimeter and length up to 6 meter. Here, the size of G.I. pipe is decided according to its inner diameter while the size of PVC pipe is decided based on its outer diameter. Nowadays ASTM pipe (a type of PVC) is used as an alternate option for the G.I. pipe.
The pressure sustenance tolerance of a pipe depends on thickness of its wall. There are three types of G. I. pipe as per the thickness of pipe wall: 'A' Class (Yellow Band), 'B' Class (Blue Band) and 'C' Class (Red Band). Among these types, the thickness of 'A' Class pipe is the lowest, while that of the 'C' Class pipe is the highest. The capacity of PVC pipe is mentioned in Kgf/cm². It is mentioned on the pipe. Nowadays, CPVC and UPVC pipes are used for domestic plumbing work.

Types of Plumbing –

1) As per types of pipe – e.g. G.I. Pipe, PVC Pipe, etc.
2) As per application/use – e.g. connection of tap for domestic use, connection of tap for domestic sewage pipeline, industrial tap connection, agricultural tap connection, gas tap connection, tap connection for tall buildings/sky scrapers, etc.

➢ **Safety and Precautionary Measures –**

1) It is needed to consider the overall length of pipe prior to cutting by measuring how much pipe will go inside the coupling (in the joint) and due to coupling.
2) Clean the pipe and apply solution on it before making a joint.
3) If a pump is supposed to be used in the pipeline, pressure sustenance capacity of pipe needs to be considered. Use pipe of appropriate capacity. There could be a possibility of breaking of pipe if the pipe is of less capacity.
   If more number of Elbow and T Joints are used in the pipeline, pump would require more energy to propel the water

CHECK YOUR PROGRESS

Fill in the Blanks

1. Plumbing connection is a very essential thing to provide _____supply in daily life (water)
2. _____or rigid PVC pipes are extensively used for domestic plumbing work (G. I.)
3. The pressure sustenance _____of a pipe depends on thickness of its wall (tolerance)

Subjective Questions

1. Mention the tools/devices required for plumbing.
2. What is the application of a T Joint during plumbing?
3. Mention the types of pipe used during plumbing.
4. What are the necessary precautionary measures to be taken during plumbing?

What Have You Learnt?
On completion of this session, are you able to: • Install simple pipe line connection using PVC pipes, connectors and other plumbing accessories.

Important joints of pipes and their application in plumbing:

Joint	Application
 T joint	For two pipelines from main pipeline
 L-bow joint	To turn the pipeline in 90° angle
 Long sweep L-bow	To turn the pipeline with a longer bend
 Plain Union joint	To join two pipelines
 Threaded union	To join PVC pipeline, GI threading pipeline
 Compiling joint	To join one stable pipeline to another unstable pipeline
 Multi-way joiner	To draw 3 to 4 pipelines in various angles from main pipeline
 End cap	To stop water flow completely
 Reducer	To join a small pipeline to a big pipeline

SESSION 9: FLOW CHART

Flow chart means to depict the action flow with the help of a diagram. In other words, it means to give information of action using a diagram. This method is easy to understand. Additional information can be explained in brief; and can be grasped quickly due to its diagrammatic format.

Method to Draw Flow Chart –

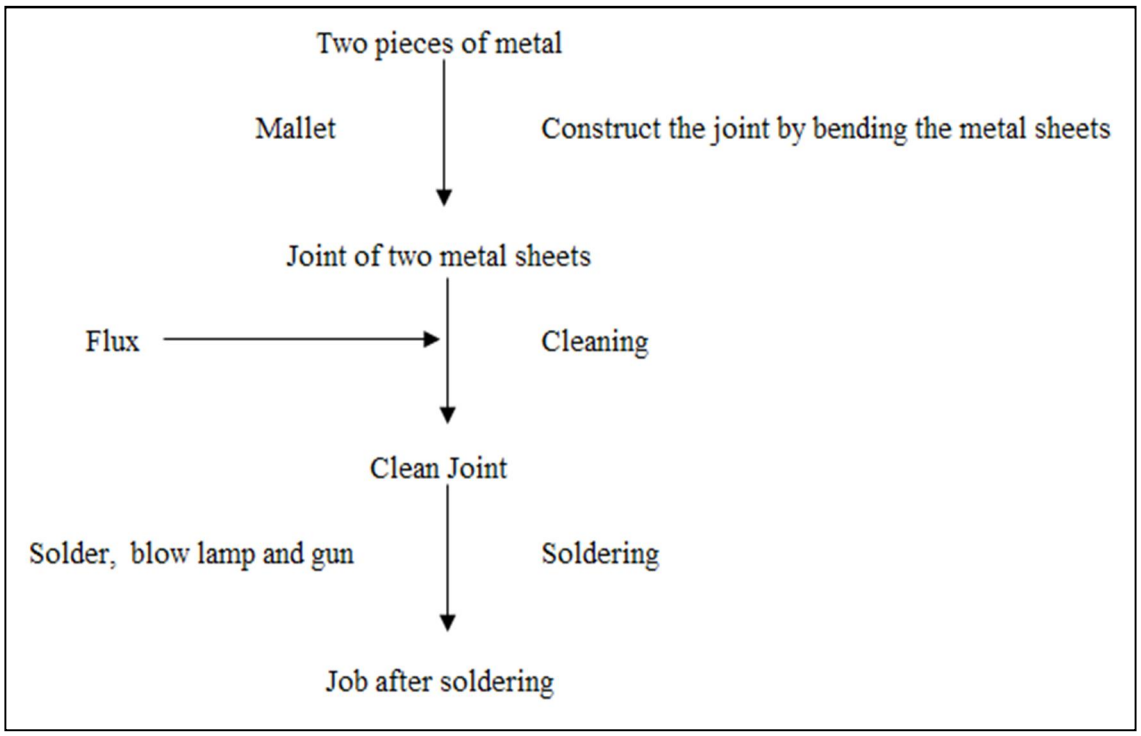
1) Raw material needed before an action is written behind (at the start of) arrow. The name of the product (material) generated from the process is written at the front end of arrow.
2) Used device is written on one side of the arrow and implemented process is written on the other side.
3) The process of original material is written in a straight line. Added material is represented by a horizontal arrow and joined together. However, the tip of the arrow is denoted on the outer side. Other information can be appended as and when required. E.g. Weight/volume of material, time, temperature, etc. This set of actions is called as a 'Process'. The flow chart of entire process is created as mentioned above.

Advantages of flow charts are as below –

1) All actions can be described in a sequential order in brief.
2) Due to systematic drafting, none of the parts is forgotten (or omitted).
3) It is possible to ensure that the goods, raw materials used are not wasted due to proper planning.
4) Easy to estimate the approximate time needed for actions. So effective time management is possible.
5) It is easy to identify exact amount of expenses incurred for specific actions.
6) It is easy to remember process/description.
1) The written information is concise, accurate and distinct.

Limitations – It is difficult to make the flow chart in a demonstration wherein, we do not process the material but measure/act using the tools. And it's also less usable. E.g. it is difficult to draw a flow chart for actions like plain table survey, dumpy level survey, electric circuit, etc. In such cases, the actions can be written in an order only.

Example 2: Soldering (Engineering) –



CHECK YOUR PROGRESS

Fill in the Blanks

1. Diagrammatic representation of sequence of performed actions is called as _____ (flow chart)
2. Drawing flow charts is difficult in that practical where goods are not _____ (processed)

Subjective Questions

1. Describe the flow charts
2. Make a sample flow chart as described in the session

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate and create flow chart as per the need.

UNIT 2

ENERGY & ENVIRONMENT

SESSION 1: INTRODUCTION TO ELECTRIC APPLIANCES, TOOLS AND SYMBOLS

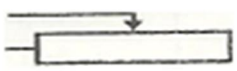
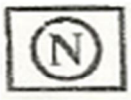
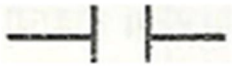
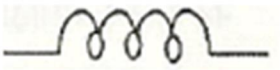
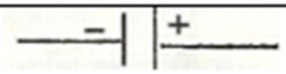
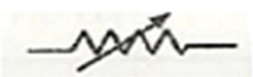
Introduction –
Energy is required to perform any task. Often this energy is not visible to eyes. Energy is stored in a chemical form in kerosene, diesel, wood and food products. After burning wood, chemical energy is converted into thermal energy.

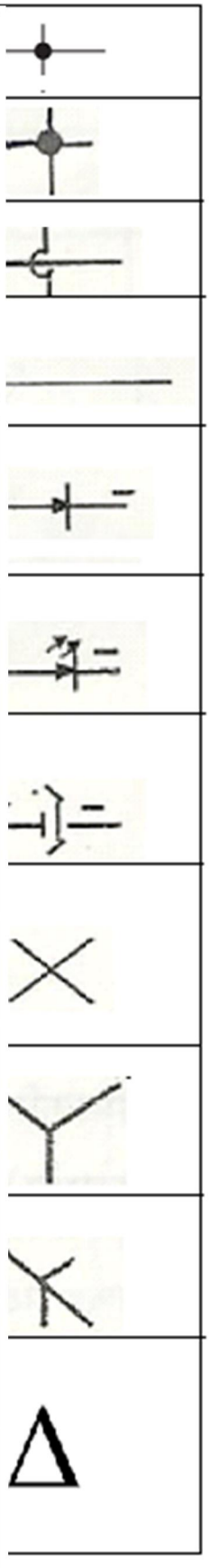
Sources of Energy – Wood, Fossil Fuels, Coal and Mineral Oil are the traditional sources of energy. Wind Energy, Solar Energy, Hydroelectric Energy, Biogas, Biodiesel and Nuclear Energy are the renewable sources of energy.

Electric Energy –
Electric power is a charge, which gets transmitted through some devices and gets converted into mechanical power, heat and light. Every material is made of three states: solid, liquid and gaseous. Not all substances are conductors of electricity. Some are good conductors, some are mild conductors and some are bad conductors. Gold, Silver, Copper, Iron and Aluminum are good conductors of electricity while dry wood, glass and plastic are bad conductors of electricity. As electricity is a very essential energy; copper, aluminum and galvanized steel are used for its affordable transmission. Electricity is an indispensable part of human life, so its scope has expanded. Apart from domestic/rsresidential lighting/illumination, other electrical appliances, amenities and small and large scale businesses solely depend on electricity. Hence, efforts are in place to find various sources of power generation. Here, we will study various electrical connections, relevant materials and tools, its care and safety measures for domestic use.

- **Symbols related to Electricity Domain –**
  It is necessary to get information about electric connection, and related symbols while working with electricity. An institute called 'Survey of India' drafts and standardizes these symbols. Symbols are effectively used for maps, transportation, government proceedings, as well as for power wiring diagrams and other electrical work. Symbols enable easy reading and understanding of a map, route or a circuit diagram and give a crystal clear understanding of it.

Symbols related to Electricity Domain –

Positive wire	+ Ve	Variable resistance with changing point (Potentiometer)	
Negative wire	-Ve	Bell Indicator (A number to be written at the 'N' to indicate whether it is 1-Way or 2-Way.)	
Earthing		Arial	
Fluorescent Tube		Capacitor	
Voltmeter		Choke	
Ammeter		Winding	
Watt meter		Battery	
Multimeter		Generator (General Symbol)	
Frequency Meter		Motor (General Symbol)	
Simple Resistance		Exhaust Fan	
Inductance or Inductor		Ceiling Fan	
Variable Resistor		Fan Regulator	



Educational Devices/Tools – Table Displaying Different Tools –

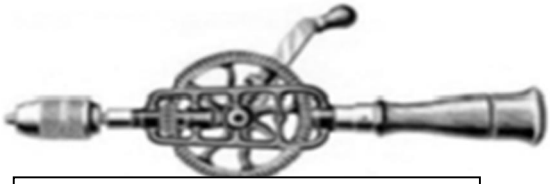
 Fig 1 - Combination Plier	 Fig 2 - Screw Driver
 Fig 3 - Round Nose Plier	 Fig 4 - Poker
 Fig 5 - Side Cutting Plier	 Fig 6 -Neon Tester
 Fig 7 - Ball Pin Hammer	 Fig 8 - Test Lamp
 Fig 9 - Mallet	 Fig 10 - Hack Saw
 Fig 11 - Hand Drill Machine	 Fig 12 - Electric Drill Machine

Fig 13 - Marfa

Fig 14 - Ratchet Brace

Fig 15 - Electrician Knife

Fig 16 - Tenon Saw

Fig 17 - Firmer Chisel

Fig 18 - Hacksaw

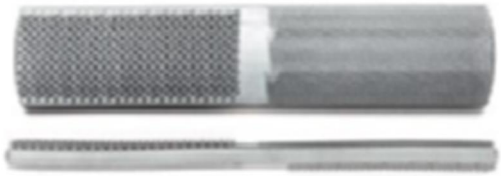


Fig 19 - File

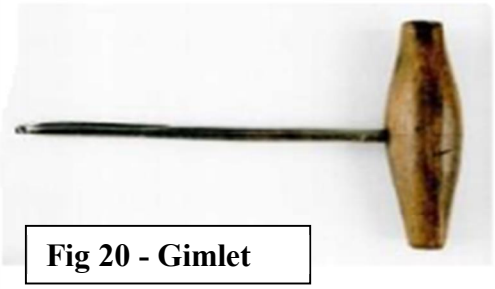


Fig 20 - Gimlet

Fig 21 - Tasseli Plug Tool

Fig 22 - Measuring Tape

Fig 23 - Wire Striper

Fig 24 - Wire Gauge

Introduction to Electrical Devices and Tools – Different tools need to be used during electric work. It is necessary to get the information about these tools, their application, appropriate selection of tools, care and safety precautionary measures to be taken during their use. The tools in the electric work can be classified into holding, twisting, hammering, cutting and drilling tools, etc.

Objective –

1. To provide information about different tools commonly used during electric work
2. To provide information about electric hand drill machine and portable power drill machine

➢ **Commonly Used Tools During Electrical Work –**

- **Plier –** Plier is made of steel alloys. The plier used in electrical work, has insulating material coating of like rubber and cellulite on both handles. Based on shape of its gripping surface; there are two types of pliers: flat and narrow tip. The use and shape of this plier is as following –

A. Combination Plier – This plier is used to twist wires, to cut wire, to bend wire for shaping and twist the screw. This plier is used for multiple purposes. So, it is called as a 'Combination Plier'. This plier is a combination of a flat surface plier and a side cutter.

B. Long Nose Plier – The front tip of this plier is long and tapering (narrow). It is specifically used while working in a remote or congested area. This plier is used to hold wires, to bend the tip of wires and to twist wires.

C. Side Cutting Plier – This plier is specifically used in a remote or congested area to cut wires precisely, to cut joint wires precisely and to cut insulation properly.

Maintenance and Care of Plier –

1. Do not use the plier to cut the iron wires, steel bar, knock down and remove nails.
2. Do not hold hot objects.
3. Do not use like a hammer
4. Ensure that the insulation on plier handles is intact and in good shape. It should not be worn out or damaged.
5. If the plier is not to be used for longer duration; apply oil on the hinges and grease on jaws.

- **Screw Driver –**It is used to fix or remove screws. Screw drivers of length 100, 150, 250, 300 mm are used. A screw driver of 75mm length is called as 'Connector'. Connector is used to fix or remove terminal screws of electric appliances like switch, holder, socket, etc.

  Star Screw Driver – Some terminal screws have a vertical and a horizontal (shape) groove on its head. These are termed as star screws. Star screw driver is used to fix and remove these star screws.

Maintenance and Care –

1. Use screw driver of appropriate size as per the groove of screw.
2. Its blade should not be sharp.
3. Do not knock down on the handle of screw driver with a hammer.
4. Ensure that the insulation on the iron handle does not get damaged.
5. Keep the handle free from oil and grease.
6. Blade should be hardened and tapered properly.

- **Neon Tester –** Its front tip is like connector and has steel blade and it is fitted into a glass or hard transparent rubber handle. High resistance and neon lamp are connected in series to the blade inside handle. The other end of neon lamp is connected to a clip at the back side. If someone is standing on the ground holding a finger on the clip and the blade is connected to electric current (to the phase); it gets earthing through phase wire and human body. This leads to electric circuit completion and the lamp in the tester illuminates and thus the existence of electric flow can be identified. We can test the continuity of phase wire only; however, the continuity of neutral wire cannot be tested.

Maintenance and Care –

1. Do not handle tester roughly.
2. Ensure that the inner neon lamp is in good (working) condition.
3. Do not use it as a screw driver.
4. Do not check high voltage with this tester.

➢ **Test Lamp –**

Test lamp is formed by connecting two PVC wires to an ordinary bulb holder. With a neon tester, only the continuity of phase wire can be checked but the continuity and faults of an electric circuit cannot be checked with it. Test lamp can be used to check continuity, short circuit, open circuit, earthing and polarity test. To check a three phase supply, two lamps of same wattage and voltage ratings are connected in series.

- **Hacksaw –** Generally there are two types of hacksaw.
  1. To cut the timber/wood
  2. To cut iron, PVC
  3. Also there is hacksaw with forward teeth direction and reverse teeth direction. This hacksaw is used in a remote or congested area.

- **Hand Drill Machine –** It is used for minor tasks like drilling small holes in wood, to fix screw, etc.

- **Electric Drill Machine –** This tool operates on electricity and rotates with a high speed. So it needs to be used with utmost precaution. It is used to drill various sized holes in wood, iron/steel, concrete wall. Different types of drill bits are

available in various sizes and they should be used for specific tasks only. Ensure that this machine doesn't get in direct contact of water; otherwise it may lead to electric shock during work and also may damage the circuit inside the drill.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Biodiesel and Nuclear Energy are the _____sources of energy (renewable)
2. Every material is made of three states: _____,_____and _____ (solid, liquid, gaseous)
3. Plier is made of _____(steel alloys)
4. _____ Front tip is like connector and has steel blade and it is fitted into a glass or hard transparent rubber handle. (Neon tester)
5. Test lamp is formed by connecting two _____wires to an ordinary bulb holder (PVC)

Subjective Questions

1. What is meant by symbols?
2. Where are the symbols used?
3. Draw any five symbols that you know and describe them.
4. Prepare a chart of symbols and place it in workshop.
5. Which tools and devices are used during electric work?
6. How to take care of a screw driver?
7. Mention different applications of a plier.
8. Describe the design of a neon tester.

What Have You Learnt?
On completion of this session, are you able to: • Identify electrical tools and equipment, their usage and the safety measures to be taken while using them.

SESSION 2: TYPES OF WIRE, CABLES & SWITCH

Introduction –

This wire (conductor) is used as a medium to transmit electricity from one place to another. Different types of wires are used for various electrical connections. The amount of load present in the electric connection is also considered while selecting a wire. Loose Wire, Concealed Wire, Underground Wire & Pole Wire are the main types of electric wire.

- **Pole Wire –**
  Aluminum Steel Conductor (ACSR Conductor) – Electric current is transmitted for miles to supply electricity at desired location. For this, poles of small – large size are setup on ground and these wires are connected from one pole to another. These wires are made by considering factors like sunshine, heat, wind and weight. The core is formed by a strong galvanized iron wire and it is surrounded by a twist of six aluminum wires. This enhances its strength.

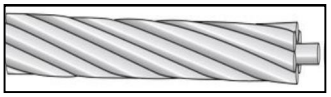


Fig 25 - ACSR Conductor

- **Copper Wire –** It is made up copper and it has two types: hard and soft. To prevent any adverse effect of weather and other compounds on its surface; it is coated with tin. The action of coating or covering an object with tin is called as 'Tinning'. The thickness (gauge) of these wires is decided based on the intensity of electric supply.

Fig 26 - copper wire

- **PVC Wire (Poly Vinyl Chloride Wire) –** The insulation of this wire is very strong as it is made of thermoplastic. They consist of copper strands and are used for concealed wiring and all other types of electric wiring.

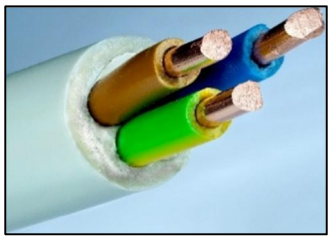
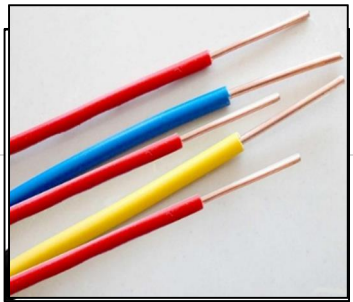


Fig 27 - PVC Wire

- **Weatherproof Wire –** This wire is used for outdoor work, service wires and all other types of electric work. Climatic factors like sunshine, natural heat and rain doesn't have any adverse effect on this wire. It is available in copper or aluminum.

- **Flexible Wire –** These wires have either silk, cotton or plastic cover. These wires are broadly used due to their various attractive colours. This wire is very flexible as it



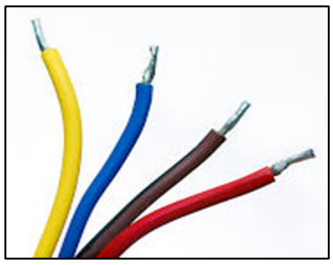
has a large number of thin strands that act as electric conductors or carriers. So the advantage of this wire is that if any of the conductors is broken, the circuit is not interrupted. This wire is used for portable devices and temporary fittings. However, this wire is not used for heavy electric current or for high tension/voltage connections.

Fig 28 - Flexible Wire

- **Single Strand Conductor –** This wire consists of good quality insulation and has only one copper strand (carrier). The conductors/carriers of low voltage electric current are made of such type. These are less flexible. These wires are available in different gauge.

Fig 29 - Single Strand Conductor

- **Multi Strand Conductor –** This wire consists of good quality insulation and has more than one strand (carrier). They have higher capacity of carrying electric current. The general terminology to name these wires in day to day business is like 3/20, 7/18, 19/18. Here, the first number denotes the number of strands and the second number indicates the thickness (gauge) of each strand like 3 strands of 20 gauge, 7 strands of 18 gauge, 19 strands of 18 gauge.



- **Cable –** A wire made by inserting two or three different wires in a strong insulation is called as a 'Cable'. It is made of either copper or aluminum. Eve n this type of wire has different types and gauge, too.

Fig 30 - Cable

- **Armed Cable –** A cable that is packed with galvanized strands, strips or steel tape to protect against any potential mechanical damage is called an 'Armed Cable'. These cables are made in 3 cores. Conductors in this cable are made of copper or aluminum. Each individual wire has a bundle of multiple strands. This cable can be securely laid underground for further transmission.

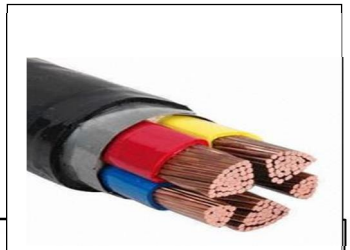
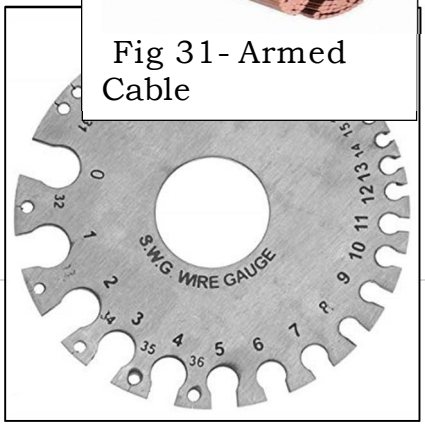


Fig 31- Armed Cable

- **Wire Gauge –** For any domestic or industrial electrical connection, the degree of gauge of wire or strands to be used depends on the electrical equipment that would be connected to the electric circuit. Strands of different gauge need to be used in the appliances like electric bulb, mixer, iron, refrigerator and geyser etc. A standard wire gauge is used to check the gauge of these strands/wires. The conventional



method to measure the number of strands and their gauge is like 1/18, 3/20, 7/18. Here, the first number denotes the number of strands and the second number indicates the gauge (thickness) of each strand like 3 strands of 20 gauge, 7 strands of 18 gauge, 19 strands of 18 gauge, etc.

Fig 32 -Wire Gauge

Table indicating the current carrying capacity of PVC wires of copper strands:

Sr. No.	Conventional Name	No. of Strands	Gauge of One Strand	Safe Current Capacity (AMP)
1	3/22	3	22	10
2	3/20	3	20	13
3	7/22	7	22	15
4	7/20	7	20	25
5	7/18	7	18	30
6	7/17	7	17	40

Switches – Water flow starts after releasing the cock of tap. Similarly, current flow starts in a circuit after pushing switch button. This is called as to switch 'ON' means to start and to switch 'OFF' means to stop. Any lamp or an electrical device in an electrical circuit needs to be switched ON or OFF. Let's study the process that happens during switch ON - OFF. Single phase circuit consists of two wires. One is a phase wire and another is a neutral wire.

In addition to that, there is a copper or galvanized steel wire as well. It is called as 'Earth Wire'. Earth wire is mandatory in the wiring. As per rule, any switch must be fitted in phase wire (live wire) only. With the help of switch, we do the process of isolating two ends of phase wires from each other. After switch ON, the two ends of phase wires are connected and the circuit is completed leading to flow of electric current. At switch OFF, these two ends of wires get disconnected and the electric current flow halts. We can start or stop electric lamps or electric appliances using a switch. Electric appliances such as lamps, tube light, fan, TV need to be switched on and off frequently in domestic wiring. These actions can be conveniently done with the help of switches. Following are the types of switch based on their application –

Different Types of Switches –

1. Single Pole Switch
2. Twin Knob Switch
3. Two Way Switch
4. Two Way Centre off Switch
5. Straight Intermediate Switch
6. Series – Parallel Switch
7. Cross Intermediate Switch
8. Double Pole Switch

9. Bell Push Switch
10. Bed Switch
11. Table Lamp Switch
12. Automatic Switch
13. Main Switch

All switches have three parts: base, top and contact mechanism. Base is made of Ceramic or Bakelite. Top is made of Bakelite or PVC. Contacts are made of copper, brass or bronze metal. The current carrying capacity of the switches used for lamps, fans is 5 ampere and rated voltage is 250 volt. The current carrying capacity of the switches used for power wiring (medium voltage) is 15 ampere and rated voltage is 250 volt. Three phase circuits have different switches. Switches are available in round, rectangular, square and cylindrical and various fancy shapes.

Fig 33 - single pole switch

- **Single Pole Switch -** There are two terminals for wire connection in this switch. In one terminal the phase wire coming from supply and in second terminal, supply wire going to load are connected. Both contacts connect to each other when the switch is ON. Piano type (Tumbler type) single switches are also available. One lamp can be switched on or off using this switch.

- **Twin Knob Switch -** There are three terminals for wire connection in this switch. Out of these terminals, two terminals of one side are shorted (connected) with strip. Phase wire is connected to it. Two different wires are connected to load for the two terminals present in front of shorted strip. They are also called as 'Off Wires'. This switch has two knobs. Each knob can be made on - off individually by moving up and down. Two lights can be controlled from one place using this switch.

- **Two Way Switch -** There are three terminals for wire connection in this switch. Out of these three terminals, two terminals are shorted with copper link (strip). They are called as 'Common Terminals'. It has only one knob. After pushing knob up, the upper horizontal contacts match. At that time lower contacts get separated. After pushing knob down, the horizontal contacts match and upper contacts get separated. Staircase wiring, godown wiring consist of such types of switches.

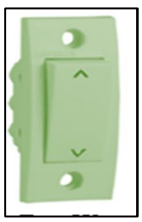


Fig 34 - Two way switch

- **Two Way Centre Off Switch –** The design of this switch is similar to a Two-Way switch. However, when you bring the switch to middle of knob, lamp switches off immediately. It is used for staircase wiring or bedroom.

- **Straight Intermediate Switch –** This switch has a total of four terminals. Contacts match horizontally at the up position of switch knob. As the knob goes down, horizontal contacts get separated and become straight. It can also be used instead of a Two-Way switch. With the help of this switch, one lamp can be operated from three different locations.

- **Series –Parallel Switch –** This switch has a total of four terminals. Only horizontal contacts of the upper side match at the up position of switch knob. Lower terminals remain separated. As the knob goes down, contacts become straight. When you bring the switch to middle of knob, lamp switches off immediately. This switch can be used to connect two lights once in a series connection and once in a parallel connection. When the lamps are connected in series, they glow dimly and while in parallel connection, they glow fully as per their wattage.

- **Cross Intermediate Switch –** This switch has a total four terminals. Contacts become straight at the up position of the knob. As the knob goes down, vertical contacts get separated and match with the cross method. With the help of this switch, one lamp can be made on - off from three or more locations.

- **Double Pole Switch –** This switch has a total four terminals. Terminals get separated at the up position of the knob. As the knob goes down, both contacts become horizontal. This switch is used to connect main power supply.

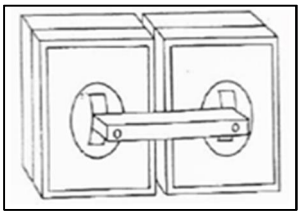


Fig 35 - Double pole switch

- **Bell Push (Piano Type) –** It has two terminals similar to a single pole switch. Here, one terminal is connected to phase and other terminal is connected to the off wire leading to the bell. These switches are available in round, cylindrical shape. When we push the knob; contacts get connected and switch becomes ON and bell rings. After releasing the pressure off the knob, it goes up due to spring action and contacts get separated. This switch is used in call bell circuit.

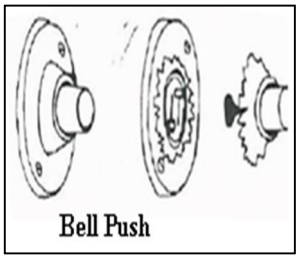


Fig 36 - Bell Push

- **Bed Switch –** The design of this switch is similar to a single pole switch. It is cylindrical in shape. As this switch is not mounted on a switchboard, it is also called as a “Hanging Chord Switch”. Generally, this switch is kept in hanging position along bedside. Lamp can be made on-off with the help of this switch. Based on this principle, bed switches are

manufactured in various fancy types.

Fig 37 - Bed switch

- **Table Lamp Switch –** The shape of this switch is flat, rectangular and it consists of a cylindrical knob. Contacts match after pressing the knob and get separated after pressing the knob again. That can be repeated as and when required. It is used in table lamp.

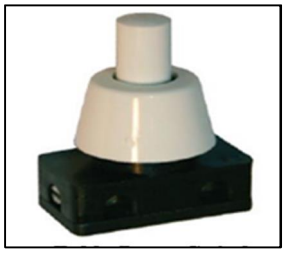


Fig 38 - Table Lamp Switch

- **Automatic Switch –** It is a single pole switch but it has a long rod instead of a push button. This switch has a provision to switch a lamp ON automatically once the door is opened. While the door is closed, the long rod is in a pressed condition and the circuit is OFF. After opening the door, door pressure on the rod is released and the switch is operated. Thus, the circuit turns ON and the lamp is lit. Automatic Switch is used in a refrigerator, scooter brakes and pedal.

- **Main Switch –** The wires of the Mains, supplied by the electricity distribution company, first connect to the electric meter of house (or factory) and electricity is further supplied in the house or the factory wiring through a distribution box. The distribution box has a provision of many circuits as per requirement, and a main switch is installed in each circuit.

  By operating this main switch either ON or OFF, the current flowing through the wiring can be operated. Due to this the lamps or load of the same circuit in the house or the factory can be switched off while keeping lights or loads in the other area switched ON. Entire power supply can be controlled via main switch. The main switch used for single phase supply is called as 'I.C.D.P.'. It means 'Iron Clad Double Pole Main Switch'. 'I.C.T.P.' means 'Iron Clad Triple Pole Main Switch'. It is used for electric appliances being operated on a three phase power supply.

CHECK YOUR PROGRESS

Fill in the Blanks

1. In PVC wire PVC stands for _____ (Poly Vinyl Chloride)
2. _____ Wire consists of good quality insulation and has more than one strand (carrier). (Multi Strand Conductor)
3. A cable that is packed with galvanized strands, strips or steel tape to protect against any potential mechanical damage is called an_____. ('Armed Cable')
4. _____wire is mandatory in the wiring (Earth)

Subjective Questions

1. What is meant by wire?
2. Mention five different types of wire.
3. What is meant by insulation? Describe its necessity.
4. What is meant by a multi strand carrier/conductor?

5. What is the application of armed cables?
6. Remove the different coatings of specified wires and cables. Note down the count of the strands present in them.
7. Mention the function of a switch in an electric circuit.
8. What is meant by main switch?
9. Describe the internal design of a Two-Way switch and draw its diagram.
10. Open all the switches placed on the table using a screw driver and refit them again.
11. Connect a wire to a switch terminal.
12. Mention the application of a wire gauge.
13. What are the precautionary measures to be taken during wire gauge handling?
14. Identify the gauge of specified cables and wires.
15. Mention the current capacity of each strand/wire given in the topic.

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate the use of wire gauge for measuring the diameter of the wire. • Identify the various types of wire, Cable and switches.

SESSION 3: JOINTS OF ELECTRICAL CONDUCTOR WIRES

Introduction – While doing electrical connection at home, we need to join the wires at few places. It is essential to have these joints appropriate and firm. In case of a loose joint, there is a possibility of sparking that may lead to fire. In addition to this, it may damage the electrical appliance connected to the electric circuit and also pose a potential threat to us. Hence, it is utmost essential to join various electric wires properly and carefully.

Precautionary Measures – The connection and joint of electric wires carried over poles is always exposed or bare. However, from a safety perspective, it is necessary to secure all other electric joints properly. Various types of insulation tapes (adhesive tapes) are available in market. So as to secure an electric joint, wrap few rounds of an insulation tape around the joint.

Devices – Cutter/knife, plier, foil paper, insulation tape, etc.

Material – Various types of strands, wires and cables

1) **Simple Joint –** This joint is made on a single wire. First remove insulation of approx. 5 cm at the end of each wire. Braze the exposed ends with foil paper for cleaning purpose and then twist them with each other as depicted in this diagram.

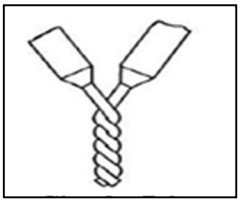


Fig 39 - Simple Joint

2) **Britannia Joint –** This joint is made for bare copper strands or wires. Initially, these strands/wires should be brazed with sand paper (0) and should be connected to each other (side on connection) as depicted in the diagram. Later on, wrap another loose and bare wire to this connection and secure a firm joint.

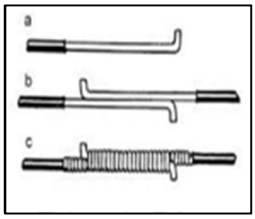
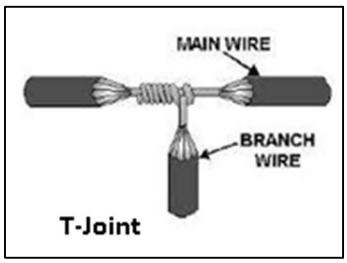
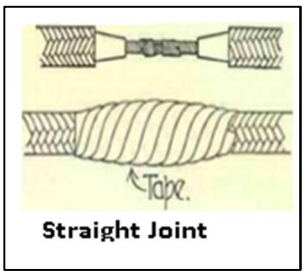


Fig 40 - Britannia Joint

2) **T Joint –** T Joint means two cables are connected to each other in a right angle.





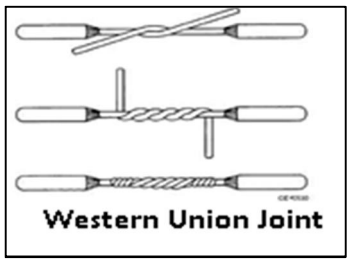


Fig 41 - T Joint

3) **Straight Joint –** This joint means face to face joining of two cables.

4) **Western Union Joint –** This joint is used to increase the length of conductor in an overhead line. This joint is apt for cases where there is supposed to be more strain on the conductor.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The connection and joint of electric wires carried over poles is always _____or _____(exposed , bare)
2. In case of a loose joint, there is a possibility of _____that may lead to fire (sparking)
3. It is utmost essential to join various _____properly and carefully. (electric wires)

Subjective Questions

1) Why is it necessary to provide joints in electric transmission lines?
2) Draw diagrams of any two joint types and describe the procedure to secure those joints.
3) Secure/form joints of given set of strands/wires.
4) Where is a T Joint used?
5) Distinguish between a Straight Joint and a Simple Joint.

What Have You Learnt?

On completion of this session, are you able to:

- Perform various types of joints used for joining electrical wires
- Demonstrate the use of wire stripping hand tools for Stripping wire.
- Demonstrate the use of plastic electrical tape

SESSION 4 : SIMPLE WIRING

In this topic, we are going to study the basic concepts related to electric technology. We are going to learn how to implement these basic concepts to accomplish simple wiring.

- **Basic Concepts Related to Electric Technology –**

1) **Voltage –** The electrical pressure needed to transmit electric current through a medium or a conductor OR an electrical pressure that drives transmission of electric current is known as 'Voltage'. It is also known as an 'Electromotive Force'. This needs to be measured in volt.

2) **Direct Current –** Electric current transmits from higher potential (availability) to lower potential (availability). Such a stable and continuous current is known as 'Direct Current'. Conventionally, this is called as 'DC Current'. This is generated from a battery, generator or rectifier.

3) **Alternating Current –** A type of electrical current, whose direction and value changes for a specific number of times in an interval of one second, is known as an 'Alternating Current'. Conventionally, this is called as 'AC Current'. This type of current is generated at a large scale and it is transmitted to long distance. Current flowing in power lines and normal household electricity that comes from a wall outlet is alternating current.

4) **Resistance –** The tendency to resist an electric current is known as 'Resistance'. Resistance is measured in 'Ohm'. Resistor is used in electric circuits to control electric current. Based on the requirement, resistors of different capacity are used in the electric circuits.

5) **Transistor –** The device that converts high voltage current into low voltage current is known as a 'Transistor'. These transistors play a vital role in electrical and electronic instruments.

6) **Capacitor –** The application of a capacitor is to store charge to a certain extent and to regulate normal fluctuations in electric current and pass it further to electric circuit.

7) **Conventional Current –** The direction in which electric current circulates in the electric circuit is called as 'Positive Charge'. The AC current passing through the conductor circulates in opposite direction after a certain time interval. This current is known as 'Conventional Current'.

8) **Conductive Path –** The electric current path of an electric circuit or path of current passing through an instrument is called as 'Conductive Path'. Generally,

we can see it in the form of sparks in an electric circuit, the thunderous lightning in the sky or spark plug of a motorcycle.

9) **Watt –** Electric power is measured in terms of watt. The amount of electric power required to pass 1 ampere of electric current through an electric circuit having 1 volt voltage is 1 watt.

10) **Ohm's Law –** While designing wiring, apart from the instruments present in the load; the voltage, current and resistance also need to be considered. This is because all of them are dependent on each other. This interrelation was invented by a scientist named 'Ohm'. As Per Ohm, at a constant temperature, the electric current flowing through an electric circuit is directly proportional to voltage of the circuit and inversely proportional to its resistance.

Voltage (V) = Current (I) x Resistance (R)

It is necessary to understand all of the above mentioned factors while designing electric circuit. We are going to learn simple wiring in this topic. For that purpose, we need to draw an electric circuit diagram.

Demonstration- To learn simple wiring assembly

Objective – To learn simple wiring assembly
Devices – Screw Driver, Wire Cutter, Tester, Plier
Material – Flexible, wire, Holder, Switch, Bulb, etc.

Electric Circuit Diagram –

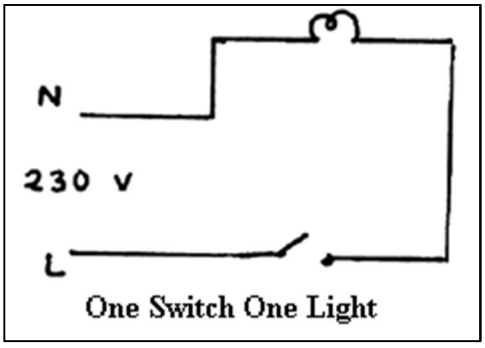


Fig 42

1) **Simple Wiring – Glow a lamp using one switch –**
Preparation –
   1) Study different symbols and signage
   2) Gather electric appliances associated with symbols. E.g. Wire, Switch, Holder, Bulb, Choke, Ammeter, Voltmeter, etc.
   3) Plier, Wire, Cutter, Screw Driver, Tester, etc.

Design an electric circuit diagram –

Procedure –

1) Connect two wires to holder
2) Connect one of the wires to one terminal of switch.
3) Connect a wire to another terminal of switch.
4) Connect open ends of both wires to power supply.
5) Mount bulb in the holder.
6) Start the switch (make it ON). Bulb will glow.

- Switches are of two types. 'One-Way Switch' and 'Two-Way Switch'. In a one-way switch, there is only one path after switch. (It has two points). Two-way switch has two paths after switch. (It has three points).

  Using a one-way switch, one lamp can be operated. This type of circuit is used to operate lamps in home. Bulb is always connected to live wires. Else, one may encounter an electric shock due to contact with holder pins while replacing a bulb from holder.

Instructions –

1) Wire insulation should be approximately 1 cm only.
2) While connecting wire to a switch, always bend it backwards before connection.

Note – Same electric circuit is used for AC as well as DC.

- **Skill Acquisition –** To learn difference between series and parallel connection

- **There are two types of simple circuit.**

1) Series Method –

Objectives –

- Control two bulbs using a single switch
- Control three bulbs using a single switch

  E.g. the decorative string lights available in electric appliance shops are assembled by series connection method.

2) Parallel Method –

Objectives –

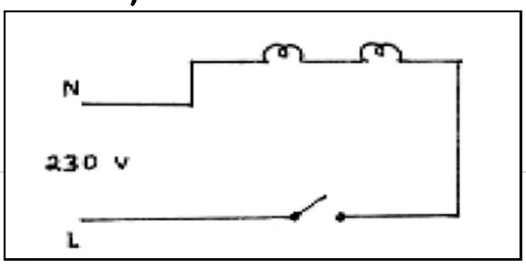
- Control two bulbs using a single switch by parallel connection method.

  E.g. the electric connections in home and offices are based on parallel connection method.

1) Glow two bulbs using a single switch (Series Method)

Preparation –

1) Study different symbols and signage



2) Gather electric equipment associated with symbols. E.g. Wire, Switch, Holder, Bulb, Choke, Ammeter, Voltmeter, etc.
3) Plier, Wire, Cutter, Screw Driver, Tester, etc.

Fig 43 - Series Method

Design an electric circuit diagram for series method –
Procedure –

1) Two holders and two bulbs have been used in this assembly.
2) Connect one terminal of each holder by a wire.
3) As depicted in circuit diagram, connect one end at holder side and another end of switch side to power supply.
4) Mount bulbs in the holders.
5) Start the switch (make it ON). Both bulbs will glow simultaneously.
   In this way, we can connect more than two bulbs in a series.

2) Glow two bulbs using a single switch (Parallel Method)
Preparation –

1) Study different symbols and signage
2) Gather electric appliances associated with symbols. E.g. Wire, Switch, Holder, Bulb, Choke, Ammeter, Voltmeter, etc.

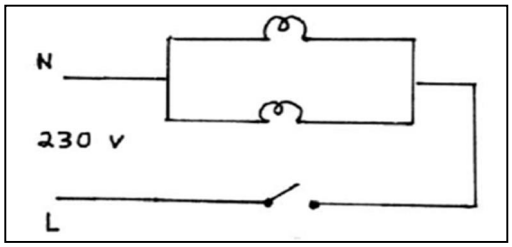


Fig 44 - Parallel Method

3) Plier, Wire, Cutter, Screw Driver, Tester, etc.

Design an electric circuit diagram for parallel method –
Procedure –

1) Two holders and two bulbs have been used in this assembly.
2) Connect one terminal of each holder by a wire.
3) Form a T Joint for one of the wires and reserve another end of it to be connected power supply.
4) Connect remaining two terminals of holders by a wire and join another wire to it by a T Joint
5) Connect another end of this wire to one terminal of switch
6) Connect a wire to the remaining terminal of switch and reserve it to be connected power supply
7) Wrap the insulation tape at the T Joint carefully
8) Mount bulbs in the holders.
9) Connect the wires designated for power supply to power supply
10) Start the switch (make it ON). Both bulbs will glow simultaneously.
    In this way, we can control more than two bulbs by a single switch by means of a parallel method.

Inference/Conclusion –

By connecting two or more lamps in series method, the bulbs provide dim light. This is due to the division of voltage between all lamps. However, in parallel method, all the lamps get same voltage (direct current) leading to brighter illumination with same set of lamps.

Precautionary Measures –

1) While connecting wire between terminals of holder and switch, ensure that there isn't any bare wire. (A bare wire means wire whose insulation has been peeled off.) While connecting wire to a switch, always bend it backwards before connection.
2) Insulate the T Joint of wire properly.
3) Students should not be allowed to start the switch before instructors have personally inspected the electric circuit and wiring.
4) Always wear slippers, shoes while dealing with electric appliances and relevant work.
5) After the demonstration is complete, clean the table immediately.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Electrical pressure that drives transmission of electric current is known as _____ ('Voltage')
2. A stable and continuous current is known as _____ ('Direct Current')
3. A type of electrical current, whose direction and value changes for a specific number of times in an interval of one second, is known as an _____ ('Alternating Current')
4. The tendency to resist an electric current is known as _____ ('Resistance')
5. The device that converts high voltage current into low voltage current is known as a _____ ('Transistor')
6. The direction in which electric current circulates in the electric circuit is called as _____ (Positive Charge)
7. The electric current path of an electric circuit or path of current passing through an instrument is called as _____ ('Conductive Path')
8. Electric power is measured in terms of _____ (watt)

Subjective Questions

1) What is meant by simple wiring?
2) What is meant by holder?
   - Mention types of electric switch.
   - Mention different types of wire.
3) What are the precautionary measures to be taken during wiring/wire connection?
4) What is meant by parallel and series method?

5) Draw electric circuit diagram of various wiring types.
6) Mention the instances where parallel and series method connection is used.

What Have You Learnt?
On completion of this session, are you able to: • Prepare the diagram of a simple electrical circuit • Prepare a simple electrical circuit for operating one lamp by one switch and 2 lamps by two switches. • Connect two or more lamps in a series • Connect two or more lamps in parallel

SESSION 5 : TYPES OF WIRING – STAIRCASE WIRING, GODOWN WIRING

Staircase Wiring – We often see electric wiring in our homes, schools, hospitals, banks, various offices. By means of a switch; lamps, fans can be operated. Merely by pressing a button, various appliances become operational. However, it must be noted that the kind of wiring being used depends on the exact location, purpose and convenience of wiring. Based on the need of the location, the relevant type of wiring can expedite manual work and may prevent any potential accidents. Hence, by means of this demonstration, we are going to learn staircase wiring. While learning such kind of wiring, material and devices mentioned below are required. Staircase wiring is useful in cases where it is desired to switch off a bulb from another location or switch it off from the original location. This kind of situation can be observed in home or offices. Thus, staircase wiring can provide us with a facility to operate a single bulb (or any appliance) from more than one location for the sake of convenience. This is typically useful for staircase, front door or back door of home or offices.

Devices Required for Staircase Wiring –
Plier, Screw Driver, Wire Cutter, Tester.

Study –
The state mentioned in the circuit diagram below, is when bulb is ON. This bulb can be operated (ON or OFF) by both switches. You are supposed to analyze and understand the supply and cut off states of the electric current to the circuit.

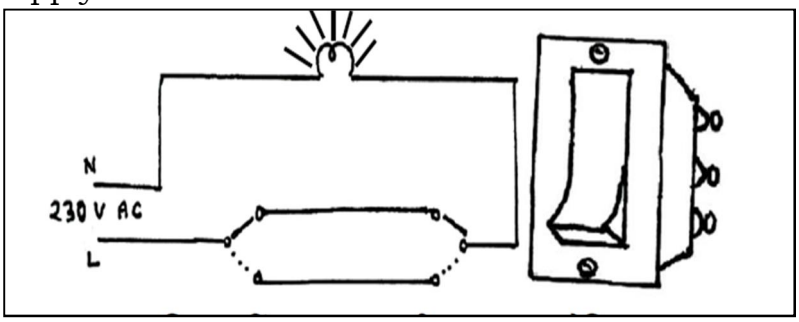


Fig 45 - Staircase Wiring

Procedure –

1) Connect a wire to one of the terminals of holder. This would be the neutral wire.
2) Connect another wire to the remaining terminal of holder and connect its second end to middle terminal of two-way switch.
3) Connect two wires to both terminals of switch and connect them to terminals of another switch in a similar pattern.
4) Now connect another wire to the middle terminal of second switch and reserve it for connection to phase (line) connection.
5) Connect this wire reserved for phase (line) and the neutral wire from holder to power supply.

- **DC/AC Current –** The current that flows unilaterally (in a single direction) is known as 'DC (Direct) Current'. This type of current can be generated from

battery. When current is required in low quantity, dry cell is used. The current whose direction and value changes for a specific number of times in an interval of one second, is known as 'Alternating (AC) Current'. Currently, in majority of the places and homes this type (AC Current) is used for electric wiring. The objects through which electric current doesn't pass are known as 'Insulators'. The objects through which electric current passes easily are known as 'Good Conductors'.

Electricity – Electricity means current/flow of electrons.

Water and Electrons – Comparison –
Water flows through pipe and electricity flows through wire. Both these simple events have a lot of resemblance. When we intake water from a pipe, we plan to use the water, and we don't intend to return the water back from the pipe. When we use electricity, electrons are of no use to us, however, we intend to use energy stored in electrons. Hence, once we extract the energy from electrons, we return them. When (6.25×10^{18}) electrons flow in one second, the current is termed as '1 ampere (1A)' of current.

Staircase Wiring – The name of wiring is derived from the specific location where it is prominently used.

Advantage – Due to use of a two-way switch, a single bulb can be operated from two different locations.

- **Answer questions mentioned below.**

1) Where is staircase wiring used?
2) Why is staircase wiring needed?
3) Which type of switch is used for staircase wiring?
4) What is meant by DC and AC current?
5) From where does DC current flow?
6) Which current flows through the wiring present in our homes?
7) What is meant by insulator?
8) What is meant by good conductor?
9) Which wire is used for staircase wiring?
10) What is the advantage of staircase wiring?
11) How many terminals are present in a two-way switch?

Godown Wiring - In staircase wiring, we operate and control one bulb from two locations. To learn further circuit, it is necessary to learn godown wiring. A typical godown has one room after another in sequence. When we enter first room and turn on the switch; the bulb glows. When we enter second room and turn on switch in that room; bulb from the first room is switched off while bulb in the second (current) room starts glowing. The same happens in next room, too. When we return to second room from third room and operate the switch in second room; the bulb from third room (that was glowing till now) goes off while bulb from second room (that was off till now) starts glowing. Thus, the operation model of godown wiring is

to keep bulb from existing room glowing and turning off bulbs from previously accessed room while the person being present in the existing room.

- **To Implement Godown Wiring Connection –**

A large building where raw materials, grains or manufactured goods may be stored prior to their distribution for sale is known as 'Godown' or 'Warehouse'. The internal structure of a godown is such that there is a provision to store different types of grains in separate rooms. There are ample rooms available in a single godown. In a godown wiring structure, once a certain lamp is lit; another lamp goes off. This allows user to move from one room to next room without a need to go back to previous room to shut off the lamp from that room. Thus, it is not needed to keep lamp from first room glowing till we reach the other end of rooms. The moment, lamp from second room is lit; the lamp from first room goes off. This saves electricity substantially. Hence, it is convenient to use such kind of wiring in a godown holistically. Hence, it is necessary for all to learn and understand such a beneficial type of wiring.

- **Material and Devices Required for Godown Wiring –**

Devices – Plier, Nose Plier, Wire, Cutter, Tester, Screw Driver

Material – One-Way Switch – 1 no., Two-Way Switch – 2 no.s, Holder, Bulb, 3 Wires (Red, Green, Blue)

Circuit Diagram – After switching ON first switch, the circuit of first lamp is completed and the first lamp glows. As the second switch is a Two-Way switch, turning it ON breaks the circuit of first lamp and hence the first lamp goes off. Simultaneously, the circuit for second lamp is completed and hence the second lamp starts glowing now. Third circuit is also based on same pattern.

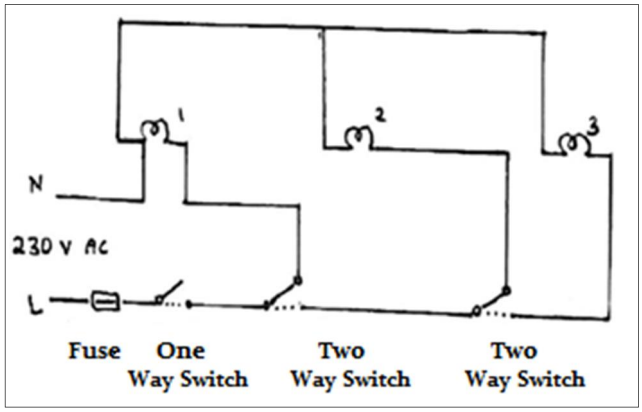


Fig 46 - Godown Wiring

Procedure –

1) Select red wire for phase (line) and connect it to one terminal of One-Way switch.
2) Connect red wire starting from second terminal of One-Way switch to middle terminal of Two-Way switch.
3) Start a blue wire from one terminal of Two-Way switch and connect it to first holder.
4) Start a red wire from third terminal of Two-Way switch and connect it to middle terminal of next Two-Way switch.
5) Start a blue wire from one terminal of this Two-Way switch and connect it to second holder.
6) Start a green wire from third terminal of Two-Way switch and connect it to third holder.

7) Start a green wire from second terminal of third holder and connect it to second and first holder, in the same order. This would be a neutral wire.
8) Mount bulbs in the holders.
9) Provide power supply connection to phase and neutral wire and observe the demonstration.

➢ **Godown Wiring Related Specific Information –**

- The total no. of Two-Way switches needed is always one less than the total no. of rooms.
- While conducting godown wiring, one One-Way switch is necessary.
- In this type of wiring, when second bulb glows, first goes off.
- This type of wiring saves electricity substantially.

CHECK YOUR PROGRESS

Fill in the Blanks

1. In staircase wiring, we operate and control one bulb from _____locations (two)
2. A typical godown has one room after another in _____ (sequence)
3. While conducting godown wiring, one One-Way switch is _____ (necessary)
4. Godown wiring saves _____substantially. (Electricity)

Subjective Questions

1) Which types of switches are used in godown wiring?
2) Which type of wire is used in godown wiring?
3) What should be the location and height of switchboard?
4) How to decide size of wire?
   - What should be the current rating (ampere) for the switch?
5) Draw circuit diagram of staircase wiring and label the symbols used in it.
6) Distinguish between staircase wiring and godown wiring.

What Have You Learnt?

On completion of this session, are you able to:

- Draw a diagram of the circuit for staircase wiring method
- Demonstrate staircase wiring
- Draw a diagram of the circuit for godown wiring method
- Demonstrate godown wiring method

SESSION 6 : EARTHING

If leakage current in the appliance or its internal metal increases, it becomes electrically charged. Due to removal of insulation on wire or excessive removal of insulation during connection or loose connection or due to some other reason; the insulation of wire gets damaged. This tends the appliance, machinery parts to be electrically live (i.e. electrically charged). If there is no provision of earthing and an operator gets in contact with such appliance or machinery part, it may lead to an electric shock to the person and subsequently serious injury. However, if proper earthing is done for the metal parts of appliance associated with machinery; the operator (who is in contact with the machine) is protected from any potential electric shock.

Electricity always prefers a path through objects having less hurdles/resistance. Also, electricity flows from high voltage area to low voltage area. Voltage of ground is assumed to be 0 (zero) volt. This means, electricity preferentially flows towards ground. Earthing is a provision to pass on the leaked electricity to ground before it passes through human body. As the resistance of earthing conductor is relatively less than that of human body or any organism, any potential leakage current flows through earthing wire towards ground. (It is assumed that the potential of ground is zero.) Thus, we can prevent electric shock. Therefore, it is essential to implement earthing for all appliances related to electricity and their every part.

- **Selection of Activity –** Implement earthing in school or town.

1) Gather detailed information about plate earthing and educate students about it.
2) Implement earthing in entire town as a part of a socially beneficial service.
3) Repair electric appliances of residents or students as a part of a socially beneficial service.
4) Check whether the electric appliances available in school have proper earthing.
5) Implement earthing for the electric appliances available in school that do have earthing yet.

- **Material and Devices/Tools Needed for Pipe Earthing –**

Material – Earthing Plate, G. I. Pipe, Salt, Coal, Brick Pieces, Sand, Funnel, Brass Nut Bolt, Earthing Wire (The current carrying capacity of this wire should be double of the current carrying capacity of entire electric circuit.)

Devices/Tools – Spade, Shovel, Head Pan, Bucket, Plier, Spanner, etc
At times, it may happen that the earthing implemented at home may have broken or damaged. In such cases, educate the family members about potential hazards. Carry out inspection in school as well as town and implement earthing, wherever necessary.

Procedure –
Dig a pit measuring approx. 1 sq. metre area and 2 metre deep.

1) Take an earthing plate made of copper or cast iron measuring up to 60 cm x 60 cm and 0.5 cm thickness.
2) Attach a 14 gauge copper wire firmly to the plate using nut bolts and pass it through G. I. pipe.
3) Mount the G. I. pipe at the centre of the pit and arrange 15 cm thick alternate layers of salt, coal, brick pieces and sand around this pipe.
4) Mount a funnel on the pipe and pour water in it.
5) Connect and fix earthing wire to the earthing pipe using nut bolt.
6) Connect the other end of earthing wire to the earthing point of electric circuit.
7) Check earthing continuity using a test lamp.

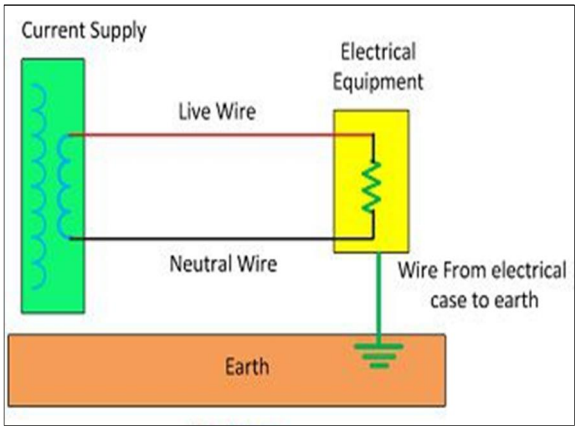


Fig 47 - Earthing

Earthing can be implemented in two ways as mentioned below:

1. **Pipe Earthing –** A pit is dug in the ground and earthing is implemented using a G. I. pipe.
2. **Plate Earthing –** A copper or cast iron plate measuring approx. 60 cm x 60 cm and 5 mm thickness is placed in a 2 or 3 metre deep pit. Alternate layers of salt and coal are placed around the plate and the other end of the earthing wire attached to this plate is connected to earth main near main switch.

Specific Information –

1. Implement earthing outside building at a minimum distance of 1.5 metre from building.
2. Ensure to select all the earthing material like electrode, conductor, nut bolt, washers made of same metal.
3. Use an earthing wire with such a thickness that its current carrying capacity should be double of the current carrying capacity of entire electric circuit.
4. Instead of using any wire being used in domestic wiring, use a 14 gauge copper wire for regular wiring while a G. I. wire of 8 to 10 gauge for power wiring.
5. Due to minerals present in salt, the current passes quickly through salt.
6. Coal has good water holding capacity. The connection of earth electrode with ground means earth.
7. The current flowing through earth is ‘Earth Current’.

8. As per 'Indian Electricity Rules (IER), 1961, earthing is mandatory for all the electric connections being operated on voltage more than 125 volt.
9. Resistance of earthing should not be more than 5 ohm.

CHECK YOUR PROGRESS

Fill in the Blanks

1. If leakage current in the appliance or its internal metal increases, it becomes electrically _____ (charged)
2. Electricity always prefers a path through objects having less _____ (resistance)
3. Voltage of ground is assumed to be _____ volt. (0 or zero)

Subjective Questions

1) What is meant by earthing?
2) What is the purpose of earthing?
3) Why salt is added in the earthing pit?
4) Why coal is added in the earthing pit?
5) What should be the resistance of earthing to avoid electric shock?
6) Why the resistance of earthing conductor is less than that of human being?
7) What is the material required for earthing?
8) Mention types of earthing.

What Have You Learnt?
On completion of this session, are you able to: • Identify the materials used in earthing • Draw a diagram for earthing • Demonstrate earthing installation by using appropriate materials and tools

SESSION 7 : TYPES AND FUNCTION OF FUSE

Due to some or the other reason, faults are observed in electric wiring. If phase and neutral or phase and earthing wire make a contact with each other, high amount of current starts flowing from phase through the electric circuit. If the domestic electric appliances like lamps, fans, TV, etc. are in ON condition while the high amount of current is passing through the electric circuit, they may get damaged. In such instances, it is essential to cut off this excess current. The provision to cater this is known as a 'Fuse'. The electricity supply being done to residential area is done via a power house or electricity board. Due to some reasons, there could be a surge in the power supply leading to potential damage to domestic appliances. There are examples of major accidents due to the effect of lightning on the domestic electric circuits. To avoid these hazards, it is a must and unavoidable to install a fuse in electric circuits.

- **Function of Fuse –** In a normal condition, the amount of current passing through fuse wire is same as that passing through electric circuit. During this process, a small amount of heat is generated in the fuse wire. However, the fuse wise doesn't melt due to this heat.

  However, with the increase in load of circuit; the amount of current passing through the circuit also increases. This subsequently increases the amount of heat generated in it. This leads to melting of fuse wire and eventually power supply cut off. It is recommended that the fuse wire should be decided based on the amount of load of the electric circuit.

- **Metals used for fuse wire –** The current carrying capacity of fuse wire depends on the metal used in it. Generally, metals having lower melting points are identified for fuse wire. Tin, Lead are used to prepare fuse wire for low current capacity fuse. Wires of metals having lower melting points are also used as fuse wire. E.g. copper, silver, etc. Commonly, people are habitual of fitting any wire in the fuse. However, if the current carrying capacity of such wire is high, then it is as good as not having a fuse installed in the circuit. It cannot prevent potential hazards due to over-current situation.

- **Precautionary measures to be taken during fuse wire installation –** Fuse wire should be installed by a scientific method. Fuse wire of appropriate configuration should be used based on the amount of circuit load. Fuse wire always needs to be installed in phase wire. The fuse installed adjacent to electric meter in our home, has a base and top (cover) made of ceramic. Whenever excess current passes through the circuit, the fuse wire melts due to heat and that may lead to sparking or fire. To avoid any potential damage, this unit is installed. Also, the arrangement in the fuse unit is such that it is convenient to change fuse wire. While fitting the fuse wire in the contact screw, a hook like turn is given to the wire below the washer and also in the direction of tightening of screw. Any excess amount of fuse wire may lead to shock due to an accidental contact while fitting or removing fuse top. While removing fuse top out of the

fuse base, wires from the supply are separated first and wires from load later and while fitting the fuse top; attach wires from the load side first followed by wires from supply side. Always remember to use fuse wire as a single strand. Do not twist it for the sake of fitting it in the fuse.

- **Types of Fuse Unit –** We have seen and understood the fuse unit (made of ceramic) fitted adjacent to electric meter at our home. There are various types of fuse units working on same principle, being fitted in different electric appliances. E.g. Various electronic appliances, microwave, amplifier wire, etc. If this fuse burns, then it is not possible to replace fuse wire but entire fuse needs to be replaced.

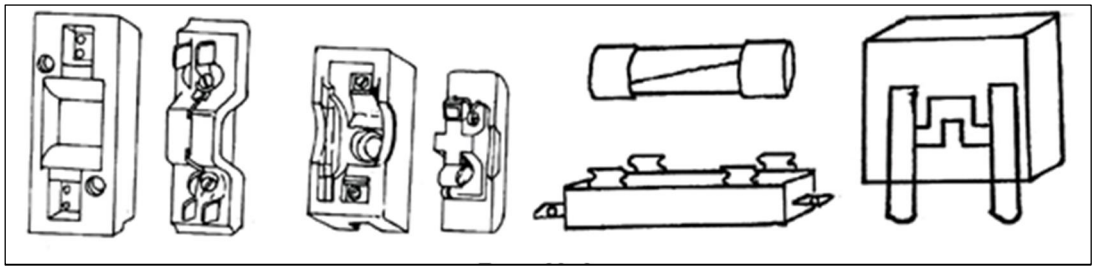


Fig 48 - Fuse Unit

- **Application of Fuse –** Due to faults like short circuit or overload condition in the electric circuit, excess current starts flowing through the circuit. Due to excess passage of current than the tolerable level, the conductor starts heating up and that leads to melting or burning of its insulation coating. This leads to damage to the electric circuit and its components. It may lead to hazardous condition like breaking of fire. Hence, fuse is used to protect electric circuit and its components.

- **Minimum Fusing Current –** The minimum electric current that leads to melting of fuse wire is known as 'Minimum Fusing Current'. In normal condition, the 'Fuse Current Rating' allows maximum passage of current through fuse wire safely, without heating the fuse wire. This degree of current is known as 'Fuse Current Rating' or 'Fuse Rating'.

- **Fusing Factor (Fusing Multiplier) –** The ratio of 'Minimum Fusing Current' and 'Fuse Current Rating' is known as 'Fusing Factor (Fusing Multiplier)'. This is always greater than 1. A good quality fuse never has the fusing factor greater than 1.4.

$$\text{Fusing Factor (Fusing Multiplier)} = \frac{\text{Minimum Fusing Current (Least Current)}}{\text{Fuse Current Rating (Safe Current)}}$$

- **Distribution Box –** Distribution box is a box where many sub-circuits are connected to the main circuit through fuse. It is also familiar with its acronym of 'DB'. Whenever a load or current higher than a wire's capacity is supposed to be connected to mains, then a distribution box is used. Distribution box is a metal box having two or more cut-outs and a neutral link. One side of cut-out is joined together by means of a copper strip. On the other side of the cut-out live (active electric current) wire is connected to each sub-circuit. Similarly, dead wire of every sub-circuit is connected to the neutral link of distribution box. Live wire is connected to the copper strip by main wire using screw while dead wire is connected to the neutral link.

  When there is a major short circuit, the resistance of the circuit becomes very less that leads to passage of very high degree of current through the circuit. In a fraction of a second, huge amount of heat is generated and the sparks are generated from fuse wire. If the voltage in the circuit increases, it leads to increase in current and above mentioned action bursts fuse.

- **Metals Used For Fuse Wire –** Wires of tin, lead, aluminum, zinc, copper and silver are used as fuse wire. Fuse wires made of alloys of tin, lead and zinc have very low tensile strength and hence sparingly used. Silver, being a precious metal, is very expensive and used only in case of HRC fuse. Due to high tensile strength, it is possible to derive very fine strands of copper (up to 45 SWG). They are strong and inexpensive. As they are easily available, galvanized copper strands are broadly used in the making of fuse elements.

- **Primary Application of Fuse –** If any fault is observed in a specific division, then by means of blowing the fuse of that division; the fault is restricted and alienated from live. This is the primary application of a fuse. Hence, fuse is always installed on live wire only. Suppose, we use wire of same size on both phase ad neutral wires or a fuse wire of smaller size is used on neutral wire; then in case of fault in the circuit, fuse on the neutral will not alienate the fault from live connection. In such cases, it becomes dangerous and difficult to repair the problematic area.

Specific Information –

- Always connect fuse in series with load. Fuse is in proportion of load and hence appliance is not damaged.
- Based on the wattage of the appliance, fuse of various ratings are available in market.

CHECK YOUR PROGRESS

Fill in the Blanks

1. In a normal condition, the amount of current passing through _____wire is same as that passing through electric circuit (fuse)

2. The current carrying capacity of fuse wire depends on the _____used in it (metal)
3. The minimum electric current that leads to melting of fuse wire is known as _____ ('Minimum Fusing Current')
4. Always connect fuse in _____with load (series)

Subjective Questions

1) What material is needed to install fuse wire?
2) Which material is used to make fuse wire?
3) Mention the formula to measure current.
4) Describe the significance of fuse wire and its application.
5) Mention different types of fuse wire.
6) How would you identify the exact reason behind burning of fuse wire?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate the use of different fuse wires
- Demonstrate fuse fitting
- Determine principle of fuse tripping
- Describe different types of fuse wires.

SESSION 8: MINIATURE CIRCUIT BREAKER (MCB)

- **Miniature Circuit Breaker (MCB) –**

  Miniature Circuit Breaker is a good alternative to fuse. This performs same function of fuse. However, it is done in a very safe way. If we do a comparative analysis between a fuse and a MCB, then we understand that if there is a sudden and persistent surge of excess current through an electric circuit, then fuse wire melts and the current is restricted. However, in a MCB there isn't any fuse wire and hence there is no question of burning of wire. One needs to open the top of a fuse unit to replace fuse wire. However, MCB circuit is installed in a tight closed box and hence there is no question of opening it. It is convenient to handle a MCB than a fuse. Looking at the superior application and handling convenience of a MCB, it is a must and unavoidable to install a MCB in domestic electric circuits.

- **Function of Miniature Circuit Breaker (MCB) –** MCB performs the task of safeguarding the wiring and preventing any potential hazards by cutting off power supply to the circuit in case there is any malfunction of an electric appliance or short circuit or a sudden surge in electric current. This circuit breaking operation is done in two ways.
  1. Whenever there is a sudden and persistent surge of excess current through an electric circuit, the specialized metal strip in the MCB expands due to heat and bends. This leads to separation of contacts and thus, breaking the circuit.
  2. Whenever short circuit occurs due to any fault leading to excess current in electric circuit, an electro-magnetic field is generated in the MCB. Due to this, the mechanical separation of contacts happens that breaks the circuit.

- **Design of Miniature Circuit Breaker (MCB) –**

MCB is a tight closed box. It is not repairable. Hence, in case of any malfunction, we need to replace the MCB with a new one. Its design has three types.

1) Box – This is a box made of heavy duty, strong rigid material wherein MCB structure is firmly fitted.

2) Mechanical Design – During circuit breaking, this mechanical operating system gets activated and it separates contacts. Also, while operating the MCB switch with hands, this mechanical operating system does its job.

3) Circuit Breaking Mechanism – This part is very important and sensitive. It works in two ways. 1) In case of excess current, the metal strip in the MCB expands due to heat which indeed leads to separation of contacts and thus, breaking the circuit. 2) Short circuit yields electro-magnetic field which indeed leads to the mechanical separation of contacts that breaks the circuit.

4) MCB has three stages: OFF, ON and Trip.

Refer to the diagram carefully. We can see three circuit breaking mechanisms. There is a metal strip, a trip coil and a manually operated ON – OFF knob. In the circuit, power terminal, metal strip, current coil or trip coil, moving contact, fixed contact and side terminal; all these components are connected in series.

Fig 49 - MCB

5) Safety Measures – As compared to Kit Kat fuse, MCB is quite safe. During an emergency when MCB trips, the knob pops out in OFF condition. Once the fault in the circuit (load) is fixed; by pressing the knob to ON condition, electric current can be restored in the circuit. Also, this knob is used to start power supply to load circuit. Different types of MCB are used for different loads in home. If a MCB is damaged, it needs to be replaced by a new one. It is not possible to repair MCB.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____is a good alternative to fuse (MCB or Miniature Circuit Breaker)
2. _____performs the task of safeguarding the wiring and preventing any potential hazards by cutting off power supply to the circuit in case there is any malfunction of an electric appliance (MCB)
3. MCB is a tight closed box. It is not _____ (repairable)

Subjective Questions

1) Describe the principle of MCB.
2) What is the application of MCB?
3) Distinguish between a fuse and a MCB.
4) What are the conditions when power supply to a MCB is interrupted?
5) Describe various conditions of MCB

What Have You Learnt?

On completion of this session, are you able to:

- Recognize the main features of Miniature Circuit Breaker (MCB)
- Explain the structure and working of MCB
- Describe safety factors involved in MCB

SESSION 9: SOLDERING

- **Necessity of Soldering –**

Soldering is required to increase the mechanical strength and conductivity of conductor's joint. There is always a need to give different joints to conductors during electrical installation. Due to a joint, the mechanical strength of overall conductor becomes less than its original strength. So, the conductor becomes weak. Often the joint may not be strong enough and there is always a possibility of a weak joint. This reduces the conductor's conducting capacity. If this joint further weakens, even a little bit of jerk may lead to sparking and carbon deposition resulting into increase in resistance to current. Conductors may get heated and the current might break. Hence, proper soldering should be done on the joint of conductor.

- **How the soldering should be –**

The alloy used for soldering is called as 'Solder'. It is also called as 'Soldering Metal' or 'Filler'. Alloy of Lead and Tin is used as a solder in electric arena, because it has following characteristics –

1) Melting point of the solder should be less than the melting point of the two metals that are supposed to be joined to each another.
2) Soldering metal should spread uniformly on entire area of the joint.
3) The solder should not oxidize very soon after melting.
4) Solder should be good conductor of electricity.
5) It should be corrosion deterrent.

- **Types of Soldering –**

1) Tin man's Solder – It has a mixture of 50% Tin and 50% Lead. It has a melting point of 200°C. It is used for fine soldering.

2) Electrician Solder – It has a mixture of 60% Tin and 40% Lead. It has a melting point of 185°C. It is used in tinning, wire joints, in electronic appliances and motor winding.

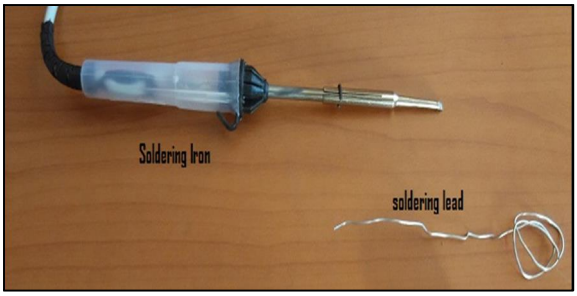


Fig 50 - Solder iron

3) Resin Cored Solder – Resin Core means a wire strand of soldering metal. It is an electrician solder only with a difference that resin flux is applied on it. It is used to join miniature wires in electronic appliances like radio, T.V etc.

- **Soldering Flux –** A material used to remove dust, dirt and carbon from the surface before soldering is called as 'Soldering Flux'.

Necessity of Soldering Flux –

1) To prevent oxidation process (To avoid carbon deposition)
2) To help uniform spreading of solder on entire surface.
3) To cool the joint faster.

4) To avoid air bubbles in the soldering.

➢ **How to do Soldering?** –

Soldering gun of the appropriate capacity should be connected to the power supply and heated prior beginning soldering activity. Clean the target area. Apply appropriate flux on the cleaned conductor. Then melt a small portion of solder on the bit of soldering gun. And apply a joint by placing gun bit on the identified location of joint. Similarly, connect various electric circuits by soldering joints, wherever necessary.

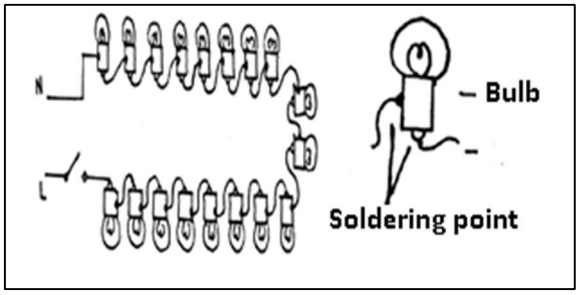


Fig 51 - Soldering circuit Diagram

Instructions – The voltage gets divided into a series circuit. So the no. of lamps in a string should be such that the addition of voltage of all lamps connected in series should not be less than the available voltage. E.g. If available voltage is 240V and voltage of one bulb is 6V then as per 240÷6 = 40, the no. of bulbs in a string should be 40.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The alloy used for soldering is called as _____ ('Solder')
2. _____ has a mixture of 50% Tin and 50% Lead. (Tin Man solder)
3. _____has a mixture of 60% Tin and 40% Lead (Electrician Solder)
4. _____ means a wire strand of soldering metal (Resin Cored Solder)

Subjective Questions

1) What is meant by soldering?
2) What is the application of soldering gun?
3) What precautionary measures need to be taken during soldering?
4) Which metals the solder is made of?
5) What is melting point? Describe its significance.
6) Describe the necessity of soldering flux.

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate soldering of basic Electronics components using soldering iron • Describe safely factors involved in soldering • Describe qualities of good soldering joint

SESSION 10: MAINTENANCE OF LEAD ACID BATTERY

There are two primary types of battery –
1) Dry Cell Battery **2)** Liquid Cell Battery

1) Dry Cell Battery – This cell is used in flashlight, torch. This type of cell is used in some electronic appliances, clocks, watches, etc.

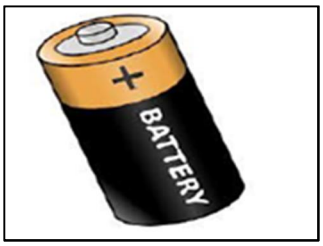


Fig 52 - Dry cell

2) Liquid Cell Battery – A bigger battery is used instead of dry cell to get a low voltage but a high capacity current. These batteries are used in many cases. These batteries are also used in vehicles like motor car, truck etc. It is also called as 'Storage Battery'. It is also called as 'Lead Acid Battery' or 'Liquid Cell Battery'.

Fig 53 - Liquid cell battery

- **Ingredients of Battery –** In the lead acid battery, a mixture of lead, water and H_2SO_4 acid is used. This mixture is called as an electrolyte. It is important to have a specific level of this mixture continuously in this battery. Due to evaporation of the liquid by means of chemical reaction, the liquid level in the battery dips over a period of time. So, it is necessary to maintain liquid level regularly by adding distilled water, available in market, in the cell.

- **Function of Battery in Electric Circuit –** Power supply starts from the meter installed in our home. It flows into the main switch and fuse first and then it further flows into all the domestic electrical appliances (load). The function of an inverter battery begins at this place only. It has two parts 1) Inverter; 2) Battery.

  Inverter – An inverter routes the current coming from meter to the battery for charging purpose and at the same time sends it to the electric circuit. Whenever the power supply from the meter is interrupted for some reasons, it sends electricity from the battery to the electric circuit. Also, when the power supply from the meter is restored, the electricity received from the battery is stopped and given to the electric circuit and battery charging starts again. Inverter performs this switching task in a fraction of a second. Thus, the task of switching the source of power supply is accomplished before we know which power supply is currently working and when it has been changed.

  1) Battery – The battery performs the task of storing the current received from inverter and supplying it as and when demanded by the inverter. Nowadays, these types of inverter, battery units can be seen in homes and offices.

However, note that this unit needs periodic maintenance for durability and a reliable service over a prolonged period.

2) **Unit of Battery** – Capacity of battery is measured in ampere hour (Ah). The battery having capacity of 1Ah supplies 1ampere current in 1 hour. It means that if 1 ampere current is used, this battery will discharge completely in 1 hour.

3) **Watt Hour** – Battery capability is described in Wh as well. If battery's ampere rating is multiplied by battery voltage rating then we get approximate value of watt hour. E.g. If the capacity of a 12V battery is 100 ampere, then electric energy of 12*100=1200 Wh or 1.2 KWh can be stored.

➢ **Maintenance of Battery –**

1. Always keep the battery in vertical position as it contains liquid.
2. It is always better to keep the battery operational to continue its charging and discharging.
3. Ensure that none of the cells of battery is discharged below 1.15 volts, and also ensure that over charging is not occurring. Due to this, lead plates tend to become weak.
4. Liquid in battery (Maintain the electrolyte (liquid) level and add distilled water available in the market, in the battery, as and when necessary).
5. Use a hydrometer to measure the density of electrolyte in the lead acid battery.

Charging Status of Cell	Density of Electrolyte
Full Charge	1.26
50 % Charge	1.20
Discharge	1.15

6. Check the specific gravity of electrolyte before and after battery charging.
7. Always place the battery in a well-ventilated location, so that the emitted gas can easily disperse in open air.
8. Battery terminals should not be rusty. To prevent this, apply petroleum jelly on it.
9. If electrolyte spills on the battery then it corrodes. To prevent this, wash the battery with soda water.

➢ **Precautionary Measures –**

1) Connect the positive terminal of charger to the positive terminal of battery and negative terminal of charger to the negative terminal of battery while charging the battery (inverter). Battery and inverter get damaged in case of wrong connection.

2) Always use safety goggle and rubber hand gloves while working with lead acid battery. If the liquid of battery comes in contact with skin or clothing, then wash it immediately.

- **Specific Gravity –** The comparison of weight of any substance with weight of water is called as 'Specific Gravity'. The unit that shows how much the weight of a substance is more or less than the weight of the water of equal volume is called the specific gravity of that substance.
  Specific gravity is a number which depicts how much a particular substance weighs lesser or more than the weight of water equal to volume of that substance.

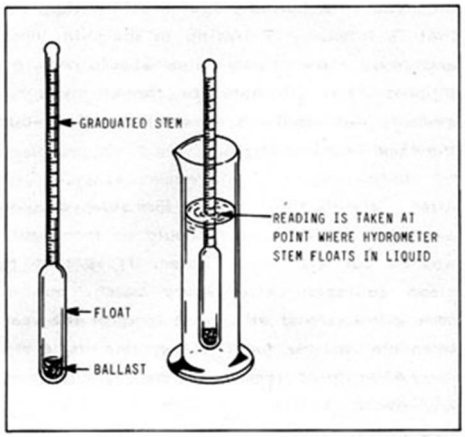


Fig 54 - Hydro meter

$$\text{Specific Gravity} = \frac{\text{Weight of substance}}{\text{Weight of equal volume of water}}$$

- **Hydrometer** – Lactometer is used to check the density of milk. For this, milk is taken in a vessel or a test tube and lactometer in dipped in it. It floats on milk. In scientific language, it is called as 'Specific Gravity'. It is very dangerous to take the liquid out of a battery to check its density. So it needs to be taken out using a dropper. The dropper is enough big in size to accommodate a lactometer (float) in it. After taking liquid out of battery using this dropper, the lactometer (float) inside dropper floats in the liquid present in dropper. This device is called as a 'Hydrometer'.

- **Indications on Float (Lactometer) –** There are markings starting from 1100 till 1400 beginning from upper part to the lower part of float. This scale is divided into three colour bands. The upper band is red, followed by a yellow band in middle and a green band right at the bottom. The specific gravity of the electrolyte in battery ranges between 1.15 and 1.3 depending on the battery status. Since decimal fraction is difficult to write and convey, numbers from 1100 to 1400 are mentioned.

- **Method to use Hydrometer –**Insert the stop cock of hydrometer in the opening of battery cell. Press the upper rubber balloon of hydrometer. The inner air will come out and the battery liquid will enter the hydrometer. Pull the liquid in meter till the internal float floats in the liquid. The indicating number till which the float has sank in liquid, represents the specific gravity of the liquid, i.e. electrolyte. When the battery is fully charged, the float will float completely and when the battery is half (50%) charged, it will float half. Similarly, it will completely sink if the battery is fully discharged.

- **Maintenance and Care of Hydrometer –**

1) Handle the hydrometer with care as it is made of glass.

2) After its use, clean it, empty the liquid contents, and keep it at a safe place.
3) Do not light any flame near the location where battery charging is in progress.
4) While handling hydrometer, ensure that the liquid does not fall on clothing or hand because such an impacted object burns due to the acid of hydrometer. So, immediately wash that part thoroughly.

CHECK YOUR PROGRESS

Subjective Questions

1) Where is lead acid battery used? What is its application?
2) What are the ingredients of the battery?
3) How to conduct battery maintenance?
4) What precautionary measures should be taken during battery maintenance?
5) What is the function of an inverter?
6) What is a hydrometer?
7) How to calculate specific gravity?

What Have You Learnt?
On completion of this session, are you able to: • Maintain lead acid batteries,& Measuring its specific gravity. • Describe what is “specific gravity” and its importance.

SESSION 11: MAINTENANCE AND APPLICATION OF VARIOUS TYPES OF STOVES

- **Wick Stove –**

In this stove, oil runs through the wick due to capillarity. As there are ample bonds of carbon in kerosene, substantial air is needed while burning it. If this air is not fully mixed with flame, then the flame becomes yellowish and soot or smut gathers on the utensil. To avoid this, there is a provision of two cylindrical meshes. When these meshes become hot, cool air from surrounding area is pulled inside; yielding a blue flame to the burning oil. When the flame completely becomes blue, we can assume that the oil is burning completely and properly. Such a blue flame has higher calorific value than a yellow flame. With a yellow flame, the oil doesn't burn completely. Thus, more oil is burnt with lesser amount of heat being generated.

At the time of shutting off the stove, the wick is extinguished by making it small and whiffing off or lead is placed on it. Even after shut off, a smoke having strong odor keeps fuming out. In such cases, the lead should be used to suppress this smoke as it is injurious or hazardous to health. While the wick stove is on, it is recommended not to pour oil in the tank. Height of flame can be adjusted by adjusting wick to a certain extent. If all the wicks are not of equal length, then the side having taller wick fetches more oil, forming a yellow flame that forms smut or soot.

In such cases, the wick should be cleaned by cutting its blackish portion and all the wicks should be made of equal height. If the wick in the wick stove becomes wet due to water, oil doesn't rise in the wick. So, ensure that water doesn't enter the fuel tank.

- **Function of Wick Stove –**

1) In a wick stove, oil rises in the wick due to capillarity and starts burning.
2) To supply air (oxygen) to the oil during burning, two cylindrical meshes are placed.
3) When these meshes become hot, cool air from surrounding area is pulled inside yielding an adequate supply of oxygen. If the flame becomes blue, it means that the oxygen supply is adequate. If the flame becomes yellow, it means that the oxygen supply is inadequate.

- **Main Parts of Wick Stove – Tank, Pump and Burner –**

1) **Tank –** Tank is made of either iron or brass. A thin pipe is attached at the centre of tank to carry the oil towards burner. This pipe reaches till the bottom of the tank. After pushing air through pump, pressure is created on the oil present in the tank and it is propelled upwards through pipe towards the burner. When the filler cap is turned to release the air from the tank, the pressure on the oil

reduces and subsequently stops its push towards the burner through pipe. Such a stove is called as a 'Pressure Stove'.

Pump – A small pump is installed on the tank to create air pressure inside tank. This pump consists of a rod. A leather or rubber washer is mounted on one end of the rod. While pulling the rod outwards, the washer slightly contracts allowing air to enter into the pump. And while pushing rod inwards, blocking of the existing air in the pump creates pressure on the washer. This inflates the washer and hence the air can't be expelled. A valve is fitted at the end of the pump. After continuous operating the rod back and forth, the air from the pump starts entering the fuel tank through this valve. The design of valve is such that air can pass through one direction only. Gradual and continuous operation of pump pushes air in the tank. Note that more the air in tank – higher the pressure on oil to move towards burner.

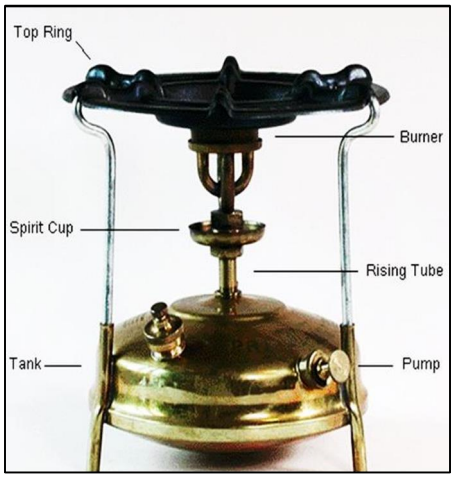


Fig 55 - Wick stove

2) Burner – Due to air pressure, oil is propelled from tank to burner. There are 4 parts of burner.

- 2 pipes are present to propel oil from tank upwards. Both are connected to a flat box.
- While igniting the stove, initially we add some kerosene to the burner box and ignite it for warming purpose. When oil coming from pipes reaches the burner box, it breaks due to heat. It means that there are 16 to 24 carbon chain/links in kerosene. Breaking of these bonds converts this oil into gas.
- This gas passes through other two pipes and reaches the internal part of burner. At the end of the pipe, a nipple with a tiny hole is fitted.
- Gas coming out from this nipple gets ignited below burner box and keeps burning. This always keeps the burner box warm. In this way, oil coming from tank breaks in the burner and generates continuous supply of gas to the burner.

- **Function of Pressure Stove –**

1. While igniting the stove, heat the burner with the help of heat applicator. (Due to heat, the liquid kerosene is converted into a gaseous form and this gaseous kerosene comes out from nipple and starts burning.
2. Now close the filler cap and start pumping. When the tank is full of air, it mounts pressure of the oil and propels it towards burner. Due to the heat in the burner, it transforms into gaseous form.
3. Gaseous kerosene gets ignited and keeps burning.

- **Reasons for Stove Malfunction –**

1) **Pressure is not maintained in the fuel tank –** If there is air leakage; then the air pressure starts reducing gradually. If a sound is heard when the filler cap is opened, then it means that there was adequate air pressure in the tank till the time of opening filler cap.
2) **Unable to propel air inside tank after pumping –** If washer or valve is worn or damaged, air doesn't enter tank.
3) **Soot or dirt present in burner –** Burning with a small flame or presence of flame on only one side is an indication that the burner is clogged with soot or dirt. Either a pin is used to remove the soot/dirt or the burner is heated with the help of another stove.
4) **Improper burning of gas through burner –** Remove the nipple; clean it and mount it again. After considerable usage of stove, it is normal to deposit soot in burner box leading to uneven burning of gas. In such cases, burner is heated with the help of another stove and air in the pipe is released to burn the soot. If this remedy doesn't work, then it is high time, you change the burner!

- **What is meant by fuel? What are the materials used as fuel?**

The substance that starts burning easily at low temperature (low burning point) and supplies ample heat (high calorific value) is used as fuel. Fuels like Kerosene, Methane, LPG (Butane) are formed by hydrocarbons. They consist of chain/link of carbon bonds. Longer the chain/link; it is difficult to burn the fuel. In the domestic gas cylinder, pressurized liquefied butane gas is stored. When it comes out of cylinder, the pressure reduces and the liquid attains gaseous state.

Fig 56 - LPG

- **Parts of gas stove –** Regulator, Rubber Gas Pipe, Steel Gas Pipe, On Off Button, Valve, Burner, Wing Nut and Stand

- **Precautionary measures to be taken during gas stove use –**

1) Check that regulation of gas from the gas cylinder to gas stove is being properly done by the regulator.
2) Using soap water test, inspect whether there is any leakage in the gas pipe. In case of leakage, air bubbles are formed in the soap water at the exact location of leakage. It is recommended to change this pipe at least once in a year.
3) If a leakage is observed in steel gas pipe, get it repaired by means of soldering immediately.
4) Periodically, open and clean On Off button of gas stove.
5) Remove the valves of gas stove and clean then with a smooth sand paper.
6) Remove the nipple of gas stove, clean its hole, or replace it with a new nipple.
7) Clean all holes of burner.

8) Tighten rubber and nuts of gas stove firmly.
9) Assemble all the dissembled parts properly.
10) Ignite the gas stove and check whether it is working as desired. If not, call the technician from authorized service centre of gas provider.

- **Specific Information –**

1) What is Kerosene? Carbon chain/link is formed by 16 to 24 carbons. As the length of chain/link increases, it becomes difficult for the fuel to burn. As it goes on shortening, it becomes easier to break and eventually it attains gaseous form.
2) The butane gas in the LPG cylinder has 3 to 5 carbon chains/links. Under pressure, it is stored in liquid form in the cylinder. When it comes out of cylinder, the pressure reduces and the liquid attains gaseous state.
3) While igniting the stove, initially we burn some kerosene to heat the burner box. When oil coming from pipes reaches the burner box, it breaks due to heat. It means that there are 16 to 24 carbon chain/links (c-c-c-c) in kerosene. Breaking of these bonds converts oil into gas.
4) Methane – It has only one carbon.

- **Smokeless Stove –** Since the beginning of primitive age till date, wood burning stove has been a device used for cooking or boiling water. Wood is its primary fuel. Till the time wood was available in abundance or human being was unaware of air pollution and importance of environment conservation; this stove was used undoubtedly. However, with ever-growing awareness about these aspects, stove working on lesser amount of fuel (wood) and generating lesser amount of smoke has been developed. And, smokeless stove was developed.

- **Smokeless Stove Design –**

1) This stove is made of clay and roasted in furnace, similar to its previous model.
2) If a vessel is kept on the normal stove, fire comes out from the sides of the vessel. However, in this type of stove, the vessel completely rests on the stove. There is a provision to bypass the fire and smoke from an alternate outlet. There is a provision to place another vessel.
3) The remaining smoke passes out through another route towards the chimney.
4) The outlet of chimney opens above roof of house.

Fig 57- Smokeless

- **Function of Smokeless Stove –**

1) The heat provided by this type of stove is almost double of that provided by a normal stove.
2) Carbon not burnt in first stage is burnt in second stage completely and the heat is used in second stage, too.

- **Advantages of Smokeless Stove –**

1) Substantial saving of fuel (wood).
2) Maximum and complete use of fuel used.
3) Safety from the fire generated by stove
4) Double use of stove concurrently
5) Safe cooking
6) Minimal air pollution
7) As less amount of fuel (wood) is required, forest cutting can be reduced; enhancing environment conservation and eco harvesting

- **Principle of Smokeless Stove –**

1) If adequate oxygen is supplied to a burning fuel, it burns completely and generates more amount of heat. Efficiency of stove increases.
2) Smoke can be passed through a pipe and easily released outside kitchen. If heat of smoke is used, efficiency of stove can be increased.

CHECK YOUR PROGRESS

Fill in the Blanks

1. In _____ stove oil runs through the wick due to capillarity (Wick stove)
2. Tank of Wick stove is made of either iron or _____ (brass)
3. Due to air pressure, oil is propelled from tank to _____ (burner)
4. If there is air leakage; then the air pressure starts _____gradually. (reducing)
5. Carbon chain/link is formed by 16 to 24 carbons is known as _____ (Kerosene)
6. The butane gas in the _____cylinder has 3 to 5 carbon chains/links (LPG)
7. _____has only one carbon (Methane)

Subjective Questions

1) Which devices are used to dissemble a stove?
2) How to check whether there is any leakage in the fuel tank of a pressure stove?
3) How to identify that washer is damaged?
4) What needs to be done if dirt has clogged in the burner of pressure stove?
5) What is the mechanism by which oil is propelled into burner in a wick stove?
6) What is the mechanism by which oxygen is supplied to the wicks in a wick stove?
7) How to identify that oxygen is not adequately being supplied to the wicks in a wick stove?
8) Describe the design of a smokeless stove.
9) Describe the advantages of a smokeless stove.

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate working of various types of stoves.
- To be able to use & maintain different stoves viz. wick / pressure stove /LPG / smokeless

SESSION 12: TYPES OF LIGHT

Light is a physical quantity. Here, photon particles falling on an object reflect and reach our eyes. We identify and understand an object due to the photon particles reaching our eyes and we say that we are able to see that object. At a global level, LED and CFL bulbs are the alternate options to the traditional incandescent bulbs. We are going to study these new types of light in this topic. This will help you to save electricity by using an appropriate and affordable illumination option for your home.

The design of an incandescent bulb is simple wherein it consists of a filament. Electric energy (electricity) passes through it. Here, electric energy is converted into heat and the light bulb emits white light. Majority part of the electricity being used to glow an incandescent bulb is wasted in the form of heat expelled by the incandescent bulb. As these bulbs emit substantial amount of heat, most of the countries have banned use of some of the incandescent bulbs. Hence, it is prudent to study alternatives of light available in today's world.

- **Types of Light –**

Man-made	Natural
1. LED	1. Sunlight
2. Incandescent Fluorescent Bulbs	2. Lightning
3. High Intensity Discharge	3. Fire

Man-made / Artificial Light Types –

- **LED – Light Emitting Diode –**

  In this type of light, light is generated in the form of photon. In short, LED is a kind of chemical chip integrated in a plastic capsule. Due to its small size, multiple LEDs are clubbed together to form a big source of light. In general, LED is more efficient as well as energy efficient than other sources of light. Currently, LED is being broadly used in domestic appliances at a large scale. LED is an energy efficient and durable type of light. By means of LED, we get directional light. It is not possible to get diffused light. LED light is expensive as compared to CFL.

- **Advantages of LED Light –**

1) An energy efficient light
2) Durable, long lasting – can be productive up to 50000 hours. LED is also known as 'Solid State Lighting (SSL)'. During the making of LED light, solid material is used instead of any type of filament or tube. Hence, there is less probability of damage in LED bulb as compared to other types of bulb.
3) In LED light, there is no warm up period.

4) No effect of cold temperature on LED light. LED light becomes operational even below 0˚C instantly.
5) LED light is directional. Hence, it is useful to shed light in a specific direction. Therefore, there is no wastage in this light.
6) There isn't any hazardous material like mercury used in LED. Hence, it is eco-friendly.
7) Colour and brightness of LED light can be controlled.

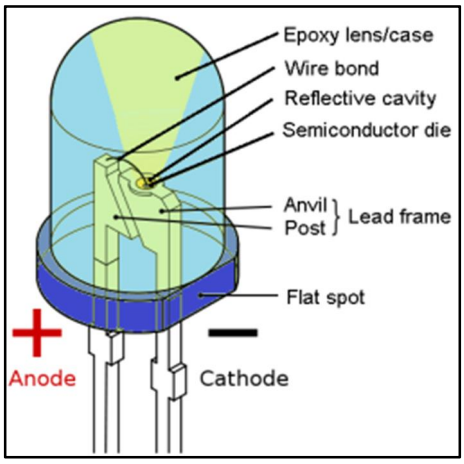


Fig 58 - LED light

- **Reasons behind widespread use of LED Light –**

1) LED is used in applications where frequent on – off cycle is necessary. Fluorescent lamp may get damaged due to frequent on – off operations. Also, HID lamps, too, consume considerable time to switch on after it's switched off. LED light becomes bright in a few seconds.

Fig 59 - LED light ceiling

- **Use of LED lights in ceiling**

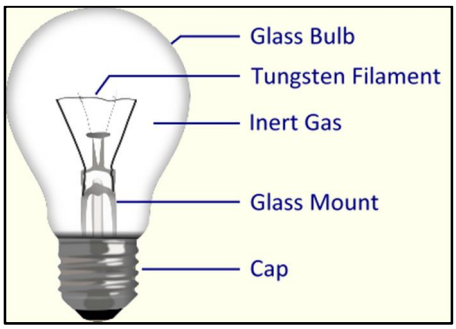
There is less probability of damage to LED light due to impact of external factors. Fluorescent and incandescent lamps are more prone to damage due to their delicateness.

- **Disadvantages of LED Light –**

1) As compared to traditional types of light; LED is prodigal and expensive. Hence, use of LED is not affordable to middle class families even though it is energy efficient.
2) Colour of LED may change with time and temperature. Two white LEDs may have two different colour characteristics. It may lead to a differential output of colours. I.e. two LEDs of same colour may emit same colour with different shades.

➢ **Incandescent Light –**

Electricity is passed through a metal rod that emits light when heated at high temperature. When electricity is passed through such a metal rod, it becomes extremely hot due to heat and starts emitting light. This type of energy is less efficient as compared to other types of light. Hence, it is used in appliances that yield high amount of light. We use such lights in day to day life. They are easily available and less expensive (economical).



Incandescent light, being economical than other types of light, is used at most of the places. This type of light resembles to skin colour and creates soothing effect on mind. On an average, a typical incandescent bulb lasts till 700 to 1000 hours. However, as compared to other types of light; it is less energy efficient.

Fig 60 - Incandescent Light

E.g. 1) Tungsten Halogen, 2) Parabolic Reflector (PAR), 3) Xenon

- **Halogen –** Halogen bulb is a type of incandescent light bulb. We can derive a light resembling to natural light from halogen bulb. This is also known as 'White Light'. Any colour looks brighter and sharper in presence of halogen light. Halogen bulbs save more energy as compared to other incandescent lights. However, they may burn out quickly if the temperature increases substantially. Halogen bulbs are costlier than other incandescent lights. Never handle/replace a halogen bulb with bare hands without adhering to relevant safety measures. If oiliness of hands gets to the surface of halogen bulb, it may make it hot leading to its burn out.

Fig 61 - Halogen

- **Fluorescent Bulbs –** Electric current is passed through cathode ray tube leading to activation of mercury and other relevant gases. This phenomenon generates heat and the bulb is illuminated. This light is converted into usable light due to illuminated phosphor coating. Mercury is extensively used in the making of fluorescent bulbs. Mercury is injurious to health and hence these appliances need to be handled and disposed appropriately.

Sub-types of Fluorescent Lamps

- **CFL – Compact Fluorescent Lamps –**

❖ CFL bulb is activated when electric current is passed through a tube containing mercury and argon. This generates an invisible UV (Ultra-Violet) light that further activates phosphor

coating of CFL lamp. Phosphor, being a synthetic material, when activated by ultra-violet light; generates visible light. **Fig 62 - CFL**

- The power consumption of CFL bulbs is less than 75% of power consumed by incandescent bulbs and life of CFL bulbs is 10 times more than the incandescent bulbs.
- Domestic use of CFL bulbs may help in reduction of greenhouse gases' emission.
- CFL are slightly costlier than incandescent lights but cheaper than LED lights.
- CFL have a warm up period, i.e. time taken to glow with full brightness. This warm up period may range from 30 seconds to 3 minutes.

- **HID - High Intensity Discharge –** In this type of generating light technique, when a high voltage electric current is passed through cathode ray tube; the metal component converts into vapor and light is generated. Its durability and energy-efficiency is very high; however, the light rays generated by halide metal are not far soothing and pleasant to eyes. The light rays generated by halide metal are injurious to eyes.

Fig 63 - HID

- **Various Metals Used in HID Lamps –** Metal Halide, High Pressure Sodium, Low Pressure Sodium, Mercury Vapor

- **Types of Natural Light –**

- **Sunlight –** In general, the solar radiation towards earth's surface is known as 'Sunlight'. Due to various complex reactions occurring in the core and surface of sun; various radiations including sunlight are emitted. Solar energy is radiated in the form of X rays, Ultra-Violet rays, Infrared rays as well as radio waves. Sunlight is responsible for moonlight, too. Moon is illuminated only because of reflection of sunlight. Plants are able to generate their own food only because of sunlight.

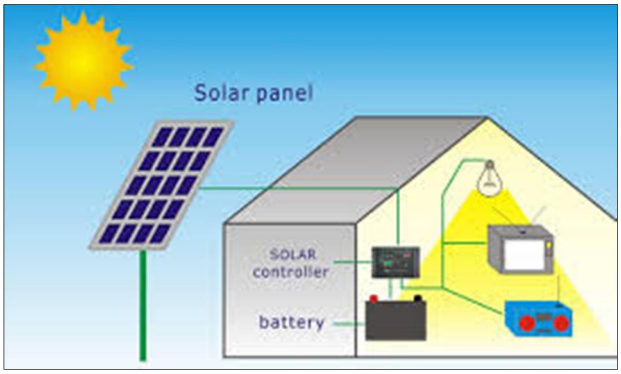


Fig 64 - Solar Panel

Fire – In ancient times, fire was primary source of light. Before invention of any advanced technology, fire was used to generate light. However, nature's balance was disturbed due to huge amount of timber cutting for the sake of burning wood to generate light through the medium of fire. Air pollution started increasing due to the poisonous gases generated by

burning of wood. Hence, by means of latest advanced technology, smoke free and pollution free source of light became available.

Fig 65 - Old Fire

- **Lightning –** Lightning is a process that occurs due to current of electric charge. In more technical words, lightning is the occurrence of a natural electrical discharge of very short duration and high voltage between a cloud and the ground or within a cloud, accompanied by a bright flash and typically, thunder, too. In short, it is electric discharge of a humongous load. Lightning event also provides us light.

Fig 66 - Lightning

CHECK YOUR PROGRESS

Fill in the Blanks

1. HID means _____ (High Intensity Discharge)
2. _____ is the major source of Natural light (Sunlight)
3. Lightning is a process that occurs due to current of _____ (electric charge)

Subjective Questions

1) Distinguish between LED light and CFL light.
2) Mention advantages of using LED light.
3) What is meant by CFL?
4) What are the natural types of light?

What Have You Learnt?
On completion of this session, are you able to: • Read wattage of bulb. • Select appropriate solution for required light. • Describe the advantages of different lighting solutions • Describe the benefits of using LED bulb

SESSION 13: ELECTRICITY BILL AND MEASURES TO SAVE ELECTRICITY

In modern days, electricity has become basic need along with food, shelter and clothing. Electricity is necessary to operate mechanical devices and appliances. In today's era, electricity has indispensable importance. Everyone's home is fitted with an energy meter to measure the consumed electric energy. However, after looking at the monthly bill, we start doubting the electricity bill. We hardly pay attention to domestic appliances in use or take into consideration the power supply needed for them. We blindly pay the energy bill amount based on the electricity bill generated by electricity board. We never think about the actual amount of electricity being used by domestic appliances and its financial value and end up paying additional amount.

In this topic, we will learn to generate electricity bill based on the usage (energy consumption) of domestic appliances.

Devices – Energy Meter, Calculator, Notebook, Pencil, etc

Preparation –

1. A chart about the no. of electric appliances being used at home and their power rating (watt) should be available in division. E.g. TV, Electric Iron, Fan, Tube light, Bulb, Stove, Refrigerator, Computer, etc.
2. Recording reading of energy meter of school by actual visit.

Remember Points Mentioned Below While Generating Domestic Electricity Bill –

1. There are separate rates for consumers based on the categorization as residential and commercial connection.
2. The billing charges differ based on the slabs of no. of units consumed. Rate for initial specified units is different than the units thereafter.

Apart from rate of electric units, other billing components like Power Charge, Fuel Charge, Tax and Meter Rental Charge need to be included in the electricity bill.

- **Chart indicating some of the domestic appliances and their power rating/wattage –**

Appliance Name	Power Rating / Wattage
Bulb	15, 25, 40, 60, 100, 200 watt
Tube 4, 2	40 watt, 20 watt
Fan (Ceiling, Table)	60 - 85 watt
Washing Machine	200 – 1000 watt
Electric Iron	450 – 750 watt
Television	60 – 200 watt

Refrigerator	200 – 300 watt
Mixer, Food Processor	250 – 650 watt
Vacuum Cleaner	1000 watt
Geyser	1000 – 3000 watt
Room Cooler	200 – 300 watt
Hair Dryer	200 – 750 watt
Toaster	800 watt
Soldering Iron	25 – 200 watt

1. **E.g.** In a home, a 15 watt colour bulb is used for 24 hours, 60 watt fan for 4 hours, 200 watt TV for 4 hours, two tube lights of 40 watt for 6 hours, 1000 watt geyser for ½ hour on daily basis. Calculate how many unit of electricity will be consumed on daily basis in this home. In the same home, how many unit of electricity will be consumed in a month?

Sr. No.	**Name of Appliance**	**Wattage**	**No.**	**Total Wattage**	**KW**	**Time H Hours**	**KW x H Unit**
1	Colour Bulb	15	1	15	0.015	24	0.36 KWH
2	Fan	60	1	60	0.06	4	0.24 KWH
3	TV	200	1	200	0.2	4	0.8 KWH
4	Tube	40	2	80	0.08	6	0.48 KWH
5	Geyser	1000	1	1000	1.000	0.5	0.5 KWH
						Total	**2.38 KWH**

2.38 unit will be consumed in this home on a daily basis.
For a month: 30 Days x 2.38 Unit = 71.40 unit
Means 71.40 unit will be consumed in the entire month.

2. **E.g.** How many unit of electric energy will be consumed if a 100 watt bulb is used for 3 hours?

Answer – 100 watt means 0.1 KW
0.1 KW x 3 hours = 0.3 unit
Means 0.3 unit of electric energy will be consumed by using a 100 watt bulb for 3 hours.

3. **E.g.** 1000 watt means 1 KW
1 KW x 0.5 hours = 0.5 KWH
= 0.5 unit
Means 0.5 unit of electric energy will be consumed by using a 1000 watt geyser for half an hour.

1 unit of electric energy means consuming 1 KW (100 watt) power for 1 hour.
Means 1 unit = 1 KW x 1 hour = 1 KWH
Hence, an energy meter is also known as a 'KWH Meter'.

4. **E.g.** Convert following quantities in kilowatt: 100 watt, 60 watt, 25 watt, 15 watt, 450 watt, 1000 watt, 85 watt, 2000 watt, 3000 watt.

Watt	Kilowatt		Watt	Kilowatt
100 W	0.1 KW		1000 W	1.00 KW
60 W	0.06 KW		85 W	0.085 KW
25 W	0.025 KW		2000 W	2 KW
15 W	0.015 KW		3000 W	3 KW
450 W	0.45 KW			

- **Calculate amount of electricity bill**

  E.g. In a home, electric appliances are used on daily basis as below. Calculate the amount of electricity bill for the house owner for a period of 30 days. (Note: Rate of electricity is Rs. 4.00 per unit)

100 watt bulb	2 no.s	7 hours
40 watt tube	2 no.s	4 hours
2000 watt heater	1 no.	2 hours
750 watt electric iron	1 no.	30 minutes
500 watt mixer	1 no.	30 minutes
2000 watt stove	1 no.	4 hours

Answer:

1000 watt = 1 KW

If an electric appliance of 1 KW is used for 1 hour, then 1 unit of electric energy is consumed. Based on this, we will derive formula mentioned below:

1)

Watt x Quantity x Hours / 1000	= unit

2)

100 Watt Bulb x 2 Quantity x 7 Hours / 1000	= 1.4 unit

3)

40 Watt Bulb x 2 Quantity x 4 Hours / 1000	= 0.32 unit

4)

2000 Watt Heater x 1 Quantity x 2 Hours / 1000	= 4 unit

5)

750 Watt Iron x 1 Quantity x 0.5 Hours / 1000	= 0.375 unit

6)

500 Watt Mixer x 1 Quantity x 0.5 Hours / 1000	= 0.25 unit

7)

2000 Watt Stove x 1 Quantity x 2 Hours / 1000	= 8 unit

Total no. of units for 30 days = 14.585 x 30 Days = 437.55
Electricity Bill Amount for 30 days = 437.55 x 4 Rs. per unit
Electricity Bill Amount for 30 days = Rs. 1750.20

- **Energy Saved Is Energy Generated –** To bring India on the roadmap of progress, maximum amount of energy is needed. To achieve this, additional energy generation and efficient use of available energy is essential. Energy generation is a prodigal affair, a serious issue and a challenge indeed. Conservation of available energy is a better solution than energy generation. By means of energy conservation, we can garner maximum benefits in a very short duration. Looking at the grave calamity of energy availability in future, it is necessary to save energy by means of prolonged conservation of available energy rather than spending resources for generating energy and this approach should be given due attention. Currently most of the appliances, utilities, facilities operate on electricity. Life comes to standstill if there is any outage of electricity. Electricity has become completely an expensive and prodigal commodity. At a personal level, saving electricity is equivalent to saving money. Bureau of Energy Efficiency has laid down few guidelines in relation to saving electricity as mentioned below.

- **Instructions for Safe Use of Electricity –**

1) If possible, restrict the light arrangement to cover actual work area only.
2) Dust settled on light bulb or tube light reduces light strength by 50%. Hence, it is advisable to clean them on regular basis.

3) Compact Fluorescent Lamp (CFL) generates 5 times more light than other bulbs. It helps to save electricity by 70%. A 15 watt CFL gives light equivalent to a 60 watt bulb.
4) In case of regular bulb, 90% of electricity is wasted in the form of heat. Only 10% of electricity is used to generate light.

➢ **Air Conditioning (AC) –**

1) An air conditioning (AC) machine requires 35 times more electricity than a regular fan. Hence, use AC only when it is essential.
2) Do tree plantation around your home. This will help to avoid direct entry of hot sun rays in home. This will help to reduce AC expenses up to 40%.
3) For temperatures above 22˚C, the efficiency of AC increases by 3 to 5% for every 1˚C. Hence, it is recommended to set AC temperature to 25˚C. This will get the AC's work done in conveniently less expense.
4) Clean the AC filter once in a month. A clogged or damaged filter restricts free flow of normal air. This adds unnecessary load on the AC unit for cooling and thus diminishes overall cooling effect. This affects performance of AC substantially and gradually wears down its parts.

➢ **Refrigerator / Chillers –**

1) Motor and compressor in refrigerator generate heat. Make a provision of ample open space around them. This will keep the air in the surrounding area cool. It is advisable to clean and wipe dust from the lower part and backside of refrigerator once in a month. This will ensure supply of fresh air and expel heat out of refrigerator efficiently.
2) If refrigerator is kept in a low light area, then install a small flashlight in it and close the door. If light of the flashlight comes out through the door, then it means that the door packing is either not fitted properly or not matching with door size.
3) Keep the refrigerator away from heat emitting appliances / devices like cooking stove, heater, furnace, etc.
4) While storing hot food in refrigerator, ensure to place an appropriate lid. This will reduce energy needed for refrigerator to maintain the stipulated cooling temperature and also expedite the process of cooling the hot food.
5) Prior opening refrigerator door, make a note of exact objective of opening the door. This will ensure that the door is not left open for a considerable time and prevent unnecessarily energy consumption.
6) Maintain an appropriate and optimum cooling temperature. Keeping the temperature 2-3˚C cooler than necessary, leads to 25% excess energy consumption and eventually burns hole in the pocket.

➢ **Water Heaters (Appliances to boil water) –**

1) If temperature of heater is set at 60˚C to 50˚C, 18% electric energy can be saved.

2) The part of pipe that doesn't supply heat should be insulated or coated with a heat-resistant material to prevent leakage of heat energy through that part.

➢ **Furnaces / Oven –**

1) First check whether the thermostat (heat measuring instrument) indicates correct measurement of heat.
2) Do not open the door of furnace/oven frequently as every time the door is opened, more than 5˚C to 7˚C heat is leaked. So, avoid opening the door frequently.
3) Inspect the quality of packing on the furnace/oven. If the packing has cracks or is broken, replace it immediately.
4) Imbibe a habit of placing lid on the vessel during cooking. This will help to complete cooking with lesser amount of heat.
5) Use only required amount of water during cooking. This will save unnecessary heat required to boil the excess water.
6) Provide relatively more amount of heat till the water boil during cooking. After attaining the boiling state, reduce the supply of heat until the food mellows (i.e. completion of cooking). Do not maintain the high intensity of heat throughout cooking.
7) Try to cook as much food at a time as you can. Try to avoid using furnace/oven repeatedly to roast or mellow different food items separately.

➢ **Microwave Oven –**

1) To cook small amount of food, it is recommended to use microwave oven. It will save 50% of energy.
2) While cooking more than one food items in a microwave oven, keep solid food on the outer side of the plate while place liquid food at the centre of the plate.

➢ **Domestic Appliances –**

1) Keep appliances like fan, AC powered off while not in use.
2) Use maximum amount of natural light (sunlight) during day time. Do not use electricity.
3) Keep electric appliances neat and clean.
4) Do not open refrigerator door in haste and frequently.
5) Use CFL bulbs.
6) User cables of appropriate ratings and specifications.
7) User reflectors for bulbs to save electricity.
8) Use timer switch for optimized electricity consumption at places where light is required for a shorter duration.
9) Use electronic regulator for fan. It will save electricity.

➢ **Washing Machine –**

1) 20% of the total amount of electricity used in a home is consumed by washing machine alone.

2) It is recommended to use cold (i.e. normal) water because 90% of energy is consumed to warm the water.
3) A single cycle of washing needs approx. 60 to 90 litres of water.
4) Think and be judicious about the amount of washing powder being used because more amount of powder consumes more energy.

➢ **Computer –**

1) Shut down computer when not in use. Computer runs for 24 hours if not shut down after use. In such cases, it may consume more energy than a refrigerator and you may end up spending more bills for it than a refrigerator.
2) If the computer (CPU) needs to be powered on while you are not using it actively, then it is recommended to switch off the monitor. This is the only device that consumes more than 50% of electricity needed for entire computer system. It will save at least 40% of energy.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Energy generation is a _____affair, a serious issue and a challenge indeed. (prodigal)
2. An air conditioning (AC) machine requires _____ times more electricity than a regular fan (35)
3. For temperatures above 22˚C, the efficiency of AC increases by 3 to 5% for every _____˚C (1)
4. A clogged or damaged filter restricts free flow of _____air (normal)
5. Motor and compressor in refrigerator generate _____ (heat)
6. To cook small amount of food, it is recommended to use microwave oven. It will save _____% of energy (50)

Subjective Questions

1) Why to generate or calculate an electricity bill?
2) What are the materials, devices needed to generate or calculate an electricity bill?
3) Why energy meters are installed in every home?
4) How many unit of electricity is consumed if an appliance of 1 kilowatt is used for 1 hour?
5) 1000 watt means how many kilowatt?
6) What is the alternate name for an energy meter?

What Have You Learnt?

On completion of this session, are you able to:

- Calculate monthly electricity unit consumption of a family using combination of lighting and kitchen equipment (blub, tubes, Mixer, water heater etc.)
- Demonstrate knowledge of Electricity saving measures.

SESSION 14: SOAK PIT / SEPTIC TANK – PURPOSE AND OPERATING SYSTEM

The surrounding around us is called as 'Environment'. Human being uses the ingredients of environment to manage his necessities of life. Due to ever increasing population and needs, use of environmental ingredients has increased. Due to substantial increase in useless, unsuitable and hazardous substances, the essential environmental ingredients like air, water, land required for living organisms are getting polluted.

While using environmental ingredients we use useful material present in them. We throw away the unwanted material that is called 'Waste Material'. If man-made waste materials stay dumped at the same location for a considerable time, they start forming changes in environment hazardous to living organisms. This is called as 'Pollution'. Due to pollution, air, water, clay is contaminated and their quality degrades. Contaminated air, water and clay are injurious to health of not only human being but also other living organisms. It may lead to illness and spread epidemic and contagious diseases. And eventually their existence is endangered. It erodes the biological diversity. Ultimately it disturbs the balance of environment. Therefore, pollution and environmental imbalance have emerged as major issues at a global level.

We are familiar with the word 'Surrounding'. We have often heard sentences like 'Surrounding of school is beautiful.' 'Surrounding of market is filthy.' Surrounding means all around a particular person, place or thing. Surrounding of a town or city is larger than that of a home or school. Surrounding things like animals, plants, air and soil are related to life. It is our responsibility to dispose water pollution. If the sewage water displaced from homes accumulates at the same place, over a period of time; it forms drains and it starts stinking. Such an unhealthy place gives an invitation to mosquitoes and indirectly to contagious diseases. Hence, it is essential to dispose sewage water properly and consistently. Hence, it is beneficial for all of us to learn about septic tank (sewage water disposal mechanism) by means of this demonstration.

Demonstration – Build a Septic Tank

Material – Brick Pieces, Coarse Sand

Devices and Tools – Spade, Mattock, Head Pan, Wrecking Bar (Crow Bar), Meter Tape

Expected Skill –

1. Gather information and estimate about amount of brick pieces and coarse sand required for building a septic tank of desired size.

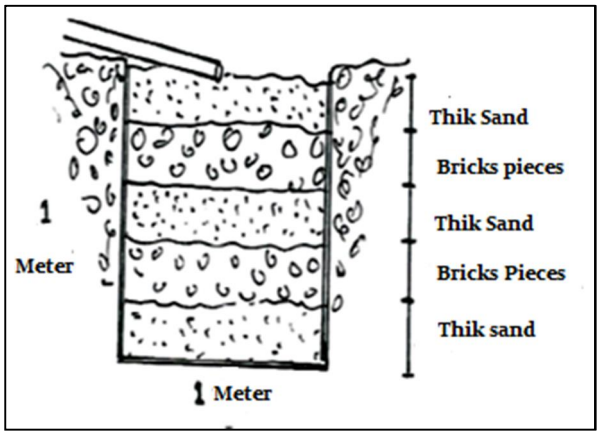


Fig 67 - Soak pit

2. Information should be acquired about thickness of layers of brick pieces and coarse sand.
3. Designate the exact location of septic tank.

Procedure –

1. Dig a pit of dimension 1 m x 1 m x 1 m at the location where sewage water needs to be released.
2. First, spread a 20 cm layer of coarse sand at the bottom of the pit.
3. Spread a 20 cm layer of brick pieces on the coarse sand layer.
4. Again spread a 10 cm layer of coarse sand on top of brick pieces layer.
5. Then make an arrangement of bringing in sewage water into this pit.

- **Advantages of Septic Tank –**

1. Reduction in percolation of sewage water in the underground water.
2. Prevention of formation of drains and accumulation of contaminated (sewage) water on ground. This controls proximity of mosquitoes and bacteria, etc.
3. Prevention of stinking and eventual air pollution due to formation of drains and accumulation of contaminated (sewage) water on ground.
4. Prevention of spread of contagious and epidemic diseases and maintenance of hygiene of surrounding area.
5. Planned disposal of contaminated water released from latrines.
6. Brick pieces and coarse sand can be easily available while building septic tank. Hence, we can protect environment at a reasonably less expense.
7. Septic tank helps sewage water to percolate and prevents formation of puddles on ground. Septic tank helps us to keep surrounding area clean and tidy.

- **Domestic Septic Tank –** We can create a small domestic septic tank using an earthen pot. As per the procedure mentioned in this topic, dig a pit and fill it with a mix of coarse sand and brick pieces. Place an earthen pot having a hole at its centre, in the middle of the pit. Release the sewage water in the earthen pot using a pipe. The dirt coming through water gets trapped in this earthen pot. The septic tank remains clean. Clean the earthen pot every two weeks.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The surrounding around us is called as _____ ('Environment')
2. Pollution and environmental imbalance have emerged as major issues at a _____level (global)
3. We can create a small domestic septic tank using an _____pot (earthen)
4. Clean the earthen pot every _____weeks (2 or two)

Subjective Questions

1. Which devices and tools are used while building a septic tank?
2. What is the used of coarse sand in septic tank?
3. What is the used of brick pieces in septic tank?
4. What are the advantages of building a septic tank?
5. Why is an earthen pot used while building a domestic septic tank?
6. Why are stones not used while building a septic tank?

What Have You Learnt?

On completion of this session, are you able to:

- Draw a diagram showing the various elements of soak pit
- Prepare a soak pit
- Describe advantages and disadvantages of soak pit

SESSION 15: WASTE MANAGEMENT AND REGENERATION

➢ **Significance of Waste Management –**

All of us throw away waste material, items out of our homes. It includes stale food, vegetables, fruit peelings, plastic, paper, glass, etc. There is a mechanism available today to collect all this waste material. However, roadside garbage or a collective garbage dump outside town/city is also equally hazardous. At such places, foul odour, various diseases, germs, epidemic diseases, contagious diseases spread and it affects general hygiene. A collective dumping of such garbage or waste material doesn't allow its natural decomposition leading to environmental imbalance. Hence, the waste management crisis becomes very grave. If this waste material is classified into different categories and processed during its disposal; it yields two useful ingredients in the form of commodities' regeneration and organic fertilizer. This provides us with twin benefit of energy conservation and generation apart from keeping the surrounding area clean and disease-free. Thus, it helps in environmental balance. Therefore, waste management is the need of the moment.

➢ **Classification of Waste –** Garbage or waste is of different types. In order to conduct waste management and regeneration; the garbage or waste needs to be segregated as per designated categories/classification. Waste classification is important in waste management.

1) Biodegradable waste
2) Recycled and regenerated waste after processing

1) Biodegradable Waste – The waste material generated due to use of natural resources is biodegradable, i.e. it decomposes naturally. Energy and organic fertilizer can be acquired by systematic management of such biodegradable waste.

E.g.

1) Grass, fodder, branches of tree, leaves, fruits, etc.
2) Droppings/faeces of various animals, dung, urine, etc.
3) Stale or wasted food at home, vegetable stalks, fruit peelings, sewage, etc.

- **Vermi-compost Plant –** If the biodegradable waste mentioned above is used in a vermi-compost plant, we get vermi-compost which is 100% useful for agriculture.
- **Gobar Gas Plant –** By using biodegradable waste like dung, urine, food waste or stale food, sewage, etc. in a gobar gas plant, we get cooking gas as well as good quality fertilizer for agriculture.

➢ **Non-Biodegradable, Recycled and Regenerated Waste –** Being a progressive and development-prone animal, human being has a strong grid for development, amenities and comforts leading to humongous amount of waste creation. Its adverse effects are impacting nature's life cycle and eventually all living organisms. As this waste material consists of different categories; it can be processed only after its due classification.

E.g.

- **Paper, Newspaper, Carton/Paperboard –** Such kind of waste material is assimilated and systematically processed to generate a pulp. It undergoes a chemical process to remove inks of various colours and paper is prepared from this pulp, once again. Approximately 1/3 amount of bamboo (raw material to prepare paper) is saved due to this type of recycling and processing. Also, there is a saving of 25% of electricity and labour. This regeneration is a separate industry altogether.

- **Metal Waste –** Aluminum, Steel can, raw iron, metal sheets, etc. are classified first and later on broken into small pieces, melted and given a desired shape/form. There is a 97% saving in aluminum regeneration while 47% saving in iron regeneration. This recycling and regeneration is processed in a factory only.

- **Glass Waste –** Glass is primarily made of sand, soda ash and lime. While recycling glass waste, this waste is added into the original process of glass manufacturing. During this process, garbage like bottle cork, lid, label, plastic, etc. is separated using magnetic and vacuum cleaner. Various new utility objects can be prepared from this recycled (regenerated) glass fluid. Thus, during this process, various new utility objects can be prepared from this recycled (regenerated) fluid. 18% energy is saved in this process. This recycling/regeneration, too, is processed in a glass manufacturing factory only.

- **Plastic Waste –** Invention of plastic is considered as an industrial revolution at global level. Many products are being made from plastic and its presence has spread across the world. It is being used at an alarmingly large scale. Obviously, management of waste being generated from plastic has been a global challenge and crisis. Consumers are attracted by the advertisement of 'Use and Throw'. Due to this, the heap of plastic waste is piling up like nothing. As a common practice, this plastic waste is burnt. However, it leads to tremendous amount of air pollution. As the dioxin gas is hazardous to living organisms; plastic waste needs to be classified by means of waste management. The plastic waste like industrial plastic, car parts, toys, transparent bottles are made via molded process. Hence, different types of plastic are segregated and melted during recycling and regeneration. 90% of energy is saved in this recycling process.

- **Biomedical Waste –** Waste material is created at a large scale while treating patients in hospitals. All the objects made of various types of medicines, paper, cotton, plastic bottles, bags, pipe, metal syringes, human organs, etc. are very hazardous to human life and hence they must be disposed off immediately. Plastic waste is sent to plastic recycling plants. Metal objects, syringes, injection tube, etc. are processed and considered for reuse. For objects like medical

clothing, cotton, human organs (which cannot be recycled or reused), deep pits are dug and they are buried under ground.

Types and Disposal of Biomedical Waste

Colour Code	Container Type	Category of Waste	Processing Method
 **Yellow**	Plastic Bag	Human body related waste (human tissue, human organs, cells, biochemical material expelled by body, umbilical cord, etc.)	Burning, Burry under ground
 **Red**	Sanitized Container, Plastic Bag	Medical cloth or clothing having blood stains or human body serums, cotton, plaster-dressing material, waste from microbiology and biotechnology laboratories	Autoclaving, micro waving, chemical processing, shredding
  **Blue, White / Transparent**	Sanitized Container, Plastic Bag	Sharp objects (like syringes, scalpels, cutters, scissors), catheter, gloves, intravenous injection bottles, etc.	Autoclaving, micro waving, chemical processing
 **Black**	Plastic Bag	Expired medicines or medicines not in use, chemical waste	Dispose in safe landfills

- **Industrial Waste –** Due to rapid industrial development in our country, industrial waste has also been generated at a large scale. Industrial waste like plastic, metal, glass, etc. can be used for recycling and regeneration. Various chemicals, various electronic instruments, radioactive materials, different poisonous gases, smoke are hazardous to entire environment; however, even today, these hazardous chemicals are being released in open surrounding area or river streams by various factories. They have an adverse effect on grains and crops. Due to an adverse effect of polluted water, the life of various animals,

fishes and aquatic animals has been endangered. To avoid this, the industrial waste needs to be disposed of in a specific manner.

Radioactive material means ash generated in a nuclear reactor plant. This is a very hazardous waste and the effect of its radiations can be observed in many generations of living organisms. Also, this radiation penetrates through many objects. Hence, such ash and relevant dangerous materials are packed in a metal box and sank at the bottom of sea so that there is least probability of them getting exposed to living organisms.

- **Three 'R' – Reduce, Reuse, Recycle**

  The principle of 'Three 'R' should be advocated and implemented so as to minimize generation of waste.

  1. Minimum use of materials
  2. Reuse the material, if needed, instead of purchasing new ones
  3. Send it for recycling and regeneration after use

  This is known as Three 'R' principle of waste management.

CHECK YOUR PROGRESS

Fill in the Blanks

1. A collective dumping of such garbage or waste material doesn't allow its natural decomposition leading to _____imbalance (environmental)
2. The waste material generated due to use of natural resources is _____ (biodegradable)
3. _____ Waste material is created at a large scale while treating patients in hospitals(Biomedical)
4. Radioactive material means_____ generated in a nuclear reactor plant (ash)

Subjective Questions

1) Mention different types of waste.
2) How would you manage biodegradable waste?
3) Describe adverse effects of waste on environment.
4) What is biological waste? How is biological waste managed?
5) Which is the important ingredient of waste management?
6) What is the Three 'R' principle of waste management? Mention its interpretation.

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate the knowledge of appropriate methods used for disposal of different types of garbage
- Explain the purpose of garbage separation and its processing

SESSION 16 : DRAWING A FLOW CHART

Flow chart means to depict the action flow with the help of a diagram. In other words, it means to give information of action using a diagram. This method is easy to understand. Additional information can be explained in brief; and can be grasped quickly due to its diagrammatic format.

Method to Draw Flow Chart –

4) Raw material needed before an action is written behind (at the start of) arrow. The name of the product (material) generated from the process is written at the front end of arrow.
5) Used material is written on one side of the arrow and implemented process is written on the other end.
6) The process of original material is written in a straight line. Added material is represented by a horizontal arrow and joined together. However, the tip of the arrow is denoted on the outer side. Other information can be appended as per the requirement e.g. Weight/volume of material, time, temperature, etc. This set of actions is called as 'Process'. The flow chart of entire process is created as mentioned above.

Advantages of flow charts are as below –

2) All actions can be described in a sequential order in brief.
3) Due to systematic drafting, none of parts is forgotten (or omitted).
4) It is possible to ensure that the goods, raw materials used are not wasted due to proper planning.
5) Easy to estimate the approximate time needed for actions. So effective time management is possible.
6) It is easy to identify exact amount of expenses incurred for specific actions.
7) It is easy to remember process/description.
8) The written information is concise, accurate and distinct.

Limitations – It is difficult to make the flow chart in a demonstration wherein, we do not process the material but measure/act using the tools. And it's also less usable. E.g. it is difficult to draw a flow chart for actions like plain table survey, dumpy level survey, electric circuit, etc. In such cases, the actions can be written in an order only.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Diagrammatic representation of sequence of performed actions is called as _____ (flow chart)
2. Drawing flow charts is difficult in that practical where goods are not _____ (processed)

Subjective Questions

1. Describe the flow charts
2. Make a sample flow chart as described in the session

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate and create flow chart as per the need.

UNIT

3

INTRODUCTION TO BASICS OF GARDENING, NURSERY AND AGRICULTURE

SESSION 1: MACHINES AND EQUIPMENT'S FOR AGRICULTURE

It is essential to have knowledge of all of these and knowledge of the good selection and maintenance of tools. In this lesson, we will be introduced to the tools essential for agriculture.

Agriculture requires various tools and machines. Following three types of tools are used for agricultural activity.

i. Agricultural equipment's: Equipment's that can be used by hand are included in this ex .Pickaxes, spade, shovel, sickle etc. Their life span is about 1 to 7 years.
ii. Agricultural tools: This includes harrow, hoe, and seed sowing plough etc. Their life span is about 10 to 20 years.
iii. Agricultural machines: The machines like electric motor pump, tractor, thresher, spray pump, dusters, knife, cutters etc. are included in this. Besides that, tools required for horticultural activities like scissors, water cans, polythene, fans, and material for poly-house have also become essential.

Agricultural works are finished in time and more efficiently because of use of machines and tools. It helps in increasing the productivity and production. Following are the advantages of using machines and tools in agriculture.

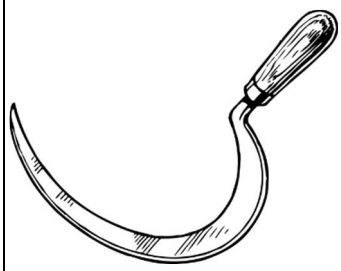
a. Speed of work increases.
b. Efficiency of the farmers increases.
c. Multiple crops are possible.
d. Saves time.
e. Reduces wastage.
f. Cost of production decreases.
g. Disadvantages of bullock power can be avoided.
h. Individual risk reduces.
i. Commercialization of agriculture is possible by large scale farming.

Taking care of tools -

Farming requires daily use of tools, therefore they need continuous care. Tools frequently come in contact with soil and water. Tools should be immediately cleaned after work is done. They should be regularly oiled and sharpened so they last longer. Don't keep tools in wet and moist place because at such places wooden

tools may get damaged by termites and iron tools may get corroded. Termites reduce life of wooden tools. Iron tools should be painted to prevent corrosion.

Following are tools used daily while working in agriculture:

Sr. No.	Name and photo of the tool	Uses
1	 **Fig : 1 Sickle**	For cutting grass, animal fodder and crops harvesting
2	 **Fig : 2 Scythe**	For weeding of crops
3	 **Fig : 3 Axe**	Axe is used for cutting unwanted bushes in the farm
4	 **Fig : 4 Spade**	To dig land and to bring out tuberous crops like potatoes, sweet potatoes etc.
5	 **Fig : 5 Pickaxe**	This tool is used for digging in a small area and for removing unwanted bushes in the farm and on the edges of farm.

6	 **Fig : 6 Ghamela (Pan)**	To carry goods
7	 **Fig : 7 Hoe**	This tool is used to create furrows, ridges, beds and basin in a small area of land.
8	 **Fig : 8 Crow bar**	For digging and for making small trenches
9	 **Fig : 9 Watering can**	To water the crops in kitchen garden, nursery in proper quantity.
10	 **Figure : 10 Harrow**	To create seed bed / to pull soil

11	 **Figure : 11 Rake**	This tool is used to mix seeds uniformly in soil. This is also called raking.

Following are equipments used while working in agriculture:

Sr. No.	Name and photo of the equipment	Uses
1	 **Figure : 12 Bali Ram Plough**	For ploughing land, making furrows, rotating soil
2	 **Figure : 13 Iron Plough**	For ploughing land, rotating layers of soil
3	 **Figure : 14 Seed sowing plough**	Seed sowing plough is used for loosening soil and for sowing. It has four spikes. Seed bowl is connected to spikes by pipes. While sowing grains are sent through seed bowl and mix in soil.
4	 **Figure 15. Hand Hoe**	1) For doing picking and weeding between two crop rows worker can drive hoe forward and backward by hands while standing. This makes work less exhausting and worker's efficiency and energy remains same which results in more and speedy work.

		2) With this hoe weeding of land up to about 3 cm depth is possible.
5	 **Figure 16 - Tiller**	For loosening soil and ploughing land.
6	 **Figure 17 - Land leveling Tool**	For leveling land, for creating bund in land and also for creating heap of soil.
7	 **Figure 18 - Reidger**	For creating ridges and leveling land
8	 **Figure 19- Rotavator**	1) In this tool on a rotating shaft 14 to 20 land tillers are fitted with nut bolts. 2) Soil is loosened by using Rotavator. This machine is used for ploughing and clod crushing simultaneously. Weeds up to 15 cm depth are uprooted.

9	 **Figure 20 - Seed sowing plough with two seed bowls**	This is traditional seed sowing plough with two seed bowls. Both bowls are fitted with iron belts with 30 to 40 cm distance between them. Each tiller has two holes, one for fertilizer pipe and other for seeds pipe. Other end of seed pipe is connected to seed bowl and other end fertilizer pipe is connected to fertilizer bowl. Pipes are of plastic and transparent.

Following are machines used while working in agriculture:

Sr. No.	Name and photo of the machines used in agriculture	Uses
1	 **Figure 21- Bullock cart**	For carrying goods
2	 **Figure 22 - Tractor and trolley**	For land tilling and carrying goods

3	 **Figure 23- Motor Pump**	For drawing water form well
4	 **Figure 24 - Thresher**	To prepare food grains
5	 **Figure 25 - Spray Pump**	To spray medicines
6	 **Figure 26 - Drip Irrigation Set**	Drip Irrigation Set is used to water the roots of plants drop by drop. This saves water and enables us to give, fertilizers and medicines in right proportion through water.

7	 **Figure 27 - Sprinkler Set**	Using this water is sprayed like rain drops. Equal water can be given on an irregular land. Fertilizers and medicines can also be given using this.
8	 **Figure 28 - Harvester**	For cutting crops and preparing food grains. e.g. Wheat, maize, soybean, rice etc.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____ is used to water the roots of plants drop by drop.
2. _____ is used for ploughing and clod crushing simultaneously
3. _____ is used for ploughing, creating furrows and rotating soil.
4. Harvester is used for _____.
5. _____ is used for digging work and making trenches.

Subjective Questions

1. Write about various tools and equipment used in agriculture.
2. For what purpose a spray pump is used?
3. Explain the importance of seed sowing plough in agricultural work.
4. For what purpose a hand hoe is used?
5. Write down the uses of thresher.
6. How will you take care of tools of agriculture?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate safe use and application of agriculture tools and equipment, while working in agriculture one has to use a variety of tools, equipment's and machines.

SESSION 2: LAND CULTIVATION, CROP PLANTATION, FERTILIZER APPLICATION, MULCHING

Land

We call earth's surface as land. Soil, humus, salt, water, bacteria are present in land. Humus is formed when organic matter in land gets decomposed. Rain water is stored in land. Plants get water and salts from land.

Components of Land

Soil, organic matter, air, water etc.

Soil – Soil is essential for growth of a plant. Importance of soil is so much that life-cycle of living organism starts in soil and ends in soil. Plants get all the components and nutrients required for their growth from soil. Soil is base of agriculture.

How soil is formed?

Soil is made up of rocks, pebbles, sand, fine soil and organic matter. Rocks are affected by atmospheric changes like heat, cold and wind. Cracks appear on the surface of rocks. When water accumulated in these cracks gets frozen due to cold, its volume increases. That results in breaking of rocks.
Rocks continue to break due to river and rain water, blowing wind and continuous weather changes. As the wear and tear of rocks continues, in the course of time they are broken into small particles and soil is formed. Layers of soil get deposited on earth's surface. This process of rocks converting into soil is called as 'erosion'. It takes about 800 to 1000 years to naturally form a 2.5 cm thick layer of fertile soil.

Characteristics of Soil

1) Size of particles – All soil particles are not of same sizes. Sizes of soil particles can range from 0.002 mm to 2 mm or more. Characteristics of soil change a lot due to changing proportion of different soil particles. Further, soils also differ due to salts present in them. Colour of soil changes due to varying proportion of materials like iron etc.

Sr. No.	Type of Soil	Size of Particles
1	Clay	Smaller than 0.002 mm
2	Silt	0.002 – 0.5 mm
3	Sand	0.05 to 2 mm
4	Gravel	Bigger than 2 mm

2) Porosity – Soil remains loose due to vacuum between soil particles. This is called porosity. Water is stored in soil because of porosity. When these pores or vacuum are completely filled with water, it can be said that soil's water holding capacity is absolute. After some time water from big pore flows out due to gravity and air will

fill the pore again, but soil may remain moist due to capillary action. Whatever water remains in soil is called as soil's Field Capacity or water holding capacity (Plants absorb this water) This water doesn't flow into wells. Water absorbed by soil particles remains as it is. But water filled between gaps of particles flows into wells. Capacity of soil particles to absorb water is called as Field Capacity. Water hold by soil particles becomes useful for plants and bacteria. Water below 1 meter in land is evaporated very slowly.

3) Capillary Action – What is capillary action? When we dip one end of a cloth in water, water rises up from the end dipped in water. This is in the same way when a cotton wick is dipped in oil, oil rises in wick and its other end keeps burning. When distance between two particles is extremely less, water rises against the gravity due to attraction between two particles and remains in that vacuum. Water and other liquids rise in a hair-like pipe due to similar attraction. Therefore this process is called as capillary action. Because of this reason moistness remains in soil. Soil's Field Capacity depends upon how much water is absorbed due to capillary action. Smaller the pores more the capillary attraction.

4) Ion Exchange – In a molecule, negatively charged electrons and positively charged protons in nucleus are not equally spread. Therefore a molecule can have negative charge concentrated on its one side and positive charge on other side at the same time. When such molecules are dissolved in water these negatively and positively charged parts are separated from each other. These are called as negative and positive (–ve and +ve) ions. Ca++, Na+, H+, CINO3 are examples of ions. Ions in soil and ions in moisture keep interchanging and exchanging as per their charge, which causes difference in soil characteristics.
E.g. Soil is loose if there are more Ca++ ions in soil and water drains easily in it. When water with Na+ ions is mixed in soil, Ca++ ions present in soil enter the water and Na+ ions in water enter the soil. This is called as Ion Exchange. If proportion of Na+ in soil increases, clay is formed and water is not drained properly from it. Along with water, plants take salts from land in ion form only.

5) Plasticity – Characteristics of soil that allows it to be given any desired shape is called plasticity. e.g. Earthen objects become hard when roasted in fire e.g. bricks, earthen pot, earthen lamp etc.
Formation of Humus – Soil is like a warehouse of micro-organisms. Innumerable micro-organisms of various kinds are found in soil. When vestiges of plants and animals are mixed in soil, micro-organisms in soil decompose these vestiges. From this nitrogenous compounds are formed which increase the fertility of soil. Soil formed after decomposition of plant and animal vestiges is called as humus.

Importance of Soil –

1) Give support to plants.
2) Plants get various minerals, nutrients necessary for their growth from soil.
3) Soil stores water required for the growth of plants.
4) Soil is also home to the various micro-organisms important for the growth of plants.

Soil Conservation Measures –
a) Tree plantation.
b) Using organic manures.
c) Using organic pesticides.
d) Prevents trees cutting.
e) Don't use chemical fertilizers, pesticides or herbicides in soil.

Types of Soil as per Fertility –
a) Alluvial Soil
b) Red Soil
c) Black / Regur Soil
d) Sandy Soil
e) Laterite Soil
f) Rocky Soil

Mulching
Polythene mulching technique is used in summer because of water scarcity. Mulching paper helps crop to be weed free. Polythene paper covers land which prevents falling of grass seeds from outside and growth of grass decreases by almost 26%. This results in increase in the soil temperature and even if temperature of soil is less at the time of sowing, the germination of seeds happens earlier by 3 to 4 days.

Fertilizers
Applying fertilizers is not possible after plastic paper is spread on raised seedbed, therefore fertilizers should be mixed while preparing raised seedbed and then covered with paper. If drip irrigation is to be used then pipes should be fitted before spreading paper. This process saves 50% of water and yield increases by 20 to 30 %.

Detailed particulars and description of practical - Mulching

Objective - Increasing crop yield and preventing soil erosion by using trash, grass, shrubs or plastic paper for mulching.

Fig -29 - Mulching paper

Expected Skills -
1) Learn how to make seedbed.
2) Increase organic properties of soil.
3) Make arrangements for irrigation.
4) Knowing how to use grass, shrubs and trash for mulching.
5) Make cover of mulching paper.
6) Making holes into paper for sowing seeds.
7) Sowing crop.
8) Applying fertilizers.

9) Cultivating crop.
10) Preparing observations, notes and report.

Material - Grass, shrubs and trash for mulching, mulching paper, fertilizers, seeds/crops, drip irrigation set / watering can, fungicide etc.

Implements - 1) Pickaxe 2) Axe 3) Shovel 4) Tape 5) Tool for making holes in mulching paper 6) Hacksaw 7) Ghamela (Pan) 8) Scythe 9) Scissors 10) Sickle 11) Axe

Every year a lot of manpower is used for destroying the used plastic paper. Besides that plastic is harmful for environment. Therefore biodegradable i.e. decomposable plastic is used. But, this process of decomposition is irregular because it depends upon weather. Due to this, Japanese scientists have invented a species of yeast which rapidly decomposes the biodegradable plastic.

Pseudozyma is a yeast species found everywhere. It can be used in a better way to decompose the biodegradable plastic. Post-harvesting farm leftovers like grass, dry leaves, dry stems, shrubs which are used for mulching can be later used for making compost which also improves soil texture.

1) Various seasons of agriculture

A) Kharif Season - The crops which are sown in June - July months and are harvested in October - November months are called Kharif season crops. Rice, pearl millet (Bajra, legumes, green gram, sorghum (jowar), groundnut, cotton etc. are kharif season crops.

B) Rabi Season - The crops which are sown in October - November months and are harvested in February - March months are called Rabi season crops. Sorghum (jowar), wheat, horse gram, safflower etc. are Rabi season crops.

c) Summer Season - These crops are grown in the summer months of March - May. E.g. watermelon, pumpkin, cucumber etc.

2) Various types of farming

a) Rain fed farming - farming which depends solely on rain water is called as rain fed farming.

b) Intensive farming - farming in which maximum input is used on a small area to get a very high yield is called as intensive farming. Food grains as well as vegetables are grown with this type of farming.

c) Irrigated farming - When a crop's water requirement can't be fulfilled by rain water then artificial arrangements of water supply have to be done. This type of farming is called irrigated farming. Wells, canals, lakes are used for water supply. Sugarcane, onion, potato, turmeric etc. are irrigated crops.

d) Horticulture farming - Farming in which fruit trees are planted for production is called as horticulture. Mangoes, oranges, grapes, cashew nuts, banana, figs etc. are grown well.

3. The agricultural work for maximizing agricultural yield includes different land cultivation practices, using good quality seeds and fertilizers, crop protection and proper storage of the grains.
The important stages in the agricultural work are –

1. **Land Cultivation -** There are generally 3 types
   - **A.** Primary Tillage
   - **B.** Secondary Tillage
   - **C.** Inter cultivation

A. Primary tillage – This includes ploughing and harrowing. Due to ploughing the upper tight and hard layer of the soil is brought at a specific depth, and the soil there loosens up. Due to deep ploughing, the upper layer of the soil goes down and lower layer comes up. This is called as interchange of layers. It results in the loosening of soil and it becomes suitable for the growth of crops. This also avoids run off of the rain water and this water percolates in the soil. As the soil is loosened, the germs and insects are exposed and they die due to sunlight. The remnants of the previous crops and roots are also exposed. They are collected and the soil is flattened. If the soil is ploughed in the winter, the beneficial bacteria in the soil increase and it results in increased crop production. So on a large scale, farmers plough in the winter season.

Fig 30 - Ploughing and Harrowing

B. Secondary tillage –

This includes building up soil, sowing the seeds or planting the saplings.

1. **Building up the soil:** Plough or harrow is used for building up the soil. As per the crop to be cultivated this includes making furrows, basins or creating beds.
2. **Sowing the seeds:** Sowing is done by different methods. E.g. sowing with the help of seed drill, sowing by dribbling the seeds in the soil. E.g. cotton, bitter gourd, pumpkin cultivation etc. The crops like paddy are cultivated by plantation method. The sugar cane and ladies fingers are cultivated in the furrows. Onions are cultivated by creating a sapling and planting it on a bed.

C. Inter Cultivation –

Inter cultural practices commence after the sown seeds start germinating. This includes following activities.

1. **Thinning** – In thinning, densely grown saplings are uprooted. While thinning, the exposed roots of saplings are covered with soil.
2. **Weeding** – After thinning, weeding is done with the help of a sickle. So the weeds are destroyed and soil near the roots, becomes aerated. Due to control of weeds, the competition of weeds with the crop for nutrients is prevented.
3. **Use of mulching**- To maintain the proper moisture in the crop, the materials like Chaff, twigs, straws, plastic etc. are used for mulching. The mulching helps to maintain the moisture in the crops.
4. **Fertilizers and Water**- The growing crop is watered at a specific time interval and proper dosage of fertilizers is given. Excessive use of fertilizers and water is harmful to the crops. In traditional method, the crops were watered by the furrow irrigation. This results in the wastage of water. In modern method, sprinkler or drip irrigation methods are used for irrigation. So the water is not wasted and it is saved.
5. **Earthing up** – Earthing up is covering the exposed roots and stems of the crop. E.g. earthing up is done for the crops like potato, turmeric, ginger, sugarcane etc.
6. **Spraying the medicines** – The crop protection is as important as fertilizers and water. To protect the crop and to avoid infestation of germs/fungus, the medicines are sprayed as preventive measure. If the medicines are used excessively, it adversely affects the soil and it becomes unfertile with time.

Fig. 31 Spray Pump

7. **Protecting crops** – Some crops need to be protected from the birds and other animals in the growth stage/ripening stage.

PRACTICAL EXERCISE

Activity 1.
Preparing land and taking one crop in farm.

Material – Seeds, water, Fertilizers

Equipment – Pickaxe, hoe, shovel, Ghamela (Pan), tape, watering can, scythe, sickle, bucket etc.

Preparations of practical:
1) Carry out practical in a group of 3 to 4 students.
2) Collect materials required for practical

Procedure –
1) First measure the land.

2) Loosen the soil by digging the land using pickaxe or hoe against the direction of slope.
3) Clean the dug land by removing rocks and grass.
4) As per requirement mix various fertilizers in the soil.
5) As per necessity of crop prepare furrow-ridge / raised seedbed / flatbed / basin in the soil.
6) Sow the treated seeds at proper distance.
7) Plant the intercrops while sowing.
8) After sowing/cultivation give 7 to 10 cm of water to that land.
9) After 4 to 6 days give 5 to 7 cm of leaven again.
10) Now as per need give water to these plants with 6 to 8 days gap.
11) When these plants become 21 to 28 days old, remove grass in them using scythe and use it for mulching.
12) Give water again as per need and apply fertilizer as per recommendation.
13) When crop is ready, harvest it and sell it.
14) Prepare profit-loss table and report of the crop.

Profit - Loss table and report of the crop

SR. NO.	WORK DETAILS	NOTES	EXPENDITURE RS. / PAISE
1	Area under cultivation	Square meter/acres/ hectare	
2	Ploughing	Pair of bullocks / Tractor	
3	Tilling	Harrowing – Sowing –	
4	Watering the crop	Motor bill	
5	Used fertilizer	Name – Weight –	
6	Spraying medicines	Name of medicine –	
7	Seed-Treatment Expenditure	Name of bio fertilizer –	
8	Cost of seeds	Name of seed – Weight –	
9	Inter cultural practices	Weeding – Hoeing –	
10	Cutting crop	Cutting – Threshing –	
11	Transport till market	Transportation cost –	
Total Expenditure –			
Income from product sale –			

Profit or Loss = Income from product sale - total actual expenditure for crop.
Profit or Loss =..... Rupees

Activity 2.

Preparation for practical -

1) Carry out practical in a group of 3 to 4 students.
2) Gather the equipments for practical.

Procedure -

1) First measure the land.
2) Loosen the soil in the measured land by digging with the help of pickaxe or spade.
3) Mix organic manures in soil to increase its organic properties. As per requirement add various manures in soil.
4) Prepare raised seedbed or flat seedbed in the land as per crop requirement and slightly wet the soil.
5) Make arrangements for irrigation.
6) Wet the soil little bit in raised / flat seedbed.
7) Spray fungicide on the seedbed.
8) Prepare mulching on raised / flat seedbed by using grass, shrubs and litter or spread the polythene mulching paper on raised / flat seedbed and put soil on its edges.
9) As per crop requirement make holes in the spread paper used hole-making tool.
10) Sow the treated seeds or saplings.
11) Apply fertilizer and water as required.
12) Harvest the crop when it is ready.

Precautions –

1) Prepare seedbed/furrows as per paper size.
2) While spreading the paper make sure that the paper doesn't get torn due to stretching.
3) Cover both edges of paper with same soil quantity.
4) Make holes of proper sizes and at proper distance as per crop requirement.
5) While sowing don't tread upon seedbed.
6) If you want to reuse the mulching paper then don't tear the paper while harvesting the crop.
7) Don't throw away the grass, shrubs and trash used for mulching and use them for composting.

CHECK YOUR PROGRESS

Fill in the blanks

1. The process of transformation of rocks to the soil is called as ……of rocks.
2. The characteristic of soil which allows it to take any shape, is called as …….
3. The size of the clay particles is less than ……mm.
4. It takes ……years to create a 2.5 cm layer of the fertile soil naturally.

Subjective Questions

1. What are two different seasons of farming? Write information about them.
2. What is irrigated farming?
3. Write about 3 stages of cultural practices of farming step by step.
4. State benefits of pre-cultural practices.
5. What are the activities included in the inter cultural practices?
6. What are the benefits of mulching?
7. How water supply can be managed in mulching method?
8. Name the equipments useful in the farming.
9. What are the benefits of using equipments and machines in farming?
10. How will you take care of the farm equipments?
11. What is meant by mono cotyledon and di cotyledon?
12. What are the components of soil?
13. How the soil is formed?
14. What are the characteristics of the soil?
15. Write solutions to protect the soil
16. How the humus is formed in the soil?
17. What do you mean by ‘porosity’?
18. What should be done to improve the soil quality?
19. What are the different types of beds which are created on the soil?
20. What should be pH of the soil?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate knowledge of land preparation / pot filling for cultivating a crop either on a plot of land / terrace garden / in a Pot.

SESSION 3: SEED PLANTATION AND SEED TREATMENT

Methods of seed treatment

A) Soak the seeds in cold water. E.g. Seeds of Indian plum (seeds with hard cover)
B) Soak the seeds in cold water. E.g. Seeds of jowar
C) Apply medicine or spray medicine, bacteria culture on the dry seeds.
D) Drench the roots of saplings in the solution.
E) Rub the seeds on hard surface. (e.g. Coriander)

Seed treatment – Seed treatment is very effective means to reduce the infestation of soil borne and seed borne diseases and pests to the cereals, pulses and oil seeds and to stimulate vigorous growth of these crops.

Seed processing – The most important thing is to learn to preserve home grown seeds. Traditional seeds should be used. It is difficult to preserve home grown seeds. The easy solutions for this are as below –

1) Dry the seeds well. Use techniques given in agriculture diary.
2) The jowar seeds are kept in the jowar bran; so that it get protected from pest attack. Using the dry leaves of sweet flag and neem, various types of seeds can be preserved easily.
3) Keeping the sacks of soybean seeds vertically in an aerated place can preserve their germination power.

'Bijamrut' is used for processing the seeds; it can be prepared by following method-

Mixture of cow urine (Gomutra) 5 liters + cow milk 1 liter + quick lime 250 gms +100 liters water should be kept overnight. This should be stirred from left to right in the morning. Seeds should be spread and the mixture should be sprinkled on it. It should be rubbed gently and then dried in the shade; afterwards the seeds should be sown. Roots of saplings should be drenched in this mixture and then they should be planted.

Benefits of seed treatment –

1) The infestation of soil borne and seed borne diseases can be avoided.
2) The germination power of the seeds increases.
3) The growth of saplings is healthy and vigorous.
4) The yield of crops increases.
5) The disease resistance power of plants or crops increases.
6) The cost for the seed treatment is reduced.

Following seed treatments are useful for the vegetable crops -

1) Drenching the seeds in the hot water – If the seeds are drenched in the hot water (50° C) for 20 to 30 minutes, the black rot disease in the cabbage is prevented and in brinjal crop, the diseases caused by phimosys fungus are prevented.

2) Use of bio fertilizers – Bacteria like azotobacter and azospirillum grow near the roots of mono cotyledon crops and fix the nitrogen, on the other hand, the micro

bacteria of rhizobium type, enter the roots of di cotyledon crops and create nodules on the roots. The process of nitrogen fixation is carried out in these nodules. Solid Bio fertilizers are manufactured from such useful bacteria and used by rubbing them on the seeds. When bacterial fertilizers are used for seed treatment, the crops grow vigorously and the yield increases by large extent.

Method to use 'rhizobium' bacterial fertilizers – Separate packets of bio fertilizer, such that for every 10 kg of seeds, 250 gm bacterial fertilizer will be applied. Take required packets of the bacterial fertilizer, empty the contents in a pot and add water, some amount of gum and jaggery in it slowly and create a slurry from it. Rub this slurry onto the seeds and dry them in shade and sow immediately.

3) Use of fungicides – Various types of fungi is present on the crop seeds. When seeds are sown, these fungi bring diseases to the plant. So, such seeds need to have seed treatment and seeds need to be made disease-free. For seed treatment, put powder of fungicide in a clay pot or seed treatment drum or in a polythene bag in the right proportion and it is moved or stirred. So the fungicide gets rubbed on the seeds or the layer of fungicide gets coated evenly on the seeds.

Types of fungicides

1) Protector – aureofungin
2) Copper based – Bordeaux
3) Nitrogen based – Captan
4) Other fungicides – Dinocap, PCNB

4) Use of growth promoters – Growth promoters are used for increase the germination power of the seeds. Gibberellic acid and N.A.A. are such growth promoters. Treating seeds with these growth promoters increases germination power of the seeds. The intensity of growth promoter for the crops like tomato, paper and brinjal is decided as per type of growth promoter. Seeds are soaked in the growth promoter solution for 24 hours.
Following equation is used to decide the number of saplings or seeds for cultivation as per the soil.

Amount of seeds / number of saplings =

$$\frac{\square\square\square\square\square\square\square\square\square\square\ (\square\ 2)}{\square\ \square\square\square\square\square\square\ \square\square\square\square\ \square\square\square\ \square\square\square\ \square\square\square\square\square\square\square\square\ \square\square\ \square\square\square\square\square\square\square\square\ \square\square\square\ \square\square\square\square\ \square\square\square\ \square\square\square\ \square}$$

Remember these units for it.

100 cm = 1 meter
3.3 feet = 1 meter
1 gunthas = 100 m^2
1 acre = 4000 m^2
1 hectare = 10000 m^2
12 inches = 0.30 meter
1 foot = 0.30 meter
40 gunthas = 1 acre
2.5 acres (100 gunthas) = 1 hectare

Example: Calculate the number of mango saplings to be cultivated in 1 hectare of land. Consider the distance between plants as 10m and distance between rows as 10m.

Number of Mango saplings =

= 1 hectare / 10 (m) X 10 (m) = 1 hectare = 10,000m^2
10,000m^2/ 10 (m) X 10 (m)
10,0~~00m^2~~/1~~00 m^2~~ =100
Thus, 100 saplings will be needed for cultivation of mango tress in 1 hectare land.

Example: Calculate the number of cotton seeds needed for 1 acre of land. Consider the distance between plants as 60cm and distance between rows as 60 cm.

Number of cotton saplings =

$$\frac{\text{Total area (m2)}}{\text{Distance between the seeds (m) X distance bewteen the rows}}$$

1 acre = 4,000m^2
Distance between the seeds = 60 cm = 0.6 m
Distance between the rows = 60 cm = 0.6 m
∴ = 4000 m / 0.6 m X 0.6 m
=4000/0.36
=11,111
∴ Thus, 11,111 seeds are needed for cultivating cotton in 1 acre of land.

PRACTICAL EXERCISE

Activity 1: Seed treatment.

Objective – To treat the seeds for improving resistance power, germination power and yielding capacity of the seeds.

Material –
1) Seeds 2) Anti- fungal medicine 3) Azotobacter 4) Rhizobium
5) Sulphur 6) Water 7) Jaggery

Equipments –
1) Ghamela (Pan) 2) Bucket 3) Waste paper
4) Hand gloves 5) Small spray pump 6) Plastic paper 7) Tarpaulin

Preparation for the Practical –
1) Carryout Practical in a group of 3 to 4 students.
2) Collect the material needed for the Practical
3) Wear hand gloves and put a mask on mouth.

Procedure –
1) To start with, take seeds on a plastic paper in a Ghamela (Pan) and sprinkle 5% sticky jaggery water on the seeds.
2) To increase the resistance of the seeds to the diseases, apply or spray medicines like anti-

fungal medicine, germinator, Sulphur etc. on the seeds and dry them in shade.

3) To increase germination power of the seeds soak them in water and then sow them.

Fig. 32 Seed treatment

4) For increasing germination power of the seeds with hard cover, soak them in the water of 80 degrees Celsius for 4 minutes and then sow them.
5) To increase yielding power of the seeds, apply bacteria culture fertilizer azotobacter for mono cotyledon and rhizobium for di cotyledon seeds and dry them in shade.
6) Before planting the saplings, drench their roots in the anti-fungal medicine.

Table for students

Sr.No.	Details	Name	Amount	Expense (Rs. Paisa)
1	Treated Seeds			
2	Anti-fungal medicine used			
3	Used bacteria culture			
			Total	

Precautions-

1) As the chemicals are poisonous, use hand gloves when applying them to seeds.
2) Spray the jaggery water just enough to stick the powder to the seeds.
3) Use completely dried seeds for sowing.

Activity 2:

How many pomegranate plants are required for 1 hectare of area? Consider the distance between plants as 10 feet and distance between rows as 12 feet.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The seeds with hard covers are kept in .....water for 3 to 4 minutes for early germination. (hot/cold)
2. For controlling fungal diseases on groundnut seeds, they are treated with .....(Thyrum/ Endosulphan)
3. Potato seeds germinate faster if soaked in ..... (Gibberellic acid, Ethrel)

Subjective Questions

1. Which medicines are used for seed treatment on mono cotyledon and di cotyledon seeds?
2. By which method, seed treatment is done on jowar seeds?

3. The onion sapling should be drenched in which solution, before planting?
4. Why the seeds are given the seed treatment?
5. Write the names of any two fungicides.
6. Get information about seed treatment is done at your home.
7. Which medicines are used to treat the seeds to avoid fungal diseases?
8. Write benefits of the seed treatment.
9. How fungicide and bacteria culture fertilizers are used for seed treatment of groundnut seeds?
10. What is seed treatment?
11. Write solutions for seed treatment at home itself.

What Have You Learnt?

On completion of this session, are you able to:

- Select healthy seeds for sowing; demonstrate the knowledge of basic seeds treatment.
- To avoid infestation of soil borne and seed borne diseases and pests as well as to increase germination power of the seeds and for vigorous growth of the saplings, before sowing, the seeds are treated with biological or chemical insecticides and cultures from time to time, this is called as seed treatment.

SESSION 4: PREPARE VERMI COMPOST AND VERMIWASH, ADVANTAGES OF VERMI COMPOST AND VERMIWASH

To prepare vermi compost on a large scale, a shade is constructed. To protect from sun light and rains, a shade or roof of 8 feet height, 10 feet width and 30 to 40 feet length is constructed. The length can be adjusted as per the need. Under the roof a 2 feet wide gap is left and beds of 3 feet width are constructed on the either side of it.

Fig. 33 Vermicompost shadehouse

Following precautions to be taken to preserve the earthworms –

1. Protect the earthworms from the enemies like frogs, mice, rats, centipede.
2. Temperature in the culture room, box or bed should be kept between 20°C and 30°C and ensure that the sunlight does not directly fall on the raised beds.
3. While sprinkling water on the raised beds, ensure that much water is not logged there. The moisture in the bed should be kept between 40 to 45%.
4. When separating earth worms and vermi compost, spread a tarpaulin or gunny bag in the sunlight and make heaps of vermi post on it. Due to the sunlight, the earthworms will go to the base of the heap and earth worms and vermi compost can be separate easily.
5. While separating earth worms and vermi compost, take care that the earthworms are not injured. The injured earth worms should be isolated so that other earthworms will not catch contagious disease.
6. Take care that ants do not eat earth worms, spread B.C.C. powder around the beds.
7. Use more composted dung in the bed.
8. It is necessary to have shade over the beds.

Important points to get good quality vermi compost

1. FYM, horse dung, goat manure, gram bran, and wheat bran, remnants of vegetables, all types of green leaves and other trash from farm is the important food for earthworms.
2. Remnants of vegetables from kitchen waste, dry leaves and FYM should be mixed in equal proportion and fed to earthworms. This mixture increases no of earthworm which gives good quality of vermi compost.
3. If gram bran or wheat bran mixed with dung in 3:1 proportion, we can get good quality of vermicompost.
4. From gober gas slurry, press mud, dung we can get good quality of vermi compost.

Precautions to be taken while using the vermi compost

1. After using vermi compost, chemical fertilizers, insecticides or weedicide should not be used in the soil.
2. For the soil having earthworms, keeping moisture near the roots of crops is necessary and it needs to be maintained for 9 months in the year.
3. As organic material is used to cover earthworms which is used as a food for earthworms. Time to Time provision of organic cover is necessary.
4. If sufficient moisture and cover is not provided then the efficiency of the earthworms decreases.
5. As per the need of the cultivated crops, use the prepared vermi compost.
6. Visit the Agriculture Services Centers (fertilizers/ seeds sales center) in your vicinity and make a list of available fertilizers and decide the dosage of fertilizers depending on the need of the crop.

Before arrival of chemical fertilizers and before the use started, farmers maintained the fertility of soil by using FYM, compost fertilizers, silt fertilizer, various oil cakes, rotation of crops. In course of time, farmers started to use chemical fertilizers excessively and its ill effect was evident on the crops and soil. Earlier, organic fertilizers were used in the farming on large scale. So, the fertility of the soil was maintained. In modern times, the farmers are using chemical fertilizers. Due to excessive use of water and chemical fertilizers the soil is becoming fallow and unfertile.

Information about earthworm – The earthworms are in existence since thousands of years. They have different colours and sizes. Earthworms are of different colours like purple, red, blue, green, brown and light reddish. The smallest earthworms have the length of less than 1 inch. Recently earthworms as big as a python are found in South Africa. But the earth worms generally found have the length of 6 to 8 inches. Big sized earthworms go up to 3 meters of depth in the soil and use soil as their food.

By rigorous research a foreign species named as Eisenia foetida has been found to be the best by all means for vermi compost production. There are 3000 varieties of earth worm in the world, out of them 300 varieties are found in India. Earth worm has very delicate, soft and smooth body like worm. The length is from 2 inches to 2 feet. The elongated body is made up of rings.

1. Life cycle of earth worm –

Earth worm is a hermaphrodite animal. Egg stage, hatchling stage, young stage and adult stage are the four stages of the earth worm's life cycle. The egg stage lasts for 3 to 4 weeks, hatchling stage and young stage last for 8 to 10 weeks and the adult stage lasts for 6 to 24 months.

Earth worm is a harmless animal living in a hole. While staying in a hole, earth worms continuously swallow the soil and the accompanying organic matter by mouth and give out excreta. Organic material is the main food of earth worm. So they eat organic material on large scale. Some species of earth worms carry the leaves fallen on the ground to their burrow for eating while some species come on the surface of the soil at night for eating organic matter there. When other types of earth worms eat soil, they get organic material from it and the soil becomes airy. So

the earth worm is called as farmer's friend. Earth worm increases the fertility of the soil as the percentage of nitrogen in the soil increases and the crops get this nitrogen.

2. Earth worms and chemical fertility of the soil –

Earth worms eat soil as much as half of their weight. Earth worms make holes in the soil, eat soil in their way and make the way clear. Some earthworms give out excreta in the hole itself. Percentage of nitrogen in their excreta is 5 times more than the surrounding soil, while phosphorus is 7 times and potash is 11 times more. The crops get these main nutrients in the easily available form. In addition to that 2 times calcium and magnesium are available in ready state in this excreta.

3. Biological fertility

The bacteria present in the excreta of earth worm like Nocardia Actinomyces and Streptomyces are effective as antibiotics. Thus, earth worm increase the number of bacteria by more than 1000 times and work as a natural reactor. On the other hand, the microorganisms from excreta increase the biological fertility of the soil.

4. Difference between vermi compost and FYM

Sr. No.	Vermi compost	FYM
1	Vermi compost takes less time to prepare. (2-3 weeks after the earth worms settle on the raised beds.)	Gets prepared slowly. (Requires almost 4 months)
2	No problem of foul smell, flies, mosquitos. Not harmful to the life.	Problem of foul smell, flies, mosquitos.
3	Needs less space.	Needs more space.
4	From a raised bed of 4 X 1 X 75 (300 m^3) we get 3 tons of compost every 15 days.	From a pit of 3 X 10 X 10, we get 10 tons of manure every 4 months.
5	Available nitrogen 2.5 to 3%	Available nitrogen 0.5 to 1.5%
6	Available phosphorus 1.5 to 2%	Available phosphorus 0.5 to 0.9%
7	Available potash 1.5 to 2%	Available potash 1.2 to 1.4%
8	Micro nutrients become available in the adequate amount.	Micro nutrients become available in small quantity.

Uses of earth worm and vermi compost –

From the soil's point of view

1) The earthworms increase the texture of the soil.
2) Proper change is made in the structure of soil particles.
3) Due to earth worms, soil erosion is reduced.
4) The holes of earthworms prepare the soil without hurting the roots of the plants.
5) The field capacity of the soil increases.
6) The soil becomes airy and roots grow well.
7) The rate of evaporation decreases.

8) The pH of soil is maintained at a desirable level.
9) The earthworms bring the soil from the lower layers on the surface and make it fertile.
10) As the hums content in the vermi compost is high, nitrogen, phosphorus and potash and other micronutrients become easily available on large extent for the plants.
11) The beneficial bacteria in the soil increases by a large number.

From the farmers' point of view

1. Without being completely dependent on the chemical fertilizer a transition towards becoming self-dependent.
2. The productivity of the soil increases.
3. The duration of irrigation decreases.
4. The yield is more and of better quality, so the agricultural produce fetches good rate.
5. Healthy growth of crops, expenses on the insecticides are saved.
6. The labor cost is saved.
7. Vermi compost production brings employment opportunities in the rural areas.

From environment's point of view

1. Reduces soil & Land pollution.
2. Erosion of fallow land and the amount of salts decreases.
3. The proper disposal of garbage reduces the health problems.

Vermiwash - These days, due to excessive use of chemical fertilizers for the farm land, the productivity of the soil is decreasing. So the fertility of the soil is also decreased. It has affected the health of animals and human beings. Due to use of chemical fertilizers, the production cost increases and preparing land has also become expensive. It has also resulted in decrease in production. To increase the fertility of soil and to decrease the expenses on farming, vermi compost and vermiwash is very essential. It increases the fertility of soil.

1) Vermiwash contains the hormones needed for plant growth. E.g. auxin, it also contains nitrogen (N). Phosphorus (P) and potash (K) and some other micro nutrients.
2) Vermiwash contains nitrogen fixing bacteria. E.g. Azotobacter Sp., Agrobacterium Sp., Rhizobium Sp. And some phosphate solubilizing bacteria.

Benefits of vermiwash

1. Vermiwash is a tonic for the plants it helps to decrease many plant diseases.
2. Mixture of 1 liter vermiwash, 1 liter cow urine in 10 liter water is used as a bio-fungicide and liquid manure.
3. Vermiwash increases rate of photosynthesis in the plants.
4. Vermiwash increases the number of micro nutrients in the soil.
5. It increases crop yield.
6. It increases resistance to the diseases.
7. The rate of disintegration of the compost increases due to vermiwash.

Components of vermiwash

1. pH - 7.48 ± 0.03
2. Organic carbon % - 0.008 ± 0.001
3. Nitrogen % - 0.01 ± 0.005
4. Phosphorus - % - 1.69 ± 0.05
5. Potassium (ppm) – 25 ± 2

Micro-Elements

Sr.No.	Micro-Elements	Quantity (ppm)
1	Sodium (Na)	8 ± 1
2	Calcium (Ca)	3 ± 1
3	Copper (Cu)	0.01 ± 0.001
4	Ferrous(Fa)	0.06 ± 0.001
5	Magnesium (Mg)	158.44 ± 23.42
6	Manganese (Mn)	0.58 ± 0.040
7	Zinc (Zn)	0.02 ± 0.001

Fertilizers - Fertile soil is needed for bumper crop yield. The fertility of the soil depends on the nutrients in the soil. For growth of crops, the amount of nutrients in the soil needs to be abundant and balanced. Trees absorb various nutrients through the roots and fulfill their need of food. Due the high yielding varieties, the supply of the nutrients in the soil depletes. Hence, to maintain the proper amount of nutrients in the soil, fertilizers need to be used.
Fertilizers – Plants take up some nutrients from soil, air and water for their growth, these are called as fertilizers.

Nutrients essential for the plants

1. Nutrients needed on the large scale – carbon, oxygen, hydrogen, nitrogen, phosphorus, potash,
2. Nutrients needed on the medium scale – calcium, magnesium, Sulphur
3. Nutrients needed on the micro scale –iron, molybdenum, boron, copper, zinc, manganese, chlorine

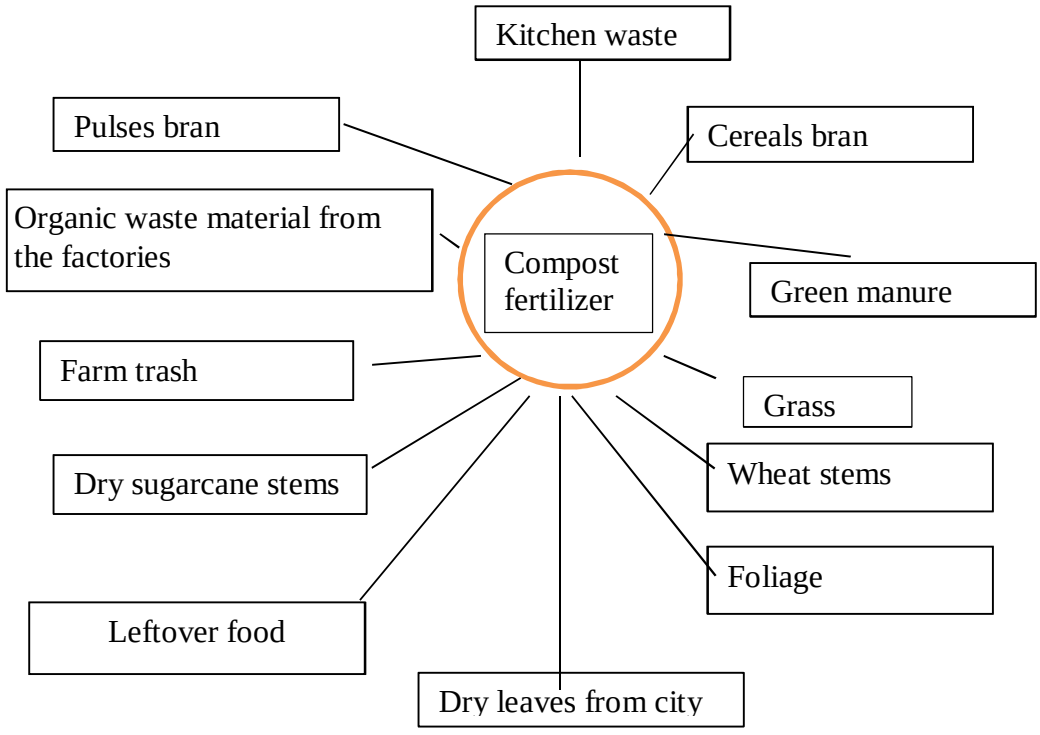
Types of Fertilizers

A) Organic fertilizers -
B) Bio fertilizers -
C) Chemical fertilizers

A) Organic fertilizers - The fertilizers obtained from plants and animals are called as organic fertilizers. There are two types of organic fertilizers –

1. Bulk manures – These contain less nutrients and help the plants slowly. They have good effect on the natural characteristics of soil. The texture of the soil improves and field capacity increases. E.g. FYM, goat manure, compost, gober gas slurry, night soil, and vermi compost are bulk manures. Farm yard manure, urine of cattle, fodder etc., are collected and a layer of soil is spread on it. Also, the dung and garbage layers dumped in soil transform into compost when they are completely rotten. At most of the places the ammonia from urine enters the air. Due to ammonia gas, the lavatories stink.

E.g. Compost fertilizer – Preparing compost fertilizer is a biological process. In this process the non -composted organic matter is disintegrated by the bacteria and the carbon-nitrogen ratio decreases. Such disintegrated organic matter is called compost fertilizer. Compost is made artificially from the trash material from the farm e.g. dry stems of the crops, weeds, grass, remnants of the crops, straws, stems of cotton, crop bran, leaves, dry sugarcane, soil from the cattle shed which has absorbed cattle urine etc. On the other hand, good quality compost can be made from the trash in the city like garbage, waste material, night soil, human excreta, garbage from homes, garbage from the vegetable market, fish market etc.



Choosing place for preparing compost fertilizer

The place for industrial production of the compost fertilizer, should be away from the human settlement. On the actual plot, there should be shade of tree. If it is not there, construct a raw construction shade. It helps to maintain the moisture.

Pit method

The width of the compost pit can be 1.5 to 2.45 meter, depth 1 meter and length can be from 6 to 10 meters as per requirement. The organic material, trash, dry leaves from farm and other available places is shredded and collected in a pit and dung slurry is poured on it. Ensure that the water content in the pit is 60%. The whole pit should be covered by a layer of 1 cm thickness of FYM or soil. In this way, compost fertilizer becomes ready within 4 to 4.5 months.

Benefits of the compost fertilizer –

1. The texture of soil improves and its productivity is maintained and improved.
2. All the nutrients required for the growth of the crops are available.
3. Along with the supply of nutrients, the structure of soil particles changes and soil texture improves.
4. The soil becomes aerated and the soil temperature is controlled, so the number of nutritious bacteria in the soil increases.
5. Increases water holding capacity of soil.
6. Improve soil texture & quality, increases crop yield.

Concentrated organic manures –

These fertilizers have high nutrient content, need to be given in the right amount only. Apart from groundnut cake, cotton seed cake, castor cake, neem cake, bone meal, fish manure, some plants are used as green manures. E.g. jute, Sesbania (dhaincha), common sesban (shevari), cowpea, guar, gliricidia etc.

E.g. Bacterial fertilizers – The fertilizer which is made by growing bacteria separately which fix nitrogen, solubilize phosphorus in soil, disintegrate organic materials and then mixing them with suitable carrier, is called as bacterial fertilizer. This fertilizer is known as bacterial culture or bacterial inoculant too. E.g. rhizobium, blue green algae, azolla, azotobacter, azospirilium, bijerikia, phosphorus bacteria.

Chemical Fertilizers

These fertilizers have nutrients in large amount. The nutrients are made available to the crops faster, so the chemical fertilizers need to be used at a proper time considering the need of the crop.

Types of Chemical Fertilizers

A. Nitrogen fertilizers = N e.g. urea, ammonium sulphate, calcium ammonium nitrate
B. Phosphorus fertilizers = P e.g. Super phosphate (single & Triple)
C. Potassium fertilizers = K e.g. Muriate of potash, sulphate of potash
D. Mixed fertilizers = N:P:K e.g. nitro phosphate, mono ammonium phosphate, di ammonium phosphate

N- Nitrogen fertilizers

There is 78% nitrogen in the atmosphere. Using lot of pressure and temperature nitrogen based fertilizers can be manufactured in the big factories, but the same work is done in nature on small scale by some bacteria. E.g. some bacteria grow on

the root nodules of leguminous plants. These bacteria take nitrogen form the atmosphere and convert it into the solid form.

P- Phosphorus fertilizers

When rock phosphate has reaction with sulphuric acid, we get super phosphate. The bone meal is also used as phosphate fertilizer. The rock phosphate is found in India in the state of Rajasthan, but it is imported from Morocco on a large scale.

K- Potash fertilizers

Potash fertilizers are found when chemicals are separated from the sea salts. When salt is separated from the sea water, Potassium Chloride (KCl) is present in the remaining salts. Potash is present in large amount in the ash of many plants. (E.g. cover of groundnut pods)

Compound fertilizers

If all the three fertilizers, N, P, K are used in combination, it is beneficial. The three numbers in it, show proportion of N, P and K. e.g. N18:P18:K10.

E.g. calculating percentage of nitrogen in urea

1) Molecular formula of Urea = CON_2H_4
2) Atomic weight of Carbon (C) = 12
3) Atomic weight of Oxygen (O) = 16
4) Atomic weight of Nitrogen (N) =14
5) Atomic weight of Hydrogen (H) = 1
6) Molecular weight of urea = C + O + N_2 + H_4
   = (12 X 1) + (16 X 1) + (14 X 2) + (1 X 4)
   = 12 + 16 + 28 + 4
   = 60

Percentage of nitrogen in urea = 28/60 X 100
Percentage of nitrogen in urea = 46.6%

E.g. 1) If urea has to be given the proportion of 120 kg/acre, how much urea needs to be given for 10 m X 10 m area of vegetable crop?
Given information – For area of 1 acre = 120 kg of urea

Let's assure 'H' Urea is needed for 10m X 10m =100m^2 area.
∴ x kg urea = 100 m^2 X 120 kg urea / 1 acre area (1 acre area = 4000 m^2)
x = 3 kg
∴ For an area of 10 m X 10 m, 3 kg of urea will be required.

Symptoms observed in the crops due to lack of nutrients and solutions

Nutrients	Symptoms observed due to lack of nutrients	Solutions

Nitrogen	Affect tree & root growth. Yellowing of leaves. New shoots stop coming up, less number of flowers.	Nitrogen fertilizers should be given as per need.
Phosphorus	Lower side of the leaves becomes purplish. The leaves become greenish and oval shaped and their growth stunts.	Phosphorus based chemical fertilizers, ash and bulk fertilizers should be given as per need.
Potassium	The stem becomes short and the shoot drops off. The sides of the leaves become reddish and red and yellow spots appear on the leaves.	Potassium based chemical fertilizers and bulk fertilizers should be given as per need.
Iron	Growth of the plant stunts. The mid rib of leaves becomes yellow.	0.5 to 1% of ferrous sulphate or ammonium sulphate should be sprayed or ferrous sulphate 5 to 25 kgs per hectare should be given through soil.
Boron	The leaves get wrinkles and yellow patches appear on them. The shoot and new leaves become whitish and then die. Red dots appear on the fruits.	5 kg borax /per hectare should be given through light/ medium soil or 0.5 gm borax should be sprayed by mixing in 100 liters of water.
Zinc	The leaves become smaller. The area between ribs become yellow and the leaves becomes dry in patches.	2 to 20 kg zinc sulphate/hectare should be given through soil.
Sulphur	Whole leave looks pale yellow.	8 to 25 kg manganese sulphate should be given per hectare.
Copper	The growth of the shoot stunts. Slow stem growth. Leaves dry early.	Spray the mixture of 4 gm copper sulphate mixed with 1 liter of water.

How to determine the amount of fertilizers

To decide which nutrients are present in the soil, soil testing is essential. From soil testing, the amount of nitrogen, phosphorus and potash to be used is easily understood. If the soil contains nutrients in very less proportion, then the amount of fertilizers should be 1.5 times of the recommended dose. If nutrients are in less proportion, 1.25 times of the normal fertilizer dose should be given. And if nutrients are present in medium proportion or more than that, then the usual recommended dose of fertilizers should be given. If the nutrients are present in more quantity, 25% fewer fertilizers than the normal dose should be given and if the nutrients are present in very large quantity, 50% fewer fertilizers than the normal dose should be given Soil testing is necessary for determining the amount of fertilizers.

PRACTICAL EXERCISE

Activity 1: Prepare vermi compost.

Material – well composted FYM, cow dung, bran, chaff, dry leaves, earthworms, water etc.

Equipments – Water can for watering, bucket, Ghamela (Pan), spade, axe, bricks, cement, sand, rope, plastic caret without net, plastic hand gloves etc.

Preparation for the Practical –

1) Make a group of 3 to 4 students and ask them to bring raw material required for the Practical. E.g. Dung, bran, dry leaves etc.
2) Collect the other material needed for the Practical

Procedure –

1) To start with, create a firm bed of 7X3 feet length and width and 3 feet height. At the base of bed make coba, also fit a 1 inch PVC pipe at the base. This is used to collect the vermiwash. Use plastic caret as a bed.
2) At the base of the bed spread a layer of bran, fibers from coconut cover, chaff, dry leaves etc. Pour sufficient water on it
3) Spread a layer of composted dung on it and spread 3 to 4 kgs of earthworms on it. Spread a layer of composted dung again. And pour water. Use 250 Gms of earthworms for plastic caret.
4) After that, spread layers of farm trash, bran and vegetable remnants on it. Pour sufficient water and cover with a gunny bag.
5) Water the bed daily for a month.
6) Create a shade on the bed or it can be created under a tree.
7) Within a month, 4 quintals of vermi compost is prepared from one bed. The colour of this vermi compost is blackish, like soil.

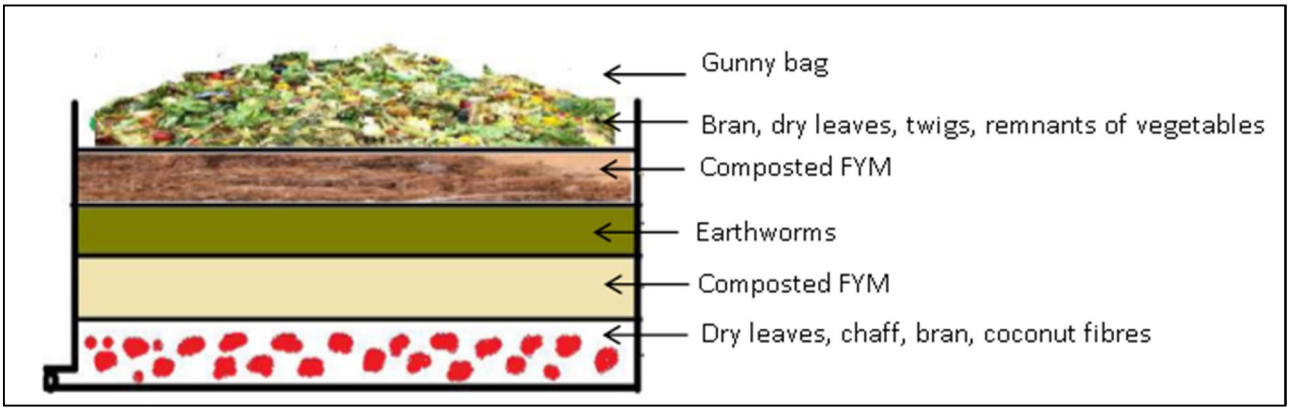
Prepared vermi compost can be used for crops in the school farm. It can also be used for pot plants and trees in the school. If it is prepared on a large scale, cost can be calculated and it can be provided to the farmers.

Costing

Sr.No.	Material	Quantity	Rate	Amount
1	Composted dung			
2	earthworms			
3	Dry leaves, twigs			
4			Total	
5			Total expenses and other charges 30%	
6			**Total**	

Size Length 7 feet, width 3 feet and height 3 feet

Approximate cost for the 7 X 3 feet bed



1) Construction expenses –

Fig. 34 - Vermi compost Bed

Sr. No.	Details	Total expenses
1	For construction of one bed : bricks, cement, sand etc.	6000/-
2	Earthworms 4 kgs	1600/-
	Total	7600/-

One time cost for plastic caret

Sr. No.	Details	Total expenses
1	Plastic caret	400/-
2	Earthworms 250 gms	100/-
	Total	500/-

Observation table -

Sr.No.	Details	Observation and records
1	Colour of the vermi compost	
2	How many kgs of fertilizer is prepared from one bed/caret	
3	How many days needed for preparing fertilizer	

Practical 2 - Prepare Vermiwash

Equipments - 15 litre bucket or drum, tap, twigs, farm trash, broken bricks, vermi compost, earthworms etc.

Procedure –

1. Fit a tap to the bucket or drum as shown in the diagram.
2. Spread a layer of broken bricks/ small pebbles at the base of bucket.
3. After that add a layer of sand, composted FYM, soil etc.
4. Fill the whole bucket in this way.

5. Spread farm trash/dry leaves/twigs, rice straws etc. for the uppermost layer and keep the bucket in shade.
6. Put 250 Gms of earthworms in that bucket.
7. Everyday pour sufficient water to maintain moisture in the bucket. (For approximately 30 to 45 days)
8. The excess water will come out from the fitted tap. This will be vermi-wash suitable for use.

Precautions –

1. Choose feed suitable and nutritious for the earthworms.
2. Ensure that ants do not harm the earthworms.
3. Store vermiwash in a cold place.
4. Make an arrangement such that the water trickles from the tap.
5. While pouring water ensure that it does not contain non-bio-degradable material.
6. Do not add green components to it.

Method of usage – For spraying add 4 liter of vermiwash to 200 liters of water.

Use prepared vermiwash in the school farm and observe.
If vermiwash is excess, calculate the cost and provide it to the farmers.

Expenses –

	Details	Quantity	Rate	Total
1	Bucket			
2	Earthworms			
3	Iron stand			
4	Labor charges and overhead charges			
			Total	

CHECK YOUR PROGRESS

Fill in the Blanks

1. After using_____, chemical fertilizers, insecticides or weedicide should not be used in the soil. (vermi compost)
2. Before arrival of _____and before the use started, farmers maintained the fertility of soil by using FYM (chemical fertilizers)
3. The earthworms are in existence since _____of years (thousands)
4. A foreign species named as _____has been found to be the best by all means (Eisenia foetida)

Subjective Questions

1. Define vermicompost
2. Define a procedure & explain to develop vermiwash

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate preparation and use of different compost and vermin-wash

SESSION 5: PREPARE ORGANIC PESTICIDE, ADVANTAGES OF ORGANIC PESTICIDE

Protection of crops from the pests, is called as 'pest control'.

Types of pest control

1) **Physical pest control –** To collect the pest by hand.

2) **Chemical pest control –** To control the pests by using different chemicals.

A) **Contact insecticide –** For the chewing and nibbling pests. E.g. for controlling larvae, Monocrotophos is used.
B) **Systemic insecticide –** These are used for sucking pest, e.g. for controlling aphids.

1) **Biological pest control –** The nature has its own system for controlling pest. In this system, the harmful pests can be controlled by the beneficial pests.

Principle of biological pest control – If following principles of biological pest controls are followed, the pest infestation will be definitely controlled.

1. On time cultivation of land.
2. Seed treatment
3. Instead of using chemical fertilizers, neem cake & organic fertilizer can be used it reduces infestation of termites, nematode etc. from soil.
4. Inter cropping - to prevent bollworm / Helicities on cotton inter cropping method can be beneficial.
5. Use of herbal products for pest control e.g. neem extract, neem oil, tobacco extract, garlic extract, chili extract etc.
6. Performing crop rotation.
7. Use of beneficial insects.

Adverse effects of chemical components on environment –

1. Use of chemical fertilizers increases salinity of soil causing adverse effect on growth of plants.
2. Action of transferring necessary nutrients to plants is naturally performed by bacteria. Due to use of chemical fertilizers these bacteria are killed.
3. Unwanted salts are produced in soil due to use of chemical fertilizers which results in less availability of micro nutrients to plants and hence growth of plants hampers.
4. Due to use of chemical fertilizers proportion of salts in soil rises which causes changes in soil structure and water holding capacity of soil decreases.
5. As chemical fertilizers are applied for pest control they also kill useful insects (friendly worms). This causes disturbance in natural food cycle.

6. Overuse of pesticides immunity of pests increases which increases pest resistivity.
7. Drinking water polluted with chemical pesticides & fertilizers can cause hazardous diseases.
8. Soils are becoming arid and infertile due to harmful residues of chemical fertilizers.

Conservation of bacteria -Soil contains unlimited amount of nutrients required for plants but they are not in usable form. Bacteria which make these nutrients available to plants are getting destroyed due to use of Chemical Fertilizers. Therefore we need to stop using Chemical Fertilizers, weedicides, pesticides and micro-nutrients and have to produce useful bacteria in the soil and make food available to them. This production of bacteria is possible with cattle manure or cow dung. Because 1 kg cow dung contains billions of bacteria. Therefore, caw dung can be used for bacterial growth. For that, purpose prepare 'Jeevamrut' solution by following method.

Method of preparing Jeevamrut
1) Dung of native cow / bull or buffalo - 10 kg
2) Cow urine - 5 to 10 kg
3) Old black or red jaggery - 1 kg
4) Flour of any legume - 2 kg
5) Soil bacteria (soil near roots) - 1 kg
6) Water - 200 liters

Take all the ingredients above in a barrel and keep it for fermentation for 2 to 7 days. Daily 2 to 3 times stir it using a stick from left to right. This jeevamrut is to be used for 1 month and for one acre. A native cow produces 10 kg dung daily. From one cow's dung and urine we can do manure management of 30 acres field.

Amrut Jal – Organic growth promoter - Take mixture of fresh cow dung and cow urine add some jaggery in equal proportion and keep it for decomposition for 6 to 10 days.
Then add water into it and sprinkle in the farm using cloth or watering can. In the process of decomposition there is huge growth of bacteria which results in increases crop yields.

Making Plant Growth Regulators - There is absolutely no need to purchase costly plant growth regulators available in market. For that Saptdhanyankur has proven effective. Seeds of wheat, moth beans, black gram, green gram, sesame, chickpea and cowpea are used to prepare Saptdhanyankur. Take 100 gm each, soak for 24 hours and make fine paste by grinding. Add 200 ml water and filter it. Spray it on all crops after fruit setting. This leads to better growth of crops as they get plant growth regulators.

Herbs and Herbal components– Herbal medicines are used in organic farming for crop protection. These medicines are effective for sure. But, for many of these medicines research is still going on about proportion of their use. Following plants and their components are used for pest control.

1) Tobacco – Tobacco is used as pesticide, miticide and fungicide on crops. Nicotine present in tobacco is mainly a fumigant pesticide. It affects nervous system. Tobacco spreads fumigating poison into pest body. Therefore it is generally used to manage aphids, larvae, stem borer, cabbage worms. There are many methods of applying tobacco.

a) Soak 1 kg tobacco leaves in 15 to 20 liters water for a day and add 100 gm soap powder. Filter this mixture and immediately spray it using spray pump.

b) Boil the mixture of about 400 gm tobacco, 60 gm soap and 8 liters of water. Its effectiveness increases when used with 1 part lime.

c) Stem borers are controlled when per acre 75-125 kg tobacco straws are buried on 5 cm depth in a paddy field.

2) Neem – Neem is a perennial tree. It is found at many places like roadside, garden. Leaves and seeds of this tree have insecticide properties and act as touch and stomach poison on insects. Fruit seeds of this plant can be used to control army worm, brown plant hoppers, aphids, mites, paddy gall fly and grasshopper.

a) In one liter water, soak 150 gm fresh leaves and 50 gm dried leaves of neem for one night. On next day, filter this solution and spray on crops. This gives protection from grasshoppers.

b) When 1:10 proportion of Neem seed extract and water is sprayed cocoons of armyworms are killed and controlled.

3) Garlic – Garlic which is consumed with daily meal and well known to all is also used as pesticide, fungicide and nematode-killer. Garlic cloves can be used as pesticide. Garlic can be used in following way to control aphids, armyworms and moths on crops, beetles on tomato and potato and worms on cabbage.

Take 200 gm peeled garlic cloves, 1 liter water, 200 gm soap and 4 tea spoon mineral oil. Soak finely grinded garlic for 24 hours. Dissolve soap in 1 liter water and add grinded garlic and mineral oil into it. Filter this mixture. Add 20 times water into it and use for spraying.

4) Chilli – Chilli has properties of pesticide and fungicide due to capsaicin nutrient present in it. Properties of pesticide are found in ripe chilies, especially in its peel and seeds. Chilies are used in following ways to control ants, aphids, worms, rice weevil.

a) Soak finely grinded ripe hot green chilies in water for one night and spray on crops in the morning.

b) Mix finely grinded ripe chilies in 1 liter water. Then filter it using a thin cloth. Add 5 part soap water in 1 part solution and spray on crops.

5) Neem – Neem contains a toxic substance azadirachtin in all its parts. It is useful as pesticide. Juice of neem leaves, fruits and bark are used against insects like American bollworm, aphids, brown plant hoppers, diamondback moth, armyworms, grasshoppers, fruit fly; storage insects like grain weevil in rice, grain borer, cowpea beetles. There are many ways of using neem. Extract in water, neem oil, seeds powder, neem cake etc. can be used.

a) Thrash 5 kg dried seeds and tie them in a small bundle. Keep it for soaking in bucket full of water for one night. Remove water from seeds after 12 hours. Add 100 gm soap powder in it and spray this mixture on crops by mixing it in 100 litre water. For horse gram and maize use 500 litre water per hectare.
b) Add powder of 500 gm neem seeds into 400 litre water and spray it on crops.
c) Add finely grinded 2 kg neem and soak it in 15 litre water for one night. Next day filter it using thin cloth and spray it.
d) Take dried seeds of neem and peel it. Thrash the inside seeds in a mortar and make pulp. Add some water while making pulp. Knead this thick ball in a big platter. Oil will start appearing on its surface. Extract this oil by pressing this pulp by hands. 1 kg seeds give 100-150 ml oil. After oil removal is put into boiling water, oil floats on surface. Take out this oil using spoon. Use this oil spraying.
e) If neem cake is mixed in 1 to 2 tonnes soil per hectare it protects brinjal plant from shoot and fruit borers.

6) Custard Apple - Mash 5 kg leaves of custard apple and soak them in the mixture of 2.5 litres cow urine and 2.5 litres water for one night. Next day remove its extract. Mix 200 ml extract in 15 litre water and spray it. This controls insects like aphids and hoppers.

7) Solanaceae - In 10 litres water soak 1 kg ball prepared by mashing entire plant of Dhatura i.e. fresh leaves, stem, flowers and seeds. Add 2 spoons of kerosene and 50 gm Nirma and keep this mixture as it is at least for one night. Next day filter it using thin cloth and spray on crops. This controls insects like worms, aphids and bugs.

8) Tomato - Tomato is effective on pests, spider, ticks and germs. It can be easily used. Fresh tomato leaves are excellent for removing extract. Make small pieces of tender shoots and fruits and mixed it in 5 litre water. Soak for one night. Filter it using cloth and spray on crops.

9) Papaya - Papaya plant is effectively used against pests and nematode. Soak chopped leaves of papaya and in morning filter it using cloth and spray it on crops.

10) Holy Basil (Tulsi) - Plant of normal (white) tulsi or black tulsi is kept in the courtyard of houses. Smell of tulsi repels mosquitoes. Take 50 ml extract of dried leaves of tulsi, stem or entire plant and mix 15 ml water and spray on crops. It controls leave borers.

11) Mahua - Mahua is medium to big sized deciduous tree with short stem. Alcohol is made from Mahua flowers. Mahua seed contains 20 to 43% oil. This tree is effectively used against various pests and rats as well as for the protection of stored food grains. Extract of bark and leaves is mixed in water and spread on crops. When Mahua cake is mixed in soil it provides protection against nematodes. Mix 100 gm Mahua cake in 1 litre water and take extract which is used as pesticide. This provides protection against beetles, moths, leaf Webbers, leaf borers and aphids.

12) Gliricidia - Gliricidia trees are planted on the edges of paddy fields for green manure and fodder. Scientific meaning of this tree's name is rat killer. Mix 2 parts

juice of gliricidia branches and leaves and 1 part heart-leaved moonseed juice in 15 liter waters and spray it on paddy crop. Mix it in 1 litre water & then spray it.

13) Five-leaved chaste tree (**Nirgudi** - (This plant is used for controlling aphids. Collect leaves of this plant and make juice. Spray it by mixing 1 litre juice in 10 litre water.

14) Marigold - Traditionally marigold is planted in those crops which face nuisance of nematodes. Nematodes which attack roots of plants are killed due to juice secreted from marigold roots. Marigold should be planted where nematode nuisance is heavy. Make powder of dried leaves and flowers of marigold and spray it on crops. This controls pests e.g. aphids, red bugs on cotton, dotted moth, leaf Webber.

15) Turmeric - Turmeric is used for crop protection. Turmeric used against armyworms, cowpea beetles, grain worms, beetles, spiders, grain weevil, rice beetle etc.

16) Indian beech (karanj - (Seeds of karanj tree contain 30-35 % bitter oil. It contains three substances with pesticide properties named karanjin, Pongamol and Glabrin. When these substances are mixed in acetone and sprayed on crops, nuisance from all types of insects is reduced. Karanj cake and leaves extract is used for control of nematodes.

Crop wise and disease wise uses of bio fertilizers – Bio fertilizers are widely used for pest control. Besides, some diseases are also controlled using bio fertilizers. In following ways bio fertilizers are used crop wise and disease wise.

Table showing crop wise and disease wise use of bio fertilizers –

Sr. No.	Bio fertilizer	Name of crop	Disease on crop	Method of using
1	Trichoderma	Cotton, pigeon pea, groundnut, sugar cane, brinjals, chillies, cabbage and all other crops and fruits	Root rot, stem rot, defoliation, crops drying, blight, fruit rot, wilt of crop	Seed treatment (10-15 gm/kg) mix in soil and process crop roots (soak 5 gm per litre for 10 minutes)
Herbs and Herbal Components				
2	Neem	Brinjals	Wilt on brinjal	Spray leaves extract
3	Belleric myrobalan (beheda)and Neem	Jujube	Mildew disease	Four sprayings of 5% extract of beheda and neem leaves with 15 days interval
4	Basil (Tulsi)	Chillies	Fruit Rot	Spray leaves extract

		Paddy	Spots and Blight	Spray leaves extract
5	Aegle marmelos (bael)	Chillies	Fruit Rot	Spray leaves extract
6	Tobacco	Wheat, Fava beans	Rust	Spray leaves extract
7	Garlic	Fava beans	Mildew and Rust	Spray garlic extract
8	Drumstick	Crops in raised seedbed	Fungus on crops	8 days before sowing mix drumstick leaves in soil

Benefits of biological control -

1. As compared to pest control using chemical components this method is less costly.
2. Chemical traces are not left behind in crop products.
3. There is no loss of useful bacteria in crops and soil.
4. Chemical pesticides have to be used frequently but bio fertilizers need to be used only once.
5. Bio resources are more effective on soil related diseases than chemical fungicides.
6. Reduces Pathogen resistivity.
7. Pollution of air, water and soil which is caused due to use of chemical fertilizers/pesticides is avoided in biological control.
8. All the hazards of chemical control are avoided in biological control.
9. Biological control is useful for control of viral diseases.
10. Along with disease control, biological balance of environment in maintained.
11. Biological control doesn't affect the health of farmer's family.

PRACTICAL EXERCISE

Activity 1: Identify the pest and measure it.

Material - convex lens, note book, pen, tape, ruler etc.

Method –

1) Go to a nearby farm to observe the pests.
2) Observe crops cultivated there.
3) Observe which pests are present on the crops and record it.
4) Observe the colour and shape of the pest or larva and record it.
5) Check if the pest or larva has an antenna to suck the sap in the water.
6) Observe the number of legs of the pest or larva.

7) Observe the way the pest or larva eats the different parts of crop (leaves of the plant, bores shoot or bores stem.)
8) Observe if the pest bores a fruit.

Identify the pest from the following symptoms –
A) Leaves eating pest/larva B) fruit borer pest/larva C) Shoot borer pest/larva D) Sucking pest/larva E) larva eating chlorophyll by boring holes in the leaves

Check if there is any other pest than this and record it. After observing the pest to determine its percentage, observe the crop in 1 X 1 sq.m. Of area and estimate the amount of pest in the whole area. (e.g. if there are 100 plants in the 1 X 1 sq.m. area, then count how many plants are infected by the pest. If 35 plants are affected out of 100, then the percentage of pest can be said to be 35%, based on it calculate the percentage of the whole area.)

Detailed information about the Practical
Our farmers prepare pesticides using many ways based on their traditional knowledge and experience. Using their knowledge get organic pesticides prepared from the students which are generally prepared and used at local level. Some common pesticides from these are mentioned below. To verify the pesticides prepared on scientific basis, ask the students to note observations and keep records. If the effect is not observed, ask them to write it clearly.

Practical – To prepare organic pesticide (dashaparni extract)

Material – leaves of 10 plant needed for dashparni extract – Neem, Five-Leaved Chaste Tree (Nirgudi), Lantana, Heart-leaved Moonseed (Gulwel), Castor, Custard Apple, Papaya, Calotropis Gigantea (rui), **I**ndian Beech (karanj), Nerium (kanher), Dung, Cow urine, water.

Equipments – buckets, measuring scale, plastic barrel, hand gloves, waste paper, bamboo stick.

Procedure –
1) Take a plastic barrel with water in it.
2) Then add the leaves of plants as below. (Consider this percentage in school as 5%)

	Percentage of Dashparnank (for farmers)		**Take 5% Percent mixture for preparing Dashparnank at school**	
Take all the mixture in 250 liter plastic barrel.	5 kg neem leaves		250 gm neem leaves	At school, take this mixture in 20 liter plastic
	2 kg five-leaved chaste tree leaves		100 gm five-leaved chaste tree leaves	
	2 kg lantana leaves		100 gm lantana leaves	

	2 kg heart-leaved moonseed leaves		100 gm heart-leaved moonseed leaves	barrel.
	2 kg castor leaves		100 gm castor leaves	
	2 kg custard apple leaves		100 gm custard apple leaves	
	2 kg papaya leaves		100 gm papaya leaves	
	2 kg Calotropis gigantea leaves		100 gm Calotropis gigantea leaves	
	2 kg Indian beech leaves		100 gm Indian beech leaves	
	2 kg nerium leaves		100 gm nerium leaves	
	2 kg native cow dung (fresh)		100 gm native cow dung (fresh)	
	5 liters cow urine and 200 liters water		250 gm cow urine and 10 liters water	

3) After mixing the material, stir it with a bamboo stick everyday 2 to 3 times from left to right.
4) Let this mixture ferment in the shade for 30 days.
5) After it is completely fermented, filter it.

- **Spray the prepared dashparnank on the pests in the crop and observe.**

How many liters of dashparnank is prepared = ...
Thus, original medicine organic pesticide, dashparnank is prepared. Dashparnank is the best solution for controlling diseases-pest on various crops.

Note – While executing this procedure, make groups of 3 to 4 students and ask them to collect information about the required material and required plants for preparing dashparnank. This will ensure active participation of all the students.

Dose of dashparnank- Mix 2.5 liter of solution with 200 liters of water and spray per acre of area.

Precaution -
1) Cover the solution with a cloth for 30 days.
2) Keep the plastic barrel in shade.
3) While stirring the solution take care that it will not spill on the body.

Activity 2: Preparing Amrut Jal (organic germinator)

Material: Cow dung, Cow urine, jaggery and water

Equipments: Plastic barrel of 25 liters capacity, stick etc.

Procedure:

1) Take a clean plastic barrel of 25 liters capacity.
2) Take 10 liters of water in the plastic barrel
3) Add 5 kg cow dung, 5 liters cow urine in the barrel. Add 50 gms of red/black jaggery. Stir the solution from left to right.
4) Rest this solution for 6 to 10 days for fermentation.
5) Stir this solution every day with a stick.
6) Keep the solution in shade.

Use the amrut jal prepared by this method in the farm. Observe the crops. Calculate the expenses incurred for preparing the amrut jal.

Costing -

Sr. No.	Material	Quantity	Rate	Amount (Rs.)
1	Dung			
2	Cow urine			
3	Jaggery			
4			**Total**	
5			**Other charges on total expenses 30%**	
6			**Total**	

Method of using it – Take this solution in water of 10 times quantity and sprinkle it in the farm using cloth or a water can.

Benefits-

1) When amrut jal (organic growth promoter) is given to the farm/ soil, the number of bacteria increases rapidly.
2) The growth promoters and micro-organisms in the amrut jal have a good effect on the palnt growth.

Note: Using fresh dung and urine of native cow, gives good effect.

Practical – Preparing a Saptadhanyankur growth promoter

Material – Wheat, moth bean, green gram, sesame, gram, cow pea, seeds, water, plastic barrel, weighing scale, mixer, cloth for sieving, hand gloves etc.

Procedure-

1) To start with take a plastic container of 3 liters capacity. Put 100 gm seeds of each of the grains, wheat, urid, moth bean, green gram, sesame, gram, cow pea and mix them.
2) Add water to the plastic container in such a way that all seeds will be soaked.
3) Soak all the grains for 24 hours.
4) Grind all the grains using mixer and sieve them using a cloth.

5) Keep the filtered solution safely in a plastic container.

In this way, Saptadhanyankur, a growth promoter can be prepared.

Spray the prepared solution on the crops in the farms and observe the growth of crops. Crops get growth promoters from this solution.

Costing –

Sr.No.	Material	Quantity	Rate	Amount
1	Wheat			
2	Urid			
3	moth bean			
4	green gram			
5	Sesame			
6	Gram			
7	cow pea			
8			**Total**	
9			**Labour charges and other charges (30%) on total expenses**	
10			**Total**	

Observation table –

How many liters of Saptadhanyankur was prepared	
Write the colour of Saptadhanyankur	

Crop protection is one of the important factors which affects expected yield In modern agriculture practice, due to excessive use of chemical fertilizers, the pests are becoming resistant to the diseases.
Most of the pests can be controlled naturally. For controlling some specific pests, we have to take some specific measures. large scale use of chemical fertilizers may affect beneficial insects. So the number of harmful insects kept on increasing and the number of beneficial insects has decreased, too. Out of total annual agriculture yield, on an average 15 to 20% yield decreases due to pests.

Any insect which damages our crop is pest. E.g. insect, spider, bacteria, fungus, nematode etc. (The animal having 6 legs or 3 pairs of legs is called as insect. E.g. aphids, jassids etc. In addition to this as cockroach has 8 legs or 4 pairs of legs, it cannot be called as an insect.)

CHECK YOUR PROGRESS

Fill in the Blank

1. Neem contains a toxic substance _____in all its parts (azadirachtin)

2. Chilli has properties of pesticide and fungicide due to _____nutrient present in it (capsaicin)
3. Garlic cloves can be used as _____. (pesticide)
4. Neem is a _____tree(perennial)

Subjective Questions

1. Write down the environmental hazards of chemical components.
2. How to prepare 'Jeevamrut'?
3. What is the benefit of giving Amrut Jal?
4. Which food grains are required for preparing growth promoters?
5. Write down the benefits of biological control?
6. Leaves of which ten plants are used in dashparni (top ten) extract?
7. For what purpose dashparni (top ten) extract is used?
8. How to prepare Amrut Jal?
9. What are the benefits of Saptdhanyankur for crops?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate making and use organic pesticide formulation

SESSION 6: METHODS OF DETERMINING THE WEIGHT AND AGE OF ANIMALS

India is an agrarian country. Animal husbandry and poultry are done on large scale as supplementary occupations with agriculture. The Farmers generally rare cattle as they are needed for the growth of agricultural business. Domestic animals provide milk, meat and are used for agricultural activities. Thus, animal husbandry is not only useful for farming but also it is complementary. Farmers should know the age and weight of these animals to take good care of them. He can estimate the physical strength of the animal according to the age of the animal. In this chapter, we are going to learn the methods of determining age and weight of animal while domesticating them.

PRACTICAL EXERCISE

Activity 1: Practical - Determining the age of animal using their teeth

Aim - To estimate the age of the animals by their teeth, to understand their physical strength & market value.

Expected skills - To estimate the age of the animals by their teeth

Animals - cow, bull, calf etc.

Procedure -

1. First of all, open the mouth of the animal with the help of animal owner and count the number of teeth.
2. Observe the teeth carefully.
3. Carefully observe the number of milk teeth and permanent teeth in the mouth.
4. Draw the diagram of observed teeth in the notebook.

Fig. 35 - Animal Teeth

Observe the diagram carefully and estimate the approximate age of an animal.

Observation chart -

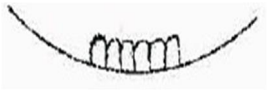
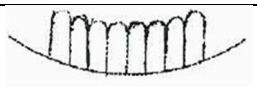
Sr. No	Description	observations
1	Name of the animal whose teeth are checked	
2	Milk teeth	
3	Permanent teeth	
4	Approximate age of animal	
5	Age told by the animal owner	

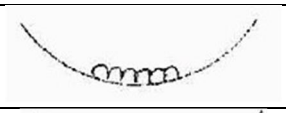
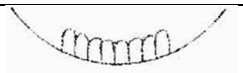
Precautions -

1. Take care of your hand while counting the teeth.
2. If the animal is unknown, then ask the animal owner for the help in counting the teeth. Otherwise the animal may harm you.

Did you know?

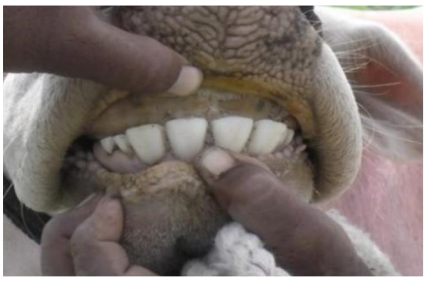
1. Cow, bull, calf, goat and male goat do not have front teeth but they have molars.
2. According to the age of the animal, one can estimate the productive value and market value of the animal.
3. As per the age of the animal, we can determine the physical strength of an animal.
4. Farmers need chickens, goats, cows for the complementary business. But chickens, goats, cows, and buffalos have certain basic differences.

Important information – Determination of age of animals by their teeth. **Cow / bull / buffalo.**			
1	By birth		2 milk teeth
2	After 15 days		4 milk teeth
3	After 21 days		6 milk teeth
4	After 30 days		8 milk teeth
5	After 2-3 years		6 milk teeth and 2 permanent teeth
6	After 3-4 years		4 milk teeth and 4 permanent teeth
7	After 4-5 years		2 milk teeth and 6 permanent teeth
8	After 5 years		8 permanent teeth

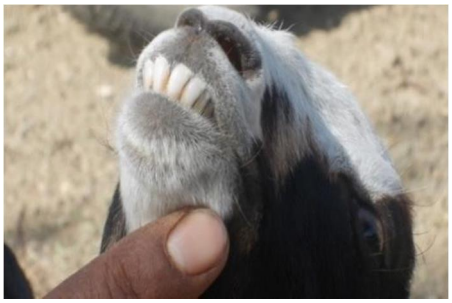
		Goat	
1	By birth		6 milk teeth
2	After 15 days		8 milk teeth
3	After 21 days		6 milk teeth and 2 permanent teeth
4	After 30 days		4 milk teeth and 4 permanent teeth
5	After 2-3 years		2 milk teeth and 6 permanent teeth
6	After 3-4 years		8 permanent teeth

Information about bull teeth: -

Sr. No.	Photo	Information
1	 **Fig 35.1**	After 21 days, bull has 6 milk teeth.
2		After 2 to 3 years, bull has 6 milk teeth and 2 permanent teeth.

	Fig 35.2	
3	 **Fig 35.3**	After 3 to 4 years, bull has 4 milk teeth and 4 permanent teeth.
4	 **Fig 35.4**	After 5 years, bull has 8 permanent teeth.

Information about goat teeth:-

Sr. No.	Photo	Information
1	 **Fig 35.5**	Goats have 6 milk teeth at the time of birth. After 30 days, they have 8 milk teeth.

2	 **Fig 35.6**	Within 30 to 35 days, goats have 8 permanent teeth.

Activity 2:

Introduction: Rings on horn can be used for determining age of animals. First ring on the horns appears at the age of 3 and thereafter every year one ring appears.

Formula for determining age of the animals from their horns -

Age of animal = N + 2 (N = rings on horn)

E.g 1)

N = rings on horn = 5

Age = N + 2

= 5 + 2

= 7

Thus, Age of animal is 7 years.

Fig: 36 - Animal Horn

E.g. 2)

N = rings on horn = 7

Age = N + 2

= 7 + 2

= 9

Thus, Age of animal is 9 years.

Domestic animals and their average age: -

No.	Name of the animal	Age (year)
1	Bull	20-22
2	Cow	22
3	Sheep	15
4	Goat	15

No.	Name of the animal	Age (year)
9	Elephant	70-90
10	Deer	35
11	Pigeon	26
12	Donkey	45

5	Hen	15	13	Horse	40
6	Dog	20	14	Buffalo	35-40
7	Camel	50-70	15	Parrot	25-30
8	Cat	20-25	16	Rabbit	9-10

Activity 3:
Weight is an important aspect of animal health. If the weight of cow is proportional to her age then she can give us sufficient output. Thus, knowing the age of cow is very important. We can predict productivity of animal based on their weight.

Equipments: cloth tape, notebook, pen.

Animal: cow, buffalo, goat
Procedure:
1. Measure the circumference of the animal (around the chest) with the help of cloth tape. (in centimeters)
2. Measure the length from horn to the pin bone of the animal. (in centimeters)

Method: To determine the approximate age of animals, following formula is used,
Mass = Density X volume
In this case, circumference and length of an animal is considered for deciding the volume.

Formula for calculation of weight:
Approximate weight of an animal (Kg) = $\frac{\square\square\square\square\square}{\square\square\square\square\square\square}$
A = Circumference of animal (around chest) in cm.
B = length of animal, from the horns to the pin bone in cm.

Observation:
A = ... cm
B = ... cm

Fig 37 - Determining the weight of animal from their body Measurement

Calculation - Approximate weight of an animal (Kg) = = □ □ □ □ □ / □□□□□□

= ..... □ .....□ ..... / □□□□□□

= ..... / □□□□□□

Approximate weight of an animal = _____Kg

You can put the values of A and B in the given formula and then get the approximate weight of an animal.

Precautions:

1. Take the measurements when the animals are standing straight. (The measurements may go wrong if the animal is bending. Consequently, the calculation of weight will also inaccurate)
2. Once you are done with the measurements, role the cloth tape and keep it safely. The animal may try to eat the cloth tape.
3. If the animals you are measuring are unknown to you then ask for the help of the animal's owner. Otherwise the animal may harm you.

Did you know?

1. Here, we have used a changed formula for area of hemisphere.
2. Every animal needs to be fed as per its weight.
3. If possible, weigh the animal with weighing scale and check difference from the calculated weight.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The Farmers generally rare _____as they are needed for the growth of agricultural business (cattle)
2. Animal husbandry is not only useful for farming but also it is _____ (complementary)

Subjective Questions

1. Define changed formula for area hemisphere
2. Define the process on how to feed animal as per their weight
3. Explain steps properly to weigh animal

What Have You Learnt?

On completion of this session, are you able to:

- Understand different breeds of animals – indigenous and breed variety
- Determine age of the animal and their feed requirements
- Determine the weight of animals to estimate feed requirement

SESSION 7 : TYPE OF THE ANIMAL FEED, DETERMINE THE EXPENDITURE OF CONSUMED FEED FROM THE WEIGHT OF AN ANIMAL

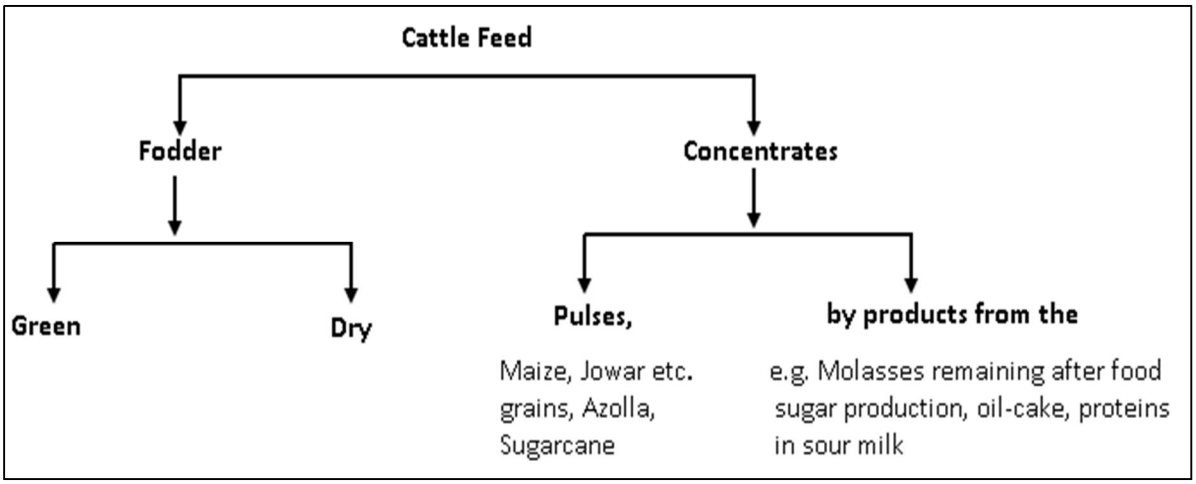
Food is required to give energy to the body, for the growth of the body and to stay fit and healthy. Hence food contain the proteins and minerals that are required by the body. Also, some amount of fibers should also be included in the diet for easy digestion. Cattle require diet for two reasons.

- 'Nutritious diet' for nourishment of body
- 'Productive diet' for milk, meat production.

Nutritious diet – Day to day essential bodily activities need to be performed at a specific pace. A nutritious diet is required for the same. Cattle need 10 grams of TDN (Total Digestible Nutrients) for every one-kilogram weight, to maintain their body i.e. their life expectancy.

Productive diet – Once the basic requirement of the body is met through nutritious diet, the remaining nutrients are used for productive purposes. Normally 0.500 kg TDN is required to produce 1 litre milk. Thus, productive work requires 50% more energy than nutritious diet.

Animals are not able to digest everything that is a part of the fodder. The digestible elements (TDN) differ as per the fodder type and its components. Dry fodder is useful as a nutritious diet. Wet fodder is useful as both, nutritious as well as productive diet .Concentrates are high on energy hence they are used in productive diet.



Green fodder, sugarcane etc. have more water content. Cattle find such food tasty. Concentrates have more nutrients and energy; hence it has a good effect on the milk producing capacity of the cattle.

Points to remember while selecting cattle feed -

1. Water content

2. T.D.N (Percentage of digestible elements to support proper digestion) fodder 40-55%, oil-cake 80-90%, food grains 70-90%
3. Cost – Please check the price on the digestible elements before buying the cattle feed.

   E.g. if 40% T.D.N. feed is Rs. 1.00/kilogram and 85% T.D.N. feed is Rs. 2.00/kilogram, then the price of 1 kilogram of first feed will be Rs. 2.50 per kilogram and the price of second feed will be Rs. 2.35 per kilogram. Hence the feed with 85% T.D.N. is available at rate than feed with 40% TDN cheaper.
4. Specific features and quality of the cattle feed.

Other features to be considered

1. Taste and flavour so that the animals will like to eat the food (e.g. oil-cake, bran)
2. Certain proteins and vitamins to improve and maintain the health of the animals. (Protein based diet)
3. Size and physical nature of the food etc. to facilitate feeding the cattle or to conserve the food. (In the form of pellet feeds or hay chaff)

If the feed can provide the above features then, one can afford to pay more for it.

Fig 38- Azolla

Fig 39 - Dry Fodder

How food cost can be reduced?

1. The rise in the animal's weight, the average amount of milk it gives in a week, whether it is pregnant etc. are the aspects that are taken into consideration while giving food to the animal. Depending on these aspects, the nutritious diet + diet for milk is decided. If animal is pregnant, considering the condition, the amount of diet should be 1.5 kg + 1 kg = 2.5 kg/ day for animal (for 300 kgs of weight). Concentrates + forage + dry fodder should be given to those animals in the above proportion. This way, the consumption of concentrates and fodder can be reduced in a large way.

2. While giving food to the animals, it should be broken down into small pieces so that everything is consumed and there is no wastage. This leads to saving the cost of food.
3. Cattle feed should be balanced, it should be soaked in water.

In the Western countries, nowadays computer is used to reduce the cost on cattle feed. (Information such as weight of the animal, milk producing capacity etc. is entered in the computer and the right proportion of diet is identified.) The cattle feed that consistently increases the milk production should be used by the cattle owner.

Usefulness of green fodder – Green fodder is a very useful diet for the animals. The fodder prepared with the help of modern technology and chemicals is more beneficial and economical. The animals get the required proteins through this fodder which help in milk production. The digestible elements differ as per the fodder type and its components. Dry fodder is useful as a nutritious diet. Green fodder is useful as both, nutritious as well as productive diet. Concentrates are high on energy hence they are used in productive diet.

Green fodder such as grass, green maize, sugarcane leaves etc. are high in water content. The animals find such food tasty. Similarly concentrates such as molasses, oil-cake have more nutrients (proteins) and energy, which have a good effect on milk production. Also, some specific proteins and vitamins help to improve the health of the animals and keep them fit.

Silage – The animals get abundant green fodder and grass to eat in the rainy season. But there is a shortage of dry fodder in this season. In the summer season, dry fodder is available in plenty and green fodder is not available. A reasonable solution to this problem is that, the farmers should store the fodder available in the rabbi and kharif season using scientific methods, and use the fodder in the appropriate quantity for the animals for the whole year.

Advantages of Cattle Feed -

1. Use of cattle feed shows rapid improvement in the health of the animals.
2. Appropriate and necessary proteins required for the body and for milk production can be provided through cattle feed.
3. Helps to build the immunity of the cattle.
4. Improves the breeding capacity of the animals and keeps them healthy in the breeding period.
5. Improve milk quantity.
6. The production of cattle feed in water scarce area makes green fodder available to the animals in the drought period also.

Determining the diet as per the animal's weight, milk producing capacity and T.D.N in the fodder (Total Digestible Nutrients)

In the previous practical, we learnt how to find the weight of the animal. In this practical we will learn to determine the diet as per T.D.N. and estimate the cost of the diet.

The following information will be useful, while determining the diet of animals.

Concentrate Type	Total Digestible Nutrients (%)
Bengal Gram	76
Maize	77
Cotton seed	80
Groundnut cake	71
Cottonseed cake	72
Wheat chaff/bran	65
Sugars	90

Forage	Total Digestible Nutrients (%)
Green Jowar	12
Green Maize	17
Lucerne	12
Maize silage	18
Jowar stover	50
Millet stover	35
Sugarcane leaves	46

Cattle are not able to digest everything that is a part of the fodder. The digestible elements (TDN) differ as per the fodder type and its components. Dry fodder is useful as a nutritious diet. Forage is useful as both, nutritious as well as productive diet .Concentrates are high on energy hence they are used in productive diet.

An example solved with the help of above information.

1) Calculate the cost of one day food based on the T.D.N. percentage, for an animal whose weight is 500 kilograms. Use the information provided below as per your requirement to calculate the cost.

1. Green maize – Rate 3.00/ per kilogram. 2. Lucerne – Rate 3.00/ per kilogram.
2. Jowar stover - Rate 10.00/ per kilogram. 4. Labor and wear and tear – 25% on the total stock

Do not consider the cost of cattle shed, cow and purchase price in budget.

Answer – 10 grams TDN needs to be given for one kilogram of weight. Therefore 5000 grams TDN needs to be given for 500 kilograms of weight. Its calculation can be done in the following way.

Sr.	Fodder Type	Percentage	Provided	TDN

No.		of TDN	fodder/concentrates	obtained
1	Green maize	17%	09 kg	1530 gm
2	Lucerne	12%	04 kg	0480 gm
3	Jowar stover	15%	06 kg	3000 gm
Total			19 kg	5010 gm

Actual cost -

Sr. No.	Stock details	Used stock	Rate	Price
1	Green maize	09 kg	Rs. 3.00/kg	27.00
2	Lucerne	04 kg	Rs. 3.00/kg	12.00
3	Jowar stover	06 kg	Rs. 10.00/kg	60.00
Total				99.00
Labour and overhead charges – 25% of the stock				24.75
Total cost (Rs.)				123.75

The cost for maintaining the health of an animal with a weight of 500 kilograms is Rs. 123.75.

1) Calculate the cost of food for one day based on the T.D.N. percentage, for a cow that weighs 500 kilograms and gives 20 litres of milk daily. Use the information provided below as per your requirement to calculate the cost.

3. Green Fodder – Rate Rs. 3.00/ per kilogram.
4. Stover – Rate Rs. 10.00/ per kilogram.
5. Sugars – Rate 18.00/ per kilogram.
6. Labor and wear and tear – 25% on the value of total stock

Answer - 10 grams TDN to be given for every one kilogram weight of the animal. In addition to it, a animal should be given approximately 500 grams TDN for every one litre of milk.

The TDN to be given for the nourishment of the body is provided through fodder. The TDN required for milk is provided through concentrates. Therefore 5000 grams TDN should be given for 500 kilograms of weight. And 10000 TDN should be provided for 20 litres of milk. Hence a total TDN of 1000 grams needs to be provided to the animal. The calculation for the same can be done as explained below.

Sr. No.	Fodder Type	Percentage of TDN	Provided fodder/concentrates	TDN obtained
1	Green fodder	17%	15 kg	2550 gm
2	Jowar Stover	50%	05 kg	2550 gm
3	Sugras	90%	11.1 kg	9990 gm
Total			31.1 kg	15040 gm

Actual cost-

Sr. No.	Stock details	Used stock	Rate	Price
1	Green fodder	15.000 kg	Rs. 3.00/kg	45.00
2	Jowar Stover	5.500 kg	Rs. 10.00/kg	55.00
3	Sugras	11.100 kg	Rs. 18.00/kg	199.80
Total				299.80
Labour and overhead charges – 25% of the stock				74.95
Total cost (Rs.)				374.75

The daily cost of fodder and concentrates for a cow, with a weight of 500 kilograms and producing 20 litres of milk daily, is Rs. 374.75.

Project Options -

1. Visit cattle shed and gather information about the daily dietary records.
2. Calculate the TDN a cow gets through her daily diet.
3. Form three groups of students, record the daily fodder given to a goat, cow and buffalo and calculate the TDN for that day.

Soak the wheat bran in water –

The percentage of proteins is quite low in monocotyledonous fodder; hence the animals get a very low supply of proteins through their diet. If such fodder is processed using urea and sugarcane molasses, nutritious fodder can be made available to the animals. To increase the nutrient value of the fodder, create a solution of 1% urea and 100% sugarcane molasses (i.e. 1kg urea, 10 kg sugar molasses and 100 litres of water) and sprinkle it over 100 kilograms of dry bran or mountain grass.

CHECK YOUR PROGRESS

Fill in the Blanks

1) To maintain the health of the animals, for every 1 kilogram weight of the animal, _____ grams of TDN should be given. (10, 100)
2) An animal with 350 kilograms of weight should be given _____ grams of TDN. (3000, 3500)

Subjective Questions

1. **Calculate the monthly cost of food as per TDN percentage, for a cow that weighs 500 kilograms. Use the information provided below as per your requirement to calculate the cost.**
   1) Green Maize – Rate Rs. 3.00 per kg.
   2) Lucerne – Rate Rs. 3.00 per kg.
   3) Jowar stover – Rate Rs. 8.00 per kg.
   4) Labor and wear and tear – 25% on the total stock

2. Calculate the monthly cost of food as per TDN percentage, for a cow that weighs 600 kilograms and gives 20 litres of milk. Use the information provided below as per your requirement to calculate the cost.

1) Green Maize – Rate Rs. 3.00 per kg.
2) Lucerne – Rate Rs. 3.00 per kg.
3) Jowar stover – Rate Rs. 8.00 per kg.
4) Sugras – Rate Rs. 18.00 per kg.

Labor and wear and tear – 25% on the cost of total stock

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate ability to estimate feed requirement, yield of the animal and its well-being.
- Calculate estimate of feed requirement of an animal by their weight.

SESSION 8: DOMESTICATED ANIMALS, DISEASES & CARE (COW, BUFFALO, GOAT)

India is an agrarian country. In our country, we domesticate various animals for personal and occupational purpose. In the rural areas, animals that help in farming are domesticated. In this lesson, we will learn about the domestic animals in the rural areas, their nurture, diseases and care.

In the beginning, let us gain some information about domestic animals in the rural areas –

Buffalo -

The total milk production comprises of 55% of buffalo milk. Since the buffalo has a high capacity to convert poor quality fodder into good quality processed milk; nowadays it is economical to domesticate buffalos for milk production. Hence it is necessary that the buffalos are reared in a proper way.

Buffalo breeds -

1) **Murrah (Delhi) -** This breed is found in North India and Maharashtra. It has a huge, impressive and strong physique. The production of milk in one lactation period is 1800 to 2000 liters. It has more percentage of fat as compared to cow's milk.

2) **Mehsana**- Mehsana is a crossbreed of Murrah and Surti breeds and its body features are similar to Murrah breed. These buffalos give an average of 2000 litres of milk in one lactation period.

3) **Surti**- They have medium physique and their big eyes are elongated and wide. The hair of the eyebrows are white, horns are medium in size and shaped like a sickle. They are dark brown in colour. The production of milk in one lactation period is 1800 liters.

Diet and Care – 25 kilograms of green fodder and 7 to 8 kilograms of dry fodder should be given daily to a buffalo, whose approximate weight is 400 kilograms, so that she gives milk as per her capacity. Concentrates amounting to 50% of total production should be given so that consistent milk production takes place. Each buffalo needs 60 to 75 litres of water daily for drinking.

Cow -

1) **Advantages of domesticating a hybrid cow –** These heifers reach puberty early on. The hybrid cow's capacity to convert food into milk as well as her reproduction capacity is better than local cows. Milk production is high and dry period is small in hybrid cows. Thus, hybrid cows are definitely more beneficial than local/native cows.

2) **Selection of a milch cow –** Normally, the rear body of a milch cow is big and wide. All the four teats are of the same shape and size. The udder veins are long

and clear. The animal is smart. It has a thin and soft glowing skin. Overall, the animal in tapering towards the front and widens at the back. General physique is strong, and stomach is relatively large.

3) **Breeds of milk cows –** Outside India Jersey, Holstein Friesian, Brown Swiss, Red Dane and Gir cow in Maharashtra **are breeds of milk producing cows.**

Cattle shed – In rural areas where animals such as cows and buffaloes are domesticated; the cattle shed should be at an elevated, well-ventilated space. Provision of sufficient light and ventilation should be there in the cattle shed. There should be enough sun-light in the shed. The feeding trough should be durable and fixed firmly. The height of the roof should be 15 feet in the centre and 6 to 8 feet at the sides. A drain for the outflow of urine should be provided at the back. A provision should be made to direct the water to the crops after the shed is washed.

Nurture of milch cow – The cow should be fed in proportion of her milk production capacity. On an average 15 to 20 kilograms of green fodder and 5 to 8 kilograms of dry fodder should be given to the cow. 1 to 1.5 kilograms of concentrates should be given for body nutrition. Concentrates amounting to 40% of milk should be given for milk production. It is important to ensure that the animal receives a balanced diet daily.

Nurture of pregnant cows – In the last 2 to 2.5 months of pregnancy, the pregnant cow should be provided with extra diet of 1.5 kilogram daily. The cow should walk in the open as an exercise before calving. At the time of actual calving, keep a watch on the cow from a distance and help her, if required. After the delivery, it is important to confirm whether her placenta has also been delivered. Pointed stones, nails should not be present in the shed. Take care to keep the cattle shed clean.

What precautions should be taken to prevent spread of disease – Separate the diseased animal from rest of the animals. Bury the faeces of the sick animal at some faraway place. If there is a doubt that some animals are infected, tie those animals at some other location. Administer disease preventing vaccine to the healthy non-infected animals. As far as possible, provide well-water to the infected animals. Same person should not take care of the diseased as well as healthy animals. Whitewash the walls of the cattle shed after every 3 to 6 months. Dispose the water accumulated in the surrounding area.

Difference between healthy and diseased animal

	Healthy animal	**Diseased animal**
Eyes	Radiant, alert	Pale, Water and pus flowing
Ears	Pricked up and making free movements	Red or paled and no movements
Skin	Soft, warm, glowing and clear hair	Too hot or cold, raised hair, pale
Dung	Little blackish, auburn, soft bound	Too hard or loose motion, mixed with blood, foul smelling
Urine	Little yellowish and white	Too red and difficulty in passing the urine

Breathing	Slow and regular	Panting heavily
Nostrils	Wet, contains fluid	Dry
Food and Water	Calm and regular rumination	Irregular or no rumination at all

Disease symptoms and their preventive measures for domesticated animals in rural areas

Disease	Symptoms	Preventive measures
Anthrax	Bleeding from ears, mouth, vagina and anus. The animal suddenly becomes sick and stops eating, drinking and ruminating.	If this disease has spread among the animals, then they should be vaccinated.
Black leg/Black Quarter	Sudden fever. The rear leg limps. The muscular areas are swollen and when pressed they make a crackling or popping sound.	Every year before the rainy season, administer the alum precipitated vaccine to the animals.
Diphtheria	The animal unexpectedly falls sick. Does not take food or water. Gets fever. Swollen lymph nodes. Hoarseness in the voice.	Every year before the rainy season the healthy animals should be vaccinated with the oil-based Oil Adjuvant H.S. vaccine.
Mastitis	The udder gets swollen. The milk produced is watery and contains blood or pus. The animal does not allow the udder to be touched.	Wash the udder with chlorine or Savlon solution before milking the cow. Get the milk examined regularly for Mastitis. At the start of the dry period of cows or buffaloes, antibiotic tube should be infused directly into the teat canal.
Johne's disease	Day by day the animal becomes weak. Passes loose motions in pauses. Area below the jaw gets swollen. Irregular food and water intake.	Separate the diseased animal from the rest of the animals. Once the disease is confirmed, consult a veterinarian.
Tuberculosis	Animal gets fever, gradually become weak. Skin becomes pale. Gets diarrhoea.	As above.

Rinderpest	Gets fever. Stops eating. Constipation in the beginning followed by foul smelling loose motions. The animal dies in 8 – 10 days.	Once in two years administer the Tissue Culture Rinderpest vaccine to all healthy animals.
Foot and mouth disease	Salivation, less food and water intake, slow rumination, spots appear on the tongue, wounds on the hoofs. Animal limps.	Administer the foot and mouth disease vaccine to all the healthy animals twice a year (September and March)
Theileriosis	Animal has continuous fever for one to two weeks. Day by day animal becomes weak. Passes hard stool. If not treated, the animal dies.	Keep the cattle shed clean. Apply tick repellent powder on the animal's body. Disinfect the animals and cattle shed using pesticides Deltamethrin 12.50% and Cypermethrin 100 E.C.E. Administer only one vaccine to the animal in its lifetime.
Three Day sickness	Animal gets high fever, low appetite, animal shivers, limps with one leg .Then the muscles of neck, back, eyes and legs contract.	This disease is spread by mosquitos hence measures to destroy mosquitoes should be taken.
Stomach bloating	The left side of the stomach bloats. The animal becomes restless, stops eating and rumination, constantly stands up and sits down. When tapped with a finger makes a tapping sound.	Do not give wet and tender fodder in excess in rainy and winter seasons.
Diarrhoea	Continuous foul smelling loose motions, sometimes contains blood. Animal is fatigued. This happens due to impure and unclean fodder.	Animal should be given pure water and good food.
Liver Fluke	Appetite drops. Area below Lower jaw swells. Animal become weak day by day and then dies.	Give deworming medicine to the animals twice a year (before and after rainy season). Alwa1ys give pure water to drink.

Genital diseases of cows and their symptoms

Sr. No	Disease	Symptoms
1	Uterine inflammation	Pus secretion from the uterus, rotten smell of the pus, enlarged and soft uterus, retained placenta, repeated miscarriages.
2	Vibriosis	Abortion in 4th or 5th month, repeated miscarriages, late conception, cow does not come into heat.
3	Leptospirosis	Sudden fever, low appetite, abortion in any period, passing red coloured urine, weakness, secreting sticky milk.
4	Brucellosis	Abortion in 6th or 7th month, retained placenta, repeated miscarriages, rise in the uterine inflammation.
5	Trichomoniasis	Abortion in 2nd or 3rd month, pus formed after uterine inflammation, cow comes into heat irregularly, repeated miscarriages.

Poisoning in animals

Reasons of poisoning	Symptoms	Preventive measures
1. Due to eating tender jowar stems	The rear part of the animal's body becomes in operational, gets convulsions, difficulty in breathing, bloated stomach, becomes restless, dilated pupils, blood look dark red, the animal faints and dies immediately.	Ensure that the animals do not eat jowar stems and shoots.
2. Due to eating crops sprinkled with pesticides and poisonous medicines	Central nervous systems in an excited state, shivering of muscles, clattering of teeth, animal stoops, difficulty in breathing, incoherent movements, gets fever.	Take extra care while sprinkling the pesticides.

3. Due to eating carrot grass	Urticaria on the animal's body, skin becomes red, swollen and lumps are formed. Restlessness, itching, milk smells and tastes bitter.	Ensure that the animals do not eat carrot grass.
4. Due to snake bite	Look for a sign of snake bite on the lower part of the body (head, nose, legs etc.) The part of the body where the snake bit, aches unbearably and swells. Sometimes it bleeds, turns red, the animal salivates, and muscles stiffen. The body bends, the animal falls on one side and is paralysed. Since the animals finds difficult to breath, it dies.	The cattle shed should not be in a mess and should be clean. Rat holes should not be present near the cattle shed.

Immunization-

An animal is vulnerable to a disease when disease developing elements such as bacteria, fungus, virus etc. enter its body. The strength of the natural immunity present in animals is less than the strength of the disease causing pathogens.

Vaccination means injecting a serum containing bacteria or virus of specific disease, so that with the aid of the natural immunity, it helps in fighting against specific bacteria and virus. Due to vaccination the disease cannot be contracted within a specific time frame.

To protect the animals from infectious diseases, they should be vaccinated from time to time as per the vaccination schedule. Vaccination improves the immunity of the animals and helps in protecting the animals from various diseases. After the animal is vaccinated, it takes minimum 21 days to build the resistance required to fight the disease. Once an animal is infected by a disease, administering vaccine to the other healthy animals of the herd is of no use. As they say, Prevention is better than cure. Hence it is beneficial and economical to get the animals vaccinated rather than bear the loss caused by the death of the animal and its treatment cost. The animal should be vaccinated as a preventive measure against various diseases.

Care of domesticated animals for clean milk production –

1) As far as possible, the cattle shed and milking station should be different. Use a clean, open space to milk the cows. Keep the surroundings clean while milking.

2) Separate the milk giving animal and clean its waist, thighs, tail, udder and teats with a clean, rough cloth/towel. This improves the blood circulation and the animal feels energetic.
3) After tying the animal, wash its udder and teats in a mild solution of warm water and very small quantity of Potassium Permanganate granules. Dry it immediately with clean cloth/towel.
4) Keep the clean and sterilized utensils required for milking, a small cup and a clean, soft white mulmul cloth for filtering the milk, at the milking station.
5) Once the udder is washed with warm water, the cow starts to give milk.
6) The person milking the cow should clean his/her hands in Potassium Permanganate solution and then start milking the cow.
7) Firstly, the initial squirts from each teat should be collected in separate cups and tested for Mastitis.
8) The process of hand milking should be completed in 7 to 8 minutes.
9) Use utensils of specific shape (dome shaped) for milking.
10) Take the utensil containing milk in another room immediately after milking.
11) As far as possible, do not give dry fodder and grass to the animal while milking. Leaven can be given.
12) Store the milk in a clean and dry utensil (preferably steel) after filtering it through a white mulmul cloth.
13) If possible, immerse the milk utensil in ice water immediately. If this is not possible, use water from earthen pot at your home. Change the water after some time.
14) The milk filtered and stored in cold water should be used/sold immediately. If milk production is carried out in this way, the quality of milk and storage capacity will definitely increases.

Cattle sheds for animals – If the animals in the dairy business are managed efficiently the business becomes profitable and for this, apart from diet, health and care of the animals, the cattle shed is important. The purpose of building cattle shed is to protect the animals from adverse conditions such as rain, wind and sun and give them a healthy place to stay.

The advantages of taking care of the animals in cattle shed –

1. In hot and dry climate, the hybrid cows and buffaloes are protected from the sun and reduction in milk production is avoided.
2. The animals are supplied with food, fodder and water as per their requirement.
3. If the cattle shed are kept clean on a regular basis, the animals are less likely to be infected by contagious diseases.
4. Nurturing the cattle in the shed helps in clean milk production and brings good price for the milk.
5. Diseased animals can be easily identified in cattle shed and the possible loss is avoided by giving them timely treatment.
6. Through artificial insemination the reproduction capacity can be maintained at a good percentage.

7. The dung and urine in the cattle shed can be disposed properly. This prevents the spread of fleas.
8. By keeping the cattle in shed, the disease spreading ticks can be controlled effectively.

Hygiene of the cattle shed –

1. Cattle shed should be cleaned daily with water and it should be dried; Dung and urine should be disposed properly.
2. Wash the shed once in a week with 2% phenyl solution.
3. Take lime and washing soda in equal proportion and sprinkle it in the area surrounding the cattle shed.
4. The feeding trough and water tanks in the shed should be cleaned and whitewashed after every two weeks.
5. Grass and dirt around the cattle shed should be burnt.
6. Use fire gun to avoid the spread of tick.

If the cattle are nurtured in the above manner, the cattle owners will gain financially due to the increase in the milk production.

Goat – Goat gives important things like milk, meat, wool, manure etc. A goat can survive in various climates. Considering the diet of a goat, it can be said that she produces more in less cost.

Breeds of goats – Goats of various colour and shapes are found in different parts of Maharashtra. In Maharashtra, mainly Osmanabadi and Sangamneri breeds of goat are found. In India, primarily; Betal, Jamnapari, Barbari, Kutchi, Surti etc. breeds of goat are domesticated for milk. Good quality wool is also obtained from these breeds.

Osmanabadi goat – This breed of goat is found in large numbers in the districts of Maharashtra (Osmanabad, Latur, Beed, Parbhani, Solapur, Aurangabad and Ahmednagar.) These goats grow well in dry climate; hence they can be properly nurtured in drought prone areas. Osmanabadi goats are totally black in colour and; have white spots on their ears or a brown belt in the area below the stomach. They have horns in arch shape or any other shape, bending towards the back. Similarly, goats without horns are also found in this breed. Generally, the percentage of goats giving birth to twin kids is found to be 60% to 65%. This breed is good for meat.

Sangamneri goat – This breed is found in the districts of Maharashtra (Ahmednagar, Pune and Nasik.) These goats are white in colour, but some goats are whitish brown in colour. They have horns in arch shape or any other shape, bending towards the back. Similarly, goats without horns are also found in this breed. This breed is used for the twin purposes of milk production and meat.

Management –The ideal shed for goats should have a roof built with sugarcane dry stems or grass, walls having a height of 4 feet to protect from wind and sun, feeding trough for the fodder and a water tank. The enclosed space for each goat should be 10-12 sq. feet and the open space should be 25 sq. feet. The goats giving more than

1 litre of milk daily should necessarily be given 3 to 4 kilograms of green fodder, 1 kilogram of dry fodder and 100 to 200 grams of concentrates. The goat likes to eat the leaves and pods of the Sesbania (Shevari), Hardwickia (Anjan), Sesbania grandiflora)hadga), Indian gum Arabic (Babhul), Subabhul, Jujube (Bor), Banyan, Peepul trees. The goat drinks 3 to 4 litres of water daily. Proper diet, care and breeding should be carried in a scientific manner. Give more concentrates and a balanced diet to the goat in the last 6 to 8 weeks of pregnancy so that they bear a plump and weighty kid.

Care of the kids – Special care should be taken of the goat in the last weeks of pregnancy so that she bears a healthy kid. Cutting the umbilical cord after the kid's birth and feeding the first milk (colostrum) within one hour is important. In the first week, the kid requires milk in proportion to 10% of its weight. In case the mother goat does not have enough milk to feed the kid, other goat's milk should be given to the kid. The kids start eating fodder after one month. After two and a half months gradually reduce the supply of milk to the kid and stop it completely after three months. Once the milk intake is completely stopped, it is important to take special care of its food and water.

Diseases in goats – The symptoms of many diseases in goats are same. Many a times the goats die before the disease is diagnosed and other animals get infected by it. For this reason, it better to prevent the goats from contracting a disease than treating it, hence the goats should be given vaccines and deworming medicines as per schedule. Also, to protect the goats from ticks and flea, a solution containing Deltamethrin chemical (e.g. Butox) should be sprayed in the shed and on the goat's body.

To avoid the spread of diseases like Black leg/Black Quarter, foot and mouth disease, it is important to administer vaccines of these diseases. It is important to inspect a big flock of goats every year for tuberculosis, Johne's disease etc. The goats which are infectious should be separated from the flock.

Sheep – A large part of Maharashtra, especially Nasik, Ahmednagar, Solapur, Satara, Sangli, Pune, districts are ideal for domesticating sheep. Of all the breeds of sheep, the Sangamneri breed is superior to other breeds (in terms of growth of the lamb, wool and meat production). Using the selection technique, the process to produce improved variety of this breed is under progress. The ram borne from this improved variety is given to the shepherds so that the reproduction of sheep increases.

Keep in mind the important points given below to take care of the sheep in a scientific manner.

1) Proportionate food, plenty of fodder should be given to the sheep, before and after lambing. Also, proper care of the sheep should be taken.
2) Protect the sheep from the worms that are formed in the stomach.
3) To increase production from a flock, select healthy male and female sheep.
4) If the male is kept away from the female sheep, its reproduction and production capacity increases; also, it does not trouble the female sheep.

5) The males used for reproduction should be changed after every two years. After service, lambing takes 145 to 147 days. The sheep come into heat in the months of June, July and August. They come into heat after every 16 – 17 days till they become pregnant. If the sheep is provided with plenty food in this period, she gives birth to lambs that are big in size and weight.

The profit and loss in the sheep rearing business depends on the immediate action taken on maggots, worms and diseases. There is lot of nuisance of worms in our climate and rainy season hence at the beginning of the rainy season proper medicine should be given to the sheep. Also, after every three months medicines should be given to prevent spread of worms. After the shearing of sheep (removing of wool), the next important task is to wash the sheep in a water tank filled with pesticides to kill lice and ticks on the body of the sheep. To kill ticks sprinkle Deltamethrin (Butox) on the sheared part of the body of the sheep.

Immunize the sheep as below.

1. Diphtheria – May – June. Again, after six months.
2. Small pox – At the beginning of summer March – April
3. Foot and mouth disease – Vaccinate in months of October and May

The hooves of sheep get infected by foot scald in the rainy season. Hence once in a month leave the sheep in a shallow tank filled with Copper Sulphate or Formaldehyde solution in such a way that all the hooves are immersed in the solution. If the sheep is sheared/wool is removed using a machine, the wool production increases. Wool received by machine shearing is continuous hence it gets good price in the market and since small pieces are not formed by this method wastage of wool is avoided.

Foliage, the best food for goats and sheep –

The capacity of a goat to digest leaves and tasty food is more than the sheep. It has been observed that leaves form 70% of the food that is consumed. Tree leaves and the pods in the milky sap of the trees are stored in two ways.

1) Produce silage from leaves.
2) Rinse the blossomed leaves and pods grown in the milk sap and dry them in the shade.

   Leaves and tree pods stored in this manner can be used as fodder and concentrates in the shortage period.

50% of the daily diet of goats and sheep can comprise of dried leaves and pods. Experiments prove that a mixture of coarsely ground maize, pigeon pea or chickpea bran when fed to the kids/lambs helps in their excellent body development.

Harmful elements in the leaves/foliage –

Mimosine in Subabul and Tannin in other foliage are the harmful elements. If the animals are fed foliage in excess quantity, the percentage of harmful elements in the body increases. If Subabul leaves are given in excess, the hair on the animal's body starts falling. Side effects such as stagnated growth of animals, animals not eating the daily dose of fodder and concentrates etc. are observed. If the proportion of Subabul leaves is less than 1/3rd of the daily dose of fodder, no harm is done.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____breed of goat is found in large numbers in the districts of Maharashtra (Osmanabadi)
2. The enclosed space for each goat should be _____sq. feet and the open space should be sq. feet (10-12, 25)
3. To avoid the spread of diseases like Black leg/Black Quarter, foot and mouth disease, it is important to administer _____of these diseases (vaccines)
4. The hooves of sheep get infected by foot scald in the _____season (rainy)
5. Mimosine in _____and Tannin in other foliage are the harmful elements (Subabul)
6. If the proportion of Subabul leaves is less than _____of the daily dose of fodder, no harm is done (1/3)

Subjective Questions

1) Explain the importance of domesticated animals in rural area.
2) How will you keep the cow shed clean?
3) Write the benefits of sheep and goat rearing.
4) Why is immunization/vaccination important for domesticated animals?

Give the symptoms and treatment for any two diseases of cows and buffaloes.

What Have You Learnt?

On completion of this session, are you able to:

- Understand different diseases for domesticized animals
- Describe different types of domesticized animals and their importance.
- Describe how to ensure wellbeing of domesticized animals

SESSION 9 : DOMESTICATED ANIMALS, DISEASES & CARE (DOG)

Selection of dog
Once you decide to keep a dog as pet, select the breed as per your needs. Generally people like dogs who are gentle by nature, obedient and who create an impression on the guests. While selecting the puppy, keep the following points in mind.

Long hair or short hair
Some breeds have long hair on their body while others have short. Puppies that have long and soft hair look adorable and hence appeal to us. But such dogs need to be combed every day and the hair on their body needs to be managed properly. Such dogs are fine up to four - five years of age. After this age, dogs with long hair are found to be infected by skin diseases. Ticks and fleas spread easily in dogs with long hair. The ticks at the bottom of the hair, near the skin cannot be found due to long hair. It is difficult to apply medicine to the body. Due to this the skin of the dog becomes diseased. Many a times this leads to large wounds. Long haired dogs are prone to skin and ear diseases. The ears and body do not get sufficient air since they are covered with hair. Due to this the inner part of the ear is always wet and hot which helps in the rapid growth of all types of germs.

On the contrary, dogs with short hair need not be combed. After washing, they dry immediately. The hair remains dry due to sunlight. Comparatively, the spread of ticks and fleas is less.

Small dog or big dog?
Whether the dog we want to pet should be small or big depends on our need. The small sized breed is ideal for domesticating in the cities since small dogs are excellent companions. Also, the cost of nurturing is less. They need small space in the house. Due to this, they can accompany the family anywhere.

Disposing the faeces of the dog in large cities is also a problem. Small breeds defecate in proportion to their weight. The defecation by a Dachshund dog, weighing 5 kilograms, is $1/10^{th}$ of the defecation by a Great Dane, weighing 50 kilograms.

- **German shepherd, Doberman, Great Dane breeds are useful for guarding.**

Colour – While selecting a dog, as far as possible choose the dog with colour other than golden and white. The dogs with these colours are more prone to skin diseases as compared to other dogs.

Ears – The hair on the ears should be short, ears should be small and standing, so that air can reach the ears. For reducing the chances of ear infection, keep the ears always dry.

Breed – Every dog has some specific features. German shepherd (Alsatian), Doberman, Terrier are strong breeds that can bite.

Pure or hybrid breed?
Hybrid dogs are better than purebred dogs. This is so because the good features of both the breeds are passed on to the puppy and the good effects of crossbreeding can be seen in all aspects. Purebred dogs look good.

Unfortunately, in India, pure breeds are used for reproduction based on their looks. It is not taken into consideration whether the original behavioral features of the breed have been adequately passed on to puppy. The appearance of a dog in a dog show is enough to make him the 'champion' and; is used again for reproduction. Due to this, the outward appearance of the dog will be as per the pure breed, but their hereditary aspects are ignored.

From where to buy the puppy?
The puppy you want is available at many places; but generally, there are two categories of sellers. First category is the businessman e.g. Shop of domestic animals, breeder and the second category is of the private sellers.

The sellers in the first category have many puppies; hence they are not in good health. It is highly likely that these puppies are infected with contagious diseases. They are likely to be suffering from Distemper, Hepatitis (jaundice). The puppies may look healthy and plump, but it is possible that they have germs of various diseases in their body. In many diseases, after getting infected, the symptoms are visible after a long time.

It is always better to buy a puppy from private sellers because as the quantity of puppies with them is limited, the history of the puppy can be acquired. Also, the puppy is less likely to be infected by worms and diseases.

Before selecting – Once you decide to pet a dog, before selecting the puppy it is important that you enquire about a few points with the breeder.

History – The information of the mother during pregnancy needs to be obtained. Similarly enquire about the behavior of the puppy since birth. The below details of the female dog's pregnancy period need to be enquired.

The salt components in the diet – Whether the female dog was given calcium during pregnancy? Due to calcium intake the strength of the bones increases during pregnancy. Ask whether the puppy given enough calcium after birth.

Deworming medicines – Was the female dog dewormed during pregnancy? Similarly, were the puppies given deworming medicines every week, after 3 weeks of age?

Vaccination – Ensure that the female dog was given with 'Distemper' and 'Hepatitis' vaccination after 3 weeks of pregnancy. Nowadays breeders give this vaccine to the six-week-old puppies that are available for sale.

Big-sized breed– Before selecting puppies of big high breed dogs e.g. Labrador, Retrievers, Doberman, German Shepherd etc. ensure that they do not get a stroke

below the waist. The puppies of these breed weight 15 kg. in three months. Make sure that the puppies parents did not have this ailment or show a six-week old puppy to the doctor who will examine the puppy and give his/her opinion.

To select a healthy puppy, it should be examined thoroughly. A puppy looks very cute and adorable. They attract us towards them; hence we do not hesitate to buy whichever puppy is shown by the seller. Before taking the puppy in your arms, observe its movements. The puppy should be smart. Skin should be glowing and it should have attractive radiant eyes. Its breed's features should be clearly visible.

Care of the puppy – The puppies grow between 3 - 7 months of age. If we take proper care in this period, he can become a 'loyal companion'. Hence in this session, information about care of the puppies, his exercise, teething, bath, deworming, immunization etc. has been provided.

Fig 40 - Breeds of Dogs

Fig 40.1 - Breeds of Dogs

Exercise – The space needed by your dog for exercise depends on its size. Small-sized breed need little space. It is difficult to find enough space in the city to take the dog for a walk and to exercise. If the dogs don't get open space they show their displeasure by barking loudly, damaging the furniture and roaming outside. When they roam outside, they fight with the street dogs and create a problem for us. Chained and Irritated dogs bite their own leg and get infected by lick granuloma.

3 to 7 months-old puppy requires a lot of exercise. Strolling in an empty room gives exercise. Take him for a walk for a specific distance. In day time it can be given running exercise by throwing a ball or stick to it.
If we want to take out the puppy for a walk, chain it properly. This should be done regularly. 3 – 7 month old puppies should not be made to walk for more than 2 kilometers because their bones are not developed fully. This rule should be specifically followed for big-sized dogs. If puppies (whose weight goes to 15 kg. in three months) are subjected to more exercise, they may develop 'hip dysplasia'.

Teeth – The puppies do not have teeth at birth, but 5 – 8 week old puppies get 28 milk teeth. Normally, at 4 months of age, the milk teeth fall and permanent teeth grow. By the 5th month, the puppy has 42 to 44 permanent teeth. This process is late by one month in small-sized dogs and by 8th month all the permanent teeth grow.

Dog is a carnivorous/meat-eating animal; hence the structure of the teeth is such that it can hunt and eat the prey. The long canine teeth are used to tightly hold and tear the meat and other teeth are used to break the meat into small pieces.

Bath – Keep the puppy clean by giving a bath to the puppy after every three weeks. Dry the hair.

Deworming – The puppies get infected by worms. For 3 – 7 months of age, give deworming medicines to the puppy once a month.

Immunization – At the age of 16 weeks, disease preventing vaccines should be administered to the dogs. After that, every year they should be regularly vaccinated. Vaccines of diseases such as anti-Rabies, D.H.L. Gastro, Enteritis should be given.

Diet – Dog is basically a violent animal, but it has been domesticated since ages. Wild animals feed themselves by hunting their prey; and it is the same with dogs. Dog is a carnivorous animal, hence its day to day dietary needs are definitely different from human beings. If we are vegetarian, it does not mean that we can give the same food to dogs. It affects the growth and life-span of the dog.
Nowadays it has become easy to give a balanced diet to dogs. We pet costly dogs and take care of them; and realizing this, readymade balanced diet is available in the market for them.
The small intestine of meat eating animals is short. Hence it can only digest food that is rich in nutrients. Due to this, dogs are never provided food that will only fill the stomach. Food items such as bread, cake have high percentage of starch and are low in nutrition, hence such food items should never be given to dogs. Non-

vegetarian food items, dog biscuits that are available in the market can be given to the dogs.
The digestion of dogs is slow as compared to human beings hence giving a balanced diet only once in a day is also sufficient. But just like children, the dog does not understand which food is good for him and how much quantity to eat. Either to show that you take good care of the dog or because of your love for him, if all members of the family force him to eat more, it is an injustice to him. This shortens the life span of the dogs. Overeating increases the fat percentage in the body and this fat saturates around the heart. As a result, the dog becomes lethargic and restless. The heart becomes weak and the dog dies.
The daily meal timings of the dog should be fixed. The dog is more aware of the time than human beings. Hence, he waits for his food at his fixed timings. Do not give food to the dog immediately after the walk or exercise. Similarly, do not give food when the dog is annoyed. Normally give food in the afternoon and evening. Giving food very early in the morning makes him lethargic and typically this lethargy keeps on increasing.
The above analysis is given with reference to usual diet. The food requirements are different from the puppy to the adult dog. The diet should be altered as per age. The puppy should be given mother's milk till 6 weeks of age and after that food should be given.

Food items – While giving food to the dog, the information or knowledge about food elements and the nutritional requirements of the dog should be known. If small-breed dogs are not given a balanced diet, they either die or their growth is seriously affected. It is a common understanding among people that giving meat to the dog ensures a balanced diet. But meat does not contain calcium and other necessary salts. At such times, salts and vitamins also need to be given along with meat. A dog grows very rapidly hence the consequences of lack of nutritious elements in the diet during the growth period can be seen. Ancient customs, the cost on the food of the dog should also be considered while giving food to the dogs. Meat, milk products, body parts of animal, bones, loaf, leafy vegetables, cod liver oil, fruits etc. are given as food to the dogs. The nutritional value and other information of these food items is given below.

Meat – Basically since dog is an animal that hunts its prey and eats the meat of the prey, 'meat' can be termed as natural food. Body parts of animals that are not savored by human beings and meat can be used as diet for the dogs. As seen earlier, meat does not contain salts. The percentage of calcium is 0.01%. Vitamin 'B' is in plenty. But other vitamins are not at all present.
Fish - Plenty amount of animal proteins can be obtained from fish. Fish contains 20% of fatty substances. Fish is the diet for those, who are unable to get up or are allergic to specific food items. Dogs like to eat all types of fishes.

Animal body parts –
Liver – Liver has plenty of proteins, fatty substances and all types of vitamins. It is mild and easy to digest. But include it in the diet in small proportion.

Milk products – Milk and eggs are nutritious. Though the components required for the growth of the body are available in it, the amount present is less than the

required amount. While giving eggs to the puppies, give boiled eggs because the egg white has 'vitamin destroying element', which can be destroyed by heat.
Milk gives calcium. Similarly, it contains lactose (milk sugar); but many dogs cannot digest it. Since chees does not contain sugar, it can be easily digested. Vitamins are obtained from milk and egg. But the level of vitamin 'A' in milk declines in the winter season.

Bones – Calcium is obtained from bones. There is a danger of bones of chicken or other small animals getting stuck in the throat or intestine. To avoid this, give large bones to eat. If one bone is given between two dogs, they will fight over it. Due to big bones, the teeth become clean, gums are massaged, and salts are obtained. Once in a week, give bones to the dogs. Before giving bones to the dog, put them in boiled water so that germs are destroyed. Bone powder mixed in food can also be given.

Bread Bhakri – Roasted items like Bhakri, chapati, bread, butter etc. are easy to digest. Proteins, calcium, fibrous substance, B1 vitamin is available in small amount and energy is available in large amount, from bread.

Leafy vegetables – Dogs do not need leafy vegetables. But since fibrous substances are available in plenty from leafy vegetables, the favorite vegetable can be given in small quantity. Many dogs like carrots and potatoes. These items can be boiled and given to them.

Biscuits and readymade food items – These are made from wheat flour. They are made tasty by mixing meat and fatty substance. The salts and vitamins not available in meat are mixed in the biscuits hence to fulfil the dog's daily nutrient need, biscuits are given instead of meat. Yeast, fish, milk and aromatic plants are used in various biscuits. The size of the biscuits differs as per the dog's breed. 75% energy can be obtained from these biscuits and total requirement of salts and vitamins is satisfied by them. But it is not as tasty as meat and if stored for a long period it rots, gathers fungus and emits bad smell. But eating dry biscuits gives exercise to the jaws and keeps the gums and teeth clean.

Milk – Milk is an important food element for a dog. Milk has large amount of proteins, fats and salts. Also, it has a sweet smell. You can keep milk for the dog to drink. Initially some puppies do not drink non-boiled milk; in such cases mix equal quantity of water to the milk and give it for 7 - 8 days. Then, after every 3 – 4 days increase the proportion of milk by 10% and reduce the proportion of water. Some puppies are allergic to milk. They get loose motions after drinking milk. Such puppies should be given very small amount of milk to accustom them to it.
Some people think, drinking milk results in spread of germs. But this is a wrong perception, because we give milk to the puppy when he is 3 – 4 weeks old; and during this time 'white worms' or 'round worms' are thrown out through his faeces as per their life cycle. Give warm milk to the puppy because drinking cold milk causes stomach disorders.

A little about the diet – If there is any change in the feeding bowl, food or meal timings; the dog does not eat food. Hence you should be aware of the things given below.

1) Feeding bowl

Give food in a shallow enamel dish that is big enough to hold one meal. The bowl should be heavy. Do not use a plastic dish. It is likely that the dog licks such plate. Use a flat dish for water. Water should be continuously available for drinking to the dog. The edges of the bowls must be turned in the inside direction. Feeding bowl should be washed daily with soap. Water bowl should be rinsed daily and scrubbed at least once a week.

2) Frequency of food

Healthy dogs should be given food only once in a day. Their big-sized stomach has the capacity to store the entire day's food. Some dog owners do not give food to the dog once in a week. They think that due to this their appetite increases and they eat more but the digestion system breaks because of this and the dog gets into the habit of eating faeces.

The dog should be fed twice or thrice in a day. Small dogs having long hair, e.g. Pomeranian, do not get enough heat for their body hence they should be fed twice a day. Similarly, big dogs like Boxer and Bloodhound suffer from 'Gastric Torsion' which means that their stomach rotates itself or twists and the alimentary tract is closed. Hence such dogs should be fed twice or thrice a day.

3) Food timings

Decide the time when you are free. But stick to the decided time daily. Do not give exercise to the dog after eating. Working dogs should be given food in the evening. Dogs used for guarding purpose should not be given large quantity of food at night because they need rest after eating. Many owners give food in the morning and afternoon; and small amount of food in the evening. Most of the dogs get accustomed to their meal timings and wait for their food at that time. If they don't get food at the specific time, they create a chaos.

4) How to bring a change in food?

If the dog can digest the food you give and is healthy, then there is no need to change the food pattern. If the dog is habituated with one type of food, he will not eat a completely different type of food. Sudden change in food disrupts the digestion control that is done by hormones-enzymes.

The quantity of food should be changed as per the weight of the dog. In summer, the dog makes limited movements and less heat is required to maintain the body temperature. Give less food in this situation. Food items like biscuits containing more energy should be fed in small quantity. Contrary to this, in winter, more food needs to be given.

5) Food given should be cooked or raw?

It is always good to give cooked food, because raw food contains lakhs of germs and bacteria due to which the dog might get some disease or even die due to food poisoning. Cooking the food makes it easy to digest. The starch particles in food items like potato cannot be digested without cooking.

6) Dry or wet food should be given?

Plaque is formed on teeth and gums when wet food is given frequently, and the dog suffers from diseases related to them. On the contrary, dogs like to chew dry food. Teeth remain clean when long bones are given to chew. Giving slightly hard biscuits to eat also keeps the teeth and gums clean.

7) Hot or cold food?

Too hot or too cold food should not be given. Food having temperature between 15^0 centigrade and 40^0 centigrade should be given.

Symptoms of illness – Loss of weight, fever, weight gain, unconsciousness, pain, loss of appetite, biting, excessive barking etc.

Different diseases of dogs, their symptoms and treatments are discussed below –

Before taking the dog to the doctor, you should be aware of the change in his behavior. E.g. Is he pale? How is his appetite? How are his faeces? You should have information about the injections given to him in the last 6 – 12 months. Based on this information, the doctor can quickly diagnose the disease. Otherwise the treatment takes a long time, because the dog cannot tell how he feels and neither can you.

Accident – First aid – Though the dog is used to our company, it is better to approach him cautiously after an accident. Even if the accident was a small one, the dog tries to bite the person who goes near him.

To go near the dog in this situation, throw a blanket or big cloth on his face and then catch him. If the dog is unable to get up, lift the dog by keeping him on a big cloth. If he has broken his leg, lift him by holding his neck with one hand and wrapping the second hand from under his chest. If the broken body part is bleeding; then wrap a bandage tightly, slightly above the wound. Do not keep the bandage tied for more than half hour. If the wound is big and bleeding profusely, stitch the wound. Also, tie a tight clean bandage strip. Tie the bandage strip from the lower part of the leg because the lower part of the strip starts to swell after some time.

1) **Distemper –** This is an infectious disease caused by virus. It is caused by coming in contact with those who have contracted the disease or from a diseased dog. The symptoms are visible within 9 days after the virus has entered the body.

   Symptoms – Gets high fever for first three days. The fever subsides and then rises again and stays for more than a week. Pus oozes from the sides of the eyes. The eyes get red. Sometimes pus mixed fluid secrets from the nose. The dog becomes dull. Food intake reduces. Passes loose motion. Starts to cough and develops Pneumonia.

   These symptoms recede and a month later, different symptoms are visible. The dog is unable to stand, jaw and neck move constantly, shifts legs continuously. The muscles at the front of the ear shiver. The dog keeps on walking straight and dashes into things that come in between. The symptoms of this disease are

visible in minimum 10 days. Sometimes the symptoms can be seen for weeks and months.

Preventive measure – A vaccine is available against this disease. This vaccine should be given to the female dog who is two months into pregnancy. Also, the puppies born must be administered the vaccine after 6 or 16 weeks.

Treatment – Since this disease is caused by virus, no guaranteed treatment is available for it. But, Anti canine Distemper Serum can be used. Antibiotics can also be used. Dextrose 20% electrolyte powder should be used. Keep a watch on the dog's food intake.

2) **Hepatitis –** This is a disease caused by infectious virus. In this disease, the dog gets slight fever and red eyes. This disease can be caused at any age. The germs of this disease are thrown out via urine and excreta. The symptoms are visible within 6 to 9 days, after the germs enter the body. After contracting the disease, the germs get accumulated in the kidney. Serious symptoms are visible after the fever.

Symptoms – Dog gets fever for first six days. The fever subsides and rises again. The dog becomes lethargic and stops eating. Feels more thirsty. Eyes get red. Fluid flows from eyes and nose, tonsils swell, and he gets cramps in the stomach. Sometimes the dog vomits. Once the symptoms reduce, the weight increases. In 25% dogs, the eyes get red after the dog is cured. A change in breathing indicates contagious hepatitis.

Preventive measure – After 2 months into pregnancy, the mother should be given disease preventing vaccine. The puppies should be given vaccine after 6 and 16 weeks. The vaccine of this disease is available in the vaccine of Distemper disease.

3) **Contagious Jaundice (Leptospirosis) –** This disease is caused by the germ Spirochete. This disease can be caused to human beings too. The germs of this disease are found in about 50% rats. Hence, a dog can get the disease by eating such rats or by eating the food that was contaminated with the urine of such rat. In this way, the disease is spread through the dog's urine. This disease can be caused at any age; but it occurs more in male dogs than in female dogs. The symptoms are visible within 5 to 15 days, after the germs enter the body.

Symptoms – Develops gradual weakness. Stops eating food. Vomits. Gets fever. Slightly red eyes. The fever recedes suddenly after two days. Difficulty in breathing. Frequently feels thirsty. The muscles become rough and stiff (specifically hind legs muscles). Gets blisters on the tongue due to burning; which fall off after drying. Sometimes wounds are seen on the entire tongue and the tip of the tongue droops. 'Canicola' is another type of the same disease or it is also called 'Stuttgart disease'. This type of disease is widely found and is caused due to the dog's habit of licking another dog's urine.

Preventive measures – As far as possible, keep the dog separate. Ensure that the dog gets a continuous supply of clean water for drinking. Dogs urinate near pot holes, water stagnated around bridges or near water tanks made for fishes. Such places are infected with germs. The dog should not be allowed to drink such water. Keep the diseased dogs away. An effective vaccine is available against this disease; it should be given to the dog.

Treatment – Use antibiotics. Use electrolyte since fluids in the body have reduced. Maintain records of all the treatments that are given to the puppy after it is brought home. The medical prescriptions and certificates of vaccines given such as Distemper, Anti-rabies, and Gastro etc. should be preserved.

4) **Ticks –** Ticks are commonly found on the dog's body. Ticks can cause paralysis. While the ticks suck blood from the dog's body, they also inject poison into his body. It takes four days to inject the poison. Hence, it is important to search and remove the ticks from the dog's body.

If the dog is constantly scratching his body with his hind leg, then it should be ascertained whether he has ticks on the body or not. Ticks are found on the head, around the ears and mouth, on the nostrils, near the eyes, below the tail, in the nails and on the thighs. If ticks are found on the body, only giving medicine is not enough. Big ticks on the body should be removed by hand or with the help of a pair of small tongs. Take care while doing this. Tick should not get cut in between while removing. The head of the tick should not remain stuck into the dog's body. The part where the head of the tick is stuck into the dog's body swells. Many ticks are found stuck at one place, remove all of them and apply Dettol or Iodine on that part.
Due to the poisoning that spreads because of the tick, the dog limps with his hind legs. The dog's voice also changes.

5) **Worms –** The spread of worms in small puppies and growing puppies poses a big problem. These dogs get worms and it affects their health. The percentage of round worms found in puppies is more. Hence, they should be treated for this. Children play with the puppies at home and since the worm spread to them, it is very important to treat it. The treatment for this is very easy. Use the deworming medicines available in the market. Give the correct dose of medicine since a high dose can be harmful. Also, use medicines of a reputed pharmaceutical company. Do not give deworming medicines to sick dogs.

The dog looks weak after getting infected by worms, it becomes lethargic and the skin becomes rough. It gets bad breath and stomach becomes big.
Apart from this, flat worms (ribbon like such as tapeworm) are also found in dogs. The worms can be controlled by giving regular medicines to the dogs. The dose of medicine to be given to the dogs is dependent on their weight.
Hence give the medicine after measuring the dose properly. Giving less dose has no effect on the worms while giving excess dose can be harmful.

6) **Fits –** A dog gets fits or seizures due to epilepsy, poisonous medicines, chemicals, Strychnine poisoning, Distemper disease or less supply of glucose to the brain through blood.

The exact reason for the fits occurring due to epilepsy is not known. The puppies, aged 2 to 6 weeks, get fits when the milk teeth fall, and permanent teeth grow. Also, when the dog is infected by round worms, it gets fits with enlarged stomach. Getting a jerk, fear, suddenly getting injured, pain or lot of stress causes epilepsy. Similarly, change in the climate also causes convulsions. In long lasting fits, the dog lies on the floor. Becomes unconscious. Stretches it legs and lies on the ground.

The percentage of fits is high in small breed dogs, but taking medicines and tonics for five to six months reduces the danger. The exact reason for fits is not known; but it may occur due to the pressure of the brain growing in the cranial cavity. These fits are common in young dogs. The older dogs get fits due to tumor in the brain or other illnesses of the cranial cavity.

Treatment – Firstly, keep the dog in a dark room. The fit lasts for 2 – 3 minutes. In this period, the dog urinates, defecates and foams at the mouth. After the dog becomes cautious, it looks weak and lays still.

Strychnine medicine is used to kill dogs. This medicine is used to kill stray dogs. In this, the muscles of the legs shiver and become stiff. The neck gets twisted, voice changes and the body loses balance.

If pesticides are used to destroy ticks, fits occur. Malathion is used for this purpose. This medicine should not be used for puppies, because this medicine gets absorbed by the skin and permanently affects the brain. When the dog gets a fit, call the doctor to find the exact reason and give treatment to the dog.

7) **Skin diseases –** Skin diseases are commonly found in dogs. Scabies, ring worm are skin diseases. These diseases are caused due to many reasons. Due to lack of thyroid glands, ticks or fleas, the skin gets swollen. Also, the hair on the body fall. The dog continuously scratches with his hind legs or bites himself. Skin diseases are caused by virus and bacteria. Also, if the quality of food given is low or the food is deficient in 'A' vitamin, skin diseases are caused. But treatment is available for such diseases. Consult your doctor for the treatment.

The puppies get yellowish blisters on the delicate skin of their stomach. The glands in the stomach get swollen hence the blisters are seen. When the blisters rupture, a wound is formed, and the skin becomes rough. There is no reason to worry. Once the blisters rupture; clean it with alcohol and Dettol solution; and sprinkle powder on it for dressing. There are two types of skin diseases – **Lack of hormones** – Treatment can be given by specifically giving thyroid gland tablets and food containing iodine. **Hair loss due to thyroid glands** – The skin becomes rough due to lack of thyroxine, mainly in female dogs. Hair below the neck, on the stomach and hind legs fall. The female dog becomes dull. Canitone tablets should be taken (it contains many hormones). **Eczema –** The swelling on the skin is called eczema.

CHECK YOUR PROGRESS

Fill in the Blanks

1. _____is an infectious disease caused by virus (Distemper)
2. The germs of _____ disease are thrown out via urine and excreta.(Hepatitis)
3. The germs of _____ disease are found in about 50% rats. (jaundice)
4. _____diseases are commonly found in dogs(Skin)
5. The puppies get _____on the delicate skin of their stomach (yellowish blisters)

Subjective Questions

1) Which contagious diseases are caused to the dog? Write about their treatment.
2) What are the important things to be considered while selecting a pet dog?
3) How will you take care of a puppy?
4) What type of diet should be given to the dog? What care should be taken while giving the food?
5) What precaution should be taken while bringing home, any domestic animal?

What Have You Learnt?

On completion of this session, are you able to:

- Understand different diseases for domesticized animals
- Describe different types of domesticized animals and their importance.
- Describe how to ensure wellbeing of domesticized animal

SESSION 10 : INNOVATIVE GARDENING (URBAN SCHOOL)

Gardening method in urban areas –

Rise in immigration in urban areas and increasing population poses the problem of space shortage and hence it is not possible for everyone to have a garden around their house. In such cases, plants can be grown in a small area in the best possible way, by making use of the balcony of the house, terrace and the space in the windows. Having plants around keeps the air clean and the mind remains fresh and energetic. We feel close to the nature. To overcome the shortcomings of a garden due to lack of space, we can plant trees in pots. The green revolution in pots is possible due to modern technology. In big cities, we can plant trees in pots and keep them in the balcony, terrace or window and thus enhance the beauty of the house and keep the atmosphere of the house pleasant.

First, let us get some information about the resources required for gardening.

Tools and resources required for gardening –

It is important to select proper tools to carry out gardening in the right manner and with ease. To develop interest in gardening, it is important to have knowledge about the various tools and resources used for it. By using these resources, gardening can be done with ease, which helps in the maintenance of the garden. The following tools and resources should be available with us for gardening.

Sr. No	Material/Tools	Use
1.	Scythe	Weeding, moving the soil, hoeing
2.	Pickaxe/ pick-fork	To dig the soil
3.	Shovel	create watering basin, to draw soil
4.	Sickle	To cut branches/twigs
5.	Knife	For grafting, budding
6.	Secateurs/ Pruning shears	Trimming of trees, pruning the trees
7.	Container	For transporting soil, waste and manure
8.	Watering can	To water garden beds, pots and trees
9.	Lawn mower	To cut the lawn / grass
10.	Plastic pipe	To water the garden
11.	Coir/Ropes	To tie the branches, saplings and grafts
12.	Bucket	To carry water, to make medicine
13.	Tank	To store water
14.	Pots	To plant trees
15.	Basket	To collect flowers
16.	Diary	To maintain notes and records

Benefits of planting trees in pot -

1) In a pot we can plant any tree we want.
2) Plant in a pot can be kept at a proper place. Again, its place or pot can be changed. This is not possible in case of trees planted on land.

3) Plant in a pot can be moved in any weather. For example, a pot can be kept in sunshine or under shade as per need.
4) Plants which can't grow well on land or in garden can be grown in a pot and then can be kept in garden to decorate it.
5) It is not possible to grow trees on marshy or rocky land. Such place can be decorated by keeping pots.
6) Small places like drawing-room, living room, balcony, terrace, staircase, steps, open space in office, around gate etc. can be beautified by keeping pots. Surrounding of all these places can be made more pleasant with pots.
7) Novelty can be created by exchanging pots.
8) Wall of a building can be decorated by using hanging pots. Pots can be used to do away with dullness of home and surrounding premises by decorating that area. Pot creates a natural and pleasing atmosphere.

These days an art of decorating homes and its surroundings with pots of ornamental plants has developed in big cities. These days many people are doing business of potted plants after taking scientific training of planting trees in pots. Planting trees is an art. In this chapter we will learn how to plant trees in pots and how to develop garden using innovative ways.

Precautions to be taken while filling the pot -

1) Fertilizer, soil, dried leaves, pieces of potsherd, sand are essential components for filling a pot.
2) Soil which contains weed seeds, salts, fungi, worms, lime shouldn't be used for filling the pot.
3) For filling pots soil from the river banks should be selected which contains silt and organic matter developed due to the leaves of trees.
4) Sieve the selected soil if needed.
5) For filling pots red alluvial soil is better than black soil.
6) Along with soil, fertilizer is also an important component of filling pots. A well decomposed dung or compost fertilizer should be crushed and used for filling pots.
7) For filling pots first prepare an equal proportion (1: 1) mixture of soil and fertilizer. This is called as soil mixture.
8) Mix insecticide in the mixture to prevent problem of worms and pests.
9) While filling pots first cover the drain hole at the bottom with small pieces of bricks. Due to this hole is not chocked and water drains properly.
10) After this make a layer of small pieces of coal or of sand.
11) This way when first layer is filled prepare a layer of dried leaves on it; and then on these layers spread a layer of soil mixture.
12) Don't fill the pot to its brim. Keep 2 to 3 cm of space vacant from its brim. This makes planting the trees and watering easier. The pots filled by this method in the summer should be used to plant trees at the beginning of rainy season.

Selection of Plants -

Pot is selected as per requirement and is filled with proper mixture. Now we need to plant in the pot. For that a plant needs to be selected now. Which trees should be planted in pots? Filling pots, its maintenance, watering it regularly are exhausting activities. Therefore it is appropriate to plant those plants in pots which have a longer flowering period. Plants which have attractive leaves should be selected.

Plants in pots -
There are two types of plants planted in pots.
1) Leafy plants 2) flowering plants
Plants with green leaves and colourful leaves are subtypes within leafy plants. From the following list select plants suitable for you.

Green leafy plants -
1) Money plant 2) Fern 3) Rubber 4) Dracaena 5) Philodendron 6) Pilea, etc

Colourful leafy plants -
1) Maranta 2) Zebrina 3) Calathea 4) Rex begonia 5) Screw pine 6) Peperomia 7) Caladia
8) Chlorophytes, etc.

Flowering plants - 1) Chrysanthemum 2) Poinsettia 3) Jasmine 4) Rose 5) Hibiscus 6) Lily etc.
There is no problem in planting in pots plants like Chrysanthemum which have variety of colours. It is also good to plant in pots trees like Amaryllis which have colorful flowers with very nice shape. Besides that cactus and plants having thick leaves look good in pots. Geranium trees grow well in pot and look good. Plants with leaves of various shapes and colours look attractive in pots and beautify our homes.

Fig 41 - Flowering Plants

Process of planting a tree in a pot -
1. In the pots filled with above mentioned method, plant trees in rainy season as far as possible.
2. At a place where water and shade is available, planting can be done in any season.
3. Plant the sapling at the center of pot. A pit should be made in the center of pot and plant the sapling vertically in it.
4. In the pot plant the sapling at the same depth as it was earlier in bag or pot.
5. While planting first remove the sapling carefully from the bag without hurting its roots.
6. While planting the sapling break or cut those roots which are too long, crisscrossed, decomposed or dead.
7. While planting make sure that roots don't get bent. Due to bending of roots sapling might die.
8. After planting, tightly press the soil in the pot from all the sides and give water slowly using watering can.
9. Keep pot in the shade till plant survives.

Following things should be done to make pots and plants in pots more attractive and beautiful -

1) Trim unnecessary branches to give plant a proper shape. While trimming remove diseased, decayed as well as dried branches and leaves to keep the plant clean.
2) Remove weed growing in the pot regularly. While weeding, loosen the top layer of soil from the pot using scythe.
3) When water is given to the pot at home, water comes out from the drain hole near the bottom of pot causing dirtiness. Hence, pots should be kept in plastic tubs and water accumulated in the tub should be removed regularly.
4) Due to excessive water and moisture porosity of the pot depletes. Moss grows up on the pot. Scrape out such moss and desiccate the pot.
5) To avoid diseases or pest take preventive measures from time to time.
6) If dust settles on plant, clean it with water spray from time to time.

Why is it important to change soil in the pot at regular intervals?
Plants in the pot grow in limited soil. If soil is not changed regularly it will become infertile due to excessive growth of roots. Roots come out of pot. Roots come out from drain hole and start growing in land. As a result, pots break. Therefore it is necessary to change pots at regular intervals.

Repotting - Pot is selected as per the requirements of plant. Yes sometimes pot turns out smaller than plant size or plant doesn't grow well in the soil of pot. In that case pot should be changed. A small plant in a big pot doesn't look good.
Even though it is true that pot should be selected according to plant size, but for a plant to grow in a small pot ventilation of air is necessary. Therefore before taking a decision to change pot, it should be carefully investigated if the plant is growing well in current pot or not. This is called 'Repotting'.

Hanging baskets -It feels pleasant when we see pots of ornamental plants, flower baskets hanging from balconies of flats in buildings. Those who say that they don't keep pots in their homes because they don't have enough space for it, should see these beautiful hanging baskets.
Nowadays the fashion of keeping such hanging baskets is growing. Because it decorates home from inside and outside. As these pots don't occupy the space in home they don't cause inconvenience. Their maintenance is also n ot difficult. By keeping such baskets in windows, balconies, entire building can be beautified. At the time of construction if hooks are fitted on the upper part of balcony then these pots can be properly hanged.

Fig- 42 Hanging Baskets

Selection of hanging pots -
For hanging such pots their selection is very important. Shallow, light weight, small earthen pot should be selected for this purpose. Plastic basket can also be selected. Such hanging slings can also be made at home by using waste material. By cutting a thick bamboo two slings can be made. Wire coil can also be used. Many things like damaged scooter tyre, empty cans of powder can be used for this.

Among various shapes like quadrilateral, triangle, circle, semi-circle your favorite shape can be selected for sling. Keep a hole at the bottom to drain water. For fitting the hook 2-3 holes should be made at the edge. Insert a nylon string through these holes and tie tightly. If needed colour the sling to make it look good. If colour combination of plant's colour, string colour and sling colour turns out perfect then it looks even more beautiful. Colour of pot and string should be decided after colour of plant. e.g. green colour of plant, yellow colour of string and red colour of pot. Pot should not be hanged more than 1-1.25 m high from the floor because it should easily catch an eye of onlooker.

Fig- 43 - Hanging Pots

Two types of plants are good for keeping in hanging baskets -

1) Straight 2) Creeper or one which grows with support of other -
For a hanging basket it is very important to select some particular plants.
Following plants are appropriate for this. Plants should be selected on the basis of your choice and availability of plants:
1) Campanula 2) asparagus 3) Pilea 4) Colonia 5) Ball Cactus 6) Columnar 7) Spider Plant 8) Zabria 9) Hydria etc.
Before planting, the basket should be filled properly with soil and fertilizer. Make sure that soil won't fall down from the basket. If things like Sphagnum moss, vermiculite are used then basket doesn't need to be watered frequently. Because these things hold water. These baskets should be given water at regular intervals. Fertilizer should be given occasionally. Also, soil in it should be changed once a year. Damaged parts of plant should be removed. Due to this care plants remain in good condition for a longer duration.

Terrace Gardening -

We really wish to 'create a beautiful garden', but what to do? How do we get space for garden? Cities like Mumbai, Pune, and Delhi etc. are seeing rapid growth of skyscrapers. As the real estate prices are touching sky high, the buildings in metro cities are also touching skies. Not only in cities, even in district places very few people can implement the idea of separate garden due to rising prices. Most of the people have to be content with small houses.

Fig 44 - Terrace Garden

In such cases, balcony and terrace can be used. That's why nowadays balcony and terrace gardening methods are increasing. Terrace gardening has some limitations. Terrace needs a good water supply. In terrace or balcony, gardening is done in boxes or pots. Therefore plants with deep roots can't be used. A special arrangement needs to be done to prevent leakage from terrace. For plants to get shade during summer a facility needs to be created on terrace. Despite these limitations, one can fulfil the desire of terrace gardening.

Water - Water tanks are mostly on the terrace. But to draw out water from it, arrangement of pipe and tap needs to done. This ensures that the water can be given at any desired time and in any desired quantity.

Shade - Terrace gets a lot of heat. Wind speed is also high. Hence, arrangement for shade and shelter for plants needs to be created. Plants in land garden get shade from large trees and house. Also, wind on the land is never as fast as that on the terrace. Therefore for shade and wind management, simple bamboos can be placed and put mats over it to create shade. Don't use plastic or metal sheet for shade because it will become hot and air won't ventilate in it.

Waterproofing - Those who want create lawn on terrace have to do waterproofing on terrace. Further, it is necessary to create separate arrangement of pipes for terrace water to go down.

Preparation for garden can be started after all these arrangements are done. As terrace garden is predominantly a garden of pots, place pots with desired plants on terrace. If pots are small then big boxes should be used. As explained before, these pots or boxes should be filled properly with soil, fertilizer and then plant trees of your choice in them. Variety of trees like flower plants, vegetables, fruits can be planted in a terrace garden.

Innovative gardening for rural areas -
Garden should be planned -
In rural area, as there is ample space around home we can develop garden the way we want. Garden should be planned by taking into consideration how the garden will look from the home. Garden is a part of home and how it will beautify the home, this should be thought while planning garden.

No crowding of trees -
An important principle of garden planning is that garden should not be crowded with trees. If garden gets crowded with trees, creepers, shrubs then it will look like a botanical garden and not a home garden.
Big trees should be planted at the back side of home.
If garden is quite spacious then diversity can be created in it. By preserving the natural elements present in the garden like slope, water streams, large rocks a natural garden can be created.

Colour and Fragrance - It is important that the garden should have various colours and fragrances. Upon entering the garden mind should become cheerful by looking at the various colour combinations. Red, Blue and Yellow are three main colours. In addition to that Violet, Green and Orange are secondary colours. Out of these Red, Orange and yellow are considered to be warm colours while Violet, Blue and Green are considered as cool colours. Contrasting colours look pleasant to eyes. e.g. Yellow and Violet or Red and Green; these contrasting colours when put next to each other they are more pleasant. While planning garden flowering plants should be planted keeping this in mind. Along with colour, fragrance in garden is also important. Hence, while selecting trees, shrubs or creepers attention should be paid to fragrant trees. For that fragrant trees like champa (Plumeria), Jasmin, tuberose etc. should be included in garden.

Distance between trees - How much distance is to be kept between two trees should be thought carefully while planting trees. Spread of tree after its full growth should be taken into consideration while deciding the distance between two trees. Distance between two trees should be such that growth of tree won't be hampered due to tangling of its branches in the branches of neighboring tree.

Vegetables, fruit trees - Which fruits and vegetables are to be grown and on how much area, should be decided by taking into consideration the number of people in your family and their likes. Approximately 1/3 part of garden should be used for lawn, fencing, roads, etc. About 1/3 should be used for flower gardening. It should have perennial and seasonal flower plants. Remaining 1/3 space should be used for fruit trees and vegetables. As per experience vegetables taken in 250 sq. m. last for 8 to 9 months for 4 to 5 people.

Water supply - Regular and adequate water supply to garden is very important. Hence, garden should be planned by considering water will be available to how much area, which type of plants and how frequently. Success of water depends upon water supply. Location of compost pit in garden, place for storage place for tools, seeds, fertilizers etc. should also be considered while planning a garden.
Based upon soil and weather of garden only those trees should considered for planting which are likely to grow well in our garden. Also, trees should be planted by taking into consideration which part of the garden gets sunlight at what time.

Land — Soil - Soil is extremely important for a garden, because plants grow in soil. Hence, soil of the garden should possibly get tested. If garden lacks good soil then soil from river banks i.e. silt should be brought and spread in garden. Black soil from the farm is not good for garden. If construction of the house is recently finished then construction material like cement, bricks, lime, debris etc. lying in the garden should be immediately removed from garden. You know that a certain plant requires a certain type of soil. For example, soil formed from laterite rocks is good for mango trees. As Konkan region has that type of soil in plenty, yield of mango is better there. Hence you should survey the soil in your garden. Get it tested. Select only those trees which best suited for soil in your garden. It is told that soil from river banks should be brought and used in garden. Soil near the stream, current next to the river contains nutrients useful for various trees. Further, water drains very well from this soil. This soil holds water at optimum level, no more or no less.
While planning a garden, make sure that it contains following features -
1) Fence 2) lawn 3) pavements in garden 4) flower plants 5) plants in pots 6) rock-garden 7) terrace 8) water garden 9) vegetables 10) fruit trees 11) ornamental plants

Mulching - In summer, garden trees require too much water. After watering, plants dry up due to sunlight. In that case grass straws, tree leaves etc. spread near the stem. Due to this, water given to plants doesn't evaporate and there is no need to water the plant again in short time. This is called as mulching the plant. Covering reduces the weeds near the stem of plant. Remove this cover after rain starts.

Trimming plants and other works -
Inter cultural practices – Inter cultural practices of our garden should be done frequently. It is not very difficult. For this, soil near the plant stem needs to be

moved using scythe. Roots of trees are extended to the same length to which branches of the tree are spread over. Hence soil till branches expanse should be moved. Generally soil up to the depth of 10 to 25 cm should be moved. Due to this porosity of soil increases. Roots of trees get water and air properly. Soil's field capacity increases. If weed has grown, it can be removed. Plant growth improves due to this. Hence, this tilling should be done without hurting its roots.

Stopping - Main part of tree stem gets flowers before others. Therefore growth of this stem is stopped by pressing its 1-2 cm part. Due to this, neighboring branches get flowers early and not this part. Because of this the flowering period of the tree lasts for a longer duration. This method is used for shrub type plant e.g. tomato, pumpkin etc. This is done 2 to 3 times in a season. Moring is ideal time for stopping.

Disbudding - Plants get numerous buds, but if all these buds are kept on tree then size of flower reduces. Therefore all the buds except one or two buds on the stem are removed. This results in better and big sized flowers. If flowers are to be shown in an exhibition then such disbudding is done.

Plantation of flowering plants - While planning garden, we decided the location to plant flowering trees. But when we ponder over it deeply, many ideas come to mind. Because there are many types of flowers.

Based on how long flower plants stay in garden they are categorized as follows -

Perennial flower plants - Plants which last more than one or two years and give flowers are called multi-yearly flower plants. 1) Rose 2) Jasmine 3) Axora etc. are included in this type.

Annual flower plants - Plants which last and give flowers for one year are called annual flower plants. Following plants are included in this - 1) chrysanthemum 2) tuberose 3) lily 4) daisy 5) canna 6) gerbera 7) carnation

Seasonal flower plants - Those flower plants which grow in different seasons like rainy season, winter or summer are called seasonal flower plants. These plants give flower for one season only. Major seasonal plants are as follows.

1) Aster 2) Marigold 3) Dahlia 4) Zinnia 5) Poppy 6) Balsam 7) Galadia 8) Salvia 9) Larkspur 10) Gladioli 11) seasonal chrysanthemum 12) Cosmos 13) Hollyhock 14) Flocks 15) Sweet William 16) Sunflower (yellow).

Every one of us desires that the flower plants should grow well and give lots of flowers. For that make sure that the flowers get proper sunlight and air. Soil in which flower plant is to be planted should be fertile and should drain water. Taking into consideration all these things we should decide at which spots in garden multi-yearly flower plants, annual flower plants and seasonal flower plants are to be planted.

CHECK YOUR PROGRESS

Fill in the Blanks

1. As _____region has that type of soil in plenty, yield of mango is better there. (Konkan)

2. Regular and adequate water supply to garden is very _____ (important)
3. Approximately _____part of garden should be used for lawn, fencing, roads, etc. (1/3)
4. Big trees should be planted at the _____side of home (back)
5. Those who want create lawn on terrace have to do _____on terrace (waterproofing)

Subjective Questions

1) What precaution will you take while gardening in urban area?
2) While planting a tree in pot why a hole is kept at the bottom?
3) How and where plants are placed in a hanging basket?
4) Which trees will you plant in terrace gardening?
5) Why is it necessary to change pot soil at regular intervals?

What Have You Learnt?

On completion of this session, are you able to:

- Demonstrate growing of one vegetable crop on a small plot / kitchen garden / terrace garden

SESSION 11: DRAWING A FLOW CHART.

What is a Flow chart?

Diagrammatic representation of sequence of performed actions is called as flow chart. Which means giving information of action in the form of a diagram.

Method of drawing flow chart -

1) Goods before processing are mentioned at the back of arrow. Product formed through processing is mentioned at pointed end of arrow.
2) Used materials are mentioned on one side of arrow and performed action is mentioned on other side of arrow.
3) Process on original goods is mentioned in a straight line. Goods put into it are denoted by a horizontal arrow forming "Junction". Output products are denoted by arrow, but arrow head is pointed outward. As per requirement other information can be shown in this. e.g. Weight / volume of goods, time, temperature etc. This whole action is called "process". As above a flow chart of complete process is drawn.

Following are benefits of flow chart -

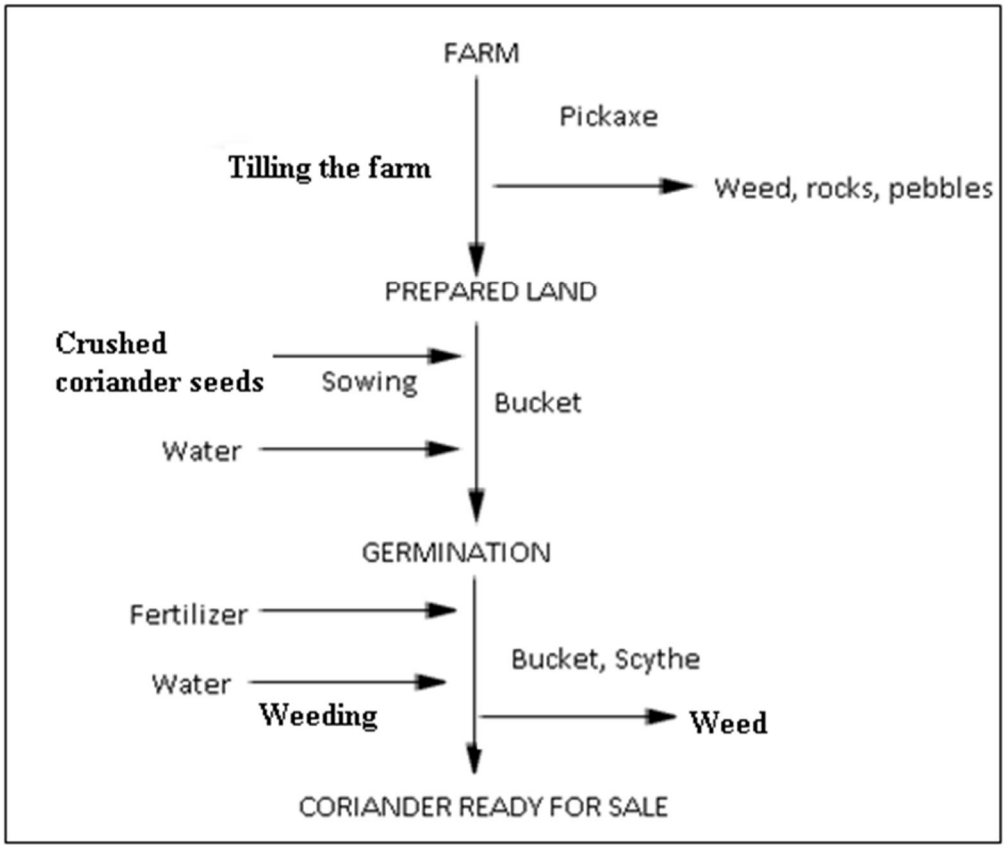
1) In brief, action can be described in sequence.
2) No part is forgotten because of systematic writing.
3) Total used goods can be planned so as to ensure that goods are not wasted.
4) Time taken by each action can be estimated. Time management can be done accordingly.
5) While pricing, expenditure on each action can be quickly found.
6) Process / description can be easily by-hearted.
7) Written information is brief, accurate and clear.

Limitations -

Drawing flow charts is difficult in that practical where goods are not processed, but measurements / actions are done using implements. It is not useful too. In that case only actions can be written in sequence.

FLOW CHART

Cultivating coriander crop in farm:-



CHECK YOUR PROGRESS

Fill in the Blanks

1. Diagrammatic representation of sequence of performed actions is called as _____ (flow chart)
2. Drawing flow charts is difficult in that practical where goods are not _____ (processed)

Subjective Questions

1. Describe the flow charts
2. Make a sample flow chart as described in the session

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate and create flow chart as per the need.

UNIT

4

FOOD PROCESSING TECHNIQUES

SESSION 1: UTENSILS AND EQUIPMENT USED IN COOKING

The responsibility of our health is indirectly dependent on the person who cooks our food and also on the cleanliness maintained while preparing the food. So, it is important to maintain cleanliness while preparing food and at the place where the food is prepared. Various utensils and equipment are used while preparing food. For food safety, it is important to have knowledge about the equipment, its handling, cleanliness and safety measures. We will be learning about the basic utensils and equipment used in cooking, in this chapter.

Utensils and Equipment used in Food Preparation -

Fig -1 Vegetable cutting board

Use – To cut fruits and vegetables in the desired shape and size

Fig 2- Electric Oven

To bake items like Bread, Biscuits, etc.

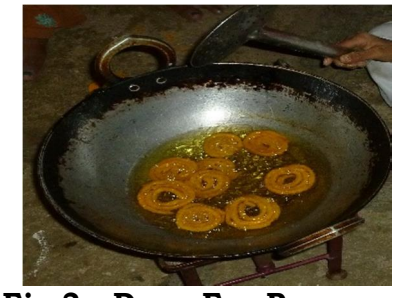


Fig 3 - Deep Fry Pan

Use - To deep fry item

Fig 4 - Shallow Fry Pan

Use – To shallow fry item using less oil

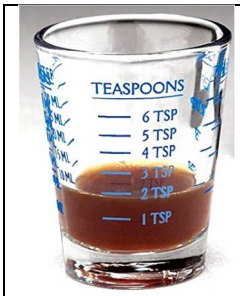


Fig 5 - Measuring glass

Use – For measuring the ingredients.

Fig 6 - Measuring Spoon

Use – To measure items like salt, chilli powder etc

Fig 7 - Kitchen Balance

Use – To weigh the ingredients.

Fig 8 -Grater

Use - To grate coconut, fruits, etc

Information about utensils used in cooking -

1. **Stainless Steel** – Stainless Steel utensils and equipment used for cooking are sturdy. The basic configuration of the raw material used in cooking remains unaffected due to use of stainless steel
2. **Brass –** Brass utensils should be used after tinning.
3. **Copper -** Since it is a very good conductor of heat, it saves fuel. These utensils should be chemically proofed before using for cooking, to avoid food poisoning. Drinking water should be stored in a copper vessel. Copper in limited quantity is very good for our health
4. **Copper Bottom Vessels** – Since it is a very good conductor of heat, stainless steel vessels are fitted with copper bottom
5. **Aluminum** – Aluminum utensils are light in weight, strong and good conductors of heat. Vessels to be used for cooking should be ISI marked or of Hindalium. Food cooked in aluminum vessels should be immediately transferred to a different vessel
6. **Iron** – Iron vessels and flat spoons when used for cooking, help in increasing the iron content of the food product by manyfolds. Iron is the best metal for Tawas (Flat pan), Kadhais (Deep fry pan), Spoons, etc. To prevent rusting of these utensils, they must be wiped dry after use.
7. **Plastic** – Used for storing and packing of food products as it is very convenient and light in weight. Plastic absorbs the colour and odour of the food product.

Recycled plastic should not be used for food products. Chemical named as BISPHENOL – A used in plastic causes cancer.

8. **Plastic Bags** – To maintain our health and preserve environment, government has banned plastic bags. Plastic bags can be dangerous for the lives of animals if consumed by them. Plastic bags are non-recyclable and hence pose a threat to the flora and fauna. Do not take thin plastic bags from shopkeepers. Use paper or cloth bags when you go to the market.
9. **Wide mouthed jars –** Used for storing dry items like masalas and cereals and pulses
10. **Sealed Water Bottles** – These bottles are not for re-use. These must be crushed and sent for recycling after use. Prevent people from re-using such bottles because it can cause cancer.
11. **Wood** – Wooden block used for chopping mutton and wooden plank used for chopping vegetables. if not properly washed and dried, will absorb moisture, stains and smell. Instead, Polypropylene items available in market should be used to maintain hygiene.
12. **Glass** – Does not create a reaction when it comes in contact with food items; as a result the item remains clean and safe. Glass when washed becomes crystal clear. Should be handled carefully.
13. **Bone China Jars** – Used to store pickles and accumulate the cream from milk. Food items remain cold in these jars.

- **Cleanliness and Precautions to be taken with respect to the Utensils, Equipment and tools**

Copper – It has great heat conducting capacity and is able to spread the heat evenly. There for stainless-steel utensils are fitted with a copper bottom. As a result, the vessel heats up faster and helps in saving fuel and gas. Since stainless steel is not a good conductor of heat, a vessel not having a copper bottom will take time to heat up. Also, a stainless-steel vessel does not heat up evenly. As a result, some portion of the vessel heats up more than the other portions and there is a possibility of the food item getting burnet in the portion which is over heated. Aluminum has almost the same conducting capacity as that of copper. So, an aluminum vessel heats up quite fast, but there is a possibility of aluminum particles getting mixed with the food if the vessel is overheated. Similarly, the acids in food items react with aluminum quite quickly, which is hazardous for our health. In case there is no option, food item cooked in an aluminum vessel should be immediately transferred to a steel or glass vessel.

Non-Stick cookware – These vessels should not be over heated when empty, else there is a chance of the coating emitting dangerous gas. Similarly, a non-stick vessel having scars should never be used. The pieces of the coating might get mixed with the food article causing serious health problems.

Copper-Brass Utensils –These vessels are tinned from the inside to avoid food article from deteriorating. Ammonium chloride is used in the process of coating. It brings down the melting point of tin. It gives a shiny surface to the tinned vessel. Acids from food do not react with tin, keeping the food product safe tinning reduces with use, such vessels should not be used unless the tinning is redone perfectly.

Iron Utensils – Use of Small iron pan for seasoning, Iron tawa (flat pan) for rotis and Kadhai or Deep pan for Deep frying helps in increasing the iron content of the food. Care should be taken to prevent rusting of these utensils.

- **Cleanliness to be maintained during Food Processing -**

The place where the food product will be prepared should be clean and tidy. In that context, the first important thing is the cleanliness of the person preparing the food. Normally, everyone has a bath daily, but it is important to also cut the finger-nails. Lot of bacteria can enter the dough, vegetables and other food items when they come in contact with a person's hands. Vegetables should be washed before cutting but at the same time they should be cooked immediately after chopping. Else the essential nutrients get destroyed. Once the vegetables are chopped, the knife should be washed immediately. Many a time the knife is left as it is after cutting and it becomes an attraction for bacteria.

Now-a-days, sealed cans are opened using can openers and used accordingly. This can opener is never washed. Such things attract bacteria immediately.

Bacteria grow between the temperatures of 15^0C to 49^0C very rapidly. The temperature in a kitchen and our body temperature falls within this range. The temperature of bacteria doubles, every 20 minutes. If there is a single bacterium in the food item at this moment, at the end of 8 hours their number will be 1 crore 60 lakh and that is why leftover perishable items should immediately be refrigerated. Left overs should be consumed or used immediately after they are taken out of the fridge, Stale or leftover items should be re-heated before eating. The bacteria increase at a very slow pace in refrigerated conditions and they are almost instantly killed by heat; hence all this process needs to be followed. Meat items, Milk & Milk products and boiled items need to be especially taken care of, because bacteria multiply at an alarming rate in these items. The basic nutrients required for bacteria. Growth are available in plenty in these items. The cloth used for wiping the kitchen top or table top should also be clean.

- **Cleaning of Utensils – From health point of view, it is essential to cook food that is nutritious and tasty. At the same time, it is essential to keep the kitchen utensils clean.**

Soap and Detergent reduces the surface tension of water. The water molecules can enter the food particles stuck to the surface of the utensil very easily, resulting in removal of the food particles quickly. Dish washing powder, Liquid soap, bar contains detergent, which removes oiliness of the vessel and make it clean. Nylon scrub for Non-stick utensils, glass containers; Scotch Brite for steel containers, plates and glasses; and Wire Scrub for Tawas, Kadhais can be used.

If hot water is used for cleaning utensils, they get cleaned very quickly. As the temperature of hot water is high, the solidified oil on the utensil surface melts and flows away along with the soap water. Hot water should not be used to clean utensil used to prepare a dough. Because hot water aids in cooking of the stuck dough. Resulting in sticking this dough to the surface more tightly.

Copper reacts with acidic agents from air and water to form Cuprous Chloride. This in turn reacts with water to form Hydrochloric Acid and Cuprous Oxide. Hydrochloric Acid again reacts with Copper to form Cuprous Chloride. A greenish-blackish layer is thus formed on the surface of Copper vessels as a result

of these reactions. This layer gets removed by use of Tartaric Acid from tamarind, hence in olden days tamarind was used to clean copper vessels. Now-a-days, powder having similar properties is available in the market. This powder is used quite often now.

Plastic is used in many households now-a-days. There are microscopic holes in Plastic containers. Particles of items such as tomato sauce get absorbed in these holes when the container is heated, leading to change in colour of the container. Washing this container with hot water helps in further widening of the holes and better absorption of the particles. Hence, these containers should be washed with cold water so that the holes are compressed and the particles thrown out resulting in proper cleaning of the container.

Utmost care must be taken while handling kitchen equipment. Microwave oven, Toaster should not be cleaned unless they are cold. Water filter needs to be cleaned frequently. Items to be kept in the fridge must be kept covered so that its odour is not absorbed by other food items. Butter must be tightly wrapped and kept. Care should be taken to prevent contact between foil and food item when the food item contains acids and needs to be wrapped in an aluminum foil.

A clean apron must be used while cooking. A clean napkin/towel must be kept nearby for wiping hands. Similarly, a clean napkin/towel must be kept to wipe plates, spoons, etc. after they are scrubbed and washed. It must be washed and dried daily to avoid accumulation of food particles in it.

Do you know the following?

1. How will you weigh oil on a weighing machine?

Answer – Adjust the display to "Zero". Weigh the empty container. Add oil into the container as per requirement and measure weight; subtract the weight of the empty container from the net weight.

2. Why is a wooden spoon used to stir food items in a non-stick vessel?

Answer – To prevent the surface from scratching and effectively to avoid the Teflon coat from getting scraped out and the aluminum surface getting exposed, wooden spoon is used for stirring.

3. Bone China/Glass container is used to store Tamarind and Kokum.

Answer – Acidic items like tamarind and kokum, if stored in metal containers, tend to react with it leading to formation of holes in the container. Same thing happens if pickles are stored in metal containers. Hence, bone china or glass containers are used to store acidic items like tamarind and kokum.

4. Why is tin coating given to brass and copper utensils used for cooking?

Answer – Most of the food items are acidic in nature and copper gets dissolved in the items when cooking which can cause vomiting, diarrhea, stomach aches and bitterness in our mouth. Brass is a composite of copper and zinc. Tin coating prevents contact of the food item with copper.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Various _____and equipment are used while preparing food (utensils)
2. _____utensils are light in weight, strong and good conductors of heat (Aluminum)

3. _____ is used for storing and packing of food products as it is very convenient and light in weight. (Plastic containers)
4. Wooden block used for chopping _____and wooden plank used for chopping_____.(mutton , vegetables)
5. _____chloride is used in the process of coating Copper- Brass Utensils (Ammonium)
6. Use of Small _____pan for seasoning (iron)
7. Acidic items like tamarind and kokum, if stored in _____containers, tend to react with it leading to formation of holes in the container (metal)

Subjective Questions

a. Why are stainless steel vessels given a copper bottom on the outside?
b. Why should scratched non-stick vessels never be used?
c. Is it necessary for the person cooking to cut his nails? If yes, why?
d. Why aluminum utensils should not be used for cooking?
e. Why should we use Iron kadhai for deep frying and Iron tawa for rotis?
f. Why should vegetables be cooked immediately after cutting?
g. Is it necessary to maintain cleanliness at the place where food is cooked?
b. List down five safety measures to be taken when working in Home Health Department.
c. How do bacteria multiply rapidly?
d. At what temperature do the bacteria multiply rapidly?
e. Why do food items get spoilt?
f. Why should boiled/perishable items be stored in a cool place?
g. Why do bacteria multiply rapidly in the kitchen and at body temperature?

True or False –

1. Aluminum is a better conductor of heat than copper.
2. Oven, toaster should be cleaned only after they are cooled.
3. If hot water is used to wash utensils, they get cleaned faster.
4. Vegetables should be washed in water after they are cut.
5. The nutrients required for bacteria to grow are found in-plenty in milk and meat products, hence they spoil very quickly.
6. Bacteria multiply every 20 minutes if they get suitable food items, water and temperature.

Match the Column

'A' Group	**'B' Group**
1. Stainless Steel	Nylon Scrub
2. Non-stick utensil	Rubber
3. Good Conductor of heat	Wire Scrub
4. Iron Tawa	Copper
	Plastic
	Nickel

What Have You Learnt?

On completion of this session, are you able to:

- Identify and handle utensils and equipment used in cooking and baking
- Describe the safety precautions to be taken for using utensils and equipment (measuring cups, spoons, knife, cutting board, frying pan, etc.)

SESSION 2: CHARACTERISTICS OF RAW FOOD MATERIAL - IDENTIFICATION (CEREALS, PULSES AND DALS, SPECIES AND CONDIMENTS)

Cereal -

To gain energy, we mainly use cereals in our diet. They are addressed as MONOCOTS due to their structure. According to Botany, seeds got from a specific type of grass are known as Monocots, Cereals and Food grains. They are a bit different than Pulses, structurally. Pulses when ground break into two equal parts, and so they are called Dicots. On the other hand, Monocots do not break into two equal parts when ground. So, they are called monocots. In India, monocot cereals like wheat, rice, jowar, bajra, ragi are used primarily.

Different cereals are used in staple diets in different regions. For example, Wheat in Punjab, Rice in Konkan and Bengal. Normally, the cereal grown in a particular area is used there and in adjoining areas.

Importance of Cereals -

1. Cereal is the main or rather only food item in poor people's daily diet. Because it is cheaper than all other grains.
2. The water content in these grains is comparatively lesser and hence they are included in grains having greater shelf life; as a result, their transportation is also easy.
3. If these grains are dried by keeping in sunlight in areas getting very high heat, they can be stored for a period of one year.
4. Another advantage of cereals is that they satisfy hunger when consumed. Because they contain 60 to 75% carbohydrates.

   Apart from that, monocots like amaranth, nagli, rale, rye, and oat are also used in other countries. Oat is a very nutritious cereal but the outer shell of oats is very hard and difficult to remove. Though there is a difference in the appearance and shape of various cereals, the internal composition and quantity and quality of nutrients is somewhat same. Following parts are usually seen in monocots:

1. **Husk –** This is the outermost covering of the grain. It is mainly made up of fiber. The coat varies in thickness and hardness in various grains. Rice is ground to remove this coating. It is not used in our diet.
2. **Bran –** This consists of 5% of the outer coat of the grain. It is not that hard in nature, but is rich in iron, phosphorous and "B" vitamins. If it is allowed to remain, the rice appears reddish in colour and does not become soft when it is cooked. Hence, those who like the rice to be pure white have to let go off the minerals and vitamins.
3. **Aleuron layer** – This is the inner coating adjoining the skin of the grain. It contributes about 8% of the total grain composition. While polishing the grains, this coating gets removed along with the skin of the grain. We get Protein, vitamins B, Phosphorous and iron from this layer. We also get starch from this layer.

4. **Endosperm –** Endosperm contributes about 82-85% of the grains structure. This part contains all carbohydrates. Traces of vitamins and salts are also found in this layer.
5. **Germ –** This contributes about 1 to 3% of the grain's structure. This is the tip of the grain and is the most important part of the grain. It is from this part that regeneration takes place. We get Proteins, Vitamins and small amounts of carbohydrates from this part. The quality of proteins is very good. While processing the grain, this part gets destroyed. The germ is covered with a coat called SCUTELLUM. It is through this scutellum that all the essential nutrients reach the plant when germination takes place.

- **Nutrients from Cereals -**

1. **Proteins –** Normally, proteins constitute about 6 to 12% of the grains or cereals. Oats contain 24%, whereas, rice contains only 6% proteins. The proteins found in cereals are of secondary quality. Because it contains less quantity of essential amino acid lysine, if used with dicots and animal proteins, the standard of these proteins can be improved.

   The quantity of proteins is almost half in rice from that of wheat. The standard of proteins obtained from the germ is very good; but while handling, polishing or grinding, this part of the grain gets destroyed.

2. **Carbohydrates –** Cereals contain about 60-70% carbohydrates, hence it provides more energy. We get almost 350 calories from 100 gms cereals. Carbohydrates contain fibre in some proportion. Most of the part consists of starch particles. On roasting, the starch particles break up into dextrin, hence they taste a little sweet. The starch part contains two types of particles namely amylase and amylopectin.

3. **Fat** – Fat content is very less. Normally it contains 1 to 9 percent fa.

4. **Minerals -** Cereals contain 2 % minerals. The amount depends on the soil and fertilizer used. Iron, Phosphorous and Calcium salts are obtained from cereals. But the salts are found in the outer coating of the grain so they are lost when wheat is ground, sieved and the husk is removed.

5. **Vitamins –** Food grains provide us with Vitamin B. thiamine, niacin and riboflavin are especially found in the grains. Some cereals are used after sprouting. This helps in increasing the amount of Vitamin C and B.

6. **Water –** Monocots are matured and dried grains, so that amount of water in them is comparatively less, about 10 to 12%. Immature or raw grains contain more water.

- **Types of Cereals -**

Wheat – This monocot is produced on a very large scale worldwide. In India, wheat is grown on a very large scale in Punjab and Uttar Pradesh. Wheat is mainly used in India for Roti, Poori, Paratha, etc. Apart from these, it is also used in Nan, Bread and cake in combination with refined flour (maida). There are various varieties of

wheat available in the market for different prices. Still the amount of nutrition remains the same in all varieties. Hence, when selecting a type of wheat in a preparation, its role in cookery must be considered..

Substances obtained due to milling of wheat -
If wheat undergoes milling process above normal, then all the nutrients are lost, dur to removal of and germ. The resultant refined flour obtained contains only starch and proteins; hence it is better to use wheat floar or Semolina (rawa) instead of refined flour in daily usage. It contains comparatively more quantity of proteins, vitamins and minerals. The quality of proteins in wheat floar can be improved by adding Amino Acids like Lysine. Apart from these items, vermicelli and noodles are also consumed in India.

Bajra – Just like wheat and rice, Bajra is also used as a primary cereal.
Bhaakri prepared from bajra flour is consumed as a main nutrition giver in daily diet. 100 g rams bajra contains 11.6 grams proteins, 67 grams carbohydrates, 8 mg iron and we get 132 kg carotenes from it. Carotene is essential for our eyes. Ingredients in bajra that interfere with absorption like Polyphenol, amylase get destroyed when millet is sprouted or cooked.

Fig 9 - Bajra

Jowar -
Jowar is used mainly in commercial establishments. A combination of wheat and jowar is used in alcohol manufacturing. Manufacturers of baby foods use jowar extensively. It is important to include jowar in our diet as it is a great source of calcium and energy.

Fig 10 - Jowar

Rice –
It is the second most extensively used cereal after wheat, in India. Varieties of rice are available worldwide. Normally, rice is categorized as small, medium and thick longish short. Various types like red rice, unpolished rice, polished rice, poha, puffed rice are obtained by processing rice. Milling is done to obtain all of these. As the extent of milling process on rice increases, the nutrients get reduced. Apart from this, boiled rice is prepared before milling process takes place on rice. **Fig 11- Rice**

Boiled Rice -
For preparing boiled rice the traditional way, dry rice is soaked in water along with its outer peel to increase the water to 30 to 35%. The minerals and nutrients from the bran get infused into the grain as a result of this. After this, the rice is steamed

or heated using water for a specific time, then it is dried and polished. The starch gets gelatinized due to this. As a result, the cooked rice is very soft.

Advantages -

As the grain of this type of rice is hard, the grain does not break during milling process and the husk gets removed quite easily.

1. The shelf life of boiled rice that has undergone milling process is greater than the other types of rice.
2. Boiled rice is more nutritious as it contains more quantity of Vitamin B.
3. Boiled rice is best for Pulav, Biryani preparation because it takes less time to cook and the grains do not stick to each other when they are cooked.
4. It is cheaper than processed rice.
5. It is best to use for fermented South Indian items like Idli, Dosa.

- **Processed Monocot cereals -**

Monocot cereals contain more quantity of polysaccharides. Hence, they are a bit difficult to digest. To make it easy for digestion, a great amount of time, effort and money needs to be spent. So, to save this effort and time for homemakers, easily digestible processed monocot cereals are available in the market. Some of these processed monocot cereals can be consumed as it is, and hence they are called as 'Ready to Eat Cereals'. Some of the processed cereals which require just a little cooking process are: -

1. Semolina, Refined flour, Normal flour are easier to digest that actual grains of monocot cereals. Rice idli, Upma, Shira, Laddoo, Roti, Poori, Jalebi can be prepared from this and add variety to our diet.
2. Noodles are flat strips whereas spaghetti is thin like vermicelli but longer in length. All these items are made after passing through a cast. To prepare KURDAI at home, wheat is soaked for 2-3 days and then ground. The pulp is removed from this and is cooked with water. It is then passed through a holed cast and left to dry out in the sun.
3. The advantages of this process are as follows:
   a) It becomes easy to digest.
   b) It becomes easy to pack and transport
   c) Different monocot cereals bring variety in the diet.
   d) The acceptability of monocot cereals increases
   e) Cooking takes less time and effort
   f) Shelf life increases

- **Ready to eat cereals – This includes various types of monocot cereals that can be consumed without cooking.**

1. **Puffed Items –** Puffed Wheat, puffed millet, popcorn, puffed rice are prepared by soaking the grains in water and then giving them heat. This results in the conversion of water in the grain into steam and the grain puffing up. The puffed-up grain can be eaten as it is.

2. **Pohe (Flattened Rice) –** Flattened Corn, flattened wheat and flattened rice are consumed regularly; for this the grains are cooked and then passed through a roller to flatten them out. The water is removed from this and the flattened grain is dry roasted and packed.

➢ **Ponits to be considered while purchasing the cereals -**

1. **Physical appearance of cereal –** The grain and flour of the cereal must be clean. It must be free from stones, dirt and other material which might adulterate it. While purchasing whole grain, care must be taken that the grains are not wrinkled and decayed. The grain must be nice, round, similar in size and free from pests. The flour must not contain worms, lumps and nets.

2. **Purpose of using cereals -**
The cereal and flour should be selected in accordance to its use in the recipe. For preparing rice flour, rice pellets or rice small broken grains can be used. Because it is cheap and gets ground easily. For preparing Pulav or Biryani, long grained Basmati can be used so that the dish becomes tasty. For preparing cooked rice, old rice grains should be used, because new rice grains contain amylopectin which makes the cooked rice sticky. Boiled rice can be used for making Idli-Dosa.

➢ **Pulses and Dals -**

It is essential to include pulses and dals in our diet because they are a great source of proteins. Mothbeans, cow pea, Peas, etch are pulses whereas Urad dal, Bengal gram are dals. Bengal Gram, Moong, Soyabean can be used as dals as well as pulses. Apart from these, pulses like Hulga, Masoor and Rajma are also used; but these do not provide all the essential proteins. Also, the quality of proteins obtained from these is also not good. To increase the standard of proteins, it is necessary to take some measures and care.

Fig 12 - Pulses & Dals

Nutrients obtained from Pulses and Dals -

1. **Proteins –** Pulses and Dals contain high amounts of proteins. Soyabean contains the maximum proteins; but the proteins obtained are of secondary standard. These items when used with milk or milk products give better quality proteins.
2. **Carbohydrates –** Pulses contain more amounts of fiber than that in dals. Carbohydrates are mainly found in these in the form of starch and small quantity in the form of sugar. Apart from these, there is very small quantity.
3. **Fats –** Pulses and Dals contain 1.5% fats.
4. **Salts –** Salts like Iron, Calcium, and Phosphorus are obtained from pulses and dals. The quantity of salts in pulses and dals decreases when they are soaked, cooked or sprouted.

5. **Vitamins –** Vitamins of Vitamin "B" category are obtained from these. The quantity of Vitamin B can be increased by sprouting and Vitamin C can also be obtained.

➢ **Digestion and Toxicity -**

Digestion – Pulses are difficult to digest as compared to other food items. Because they contain a very hard coating. It takes time for this coating to crack up and the inner material to get cooked. Dals do not contain this coat and hence are easy to digest as they get cooked properly. But excessive consumption of pulses and dals can lead to digestive ailments like stomach ache and gases. Dals are comparatively easy to digest than pulses and flour of dals is even easier to digest. Pulses when soaked, ground or sprouted become easy to digest.

Toxicity – Many pulses contain ingredients that are difficult to digest and toxic. For proteins to get digested, enzyme named trypsin is essential. Pulses contain trypsin, inhibitor which opposes action of trypsin.

As a result, it becomes difficult to digest proteins and pulses like soybean, wal. Contain more amount of this. These pulses if consumed raw can affect nervous system and muscular system.

Table – Toxic items in Pulses and Dals -

Pulses or Dals	Toxic Ingredient	Adverse Effect
1. Soybean, Wal	Inhibitor trypsin	Proteins are not digested
2. Some Pulses	Haemaglutinin	anemia
3. Kesari Dal		Lathyrism

Trypsin inhibitor gets destroyed by heat. Some pulses contain haemaglutinin which can affect blood cells and cause anemia. Kesari Dal also contains toxic ingredients. This dal if consumed over a long period can cause lathyrism.

➢ **Use of pulses in our diet -**

To get different nutrients, pulses and dals are used in various forms in different food items. Sometimes these are used without processing. Different forms of use are as follows -

1. **Mature Seeds –** Many pulses are used in this form as they are dried resulting in reduction in water quantity. As a result, their storage becomes easy. Lentil, Peas, etc. are soaked, sprouted, cooked and then eaten. It provides more nutrients.

2. **Fresh Seeds –** The water content of these is high. Tuvar, Lentils, Peas, etc. are removed from their pods and cooked by adding water to them. These seeds are tastier than mature seeds. But the water content is very high and nutrient content is very less.

Raw seeds or pods – Various beans are used as vegetables in our diet. These beans are cooked and used in place of regular vegetables. These beans cook faster. But the quantity of nutrients and vitamins is comparatively very less in these. Hence fresh pods and raw seeds are categorised as vegetables. They are not included in cereals and pulses.

➢ **Various Processes carried out on Pulses and Dals -**

1. **Decortication –** The whole grain of the pulses is ground and the outer skin is removed. As the skin is removed, the grain gets divided into two parts and the sprout in the middle gets removed. Since the other mineral salts get removed along with the skin, the colour of the flour of these pulses is very attractive. The bitterness also gets reduced. The taste improves. Dals are easier to digest than the pulses. But as the outer skin of the dals is removed, there is a possibility of these getting spoilt faster than the pulses. Sometimes, the grain is soaked, dried and ground to prepare dal.
2. **Grinding –** This is done to get thick and thin flour of the pulses or dals. This aids in the taste and digestion.
3. **Soaking –** To reduce cooking time, the dals and pulses are soaked in water for variable timings. As the pulses mature, the water content in them starts reducing. While cooking, these absorb water once again and puff up thus reducing cooking time and saving fuel and time required for cooking. If the pulses are soaked in cold water, the nutrients do not get destroyed. The time required to soak depends on the temperature of the water used to soak the pulses. The pulses get soaked faster in hot water. To make the pulses soft, they can be soaked in normal water for 12-15 hours or overnight or can be boiled for 2 minutes and left to soak for 1 hour. The time required for the pulses to get soaked and become soft and sprout also depends on the type of grain. The atmospheric temperature also has an effect on this. The dal gets soaked faster in summer that that in winter.
4. **Germination or Sprouting –** The pulses are soaked wholly to enable sprouting. As a result, the outer coating is broken, becomes loose and the sprout comesout. The grain puff up as a result of absorbing water. The proteins and carbohydrates get broken down into simpler forms. As a result, digestibility increases. Since the water gets absorbed, the time required for cooking reduces and the nutrients do not get destroyed.

Fig 13 - Sprout

As a result of sprouting, iron content increases. Vitamins and primarily riboflavin (vitamin B_2) increase. Vitamin C is formed, which is virtually absent earlier. The quantity, is dependent on the time, technique and temperature of soaking of the pulses. Pulses have to be soaked for 10-12 hours for sprouting. Afterwards, they have to be stored in a nice, warm place for 12 to 15 hours. In winters, water temperature should be 40 to 45 degrees Celsius for the sprouting process to be proper. After soaking, the grains require warmth and airiness for sprouting.

5. **Dry Roasting –** Moong is roasted using dry heat and then cooked. As a result, the cooking time reduces and digestibility increases. Nutrients to become available in more quantity.
6. **Parching –** Pulses are parched after soaking or wetting. Sometimes, salt and turmeric are added to the water. Bengal Gram is given a coat of a paste of turmeric-salt. Then it is parched in a furnace for 1 to 3 minutes. As a result, particles obstructing Trypsin and other toxic ingredients get destroyed. Nutrients

become available in greater quantities. As a result of roasting in a furnace, the pulses become tastier. They puft up and become easier to digest. Month beans, Phutana are processed in this way.

7. **Fermentation –** Bengal Gram flour is especially fermented to prepare Dhokla & Urad dal and rice semolina (rawa) is combined and fermented to prepare Idli. For fermentation, the flour is combined with semolina and soaked in water to prepare a thin paste; the paste is left to ferment for 10 to 12 hours. As a result, the batter becomes light and porous. If a food item is cooked after using this method, the resultant food item become light and fluffy. Fermentation makes the food item easily digestible. The quantity of Vitamin B in it increases. The food item also acquires a specific taste and feel. The item becomes easy to digest as a result of this entire process.

➢ **Processes used for germination or sprouting -**

1. The soaked pulses are tied up in a wet cloth and kept on a plate. It is then covered with a vessel. This is the most commonly used technique.
2. The soaked pulses are kept in a wet earthen vessel and covered with a wet cloth. This in turn is covered with a steel vessel. Bamboo Container can be used instead of a earthen vessel.
3. A sieve is fitted onto a container containing water. A wet cloth is put into the sieve, the tips of this cloth should touch the water in the container. Just so that it remains wet all the time. The sieve is covered with a plate.
4. In sprouted pulses, the starch gets converted into sugars making the pulses sweet. Since the proteins are broken up by water, their digestibility also increases. The absorption capacity of proteins also increases. The amount of salts and vitamins also increases. Especially, Thiamine and Riboflavin from Vitamin B increases by 10 to 15 % and Vitamin C is formed.

➢ **The role of Pulses and Dals in cookery -**

Pulses are used in *Usals* or *Misals*. Pancakes are made after sprouting, grinding and fermenting. Dals are used in preparation of curries, raitas, and laddoos. The flour of dal is used to make bhajiyas, Mysore paak, etc.

1. **Thickening –** Flour of dal is used in some food items as a thickening agent. Gram flour is used in preparation of Kadhi, Veg Gravy, etc. Due to application of heat, the starch gets gelatinized and the food item thickens.
2. **Binding –** Gram flour is used in some dry vegetable or onion preparations as a binding agent.
3. **To prepare outer coat –** Gram flour is used in preparing the outer coating of items such as Batata Wada, Palak Bhajiya, Bread Pakoda, etc. To prepare these items, the ingredients are dipped in a batter prepared from besan. Application of heat turns the starch into red colour and the coat sticks to the filling.
4. **To spread taste evenly –** Taste imparting compounds in masalas are fat soluble. Gram flour is added in various masalas. The starch from the flour helps in spreading the taste imparting compounds evenly. E.g. Sambar Masala, Garam Masala.
5. **Garnishing/Decoration –** *SEV* prepared from gram flour is used for garnishing on bhel, missal, etc.

- **Selection, Purchase and Storage –** We use different types of pulses, dals prepared from these pulses and flour of these dals for preparation of various dishes. Bengal gram is used whole or in the form of flour. Lentil or Urad Dal is comparatively easier to digest. In comparison to Moong Dal & Tuvar Dal, Dried peas, Rajma, etc. are difficult to digest. Lentil cooks quickly. Its price is also less. Soybean is highly nutritious, but it has a typical odour and hence its usage is limited. But there is a practice of using various pulses in various regions. Punjab has Kabuli Chana and Thick curry made of urad, Gujarat has use of raw tuvar pods, mathiyaas made of matki, South India has use of a paste prepared from urad dal as a taste changing agent. Andhra Pradesh, Madhya Pradesh has crop of red and kesari dal. It is best to use various pulses in combination with each other as per one's taste. It adds a little variety to our diet. The biological value of pulses or dals increases when used in combination with monocot cereals.

  There is a possibility of the pulses getting infected by pests. So, after buying new pulses, they must be stored in a dry place in air tight container. There is a practice to store pulses in ash to prevent them from coming in contact with air. Dal must be sun dried and stored in an air tight container after application of oil, in a dry place free from moisture.

- **Oilseeds and Nuts -**

  Oilseeds are mainly used to get oil. Hence, they are also called as oilseed crops. They contain maximum quantity of proteins. Groundnuts, Soybeans, Sesame, Coconut, Sunflower seeds are used to get oil. Linseed, Castor, Poppy, etc. are used to prepare medicinal oils. Mustard oil is used in preparing pickles.
  Walnuts, Cashew, Almond, and Pista also are used. Their oil can also be used. But these items are costly and hence instead of using as nutrients, they are used for garnishing. They contain good quantities of proteins of good quality. Groundnuts, Sesame are used for oil making. The remaining husk is used as fodder for animals.

  Oilseeds are also used for purposes other than oil. Groundnuts can be dry roasted and ground to get groundnut powder which can be used in vegetables, curries, chutneys, etc. Sesame can be ground and used in preparing chikki, jaggery roti, etc. Chutneys are also made directly from oilseeds. They can also be used as a source of protein in vegetarian food.
  In cookery, the effect of these items is the same as pulses. When they are roasted and ground, they give out oil due to application of pressure.

- **Use of Oilseeds and nuts -**

1. Items used for garnishing or decoration – Pista on Shira, Sesame on biscuits, Pieces of groundnut, walnut on cake, cashew on ice cream are the uses of various oilseeds for decoration.
2. Flavour imparting ingredient – Used for imparting flavour. E.g. Groundnut powder is used in raita for adding flavour. Pieces of almonds are added to Shira for flavour.
3. Thickening Agent – The proteins in oilseeds and nuts coagulate due to heat and in turn thicken the food item. Groundnut powder, dry coconut and sesame

powder are used for thickening of curry. The MASALA used in preparing masala milk contains almonds, sesame which help in its thickening and add taste.

4. Side Item and Snack Item – Groundnut, Coconut, Sesame are used in preparation of varieties of chutneys, whereas groundnut, cashew, almonds are used in preparation of chikki, laddoo. Barfi, Katli made of cashew, almonds is very famous in the market. Revadi made of sesame seeds is also very famous.
5. Groundnut powder is used in khichadi prepared using sago. The groundnut powder helps in avoiding the sticking of sago grains to each other making the khichadi nice.
6. Medium of cooking – Oil extracted from groundnut, sunflower, karadai, cotton seed, etc. is used for deep frying and shallow frying.

Selection, Purchase and Storage – Oilseeds and nuts must be selected such that they are clean, not infected and free of any foul smell. Since these contain high amounts of aliphatic substances, they tend to get a foul smell. It should be stored in an air tight, clean container.

➢ **Identifying Spices -**

Spices are an inseparable part of Indian Food Culture. Indian food stands out differ entry in the world due to use of spices. Spices obtained from trees can be seed, fruit, bark, pod, flower of the same. Its main use is to add flavour to food items, add colour or to increase storing duration of the food item. Spices also have disinfecting qualities.

Fig 14 - Spices

Categorization of Spices -

1. Hot Spices – Mustard, Chili, Ginger, Black Pepper.
2. Aromatic Spices – Nutmeg, Cardamom, Fenugreek, Cumin, Coriander.
3. Aromatic Bark, Peel – Cinnamon, Licorice (Jeshthamadh)
4. Coloured Spices – Saffron, Turmeric.

➢ **Information regarding some important spices -**

1) Black Pepper – Black pepper is the most widely used spice in the world. Black Pepper is a fruit of a creeper. The raw green fruits are plucked from the creeper and cooked in hot water and cleaned. In this process, the green peel dries out and become black and wrinkles, hence it is known as black pepper. Similarly, white pepper and green pepper are also used.

In Indian cookery, pepper is used wholly or in powdered form. Piperine gives the pepper its hot taste. Black Pepper is also added to garam masala, sambar masala, etc. Black Pepper is cultivated on a large scale in South India.

2) Cardamom – Cardamom is the third most costly spice in the world. Cardamom is the seed of a plant and grows near the root just above the surface. It is found in two types, green and black. Green cardamom is smaller in size and is used to add flavor in sweet items. The peel of green cardamom is removed and the inner seeds are used in powdered form. Black cardamom is bigger in size and is used in hot items. Cardamom is also used to add aroma to tea or coffee. India ranks 2nd in the world in production of cardamom.

3) Cinnamon – Cinnamon is the inner peel of the bark of the tree and is known for its fantastic aroma. It can be used as it is or in powdered form. The peel is

brownish in colour. It is very effective for heart ailments, blood ailments, and skin diseases. It is also used in preparing tea masala. Cinnamon is used to add flavor during preparation of chocolates in Mexico. In India, cinnamon is primarily grown in Western Ghat regions.

4) **Bay Leaf** – Bay leaf is the leaf of the tree of cinnamon. It is slightly less fragrant and lighter in taste than cinnamon. The aroma increases as the leaves dry out. Bay leaf is used in preparation of spicy vegetables and biryanis. It is an ingredient of Garam Masala.

5) **Nutmeg** – Nutmeg is the seed of a tree and is usually egg-shaped. Its colour is brownish. It takes around 7 to 9 years for a nutmeg tree to bear fruits after planting. Nutmeg is used in powdered form in sweet items. The oil of nutmeg is used to prepare aromatic oil and medicine.
Mace is the reddish and porous outer coat of nutmeg It is mainly used in mix spices or masalas. The flavour of nutmeg and mace is similar; nutmeg is sweeter whereas the taste of mace is lighter that nutmeg

6) **Clove** – Clove is the bud of a very aromatic flower and is widely used as a spice. A clove tree is evergreen and grows to a height of 8 to 10 meters. Clove is also used as a disinfectant. Its oil is medicinal and very effective on mild pains and toothache.

7) **Saffron** – Saffron is obtained from caucus sativus flower. Each flower contains 3 stamens. They are orange in colour; they are dried to get saffron. Saffron is mainly used to impart flavour and colour to a food item. To get 12 grams saffron, 1 kg flowers are required. In India, saffron is widely manufactured in Kashmir region. Saffron is used in milk products, sweets, biryanis and other food items. Saffron is the costliest spice in the world.

8) **Star Anise** – Star Anise is a medium sized fruit of an evergreen tree. It has a very high intensity of aroma. Its oil is used in soap, toothpaste, etc. Star Anise is used to add flavour to tea and biryani. It is an important ingredient of Garam masala.

9) **Coriander Seeds** – These are the fruits that grow on coriander tree. It is used in various Ayurveda medicines.

10) **Turmeric** – It is used as an antiseptic. It is also used to add colour to food items.

Function of Spices -

1. Spices have aroma, flavour and hence are used to impart taste to the food item. As a result, the food becomes tastier. E.g. Saffron BASUNDI, Curry prepared by adding black masala.
2. Spices are used for garnishing. E.g. Turmeric and Asafoetida are used as tempering on dhokla, cloves inserted into betel leaf.
3. Spices also help in adding colour to food items.
4. Sometimes, in pickles & sauce, spices are used as preservatives
5. Saunf, clove, cardamom are used as mouth fresheners.
6. Turmeric. Coriander, Cumin, Garlic are used as medicines. Cumin, Ginger, Mint, and Pepper act as appetizers and hence are used in preparation of appetizing drinks.

CHECK YOUR PROGRESS

Fill in the Blanks

1) Turmeric is used as a _____.
2) Spices are used as _____ in pickles and sauce.
3) _____ are the seeded fruits that grow on coriander trees
4) Oilseeds are mainly used in preparation of _____.
5) In sprouted pulses, the conversion of starch into sugar results in _____taste.

Subjective Questions

1. State types of Spices.
2. Explain importance of cereals in our diet.
3. What are the processes carried out on pulses and dals?
4. What are the methods of sprouting pulses?
5. Divide the following into cereals and pulses.

Wheat, Moong, Jowar, Bajra, Moth beans, Chavli, Rajma, Corn, Rice, and Ragi.

What Have You Learnt?

On completion of this session, are you able to:

- Identify the basic characteristics of raw food materials and apply cleaning and sanitation method
- Read the names of vegetables, grains, spices, herbs, etc. Used in preparation of culinary

SESSION 3 : FOOD PROCESSING METHODS (BOILING, STEAMING, SHALLOW FRYING, BAKING, SAUTEING) AND FUEL CONSERVATION METHODS

- **Aim and Purpose of cooking food** -

To make the food palatable for us, to increase its nutrient value and to protect it from getting spoilt, it has to go through various processes during the time it takes to reach our house from the farm. The food that we eat is cooked using different techniques, as a result the micro-organ is ms are destroyed to some extent, the nutrient value in the food item increases and it becomes tastier. Recipe made using different ingredients adds variety to the diet and also helps us in getting a balance diet.

Cooking Food means applying heat to the food item to make it palatable and bring about acceptable changes in it.

- **Aim of cooking food –**

1) **Increase acceptability of Food** – The following ingredients play an important part in increasing the receptivity of food.

Change in Taste – Cooked potato tastes better and sweeter than raw potato or it tastes salty when it is deep fried and sprinkled with salt; or its SHIRA can be prepared by adding sugar to it.

Change in Flavour – Semolina or groundnut when dry roasted acquire a nice crisp flavour; food so cooked acquires a nice flavour.

Change in texture – Depending on the technique used to cook food, the texture of the item also changes. Pulses, Cereals when cooked become soft, whereas thin slices of potato when deep fried become crisp. Cake batter when baked becomes soft and porous, whereas fermented dosa batter when spread on a tawa become crisp and porous.

Change in Colour – On grilling, cake becomes brown, whereas spinach and peas become bright green on cooking.

2) **Increasing Digestibility of Food –** The water gets absorbed by the food and makes it soft as a result of cooking. As a result, it becomes easier to chew. Digestive juices act on it easily. So, it becomes easy to digest.

3) **Bringing Variety to the Diet** – Using different techniques of cooking food, innumerable items varying in taste, flavour, text ture, size and colour can be prepared. As a result, monotonous nature of diet is removed and eating process becomes enjoyable. E.g. from Potato, Cutlet, Chivda, Vada, Kachori by deep frying, Chips, Shira by boiling. Similarly, Shankarpaale, Pooris, Salty Biscuits, Chirotas or Porous cakes from Maida can be prepared.

4) **To make the food SAFE to eat –** When some food items are heated upto a specific temperature, the micro-organisms are destroyed and the food items becomes SAFE. Its shelf life increases. Hence, boiled milk stays for a longer duration and giving more heat will result in getting Milk Powder; it can be stored for a longer duration.

- **Preliminary treatments and Processes carried out before food item is cooked**

Various treatments are done on different food substances before cooking. These are known as Preliminary Treatments or Primary Processes. Various preliminary treatments are done on different food items. Soaking the dal for making Dahi-Wada or washing and grating carrot for making halwa are some of the primary processes. Following table illustrates the effect that primary process has and advantages of the same on food items.

No.	Food Item	Primary Process	Effect on Food Items
1.	Varan	Wash Dal	Becomes clean and safe to consume
2.	Potato Bhaaji	Peel, Wash and Chop Potato	Clean and Safe to consume, Reduce cooking time
3.	Dahi Wada	Wash, Soak and Grind Dal	Clean and safe to consume, reduces cooking time and makes it light and porous
4.	Idli	Wash, Soak, Grind and ferment Dal & Rice	Becomes clean, cooking time decreases, item becomes easily digestible. Nutrient value increases
5.	Matki Usal	Wash, Soak and Sprout Matki	Becomes clean, Cooking time decreases, Nutrient value increases, Becomes tasty
6.	Thalipith	Dry roast and Grind Cereals and Dals	Colour changes, becomes tasty, Digestion becomes easy
7.	Roti, Bhakri	Mix using water and flour	Item gets proper smooth texture, can be shaped as per choice

Due to the processes done on the food items, their standard changes. But, if for specific food items, proper preliminary preparation is not done properly, they become unacceptable. Idli batter if fermented for a long time or dal for Dahi Wada if kept soaked for a long duration, they acquire a specific strong odour. Hence, during preliminary processes, the colour, flavour and nutrients of the food must be retained.

Food Cooking Techniques – These techniques are categorised according to the medium of cooking used.

1) Dry Roasting
2) Baking
3) Grilling
4) Steaming
5) Steaming under pressure
6) Sautéing
7) Cooking on Low flame
8) Deep Frying or cooking on high flame

➢ **Food Cooking Techniques -**

Medium	Food Cooking Techniques	Temperature Degree Celsius	Examples
1. Air	1. Roasting	160-175	
	2. Baking	160-220	Cake, Biscuits, Pudding
	3. Grilling		Mutton Chops, Grilled Sandwich
2. Water	1. Boiling	100	Dal, Rice, Kadhi, Kheer
A) Direct Contact	2. Slow Boiling	85-90	Eggs, Soup
	3. Mild Boiling in less water	85-90	Mutton, Potato Rassa
B) Indirect Contact	1. Steaming	100	Idli, Dhokla, Alu Wadi
	2. Pressure Cooking	110-120	Rice, Dal, Vegetables
3. Fats (Oil, Ghee)	1. Sautéing		Vegetables for Masale Bhaat, Noodles
	2. Cook on less Oil	180	Dosa, Paratha, Thalipith. Cutlet
4. Combination of two mediums	Mix Technique		Upma, Pulao rice

➢ **Food Cooking Techniques -**

A) Techniques that are been used since ancient times are known as traditional techniques. Methods like Boiling, Deep Frying, and Steaming come in this category.

B) Techniques used now-a-days like Solar Cooker, Microwave, Inframatic cooker are known as modern techniques.

Food cooking techniques, as stated in the table, are as follows -

➢ **Using Air as a medium of cooking –** In this method, the food item is given dry heat to cook.

1. Dry Roasting -

Two methods are used in this.

A) Open Fire roasting – In this method, the food item is roasted on open flame. E.g. Papad, Corn, Fulka, Brinjal. There was practice of eating potato, brinjal, onion, sweet potato roasted in open fire, in olden days. In this, food item comes in direct contact with flame.

B) Roasting on Hot Metal – In this method, the item is roasted on a metal tawa. E.g. Roti & Khakra; or the item is roasted in a kadhai or on heated sand. E.g. Groundnut, Semolina, Jowar, making flakes of corn. In this method, the item puffs up when it is heated due to evaporation of water. Roasting done using this method is known as PUFFING. In this method, the food item is indirectly heated.

Roasting is used as a preliminary technique in preparation of some food items. E.g. Brinjal for making vegetable (bharit) or in some foods, roasting is used as the last step in cooking the food item. When the item is roasted on open flame, it gets heat through "Emission" method. While doing this, the item needs to be constantly moved and turned. When roasting corn, it is turned and when roasting groundnuts, they are stirred. If not done so, the item gets burned. In this technique, temperature in the range of 160 to 175 degree Celsius is used. Due to roasting, the food item becomes reddish in colour and gets a nice flavour; the outer surface also becomes crispy. As a result, roasted item is more tasty and palatable. It is difficult to control the temperature in this method. But the nutrients are retained in this method.

2. Baking -

In this method, the food item is roasted in a closed furnace or oven. An oven has a metal coated pipes or wire at the bottom or in some cases at the bottom as well as top. Which is used for heating the surrounding air inside. When the oven is started, due to electricity these metal coated wires or pipes get heated & the air around the pipes also gets heated. The oven metal becomes hot due to convection currents by use of electricity. In this method, the temperature varies from 150 to 250 degrees Celsius. The main advantage of this method is that the temperature can be controlled and maintained. The food item is cooked through conduction and convection. The main purpose of this technique is to cook food thoroughly. It takes time to roast food item, but items roasted using this method are easier to digest and the nutrients too are not destroyed. If a lot of oil or ghee is used, the food item becomes crispy. Cake, Bread, Vegetables in White Sauce, Pudding are food items prepared using this technique.

3. Grilling -

Grill is a part of the cooking range. When the grill is switched on, the copper wire heats up and the food item gets heat through Radiation. In this, the top and bottom of the food item is heated. Grilled sandwiches are prepared using this method. Due to radiation, the outer part of the food item becomes nice and crispy.

Fig 15 - Grilling

- **Using Water as a medium of cooking -** In this method, the food item is given wet heat. In this, water is used as a medium. In some techniques, the food item and water come in direct contact, whereas in some methods they come in indirect contact. As a result, the food is cooked by steam. Water is used as medium frequently, because it is freely available and water absorbs heat easily.

- **Items coming in direct contact with Water –** In this method, the item comes in direct contact with water, for cooking purposes. The vessel in which the food item is cooked gets heated by radiation and the water gets heated by conduction. Boiling, slow boiling are some methods in this technique.

1. Boiling – In this method, the water is heated upto 100 degree Celsius, water starts boiling at this temperature. The food item is put in this boiling water to cook. The quantity of water used is such that the food item is completely immersed in it. After cooking, the water is thrown away which results in the essential nutrients getting destroyed. Hence this water must be used for making curry, kadhi, etc. If the vegetables are cooked with their peel, nutrients get retained. Similarly, using right quantity of water for cooking also helps in retaining nutrients. Since wet heat is used, the food items absorb water and puffs up and becomes easy to digest. Water boils at a higher temperature in areas that are above sea level. Hence time taken to cook is also more. Rice, Dal are cooked using this method.

Fig 16 - Boiling

2. Simmering – Many items are cooked using simmering as method of cooking. In this, the water is slow boiled at 85-90 degree Celsius. In this method, water bubbles form at the base of the vessel and get dissolved in water before reaching the top. Especially, items like Kadhi, Kheer if boiled at high temperature, the dense particles and water get separated. Hence, such items are simmered. Similarly, the proteins in eggs get solidified at 100 degrees Celsius, so eggs too are simmered at 85-90 degree Celsius.

3. Poaching – In this method, the temperature of the water is maintained at 85-90 degree Celsius. The food item to be cooked is immersed in this water for a few minutes, then it is served. Fish and broken egg is cooked using this technique. As the item is cooked for a short duration, the item becomes jelly-like and easy to digest.

In mild boiling and poaching, the temperature is below boiling temperature. As a result, the destruction of nutrients is reduced.

4. Stewing – In this technique too, food item is cooked in 85 to 90 degrees Celsius. But the water used is very less and after cooking, the water is let to remain with the item. Vegetables are cooked using this method; As a result, the flavour of vegetables enters the water and the water remains with the vegetable. If cooked using a lid, it gets cooked faster and evaporation of some nutrients is prevented. Meat, Pulp of fruits for jam and Jelly is prepared using this technique. The pieces of vegetables, Meat or fruits should be equal in size so that the heat is evenly distributed between them. Use only the required quantity of water and cook on low flame. Else the food item will get burnt.

Fig 17 - Stewing

- **Methods using Indirect Contact of Water –** In this method, water does not come in direct contact with the food item. Steaming and Pressure cooking comes under this.

- **Steaming –** Steam formed due to boiling of water is used in cooking. Dhokla, Idli, Modak, Aluwadi are prepared using this method. The main advantage of this method is that since there is no direct contact between food and water, nutrients are retained. In this method, more items can be cooked at one time. Steamed food items are light and easy to digest. Constant care is not needed to be taken in this technique. Food item does not shrink as water gets absorbed in it. Many items can be cooked at one time using a cooker, thus saving fuel.


Fig 18 - Double Boiler & Modak Patra

2. Pressure Cooking – Pressure cooker is used in this technique.

Principle – When pressure is applied, on water or steam water boils at a higher temperature; its boiling point increases. This principle is used in a pressure cooker. As we go above sea level, atmospheric pressure decreases and water boils at a lower temperature; thus food does not cook properly. Hence it is essential to use a pressure cooker. Dal, Rice, Meat, vegetables are cooked using this method. The main advantage of this method is that the item cooks fast. So, nutrients destruction is also less and time taken too is less. Constant care is not required to be taken. As the temperature is high, the food item becomes soft and easy to digest.

Fig 19 - Pressure Cooker

The composition of the food item determines time taken for cooking. Dal requires more time whereas vegetables cook faster. Hence a check has to be kept on the cooking time. Cooked for a shorter duration, it will not cook properly and vegetables overcook if cooked for a longer duration. 2 to 3 items can be cooked at one time in a pressure cooker. But items requiring same duration to cook must be cooked together. Green leafy vegetables containing chlorophyll, if cooked in a cooker become brownish green. Cabbage gives out a foul odour when cooked in a pressure cooker because it contains sulphur compounds which decompose when heat is applied, which give foul odour. So, such vegetables should not be cooked in a pressure cooker.

Method of cooking using fats as a medium -

1. Sautéing – The amount of oil used is such that it is totally absorbed by the food item. The food items are cut or made into same sized portions so that they cook evenly. For this reason, the food item is constantly stirred using a ladle. The item

becomes half cooked. Vegetables, especially, get a good colour. When water is added after using this method, the item cooks faster. Sautéing also gives it a good flavour. E.g. Sautéing vegetables for noodles.

2. Shallow Frying – The food item is heated in a pan or on a tawa by adding just a little oil. Dosa, Paratha, Omelets are made using this method. Many a times, the food item is cooked from both sides. It becomes crisp and tasty.

3. Frying – In this method, sufficient oil is taken and the food item is cooked by completely immersing it in the oil and heating. A kadhai is used for this; the food item gets immersed completely and cooks properly. The item is cooked at a temperature of 180 to 220 degree Celsius. As this temperature is higher that the boiling point of water, the food item is cooked faster. The main disadvantage is that constant check has to be kept on the food item. The food item has to be stirred constantly and as oil is absorbed, we get more calories on consumption, but the item is difficult to digest. In this method, the kadhai heats up by conduction and the oil is heated by radiation. The outer layer of the food items becomes crisp and crumbly. The feel of the external coat of the item is dependent on the oil, soda, baking powder added to the item. Samosa, Batata Wada, Wafers are made using this method.

Fig 20 - Frying

4. Electric Fryer – Electric Fryer is easily available in the market. In this, oil is heated using electricity. Control is auto.

Cooking, using combination of two or more Mediums -
Many food items require oil and water or air to completely cook. This is called combined cooking technique. E.g. for making Pulav, Vegetables and Rice are first sautéed and then cooked by adding water which means a combination of oil and water is used.

MODERN TECHNIQUES –
1. Cooking without using any medium –
1. MICROWAVE OVEN – As the diets started changing and as heat and eat food articles became available in the market, the use of microwave for cooking food has increased. Many companies started manufacturing Microwave ovens. Still, they are used by the upper class as they are quite costly.

Fig 21 - Microwave oven

In this method, heat is not transferred to the food item using any medium, it is created in the food item itself. This is the specialty of this method. A magnetron pipe is fitted in microwave ovens. This pipe converts electricity into high frequency waves, when the oven is switched on. These are known as Electro-Magnetic Energy Radiation waves. These waves create movement in food particles and this movement causes friction thus resulting in heat generation.
Metals repel these waves. So, the oven's inner walls are made of metal. These waves can go through paper, clay, earthen vessels. So, such type of vessels should be

used in these ovens. If metal vessels are used, food does not cook properly as the waves cannot enter; but when glass vessel is used the waves can pass through thus cooking the food properly.

This method has a lot of advantages. The food cooks up to 10 times faster. Hence time and fuel are saved. Food item can be heated in this. The vessel in which the food item is kept does not heat up. Frozen or cold item can be heated within a couple of minutes. Electricity cost is also less.

Still there are some limitations of this technique. One is that the oven is costly. As all the particles of the food item get heat at the same time, they do not become brown in colour. Now-a-days, there is facility in some ovens to grill the item. As the number of food items getting cooked in this method increases, the time taken to cook also increases. So, if 50 grams potatoes take 2 minutes to cook, then half kg will take more time. For cooking using this method, paper, glass or plastic vessels must be used. Metal vessels cannot be used in this method.

2. SOLAR COOKING – Solar energy or sunlight is used for cooking in this method.

Principle – The energy received from sunlight is converted into heat.

This is a very important method especially in India. Solar Cooker is like a box. The inner sides of this box are coloured black. The food item to be cooked is kept in black coloured vessels and the lid of the box is kept open. These vessels are covered with a thin glass lid. The energy obtained from sunlight is by means of radiation. When the solar cooker is kept in sunlight, the sun's rays are reflected by the mirror and pass through the glass lid. It gets converted into heat and the black coloured vessels absorb this heat and the food gets cooked.

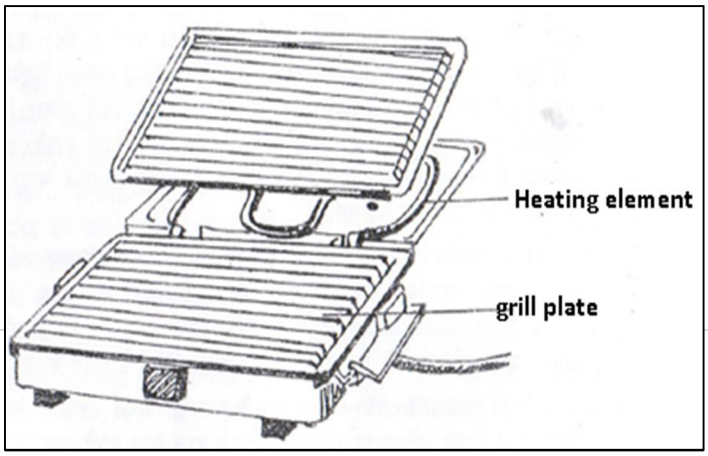
Fig 23 - Solar cooker

In this method, energy obtained naturally is used. So, the advantage of this method is that no fuel is required. So, this method is cheap and economical. Also, the cost of a solar cooker is also less. Constant care is not required when food is kept for cooking and the food stays hot for a long duration.

The main disadvantage of this method is that we have to be dependent on the season and weather. This cannot be used in cloudy weather. Another disadvantage is that time taken to cook ranges between 2 to 4 hours. This is dependent on the intensity of the sunlight. Also, for the rays to fall on the mirror properly, its angle has to be changed sometimes. Still, fuel is saved and this method is economical. Dal, Rice, Dhokla, Cake can be prepared using this method.

3. Inframatic Cooking:

This is an advanced cooking method. In this method, infra-red cooker is used. It contains a rectangular vessel. In this, the top side and the bottom is fitted with heating wires. As a result, the item that is in the vessel gets heat uniformly from all sides. Also, since infra-red rays are also used in combination with heat, the food cooks faster. A lot of fuel and time is saved due to this. In such a



vessel, a cake gets baked in 6 minutes as against 45 minutes in an oven. This type of oven gets heated due to infra-red rays and radiation.

Fig 24 - Inframatic Cooking

In this oven, the heating wires are given a coating of non-stick material. So, items like chicken, sandwich, cake, etc. can be prepared. The non-stick coat is not harmful for our health. Hence, any food item can be cooked in this. Also, less amount of oil is used for cooking. As a result, it becomes easy to clean.

A major disadvantage of this method is that the food item does not become crisp, and brown. Because the temperature is less than other cooking techniques, but due to heat from all side the food cooks faster. The interior and exterior of the food item cooks at the same time. So, meat items when cooked using this method do not shrink. Also, the design of this oven is such that maximum food can be fitted in minimum space for cooking. Also, it has a thermostat which helps in maintaining the temperature. The infra-red emission rods are coated and do not pose a threat to our health and it becomes easy to cook food.

Care to be taken to protect nutrients while cooking food –

1) Select fresh fruits and vegetables
2) Wash vegetables before cutting or peeling
3) Cut vegetables for salad at the time of serving.
4) Do not throw away the water used for cooking
5) Do not cook excessively food
6) Cover the vessel when cooking
7) Do not add soda to dals and vegetables

Effects of using wrong cooking methods –

There are many advantages of cooking food, but if proper methods are not used and care is not taken, all the essential nutrients are lost and the food becomes waste. Water soluble vitamins and minerals dissolve in water. If this water is used while cooking, then it is useful; but if the water is thrown away, all the nutrients are lost. If fruits and vegetables are cut and kept for a few hours before cooking, the vitamins A and C gets destroyed due to contact with air; as a result, these dry out. Addition of soda to food articles makes them difficult to digest and destroys the B complex and C vitamins in them.

Methods of saving fuel –

When cooking food, steps should also be taken to conserve fuel. The cost of cooking food changes a lot if substantial fuel is saved. Also, it helps in maintaining the environmental balance. We can save fuel at our homes using the techniques given below:

Methods of saving LPG in our kitchens –

1) Use stainless steel vessels instead of using earthen ones. Steel vessels are good conductors of heat. So, food cooks faster thus saving gas.
2) Do not keep the gas flame high while cooking. The flame should not exceed the edges of the vessel.
3) The gas regulator should be switched off after use. This avoids gas leakage and saves it.
4) All the material required for cooking should be kept ready to save gas and time.
5) Pressure cooker should be used for cooking

6) When cooking or heating a food item, it should be kept covered to save gas.
7) Use right amount of water for cooking
8) Use of blackened vessels should be avoided. They consume more gas for heating up.
9) Gas regulator, pipe, burner should be inspected regularly
10) Use of unconventional energy can help save gas. Solar energy can be used to dry an item; also, solar cooker can be used for cooking
11) Use solar water heater for heating water.

CHECK YOUR PROGRESS

Fill in the Blanks

1) The amount of heat is very high when deep frying and results in destruction of _____.
2) Use of _____ equipment for cooking will help in the item getting cooked faster.
3) _____ medium is used when cooking food using grilling method.
4) _____ method is used for cooking dhokla.
5) _____ currents in oven help in maintaining the temperature in an oven.
6) _____ Method of cooking is used when making pulav.

True or False.

1. Do not chop the vegetables, firely.
2. It is better to eat fried food that eating steamed food.
3. Soda must be used while cooking
4. Do not rub rice in water excessively.
5. Once the item is cooked, excess water should be thrown away.

Subjective Questions

1. What are the advantages of using pressure cooker for cooking food?
2. What is the purpose of cooking food?
3. Describe any three methods of cooking food.
4. What care should be taken to preserve the nutrients in vegetables?
5. Write advantages and limitations of the following in detail.
   a. Cooking food in a pressure pan.
   b. Using microwave for cooking food.
   c. Cooking food in a solar cooker.

What Have You Learnt?
On completion of this session, are you able to: • Prepare food items using safe and appropriate procedure. • Apply fuel conservation methods.

SESSION 4 : FOOD PRESERVATION METHODS (DRYING, PICKLING, BRINING- PUTTING IN SYRUP, FREEZING, CANNING)

Vegetables and fruits hold an important place in our daily diet. Fruits and vegetables are healthy, nutritious and help in maintaining our overall balance. So, it is important to include them in our diet in some form or the other.
India has a variety in weather and seasons, so various fruits and vegetables are available in various regions of India. Various fruits and vegetables have different seasons. Great amount of fruits are produced during the season. If they are not picked, they decay and the price received too is less. Also, as fruits and vegetables are perishable, the trader does not benefit. Once the season is over, they become rare; so, it is necessary to process the fruits and vegetables so that they become available throughout the country all year round. Various by-products can be made by processing fruits and vegetables. Preparing and preserving such products is the main objective of food preservation. If preparation of these food items is taught in a proper, classical way, then the subject becomes interesting and a small scale, profitable business can be started. It will then become self-dependent in today's world.

Food Preservation –
To avoid the food from getting spoilt due to micro-organisms, the process of stopping their growth and removing them from the food is known as Food Preservation.

- **Purpose of Food Preservation –**

1) Fruits and Vegetables can be enjoyed throughout the year.
2) Use of food preservation techniques will help in avoiding the spoilage of food
3) The fruits and vegetables available during the seasons are available in plenty and are cheap. Preservation technique will help in saving money.
4) This process results in decreasing the weight of the item, hence its transportation becomes easier
5) These food items are useful during times of natural disaster like earthquakes, floods, war, etc.
6) These food items are beneficial to trekkers because they have to carry weights while trekking. It requires time.
7) On getting basic information about the same, a small business can be started
8) As the items are self-prepared, we get joy out of the same.

Factors resulting in spoilage of food –
The increase in the microbes in the food item results in its spoilage. These microbes grow at a very fast pace in favorable conditions. The increase in microbes results in change of the taste and smell of the food item. This is called as spoilage of the food

item. To preserve the food item for a longer duration, it is necessary to stop the growth of microbes.

Microbes grow because of the following factors –

1) TEMPERATURE – Microbes can grow at a fast pace between 5 degrees Celsius and 65 degrees Celsius. That is why a food stays for a longer duration in a refrigerator at temperatures below 5 degrees Celsius; similarly, when a food is heated above 65 degrees Celsius, it stays for a longer duration.

2) Water Content of the food – Water is necessary for the growth of microbes. Decreasing water content of the food results in increasing its shelf life. E.g. Food when dried using solar energy or artificial heat, tends to get preserved for a longer duration. Use of sugar or salt while making a food results in decreasing the water content thereby arresting microbial growth. Food items are basically organic in nature and hence contain natural microbes. At the same time, microbes from outside too enter these items and they cannot survive without water. Water content if reduced using various techniques will arrest their growth. Reducing the water content will increase the shelf life of the food item.

3) Food Item's contact with Air – Microbes too require oxygen for their growth, just like humans being. Stopping the oxygen supply will arrest the growth of microbes. Packing in air tight manner or packaging under contact with nitrogen, packing in vacuum by removing the air will result in arresting growth of microbes and increasing the shelf life of the item. Some microbes in the food item cannot survive without oxygen. If we avoid contact of the item with natural air, its shelf life can be increased. But some microbes can survive without oxygen, this process is known as fermentation.

Methods of Food Preservation –

Drying – (Drying the food item by removing its water content) Cereals, Dals, Pulses, papad, some vegetables, etc. are dried in direct sunlight or in a solar dryer to remove its water content. Ambapoli, Fanaspoli, Amchur Powder, Amla Supari, Amla Candy are dried to reduce the water content and increase their shelf life. During drying, the water content is reduced; at the same time some unwanted microbes get destroyed because of heating.

Use of Preservatives – Salt and sugar are preservatives. They absorb the water content from the food item through osmosis and deprive the microbes from getting water for their growth. The process of attraction of water particles towards dense solution is known as Osmosis. When fresh grapes are immersed in sugar syrup, the water content from the grapes gets absorbed in the sugar solution. As a result, the grapes shrink and can be stored for a longer duration. Sodium Benzoate, Potassium metabisulphite, glacial acetic acid are artificial solutions which arrest growth of

microbes. Their standard is predetermined by Food Preservation Law. They are classified as Class I and Class II. It is necessary to write the class of [preservative used in the food item on its packaging

Canning – To store the food items for a longer duration, they are stored in air tight containers or bottles. In this method, both container and food item are sterilized using heat. Due to sealing, the microbes which spoil the food item are destroyed, at the same time, the influx of external microbes is also stopped. Fruits, Vegetables, Fish, Meat Items, Milk and Milk products are stored in sealed containers. Now, canning has become a business. Tin cans, glass bottles, excellent quality cartons like cardboard boxes, tetra pack are used for canning.

Heating – Food items prepared in sugar syrup, different masalas, sauce, chikki, jam, jelly, milk products, and other deep-fried items are heated to a specific temperature during cooking, they are evaporated, and water content is reduced due to high temperature.

Freezing - The growth of some microbes can be arrested at very low temperature. This method is especially used for fruits and pulps. Items like peas, some vegetables, paneer, khoya, etc. are stored using this method.
Sometimes, multiple methods are used in preparing some food items.

Brining – This method is used for storing vegetables in air tight containers. In this method, salt solution is used. Good quality salt is used for this method. Vegetables like Cabbage, Cucumber, Onion, Peas do not get spoilt if 7% to 15% salt is added. Beet, Carrot, Onions are preserved using a strong salt solution containing 15-20% salt. The quantity of salt solution is dependent on the vegetable or fruit to be preserved.

Smoking – Meat items are preserved by drying them on smoke. Components like formaldehyde, creosote, pyrolygnius acid, phenol compounds present in smoke mix up with the meat and act as preservatives. These are oxidizing agents and hence act as anti-oxidants against meat and prevent growth of microbes thus stopping the meat item from emitting a foul smell. To prepare smoke, wet husk of wood is burnt. Normally, sawdust of oak and hickory trees is used for this method. The quantity of smoke to be given depends upon the type and size of the meat item.

Sterilization – In this method, the food item is heated to very high temperature for a short duration. E.g. At temperature of 72 degree Celsius for 15 seconds or at 138 degrees Celsius for 2-3 seconds. The harmful bacteria are instantly killed due to this and the food item can be stored for a longer duration. E.g. Milk

Preparing Sugar Syrup – Amla, Chikki, Jam are prepared by adding them in sugar or jaggery syrup, thus increasing their shelf life and making it tasty.

Types of Syrups –

1) Single string Syrup - Jaggery or Sugar and water when heated together give us a transparent solution. This solution is tested using our thumb and little finger, by taking a drop of the same between these two fingers and checking the stickiness. If a single string is formed, then the syrup thus obtained is single string syrup.

2) Double String Syrup – If the syrup is heated for some more time and tested, we get two strings between our fingers. This is Double String syrup.

3) Triple String Syrup – Similarly, as the syrup thickens, we get triple String Syrup.

4) Ball Syrup – If a drop of this syrup solidifies instantly a candy-like drop, on adding it into cold water, we have ball syrup.
Normally, Single String Syrup is used for marmalade, double or Triple for Jam and soft ball for Chikki.

Carrying out preservation methods on food items results in reducing the nutritional value of the same sometimes, whereas sometimes the nutritional value increases. Given below are some food items and the effects that are seen on then when preservation methods are carried out.

Food Item	**Process**	**Effects**
Soyabean	Heating	Digestion and Absorption of Proteins becomes easier
Sugar	Heating	Caramelizes at 163 degrees Celsius gives good flavour.
Bakery Products	Heating	Product becomes crisp, get brown and become tasty.
Cereals and Pulses	Soaking and Sprouting	Digestibility increases, Vitamin B increases, Minerals are absorbed properly
Wheat	Grinding	Effect changes depending on grinding technique. In refined flour, all the husk, fibrous particles and B complex gets destroyed.
Cereals and Dals (Idli, Dhokla)	Fermentation	Digestibility increases, Vitamin B increases, Minerals are better absorbed.
Carrot	Drying in sunlight	Carotene and Vitamin K are destroyed due to contact with air

Vegetables and Fruits	Freezing	Boiling before freezing results in destroying Vitamin B1, B2 and C
Groundnut	Heating	Maillard Browning Reaction and gives superb taste

Jam can be prepared using natural preservatives like sugar and lemon.

Jam – Jam is a food item which is prepared by heating the pulp of fruits along with sugar and acid to a thick consistency and homogeneous texture.

Essential Ingredients for Jam – For preparing good quality jam, proper quantity of sugar, pectin and Acid is necessary

1) Pectin – The substance connecting two tissues in fruits is called Pectin. Guava, some varieties of Apples contain good amounts of pectin. Pectin powder too is available in the market.

2) Sugar – Sugar helps in preserving Jam. As sugar is water absorbent, it binds together the water content in fruits and does not let water be available for growth of bacteria. Sugar acts as a PRESERVATIVE in Jam.

3) Acid – Acid gives taste to the item. Acids are also used as preservatives to some extent. Apart from this, it prevents caramelization of sugar thereby avoiding the jam from becoming hard and thick. 5 grams citric acid should be used for 1 kg fruit pulp.

4) Water – Water is required for removing the pectin from fruits to prepare pulp.

5) Colour, Flavour and Preservatives – Jam becomes tasty attractive due to proper colour and flavor. Preservative helps in increasing its shelf life.

CHECK YOUR PROGRESS

Subjective Questions

1. Write down five important purposes of food preservatives.
2. What is Food Preservation?
3. What are the reasons of a food item getting spoilt?
4. Write down the factors and effects of drying.
5. Write down the types of syrups.
6. How do you identify candy syrup?
7. Why is it necessary for the spoon to be dry and clean when taking out pickle from the bottle?

True or False

1. Single string syrup of jaggery/sugar is used in preparing chikki.
2. Sodium Benzoate is and artificial preservative.
3. Ripened fruits should be used to prepare jam/jelly.
4. Salt is a natural food preservative.
5. Write the process of preparing the following.
    a. Tomato Sauce
    b. Jam
    c. Jelly

What Have You Learnt?
On completion of this session, are you able to: • Describe various methods of food preservation (salting, Pickling, drying, smoking, preserving in brine water, etc.) • Describe principles behind basic preservation technique viz. use of high or low • Temperature, exclusion of air, removal of moisture, use of preservatives, etc. • Describe importance of maintaining hygiene in cooking area.

SESSION 5 : COSTING, PACKING AND LABELLING OF FOOD PRODUCTS

Various processes are carried out in preparing a food item and preserving it for a long duration. We have studied the various processes that a food item undergoes, in the earlier experiments. It is imperative to decide the marketing, costing and labelling of the food item during its preparation stage. We are going to gain basic knowledge about marketing survey, costing and labelling in this chapter.

Marketing Survey –

Market research is very necessary even if your business is small or big, domestic or international, big enough for export or not. Many a times, there arises a need to change the product of the business after market survey. E.g. If we decide to do a business of Jam manufacturing from fruits and do market research and realize that there are many local manufacturers or there are old manufacturers which are huge companies, then you will have to sell your product at very less prices. Then it is better to change the business itself.

Advantages of Market Survey –

1) The demand for the product to be manufactured can be determined. E.g. If phenyl or jelly is to be manufactured, it is required in urban market rather than in rural markets.
2) We get to know other manufacturers of the same item or we come to know which other items similar to ours are available in the market. Also, it can be determined if there is anyone having monopoly in the market. The profit percentage and [pricing can be decided accordingly.
3) We can determine our target consumers and their spending ability. This has a direct effect on the pricing of the item. E.g. Tomato sauce is purchased by urban middle-class people and not by the lower economic class or the rural class. So, cost can be high and profit generated is also high.
4) Daily manufacturing proportion can be determined. The daily or monthly sale can be known.

COSTING – Fixing the sale price of the manufactured product is known as Costing.

Advantages of Costing –

1) Production cost, other cost and profit/loss can be determined.
2) High cost items or processes can be replaced by more economical ones and the profit margin can be increased or loss can be decreased.
3) Unnecessary expenses can be determined and curtailed.
4) Loan can be returned regularly.
5) Raw material can be selected as per our budget and requirement.

Following needs to be considered while costing – While fixing the price of the item, if only the raw material cost and 25-30% labour charges are considered, it can lead to losses. At the same time, when trading or selling in bigger markets other than the local market, the cost of middlemen increases. For this, costing should be fixed in the following manner:

Factors can be left out as per need.

A) Production cost

Raw Material cost and Transportation Cost
Labour cost is 25-30% of the raw material cost
Production Process cost
(Power and water used, depreciation of the machinery used, etc.)
Rent of the space/ Depreciation value of the space used for production

B) Cost for sale

Transportation cost of the ready product (cost incurred for transportation to distributor or wholesaler)

C) Profit (Dependent on the expenses)

Production	10 %
Distributor	1 to 5 %
Wholesaler	10 to 15 %
Retailer	10 to 20 %
Total Profit	50 %

Essential factors from the above can be selected for fixing market price of the product. The costing of the product changes depending on the market survey. If our product has a monopoly in the market, then it is sold at the price that we fix. Else the price has be varied according to the other similar products in the market. This can be obtained by varying the profit percentage.

PACKING –

Finished product needs to be packed properly. This means that the finished product need to be wrapped in a cover or kept in a closed container or pack. Many fruits have natural packing. E.g. Bananas, Coconut, Aloe have natural packing over them. Some natural packing is used by us too. E.g. Flowers wrapped in banana leaf stay fresh for a longer duration. When packing figs, its leaves are used for filling the space in a basket. Farm produce or food items stay fresh in packing made up of leaves. Man has invented packing material like Aluminum foil, plastic, wood boxes, paper or cardboard boxes, cartons, tissue papers, laminated plastic, etc. Packing machines too are available in the market now.

Advantages of Packing –

1) The product remains safe till the time it reaches the consumers hands
2) The product can be handled properly depending on its texture and size. E.g. Perishable farm produce like tomato
3) The product can be made attractive for the customer. E.g. Fruit pulp filled in small bottles
4) Use of one type of packing establishes the brand in the market and the product becomes famous in the market by a specific brand name. E.g. Kissan, Parle, etc.
5) Packing can be done depending on the weight and number to make it easy for transport and attractive in appearance e.g soap powder, small shampoo sachets, dal, waters etc.
6) It avoids contact of perishable items with air, thus increasing their shelf life. Eg. Vegetables stay for a longer duration when wrapped in laminated plastic than when kept in an open basket
7) Packing can be changed depending on the market. E.g. Fruits available in open baskets or cardboard boxes in local market are sent in AC Boxes when sent overseas.
8) Packing can be done depending on the standard or quality of the product. E.g. Normal Chikki can be packed in plastic and special chikki can be packed in special type of paper which is plastic from inside and attractive paper from outside.

Contents of the Packing Label – It is necessary for the manufacturer to mention a few things on the packing label. These become very important in case of farm produce or food items.

- Name of the Product
- Contact Details (Address, Contact number, Mobile)
- Date of Manufacturing, Date of Packing
- Weight at the time of packing, quantity manufactured
- USE BY Date or Expiry Date
- Sign and colour specifying whether the product is Vegetarian or Non-vegetarian
  Vegetarian ● (Green colour)
  Non-vegetarian ● (Red colour)
- ISI, FPO number

If the product is to be sold in the local market, some details from the above can be left out.

CHECK YOUR PROGRESS

Fill in the Blanks

1. The process of fixing the price of an item is called as _____.
2. When packing Figs, leaves of _____ are used in the basket.
3. The item remains _____ because of packing.
4. Perishable items remain for a longer duration due to prevention of contact with _____.
5. _____ colour is used on packing of vegetarian items.
6. _____ colour is used on packing of non-vegetarian items.
7. Banana, coconut are examples of _____ packing.

Subjective Questions

1. Write the advantages of packing.
2. What are the specifications necessary on the label of packing?
3. Write four examples of natural packing.
4. Which natural packing items do we use?
5. Write the advantages of costing.
6. Write the advantages of Marketing Survey

What Have You Learnt?
On completion of this session, are you able to: • Interpret food label • Weight and packaging of food product using Sealing method • Describe food label. • Describe advantages of different food packaging types

SESSION 6 : FOOD AND NUTRITION REQUIREMENTS OF ADOLESCENT BOYS AND GIRLS

Diet in Adolescent Stage –

Teens is a stage of rapid growth. 12 to 14 and 14 to 16-year-old boys and girls grow at a rapid rate. The overall development of the body happens at this stage. The length of the bones increases. The number of muscles increases, fat starts accumulating in the soft tissues. This stage of growth stays for duration of 2-3 years. Taking into consideration this stage of growth, the dietary requirements too increase manifolds. Hunger is also more at this age. As a result, more food is consumed. But it is essential to see if this food is correct and nutritious. Previous correct or incorrect dietary habits have a great impact at this age.

The personality is also developing along with the body. As a result, mental strain also develops. Proper guidance from parents is essential at this stage. As a result of the independent thought process of this age, Tea and Coffee enter the daily diet. Care should be taken to avoid over consumption of these drinks.

During this stage, girls start thinking about being slim and trim, and resultantly start taking weird measures and practices. Milk, Vegetables, Eggs, and Roti is left out of the diet as a weight reduction measure, and items such as chikki, bhel, chocolates, candy are consumed in large quantities. This does not result in a toned body, but results in a weak, malnourished body with low immunity. It is necessary to include iron with proteins in the diet for girls.

Taking into consideration all the above factors, the diet for teens must be such that it should contain all the nutrition factors but must also be easy to digest. For this reason, items containing multiple nutrients must be selected. The items selected must have ample amounts of proteins, vitamins and other essential salts. Milk must be consumed in good quantities. Special care should be taken for breakfast and lunch. 300 calories are required in excess at this age. 2 to 2.5 grams per kilogram of proteins are required. Vitamin C requirement is above 50 mg. The food items required at this age and their quantity is given in the table below. Diet in the infant stage and teen age stage is costly. But for a healthy and nourished life ahead, this diet has to supply by all means possible.

Prescribed values of Nutrients –

Category	Nature of Work and Age	Weight in kilograms	Energy in Kilocalories	Proteins in Grams
Adult Male	Secondary Moderate Heavy	60	2425 2875 3800	60
Adult Female	Secondary Moderate Heavy	50	1875 2225 2925	50

Boys	16 to 18 years	57	2640	78
Girls	16 to 18 years	50	2060	63

Nutrients if not provided in the diet as stated in the table can lead to various diseases. Low amounts of iron can cause degradation of blood vessels. Similarly, nutrients consumed in excessive quantity than required can cause considerable harm. Consuming more fat in the diet can cause Obesity.

To avoid all the above harms, our diet must be balanced i.e. it should contain all the nutrients in the right quantity. For this, the following 5 categories must be included in the diet.

Basic five Categories of Diet –

No.	**Name of the group**	**Food Items**	**Size of one serving**	**Daily Servings**
1.	Proteins group	1. Dals and Pulses 2. Oilseeds and nuts 3. Milk, curd 4. Other Milk Products 5. Eggs 6. Meat, Fish	25 gms 25 gms 150 ml 25 gms 50 gms 30 gms	1. Kids – 3 to 4 2. Teens – 5 or more 3. Adults – 4 or more
2.	Protective Group	1. Green Leafy vegetables 2. Orange and Yellowish Vegetables and fruits 3. Vegetables and Fruits containing Vitamin C	50 to 75 gms 50 to 75 gms 50 to 75 gms 50 to 75 gms	1 or more 1 or more
3.	Secondary Protective group	Other fruits and vegetables	50 to 75 gms	2 or more
4.	Monocots group	Cereals and cereal products.	25 gms	6 to 12
5.	Saturated Energy group	1. Sugar, Jaggery 2. Oil, Ghee		

Following points must be considered while preparing the diet plan using the above table –

1. Every meal must consist of one item from every food group.
2. As given in the table, the daily serving quantity must be taken and then depending on the person, more servings can be taken. E.g. A laborer requires more energy to carry out his daily routine, hence more amounts of cereals must be consumed over the minimum prescribed servings.
3. There should be variety when selecting food items from the 5 food groups because different items of one category do not contain same amounts of nutrients. E.g. Wheat and Rice give us same amount of energy, but the amount of proteins is very less in rice as compared to wheat; similarly, adding different items in the diet adds variety to our meal.

Why do we eat food?

To keep our various bodily activities operational, we eat food. The activities are as follows:

1) Bodily Growth and Reinforcement
2) Nutrition and Repair of Body tissues
3) Gaining Energy for Body
4) Increasing the Immunity of the Body
5) Keeping all the processes of the Body working (digestion, blood circulation etc.)

How will you decide your diet –

In our proper diet, 10 % energy is contributed by Proteins (Milk, Eggs, Meat, Fish, etc.), 25 % is contributed by Fats (Oil, Ghee, Butter) and remaining 65 % is contributed by Carbohydrates.

To maintain proper health, the amount of food varies from person to person. The need for nutritious diet is dependent on many factors. E.g. Age, Gender, Built, Movement, Health, etc.

Protein requirement is dependent on the age and weight. The ideal quantity of proteins for our body is 1 gram per kg. Calories or Energy requirement is dependent on bodily movement. A person doing office work requires lesser calories than the person doing garden work and other heavy work.

It is necessary to select proper food items for a balanced diet. To make this selection easier, food items and their nutrients are categorized as per their functionality.

Three main Functions of Food –

1) Provide energy to the body
2) To aid in growth and building of our body
3) Controlling various activities of the body and increasing the immunity

Taking into consideration these three functions, food has been divided into three categories –
A) Energy Giving B) Food required for growth C) Food required for immunity

A) Energy Giving Food – We get Carbohydrates, Proteins, fats and vitamins, essential salts and Fatty Acids from these food items.

Following items come under this category:
1) Grains and Roots – Rich in Carbohydrates and other nutrients
2) Sugar and Jaggery – Only Carbohydrates
3) Oil and Ghee – Fats

B) Food required for growth - We get a lot of proteins from this food group. Nuts and oilseeds give us fats along with proteins.

➢ **Following items come under this group :**
All Non-vegetarian items – Meat, Fish, Eggs, Milk and Milk products. These contain high amounts of proteins, vitamins and minerals.

Dals, Cereals, Nuts and Oilseeds – Proteins, Vitamins, minerals, Fiber and Fats

C) Food required for immunity - All fruits, leafy vegetables and other vegetables come under this group.

✓ **Leafy Vegetables, orange, yellow and orange coloured vegetables and citrus fruits –** This category contains huge amounts of Vitamins A and C. It also contains minerals, carbohydrates and other fiber items.

➢ **Information required for calculation of diet –**
Table depicting the average activity and energy consumption/requirement of a 16-year-old boy –

Activity	Time	Energy required (kcal/hr.)	Used Energy
Sleeping	8 hours	65	520
Bathing and Wearing clothes	30 mins	160	80
Washing clothes/Ironing	30 mins	160	80
Arranging room	10 mins	240	40
Cycling	15 mins	240	60
Climbing stairs	15 mins	420	105
Sitting in	4 hours	100	400

Classroom			
Talking while sitting	1 hour	100	100
Doing Experiments in the Lab	3 hours	160	480
Walking	50 mins	160	130
Eating	2 hours	100	200
Watching TV	2 hours	100	200
Fast Exercises	15 mins	500	125
Studying	Up to 2 hours	135	125
Time	24 Hours		
Total Energy Requirement		2640	2645

In the above example, energy required is 2640 kcal and he is using 2645 kcal. As a result, energy received and energy used is balanced.

Depending on the above table, prepare you own list of activities and calculate the energy used. Compare that to the table depicting daily balanced diet. Then calculate if you have energy left over.

If a person consumes food that gives more energy than the required amount, that person tends to become heavier in weight.

If a person consumes food that gives less energy than the required amount, that person tends to lose weight.

Sample of balanced diet for kids aged between 13 to 15 years (According to Dietary science, 2450 cal and 70 gms proteins must be received daily) –

No.	Food Category	Food Item	Serving Quantity Daily	Wt. in gms	Calories	Proteins in gms
1	Energy Giving	Grains	15	300	1050	30
		Roots	2	120	140	04
		Sugar	8	40	160	-
		Fats	8	40	360	-
2	Food required for Growth	Milk	1	250	170	8
		Dals	3	90	300	21
		Eggs	1	50	70	7

3	Food giving Immunity	Leafy Vegetables	1	100	-	-
		Other Vegetables	3	300	120	3
		Fruits	2	200	80	-
		Total			2450	73

Balanced diet for 13 to 15-year-old kids -

No.	**Time**	**Item**	**Material**	**Serving Quantity**
1	Morning Tea	1 cup	Sugar	1
			Milk	(50 ml)
2	Morning Breakfast	Sweet Vermicelli	Grains Milk Ghee Sugar	1 ½ 1 1
		Paratha	Grains Ghee/Oil	3 ½
		Omelette	Eggs Oil Other Vegetables	1 ½ ½
		Fruits	Banana	1
3	Lunch	Fenugreek, Potato Vegetable	Leafy Vegetable Oil Roots	1 1 1
		Dal	Dal Oil	1 1
		Roti/Bhaakri	Grains	4
		Rice	Grains	1
		Salad (Tomato/Cucumber)	Other Vegetables	½
		Sweet potato halwa	Roots & tubers Ghee Sugar	1 1 2
4	Evening Tea	1 cup	Sugar	1
			Milk	50 ml
		Ragi Biscuits	Grains Sugar Ghee	1 2 1

		Bhel	Grains Dal Sugar/Jaggery Other Vegetables	1 1 ½ ½
5	Dinner	Usal (Sprouted)	Dal Other Vegetables Oil	1 ½ 1
		Guar Vegetable	Other Vegetables Oil Sugar/Jaggery	1 1 ½
		Chapati	Grains	3
		Rice	Grains	1
		Papaya	Fruits	1

Diet according to Season –

Indian has mainly 3 seasons namely summer, monsoon and winter. When there is a change in the season, there is definite change in the weather and that has an effect on our health. It is necessary to take note of the changes in weather and change our diet accordingly and maintain proper health.

Bright sunlight kills all the bacteria. In the monsoon season, the sun is covered by clouds, hence there is shortage of sunlight. This is the time when maximum diseases spread when rain falls on the land which is heated due to sun rays, steam is formed. This has an effect on our health. As a result, we do not feel any sort of excitement. The atmosphere is also not favourable for digestion. So, the diet in these days must be light. We should eat a little less than normal. The food that we eat must be clean, fresh and heat generating. Items such as onion, garlic, asafetida, dry ginger should be used in our diet to aid digestion. Water should be boiled before drinking, cleanliness must be maintained where food is concerned.

In summer, we sweat a lot. For evaporation of the sweat, energy from our body is used and thus the body temperature is maintained. In winter, the amount of fat in the body is more. As a result, cough accumulates in the body. It becomes thin due to sunlight. Ailments such as cough, cold, throat infection, fever, etc. develop because of this. Diseases spread more during this time. So, cough reducing diet is necessary. Hence, in summer, the intake of oil, ghee, butter, milk should be reduced, cereals must be increased. Hot onions and bitter vegetables intake must be increased. Intake of dahi, sour items must be reduced. Cold drinks increase the quantity of cough hence cold drinks, ice creams must be avoided. Instead, Ginger pulp, honey must be eaten. In summer, salt gets thrown out of our body due to sweat. These salts are necessary for our body. In summer, decrease in salt proportion results in cracks on our skin. People doing heavy work must especially increase intake of salt in summers.

The pores in our body shrink during winter, and hence we do not sweat. The heat is blocked in our body. In winters, gastrodynia is also activated. Hence our eating capacity increases. Digestion problems are also less. More food is required in

winters than in summer. It is best to increase the intake of fatty items like oil, ghee in winters. Butter is better than ghee as it is easy to digest and contains high proportion of Vitamin A. In this manner, maintaining balance between season and diet will help us in maintaining our health.

INFORMATION –

Calorie and Food Calorie – Calorie is an energy measuring unit. The energy required to increase the temperature if 1 gm water by 1 degree Celsius is 1 calorie. The energy required to increase the temperature if 1 kg water by 1 degree Celsius is 1 kilocalorie. Nutrients and food items are always related and explained using Kilocalories.

CHECK YOUR PROGRESS

Fill in the Blanks

1) In a good diet, _____ percent energy of the total energy is contributed by proteins.
2) Oil and Ghee mainly give us _____.
3) Vegetables and Citric fruits contain ample amounts of Vitamin _____ and _____.
4) Groundnuts and oilseeds give us ample amounts of _____.
5) In a good diet, _____ percent energy of the total energy is contributed by fats.
6) 10 to 18-year-old children require _____ to _____ calories daily.

Subjective Questions

1) What are the three main functions of food?
2) From which items do we get energy?
3) Which items are necessary for growth of our body
4) Why is it necessary for people doing heavy work to increase intake of salt in summer?
5) How will you decide if our diet is balanced or not?

What Have You Learnt?

On completion of this session, are you able to:

- Identify food requirements of adolescent male and female
- Prepare a diet chart to meet the nutrient requirements of adolescent male and female from locally available food
- Describe shelf life and factors affecting shelf life of food items.

SESSION 7 : METHODS OF IDENTIFYING FOOD ADULTERATION

Mixing sub-standard item in a quality item, mixing a different item which is similar in appearance to the original one, putting up wrong labels, selling rotten items, mixing poisonous material is known as Food Adulteration.

Items used in adulteration of various food items –

1	**Milk and Milk Products -**	
A	Milk	Mixing water, removing fat, adding fat free milk powder
B	Milk and Powder	Dextrin or Starch
C	Ice Cream	Artificial Sweetener, Banned colours, Paper pulp
D	Ghee	Animal Fat, Vanaspati,
2	**Vanaspati Oil**	
A	Costly Oil	Cheap Oil, such as mineral Oil, cotton seed oil.
B	Mustard Oil	Argimone Oil
3	**Grains and Flour**	
A	Rice, Wheat	Stones, Sand, garbage.
B	Wheat Flour	Chalk Powder, Talcum Powder
C	Gram Flour	Other gram flour
D	Maida	Shingada Flour
4	**Dals**	
A	Bengal Gram and Tuvar Dal	kesari Dal, Metanil Yellow
5	**Masala Items (Spices)**	
A	Turmeric	Lead Chromate Colour
B	Turmeric Powder	Yellow Starch, Other colours
C	Chilli Powder	Brick Powder, Red starch
D	Grain Powder	Starch, horse dung.
E	Pepper Powder	Dried Papaya Seeds
6	**Other**	
A	Honey	Sugar-Jaggery Syrup
B	Tea	Wood Dust, Used Tea Powder
C	Coffee	Grain Shell Powder
D	Processed Supari	nut shell powder

We can easily identify the adulteration in some items at home. Various adulteration methods and how to identify are as follows –

Required Material – Clear Glass strip, Milk, Butter, Curd, Oil, Dal, Chilly Powder, asafetida, Coffee, Sugar Powder, Hydrochloric Acid, Sugar, tincture Iodine, Nitric Acid, Water, Test Tube, Alcoholic Potassium Hydroxide.

1) Identifying Water in Milk –
Test – Put a drop of the milk on a clear glass strip and let it flow down.
Observation and Inference – If there is no whiteness left behind and the drop just flows down, then water is mixed in the milk.

2) Identifying Vanaspati in Pure Ghee –
Test – Take Ghee in a test tube and heat it so that it melts. Add equal quantity of Hydrochloric acid to it and then add a pinch of sugar. Stir this mixture for a minute and keep the test tube steady for 5 minutes.
Observation and Inference – If the lower layer becomes orange in colour then Vanaspati has been mixed.

3) Identifying Flour in Butter or Curd –
Test – Add 5 drops tincture Iodine to a spoon of curd or butter
Observation and Inference – If purple colour is seen, then the butter or curd is adulterated

4) Identifying Argemone Oil in Normal Oil –
Test – Take oil in a clean test tube. Add equal quantity of nitric acid and shake well. Keep the test tube steady for 2 minutes.
Observation and Inference – If the mixture becomes reddish in colour, then the oil is adulterated.

5) Metanil Yellow in Dal –
Test – Take about 5 grams dal in a test tube and then add 6 ml water and shake well. Then add few drops of Hydrochloric Acid to it.
Observation and Inference – If the mixture turns pinkish in colour, then the dal is adulterated.

6) Brick Powder in Chilly Powder –
Test – Take a pinch of chili powder in a big measuring flask. Add half flask water to it and mix well. Keep it steady for 5 minutes.
Observation and Inference – If some powder gathers at the base of the flask, then the chilly powder is adulterated.

7) Pure Asofoetida –
Pure asofoestida readily dissolves in water and the mixture becomes milky. When pure asofoetida is burnt the flame is very bright.

8) Adulteration in Turmeric Powder –
When turmeric powder is mixed with water and concentrated hydrochloric acid is added to it, the mixture turns reddish in colour. If the powder is pure, this reddish colour disappears after some time. But if there is metanil yellow in it, the reddish colour stays.

9) Pure Coffee –
Pure Unadulterated coffee floats on water

10) Adulteration in Powdered sugar –
If powdered sugar is mixed with washing or eating soda, it becomes frothy when hydrochloric acid is added to this.

TEST AND OBSERVATION –

No.	Food Item	Test	Observation	Inference
1.	Milk	Put a drop of the milk on a clear glass strip and let it flow down		
2.	Pure Ghee	Add equal quantity of Hydrochloric acid to it and then add a pinch of sugar to melted ghee		
3.	Butter, Curd	Add 5 drops tincture Iodine to a spoon of curd or butter		
4.	Oil	Take oil in a clean test tube. Add equal quantity of nitric acid and shake well		
5.	Dal	Take about 5 grams dal in a test tube and then add 6 ml water and shake well. Then add few drops of Hydrochloric Acid to it		
6.	Chilli Powder	Take a pinch of chilli powder in a big measuring flask. Add half flask water to it and mix well. Keep it steady for 5 minutes		
7.	Pure Hing	Add 1 spoon asofoetida to 3/4th cup water and stir well		
8.	Turmeric Powder	Add ½ portion water to 1 spoon turmeric powder and then add 4-5 drops of Hydrochloric Acid		
9.	Coffee	Take water in a bowl and add 1 spoon coffee powder		
10.	Powdered	Add 5 drops of		

	Sugar	hydrochloric acid to 1 spoon powdered sugar		

- **Side Effects of Adulteration –**

Though there are no harmful effects of mixing water in milk, cheap oil in costly oil or cheap grains in quality grains flour, it has an effect on the nutrition value of the item. And the purity of the item is also disturbed. Some items are naturally poisonous and eating them in more quantity can have harmful effects. When dal by the name of Lathyrus Satyvas is consumed, it can cause handicapped condition by the name of Lathyrism. This dal when soaked in hot water, and the water changed from time to time, the poisonousness can be removed.
Consumption of Mustard oil mixed with 10% Argemone Oil causes disease known as Epidermic Dropsy. The symptoms of this are stomach ache, fever, rashes on body. Sometimes it leads to death of a person due to stoppage of heart. Mixing of mineral oils in Vanaspati oil can cause stomach ailments. Consumption of turmeric coloured using lead chromate can cause lead poisoning. Lead is very poisonous and causes ailments of kidney, liver and intestines. Stomach ache, Anaemia, Loss of sleep, effects on brain, etc. are the common symptoms seen.

- **Standardization of Food –**

To avoid any side effects to the consumer's health, Government of India introduced Anti-Adulteration Law in 1954. Under this law, standards have been set up to maintain quality in various food items. These standards are known as INDIAN STANDARDS INSTITUTION (ISI) and AGRICULTURAL MARKETING (AGMARK).
State governments appoint Food Inspectors to check quality of the food items. These inspectors collect samples of the items. These samples are tested at local levels, or if needed, these are sent to Central Food-Technological Organization, Mysore and Central Food Laboratory, Kolkata. If adulteration is found in the food items, cases are registered against the seller and manufacturer and punished accordingly.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Consumption of Mustard oil mixed with Argemone oil can cause _____.
2. Lead is _____ in nature.
3. When dal by the name of Lathyrus Satyvas is consumed, it can cause handicapped condition by the name of _____.
4. Dried seeds of _____ are used for adulteration in black pepper.
5. _____ and _____ are used for adulteration in honey.

Subjective Questions

1. How will you identify adulteration of metanil yellow in dal?
2. How will you identify adulteration in turmeric powder?
3. How will you identify pure asofoetida?
4. How will you identify adulteration in chilly powder?

5. What are the side effects of food adulteration?
6. What is Food Adulteration?

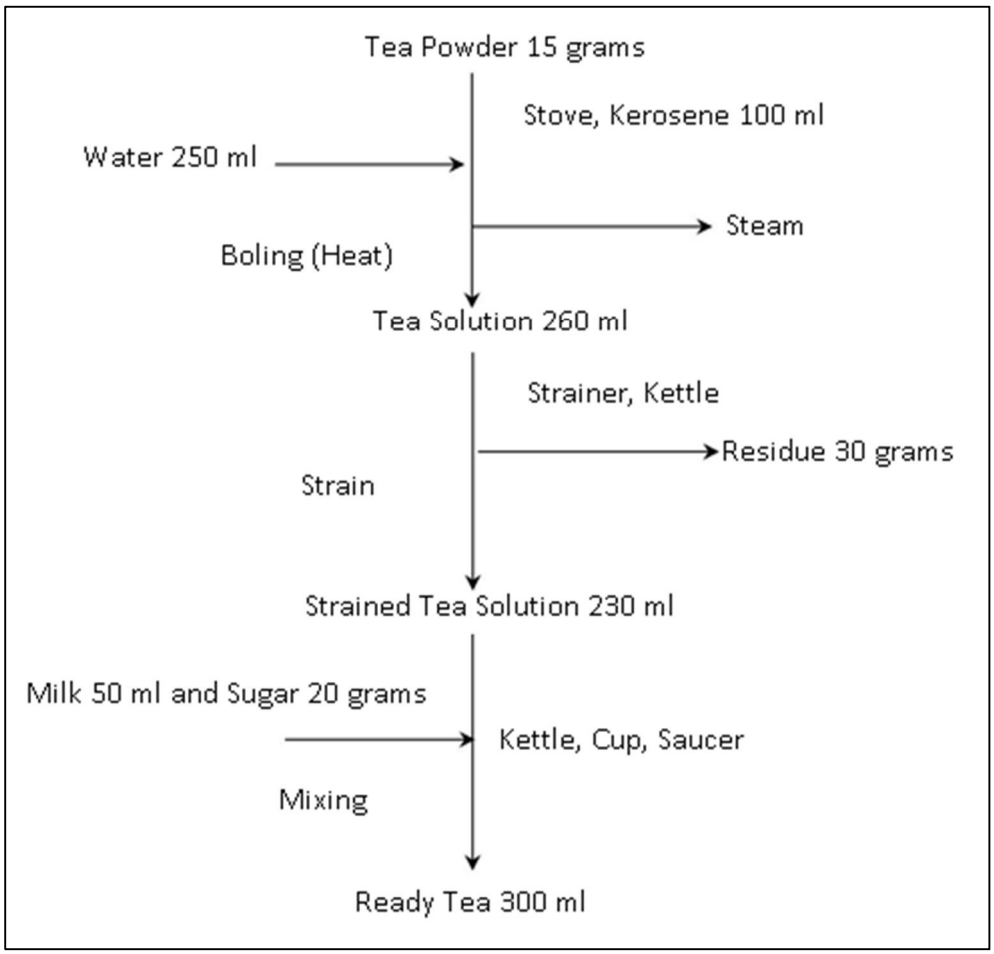
What Have You Learnt?

On completion of this session, are you able to:

- Select healthy seeds for sowing; demonstrate the knowledge of basic seeds treatment.
- To avoid infestation of soil borne and seed borne diseases and pests as well as to increase germination power of the seeds and for vigorous growth of the saplings, before sowing, the seeds are treated with biological or chemical insecticides and cultures from time to time, this is called as seed treatment.

SESSION 8 : FLOW CHART

Flow Chart is the method of showing the entire process using a flow diagram. Meaning giving process information through diagram. This method is easy to understand. Lot of information can be given in short and can be easily understood.



Example – Preparing Tea (For 5 people, 300 ml per person)

Flow Chart Drawing Technique -

1) Previous part of the process is written at the base of the arrow. The end product or result is written at the tip of the arrow. Used item or ingredient is written on one side of the arrow and process is written on the other side.
2) The process of the main material is written in one line. Added material is merged into it using an arrow. Removed material is also shown by an arrow. But the tip of the arrow is pointing outwards. Other information is written as required.

Advantages of Flow Chart are as follows –

1) The process can be explained properly in short
2) As it is written systematically, no part is left out
3) Proper planning of the material is done and wastage is avoided
4) We get proper estimate for time taken by each process. Planning can be done accordingly

5) While drawing cost, expenses can be drawn up quickly
6) It becomes easy to remember the process
7) Information is brief and correct

Drawbacks –
Experiment in which the material is not processed but only instruments are used and procedure is done, it becomes difficult to draw a flowchart for such a process. Only a diagram can be drawn for such a process, writing the procedure serially.

CHECK YOUR PROGRESS

Fill in the Blanks

1. Diagrammatic representation of sequence of performed actions is called as _____ (flow chart)
2. Drawing flow charts is difficult in that practical where goods are not _____ (processed)

Subjective Questions

1. Describe the flow charts
2. Make a sample flow chart as described in the session

What Have You Learnt?
On completion of this session, are you able to: • Demonstrate and create flow chart as per the need.

FURTHER READING

Regarding Unit 1-Printed Reference Material –

- **'Vigyan Ashram' (Pabal Village) – Handbook of 'Introduction to Basic Technology (IBT)'**
- **Educational Handbook of 'Introduction to Basic Technology (IBT)' by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Textbooks published by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Dog care – Dr. Anilkumar Kulkarni**
- **Fulbag – A. B. Patil**
- **Hybrid Cow Management - Arun Deshmukh**
- **Booklet published by 'National Institute of Open Schooling (NIOS)'**
- **Books published by 'National Council of Educational Research and Training (NCERT)'**
- **Reference books used for competitive exams.**

Regarding Unit 1- Reference Material Available on Internet –

- **Official Website of Maharashtra Government (https://www.maharashtra.gov.in)**
- **Google Search Engine**

Regarding Unit 2-Printed Reference Material –

- **'Vigyan Ashram' (Pabal Village) – Handbook of 'Introduction to Basic Technology (IBT)'**
- **Educational Handbook of 'Introduction to Basic Technology (IBT)' by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Textbooks published by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Booklet published by 'National Institute of Open Schooling (NIOS)'**
- **Books published by 'National Council of Educational Research and Training (NCERT)'**
- **Reference books used for competitive exams.**

Regarding Unit 2-Reference Material Available on Internet –

- **Official Website of Maharashtra Government (https://www.maharashtra.gov.in)**
- **Google Search Engine**

Regarding Unit 3-Printed Reference Material –

- **'Vigyan Ashram' (Pabal Village) – Handbook of 'Introduction to Basic Technology (IBT)'**
- **Educational Handbook of 'Introduction to Basic Technology (IBT)' by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Textbooks published by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Booklet published by 'National Institute of Open Schooling (NIOS)'**
- **Books published by 'National Council of Educational Research and Training (NCERT)'**
- **Books published by 'Swiss Federal Institute of Vocational Education and Training'**
- **Reference books used for competitive exams.**

Regarding Unit 3-Reference Material Available on Internet –

- **Official Website of Maharashtra Government (https://www.maharashtra.gov.in)**
- **Google Search Engine**

Regarding Unit 4-Printed Reference Material –

- **'Vigyan Ashram' (Pabal Village) – Handbook of 'Introduction to Basic Technology (IBT)'**
- **Educational Handbook of 'Introduction to Basic Technology (IBT)' by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Textbooks published by 'Maharashtra State Board of Secondary and Higher Secondary Education'**
- **Booklet published by 'National Institute of Open Schooling (NIOS)'**
- **Books published by 'National Council of Educational Research and Training (NCERT)'**
- **Reference books used for competitive exams.**

Regarding Unit 4-Reference Material Available on Internet –

- **Official Website of Maharashtra Government (https://www.maharashtra.gov.in)**

References for photos

WORKSHOP & ENGINEERING TECHNIQUE		
Fig.No	**Tools Name**	**Image Reference**
1	Screw Driver	Original Photo
2	Hammers	Original Photo
3	Types of chisels	https://goo.gl/images/A1DmJw
4	Types of files	https://goo.gl/images/FuDkoZ
5	Hacksaw	Original Photo
6	Spanners	Original Photo
7	Combination Plier:	https://pixabay.com/photo-2953915/
8	Long Nose Plier:	https://goo.gl/images/aiNvRr
9	Flat Nose Plier	https://goo.gl/images/NBTMKp
10	Side-Cutting Plier	https://goo.gl/images/kDcCmU
11	Poker	https://goo.gl/images/ddUitq
12	Try Square	https://goo.gl/images/APo9tF
13	Measuring Scale	https://goo.gl/images/b6ufBD
14	Measuring Tape	https://goo.gl/images/UJ1me7
15	Kitchen Balance	https://goo.gl/images/q66kZ1
16	Thermometer	https://goo.gl/images/C776c8
17	Vernier Caliper	https://goo.gl/images/6bCQee
18	Steel Ruler	https://goo.gl/images/C8Qhih
19	Divider	https://goo.gl/images/wZw3uq
20	Scriber	https://goo.gl/images/7gQHME
21	Punch	https://goo.gl/images/Y1ijKt
22	Bench Vice	https://goo.gl/images/gwM7FA
23	C-Clamp	https://goo.gl/images/LxFPX7
24	Wooden Plane	https://goo.gl/images/Rnw2HA
25	Iron Plane	https://goo.gl/images/vvLTTk
26	Firmer Chisel	https://goo.gl/images/sjkAu1
27	Mortise Chisel	https://goo.gl/images/xGmLoC
28	Paring Chisel	https://goo.gl/images/34vREt
29	Gouge Chisel	https://goo.gl/images/KiEncu
30	Hand Drill	https://goo.gl/images/5xJFNW
31	Gimlet	https://goo.gl/images/Q7qkDY
32	Hand Saw	https://goo.gl/images/1iGbej
33	Tenon Saw	https://goo.gl/images/pvwDgf
34	Butt Hinge	https://goo.gl/images/1USfDJ
35	Rising Butt Hinges	https://goo.gl/images/G3Fszo
36	T-Hinge	https://goo.gl/images/2LuKnx
37	Strap Hinge	https://goo.gl/images/XVFwcY
38	Parliament Hinge	https://goo.gl/images/oo2uR6
39	Piano Hinge	https://goo.gl/images/ASeBvi
40	Types of carpentry Joints	https://goo.gl/images/y9NdFt
41	Metal Joint	Original Photo

42	Sheet metal job drawing	Original Photo
43	Drilling Machine	https://goo.gl/images/Hf6WYo
44	Bench drilling machine	Original Photo
45	Drilling Bits	https://goo.gl/images/d76wJU
46	Tapping machine set	Original Photo
47	Welding joints	https://goo.gl/images/T9fTtM
48	Stretcher Bond	https://goo.gl/images/JsXM2G
49	Header Bond	https://goo.gl/images/3R8DwZ
50	English Bond & Flemish Bond	https://goo.gl/images/gdizCR
51	Helmet for construction use	https://goo.gl/images/uFCpGK
52	Measurement of bricks	Original Photo

ENERGY & ENVIRONMENT		
Figure. No.	**Tools Name**	**Image Reference**
1	Combination Plier	https://pixabay.com/photo-2953915/
2	Screw Driver	https://pixabay.com/photo-33634/
3	Round Nose Plier	Original Photo
4	Poker	Original Photo
5	Side Cutting Plier	https://goo.gl/images/4iS1bJ
6	Neon Tester	https://goo.gl/images/QXR2xT
7	Ball Pin Hammer	https://goo.gl/images/EkobC1
8	Test Lamp	Original Photo
9	Mallet Hammer	https://pixabay.com/photo-117187/
10	Hand Saw	https://pixabay.com/photo-159622/
11	Hand Drill Machine	https://pixabay.com/photo-788911/
12	Electric Drill Machine	https://pixabay.com/photo-152897/
13	Liogier Cabinet Tool/Marfa	Original Photo
14	Ratchet Brace	Original Photo
15	Electrician Knife	Original Photo
16	Tenon Saw	https://pixabay.com/photo-1294191/
17	Firmer Chisel	https://goo.gl/images/XWhPa4
18	Hacksaw	https://pixabay.com/photo-148446/
19	File	https://pixabay.com/photo-41372/
20	Gimlet	https://pixabay.com/photo-29389/
21	Tasselli Plug Tool	https://pixabay.com/photo-950187/
22	Measuring Tape	https://pixabay.com/photo-311800/
23	Wire Stripper	https://pixabay.com/photo-1031979/
24	Wire Gauge	https://goo.gl/images/8zxEae
25	ACSR Conductor	Original Photo
26	Copper Wire	https://goo.gl/images/K1RJ89
27	PVC Wire	https://goo.gl/images/PzXyiL
28	Flexible Wire	https://goo.gl/images/nAWXhU
29	Single Strand Conductor	Original Photo

30	Cable	https://goo.gl/images/tyzfis
31	Armed Cable	https://goo.gl/images/exBD9M
32	Wire Gauge	https://goo.gl/images/dQMbg3
33	Single Pole Switch	Original Photo
34	Two Way Switch	Original Photo
35	Double Pole Switch	Original Photo
36	Bell Push	Original Photo
37	Bed Switch	Original Photo
38	Table Lamp Switch	Original Photo
39	Simple Joint	Original Photo
40	Britannia Joint	Original Photo
41	T-Joint	https://goo.gl/images/JdDkDC
42	Electric Circuit Diagram - One Switch One Light	Original Photo
43	Circuit Diagram - Series Method	Original Photo
44	Circuit Diagram - Parallel Method	Original Photo
45	Staircase Wiring	Original Photo
46	Go down wiring	Original Photo
47	Earthing	https://goo.gl/images/GXKpf1
48	Fuse Unit	Original Photo
49	MCB	https://goo.gl/images/VErXcc
50	Soldering iron	https://goo.gl/images/abQgDo
51	Soldering Circuit Diagram	Original Photo
52	Dry Cell Battery	Original Photo
53	Liquid Cell Battery	Original Photo
54	Hydrometer	https://goo.gl/images/kSi21Q
55	Wick Stove	https://goo.gl/images/ESVhsE
56	LPG Burner gas stove	Original Photo
57	Smokeless Stove Design	https://goo.gl/images/cgGXbw
58	LED Light	https://goo.gl/images/XnGjXr
59	LED Lights in Ceiling	https://goo.gl/images/3XfP7y
60	Incandescent Light	https://goo.gl/images/yYqYUt
61	Halogen light	https://goo.gl/images/DpqQze
62	CFL – Compact Fluorescent Lamps –	https://goo.gl/images/Qcbn7p
63	HID - High Intensity Discharge	https://goo.gl/images/bF4kse
64	Solar Panel	https://goo.gl/images/2cnbnL
65	Types of Natural Light - old Fire lamp	https://goo.gl/images/FEkUM3
66	Lightning	https://goo.gl/images/nMHvbo
67	Soak Pit	Original Photo

GARDENING, NURSERY & AGRICULTURE TECHNIQUE		
Figure. No.	**Tools Name**	**Image Reference**
1	Sickle	https://pixabay.com/photo-2027862/
2	Scythe	https://goo.gl/images/5iL2yN
3	Axe	https://goo.gl/images/nSdWbT
4	Spade	https://www.gardentoolcompany.com/products/5-tine-hand-eye-hoe-by-shw
5	Pickaxe	https://goo.gl/images/Y3qbY1
6	Ghamela	Original photo
7	Hoe	Original photo
8	Cow Bar	Original photo
9	Watering can	Original photo
10	Harrow	Original photo
11	Rake	Original photo
12	Baliram plough	Original photo
13	Iron Plough	Original photo
14	Seed Sowing Plough	https://goo.gl/images/KrvTeq
15	Hand Hoe	Original photo
16	Tiller	https://goo.gl/images/kjqrEL
17	Land Leveling Tool	https://goo.gl/images/yBeSwx
18	Reidger	https://goo.gl/images/4FHnVc
19	Rotavator	https://goo.gl/images/TRQAP3
20	Seed Sowing Plough with two seed bowls	Original photo
21	Bullock Cart	https://goo.gl/images/R2VdCZ
22	Tractor & Trolley	https://goo.gl/images/6dbb9A
23	Motor Pump	https://goo.gl/images/3M9Lqv
24	Thresher	https://goo.gl/images/qbN9Vs
25	Spray Pump	https://goo.gl/images/2eqTHW
26	Drip Irrigation Set	https://goo.gl/images/hDuJM2
27	Sprinkler Set	https://goo.gl/images/y3tUzx
28	Harvester	https://goo.gl/images/tw7weG
29	Mulching Paper	https://goo.gl/images/z61EV5
30	Ploughing and Harrowing	https://goo.gl/images/iuMWbU
31	Medicines Spraying	https://goo.gl/images/osePhi
32	Seed Treatment	original photo
33	Vermi compost	original photo
34	Vermi compost bed	original photo
35	Animal Teeth	original photo
36	Animal Horn	original photo
37	Determining weight of animals	original photo
38	Azolla	https://goo.gl/images/SjVxKj
39	Dry Fodder	https://goo.gl/images/z9XKZr
40	Breeds of Dog	Original photo
41	Flowering Plants	https://pixabay.com/photo-57476/

42	Hanging Baskets	https://goo.gl/images/UuhpZG
43	Hanging Pots	https://pixabay.com/photo-376753/
44	Terrace Garden	https://commons.wikimedia.org/wiki/File:Terrace_Gardening,_decorated_with_clay_flower_pots.JPG

FOOD PROCESSING TECHNIQUE		
Fig No.	**Tools Name**	**Image Reference**
1	Vegetable cutting board	original photo
2	Electric oven	original photo
3	Deep fry pan	original photo
4	Shallow fry pan	https://goo.gl/images/D5HeoK
5	Measuring glass	https://goo.gl/images/R4u5SQ
6	Measuring Spoon	https://goo.gl/images/H7sTVb
7	Kitchen Balance	https://goo.gl/images/VdjCKN
8	Grater	https://pixabay.com/photo-1238759/
9	Bajra	https://goo.gl/images/iW3tbA
10	Jowar	https://pixabay.com/photo-275258/
11	**Rice**	https://pixabay.com/photo-498688/
12	Pulses and Dals	https://goo.gl/images/qVUTDS
13	Sprouts	https://pixabay.com/photo-1725589/
14	Spices	https://goo.gl/images/W7uqQQ
15	Grilling	https://pixabay.com/photo-2491123/
16	Boiling	https://goo.gl//MYxfhX
17	Stewing	https://goo.gl/images/35Cvga
18	Double boiler	https://goo.gl/images/Qio6Br
18	modakpatra	original photo
19	pressure cooker	original photo
20	Frying	original photo
22	Microwave oven	original photo
23	solar cooker	original photo
24	Inframatic cooking	original photo