ESSCI
Skilling India in Electronics

Participant Handbook

Sector
Electronics

Sub - Sector
Electronics Manufacturing System

Occupation
Assembly & Soldering

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NSQF Level 4

EMS Technician

Price: ₹

> **"** Skilling is building a better India.
> If we have to move India towards
> development then Skill Development
> should be our mission. **"**

Shri Narendra Modi
Prime Minister of India

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SKILLING CONTENT : PARTICIPANT HANDBOOK

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About this Book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- Identify the role and responsibilities of an EMS technician
- Identify the components in PCB loading list
- List the maintenance tasks
- Select the soldering components as per specifications
- Identify the correct stencil
- Use Correct Screen and Design
- Work with the PCB as per Standards
- Inspect the PCBs using microscope
- Perform cleaning of stencil and other components
- Identify the importance of altering sheets in roller
- List the do's and don'ts for applying paste
- Demonstrate attaching stencils and securing of boards
- Check printing settings and parameters
- List the tasks to be accomplished for preventive maintenance
- Identify the maintenance schedule
- List the advantages and disadvantages to SMD
- List the ESD
- Execute visual inspection of PCB manufacturing
- Define work requirements
- Identify work behaviour
- Explain communication skills
- Identify the steps to effective listening
- List the components of PPE
- Explain electrostatic discharge (ESD)

The symbols used in this book are described below.

Symbols Used

Key Learning Outcomes	Steps	Role Play	Tips	Notes	Unit Objectives

Activity	Practical

Table of Contents

1. Introduction

Unit 1.1 – Introduction to EMS technician

Key Learning Outcomes

At the end of this module, you will be able

1. Identify the role and responsibilities of an EMS technician
2. Identify the qualifications required to be an EMS technician

UNIT 1.1: Introduction to EMS technician

Unit Objectives ◎

At the end of this unit, you will be able to:

1. Identify the role and responsibilities of an EMS technician
2. Identify the qualifications required to be an EMS technician

1.1.1 Who is an EMS Technician

Electronics manufacturing services, known as EMS, is a term used for companies that are responsible for designing, manufacturing, testing, distributing and providing return or repair services for electronic components and assemblies on behalf of the original equipment manufacturers (OEMs). This concept is also known as electronics contract manufacturing or ECM.

An EMS technician works on Surface Mount Technology (SMT) machines, circuit boards and soldering equipment. S/he is responsible for the troubleshooting and maintenance of SMT equipment. S/he also helps in the assembly of the SMT equipment and its programming.

The following image shows an EMS technician working with a printed circuit board (PCB):

Fig. 1.1.1: An EMS technician working with a printed circuit board (PCB)

1.1.2 Role and Responsibilities of EMS Technician

An EMS technician monitors and maintains equipment that are used to create electronic circuits with SMT. In SMT, electronic components are mounted directly on circuit boards, which are then used in different industries. They also adjust equipment to achieve production schedules and quality control.

The following figure lists the responsibilities of an EMS technician:

Understand work requirements and be regular in reporting to superior.

Apply solder paste, operate soldering machine and pick and place machine.

Understand and follow safety procedures and report potential hazards.

Follow standard operating procedures, work policies and maintain work place ethics.

Work in a team and ensure smooth workflow, quality and productivity.

Fig. 1.1.2: Responsibilities of an EMS Technician

1.1.3 Pre-requisites for an EMS Technician

The job of an EMS technician involves working in a process driven environment. A good EMS technician must have the following qualities:

- Good eyesight
- Visual accuracy
- Attention to details
- Ability to work for long duration, mostly in a standing position

The EMS technician requires to possess some skills which are essential for his/her job. The following figure lists the skills required for EMS technician:

- •Understanding of electronics and PCB
- •Mechanical assembly skills and soldering ability
- •Working knowledge of equipment used in SMT Operation
- •Communication and team building skills
- •Basic knowledge of computer and how to operate it

Fig. 1.1.3: Skills required for EMS technician

The technician must be qualified enough to be fit for the job role. The minimum qualification required is 12th standard, with science background or a degree of ITI/Diploma. Minimum age required for this role is 18 years. The individual should have adequate decision-making ability to take care of some problems such as:

- Repetitive defects
- Machine failure
- Potential hazards
- Process disruptions
- Repair and maintenance of machine

Activity

1. Write three responsibilities of an EMS technician apart from his job role.

    a. _____

    b. _____

    c. _____

2. List essential skills required for an EMS Technician.

    a. _____

    b. _____

    c. _____

    d. _____

    e. _____

2. Operate Reflow Oven Soldering Machine

ELE/N5304

Key Learning Outcomes

At the end of this module, you will be able to:

1. Identify the components in PCB loading list
2. Explain the steps of PCB assembly process
3. Explain how to load program for the assembly process
4. Demonstrate the operation of reflow oven machine
5. Manage operating temperature, time profile and reflow settings
6. Inspect assembled boards before loading and the soldered boards after soldering process
7. List the causes of ESD and its effects on electronics
8. Apply correct measures for ESD protection
9. Explain contamination prevention practices
10. Manage the records for reflow operations

UNIT 2.1: Basics of PCB and Loading List

Unit Objectives ⊚

At the end of this unit, you will be able to:

1. Explain PCB and its types
2. Identify the components in PCB loading list

2.1.1 PCB

The first task for an EMS technician in his/her daily schedule is to check the PCB loading list. Hence, knowledge about PCB and its components is a must for the technician.

A PCB is the board found inside common electronic gadgets. It is used to support the electronic components mechanically and connect them electrically together by copper traces. All electronic devices such as mobile phone, radio, computer, key board, car dash board, video player, video games, calculator use PCBs. Connections between the components are created via copper connections called routes which become passage for electrical signals.

Generally, there are three types of PCBs: single-sided, double-sided and multi-layered. In the single-sided boards, the components are mounted on one side. The following image shows single-sided PCB:

Fig. 2.1.1: Single-sided PCB

When, for a single-sided board, the number of components becomes too much or the circuits become complicated to be placed on a single sided board, double-sided boards are used.

The following image shows double-sided PCB:

Fig. 2.1.2: Double-sided PCB

A multi-layered board consists layers of printed circuits that are separated by layers of insulation. The following images show a multi-layer PCB and its structure:

Fig. 2.1.3: Multi-layer PCB and its structure

The following images show some other types of PCBs:

Single Side Flexible PCB

Rigid Flexible PCB

Metal Core PCB

Multi Layer PCB in Panel Form

Fig. 2.1.4: Different types of PCBs

2.1.2 PCB Loading List

The PCB loading list contains all the components that are required to be loaded on the PCB. Hence, it is essential to check the components and map them with the list. The technician must have knowledge about the electronic components so that they are loaded according to the requirement.

All the components including transistors, LEDs, ICs or any other electronic components should be mentioned in the loading list.

The electronic components are secured on the board by drilling holes in respective positions on board, placing the components through holes and then soldering them appropriately so that the components and the copper tracks together form a circuit. The following image shows a PCB loaded with electronic components:

Fig. 2.1.5: Electronic components loaded on PCBs

Classification of Electronic Components

All electronic equipment are made using electronic components. Electronic components have two or more electrical terminals. These leads are then soldered to a PCB. An electronic component may be classified into active, passive or electro-mechanic. The following image shows different electronic components:

Fig. 2.1.6: Electronic components

Active Components

Active components are those which are capable of amplifying a signal or processing electrical signals. They derive power from a DC source. These include components such as transistors, diodes and so on.

Diode

A diode is a two-lead semiconductor acting as a one-way gate for the electron flow. A diode allows the current to pass only in one direction. The following image shows diode and its symbol:

Fig. 2.1.7: Diode and its symbol

Light Emitting Diode (LED)

LEDs are used to give a visual feedback from our circuit; for example, to show that the circuit has power. These components are found everywhere, in laptop, on mobile phone, on camera, in car. Now a days, LEDs are also used for general lighting. The following images show LED and its symbol:

Fig. 2.1.8: LED and its symbol

Transistors

A simple way to understand a transistor is to look at it as a switch that is controlled by an electrical signal. But, instead of just two states, i.e. on or off, it can also have a state of being "a bit on" by controlling the current that goes through its base.

Fig. 2.1.9: Transistor and its symbol

A transistor is a three-lead semiconductor device which behaves as an electrically controlled switch, or a current amplifier. A small voltage or current applied at the control lead of a transistor, controls a larger current flowing through the other two leads. The following figure lists three types of transistors:

Bipolar Junction Transistor (BJT)	Junction Field Effect Transistor (JFET)	Metal Oxide Semiconductor FET (MOSFET)
BJT	JFET	MOSFET
•It is used in LED driver to control the current. •The types of BJTs are: •NPN •PNP	•It is used in LED Driver to control the voltage. •The types of JFETs are: •N-channel •P-channel	•It is also used for voltage control in LED driver. •Depletion type (n- and p-channel) •Enhancement type (n- and p-channel)

Fig. 2.1.10: Types of transistors

Integrated Circuit

An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on a single small chip of semiconductor material, normally silicon. ICs can be very compact, comprising up to several billion transistors and other electronic components in a small area. With advancement of technology, the width of each conducting line in a circuit is being made smaller and smaller. In 2008, the width dropped below 100 nanometers, and now it is tens of nanometers. The following image shows ICs:

Fig. 2.1.11: ICs

The main advantage of ICs over discrete circuits is cost and performance.

- Cost is low as the chips are not made one transistor at a time, rather they are printed with all components as single units by photolithography. Moreover, packaged ICs use less materials as compared to discrete circuits.

- Performance is high as the components of the ICs switch quickly and consume less power than their discrete counterparts. This happens because of the close proximity and the small size of the components.

ICs are used in all electronic equipment such as c, mobile phones and other digital home appliances. This is made possible because of the low cost of integrated circuits.

An IC comprises of a number of basic electronic components. Essentially, an IC is an electronic circuit, fitted inside a chip. It may be an amplifier, a microprocessor, a USB to serial converter or anything.

Passive Components

Passive components are those which are not capable of amplifying electrical signal, although they may amplify the voltage or current like a resonant circuit or a transformer. Passive components include components with two-terminals, such as capacitors, resistors, inductors and transformers.

Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors reduce the flow of current and lower the voltage level within the circuit. In electronic circuits, resistors are used for limiting current flow and adjusting signal levels. The following image shows a resistor and its symbol:

Fig. 2.1.12: A resistor and its symbol

High-power resistors with ability to dissipate many watts of electrical power as heat, are used as test loads for generators or as part of motor controls, in the power distribution systems. Resistance in the resistors with fixed resistances, may change slightly with time, temperature or operating voltage. Variable resistors can be used for adjusting the circuit elements; for example, as a lamp dimmer or a volume control, or as sensing devices for light, humidity, heat, force or chemical activity.

Resistance is measured in Ohms (Ω):

<div align="center">

1000Ω = 1kΩ   1,000,000Ω = 1MΩ

</div>

Resistors are also rated by its power carrying capacity such as 1/4W, 0.5W, 1W, 5W etc.

Resistance Colour Coding Table

The following diagrams show colour coding table for the resistor colour codes:

Fig. 2.1.13: Resistor colour code

Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store electrostatic energy in an electric field. All capacitors contain at least two electrical conductors (plate) separated by a dielectric (insulator). The conductors can be sintered beads of metal, thin films, foils or conductive electrolyte. The "non

conducting" dielectric is used to increase the charge capacity of the capacitor. A dielectric can be glass, air, ceramic, vacuums, paper, plastic film, mica, oxide layer etc. Capacitors are used in electrical circuits of common electrical devices. A capacitor stores energy, rather than dissipating energy, in the form of an electrostatic field between the plates. The following image shows a set of different capacitors:

Fig. 2.1.14: Resistor colour code

It's commonly used to remove noise or make the circuit's supply voltage more stable. Capacitance is the ability of a capacitor to store electrical charge onto its two plates. Capacitance is measured in Farad (abbreviated to F).

Microfarad (µF) $1µF = 1/1,000,000 = 10^{-6}$ F

Nanofarad (nF) $1nF = 1/1,000,000,000 = 10^{-9}$ F

Picofarad (pF) $1pF = 1/1,000,000,000,000 = 10^{-12}$ F

The following figure lists two types of capacitors:

- Polarized
  - Examples of polarized capacitors are electrolytic capacitors.

- Non-Polarized
  - Examples of non-polarized capacitors are film capacitor, ceramic capacitor, paper capacitor etc.

Fig. 2.1.15: Types of capacitors

Inductors

An inductor, also called a coil or reactor, is a passive two-terminal electrical component which resists changes in electric current flowing through it. It comprises of a conductor such as a wire wound into a coil. When a current passes through it, energy is stored temporarily in a magnetic field in the coil.

The following image shows inductors:

Fig. 2.1.16: Inductors

Inductance is the ratio of the voltage to the rate of change of current passing through the inductor. It is measured in henries (H). The value of inductors typically ranges from 1 μH (10^{-6}H) to 1 H.

Many inductors have a magnetic core made of ferrite or iron inside the coil, that serves to raise the magnetic field and thus the inductance. The following figure shows three types of inductors:

•Air Core Inductor	•Ferromagnetic Core Inductor	•Variable Inductor

Fig. 2.1.17: Type of inductors

Inductors are widely used in alternating current (AC) electronic equipment, especially in radio equipment. They allow the DC to pass by blocking the AC current flow. Inductors, designed for this purpose, are called chokes. They are also used in electronic filters for the separation of signals of different frequencies. They are used to make tuned circuits along with capacitors.

Electromechanical Switches

These devices use electrical connections or moving parts to perform electrical operations. The devices that use moving parts for carrying out electrical operations, are known as electromechanical. A manually operated switch is an example of electromechanical component. The term, electromechanical, refers to devices such as relays, that enable a voltage or current to control other isolated voltages and currents by switching sets of contacts, solenoids, mechanically. Thus, it enables a voltage, actuate a moving linkage, vibrators, that convert DC in to AC with the help of vibrating sets of contacts.

The following image shows an electromechanical relay:

Fig. 2.1.18: Electromechanical relay

Activity

1. Write the measuring units of the following components.
   a. Resistor: _____
   b. Capacitor: _____
   c. Inductor: _____

2. List different types of PCBs.
   a. _____
   b. _____
   c. _____

3. Calculate the value of a 4-band resistor. The bands are as follow:
   - 1st band → Violet
   - 2nd band → Orange
   - 3rd band → Yellow
   - 4th band → Silver

UNIT 2.2: Loading Program for PCB Assembly

Unit Objectives

At the end of this unit, you will be able to:

- Define PCB assembly
- Explain the steps of PCB assembly process
- Explain how to load program for the assembly process

2.2.1 PCB Assembly (PCBA)

PCBA, refers to the steps for assembling the electronic components onto a PCB. A PCB is a bare circuit board containing electronic components. Once the components are mounted and soldered on it, the board is known as Printed Circuit Board Assembly (PCBA) or Printed Circuit Assembly (PCA).

The assembly of a circuit board involves designing a PCB and creating its prototype. The type of assembly depends on the purpose, type of the circuit board and the electronic components that are required to be integrated on the circuit board.

2.2.2 PCBA Process

The following figure shows the overall steps of the PCB assembly process:

Solder Paste Stenciling	→	Pick and Place	→	Reflow Soldering
Inspection and Quality Control	→	Through-Hole Component Insertion	→	Final Inspection and Functional Test

Fig. 2.2.1: Steps of PCBA

Solder Paste Stencilling

The first step of PCB assembly is to apply solder paste on to the board. In this process, a thin stencil is placed over the PCB. The solder paste is applied only to those parts of the board where the components are to be placed.

The following figure shows the composition of a solder:

Fig. 2.2.2: Composition of solder

In a professional PCB assembly line, a mechanical fixture holds the PCB and solder stencil in place. An applicator places specific amounts of solder paste on the intended areas. The paste is spread by the machine across the stencil, and is applied it evenly to the open area. After the stencil is removed, the solder paste remains in the intended locations.

Pick and Place

The PCBA process moves on to pick and place machine after solder paste is applied to the board. It is a robotic device that sets the surface mount devices (SMDs) on the PCB. The following image shows a pick and place machine:

Fig. 2.2.3: Pick and place machine

Reflow Soldering

When the solder paste and the SMDs are in place, the solder paste requires to solidify, to adhere the components to the board. After the pick and place process, the PCB board is transferred to conveyor belt. This conveyor belt moves through a large reflow oven which contains a series of heaters.

Once the solder melts, the PCB continues to move through a series of cooler heaters, which allow the melted solder to cool and solidify in a controlled manner. As a result of this process, a permanent solder joint is created that connects the components to the board.

Inspection and Quality Control

After the surface mount components are soldered in place, the assembled board is tested for functionality.

Through-Hole Component Insertion

In addition to the SMDs, the board may also include a variety of other components such as plated through-hole or PTH components.

A plated through-hole is a hole in the PCB which is plated all the way through the board. These holes are used by the PCB components for passing a signal through the board. In such cases, the soldering paste is not effective as the paste will not adhere and will run straight in to the hole.

Final Inspection

A final inspection tests the functioning of a PCB by simulating the normal circumstances in which the PCB will operate. Power and simulated signals are run through the PCB and its electrical characteristics are monitored with the help of testers.

2.2.3 Types of PCBA Processes

There are two types of PCB assembly processes:
- Thru-Hole Technology (THT) Assembly Process
- Surface Mount Technology (SMT) Assembly Process

The circuits and components can be mounted on a double-layer PCB board using one of the following ways:

•Thru-hole Mounting

Electronic components having leads at the ends are inserted through the tiny holes in the board for soldering.

•Surface Mounting

•This mounting method is used in the case of components which are very small in size. For example, this method can be used to mount components which are the size of a pencil point onto a PCB.

Fig. 2.2.4: Mounting techniques

The following figure shows the steps of THT assembly process:

| Components Placement | Inspection & Rectification | Wave Soldering |

Fig. 2.2.5: THT assembly process

The following figure shows the steps of SMT assembly process:

| Solder Paste Printing | Components Mounting | Reflow Soldering |

Fig. 2.2.6: SMT assembly process

2.2.4 Loading Program for PCB Assembly

PCB manufacturing is done from fabrication of data generated by the software, Computer Aided Design (CAD), and component information.

CAD is used to create, modify, analyse and optimize a design using the computer. The fabrication data is read into another software Computer Aided Manufacturing (CAM). The functions performed by CAM are listed as follows:

- Input of the fabrication data

- Verification of data

- Compensation for the deviations in manufacturing processes; for example, scaling is used to compensate for the distortions occurred during the lamination process

- Penalization

- Output of the digital tools such as drill files, copper patterns, inspection and others

To assemble a specific type of PCB, right text files such as loading list, containing the component's name, location and rotation angle are needed. The technician needs to load the right program file in the machine, so that the right components are placed on right position on the PCB. The following figure lists the steps for program loading:

Collect the right text files containing information about the name and position of the components.

Choose the component data files and the output directory.

Enter the column number in the text file along with the X coordinate, Y coordinate and the designator label of the corresponding component.

Fig. 2.2.7: Steps for program loading

The technician should keep in mind that:

- The component coordinates should be read properly.
- If there is a deviation even in millimetres, the scale factor in XY scaling field should be used.

Activity

1. Write the steps of PCBA.

2. List the differences between THT and SMT assembly process.

_____

_____

_____

UNIT 2.3: Reflow Oven Soldering Machine Operation

Unit Objectives 🎯

At the end of this unit, you will be able to:

• Explain the reflow soldering process
• Demonstrate the operation of reflow oven machine
• List different operating temperature and time profile
• Identify the importance of changing of reflow settings
• Inspect assembled boards before loading
• Identify how to adjust conveyor belt in reflow oven
• Perform loading of boards and starting the oven
• Monitor soldering process
• Inspect of soldered boards

2.3.1 Reflow Soldering Process

Reflow soldering process involves surface mounted components, whose lead sits on pads on the board. A solder paste is applied to the pads which, when headed, combines with the reflowed solder on the pads on the board to form a joint. The reflow "oven" therefore, is a convection oven with tightly controlled temperature parameters which will heat the board, "spike" the temperature to the point of reflowing the solder, then cool the board. The following image shows a PCB in a reflow soldering oven:

Fig. 2.3.1: A PCB in a reflow soldering oven

Reflow Soldering Reliability

More recently designed products utilizing the low profile, high lead count, fine pitch SM components, when combined with Chip Scale Packages (CSP) present additional challenges to the techniques and technologies of high reliability component interconnection.

The significant obstacles of highly reliable interconnections between fine pitch SM and reduced size CSP component are dependent upon following parameters:

- Quality and repeatability of reflow process
- Technology and package construction
- Uniformity and contents of the solder paste and the interconnection pad plating
- Individual board design, both internally and externally
- Conditions in which the product will be used
- Intended product life

Reliability level demands are higher for products using the new low profile, fine-pitch, high lead count miniature IC packages, such as CSP and reduced size BGA over assemblies built around older, more conventional packages with their longer and more compliant leads.

2.3.2 Reflow Process

The reflow process consists of 4 steps.

- Preheat
- Dry out
- Reflow
- Cooling

Preheat

In the preheat section, the SMT assembly is preheated to temperatures between 100°C and 150°C. To minimize the thermal shock on the assembly components, the rise in temperature is controlled at a rate between 1-4°C/second. Also, solder paste may spatter because of rapid heating.

Dryout

Dryout, also known as preflow zone, is mainly used to ensure that the solder paste is fully dried before reflow temperature is reached. It has a consistent temperature, 150°C to 170°C, for an extensive time period, that is 60 to 120 seconds. For RMA solder pastes, this section acts as a flux activation zone. To ensure uniform heating for the SMT assembly before entering the reflow zone, dryout provides thermal stabilization of components (both large and small).

Reflow

The reflow section heats the solder paste to a temperature greater than its melting point. To ensure quality reflow for the solder joint leads, the reflow temperature must be raised by 20°C (approximately).

The duration for which the solder joint remains above its melting point, is referred to as time over or wetting time. For most pastes, it is between half a minute to one minute. If the wetting time is too high, it would lead to formation of intermetallic layer in the joint and make the joints brittle.

Cooling

The aim of the cooling system is to bring the product below liquidus temperature before it exits the oven. The temperature is reduced gradually from +183°C to < +40°C over a period of 3 minutes. The gradual cooling is important for the printed wiring board (PWB) after reflow process. During this period, the molten solder solidifies and forms a strong solder joint.

2.3.3 Reflow Oven

The reflow oven contains multiple zones for the four steps of the reflow process. These zones can individually be controlled for different temperature. The PCB moves on a conveyor belt through the oven, and is subjected to a controlled time-temperature profile.

Normally, the heat source is the ceramic infrared heaters, from where the heat is transferred to the assemblies via radiation. Infrared convection ovens use fans to force the heated air towards the assemblies. These are generally used along with ceramic infrared heaters.

Some ovens are designed to reflow PCBs in an oxygen-free atmosphere. Nitrogen (N2) is a common gas used for this purpose. This minimizes oxidation of the surfaces that are to be soldered. The following image shows a reflow oven:

Fig. 2.3.2: Reflow oven

Fig. 2.3.3: Internal structure of reflow oven

Operation of Reflow Machine

The technician must have knowledge of how to operate a reflow oven soldering machine. The following figure lists the steps to operate a reflow oven:

- Switch on the reflow machine.

↓

- Set the reflow profile parameter and the number of boards to be reflowed at a time.

↓

- Wait till set profile is achieved.

↓

- Place pilot board for reflow in oven.

↓

- After reflow, have a quick look at the pilot boards for proper soldering.

↓

- Send the board to the visual inspection section.

↓

- Send the pilot lot for quality approval.

↓

- Start production after quality approval.

↓

- If power failure occurs when the board is running in oven, pass the board for quality inspection.

↓

- If any problem is found in the board then reflow the board again.

Fig. 2.3.4: Steps to operate a reflow oven

If it is required that a PCB has components mounted on both sides of the board, the following practices should be applied:

1. Set reflow temperature slightly lower than the other side and wait till set profile is achieved. → 1. Place pilot boards for reflow in oven. → 1. After reflow, have a quick look at the pilot boards for proper soldering and pass the board to the visual inspection table.

1. Wait for mass production until quality approves the pilot lot. → 1. Start production after quality approval.

Fig. 2.3.5: Steps to operate a reflow oven for a double-side PCB

2.3.4 Operating Temperature and Time Profile

Soldering of high quality and low defect, requires identification of the optimum temperature profile for the reflow process. It is critical to apply uniform heat to every solder joint on the board. There must be compatibility of the components and the solder paste with the temperature rise rates for heating and cooling. The duration for the assembly being exposed to a certain temperature must be set and maintained.

As an assembly moves through a soldering system, it is exposed to a controlled rise and fall in temperature.

the reflow profile depends on the correlation between the heating temperature and the duration. A typical reflow profile comprises of three heating slopes. The time and temperature limits within these slopes are different for different solder pastes.

The following figure shows a typical thermal profile:

Fig. 2.3.6: A typical thermal profile

Profile Control Limits

To define profile control limits, solder paste requirements along with specific requirements of components or board material need to be taken care of. The process bandwidth is defined as the total deviation in temperature that may occur and yield reliable results. For determining the profile control limits, thermocouples are attached to a board with components.

Thermocouple (TC) Attachment Process

The following figure lists the steps for attaching a thermocouple to the PCB:

•Measuring the temperature profile   •Determining the TC locations   •Preparing the surface   •Attaching the TC   •Setting up the oven

Fig. 2.3.7: Steps for attaching a thermocouple to the PCB

Measuring the Temperature Profile

To monitor the temperature, during the soldering process, at critical points of the PCB thermocouples (TC) are used. These consist of two wires of different materials, welded together at one end.

The temperature-dependent contact voltage (thermal voltage), built up between the wires, is measured and is assigned to the appropriate temperature value.

Determining the TC Locations

The location of TC is determined by identifying the critical points and attaching the TCs to the proper pads. The TCs should be attached in places such that the temperature readings are received from the hottest and coldest points on the board. The measurements received from these TCs are used to check the consistency of the thermal profile throughout the product, and to measure the thermal profiles of heat sensitive components. The following image shows placement of thermocouple to determine the profile control limits:

Fig. 2.3.8: Placement of thermocouple to determine the profile control limits

Remember that TCs in densely populated areas will take more time to heat up and will hold the heat longer. TCs should also be placed at the edges of the board and in any areas with small or non-existent components that will heat up faster than the rest of the board.

Preparing the Surface

The following figure lists the steps for preparing the surface:

Thoroughly clean your selected TC locations.	→	Remove any residual low temperature solder and other contaminants that might prevent complete high temperature solder wetting.	→	Use alcohol or a suitable solvent to scrub the attachment surface.
Place the solder wick on the surface and press the soldering iron into the wick, heating both the wick and the surface to be cleaned.	→	Use as much wick as necessary to remove all free flowing solder droplets.	→	When solder has been completely removed, re-scrub the attachment surface to remove any remaining contaminants.

Fig. 2.3.9: Steps for preparing the surface

Attaching the TC

The TC bead is placed on the attachment surface and both are then heated evenly. The solder is touched to the heated TC bead. The solder is melted by the heat from the TC bead. This method allows superior wetting and a stronger solder joint to the pad or the lead. The temperature reading is received from the first point of contact between the two wires leading from the TC. To receive accurate readings, separate both wires all the way up to the TC bead after soldering.

Setting Up the Oven

When the thermocouples are attached on the test board, the oven is set up for creating a three-step thermal profile on the board. To create the thermal profile, the following oven parameters are adjusted:

1. Zone set point temperatures
2. Conveyor speed
3. Fan speed
4. Cooling rates (if applicable)

If the test board temperature results are different from the desired profile, profiling needs to be repeated. The oven parameters are adjusted and again compared with the standard results. The following image shows a report profile of thermocouples:

Fig. 2.3.10: A report profile of thermocouples

In the above graph, the curved lines represent the temperature sensed by the thermocouple attached to a product while passing through the oven.

Different Heat Transfer Modes

There are three heating modes: conduction, convection and infrared radiation (IR).

- **Conduction:**

Conduction heat transfer takes place when two solid objects of different temperatures are placed together. The following diagram shows the conduction process:

Conduction

Hot Spot ——> Heat ——> Cold Spot

Heat Flows From Hot to Cold
To Help Equalize Temperatures

Fig. 2.3.11: Conduction heat transfer process

Conduction helps in heating a product uniformly, as the heat travels from a hot spot to a cold spot. If there is difficulty in reflowing a product, use a good solution to reduce the set point temperatures of the oven heater and the conveyor speed. This will lead to heat the product more uniformly by allowing time for the conductive flow.

If the edge of the conveyor in contact with the board is hotter or cooler than the product, conduction hinders the reflow process. It can lead to formation of hot or cool spot along the edge of the product, preventing the formation of uniform solder joints on the PCB's outer fringes.

- **Infrared Radiation (IR)**

IR occurs when two objects with different temperatures are within each other's sight. The earth is heated by the sun through IR mode. Dull and rough surfaces absorb the heat from the sun better than the shiny and smooth surfaces. The following diagram shows the IR process:

Radiation

Sun

Radiant Energy
From The Sun
Heats The Earth

Fig. 2.3.12: Infrared radiation process

Plastic components, fluxes and epoxy glass laminates absorb the IR very well. Shiny, reflowed solder reflects the IR energy away. Solder joints around the small packages, in sight of the IR energy, get heated better that the solder joints around larger devices.

- **Convection**

Convection heat transfer takes place when a fluid passes over an object. This heat transfer requires the flow to be in contact with the solid. Only the layer of the flow which is in contact with the solid actually transfers the heat. Convection may be categorised as natural or forced.

- o Natural convection takes place when there is no flow being forced over the object. The temperature differences between the environment and the object lead to the convective heat transfer.
- o Forced convection requires an external force to push or pull the flow over the object.

2.3.5 Reflow Profile Settings

There are 8 zones in reflow oven machine. Let us take an example of a machine with the following characteristics:

- Model no: OMEGA CL23A, Version S/W-KIC 2000
- Test point (°C): 100°C, 250°C, 350°C
- Melting point: 217°C, 217°C, 221°C
- Preheat time: 60-180second
- Reflow profile for lead free:

Zone1	Zone2	Zone3	Zone4	Zone5	Zone6	Zone7	Zone8
120°c	160°c	185°c	195°c	220°c	240°c	250°c	240°c

- Reflow profile for non-lead free:

Zone1	Zone2	Zone3	Zone4	Zone5	Zone6	Zone7	Zone8
100°c	130°c	155°c	160°c	170°c	190°c	220°c	245°c

The zones are categorised as listed in the following figure:

Zone 1, 2, 3	Preheat zone
Zone 4, 5, 6	Soaking zone
Zone 7	Thermal equalization/stabilization zone
Zone 8	Reflow zone
ZONE 9, 10	Cooling zone

Fig. 2.3.13: Reflow zones

Characteristics of Reflow Oven

The following image shows the characteristics of a reflow oven with the reflow soldering stages:

Fig. 2.3.14: Characteristics of a reflow oven with reflow soldering stages

The stages in the reflow soldering process are as follows:

- **Initial Pre-Heat Stage:** During pre-heat stage, as the volatile ingredients get evaporated, the solder paste starts to dry. The initial pre-heat stage occurs during the first 90 seconds of the reflow profile when the temperature is increased slowly from room temperature to approximately +155°C.

- **Flux Activation and Pre-Heat Soak Stage:** The temperature is increased gradually, after the pre-heat stage, to +183°C over approximately 90 seconds, so that the flux in the paste can clean the bonding surfaces. During this stage, the temperature of the solder paste and soldering surfaces should roughly be same.

- **Ramp Up:** Over a duration of 30 seconds, the temperature is increased to the peak reflow temperature. The duration of the exposure at the peak temperature depends on the package dimensions. Peak reflow temperatures are as follows:
  - +220°C to +225°C for IR and FC Reflow Systems
  - +215°C to +220°C for most VPR Systems

- **Ramp Down:** The reflow stage is completed when the temperature is reduced to the melting point of the paste (+183°C approximately) with an approximate duration of 30 seconds.

- **Cooling Zone:** The temperature profile is completed as the temperature is reduced gradually from +183°C to < +40°C over an approximate duration of 3 minutes. During this period the molten solder forms a strong joint fillet by getting solidified.

2.3.6 Inspection of Assembled Boards Before Loading

Printed Circuit board (PCB) is a platform for different components as well as circuit signal transmission. Reliability and quality of the end products depend on the quality of PCBs. Timely inspection of PCBs is very important to avoid failure issues such as bad wettability, crack, delamination.

In order to maintain the quality of assembled PCBs and eliminate surface defects, PCB manufacturers and assemblers perform inspection of boards at different stages of manufacturing and assembly process.

Technology like Surface Mount (SMT), increases the inspection requirement. Long term electrical reliability of SMT assembled devices depends on the structural integrity of solder joints, which definitely makes it necessary to conduct PCBA inspection.

Many a times, a small displacement during the reflow process results in lack of a connection or poor connection quality. Another common side effect is shorting of connections. The misplaced components sometimes connect the unintended parts of the circuit.

The following figure lists different faults that can occur in the reflow process:

Shifting	Bridging	Missing	Tomb stoning	Shorting
Wrong value	Reverse direction	Off-set down	Polarity	OCV

Fig. 2.3.15: Different faults that can occur in the reflow process

Tombstoning also known as Manhattan Effect or Chip Lifting is a common defect in modern SMT processes relating to the small passive chip components which are mounted on PCBs. Tombstoning refers to the scenario when one end of the component gets detached from copper pad of the board. The following diagram shows tombstoning effect:

Fig. 2.3.16: Tombstoning effect

Bridging occurs when multiple adjacent pads get connected and form a conductive path.

The following diagram shows bridging fault:

Fig. 2.3.17: Bridging fault

The following images show correct and incorrect placements of the components:

Incorrect Placement

Correct Placement

Fig. 2.3.18: Correct and incorrect placements of the components

These misalignments and errors are required to be checked using different inspection methods. The following figure shows the most common inspection methods:

Manual Checks

- An in-person visual inspection by a designer is an effective method to ensure the quality of a PCB after the reflow process.
- However, this method becomes increasingly impractical and inaccurate as the number of inspected boards increases.

Automatic Optical Inspection (AOI)

- AOI is used for inspecting larger batches of PCBAs. An AOI machine uses a series of high-powered cameras, arranged at different angles, to view solder connections.
- Different quality solder connections reflect light in different ways, allowing the AOI to recognize a lower-quality solder.
- The AOI does this at a very high speed, allowing it to process a high quantity of PCBs in a relatively short time.

X-ray Inspection

- This inspection method is used for complex or layered PCBs.
- The X-ray allows a viewer to see through layers to identify any hidden potential problems.

Fig. 2.3.19: Common inspection methods

If any unacceptable fluctuation is observed in any of the characteristics such as voltage, current or signal output or these characteristics hit peaks beyond a predetermined range, the PCB fails the inspection test. The failed PCB is then recycled or scrapped.

2.3.7 Adjusting Conveyor Belt in Reflow Oven

After the components are soldered on a PCB board, it gets transferred to a conveyor belt. The belt moves through the reflow oven.

Conveyors are used to transport circuit boards to various assembly process stations with adjustable features like height, depth, transfer speed and travel direction. Boards are placed on the belt from the outermost edge as components are mounted on both sides of PCB. The following image shows PCBs on conveyor belt:

Fig. 2.3.20: PCBs on conveyor belt

An adjustable conveyor includes a frame with two tracks of two conveyor belts. The first and the second track are mounted on the frame so that they are parallel to each other. Each of the track includes two elements that are connected to each other. The space between the first and the second element can be adjusted according to the change of the length of the respective track. The following image shows the setup of conveyor belt in the production line:

Fig. 2.3.21: Setup of conveyor belt in the production line

The conveyor also includes a device for simultaneously driving the first and second conveyor belts.

Different steps of assembly process are carried out at different speeds, so the conveyor acts as a holder for the boards. Transportation on a conveyor has to be done smoothly to make sure that unfixed components on the board don't move.

2.3.7 Loading Boards and Starting the Oven

After the conveyor belts are adjusted as per the PCB size, the PCBs are loaded on to the belts and the reflow oven is started. The thermal and time profiles and the reflow settings are adjusted as per the requirement.

The board is normally transported into and out of the working area by conveyor belts. Once in the working area, the board is stopped in the desired position either mechanically or by using an optical sensor. The board is clamped rigidly in position to prevent lateral movement and supported to resist the downward forces during the print stroke, which would otherwise lead to warping and solder depletion under the stencil.

Fixtures can be of several forms, including:

- A dedicated tooling plate with dowel pins to align the board

- A matrix of manual or programmable universal mounting pins

The solution chosen will depend on the application. Providing adequate support during second side printing can be problematic, particularly when the first side assembly is densely packed with components, or the board is thin. The common method is to use a dedicated tooling plate which is machined to accommodate the components. This gives better support than a bed of nails fixture, especially around the board periphery.

Alignment

Accuracy of alignment is critical. The aim is to position the board accurately to align the solder pads on the PCB pattern with the stencil apertures. This requires three adjustments (X, Y, Z). As the range of angular adjustment is small, alignment is often implemented using x1, x2 and Y adjusters. The following diagram shows the alignment of PCBs:

Fig. 2.3.22: PCB alignment

Manual adjustment has now been replaced by vision systems using a CCD camera to image fiducial marks on the board. A number of different shapes of fiducial have been used in the past. Now, the industry tends to use a solid filled circle between 1mm and 3mm in diameter. The following figure lists the sequence of operations for aligning the boards:

1.Board moves to board stop and is clamped	1.Camera moves to fiducial 1 and 2 sequentially and locates their positions	1.Stencil is aligned
1.Board support moves up	1.Squeegee operation commences	1.Board support moves down
1.Board is unclamped and moves out of machine		

Fig. 2.3.23: Sequence of operations for aligning the boards

The accuracy of alignment depends on the:

- Optical and lighting system used
- Size of the picture elements into which the board image is converted by the camera
- Algorithm used to determine the necessary location information from the board image

Alignment compromises

Differences in temperature and humidity during production can lead to small differences in dimensions, particularly on large boards, so it cannot be guaranteed that the stencil will exactly match the board even though these have been created from the same CAD artwork. The following diagram shows some alignment compromises:

Fig. 2.3.23: Some PCB alignment compromises

2.3.8 Monitoring Soldering Process

Once the reflow oven is started, the technician needs to monitor the soldering process. The temperature sensor is attached to the soldering system's area at the same height where PCBs are to be soldered. This reduces the time-consuming process of preparation and connection of thermocouples. The effort of connecting a data logger to computer, starting and ending a measurement is eliminated as each process cycle is measured and saved automatically. This makes sure that each manufacturing batch is monitored with uninterrupted documentation of soldering profiles.

Temperature sensors are available throughout the entire soldering process from preheating to cool down phase, resulting in a continuously reproducible profile.
The following image shows a screenshot of the software for eC-reflow-mate, with prescribed profile superimposed in order to indicate temperature profiles in practice:

Fig. 2.3.24: Ideal profile versus measured profile

In the above screenshot,

- **Red Curve**: Represents a sensor that floats above the PCB

- **Yellow Curve**: Represents a sensor that floats below the PCB

- **Green Curve**: Represents a sensor that touches the PCB

- **Blue Curve**: Represents the prescribed profile

The curves correspond to a PCB with a size of 100×150mm that was put on PCB spacers in the middle of the oven. The bottom heating is set to follow the top heating ("Follow 0 °C"). The following image shows the corresponding PCB for the curves:

Fig. 2.3.25: Corresponding PCB for the curves

2.3.9 Inspection of Soldered Boards

Once the components are soldered on the PCB board, the technician needs to check the solder joints to ensure quality. The soldered boards may contain various faults listed in the following figure:

Pin holes or blow holes	Bulbous joint / excess fillet	Cracking of a solder joint	Incomplete joints	Inconsistent or poor hole fill
Joint contamination	Pad contamination	Poor penetration	Solder flags or spikes	Solder shorts
	Sunken joints	Solder mask discoloration		

Fig. 2.3.26: Faults in soldered boards

The soldered boards can be tested using test systems. Some of them are as follows:

Structural Process Test System (SPTS)
Structural Process Test System uses emitting light like visible light, laser beam and X-ray to process images and measure defects related to solder joint quality. There is no requirement to physically touch circuit board in SPTS. SPTS eliminates the subjectivity from measurement of defect.

Automatic/Automated Optical Inspection (AOI)
AOI provides information about the solder joint curvature, that helps in determining whether the solder is sufficient, the solder joints are complete and whether any bad wetting has taken place. Besides, AOI system also inspects missing components, solder bridging and component displacement after the reflow soldering. The speed of an AOI equipment is 30-50 joints per second and features relatively low cost. The following image shows a technician inspecting soldered boards using AOI system:

Fig. 2.3.27: A technician inspecting soldered boards using AOI system

Automatic Laser Test (ALT) Measurement

ALT is used to test the height and the shape of solder paste deposition and the solder joints.

X-ray Fluoroscopic System

X-ray fluoroscopic system inspects the solder joint defects including bridging, misalignment, crack, insufficient solder and so on. Besides these, it can inspect any missing components and reversed tantalum capacitors.

X-ray Lamination System

This system can provide process defect coverage by measuring the parameters of the physical solder joints at different focal planes. After the measurement results are analysed, data is provided to characterization and assembly improvement.

Activity

1. List six faults that can be found in the soldered boards.

2. Name the gas that can be used instead of oxygen in the reflow process.

_____

3. Name the four stages in reflow process and briefly describe them.

UNIT 2.4: Electro Static Discharge (ESD) Precaution and Contamination Prevention

Unit Objectives

At the end of this unit, you will be able to:

- Define ESD
- List the causes of ESD and its effects on electronics
- Apply correct measures for ESD protection
- Explain contamination prevention practices

2.4.1 Introduction to ESD and its Causes

In today's world, it is very important to get protection against system-level ESD, both in the industrial space and the consumer space. A single ESD strike is enough to damage a product permanently. Hence, ESD protection is very critical for a system design.

Electrostatic discharge (ESD) is the unexpected flow of electricity between two electrically charged objects caused by contact, an electrical short or dielectric breakdown. A build-up of static electricity can be a result of electrostatic induction or tribo charging. The causes are listed as follow:

- One of the causes of ESD events is static electricity. Static electricity is often generated through tribo charging. When two materials are brought together into contact and then separated, the electric charges get separated. Tribo charging leads to a build-up of static electricity by rubbing or touching of surfaces of two dissimilar materials (in specific combinations). Rubbing plastic comb against dry hair and rubbing balloon against sweater are some examples of tribo charging.

- The ESD may take place when the dielectric between the objects breaks down, creating a visible spark.

- ESD event can be caused through electrostatic induction. This takes place when an electrically charged object is brought near a conductive object which is isolated from ground. An electrostatic field is created because of the charged object and it causes redistribution of electrical charges on the other object's surface. The net electrostatic charge of the object is same but there are some regions with excess negative and positive charges.

2.4.2 Effects of ESD on Electronics

With most electronics ICs and components being designed to operate at voltage of 5 V or less, it is hardly surprising that electrostatic discharges can cause damage. For any electronics manufacturing, repairing, maintaining, or working, it is imperative that the effects of ESD are

taken seriously. To this end, ESD measures ranging from full ESD protected areas using ESD workbenches, ESD flooring, ESD clothing, ESD wrist straps and the like are used.

ESD can have disastrous effects on electronic components. With ICs operating at supply voltages of 5 V and less these days, and with the feature sizes measured in fractions of a micron, the static charges that go unnoticed in everyday life can easily destroy a chip. Worse still, these effects may not destroy the chip instantly, but leave a defect waiting to cause a problem later in the life of the equipment. The following image shows ESD sparks over electronics components:

Fig. 2.4.1: ESD sparks over electronics components

2.4.3 ESD Protection

In view of their sensitivity to static, most semiconductor devices today are treated as static sensitive devices (SSD). To prevent the damage caused by ESD, the devices must be handled in anti-static areas, often called Electrostatic Protected Areas (EPAs). Within these areas, a variety of precautions are taken to make sure that static charge is dissipated and the SSD, static sensitive devices do not encounter any static discharges. Anti-static areas include benches with dissipative surfaces, wrist straps for the operators, anti-static flooring and so on.

To combat ESD effects and to prevent damage to the electronic components from the effects, industry is spending considerable amount of money. Anti-static areas along with measures to ensure that the people are not carrying any static are used. During manufacturing, electrostatic discharge protected areas (EPA) are used to virtually remove the destructive effects of static on the electronics equipment.

ESD protection can be implemented in following ways:

- **ESD protection at circuit and assembly design:** In normal use, electronic circuits can survive electrostatic discharges encounter. It is important that the circuitry has an inbuilt ESD protection. It is essential that the sub-assemblies and boards have measures of ESD protection so that they do not get damaged when they are handled.

- **Building and testing equipment in EPA:** The level of ESD protection necessary in an environment is achieved by using an ESD protected area or EPA. Strict controls are employed within an EPA to ensure dissipation of ESD and provide protection to the components and assemblies.

- **Storing components in ESD controlled area:** Besides the fact that, the electronic assemblies are built within an ESD protected environment, it is also essential to ensure that all the components are transported and stored within an environment with ESD protection.

- **Introducing ESD control process:** Ensuring dissipative environment is the first step for creation of an ESD protected area while the installing an equipment and physically generating a static. ESD training is required to ensure that people follow the right processes. EPA will work properly when the individuals using the area understand the right way to handle the components, equipment and the assembles and prevent the damage caused by ESD.

ESD Protected Area

The following figure lists the measures that are used within an EPA:

ESD environment
- Flooring should be static dissipative. Suitable tiles or carpet can be installed.
- Other items, such as humidifiers, are used to control the humidity.

•ESD products
- These include Static shielding bags, Static dissipative IC tubes and other ESD packaging for components.

•ESD workbench and ancillaries
- An ESD workbench with ESD straps and ESD seats is used to ensure that the operator or user is grounded via a high resistance dissipative path.

•ESD tools
- ESD tools, such as ESD soldering iron, can easily transfer static directly to the components. This can provide a good transfer path resulting in high current levels that can cause more damage.

ESD clothing
- These include ESD coat, ESD shoes, ESD gloves and so on.

Fig. 2.4.2: Measures that are used within an EPA

The technician should use the ESD tools and clothing while working.

The following figure shows the images of a technician using ESD tools and clothing:

Fig. 2.4.3: A technician using ESD tools and clothing

2.4.4 Contamination Handling

An EMS technician needs to work with small electronic components. He/she must ensure that the components are connected in right places with right terminals joined to the right points on the PCB. Otherwise, they may damage the PCB and the connection and may cause ESD.

The technician needs to take care of the solder and flux. These are chemical components and should be handled properly so that they are not touched with bare hands. Amount of these components should be checked, otherwise, soldier joints will be broken or burnout.

The temperature needs to be maintained during the soldering operations to get a correct solder joint.

The reflow machine and PCBs with other components must be cleaned to avoid any contamination due to dust and chemical components.

Activity

1. List two causes of ESD.

2. What are the measures that are used in EPA?

   _____
   _____
   _____
   _____
   _____
   _____

UNIT 2.5: Maintaining Records

Unit Objectives ◎

At the end of this unit, you will be able to:

- Manage the records for reflow operations

As an EMS technician, all the assembly records of the setup, operations and routing maintenance tasks must be kept. The following figure lists the documents that are required to be understood and maintained:

Production schedules	Operation manuals	Verbal instructions	Sequential start-up and operation tasks	Daily tasks

Fig. 2.4.1: Documents to be understood and maintained

All the daily tasks are maintained in the form of a log file. Other tasks that need the records to be documented include:

- Cleaning activities
- Visual inspections
- Production reports
- Procurement of materials
- Repurchase of components

At the end of the day, the technician needs to record:

- Number of PCBs manufactured
- The status and count of the electronic components
- Any challenge during the reflow work
- Any damaged electronic components or PCBs
- Voltage values, Values for current, Tolerance values, Base part numbers of the components

He/she should also maintain the record of the parameters during the reflow work. The report of visual inspection must be recorded for further work.

3. Undertake Preventive Maintenance of the Machine

Unit 3.1 – Maintenance of Reflow Oven Machine

ELE/N5304

Key Learning Outcomes

At the end of this module, you will be able to:

1. Identify how to maintain reflow oven machine
2. List the maintenance tasks

UNIT 3.1: Maintenance of Reflow Oven Machine

Unit Objectives 🎯

At the end of this unit, you will be able to:

1. Identify how to maintain reflow oven machine
2. List the maintenance tasks

3.1.1 Maintaining Reflow Oven Machine

It is the responsibility of an EMS technician to clean and maintain the reflow oven on a regular basis. It increases the lifetime of the machine and also helps in avoiding downtime during production and manufacturing.

Proper maintenance of reflow oven machine can improve the production quality and efficiency. The foremost maintenance task is the removal of the built-up flux residue inside the chamber of the oven. Although flux collection system is available in modern reflow machines, still there are chances that flux can get stuck to the inert air ventilation pipe and thermal regulator panel. This results in incorrect thermal data readings and as a result, thermal controller will make wrong adjustment instructions. The following figure lists the daily tasks to maintain a reflow oven:

- Clean and wipe down the machine daily. Make a neat workplace.

- Check conveyor chains, sprockets, mesh and the automatic lubrication system.

- Add oil on time to lubricate the machine.

- Clean the photoelectric switches.

Fig. 3.1.1: Daily tasks to maintain a reflow oven

The following image shows an open cover reflow oven under maintenance:

Fig. 3.1.2: Open cover reflow oven under maintenance

The following figure lists some additional maintenance tasks for the reflow oven:

- Once the chamber temperature decreases to room temperature, open the hood and clean the inside surface of chamber with a proper cleaning agent.

- Clean the ventilation pipe with a cleaning agent.

- Vacuum the chamber and remove the flux residue and soldering balls.

- Check and clean the air blower and air filter.

Fig. 3.1.3: Additional maintenance tasks for the reflow oven

The technician should maintain a lubrication schedule and checklist for the maintenance of the machine.

The following figure shows a sample lubrication schedule:

Item	Description	Period
1	Head sprocket, bearings and adjustable chain	Every month
2	Timing chain, bearings, and tension pulley	
3	Guide, mesh, and cylinder bearing	
4	Conveyor bearings	
5	Ball screw	
6	PCB carrier chain	Every day
7	Inert ball screw and guider	Every week
8	Guider support	

Fig. 3.1.4: Lubrication schedule

Activity

1. Create a daily task list to maintain a reflow oven.

   _____

   _____

   _____

   _____

4. Achieve Productivity and Quality Standards

Unit 4.1 – Achieving Quality and Productivity

Unit 4.2 – Soldering of Boards

Key Learning Outcomes

At the end of this module, you will be able to:
1. Identify how to achieve quality and productivity
2. List the industry quality standards
3. Explain the process of soldering and the precautions to be taken while soldering
4. Select the soldering components as per specifications
5. Explain wave soldering process
6. Identify the soldering defects
7. Define RoHS compliance

UNIT 4.1: Achieving Quality and Productivity

Unit Objectives ⊚

At the end of this unit, you will be able to:

1. Identify how to achieve quality and productivity
2. List the industry quality standards

Achieving quality and productivity is very important for any kind of work. An EMS technician requires to maintain the quality standards and achieve daily productivity. For this, he/she should know the quality standards to follow. Maintaining quality will help in meeting the daily target, as compromise in quality may lead to wastage and consumption of hours in rework.

The technician needs to:

- Inspect the components
- Deliver board as per expected timelines
- Follow the industry quality standards for PCB soldering
- Follow the machine instruction provided in the manual and the specified thermal and time profile as prescribed for the PCB

4.1.1 Inspection of Components

The technician should check all components as well as the reflow machine before placing the components on the PCB. He/she must check:

- Whether the components are in working condition
- Whether all required components are available
- The compatibility and specification of the PCBs

While placing the electronic components on PCBs, the polarity should be taken care of. Adjusting the negative and positive ends should always be initiated to prevent any short-circuits or functional failures of the circuit board. The part polarity needs to be assigned in the silkscreen layer to help in reducing the turnaround time (TAT) for DFM checking in PCB assembly. The polarity should be visible even when the components are soldered on the board for easy identification later on.

The EMS technician should maintain a checklist to maintain record of the inspection. After the work is started, if there is any missing component or the board does not match with the specification or any such problem occurs, it will affect the workflow.

4.1.2 Delivering PCBs as per Timeline

Timely delivery is very important for a production line. If a product, at any stage, is not received from the its previous stage, it will delay the production of the finished product. Same happens with the product quality. If product quality, at any stage, is low, it gets lower in the later stages too.

The technician should be aware of his/her work requirement and delivery schedules. He/she needs to take care of the quality by:

- Monitoring the machine operations
- Inspecting the components
- Following the standard parameter values and specifications
- Working as per the standard operating procedures

4.1.3 Maintaining Industry Quality Standards

The technician has to follow the industry quality standards while working with PCBs. IPC, the Association Connecting Electronics Industries, is a trade association which standardizes the requirements for the assembly and production of electronic assemblies and equipment.

IPC is accredited by the American National Standards Institute (ANSI) as a standard developing organization and is globally known for its standards. It publishes the most widely used acceptability standards followed in the electronics industry.

IPC Standards

IPC-A-610, Acceptability of Electronic Assemblies, is used by EMS companies and the original equipment manufacturers across the world.

The following figure lists the reasons of following IPC standards in manufacturing:

•**Gain control over end product quality and reliability**	Quality and reliability play an important role in market competition and maintaining reputation and profitability for a company.
	Implementation of IPC standards throughout the manufacturing process helps in better performance, longer life and compliance with lead-free regulations.
•**Improve communication with suppliers and employees**	IPC standards are being followed by everyone in the market including competitors, suppliers and EMS providers.
	IPC standards help to understand global electronic industry.
	These standards eliminate confusion as these are established industry standards.
•**Help reducing costs**	Ensure that assembly design and bare boards comply with IPC standards.
	This results in producing electronic assemblies with the required quality, minimizing costs, reword and wastage.

Fig. 4.1.1: Reasons of following IPC standards in manufacturing

The following figure lists the standards published by IPC:

General documents
- ☐ IPC-T-50 Terms and Definitions
- ☐ IPC-2615 Printed Board Dimensions and Tolerances
- ☐ IPC-D-325 Documentation Requirements for Printed Boards
- ☐ IPC-A-31 Flexible Raw Material Test Pattern
- ☐ IPC-ET-652 Guidelines and Requirements for Electrical Testing of Unpopulated Printed Boards

Design specifications
- ☐ IPC-2612 Sectional Requirements for Electronic Diagramming Documentation (Schematic and Logic Descriptions)
- ☐ IPC-2221 Generic Standard on Printed Board Design
- ☐ IPC-2223 Sectional Design Standard for Flexible Printed Boards
- ☐ IPC-7351B Generic Requirements for Surface Mount Design and Land Pattern Standards

Material specifications
- ☐ IPC-FC-234 Pressure Sensitive Adhesives Assembly Guidelines for Single-Sided and Double-Sided Flexible Printed Circuits
- ☐ IPC-4562 Metal Foil for Printed Wiring Applications
- ☐ IPC-4101 Laminate Prepreg Materials Standard for Printed Boards
- ☐ IPC-4202 Flexible Base Dielectrics for Use in Flexible Printed Circuitry
- ☐ IPC-4203 Adhesive Coated Dielectric Films for Use as Cover Sheets for Flexible Printed Circuitry and Flexible Adhesive Bonding Films
- ☐ IPC-4204 Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Circuitry

Performance and inspection documents
- ☐ IPC-A-600 Acceptability of Printed Boards
- ☐ IPC-A-610 Acceptability of Electronic Assemblies
- ☐ IPC-6011 Generic Performance Specification for Printed Boards
- ☐ IPC-6012 Qualification and Performance Specification for Rigid Printed Boards
- ☐ IPC-6013 Specification for Printed Wiring, Flexible and Rigid-Flex
- ☐ IPC-6018 Qualification and Performance Specification for High Frequency (Microwave) Printed Boards
- ☐ IPC- 6202 IPC/JPCA Performance Guide Manual for Single- and Double-Sided Flexible Printed Wiring Boards
- ☐ PAS-62123 Performance Guide Manual for Single & Double Sided Flexible Printed Wiring Boards
- ☐ IPC-TF-870 Qualification and Performance of Polymer Thick Film Printed Boards

Flex assembly and materials standards	□IPC-FA-251 Assembly Guidelines for Single and Double Sided Flexible Printed Circuits □IPC-3406 Guidelines for Electrically Conductive Surface Mount Adhesives □IPC-3408 General Requirements for Anisotropically Conductive Adhesives Films

Fig. 4.1.2: Standards published by IPC

Source: *https://en.wikipedia.org/wiki/IPC_(electronics)*

IPC-A-610

The IPC-A-610 Acceptability of Electronic Assemblies is the most common standard for electronic assemblies which defines acceptability for printed circuit boards assembly. There are 3 classes of IPC-A-610 which are used to divide PCBA acceptability, so that correct requirements can be determined for your products.

IPC-A-610 classes:

The following table explains the classes:

Class	Type of Products	Application
Class 1	General Electronic Products	In those products where function of the finished assembly is required
Class 2	Dedicated Service Electronic Products	In those products where extended life and continued performance are required, and uninterrupted service is expected
Class 3	High Performance or Harsh Environment Electronic Products	In those products where performance-on-demand or continued high performance is very important; equipment downtime is not permissible. Example: life support or other critical systems

4.1.3 Following Specifications

The EMS technician should always follow the standard operating procedures to reduce chances of errors. To maintain the quality of the products he/she should set the temperature as well as time profile as required. Otherwise, higher or lower temperature and the duration beyond limits will damage the product.

The temperature and time duration differ with the type and specification of the PCBs. Hence, it is of utmost importance that the technician sets the right temperature and time and the right reflow settings as specified for the production.

Activity

Match the IPC standards with their descriptions.

Standards	Description
IPC-FA-251	Acceptability of Printed Boards
IPC-A-600	Specification for Printed Wiring, Flexible and Rigid-Flex
IPC-3406	Generic Standard on Printed Board Design
IPC-6013	Assembly Guidelines for Single and Double Sided Flexible Printed Circuits
IPC-2221	Guidelines for Electrically Conductive Surface Mount Adhesives

Unit Objectives ◎

At the end of this unit, you will be able to:

1. Explain the process of soldering
2. List the precautions to be taken while soldering
3. Select the components required for soldering as per specifications
4. Explain wave soldering process
5. Identify the soldering defects
6. Define RoHS compliance

4.2.1 Soldering Process and Precautions

As an EMS technician, an individual should have the knowledge of soldering process.

A permanent connection is made between electronic components using soldering by melting the soldering metal and filling it into the joint. Melting point of the solder metal is lower than the electronic components; therefore, only the solder melts and then solidifies.

The following image shows soldering components on the PCB:

Fig. 4.2.1: Soldering electronic components onto a PCB

The following table lists different components required in soldering:

Component	Description	Image
Soldering Iron	Used as a tool for melting the solder and applying it to metals for joining them together	
Solder	Used for combining the metal alloy with the pitch-like organic compound	
Solder Stand	Used to hold the soldering	

	iron safely in one place	
Sponge	Used to clean corrosion on the tip of the soldering iron	

Fig. 2.2.8: Soldering components

How to Solder?

The following figures list the steps of the soldering process:

•Clean the surface of the PCB with a steel wool and remove any oil, wax or debris	•Heat the connection with the soldering iron tip and then apply the solder	•Keep the soldering tip on the connection to ensure that the solder material flows into and around well heated connections

•When the solder has flown completely, remove the tip and then the iron	•Inspect the joints closely to ensure that the soldering has been done properly

Fig. 4.2.2: Steps for soldering

Technician should take care of the following points while soldering:

Soldering should always be done on a clean PCB. Remove any dirt or other debris with a fine sandpaper or soft cloth before proceeding

When soldering a wire onto a PC board, it should have a volcano shape. If it doesn't, then reheat it and solder again

Fig. 4.2.3: Key points to be considered while soldering

Precautions

The following figure lists the precautions that are to be kept in mind while soldering:

Be careful when operating a soldering iron as high temperatures are involved.	The iron must always be unplugged when not in use.	The tip of the soldering iron should never be touched.
Soldering must be done in a well-ventilated area.	The flux creates smoke, so keep your head away from it.	Hands should be washed after soldering as it contains lead, which is poisonous.
The connection must not be tampered while it is cooling.	Some components like transistors can be heat damaged, so a crocodile clip should be used as a heat sink.	Bulky components must be soldered before the smaller ones to allow soldering of smaller components with help of tweezers and adhesives.

Fig. 4.2.4: Precautions to be considered while soldering

Troubleshooting

Some of the common issues that can occur while soldering on a PCB are shown in the following figure:

The solder is not flowing from the soldering tool	•The parts need to be cleaned of all dirt.
The connection looks grainy/crystalline	☐Reheat to form a good joint, preferably, with a larger soldering iron.
The tip is oxidized	☐Avoid keeping the iron unplugged when not in use and always clean the tip with a damp synthetic sponge.
Adjacent joints are accidently connected or the electrical conductivity is low	☐Use of a large or less amount of solder accidently connects the adjacent joints. ☐ If the amount of solder is too less it causes low conductivity. ☐Always use the right amount of solder material.

Fig.4.2.5: Common issues while soldering

4.2.2 Selection of Soldering Components

For a perfect soldering, all the required components need to be selected properly.

Selection of Tip

Choosing the right tip geometry for a soldering iron is very crucial for the soldering. The tip must appropriately fit the joint. An appropriate fit maximizes the power delivery, increases the tip life and results in higher efficiency.

There are several types of tips. The following images shows from left to right, the bevel tip, two conical tips with varying widths, and the chisel tip:

Fig.4.2.6: Types of tips

The EMS technician needs to keep the following points in mind:
1. Using a small tip takes longer time to solder. It will damage the tip and power will not efficiently be passed to the load. A small tip appears to be too cold or too slow.
2. A large tip damages the PCB. The tip may be damaged and using this could also cause a hole in the tip.
3. A shorter and bulky tip delivers more power.
4. Short and blunt tips are used for the heavy loads only. They are not suitable for the fine pitch rework.
5. Long and fine tips are most suitable for the applications which are hard to reach and also for fine terminals with 20 mil QFP.
6. Long and fine tips can't deliver power efficiently, as the solder joint is farther from the heater. Hence, these tips considerably slow the heat transfer.

The following diagram shows the size of soldering tips:

Fig.4.2.7: Size of soldering tip

A simple process is involved in changing the tip. It involves either unscrewing the wand or simply pushing the tip in and pulling it out. The following image shows the parts of a soldering iron:

Fig.4.2.8: Parts of a soldering iron

Solder Selection

Solder refers to the alloy which is available as a long, thin wire in spools or tubes. The following images show solder wire as a spool and in a tube:

Fig.4.2.8: Solder wire sold as a spool (left) and in a tube (right)

The solder wire comes in leaded and lead-free varieties. Generally, there are two types of solder:

- Tin-Leaded Solder
- Lead Free Solder

Wand Selection

The wand holds the tip in the soldering iron. Wands are generally made of different insulating materials (for example, rubber). The insulation helps to prevent the heat from the tip from getting transferred to the outside wall of the wand. The wand houses wires and metal contacts which transfer the heat from base or the outlet to the iron tip. Hence, a high-quality wand much appreciated. Some wands allow interchangeability of tips and some soldering irons comprise of just a wand which plugs into a power outlet. The following images show different types of wand:

Fig.4.2.9: Types of wands

Stand (Cradle)

The iron stand, also known as a cradle, houses the iron when it is idle. The stand can be as simple as a metal stand. It can also be complex, providing an auto-shutoff feature which reduces the tip's temperature when the soldering iron is placed in the cradle. Some cradles also offer a regular sponge while others provide a brass sponge. The following image shows different types of cradles:

Fig.4.2.10: Types of cradles

Base Selection

The base of the soldering iron allows adjusting of temperatures. There are analog bases, with dial controlling the temperature. The digital bases offer buttons for setting the temperature and displays the current temperature. Some bases offer extra features such as heat profiles allowing the operator to change the amount of heat to the tip. The following figure lists the types of base:

A digital base with control buttons and a digital display

An analog base that uses a dial to control the temperature

Fig.4.2.11: Types of bases

Selection of Flux

Flux is an acidic material designed to clean the oxides from solder joints and help in transferring heat to the joint. Flux can be available in solder core wire or it is added in liquid or paste form to the solder joint. Flux is very important for controlling the soldering process. The technician should understand the function of flux, how it differs and performs, how it affects the PCB quality and the solder tip life. The following figure lists the different types of flux:

1.Clean (RMA)	1.No-Clean	1.OA (Aqueous)
•A traditional type of flux, RMA has more acidic content.	•The most common in today's marketplace. There is less flux per volume in wire core solder. No-Clean flux has weaker acid than RMA.	•The acid in OA flux is inorganic and more active than the acid found in RMA flux.

Fig.4.2.12: Types of flux

The following diagram shows the difference between clean and non-clean flux:

Fig.4.2.13: Difference between clean and non-clean flux

The type of flux and the amount is very crucial for soldering. The flux may affect the joints and PCBs as follows:

- Flux affects the solder joint quality:

  o Clean flux (RMA) is more acidic and leaves heavy residue to be cleaned off the PCB.
  o No-Clean flux leaves less residue. Cleaning the PCB is not necessary after light touch-up with no-clean flux. For using no-clean flux, tip temperature should be lower.
- Flux affects the solder tip life greatly:

- o RMA flux is better for the solder tip. Due to its gummy consistency, the RMA flux stays longer on the tip. RMA core solder wire covers the tip while soldering and thus protects it from oxidation.
  - o No-Clean flux is worse for the solder tip as it burns off right away. Therefore, the tip oxidises faster.
- If liquid or paste flux is added to the joint, it means that there is deficiency of flux in the wire core solder. The flux available in the wire core solder is adequate for general through-hole soldering. More flux makes soldering easier. But:
  - o Too much flux contaminates the board.
  - o Too much flux attacks the tip faster. As flux activates, it attacks the oxides on the tip and the iron plating.

4.2.3 Wave Soldering

One of the most important types of soldering is wave soldering. Wave soldering is very good, low-cost solution for boards with mostly PTH components.

Three types of machines are used in the production of circuit board assemblies: reflow soldering, wave soldering, and cleaning. These machines are used in the attachment of components to the circuit board and the subsequent, post soldering removal of process chemicals and residues. A wide variety of machines are available to accommodate low to high production volumes and different process requirements.

Wave soldering is the most economical means of mass soldering leaded components into holes in a circuit board. The board is transported over a flux station, preheated and finally passed over a "wave of solder". Molten solder is pumped through one or more nozzles forming the wave. Solder joints are formed in pads or PTH on the board and the leads of the components.

Most wave soldering systems for the PCBs contain two waves:

- o The first, turbulent wave, is used for scrubbing the wettable surfaces, removing oxidation and soldering all solderable areas.
- o The second, finishing wave, is a smooth wave for removing the bridging and icicles. These waves are perpendicular to the board.

The PCBs travel at an angle to get rid of bridging while the boards are coming out of the finishing wave. The angle of the board travel does not have to be very drastic; the range is usually from 3 to 6 degrees.

The following figure lists the steps of wave soldering:

1)Switch ON the machine and set wave soldering profile per assembly requirements.	1)Log the Set profile in the Log Book.	1)Verify the solder bath temperature with the help of digital thermometer.
1)Load one pilot board & start the wave soldering cycle.	1)Put one dummy board for machine trail and set the PCB carrier per board size.	1)Check the specific gravity of the solder flux and tune up the mixture if it is required.
1)Check the board for proper soldering and pass the board to the quality inspection table for mass production approval.	1)After approval start mass production and record total day production.	

Fig.4.2.14: Steps of wave soldering

4.2.4 Soldering Defects

The following list explains the different types of defects that can occur during soldering:

- **Pin Holes and Blow Holes:** During wave soldering, pin and blow holes are formed due to the thickness of copper plating. Moisture in the board escapes through either the thin copper plating or the voids available in the plating. The following image shows pin hole on a PCB:

Fig.4.2.14: Pin hole on a PCB

This can be eliminated by improving the quality of the board with a minimum of 25um of copper plating in the through hole. The gassing problems can sometimes be eliminated using baking by drying out the board.

- **Bulbous Joint / Excess Fillet:** It is common in nitrogen soldering. It is caused when the board is separated from the solder wave. The following image shows bulbous joint on a PCB:

Fig.4.2.15: Bulbous joint on a PCB

- **Cracked Joint:** The joint fails because of expansion and contraction of the lead in the joint. Due to poor handling during assembly, single-sided joints can fail. In this case the joint's surface shows stress lines produced during repeated movement. The following image shows cracked joints on a PCB:

Fig.4.2.16: Cracked joints

- **Lifted Component:** Lifted components can take place during the wave soldering process for several reasons. The part may be lifted due to the thermal requirement on the leads. Generally, the components lift as a result of incorrect lead length that causes the leads to hit the solder bath and lift it during the entry to the wave. Light components are lifted by the turbulent wave. Components with different lead solderability and different thermal requirements can also cause the lifting seen during wave contact.

The following image shows lifted components on a PCB:

Fig.4.2.17: Lifted components on a PCB

- **Flux Residues:** Flux residues visible on the board are caused due to the reduction in the use of cleaning. The residues are either a result of the formulation of the flux or due to poor process conditions. The following image shows flux residues on a PCB:

Fig.4.2.18: Flux residues on a PCB

- **Incomplete Joints:** The incomplete solder fillet can be seen after wave soldering on the single-sided boards. Incomplete solder fillets are due to excessive wave temperature, poor hole-to-lead ratio, steep conveyor angles and contamination on the edges of the pads. The following image shows incomplete joint on a PCB:

Fig.4.2.19: Incomplete joint

- **Inconsistent or Poor Hole Fill:** This is due either to the pre-heat temperature being set too low or poor flux is applied. In both cases, to eliminate such problem, the process parameters should be checked. When a company replaces a foam fluxer to a spray flux unit, this problem is common. It is caused due to poor penetration of the flux into the through hole.

The following image shows poor hole fill on a PCB:

Fig.4.2.20: Poor hole fill on a PCB

- **Joint Contamination:** It takes place if the temperature causes softening of the coating on the resistor network and the board surface gets contaminated. The following image shows joint contamination on a PCB:

Fig.4.2.21: Joint contamination on a PCB

The following figure lists some other defects in the soldered boards:

| Pad contamination | Poor lead solderability and wetting | Poor penetration | Out-gassing |

| Solder flags or spikes | Solder shorts | Sunken joints | Solder mask discoloration |

Fig.4.2.22: Defects in the soldered boards

4.2.5 RoHS Compliance

When it comes to solder, one of the most essential things to be aware of, is the components of solder. Traditionally, it was composed of tin (Sn), lead (Pb) and a few other trace metals. This solder is referred to as leaded solder.

Lead is harmful to humans and can lead to lead poisoning when exposed to large amounts. Unfortunately, lead is also a very useful metal for soldering as its melting point is low and it has the ability to create good solder joints.

When the adverse effects of leaded soldering were widely known, it was decided to not use the leaded solder anymore. The European Union, in 2006, adopted the Restriction of Hazardous Substances Directive (RoHS). This directive restricts the use of leaded solder in electronics and electrical equipment. In electronics manufacturing, the use of lead-free solder has now become the norm.

Lead-free solder is similar to the leaded counterpart, with a difference that it does not contain any lead. Instead of lead, it is made up of tin and other trace metals, such as copper and silver. This solder is generally marked with ROHS symbol to let the potential buyers know about the conformance with the standard.

Activity

1. Write down the steps of soldering.

```
┌──────────┐      ┌──────────┐      ┌──────────┐
│          │ ──→  │          │ ──→  │          │
│          │      │          │      │          │
└──────────┘      └──────────┘      └──────────┘
                                          │
     ┌────────────────────────────────────┘
     ↓
┌──────────┐      ┌──────────┐
│          │ ──→  │          │
│          │      │          │
└──────────┘      └──────────┘
```

2. List three precautions to be considered while soldering.

   _____

   _____

   _____

   _____

3. How can formation of pin holes and blow holes be eliminated?

   _____
   _____
   _____
   _____

5. Apply Solder Paste

Unit 5.1 – Standard Operations for Applying Solder Paste

Unit 5.2 – Setting Up Printing Machine

ELE/N5201

Key Learning Outcomes

At the end of this module, you will be able to:

1. List the standard operations for applying paste
2. Identify the correct stencil
3. Use Correct Screen and Design
4. Work with the PCB as per Standards
5. Inspect the PCBs using microscope
6. Perform cleaning of stencil and other components
7. Identify the importance of altering sheets in roller
8. Demonstrate cutting of apertures using a laser cut
9. Explain stencil printing process
10. List the printer operations in stencil printing
11. Set different parameters in printing machine

UNIT 5.1: Standard Operations for Applying Solder Paste

Unit Objectives ⊚

At the end of this unit, you will be able to:

1. List the standard operations for applying paste
2. Identify the correct stencil
3. Use Correct Screen and Design
4. Work with the PCB as per Standards
5. Inspect the PCBs using microscope
6. Perform cleaning of stencil and other components
7. Identify the importance of altering sheets in roller
8. Demonstrate cutting of apertures using a laser cut

Solder Paste

Solder paste is used to connect the leads of surface mount devices to attachment points in the circuit patterns on a PCB. The paste is applied to the intended areas using a stencil to get printed and it is followed by heating which fuses the connection by melting the paste. The following images show solder paste:

Fig.5.1.1: Solder paste

The EMS technician needs to use the right stencil, screens and the design to print the boards. The standard procedure before the printing starts, includes the following steps:

- Identify the correct stencil and collect it from stores
- Use the correct screens and design to print
- Work with the PCB as per standards
- Alter the sheet in the roller
- Clean the stencil and other components regularly
- Cut apertures using a laser cut

5.1.1 Identification of Correct Stencil

For the assembly process to start, solder paste is added to the specified areas of the unpopulated bare PCB. Solder paste goes only where a component is required to be in electrically conductive contact with the metal pad on the PCB. Typically, it is achieved using a stencil.

Stencil Printing is the process of depositing solder paste on PWBs to set up electrical connections. It is the first and the most critical stage of the PCB manufacturing process.

Basically, solder stencils are of two types. They are as follows:

- Framed stencils: used for solder paste machinery
- Prototype stencils: used for application of solder paste manually

Three different metal stencil-manufacturing methods are used. They are listed as follows:

1. Etching
2. Electroforming
3. Laser cutting

The following image shows a stencil printer:

Fig.5.1.2: Stencil printer

The stencil, has a curved shape in the direction of printing. The solder paste is left in these curved sections during printing. As the number of boards printed increases, this remaining paste matter can cause the apertures to clog. This can cause thin areas and the solder paste may work its way around to the stencil's back side (the side that contacts the printed wiring board) during print and cause bleeding and smearing.

To improve these problems, stencils with improved etching precision and stencils produced by new methods are now being sold.

The EMS technician must be able to identify the correct stencil required for the assembly. He/she must ensure that it is made from stainless steel, chromium, or cobalt nickel.

The following table lists the characteristics of different stencil manufacturing methods:

Method	Etching	Additive	Laser	Laser + Special Processing
Material	Stainless steel, copper, phosphor bronze	Nickel	Stainless steel	Stainless steel
Cross section shape	A — B film correction: 50 to 60% C = C' *			
Aperture photographs				

For solder printing of fine pitch patterns, either additive or laser methods should be used.

Stencil Thickness

The following table lists the recommended thickness for stencils:

Inch	Mm
0.008 – 0.010	0.20 – 0.25
0.006 – 0.008	0.15 – 0.20
0.004 – 0.006	0.10 – 0.15

5.1.2 Using Correct Screen and Design

Solder screen is used to apply the solder paste on the board. The solder screen is placed directly on the board and is registered in the accurate position. A runner is moved across the screen and a small amount of solder paste is squeezed through the holes in the screen as well as on the board. As the solder screen is generated from the PCB files, it has holes on the intended positions of the solder pads. In this way, the solder is deposited only on the solder pads.

The technician must use the correct screen to paste solder on the boards. He/she should follow the print design minutely so that the paste is applied on the boards correctly.

5.1.3 Working with the PCB as per Standards

Board surfaces should be kept contamination free prior to soldering and after removal of protective wrappings. In case a firm grip is required on board for any mechanical assembly, gloves used in the process must meet EOS/ESD requirements. These requirements must be noted, especially when no-clean methods are followed. Inspection care must be taken at all the times to ensure product integrity.

Printed circuit boards absorb and release moisture at different rates. Heat, during the soldering, causes an increase in moisture. It can damage the materials' ability to perform as expected. This damage such as a crack, popcorning, internal delamination, may not be visible and can occur during soldering and rework operations.

If the level of moisture is unknown, to prevent laminate issues, the PCBs needs to be baked to reduce internal moisture content. Handling of moisture or process sensitive components (as classified by IPC/JEDEC J-STD-020, ECA/IPC/JEDEC J-STD-075 or equivalent documented procedure) must comply with IPC/JEDEC J-STD-033 or an equivalent documented procedure. Moisture control, and handling and packing of PCBs are mentioned in IPC-1601. The PCBs must be cleaned and inspected visually to check there is no dust.

Cleaning of Printed Circuit Board

Printed circuit boards are very small and delicate, so it is very important to carefully remove any dirt or sediment as extensive handling can cause their damage.

The following figure lists the techniques for cleaning the PCB:

•Canned Air

- •Canned air is highly compressed which can pinpoint dust particulates without disturbing the circuit board.
- •Connections get dislodged if one uses a dust rag or harsh cleaning agent.
- •Rough cleaning of circuit board can break connections and even lead to need of replacement.

•Solvents

- •Simple dusting is not sufficient to remove dust particles on PCB.
- •Solvents are used to remove deposits like corrosion, rust, solids that are formed on the surface and other issues which can damage the functioning of PCB.
- •It is important to choose a product that has vapor rinse while selecting solvent which helps in removing all residue left after soldering.
- •Submersion of PCB in proper solvent is one way of removing residue. Water based submersions work best for soldering residue.
- •Air based cleaning may also be sufficient to remove these harmful residues. Solvent helps for tougher residues.

•Ultrasonic Cleaning

- •Ultrasonic cleaning helps in removing residue without getting much in contact with PCB.
- •It is better if there is less touch as extensive handling can cause damage without actually cleaning the PCB.
- •As circuit boards are small and delicate, precision is important to remove dust or other sediment.
- •This technique ensures a clean and well-functioning PCB.

Fig.5.1.3: Techniques for cleaning the PCB

The most common method for the board cleaning is tacky roller systems. The PCB is conveyed under a roller with a tacky surface that lifts the foreign material from the board. But, if the roller is not monitored, the foreign material can be reapplied to subsequent boards or the roller material itself may stick to the board.

There is a new solution where the PCB is passed in the blow-off chamber between air knives while turning over the air and then to a clean room-rated vacuum cleaner. The air knives are equipped with ionizer bars which eliminate the build-up of static electricity.

The following figure lists some points to be taken care of while cleaning PCBs:

1)Avoid using regular vacuums

1)Use liquid detergents and water with extreme caution

1)Use heat to dry "washed boards" only in controlled amounts

1)Let only those persons who know what they are doing clean PCBs

1)Read up on the dos and don'ts of PCB cleaning before attempting it.

1)Don't be afraid to clean up sticky grime, paint, solder flux, etc.

1)Corrosion (especially from battery acid) should always be cleaned up

1)Take proper ESD precautions

1)Avail yourself of the latest products and services

Don't forget to remove any components (even if it involves de-soldering something) that may hamper the cleaning process.

Fig.5.1.4: Some points to be taken care of while cleaning PCBs

5.1.4 Inspection of PCBs using Microscopes

The PCBs must be cleaned and inspected using microscope to ensure that there is no dust. The following image shows a technician inspecting the PCB using microscope:

Fig.5.1.5: A technician inspecting the PCB using microscope

The following figure lists some features digital microscope:

• Rapid, easy tilting and rotation to view the sample from different perspectives

• Integrated illumination for versatile contrast

• High dynamic range (HDR) imaging

Large mosaic overview of the sample

Fig.5.1.6: Some features digital microscope

It is essential to identify PCB shorts, PCB voids, opens, misalignments and solder integrity of area-array chip packages. There are three major processes of SMT circuit assembly

- Solder paste inspection
- Component placement
- Post re-flow inspection

As size of components is getting smaller, more and more components can be placed on PCB, use of microscope is becoming essential. During PCB manufacturing, it is necessary to inspect and measure the connections and vias during and after production. Microscopes are used in inspections of PCBs to improve the quality and increase output.

Microscopic inspection provides different perspectives to PCB components such as capacitors, transistors, diodes, amplifiers, voltage regulators, assemblies and so on. The following image shows a PCB under digital microscope:

Fig.5.1.7: PCB under digital microscope

5.1.5 Cleaning Stencil and Other Components

The components and the PCB should be properly cleaned to avoid contamination.

Cleaning of Stencil

Stencil cleaning is a low technology part of the printing process but is nevertheless vital. Cleaning is required when the stencil is removed from the printer, and it is important to remove all accumulations of solder paste from the apertures and the stencil surfaces before the deposits harden. The underside of the stencil gradually acquires solder paste through:

o   Stencil bleeding

o   Misalignment

o   Poor release

The underside of the stencil should therefore be cleaned periodically. This is particularly important for fine pitch applications, because a small degree of contamination of the board by solder paste degrades the print through smearing.

Cleaning may be by hand, or automatic. Programmable in process stencil cleaning may be built in to an automated stencil printer, while separate automatic spray cleaning tanks may be used for stencils after a print run.

Stencils and screens should be cleaned of unused solder paste using water heated to approximately 60°C in conjunction with a pressure spray.

The following figure lists some points about the stencil cleaning process:

It is recommended that a final rinse be performed using de-ionized water, followed by an iso-propanol rinse.

This same procedure should also be followed for any hand tools and the squeegee used to apply the solder paste.

At no time should the stencil, screen or tools which have come in contact with un-reflowed solder paste be cleaned in equipment used to clean printed circuit boards of reflowed solder paste residues.

Fig.5.1.8: Some points about the stencil cleaning process

5.1.6 Altering Sheets in Roller

The technician should alter the sheet in the roller for every 10 boards. It is to avoid any malfunctioning of the roller or any dump of foreign material to be pasted on the board. To keep the sheets clean, they should be changed after a specific quantity of boards undergone.

5.1.7 Cut Apertures Using a Laser Cut

During reflow soldering, the thickness of the stencil along with the size of the aperture determines the solder paste amount to form each solder joint. The following figure lists the thickness and aperture for stencils:

Thickness	The thickness of the metal stencil is typically 150 microns (6mils) but 100(4mils), 125(5mils) and 200(8mils) microns are also available.
	The thickness is chosen based on the job in hand. For very fine pitch such as 0.3 mm lead pitch, 100 or 125-micron stencils could be used and for lead pitch down to 0.5 mm, 150-micron stencils can be used.
Aperture	The minimum stencil aperture width must be at least 3 times (preferable 5 times) the diameter of the largest solder particle and the stencil aperture width is larger than the stencil thickness.
	Rounded aperture corners reduce clogging of fine pitch apertures and smearing. The top surface of the metal stencil is slightly roughened to achieve a perfect solder paste roll during printing.

Fig.5.1.9: Thickness and aperture for stencils

In both laser-cut and electroformed stencils, the apertures are of very sharp edges and slightly conic. This makes it possible to easily slip the solder paste from the aperture edges and thereby, a uniform print is secured. Metal stencils are attached to printing frame either by using a tensioned mesh or by using a special frame with gripping systems. It can damage the stencils easily and thereby can result in poor printing quality.

The solder mask aperture should be as large as possible, between 2 to 3 times the diameter of the copper. All the fiducials on a board should be of the same size.

Fiducials should be placed as components from a library, not as free pads, so that they appear as components with coordinates in the pick and place centroid data file.

There should be no traces or surface mount component bodies within the solder mask aperture which may confuse the vision system, but it is okay to place through-hole components on top of fiducials.

Laser Cut Process

In laser-cut process, the aperture is cut out by:

* moving only the laser head
* moving only the table that is holding the stencil
* a combination of each

The laser beam goes inside the aperture boundary. Then, it moves to the perimeter and cuts the aperture (one at a time) completely out of the metal. The following image shows a laser beam on a metal:

Fig.5.1.10: A laser beam on a metal

The smoothness of the aperture cut depends on parameters such as ,cut speed, laser power, beam focus and beam spot size. The laser can cut aperture sizes very accurately, meeting a wide range of size and shape requirements. At a given area ratio, an electropolished laser-cut stencil releases a higher percentage of paste than a non-electropolished stencil can release, as the former has smoother aperture walls inside than that of the latter. The following image shows electropolished and non-electropolished laser-cut stencils:

Laser cut with non polished
surface wall

Laser cut with electropolish
wall

Fig.5.1.11: Non-electropolished and electropolished laser-cut stencils

Activity

1. Write down the differences between the electropolished and non-electropolished laser cut stencils.

_____
_____
_____
_____
_____
_____

2. Write down the key points about cleaning of the stencil.

_____
_____
_____
_____
_____
_____

3. Why correct screen is important in stencil printing?

_____
_____
_____
_____
_____
_____

UNIT 5.2: Setting up Printing Machine

Unit Objectives 🎯

At the end of this unit, you will be able to:

1. Explain stencil printing process
2. List the printer operations in stencil printing
3. Set different parameters in printing machine

The process of solder paste printing involves depositing a specific volume of paste or a brick on the correct location on a substrate. It is required to fill the stencil aperture with solder paste using a squeegee blade. The aperture's orientation with respect to the squeegee blade and its speed have influence on the filling process. The following diagrams show the process of stencil printing:

Fig.5.2.1: Stencil printing process

5.2.1 Printer Operations in Stencil Printing

In the stencil printing process, a printer must be able to carry out several operations to complete the print cycle. The following figure lists the operations:

Transport and mounting

Alignment

Printing

Inspection of solder paste deposits

Cleaning of the underside of the stencil

Fig.5.2.2: Printer operation

The complete operation cycle time is important in determining the throughput and capacity of a surface mount line. To avoid inspection adding to the cycle time, it is often carried out as an offline operation or using a separate work station.

There are many variations in the way mounting, alignment and cleaning are implemented.

The following image shows a solder paste printer of model SJ Inno Tech HP-520S:

Fig.5.2.3: Solder paste printer of model SJ Inno Tech HP-520S

5.2.2 Setting up Printing Machine

The EMS technician needs to have knowledge of printer settings and components for different components, PCBs and solder paste.

The following figure lists the process steps for the screen printing:

| Load the PCB, and apply soldering paste over SMD pads on the PCB. | → | Place the board in alignment with stencil cuts outs on the pasting platform. | → | Set the height/thickness of the board in the machine. |

| Pass the board to the visual inspection table via conveyor. | ← | Set the squeegee pressure. | ← | Mix the paste homogeneously. |

After approval start mass production.

Fig.5.2.4: Process steps for the screen printing

The conditions and settings are listed as follows:

- **Squeegee**

Squeegees have an elastic blade made from rubber, in particular, polyurethane rubber is widely used. The hardness of the rubber is an important condition; hardness in the range 60 to 90 degrees is appropriate.

There are three cross sectional shapes used for the tip of the polyurethane squeegees described above: flat, angled, and acute.

More recently, metal squeegees that are resistant to wear and have superlative stability in the amount of solder applied have become available commercially.

During printing, it is desirable to reduce the squeegee tip pressure and print at a low speed. In this case, a phenomenon called rolling, in which the solder paste is rolled in, can be observed.

- **Printing gap (separation between the PWB and the stencil)**

If the printing gap is too small, bleeding can occur and if too large, problems such as variations in the form of the printed solder and scattering of solder when separating the work may occur. Therefore, an appropriate gap must be set.

In recent contract printing technology, this printing gap is set to 0. However, adoption of contact printing requires the use of printing equipment that supports low printing pressures and speed control when separating the screen from the work.

- **Printing pressure**

The actual printing pressure is generally around 5 to 10 g/cm^2. However, this is the pressure at the tip of the squeegee and can be influenced by the way the squeegee collapses under this pressure. Care is therefore required when determining the printing pressure.

More recently, printing equipment that provides a floating squeegee structure to achieve lower and more even printing pressures have become available commercially.

- **Squeegee speed**

During printing, a squeegee speed in the range 5 to 50 mm/s is used. However, it is important to slow the squeegee speed as much as possible so that the rolling of solder paste takes place.

- **Screen removal speed**

The shear elastic force that occurs between the solder paste and the stencil after printing at screen separation can be suppressed by controlling the speed of screen removal, and the solder paste's ease of screen removal characteristics can be improved. The following figure shows shear elastic force between stencil and solder paste:

Figure 3.2 Shear Elastic Force Occurring Between Stencil and Solder Paste

Fig.5.2.5: Shear elastic force between stencil and solder paste

- **Temperature and Humidity**

The screen printing of solder paste should be performed between a temperature of 20° to 26° C. The relative humidity of the application area should be kept between 35% to 65%. Solder paste not applied to PCBs should not be returned to the container from which it was taken.

Parameters Used in Printing Machine

There are two supply methods for solder paste: dispenser supply and printing. Usually, printing is selected for its mass production efficiency. An EMS technician should know the parameters of printing and set them accordingly. The following figure lists the printing parameters:

Printing precision	Printing equipment with image recognition functions is used for solder printing for fine pitch devices (e.g. 0.5 mm and finer pitch QFP and 0.8 mm and finer pitch BGA packages).
	The printing precision of current printing equipment with image recognition functions is ±0.025 to ±0.05 mm.
Printed form (of the solder)	Factors that can influence the printed form include the type of the stencil, the surface shape and surface processing on the mounting pads of printed wiring board, the printer settings and conditions, and the solder paste used.

Fig.5.2.6: Printing parameters

Activity

1. List the conditions and the parameters to be set for the printing machine before the printing starts.

    _____
    _____
    _____
    _____
    _____
    _____

2. Write down steps for the screen printing process.

6. Load Stencil, Boards and Program Printing Machine to Apply Solder Paste

Unit 6.1 – SOPs before Printing

Unit 6.2 – SOPs after Printing

ELE/N5201

Key Learning Outcomes 💡

At the end of this module, you will be able to:

1. List the tasks to be accomplished before the printing starts
2. List the do's and don'ts for applying paste
3. Demonstrate attaching stencils and securing of boards
4. Check printing settings and parameters
5. List the tasks after the pasting and printing operations
6. Inspect print quality and paste measurement

UNIT 6.1: SOPs before Printing

Unit Objectives

At the end of this unit, you will be able to:

1. List the tasks to be accomplished before the printing starts
2. Identify how to load program
3. List the do's and don'ts for applying paste
4. Demonstrate attaching stencils and securing of boards
5. Check printing settings and parameters

Before the printing machine is set up according to the required parameters and specifications, the EMS technician must ensure that the boards are secured to the machine and the specified program is loaded. The following figure lists the tasks to be accomplished before the printing starts:

Load specified programs on the machine's computer

•Apply paste using automated application process

•Attach the stencil and board to printing machine

•Secure the PCBs

•Verify printer settings

Fig.6.1.1: Tasks to be accomplished before the printing starts

6.1.1 Load Programs

After the schematic for the circuit is designed, the schematic design gets translated into Gerber format through an electronic design automation (EDA) software package such as KiCAD, Altium Designer, Eagle, Allegro or ExpressPCB. This PCB design software contains list of components used to build the circuit. Design is exported into Gerber format which serves as a set of instructions that are followed in the production of printed circuit boards.

Some machines use a touch screen interface for accomplishing simple system operations. The programming for the machine can be achieved by entering the location of the holes or by loading the offline programming.

The operator interface allows simple programming and automatic setup through a touchscreen interface.

Some system makes the program by itself, and also the operator can easily output, input, edit and save the data with computer.

The technician needs to load the specified program file on to the machine so that the printing is done as per the design.

6.1.2 Applying Paste

The technician needs to apply paste on the board using automated application process. It needs to be ensured that as precision fixture, an optimized program overlay is used. Solder paste is used for connecting the leads of surface mount devices to attachment points in circuit patterns designed on a PCB. The paste is applied using a stencil to the intended lands to "print" the paste on the board. The paste is then melted by heating, leading to fusing the connection.

Consistency and uniformity are very important for any successful solder paste material. To ensure that a predicable paste printing operation produces a specific pattern definition, these qualities are required. The basic requirement for a solder paste is a stable and homogeneous mixture of atomized metal alloy in combination with a binder, flux and solvent system that removes the possibility of later separation of the respective materials.

The following figure lists the do's and don'ts for applying solder paste:

Do's	Don'ts
☐ ➤Always keep solder paste in cool and dry place(below 10°c).	☐ ➤Don't touch paste with bare hand.
☐ ➤Always use glove & goggle.	☐ ➤Don't inhale the vapors coming from solder paste.
	☐ ➤Don't overheat the solder paste as it produces metal fumes that leads to metal poisoning.

Fig.6.1.2: Do's and don'ts for applying solder paste

6.1.3 Attaching Stencils and Securing Boards

The printing process starts with loading board into the printer. The internal vision system helps in aligning stencil to the board. After the stencil is aligned to the board, solder paste is squeegeed over the openings.

Amount of paste on board, will be determined by the thickness and size of the openings, once the stencil is removed. The right amount is important for effective electrical connections. Hence, the right stencil must be attached to the system properly.

Framed and Prototype Stencils

Solder paste stencils are used to apply the solder paste easily and accurately. Stencils are used for saving time and ensuring consistency as compared to manual application, especially when PCBs are handled in bulk. The two types of stencils are as follows:

Framed stencil: Framed stencils are equipped with a specific style of mounting hardware (the frame) to get it attached to the screen printing machine. The following image shows framed stencil:

Fig.6.1.3: Framed stencil

The following figure lists two types of framed stencil:

• Fixed frame stencil

☐ These range in size from 15"x15" up to 23"x23" and use either a solid (extruded) or hollow aluminium frame to hold the stencil.
☐ The stencil is permanently attached to the frame.

• Universal frame stencil

☐ These stencils allow changes to be made to the stencil as needed.
☐ This helps in manging overall costs because only a frameless stencil needs to be purchased while reordering, without the need of complete stencil replacement.

Fig.6.1.4: Types of framed stencil

1. **Prototype Stencils:** Prototype stencils are not mounted to a frame. To stiffen the stencil and to provide handles for the user, a right angle is formed by bending three edges of the stencil. This creates a sink for the paste. The following figure lists the steps to use the prototype stencil:

Place the PCB and L-shaped board fixtures and tape down the fixtures to prevent movement.

Align stencil over SMT pads and tape the flat edge to L-shaped bracket.

Apply solder paste along an edge of prototype stencil.

Deposit paste using squeegee over the apertures to deposit paste.

Fig.6.1.5: Steps to use prototype stencil

Secure Boards

The printing operation must be controlled carefully as misalignment can result in several defects. The board should be secured properly in beginning of the process. A snugger and several vacuum holders secure the X and Y axes of the PCB. Vacuum holders should be used carefully as misalignment can affect pin-in-paste printing process.

It is important that the PCB is held flat against stencil during the printing process. The squeegee angle is usually between 45-60 degrees. If the PCB is not completely supported, it may cause printing defects such as improper paste deposit and smudging. Generally, PCB supports are supplied with the printing machines. These supports are placed at a fixed height and contain programmable positions ensuring a consistent process. There are also adaptable PCB supports available in different designs that adjust themselves according to the PCB. They are useful for the double-sided PCB assemblies.

The following image shows an adaptable PCB support in use:

Fig.6.1.6: Adaptable PCB support in use

6.1.4 Verifying Printing Settings and Parameters

The technician should verify the printer settings for high-quality solder paste printing. The critical parameters are as follow:

1. **Print speed**: Printing speed for solder paste should usually be in the range of 20 to 80 mm per seconds. This is an important factor and can compromise the printing quality. A printing operation has an approximate speed of 15 to 45 seconds per board. Speed of the print head is generally 1 to 8 inches per second.

2. **Print/squeegee pressure**: While printing, squeegee pressure is used to scrape the stencil clean of solder paste particles. It should be as low as possible. The type of stencil and the printing speed determine the amount of pressure.
    The following table lists some parameters for setting the squeegee:

Squeegee length	Angle	Blade thickness	Used for
14 inches	60°	0.2mm	>14inchs
24 inches	60°	0.2mm	10-24inchs

3. **Separation speed:** It is important to separate the stencil from the PCB immediately after the printing operation. While printing a fine pitch, very fast separation speed will result in clogging of the stencil apertures. It also results in tailing and formation of high of edges around paste deposits**.**
4. **Distance:** The gap between the stencil underside and the PCB placed in print position is called snap off. In this position, the squeeze does not touch the stencil. A high snap off results in a thicker solder paste layer.
    *   The snap off needs to be zero in metal stencil printing, also called contact printing.
    *   The snap off needs to be in between 0.5 and 3.0 mm in mesh screen-printing.

The following diagram shows the position and settings at the starting of the solder paste printing:

Fig.6.1.7: Position and settings at the starting of the solder paste printing

5. **Printer alignment:**

The stencil, boards and the squeegee need to be aligned properly to get a fine printing. The technician needs to take care of the printer alignment.

Activity

1. Fill in the blanks to classify the stencils.

```
                    ┌──────────┐
                    │  Stencil │
                    └────┬─────┘
           ┌─────────────┴─────────────┐
     ┌─────────────┐           ┌─────────────┐
     │             │           │             │
     └──────┬──────┘           └─────────────┘
            │
     ┌──────┴──────┐
     │             │
     └──────┬──────┘
            │
     ┌──────┴──────┐
     │             │
     └─────────────┘
```

2. Write down the standard speed for the following parameters.
   - Printing speed for the solder paste: _____
   - Print head speed: _____
   - Printing speed per board: _____

3. List the do's and don'ts for applying the solder paste on the board.

Do's	Don'ts

UNIT 6.2: SOPs after Printing

Unit Objectives 🎯

At the end of this unit, you will be able to:

1. List the tasks after the pasting and printing operations
2. Inspect print quality and paste measurement
3. Explain the process of Z-check solder paste inspection

After the paste is applied, the technician is required to check that the paste is applied on the board at the intended places. He/she should clean the PCB and polish the boards and ensure that the paste release is even to provide a finish as per standards. The following figure lists the tasks after the pasting and printing operations:

Inspect the components

Inspect the paste

Deliver PCBs

Fig.6.2.1: Tasks after the pasting and printing operations

6.2.1 Inspection of Components

The technician should inspect the components placed the board after the board is cleaned. He/she must ensure that there is no leakage through the stencil holes to areas other than intended.

6.2.2 Inspection of Paste

In order to verify the printing process accurately, the technician needs to check solder paste deposits. He/she must ensure that all parts are printed evenly and the paste is within expiry date. The following figure lists some points about the expiry of the solder paste:

Solder paste which is being used for more than 8 hours should be disposed of.

Solder paste in use for up to 4 hrs, can be stored in a sealed container at room temperature for up to 24 hours before being re-used.

The solid paste should be refrigerated while being stored.

Before use, the solder paste must be brought to room temperature for a minimum of 8 hours and should be mixed to ensure even distribution.

Fig.6.2.2: Some points about the expiry of the solder paste

The following figure lists the types of inspection available:

2D Inspection: Checks the area of the paste deposit

3D Inspection: Checks the volume of the paste deposit

Fig.6.2.3: Types of inspection available

Print Quality

Visual assessment of paste deposits offers a quick and helpful guide to check that the process is under control. Best results are obtained with relatively low magnification using a magnifier.

The following image shows some possible solder paste print inspection results:

Fig.6.2.4: Possible solder paste print inspection results

The slumped print usually occurs in a process run at temperatures higher than the recommend level. The scavenged print takes place if squeegee pressure is too high and scooping occurs. Bridging can be caused due to improper board support or poor stencil condition and cleanliness. Peaking is usually observed if the separation speed of the stencil is too high.

Paste Measurement

The measurement of the paste deposit is crucial to quality control. The technician needs to check:

- Whether the whole of the intended pattern has been printed
- The volume of the paste deposit, for which the paste height is a convenient proxy measurement

The methods of evaluating a print vary between fully automated inspection, both for coverage and paste height, and occasional operator visual checks. There is a trend towards building in automatic checks when the print cycle ends. There are variations in practice between different manufacturers and users, depending to some extent on the required cycle time and the sophistication and speed of the optical arrangements.

Optical inspection for coverage relies on a visual difference between a pasted and bare pad. This is easy when printing onto a nickel gold finish, but very much more difficult when printing onto solder surfaces.

The so-called Z-Check for paste height is carried out easily with a light section microscope.

The following figure lists the process of Z-check solder paste inspection:

➤Turn on the machine.

➤Check whether the assembly program is existing or not. If yes, open the file.

➤If it is a new assembl,y create a new program.

➤Carefully place the board on the table.

➤The PCB should be ideally placed so that the pad is positioned at the top of the machine screen.

➤Select five pads per board and measure the board for validation of paste height.

➤If it is not under limit, inform the machine operator to change the machine parameter.

➤After changing the parameter, revalidate the board.

➤If it is under limit, it is acceptable & ready for production.

➤Check paste height for every first and last board of running assembly.

➤Upper limit should be 2mil and lower limit should be zero from the stencil thickness.

➤Standard paste height is 5mil.

Fig.6.2.5: Process of Z-check solder paste inspection

6.2.3 Delivering PCBs

The technician should inspect the components, inspect the paste quality and print quality. After inspection, if the boards are rightly printed, the PCBs are delivered for the later stages of manufacturing. The PCBs need to be delivered for mounting within five hours or less after stencil printing.

After the production, the technician needs to unload the stencil, remove the squeegee, clean them using IPA solution and place the stencil back to its appropriate place in stencil rack and place squeegee back to appropriate place.

Activity

1. Write down the functions of the following inspection.

2D Inspection

3D Inspection

2. Fill in the blanks.
   - Solder paste which is being used for more than _____ should be disposed of.
   - Solder paste in use for up to _____, can be stored in a sealed container at room temperature for up to _____ before being re-used.
   - Before use, the solder paste must be brought to room temperature for a minimum of _____ to maintain quality.

7. Undertake Preventive Maintenance of the Machine

Unit 7.1 – Preventive Maintenance of the Machine

Key Learning Outcomes

At the end of this module, you will be able to:

1. List the tasks to be accomplished for preventive maintenance
2. Identify the maintenance schedule
3. Explain maintenance checklist for a technician
4. List the work standards to be followed

UNIT 7.1: Preventive Maintenance of the Machine

Unit Objectives

At the end of this unit, you will be able to:

1. List the tasks to be accomplished for preventive maintenance
2. Identify the maintenance schedule
3. Explain maintenance checklist for a technician
4. List the work standards to be followed

The solder printing machine and the inspection machines need maintenance so that repeated errors and machine malfunctioning and breakdown can be prevented.

The following figure lists the tasks to be accomplished for preventive maintenance:

- The machine should be handled carefully and collision should be avoided.

- Machine calibration should be done once in a year**.**

- Regular cleaning of the machine and its components needs to be performed.

- A checklist for preventive maintenance schedules should be maintained.

- Work standards defined by the organization should be followed.

Fig.7.1.1: Tasks to be accomplished for preventive maintenance

The following figure lists some good practices for handling electronic assemblies and machines:

Keep workstations clean and neat. Do not eat, drink, or use of tobacco products in the work area.

Change gloves frequently to prevent contamination from dirty gloves.

Do not handle solderable surfaces with bare hands or fingers.

Do not use hand creams or lotions containing silicone since they can cause solderability and conformal coating adhesion problems.

Never stack electronic assemblies or physical damage may occur. Special racks may be provided in assembly areas for temporary storage.

Always assume the items are ESDS even if they are not marked. Never transport ESDS devices unless proper packaging is applied. Follow appropriate ESD practices and procedures.

Fig.7.1.2: Best practices for handling electronic assemblies and machines

7.1.1 Maintenance Schedule

The following figure lists the types of maintenance:

Annually

Monthly

Weekly

Daily

Fig.7.1.3: Types of maintenance

The following table shows a maintenance checklist for a technician for all types:

Maintenance type	Task	Status (Completed/ Not completed)	Date
Daily	Remove the left-over paste and other debris from machine.		
	Clean the monitor screen and the top cover.		
	Check or replace stencil cleaner paper.		
	Check or replace solvent.		
	Check the automatic paste dispenser, if installed. Replace it if required.		
Weekly	Complete all the daily action items.		
	Visually check the conveyor belts as well as the board foil clamps.		
	Clean the edges (both top and bottom) of board supports.		
	Clean the camera prism lenses.		
	Clean individual board supports.		
	Check the squeegee condition.		
	Check solvent tank for leaks.		
	Check wiper blade and solvent tube for paste deposits.		

	Check the squeegee blade contact with the stencil.		
Monthly	Perform weekly maintenance tasks.		
	Wipe print carriage bearings using oil.		
	Wipe camera guide rails and the stencil cleaner with oil.		
	Wipe print carriage bearings with oil.		
	Inspect stencil wiper, solvent tubes, hoses and solvent bar.		
Annually	Re-grease the camera rack.		
	Re-grease printhead carriage bearings.		
	Re-grease the stencil cleaner bearings.		
	Re-grease the table rising bearings.		
	Re-grease the camera carriage.		
	Check conveyor belts.		
	Check squeegee drive belts.		
	Check squeegee bearing movement.		

7.1.2 Following Work Standards

The following figure lists the work standards that a technician needs to follow to maintain the equipment:

1. Setup the production equipment and supplies before executing the job orders.

1. Operate equipment safely and effectively for production processing.

1. Ensure that equipment is maintained in good and safe working condition.

1. Inspect equipment to identify any replacements, malfunctions and repairs.

1. Perform regular equipment maintenance to ensure production capacity and quality.

1. Provide assistance to junior operators in their assigned responsibilities.

1. Repair and clean the equipment when needed.

1. Work under the guidance of Supervisor to perform and complete the assigned duties in timely manner.

1. Evaluate equipment performance and recommend improvements.

1. Operate trucks and other industrial vehicles to transfer the production equipment between warehouse and working area.

1. Follow safety procedures and company policies for equipment operation.

1. Recommend process improvements to enhance operational efficiency and safety.

1. Contribute to waste management programs.

1. Identify and report unsafe operations to Supervisor immediately.

1. Maintain the work area clean, safe and organized.

Fig.7.1.4: Work standards to maintain the machine

Activity

1. Create a daily and weekly maintenance checklist.

Maintenance type	Task	Status (Completed/ Not completed)	Date
Daily			
Weekly			

8. Operate Pick-and-Place Machine for PCB Assembly

Unit 8.1 – Identification of Components

Unit 8.2 – Pick and Place Machine Operations for PCBA

ELE/N5102

Key Learning Outcomes

At the end of this module, you will be able to:

1. Explain surface mounted devices (SMD)
2. List the advantages and disadvantages to SMD
3. Identify the types of SMT components used in pick and place machine
4. List the resistors and capacitors used as SMDs
5. Identify the transistors, diodes and ICs
6. List the tasks during the pick and place machine operations
7. Identify different types of solder paste for different SMD packages
8. Demonstrate how to load program
9. Identify how to program the coordinates
10. Perform troubleshooting and optimization of pick and place machine

UNIT 8.1: Identification of Components

Unit Objectives

At the end of this unit, you will be able to:

1. Explain surface mounted devices (SMD)
2. List the advantages and disadvantages to SMD
3. Identify the types of SMT components used in pick and place machine
4. List the resistors and capacitors used as SMDs
5. Identify the transistors, diodes and ICs

Surface mounted devices (SMD) are electronic components, active and passive, without having any conventional connecting wires.

In THT, the components are placed on PCB's components side, with the wires inserted through holes and then soldered to copper pads on the solder side of the board.

In SMT, the SMD components are placed on solder side with their metal caps soldered to the copper pads. Both layers of the PCB can be used as active areas. PCBs used for SMD have thickness between 0.8 and 1.60 mm.

SMD Advantages
The following figure lists some advantages of SMDs:

- PCB area is much smaller than that containing conventional through - holes components.

- Since the both layers of the PCB could be used for assembling, the final PCB area for the same circuits could be decreased by 50 %.

- Automatic assembling is very easy resulting in low cost of the assembling.

- Small size of components makes very high packing density possible. For the same circuits a volume of a module assembled with SMD could be reduced to 30 % of the device assembled with the conventional technique.

- Very high resistance to mechanical shock and vibration.

- Low storage and transport cost.

Fig. 8.1.1: Some advantages of SMDs

SMD Limitations

The real purpose of the SMD applications is maximal packing density and reduction of volume of the modules. The following figure lists some disadvantages of SMDs:

•Use of ICs with a high amount of the pins (raster 0.5 to 1.27 mm, max. 148 pins) makes routing of the traces between IC pins impossible.

•Design of SMD layout is very complex.

•High packing density brings thermal problems. Power dissipation of the power components is transferred directly through a copper layer of the PCB.

•Not all SMD components are labelled with a clear text. Moreover, very often the components have no labels at all.

•Repair is more complex and difficult than the conventional components.

Fig. 8.1.2: Some disadvantages of SMDs

8.1.1 SMT Component Identification

The method of identifying the electronic components by looking at the package is known as SMT component identification. This helps to identify the basic function of a board in the PCB. To make it easy to identify the electronic components known as surface mount devices (SMD), an SMD code book is used. Cleaning the circuit board also helps in identifying the mounted components on the circuit board. The following image shows SMT component identification:

Fig. 8.1.3: SMT component identification

The types of components which may be placed are restricted by the types of feeders that may be interfaced to the placement system. The following lists some representative

component types which are being automatically picked and placed by placement systems of the latest design:

Chips	Chip-scale Package (CSP)	Quad Flat Package (QFP)
Ball Grid Array (BGA)	Metal Electrode Leadless Face (MELF)	Small Outline Integrated Circuit (SOIC)
Plastic Leaded Chip Carrier (PLCC)	Thin Small Outline Packages (TSOP)	Flip Chip

Fig. 8.1.4: Types of SMT component used in pick and place machine

The SMT components can be categorized as shown in the following figure:

Passive SMDs	Transistors and diodes	Integrated circuits (ICs)

Fig. 8.1.5: Types of SMT components

8.1.2 Passive SMDs

The passive SMDs consist mainly of resistors or capacitors. With time, the size of SMT components has reduced. Other components such as coils and crystals are also included as per the requirements. The various passive SMD packages can be classified according to their sizes. The following table lists various standardized packages:

SMD Package Type	Dimensions (Inches)
1812	0.18 × 0.12
1206	0.12 × 0.06
0805	0.08 × 0.05
0603	0.06 × 0.03
0402	0.04 × 0.02
0201	0.02 × 0.01

Fig. 8.1.6: Standardized packages of SMD

SMD Resistors

SMD resistors are available in rectangular form as a chip or in cylinder form as a MELF. In SMT, "zero W resistors" are used instead of jumpers. These are available in all standard dimensions of SMD resistors and are coded with "000".

The popular resistors case forms are **1206** (w = 1.6 mm, L = 3.2 mm, h = 0.6 mm, Pmax =0.25 W) and **0805** (w = 1.25 mm, L = 2 mm, Pmax = 0.125 W).

The resistance values range between 1 W and 10 MW.

Chip resistors are manufactured using the thick film technique on a ceramic substrate. They contain metallic areas on narrow ends of the chip, that allows soldering. These resistors can be soldered using all the common soldering techniques such as reflow, wave and solder iron. The following image shows resistors with different resistance:

Fig. 8.1.7: Resistors with different resistance

The following figure shows how resistance is calculated from the resistor code:

A = 1st digit of the resistor's value

B = 2nd digit of the resistor's value

C = number of zeros

Fig. 8.1.8: Resistance calculation from the resistor code

Ceramic Multilayer Chip Capacitors

These are available with a very wide range of values, from 0.47 pF to 1 mF. The most popular case forms for these capacitors are **0805** and **1206**. Unfortunately, these components are not marked with colour code or any digital values. The following image shows the polarity of capacitors:

Fig. 8.1.9: Polarity of capacitors

The following diagram and table list the ceramic multilayer chip capacitors' case forms:

Case Form	L (mm)	B (mm)	H (mm)	A (mm)
0508	2.0	1.25	0.51 to 1.27	0.25 to 0.75
0603	1.6	0.8	0.80	
1206	3.2	1.6	0.51 to 1.6	0.25 to 0.75
1210	3.2	2.5	0.51 to 1.9	0.3 to 1.0
1808	4.5	2.0	0.51 to 1.9	0.3 to 1.0
1812	4.5	3.5	0.51 to 1.9	0.3 to 1.0
2220	5.7	5.0	0.51 to 1.9	0.3 to 1.0

Fig. 8.1.10: Ceramic multilayer chip capacitors' case forms

SMD Tantalum Capacitors

These are available in different case forms. The positive polarity is marked by a white "M" or a white line. The case forms depend of nominal voltage and capacitance value. These capacitors are available in following standard sizes:

• 7.3 x 4.3 mm

• 6.0 x 3.2 mm

• 3.5 x 2.8 mm

• 3.2 x 1.8 mm

The values are coded with alphanumerical characters or with digits.

8.1.3 Transistors and Diodes

The connections of these SMT components are made through leads that come in the package. The leads are bent a little which make the components able to be mounted on the circuit board. There are three leads for the packages and that makes it easy to recognize which way the devices need to go.

Almost all standard diodes and transistors are available as SMD components as small outline transistor (SOT) in following cases: 23, 89 and 143. Electrical parameters of these SMD components are the same as comparable standard types. For the components with power dissipation from 200 to 400 mW, SOT 23, 143 cases are used. For power dissipation from 500 mW to 1W, SOT 89 cases are used.

8.1.4 IC

Logic chips
- For iCs, different kind of packages are used depending on the level of interconnectivity.
- Simple logic chips require only 14-16 pins, whereas the VLSI processors need 200 or more pins.

SOIC/SSOP
- For much smaller chips, Small Outline Integrated Circuit (SOIC) can be used or the Thin Small Outline Package (TSOP) and Shrink Small Outline Package (SSOP) can be used.

VLSI/BGA
- Very Large Scale Integration (VLSI) chips need quad flat pack which has a square/rectangular shape with pins on all four sides.
- Ball Grid Array (BGA) has connections on the sides of the package and the connection pad.

The following figure shows the major types of ICs:

Fig. 8.1.11: Major types of ICs

Activity

1. Write the full form of the following abbreviations.

    CSP: _____

    TSOP: _____

    SOIC: _____

    MELF: _____

    BGA: _____

2. Calculate the resistance value of a resistor with imprint value 122.

UNIT 8.2: Pick and Place Machine Operations for PCBA

Unit Objectives ⌖

At the end of this unit, you will be able to:

1. List the tasks during the pick and place machine operations
2. Identify different types of solder paste for different SMD packages
3. Demonstrate how to load program
4. Identify how to program the coordinates
5. Perform troubleshooting and optimization of pick and place machine

Pick and place systems are widely used in the manufacturing of today's SMT electronics circuit boards. Using these pick and place machines, it is possible to accurately place large number of components quickly and accurately onto circuit boards.

With some circuit boards using over 1000 SMT components, including very small ones and requiring very accurate placement, it is not practical to manually place them. Pick and place machines are used to place the components in a repeatable fashion. The technician needs to identify the components to check that right components are placed on the machine reel and they are ready to be placed on the board.

The following figure shows the process flow of PCBA using the pick and place machine:

Apply solder paste → Pick and place components → Reflow → Test

Fig. 8.2.1: Process flow of PCBA using the pick and place machine

To accomplish the PCBA process, the EMS technician needs to perform some certain tasks other than the identification of the components. The following figure lists the tasks of the technician during the pick and place machine operations:

- •Inspect printed solder paste for accuracy
- •Load specified programs on machine's computer
- •Program the coordinates as per specifications
- Perform the steps to troubleshoot and optimize the program

Fig. 8.2.2: Tasks of the technician during the pick and place machine operations

8.2.1 Inspection of Printed Solder Paste

To operate the pick-and-place machine, all the components must be well placed and the paste needs to be applied properly for PCB assembly.

There are varieties of solder paste available for different SMD packages. The following figure lists the solder paste for different SMD packages:

Solder paste for Standard SMD Packages

- The selected solder paste should be formulated so as to eliminate potential breakdown of the metal, flux, binder, and solvents combination or the premature drying of the solder paste on the printer.
- The selected solder paste should be formulated so as to prevent slump and provide over 8 hours of screen working life, with no presence of skipping, scooping and clumping during printing.
- For stencil printing of standard pitch SM packages, the metal alloy powder's shape, size and content should remain the same but the viscosity should be increased to 700,000 or 800,000 centipoise.
- In most cases, R, RMA and RA rosin-based fluxes are removed using an aqueous de-ionized heated water cleaning system, augmented with a saponifier or another surfactant additive. The resultant cleaning water should produce biodegradable saponified products.

Solder Paste for Fine Pitch SMD Packages

- Those solder pastes specifically designed for high lead count; fine pitch packages with lead spacing of 0.015 require a unique formulation for stenciling, screening and automatic point to point dispensing.
- Solder pastes specifically formulated for fine pitch SM components should incorporate all of the previously cited qualities, plus a flux system developed specifically to ensure that no slumping occurs while still in the wet stage. Fine pitch solder paste should not produce bridging, shorting or solder balling when the paste experiences the reflow.
- As is in the case of Standard Pitch SM components, R, RMA and RA rosin-based fluxes will normally be removed using hot de-ionized water, augmented with a surfactant or other additive.

Water Soluble Solder Paste for Fine Pitch SMD

- Water soluble solder pastes should display all of the stencil or screen printing qualities displayed by conventional rosin based pastes, but should also eliminate the need for chlorofluorocarbons, chloro carbons or other solvent blends sometimes used for rosin-based flux residue removal.
- Water soluble pastes should not be hygroscopic and should be formulated to provide up to 8 hours of screen working life and 48 hours of tack time similar to rosin-based pastes.
- Water soluble, fine solder pastes should be halogen-free. The water-soluble residues should be capable of being cleaned to the extent that they are equivalent in performance, water extract resistivity and SIR values to standard RMA fluxes. Flux residues should be able to be removed with a cool presoak followed by a 60°C spray.

Fig. 8.2.3: Different solder paste for different SMD packages

8.2.2 Loading of Specified Programs

The pick and place machine uses a vacuum grip to pick up a PCB board and moves it to the pick and place station. The machine then adjusts the PCB at the station and starts applying the SMDs to the PCB surface. The components are placed in pre-programmed locations on top of the soldering paste.

The machine requires to be programmed so as to precisely mount components on to a PCB. For this, the software program of a pick and place machine should be able to communicate effectively with the hardware. The following image shows a PCB layout:

Fig. 8.2.4: PCB layout

The technician should check the printed solder paste on the PCB to ensure that it is applied at the right places on the board and in right amounts.

To make the pick and place machine operate without any errors, right text files containing the component's name, location and rotation angle are needed. To load a program in the machine's computer, a technician needs to:

- Collect the right text files that contains the information about component's placement.
- Load the program data into the computer associated with the machine
- Perform parts registration

The technician should keep in mind that:

- The component coordinates should be read properly.
- If there is a deviation even in millimetres, the scale factor in XY scaling field should be used.

8.2.3 Program the Coordinates

To make the PCB work, two coordinates i.e. X AND Y are set and given the values. Their importance is explained below:

X-Y Coordinates on PCB

The X-Y coordinate values on a PCB are obtained by dividing it into the plurality of sections. The number of electronic components is printed, based on the X-Y coordinate values of the corresponding section serial number. Basically, the X-Y coordinate gives the corresponding section serial number of the component for accurate mounting on the circuit board.

The following image shows the mapping of X-Y coordinates on a PCB:

Fig. 8.2.4: Mapping of X-Y coordinates on a PCB

Once the PCB is assembled, the X-Y coordinates come-in handy at the time of repair, maintenance or board artwork. Also, if a new component has to be added or removed, then it can be easily identified on the section of the PCB.

8.2.4 Troubleshooting and Optimization

Pick and place machine can encounter software errors just like the hardware errors, and the machine operator needs to troubleshoot at the earliest to avoid any downtime.

Some of the most common occurring errors that are attributed to software glitches are listed in the following figure:

Machine Cover Open Error	Pick Retry Fault	Adjusting Number Failed Attempts
•There can be instances when the pick and place machine cover is closed but still, the program shows the error that it is open. •To solve this issue, re-align the permanent magnet on the hood. •If that does not solve the issue, then try and install a strong magnet on the side of the cover, which will then be sensed by the proximity sensor.	•This error is encountered when there is a component on the tip, due to inadequate vacuum pressure threshold or a misaligned piece. •To resolve it, drop the component by turning off the tool suction and moving the head manually to an empty spot.	•Sometimes there can be an error in the Pick Retry attempts in pick and place operations. •To solve this, the feeder needs to be advanced manually with controls on the reel or feeder control in the computer program. •Another method is that one can change the Pick Retry attempts in the Parameters window to make the machine try for more attempts after the initial failure.

Fig. 8.2.5: Common software errors

Activity

1. List the software errors of a pick and place machine.
    a. _____
    b. _____
    c. _____

2. Write down the process flow of pick and place system operations.

9. Load Components and Operate the Machine for Assembling on PCBs

Unit 9.1 – Parts of a Pick and Place Machine

Unit 9.2 – Pick and Place Machine Operations

ELE/N5102

Key Learning Outcomes

At the end of this module, you will be able to:

1. Explain pick and place machine briefly
2. List the parts of a pick and place machine
3. Perform setting up of the machine for operation
4. List the steps of loading or reloading the feeders
5. Monitor the equipment and the operations
6. Maintain records of assembly
7. List the ESD handling and contamination handling practices

UNIT 9.1: Parts of a Pick and Place Machine

Unit Objectives ◎

At the end of this unit, you will be able to:

1. Explain pick and place machine briefly
2. List the parts of a pick and place machine
3. Explain the main features of commonly used SMT machines

9.1.1 Pick and Place Machine

Pick and place machines pick the components from the packaged forms of components or the reels and place the components on the PCBs. The machines are pre-programmed with the information about component positions so that they are aware of where to place them. This program is created directly from PCB design information.

The component placement system must meet the requirements to keep in pace with the trends of continued down-sizing of the component package and higher board densities. This is enabled by employing a computer controlled, highly accurate, camera directed placement nozzle which is responsible for constraining the component during pick-up through push-off after placement.

To enable the placement system producing high density, high speed and accurate component placements, the system may be equipped with the following elements:

- Vision correction system
- Computer controller
- Component body height adjustment
- Windows or vendor software
- Z-Axis placement programmability
- Single head and dual head - Multiple programmable nozzles
- Dual Work Table - 12 heads with 3 nozzles per head

The following image shows a pick and place machine of model Mirae Mx200LP pick and place machine:

Fig. 9.1.1: Mirae Mx200LP pick and place machine

9.1.2 Parts of Pick and Place Machine

The following figure shows different parts of a pick and place machine:

| Working Head | Working Zone | Feeding Zone | Reel Rack | Nylon Spool Wheel | Operation Panel |

Fig. 9.1.2: Parts of a pick and place machine

Working Head

The working heads of a pick and place machine are:

- A Pick and Place Head: Used to pick the components and place them in their correct position.
- A Vacuum Indicator: Used for visualizing the working status with the help of an air pressure sensor.
- A Laser Positioner: Used for editing the coordinates of a component manually.

The following image shows the working heads of a pick and place machine:

Fig. 9.1.3: Working heads of a pick and place machine

The most common technique of picking up the component is using the vacuum nozzle. It is because of the system's ability to create a negative pressure immediately upon making contact with the top surface of the component with the soft rubber nozzle contact, and then reverse the process by producing a positive pressure to blow the component off the nozzle upon placement. Mechanical chucks, although preferred for some time, are expensive to maintain and do present some mechanical difficulties in their operation.

- Vacuum Nozzles
- Mechanical Chucks

Working Zone

The working zone of a pick and place machine consists of the followings:

- A PCB Holder: Used to hold and fix the PCB. It should always be kept clean and flat.

- A Clamp Fixture: Used for holding down the PCB and keeping it fixed.
- A Spring Load Tension Adjuster: Used for adjusting the tension of the holder by moving the spring clamp. It must be kept light while working on a thin circuit board.

The following image shows the working zone of a pick and place machine:

Fig. 9.1.4: Working zone of a pick and place machine

Feeding Zone

The feeding zone of a pick and place machine consists of the followings:

- A Feeding Slot: Used as a fixture to accommodate different sizes of reel tapes.
- A Front Load IC Plate: Used to accommodate large size components other than the reel tape package.

The following image shows the feeding zone of a pick and place machine:

Fig. 9.1.5: Feeding zone of a pick and place machine

Reel Rack and Conveyor Belt

The following image shows a reel rack which is used to hold the reels:

Fig. 9.1.6: Reel rack

The technician needs to identify the components to be placed on the reels accurately, and put them on the reels efficiently.

There is a conveyor belt through the middle of the machine. The blank PCBs travel along the belt. There is a PCB clamp at the centre of the machine to secure the PCB. The nozzles pick up the components from the feeders or components trays, rotate them to the correct positions and orientations and place them on the appropriate pads with high precision. High end machines can contain multiple conveyors that can produce multiple similar or different kinds of products simultaneously. The following image shows a conveyor belt:

Fig. 9.1.7: Conveyor belt

Nylon Spool Wheel

It is used for collecting the nylon string that is on top of the tape. The two types of grooves on the spool wheel are:

- V-groove: Used to keep the nylon string head secured.
- U-groove: Used for adjustment of the tension of the nylon string.

The following image shows a nylon spool wheel of a pick and place machine:

Fig. 9.1.8: Nylon spool wheel of a pick and place machine

Operation Panel

The operation panel of a pick and place machine is used to control the functions of the machine. This panel consists of the followings:

- An SD Card slot: Used to insert the standard SD card containing the data for the placement of the components.
- An LCD: Used as an interface to input the information about the positioning of the components.
- Control Switches: Used to turn to the next or previous items with the help of Right and Left and to go to the items in the rows above or below with the help of Up and Down.

The following image shows the interface of a pick and place machine:

Fig. 9.1.9: Interface of a pick and place machine

9.1.3 Main Features of Commonly used SMT Machines

The following figures lists some features of the machines working with SMT components:

• Vision Assisted Component Placement

- The vision system should include as a basis element of the design, an ability to process (establish X/Y/Theta) the component location on the pick-up head and match the component to the respective component pads.
- To achieve the required placement accuracy, the following is necessary:
  - Gray scale vision processing
  - Component placement algorithms
  - Fiducial (local and global) camera
  - Component pad/lead recognition camera

• Placement Speed

- Although placement speed is typically quoted at approximately 0.1 second per placement, Flip Chip components can take as long as 3.5 to 5.0 seconds per shot (placement).
- Component placement speed is dependent upon such factors as distance which the placement head must travel between component pick-up and placement location, and the requirement to view the component leads/pads for component-to-pad alignment prior to placement
  - Min. 0. 09 sec. per component
  - Max. 0. 12 sec. per component

• Placement Accuracy

- The accuracy to which the component is aligned and placed on the solder pads is contingent upon several factors, such as use of local fiducial marks; datum point location; size of printed circuit board; flatness of printed circuit board; etc.
  - Min. ± 0.025 mm (using local fiducial marks)
  - Max. ± 0.1 mm

• Component Placement Pressure

- Programmable placement pressure can be specified for each component, enabling placement of very delicate parts.

• Printed Circuit Board Dimensions

- Current placement systems are designed to provide the end user with the maximum printed circuit board size in both the X and Y axis.
- Most of the current designs will allow a change in the conveyor rail width to be automatically executed by servo motors by program commands conveyed through the computer controller.
  - Min. 80 x 50 mm (3" x 2")
  - Max. 508 x 457 mm (20" x 18")

Fig. 9.1.10: Some features of the machines working with SMT components

Activity

1. List different parts of a pick and place machine.

    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____

2. Write down the features of the machines working with SMT components.

    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____

UNIT 9.2: Pick and Place Machine Operations

Unit Objectives 🎯

At the end of this unit, you will be able to:

1. Perform setting up of the machine for operation
2. Identify the tools required for pick and place of components
3. Demonstrate how to load components
4. Classify the feeders
5. List the steps of loading or reloading the feeders
6. Explain placement of components
7. Identify how to adjust the PCB transport rails
8. Monitor the equipment and the operations
9. Maintain records of assembly
10. List the ESD handling practices
11. Identify the contamination handling practices

9.2.1 Setting up Machine for Operation

An EMS technician needs to set up the pick and place machine to make it operation ready. After the machine parts are set up, he/she should warm up the machine for a specific time period to start the operation.

Setting up a pick and place machine requires certain steps to be performed, as listed in the following figure:

Set the vacuum tip

Position the circuit board

Route reels and tape via the feeders

Fig. 9.2.1: Steps for setting up a pick and place machine

Routing Reels and Tape Via the Feeders

Proper care should be taken when routing the tape via the component feeder. Setting up tools for machine operations is important to avoid any time or material wastage.

The technician should consider the following points while doing so:

Make sure to get extra length of component tape/reels to avoid wasting electronic components in the process of routing

Have 6-8 inches of dead tape for proper movement until the clear covering is pulled back and clamped into the gold-coloured wheel

Note down which electronic component is put in each of the feeders.

Fig. 9.2.2: Points to be considered for routing reels

The following image shows getting the feeder ready for operation by adding tape and reel to it:

Fig. 9.2.3: Getting the feeder ready for operation

Positioning the Circuit Board

The circuit board is positioned on the machine by using the guide rails. The placement of the board must be locked down with the stopper. The technician must ensure that the guide rails are set perpendicularly to the rails across the machine's length.

Even if the guide rails are slightly tilted, the components cannot be properly placed as the board would not line up with the X and Y axes of the machine. The following figure shows positioning of the circuit board:

Fig. 9.2.4: Positioning of the circuit board

Setting the Vacuum Tip

The technician requires to choose the nozzle and vacuum tip for the accurate placement of the components.

If the obtained dimension of the nozzle is outside the regulated range, the message indicating that no nozzle information is registered appears on the screen.

In this case select the appropriate nozzle number from the "Nozzle no table" dialog box displayed the next. If you do not find any appropriate nozzle number, select the nozzle and enter the correct number manually. The technician needs to set the nozzle number and type to be assigned to the ATC. The following table lists the types of nozzles:

Setting item	Description
Normal	Normal nozzle
T-type	Cleaner type nozzle
Gripper	Gripper nozzle

The following image shows some standard nozzles and nozzles for LED components:

Fig. 9.2.5: Some standard nozzles and nozzles for LED components

The following figure lists the process of setting the nozzle height and vacuum:

To set the nozzle height, the technician needs to set the offset value of the length with viewed from the reference nozzle.

•This value is used to make fine adjustment for controlling the height when the system measures a component with laser.

To set the vacuum, the technician requires to set the vacuum value when a nozzle is mounted on the reference head.

•This value is used to judge whether a nozzle is mounted or whether a component is located on the regulated position by combining with the value set with the (vacuum value without nozzle) menu.
•The value set here is just auxiliary information since the system uses laser to check whether a nozzle is mounted or not or whether a component is located at the regulated position.

Fig. 9.2.6: Process of setting the nozzle height and vacuum

The following figure shows the general steps to start a pick and place machine:

> Start machine by rotating knob in clockwise direction and wait until all machine initializes. System will initialize it's all axis automatically.

> After initialization, select the desired group settings option available. All function will be displayed on the screen.

> Then open file and select the desired program from the list, which is displayed on the bottom.

> Open the lid and adjust the conveyor width according to PCB size.

> Remove any earlier production setting so that current production will display.

> Click on the available option for production.

> Check all feeder loading according to the design and specification.

Fig. 9.2.7: General steps to start a pick and place machine

9.2.2 Setting up Tools

Pick-and-place components can be placed either by hand, or by machine on the PCBs. To accurately complete the assembly of PCB for electronic components, some basic precision hand tools are needed. These tools are made for PCB assembly requirements and have perfect balance for precision work. The following image shows different hand tools for a PCB assembly:

Fig. 9.2.8: Different hand tools for a PCB assembly

The following table lists different hand tools:

Tool	Description	Image
Callipers	Used to measure two sides of an object	
Microscope	Used in a PCB assembly process for viewing very small (microscopic) components	
Screwdrivers	Used for tightening small screws on a PCB	
Tweezers	Used for handling various devices/part sizes and shapes	
Pliers	Used to handle small wires connected to PCB components	
Wire cutters	Used to cut small wires connected to the PCB components	

Stencils	Used to transfer solder paste to the circuit board	
Feeders	Used to feed electronic components to be mounted on a PCB	
Micro spatulas	Used to dispense adhesives in electronics assembly and to apply lubricants	
Supporting pins	Used to secure electronic components to the supporting circuit board	

The small components must be placed on the board by using the right tools and must be handled with care. Otherwise, the components may be damaged or broken.

9.2.3 Loading of Components

Surface mount components are placed along the front (and often back) faces of the machine. The components are supplied in tape reels which are loaded to the feeders that are mounted to machine. Sometimes, larger ICs are supplied in an arranged manner in trays, stacked in a compartment. Generally, ICs are supplied in tapes rather than sticks or trays. The tape format, with the improvements in feeder technology, is becoming the preferred method to present the parts on an SMT machine.

The following image shows placement of components using hand tools:

Fig. 9.2.9: Placement of components using hand tools

In the pick-and-place system, a machine loaded with components picks the components and places them onto the board. The tension of the solder paste is sufficient for keeping the components in place. The machine uses the information of the component's location and orientation (typically held in a Centroid file) as a reference to place the components onto the board accurately. Centroid files are derived from the CAD data for the PCB design.

Checking the Loading List

The technician needs to ensure all components according to the selected program. He/she needs to check that the value loaded on particular wheel matches the selected program.

To place all the components on a PCB, all parts including transistors, LEDs, ICs or any other electronic components need to be mentioned in the loading list. The corresponding files for the pick and place programming machine also need to be updated in the programming software that controls the pick and place operations.

9.2.4 Loading/Reloading of Feeders

The feeder is used to supply the components to the movable pick-up mechanism. It also moves the components to a fixed location and aids the pickup head in removing components. The following image shows a feeder:

Fig. 9.2.10: A feeder

The technician needs to load the feeders according to the selected program. For that, he/she must select the type of feeder required for the operations. Depending on the kind of components to be placed on the PCB, the feeder can be classified as shown in the following figure:

Feeder	Description
Tape & Reel Feeder	• Most commonly used feeder in which tape-on-reel feeders are loaded with a reel
Stick Feeder	• Designed for components that come packed in linear sticks, and the components are moved to the pick-up location via gravity or vibration
Matrix Tray Feeders	• Used for placing large or expensive components. This process is a little slow as the level of accuracy required is quite high.
Bulk Feeder	• Used for chip like components used in large numbers. It is cheaper as compared to other feeders.
Direct Die Feeder	• Used for flip-chip or chip on board PCBs. It is a much economical placement method and has higher speed.

Fig. 9.2.11: Classification of feeders

The following figure shows different types of feeders:

Tape and Reel Feeder

LED SMT Feeder

Direct Die Feeder

Stick Feeder

Fig. 9.2.12: Different types of feeders

The following table lists the feeder size required for the components package:

Feeder size	Component package
8mm	0402, 0805, 0606, 1206, SOT-23, SOD-123
12mm	2010, 2512, SOIC-8
16mm	Electrolytic capacitor, SOIC-16, SOIC-18
24mm	Crystal oscillator, coil
32mm	Crystal oscillator, coil of different size

Loading of components into the feeder is a very important stage of PCB assembly. Therefore, it needs to be done with utmost caution. The following figure lists the steps for loading the components into the feeder:

Choose the required program of the machine. → Load the components according to the chosen program by adjusting the PCB transport rails. → Check the values loaded on the individual wheels of the machine and in the software.

Fig. 9.2.13: Steps for loading the components into the feeder

When loading components, it is important to keep in mind that:

- There should be just the specified gap between two PCBs for accurate placement of electronic components.
- Once everything is ensured, no further movement or alteration should be done.

Similarly, reloading of components for the next batch needs to be taken forward following the same guidelines. The following image shows components on the feeder:

Fig. 9.2.14: Components loaded on the feeder

9.2.5 Placement of Components

All the electronic components that need to be printed onto the PCB by creating interconnections can be done by a pick and place machine by configuring the hardware and the software optimally.

The placement of electronic components on a PCB and the adjustment of the component feeder and the transport rail needs to be done with utmost precaution. Thankfully, most of

the component placement tasks are automated these days, with specialized machines making the task easier for pick and place operators. For accurate placement of components, some specialised machines, as shown in the following figure, are used:

Flexible Placer	Chip Shooter
Used to place high I/O active components like Quad Flat Packages (QFPs) that require high accuracy. There are three types of flexible placers - overhead gantry, revolver head and split axis	Used to place passive and small active components with a fast speed of 20,000 – 80,000 components per hour but having comparatively low accuracy

Fig. 9.2.15: Types of specialised machines for placement of components

The components are supplied by the feeder and the computer files control the location of each component on the PWB. The following figure lists the determinants of component loading:

Feeder inventory levels	Placement machine vacuum holder capability	Automatic component realignment	Transportation of PCBs through the lime

Fig. 9.2.16: Determinants of component loading

9.2.6 Adjustments/Configurations

The configuration and adjustment of values according to the planned design of a PCB is important for smooth manufacturing of circuit boards in a facility. For this, a pick and place machine has to be fed with the right values in the programming software and correspondingly the correct components in the reel.

The following image shows the placement head of a pick and place machine on the PCB:

Fig. 9.2.17: Placement head of a pick and place machine on the PCB

PCB Transport Rails

For proper mounting of electronic components on the PCB, it is important to take care of the configurations and positions of the rails. If the guide rails are slightly tilted or out of position, then the PCB will not line up correctly with the machine's X and Y axes. This will either result in inadequate placement of electronic components or make the whole process difficult and time consuming.

The following figure lists the steps of adjusting the transport rails:

| Set the guide rails perpendicular to the long rails running along the length of the machine. | Once the alignment is right, position the circuit board on the machine using the guide rails. | Lock down the placement of the circuit board with the gold stopper. |

Fig. 9.2.18: Steps of adjusting the transport rails

Adjusting of PCB Transport and Checking the Value on Wheel

The technician should adjust the PCB rails as well as the value on the wheel. He/she needs to check that the value loaded on particular wheel matches the selected program.
PCBs are fabricated in large panels, typically 18 x 24 inches sheets, and then routed out either individually or into smaller panels. Even a single-up panelization may provide manufacturing benefits over a simple individually routed board by having rails which provide clearance between components and the edge of the board or by providing missing fiducials.

The following image shows a large set of panels in green, an individual panel in blue and smaller panel set in red:

Fig. 9.2.19: A large set of panels (green), an individual panel (blue) and smaller panel set (red)

Panels are transported by edge supported conveyor lines. This permits components to be placed on both sides of the board, but no components are recommended to be placed within 3.2mm of the edge even if you are only using one side because some stages have overhang above the board conveyor. Panelization will typically add rails along the edge much larger than that, permitting you to place components closer to the edge of your board.

Fig. 9.2.20: Edge supported conveyor lines

Identification of the Width of Component Reels

The separation between the edge conveyors of each piece of equipment in the line must be adjusted to the width of the panel. Each machine has at least one eye for detecting the presence of a board on the conveyor. The technician needs to adjust the width of components reels as required.

Very wide panels may sag between the conveyor edges, especially in the reflow oven, and they are prone to vibration and bouncing during population in the pick-and-place machine.

9.2.7 Monitoring the Equipment

Monitoring the operations of pick and place machine starts from monitoring the efficacy of equipment. Before starting the process, all the equipment must be in proper working condition so that the process must not be hampered in a mid-way. All the equipment must

be available in the required quantity and at the desired place so that it may not lead to wastage of time.

9.2.8 Monitoring the Operations

The pick and place machine require constant monitoring to avoid any downtimes or faulty placement of components.

Operating Speed and Temperature

It is very important to maintain the operating temperature of a pick and place machine inside the manufacturing facility. Not only the temperature, but humidity levels should also be maintained at all times to avoid any operating complications. Ideally, a temperature ranging from 70-77° F and humidity level of 35-65% is recommended.

Any more variation in the temperature than what is recommended can lead to problems that are listed in the following figure:

Low Humidity	•The solder paste solvent evaporates quickly causing the paste to dry, which leads to poor stencil release and insufficient joints.
Low Temperature	•The paste viscosity increases, creating poor printing behaviour that results in weak solder joints.
High Humidity	•The solder paste accepts water and may begin to slump, creating additional bridging defects.
High Temperature	•The solder paste viscosity decreases, creating excess of paste smearing and slumping that causes bridging or solder balling defects.

Fig. 9.2.21: Problems due to variations in the operating temperature

The placement speed of a pick and place machine is affected by a lot of factors.

The following figure lists some examples:

Feeder Problems

•Account for the maximum downtime

PCB Design

•Affects the operating speed, as the components that need to be loaded require different kinds of feeder mechanism

Improper Setup Procedure

•Contributes to the downtime, which in turn reduces the operating speed of the machine

Fig. 9.2.22: Some factors that affect the operating speed

Reloading the Components

When the pick and place machine starts operating, the process is monitored carefully to ensure its completion. The supply of necessary components is kept continued. All the components must be in a particular quantity to ensure the continuity of the process. The components are reloaded in the tray or reel as soon as it starts becoming empty, otherwise the process may be hampered.

9.2.9 Maintain Records of Assembly

EMS technician must maintain all the records of assembling the PCB in a proper manner so that he would not repeat the mistakes done once and be ready for the same procedure in future. He/she must keep the records of the following information:

• Number of components used and not used
• Number of PCBs delivered
• Any type of defects
• Machine and tools calibration

9.2.10 Handing over the finished boards

After maintaining all the records of the process and ensuring the completion of process, the completed or finished boards are handed over to the reflow machine operator. Technician has ensured the standard of the boards on his part but now the operator will decide the quality of these boards and will forward his feedback to the technician. The following figure lists the type of feedback a technician may receive:

Satisfied   Unsatisfied

Fig. 9.2.23: Type of feedback a technician may receive

If the operator is satisfied with the quality of the boards, he/she will simply approve them but if he is unsatisfied and thinks that the boards lack a particular and standard quality, he/she will return the boards to the technician along with his desired changes. Now, it is the responsibility of the technician to restructure it as per the operator's demands.

9.2.11 ESD Handling Practices

As described earlier, Electrostatic discharge (ESD) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short or dielectric breakdown. The causes of ESD are as follows:

- Human negligence
- Uses of synthetic materials
- Movement of air
- Absence of electrostatic wrist scrap

To remain protected from the ESD, the technician needs to follow the ESD prevention measures, use ESD clothes and tools and so on.

ESD Protection

The following figure lists some practices for ESD protection:

Protection at circuit and assembly design

- To protect boards and sub-assemblies from getting damaged, ESD protection is must

Testing of equipments in an EPA

- Within an EPA strict controls are employed to ensure protection for any electronics components and assemblies.

Storage of components

- It is necessary to ensure that all components are stored and transported within an environment in which ESD protection is implemented.

ESD control process

- As it is necessary to create the ESD protected area, it is also important to introduce right processes and provide training.

Fig. 9.2.24: Some practices for ESD protection

ANSI ESD S20.20 standard

Electrostatic Discharge Association (ESDA) was set up in 1982 for providing standards and assistance regarding ESD, to the electronics industry. The S20.20 standard has been developed by the ESDA. The standard is known as ANSI ESD S20.20, supported by ANSI. It

specifies the requirements for designing, implementing, establishing and maintaining an ESD control program.

Although some of the ESD precautions may seem to be rather extreme, electronic development and manufacturing companies take ESD control very seriously in view of the damage that can be caused. Investment into equipment such as ESD wrist straps, ESD workbenches, ESD flooring, ESD bags and the like pays dividends in terms of lower fault-finding costs during the manufacturing cycle, and also lower warranty repair costs. This does not take into consideration any benefits to be gained from maintaining equipment that gives long and reliable service to customers.

In order to ensure an environment where work on electronics components, sub-assemblies such as printed circuit boards, and assemblies is carried out is safe from ESD, most companies these days set up what is known as an ESD protected area or EPA.
By setting up an EPA and using it correctly, the level of failures during the production is minimized. As a consequence, the investment in the EPA repays itself in terms of the rework cost and higher reliability of the product. This not only reduces the costly call-outs but also the long-term reliability results in customer satisfaction.

9.2.12 Contamination Handling Practices

Pick and place machine may face contamination from different sources, so it must be protected, and the contamination must be handled properly by the following methods:

- There must not be too much flux on the board as it will contaminate the board.
- The temperature beyond the limit may cause the surface coating on the resistor network to contaminate the surface of the board. This following image shows PCB contamination:

Fig. 9.2.25: PCB contamination

- The solder joints may be fine but the solders resisting on the pads may result in a reduction in the solder volume. The left-over of the solder paste may contaminate the PCB surface. The technician needs to check for the left-overs and clean the PCBs.
- The components should not be handled with bare hands. Improper handling of the components may damage the components as well as contaminate the PCBs.

10. Check Visually and Ensure Completion of Post Assembly Cycle

Unit 10.1 – Visual Checking of the Assembly

ELE/N5102

Key Learning Outcomes

At the end of this module, you will be able to:

1. Execute visual inspection of PCB manufacturing
2. List the elements to be inspected

UNIT 10.1: Visual Checking of the Assembly

Unit Objectives ◎

At the end of this unit you will be able to:

1. Execute visual inspection of PCB manufacturing
2. List the elements to be inspected

10.1.1 Visual Inspection

Before starting the pick and place operation, there is a visual inspection checklist that needs to be kept in mind. The operator needs to check for all the components required to operate the pick and place machine. Otherwise, it may lead to:

• Malfunctioning of the SMT

• Increased turn-around-time.

In both the cases, automatic tool picking and manual tool loading SMT machine inspection is important.

Fig. 10.1.1 Inspection of PCB manufacturing

The following figure lists the elements to be inspected:

Components

- The components received from screen printing need to be thoroughly inspected.
- The screen solder mask should be administered with care.

Installed Components

- All the installed components on the PCB need to be double-checked according to the design and requirements set by the client.

Missed Components

- The missing components can be identified with the Automated Optical Inspection (AOI) system.
- They need to be noted down and loaded onto the PCB again.

PCB

- AOI system is used to improve process efficiency and quality.
- An automated visual inspection camera scans the PCB for missing components and quality defects. This non-contact method is used in PCB manufacturing stages, including bare board inspection, pre-reflow and post-reflow.

Solder Paste

- The solder paste used to connect the surface mount components to pads on the board for electrical connection should be inspected by the technician or the AOI system.
- The process includes checking for excessive solder joints, insufficient solder joints and solder bridges.

Cross Checking the Assembly with Design

- The high-quality PCBs have to adhere to the parameters set by the designers and have to be free from errors.
- PCBs are complex in nature. It is important to implement visual inspection and AOI.

Fig. 10.1.2: Checklist for visual inspection

Visual inspection is a process that requires concentration, therefore visual inspection operators need to be very skilled and thorough. The rate of success of visual inspection is 80% due to the microscopic nature of the components that need to be mounted on the PCB. Hence, AOI is a far reliable method of inspecting PCB manufacturing.

11.. Soft Skills and Work Ethics

ESSCI
Skilling India in Electronics

Unit 11..1 –Effective Communication and Coordination at
  Work
Unit 11..2 – Working Effectively and Maintaining Discipline
  at Work
Unit 11..3 –Maintaining Social Diversity at Work

ELE/N9905

Key Learning Outcomes 💡

By the end of this unit, participants will be able to:

1. State the importance of work ethics and workplace etiquette

2. State the importance of effective communication and interpersonal skills

3. Explain ways to maintain discipline in the workplace

4. Discuss the common reasons for interpersonal conflict and ways of managing them effectively.

UNIT 11..1: Efffecte Communicacation a Coordinaination at work

Unit Objectives ◎

By the end of this unit, participants will be able to:

1. Work efffectely at the workplace.
2. Demonstrate practicesrelated to gender and PwD sensitazation.

11..1.1 Importance of Work Ethics and Workplace Etiquette

Workplace ethics are a set of moral and legal guidelines that organizations follow. These guidelines influence the way customers and employees interact with an organization. Workplace ethics essentially guide how an organization serves its clients and treats its employees.

For example, if a company seeks to fulfil the promises it makes, it may develop processes and set up a robust support system to address this policy and build customer/client loyalty. To achieve this goal, the company may implement specific incentive programs for employees to encourage them to produce high-quality work and ensure the organization fulfils the promises it makes to its clients/ customers.

Many organizations, often the large ones, set detailed ethical codes to guide their operations and control how the organizational processes impact the stakeholders. These ethics usually help organizations maintain certain standards of responsibility, accountability, professionalism and among others, as they navigate through different challenges and day-to-day circumstances. By following these guidelines, organizations often experience several benefits that improve the lives of stakeholders, such as customers, employees, leaders, etc.

Examples of Common Workplace Ethics

Accountability
Responsibility
Equality
Transparency
Trust
Fulfilling promises
Loyalty
Fairness
Cooperaton
Dedication
Discipline
Professionalism

Fig. 11..1.1 Examples of Common Workplace Ethics

Workplace ethics are essential for a successful organization with a satisfied and loyal team. High ethical standards help in ensuring all stakeholders, such as customers, investors, employees, and other individuals involved in the workplace operations, feel the organization is safeguarding their interests. By creating and implementing ethical guidelines, organizations can keep the best interests of their employees in mind while maintaining a positive influence on those they impact through their processes. As a result, employees maintain the organization's best interests by being ethical in their daily work duties. For example, fairly-treated employees of an organization who understand the organization's commitments to environmental sustainability are usually less likely to behave in a manner that causes harm to the environment. Thus, they help maintain a positive public image of the organization. It means that workplace ethics help in maintaining reciprocal relationships that benefit organizations at large and the individuals associated with and influenced by the organizational policies.

Benefits of Workplace Ethics

There are various benefits of implementing workplace ethics. When organizations hold themselves to high ethical standards, leaders, stakeholders, and the general public can experience significant improvements. Following are some of the key benefits of employing ethics in the workplace:

Employee satsffacon

Improved workplace culture

Legal compliance

Improved public reputation

Customer engagement and loyalty

Streamlined decision-making processes

Fig. 11..1.2 Benefits of Workplace Ethics

11..1.2 Interpersonal Communication

Interpersonal communication is a process that involves sharing ideas and emotions with another person, both - verbally and non-verbally. It is essential to interact effectively with others in both personal and professional lives. In professional life or the workplace, strong interpersonal skills play a crucial role in achieving effective collaboration with colleagues.

Interpersonal Skills

Interpersonal skills, in other terms, are known as people skills, which are used to communicate and interact with others effectively. These are soft skills one uses to communicate with others and understand them. One uses these skills in daily life while interacting with people

Examples of Interpersonal Skills

Activ listening
Teamwork
Responsibility
Dependability
Leadership
Motvaaon
Flexibility
Patence
Empathy
Conflict resooluon
Negoti atn

Fig 11..1.3 Examples of Interpersonal Skills

Numerous interpersonal skills involve communication. Communication can be verbal, such as persuasion or tone of voice — or non-verbal, such as listening and body language.

Importance of Interpersonal Skills

Interpersonal skills are essential for communicating and collaborating with groups and individuals in both personal and professional life. People with strong interpersonal skills often are able to build good relationships and also tend to work well with others. Most people often enjoy working with co-workers who have good interpersonal skills.

Among other benefits of good interpersonal skills is the ability to solve problems and make the best decisions. One can use the ability to understand others and good interpersonal communication skills to find the best solution or make the best decisions in the interest of everyone involved. Strong interpersonal skills help individuals work well in teams and collaborate effectively. Usually, people who possess good interpersonal skills also tend to be good leaders, owing to their ability to communicate well with others and motivate the people around them.

Interpersonal communicationis the key to working in a team environment and working ccollectely to achieve shared goals. Following are the interperso

Verbal Communication

The ability to speak clearly, appropriately and confidently can help one communicate effectively with others. It is vital to select the appropriate vocabulary and tone for the target audience.

For example – one should speak formally and professionally in the work environment, while informal language is acceptable in an intimate environment with close friends and family. Also, one should avoid using complex or technical language while communicating with an audience that may not be familiar with it. Using simple language in a courteous tone helps achieve better communication, irrespective of the audience.

Active Listening

Active listening is defined as the ability to pay complete or undivided attention to someone when they speak and understand what they are saying. It is important for effective communication because without understanding what the speaker is saying, it becomes difficult to carry forward a conversation. One should ensure to use appropriate verbal and non-verbal responses, e.g. eye contact, nodding, or smiling, to show interest in what the speaker says. Active listening is also about paying attention to the speaker's body language and visual cues. Asking and answering questions is one of the best ways to demonstrate an interest in conversing with the other person.

Active listening is critical for communicating effectively without ambiguity. It helps one understand the information or instructions being shared. It may also encourage co-workers to share their ideas, which ultimately helps achieve collaboration.

Body Language

One's expression, posture, and gestures are as important as verbal communication. One should practice open body language to encourage positivity and trust while communicating. Open body language includes - maintaining eye contact, nodding, smiling and being comfortable. On the other hand, one should avoid closed body language, e.g. crossed arms, shifting eyes and restless behaviour.

Empathy

Empathy is the ability to understand the emotions, ideas and needs of others from their point of view. Empathy is also known as emotional intelligence. Empathetic people are good at being aware of others' emotions and compassionate when communicating with them. Being empathetic in the workplace can be good to boost the morale of employees and improve productivity. By showing empathy, one can gain the trust and respect of others.

Conflict Resolution

One can use interpersonal communication skills to help resolve disagreements and conflicts in the workplace. This involves the application of negotiation and persuasion skills to resolve arguments between conflicting parties. It is also important to evaluate and understand both sides of the argument by listening closely to everyone involved and finding an amicable solution acceptable to all.

Good conflict resolution skills can help one contribute to creating a collaborative and positive work environment. With the ability to resolve conflicts, one can earn the trust and respect of co-workers.nal communicationskills that vital for success at work:

Teamwork

Employees who communicate and work well in a team often have better chances of achieving success and common goals. Being a team player can help one avoid conflicts and improve productivity. One can do this by offering to help co-workers when required and asking for their feedback and ideas. When team members give their opinions or advice, one should positively receive and react to the opinions/advice. One should be optimistic and encouraging when working in groups.

Improving Interpersonal Skills

One can develop interpersonal skills by practising good communication and setting goals for improvement. One should consider the following tips to improve their interpersonal skills:

- One should ask for feedback from co-workers, managers, family or friends to figure out what needs improvement concerning their interpersonal skills.
- One can identify the areas of interpersonal communication to strengthen by watching others.
- One can learn and improve interpersonal skills by observing co-workers, company leaders and professionals who possess good interpersonal skills. This includes watching and listening to them to note how they communicate and the body language used by them. It is vital to note their speed of speaking, tone of voice, and the way they engage with others. One should practice and apply such traits in their own interactions and relationships.
- One should learn to control their emotions. If stressed or upset, one should wait until being calm to have a conversation. One is more likely to communicate effectively and confidently when not under stress.
- One can reflect on their personal and professional conversations to identify the scope of improvement and learn how to handle conversations better or communicate more clearly. It helps to consider whether one could have reacted differently in a particular situation or used specific words or positive body language more effectively. It is also vital to note the successful and positive interactions to understand why they are successful.
- One should practice interpersonal skills by putting oneself in positions where one can build relationships and use interpersonal skills. For example, one can join groups that have organized meetings or social events. These could be industry-specific groups or groups with members who share an interest or hobby.
- Paying attention to family, friends and co-workers and making efforts to interact with them helps a lot. One should complement their family, friends and co-workers on their good ideas, hard work and achievements. Trying to understand someone's interests and showing interest in knowing them can help one build strong interpersonal skills. Offering to help someone, especially in difficult situations, helps build stronger and positive workplace relationships.
- One should avoid distractions, such as a mobile phone, while interacting with someone. Giving someone full attention while avoiding distractions helps achieve a clear exchange of ideas. By listening with focus, one can understand and respond effectively.

- One can attend appropriate courses on interpersonal skills or sign up for workshops at work to improve interpersonal skills. One can find many resources online also, such as online videos.

- For personal mentoring, one can approach a trusted family member, friend, co-worker, or current/ former employer. A person one looks up to with respect and admires is often a good choice to be selected as a mentor. One can even hire a professional career or communication coach.

Interpersonal communication skills often help one boost their morale, be more productive in the workplace, complete team projects smoothly and build positive and strong relationships with co-workers.

Notes

UNIT 11..2: Working Efffectely and Maintaining Discipline at Work

Unit Objectives ⊚

By the end of this unit, participants will be able to:

• Discuss the importance of following organizational guidelines for dress code, time schedules, language usage and other behavioural aspects
• Explain the importance of working as per the workflow of the organization to receive instructions and report problems
• Explain the importance of conveying information/instructions as per defined protocols to the authorised persons/team members
• Explain the common workplace guidelines and legal requirements on non-disclosure and confidentiality of business-sensitive information
• Describe the process of reporting grievances and unethical conduct such as data breaches, sexual harassment at the workplace, etc.
• Discuss ways of dealing with heightened emotions of self and others.

11..2.1 Discipline at Work

Discipline is essential for organizational success. It helps improve productivity, reduce conflict and prevent misconduct in the workplace. It is important to have rules concerning workplace discipline and ensure that all employees comply with them. In the absence of discipline, a workplace may experience conflicts, bullying, unethical behaviour and poor employee performance. An efficient workplace disciplinary process helps create transparency in the organization. Benefits of disciplinary standards:

> All employees follow the same rules which helps establish uniformity and equality in the workplace

> Managers and supervisors have defined guidelines on what accon to take while initi atg disciplinary y aon

> With well-defined and enforced disciplinary rules, an organiizaon can avoid various safety, security, rupati nal risks

Fig 11..2.1 Benefits of Disciplinary Standards

Maintaining an organized and cohesive workforce requires maintaining discipline in both personal and professional behaviour. It is important to follow the appropriate measures to keep employees in line without affecting their morale.

Defining Discipline

The first and crucial step in maintaining workplace discipline is to define what is meant by discipline. It helps to evaluate common discipline problems and devise guidelines for handling them effectively.

Among a number of areas, discipline usually covers:

Fig 11..2.2 Examples of Workplace Discipline

According to demography and local issues, it may also include substance use and related issues.

It is vital for a workplace to have an employee handbook or company policy guide, to serve as a rulebook for employees to follow. The employee handbook/ company policy guide should be reviewed and updated periodically according to any issues or areas, or concerns identified concerning workplace discipline. Such manuals should also cover all the laws and regulations governing workplace behaviour.

Defining and documenting workplace rules aids in their implementation, ensuring little or no ambiguity. All employees in a workplace should also have easy access to the workplace guidelines so that they can refer to them to get clarity whenever required. To maintain discipline at work, it is also critical to ensure uniform application of workplace guidelines to all employees without exception.

11..2.2 Employee Code of Conduct

The employee code of conduct manual serves as a guide for employees to inform them regarding the behaviour expected from them at work. It helps create a good work environment with consistent behaviour from employees. The manual should list examples of acceptable and not acceptable behaviours at work. The code of conduct should be discussed with employees so that they have the clarifications required.

For example, an organization may create guidelines concerning the conduct with clients to ensure no contact is made with them except for business purposes, also prescribing the use of appropriate means of communication.

Employees should have a clear understanding concerning their job responsibilities and the behaviour expected from them with all stakeholders, e.g. company personnel, clients and associated third parties. It is critical to have documented guidelines for employees to follow concerning all aspects of work. It should also document the disciplinary action to be followed in case of non-compliance, e.g. verbal and

then written warning, temporary suspension or eventual termination of service in case of repeated non-compliance with the employee code of conduct. Employees should know what the company rules are and what will happen if they break the rules. However, disciplinary action should be initiated only when reasonably required to avoid its misuse for employee harassment.

There should also be an effective mechanism for employees to raise their concerns/ grievances and have them addressed while maintaining privacy, as required, e.g. raising concerns regarding the behaviour of a co-worker.

The employee code of conduct manual must be duly reviewed and approved by the concerned stakeholders, such as the Human Resources (HR) department and company executives.

11..2.3 Interpersonal Conflicts

Interpersonal conflict is any type of conflict between two or more people. These are found in both - personal and professional relationships - among friends, family, and co-workers. In the workplace, interpersonal conflict is often observed when a person or group of people interfere with another person's attempts at completing assignments and achieving goals. It is critical to resolve conflicts in the workplace to boost the morale of employees, repair working relationships among them, and improve customer satisfaction.

Reasons for Workplace Conflicts

Workplace conflicts are often observed when two or more people have different points of view. This can happen between managers, co-workers, or clients and customers. In general, interpersonal conflicts are caused by a lack of communication or unclear communication.

Some of the leading reasons for workplace conflicts are:
- Difference in values
- Personality clashes
- Poor communication

Example of poor communication – if a manager reassigns a task to another employee without communicating with the employee to whom it was originally assigned, interpersonal conflict can arise among them. This may potentially make the first employee, i.e. who was originally assigned the task, feel slighted and mistrusted by the manager. It may even cause animosity in the first employee toward the employee who has now been assigned the task.

Types of Interpersonal Conflict

Following are the four types of interpersonal conflicts:

a. **Policy-related interpersonal conflict**

When a conflict relates to a decision or situation that involves both parties, it can be called a policy-related interpersonal conflict. Example – two people or groups working on the same project, trying to adopt different approaches. To resolve policy-related interpersonal conflicts, the parties involved should try to look for a win-win situation or make a compromise. This is especially critical to resolve trivial issues so that work is not affected and common goals are achieved.

b. **Pseudo-conflicts**

Pseudo-conflict arises when two people or groups want different things and cannot reach an agreement. Pseudo-conflicts usually involve trivial disagreements that tend to hide the root of the issue.

c. **Ego-related interpersonal conflicts**

In ego conflicts, losing the argument may hurt or damage a person's pride. Sometimes ego conflicts arise when a number of small conflicts pile up on being left unresolved. To resolve ego-related conflicts, it's best to find the root of the issue and work towards a resolution.

d. **Value-related interpersonal conflicts**

Sometimes conflicts may occur between people when they have different value systems. Such conflicts can be difficult to identify initially, making the people involved think the other party is being disagreeable or stubborn, wherein they just have different values. Some co-workers may highly value their personal/ family time after office that they may be unreachable to clients during non-office hours, while others may place a high value on client satisfaction and may still be available for clients during non-office hours. Conflict may arise among such people when they may be required to coordinate to help a client during after-office hours. Value-related interpersonal conflicts are often difficult to settle since neither party likes to compromise.

Resolving Interpersonal Conflicts

Conflicts are usually likely in the workplace; they can, however, be prevented. Often resolving interpersonal conflicts through open communication helps build a stronger relationship, paving the way for effective coordination and success. Some ways to resolve interpersonal conflict:

• **Communication -** A great way to resolve interpersonal conflicts is for the opposing parties to listen to one another's opinions and understand their viewpoints. Meeting in person and keeping the conversation goal-oriented is important. One can have effective communication by following some measures, e.g. staying on the topic, listening actively, being mindful of the body language, maintaining eye contact, etc.

- **Active Listening -** One should patiently listen to what the other person is saying without interrupting or talking over them. It helps one display empathy and get to the root of the issue. Asking questions to seek clarification when required helps in clear communication and conveys to the other person that one is listening to them. Practising active listening is a great way to improve one's communication skills.
- **Displaying Empathy -** Listening attentively and identifying the anxieties/ issues of co-workers is a great way to show empathy and concern. It is essential to understand their feelings and actions to encourage honesty and avoid future conflict.
- **Not Holding Grudges -** With different types of people and personalities in a workplace, it is common for co-workers to have conflicts. It is best to accept the difference in opinions and move on. Being forgiving and letting go of grudges allows one to focus on the positive side of things and perform better at work.

Work-related interpersonal conflicts can be complicated because different people have different leadership styles, personality characteristics, job responsibilities and ways in which they interact. One should learn to look above interpersonal conflicts, resolving them to ensure work goals and environment are not affected.

11..2.4 Importance of Following Organizational Guidelines

Policies and procedures or organizational guidelines are essential for any organization. These provide a road map for the operations of the organization. These are also critical in ensuring compliance with the applicable laws and regulations by guiding the decision-making process and business operations.

Organizational guidelines help bring uniformity to the operations of an organization, which helps reduce the risk of unwanted and unexpected events. These determine how employees are supposed to behave at work, which ultimately helps the business achieve its objectives efficiently.

However, organizational guidelines are ineffective and fail to serve their purpose if they are not followed. Many people don't like the idea of following and abiding by specific guidelines. Such people should be made to understand the benefits of following the organizational guidelines. Some of the key benefits are given below:

With well-defined organizational guidelines in place, no individual can act arbitrarily, irrespective of their position in the organization. All individuals will know the pros and cons of taking certain actions and what to expect in case of unacceptable behaviour. Benefits of following organizational guidelines:

- Consistent processes and structures - Organization guidelines help maintain consistency in operations, avoiding any disorder. When all employees follow the organizational guidelines, an organization can run smoothly. These ensure that people in different job roles operate as they are supposed to, knowing what they are responsible for, what is expected of them, and what they can expect from their supervisors and co-workers. With clarity in mind, they can do their jobs with confidence and excellence. With every person working the way intended, it's easy to minimise errors.

  With all the staff following organizational guidelines, the organization has a better scope of using time and resources more effectively and efficiently. This allows the organization to grow and achieve its objectives.

- **Better quality service -** By following organizational guidelines, employees perform their duties correctly as per the defined job responsibilities. It helps enhance the quality of the organization's products and services, helping improve the organization's reputation. Working with a reputable organization, employees can take pride in their work and know they are contributing to the reputation.

- **A safer workplace -** When all employees follow organizational guidelines, it becomes easy to minimise workplace incidents and accidents. It reduces the liabilities associated with risks for the organization and limits the interruptions in operations. Employees also feel comfortable and safe in the workplace, knowing their co-workers are ensuring safety at work by following the applicable guidelines.

Different organizations may have different guidelines on dress code, time schedules, language usage, etc. For example – certain organizations in a client-dealing business requiring employees to meet clients personally follow a strict dress code asking their employees to wear formal business attire. Similarly, organizations operating in specific regions may require their employees to use the dominant regional language of the particular region to build rapport with customers and serve them better. Certain organizations, such as banks, often give preference to candidates with knowledge of the regional language during hiring.

Working hours may also differ from one organization to another, with some requiring employees to work extra compared to others. One should follow the organizational guidelines concerning all the aspects of the employment to ensure a cohesive work environment.

11..2.5 Workflow

Workflow is the order of steps from the beginning to the end of a task or work process. In other words, it is the way a particular type of work is organised or the order of stages in a particular work process.

Workflows can help simplify and automate repeatable business tasks, helping improve efficiency and minimise the room for errors. With workflows in place, managers can make quick and smart decisions while employees can collaborate more productively.

Other than the order that workflows create in a business, these have several other benefits, such as:

* Identifying Redundancies - Mapping out work processes in a workflow allows one to get a clear, top-level view of a business. It allows one to identify and remove redundant or unproductive processes.

  Workflow gives greater insights into business processes. Utilizing such useful insights, one can improve work processes and the bottom line of the business. In many businesses, there are many unnecessary and redundant tasks that take place daily. Once an organization has insight into its processes while preparing workflow, it can determine which activities are really necessary.

  Identifying and eliminating redundant tasks creates value for a business. With redundant tasks and processes eliminated, an organization can focus on what's important to the business.

* Increase in Accountability and Reduction in Micromanagement - Micromanagement often causes problems in a business setting as most employees don't like being micromanaged, and even many managers don't like the practice. Micromanagement is often identified as one of the reasons why people quit their job.

  However, the need for micromanagement can be minimized by clearly mapping out the workflow. This way, every individual in a team knows what tasks need to be completed and by when and who is responsible for completing them. This makes employees more accountable also.

  With clearly defined workflow processes, managers don't have to spend much time micromanaging their employees, who don't have to approach the manager to know what the further steps are. Following a workflow, employees know what is going on and what needs to be done. This, in turn, may help increase the job satisfaction of everyone involved while improving the relationships between management and employees.

* Improved Communication - Communication at work is critical because it affects all aspects of an organization. There are instances when the main conflict in an organization originates from miscommunication, e.g. the management and employees disagreeing on an aspect, despite pursuing the same objectives. Poor communication is a common workplace issue that is often not dealt with.

* This highlights why workflow is important. Workplace communication dramatically can increase with the visibility of processes and accountability. It helps make the daily operations smoother overall.

- Better Customer Service - Customers or clients are central to a business. Therefore, it is imperative to find and improve ways to improve customer experience. Relying on outdated manual systems may cause customer requests or complaints to be overlooked, with dissatisfied customers taking their business elsewhere. However, following a well-researched and defined workflow can help improve the quality of customer service.

By automating workflows and processes, an organization can also reduce the likelihood of human error. This also helps improve the quality of products or services over time, resulting in a better customer experience.

11..2.6 Following Instructions and Reporting Problems

All organizations follow a hierarchy, with most employees reporting to a manager or supervisor. For organizational success, it is vital for employees to follow the instructions of their manager or supervisor. They should ensure they perform their duties as per the given instructions to help achieve the common objectives of the organization and deliver quality service or products. This consequently helps maintain the reputation of the organization.

It is also important to be vigilant and identify problems at work or with the organizational work processes. One should deal with the identified within their limits of authority and report out of authority problems to the manager/ supervisor or the concerned person for a prompt resolution to minimise the impact on customers/clients and business.

11..2.7 Information or Data Sharing

Information or data is critical to all organizations. Depending on the nature of its business, an organization may hold different types of data, e.g. personal data of customers or client data concerning their business operations and contacts. It is vital to effective measures for the appropriate handling of different types of data, ensuring its protection from unauthorized access and consequent misuse.

One should access certain data only if authorised to do so. The same is applicable when sharing data which must be shared only with the people authorised to receive it to use it for a specific purpose as per their job role and organizational guidelines. For example – one should be extra cautious while sharing business data with any third parties to ensure they get access only to the limited data they need as per any agreements with them. It is also critical to monitor how the recipient of the data uses it, which should strictly be as per the organizational guidelines. It is a best practice to share appropriate instructions with the recipient of data to ensure they are aware of the purpose with which data is being shared with them and how they are supposed to use and handle it. Any misuse of data must be identified and reported promptly to the appropriate person to minimise any damage arising out of data misuse.

These days most organizations require their employees and business partners or associated third parties to sign and accept the relevant agreement on the non-disclosure of business-sensitive information. In simple terms, business-sensitive information is confidential information. It is proprietary business information collected or created during the course of conducting business, including information about the business, e.g. proposed investments, intellectual property, trade secrets, or plans for a merger and information related to its clients. Business-sensitive information may sometimes also include information regarding a business's competitors in an industry.

The release of business-sensitive information to competitors or the general public poses a risk to a business. For example, information regarding plans for a merger could be harmful to a business if a competitor gets access to it.

11..2.8 Reporting Issues at Work

Most organizations have defined guidelines on appropriate reporting processes to be followed for reporting different types of issues. For example – one can report any grievances or dissatisfaction concerning co-workers to their manager/supervisor, e.g. data breaches or unethical conduct. If the concern is not addressed, then the employee should follow the organizational guidelines and hierarchy for the escalation of such issues that are not addressed appropriately.

For example – any concern related to sexual harassment at the workplace should be escalated to the concerned spokesperson, such as Human Resources (HR) representative, and if not satisfied with the action taken, it should be reported to the senior management for their consideration and prompt action.

11..2.9 Dealing with Heightened Emotions

Humans are emotional beings. There may be occasions when one is overwhelmed by emotions and is unable to suppress them. However, there may be situations when one must manage emotions well, particularly at work.

Stress in one's personal and professional life may often cause emotional outbursts at work. Managing one's emotions well, particularly the negative ones, is often seen as a measure of one's professionalism. Anger, dislike, frustration, worry, and unhappiness are the most common negative emotions experienced at work.

Ways to manage negative emotions at work:

- **Compartmentalisation –** It's about not confining emotions to different aspects of one's life. For example, not letting negative emotions from personal life affect work-life and vice versa. One should try to leave personal matters and issues at home. One should train their mind to let go of personal matters before reaching work. Similarly, one can compartmentalise work-related stresses so that negative emotions from work don't affect one's personal life.

- **Deep breathing and relaxation –** Deep breathing helps with anxiety, worry, frustration and anger. One should take deep breaths, slowly count to ten - inhaling and exhaling until one calms down. One can also take a walk to calm down or listen to relaxing music. Talking to someone and sharing concerns also helps one calm down.

- **The 10-second rule -** This is particularly helpful in controlling anger and frustration. When one feels their temper rising, they should count to 10 to calm down and recompose. If possible, one should move away to allow temper to come down.

- **Clarify -** It is always good to clarify before reacting, as it may be a simple case of misunderstanding or miscommunication.

- **Physical activity -** Instead of losing temper, one should plan to exercise, such as running or going to the gym, to let the anger out. Exercise is also a great way to enhance mood and release any physical tension in the body.

- **Practising restraint -** One should avoid replying or making a decision when angry, not allowing anger or unhappiness to cloud one's judgement. It may be best to pause any communication while one is angry, e.g. not communicating over email when angry or upset.

- **Knowing one's triggers -** It helps when one is able to recognise what upsets or angers them. This way, one can prepare to remain calm and plan their reaction should a situation occur. One may even be able to anticipate the other party's reaction.

- **Be respectful -** One should treat their colleagues the same way one would like to be treated. If the other person is rude, one need not reciprocate. It is possible to stay gracious, firm and assertive without being aggressive. Sometimes, rude people back away when they don't get a reaction from the person they are arguing with.

- **Apologise for any emotional outburst –** Sometimes, one can get overwhelmed by emotions, reacting with an emotional outburst. In such a case, one should accept responsibility and apologise immediately to the affected persons without being defensive.

- **Doing away with negative emotions -** It is recommended to let go of anger, frustration and unhappiness at the end of every workday. Harbouring negative emotions affects one emotionally, affecting their job performance also. Engaging in enjoyable activities after work is a good stress reliever.

Notes

UNIT 11..3: Maintaining Social Diversity at Work

Unit Objectives ◎

By the end of this unit, participants will be able to:

1. Explain the concept and importance of gender sensitivityand equality.
2. Discuss ways to create sensitivityfor different genders and Persons with h Disabiliti(PwD).

11..3.1 Gender Sensitivity

Gender sensitivity is the act of being sensitive towards people and their thoughts regarding gender. It ensures that people know the accurate meaning of gender equality, and one's gender should not be given priority over their capabilities.

Fig 11..3.1 Gender Equality

Women are an important source of labour in many sectors, yet they have limited access to resources and benefits. Women should receive the same benefits and access to resources as men. A business can improve its productivity and quality of work by providing better support and opportunities to women.

Important Terms

*   **Gender Sensitivity-** Gender sensitivity is the act of being sensitive to the ways people think about gender.
*   **Gender Equality -** It means persons of any gender enjoy equal opportunities, responsibilities, and rights in all areas of life.
*   **Gender Discrimination –** It means treating an individual unequally or disadvantageously based on their gender, e.g. paying different wages to men and women for similar or equal job positions.

Strategies for Enhancing Gender Equity

To enhance gender equity, one should:

- Follow gender-neutral practices at all levels at work.
- Participate together in decision-making.
- Help in promoting women's participation in different forums.
- Assist women in getting exposure to relevant skills and practices.
- Assist women in capacity building by mentoring, coaching or motivating them, as appropriate.
- Assist in the formation and operation of women support groups.
- Assist in the implementation of women-centric programmes.
- Combine technical training with reproductive health and nutrition for coffee farming households.
- Assist in making a work environment that is healthy, safe, and free from discrimination.

Bridging Gender Differences

Men and women react and communicate very differently. Thus, there are some work differences as both genders have their style and method of handling a situation.

Although, understanding and maturity vary from person to person, even between these genders, based on their knowledge, education, experience, culture, age, and upbringing, as well as how one's brain functions over a thought or problem.

In order to bridge the gap, one should:

- Not categorize all men and women in one way.
- Be aware of the verbal and non-verbal styles of communication of every gender to avoid any miscommunication and work better.
- Be aware of partial behaviour and avoid it.
- Encourage co-workers of different genders to make room by providing space to others.

Ways to reduce Gender Discrimination

- Effective steps against sexual harassment by the concerned authorities and general public.
- Gender stereotypes are how society expects people to act based on their gender. This can only be reduced by adopting appropriate behaviour and the right attitude.
- Objectification of females must be abolished.

Ways to Promote Gender Sensitivity in the Workplace

Practices that promote gender diversity should be adopted and promoted.

- All genders should receive equal responsibilities, rights, and privileges.
- All genders should have equal pay for similar or the same job roles/ positions.
- Strict and effective workplace harassment policies should be developed and implemented.
- An open-minded and stress-free work environment should be available to all the employees, irrespective of their gender.
- Women should be encouraged to go ahead in every field of work and assume leadership roles.
- Follow appropriate measures for women's empowerment.
- Men should be taught to be sensitive to women and mindful of their rights.

11..3.2 PwD Sensitivity

Some individuals are born with a disability, while others may become disabled due to an accident, illness or as they get old. People with Disabilities (PwD) may have one or more areas in which their functioning is affected. A disability can affect hearing, sight, communication, breathing, understanding, mobility, balance, and concentration or may include the loss of a limb. A disability may contribute to how a person feels and affect their mental health

Important Terms

·**Persons with Disabilities (PwD) –** Persons with Disabilities means a person suffering from not less than 40% of any disability as certified by a medical authority.

·**Types of Disability:**

    a. Blindness – Visually impaired

    b. Low Vision

    c. Leprosy Cured

    d. Hearing impairment

    e. Locomotor disability

    f. Mental retardation

    g. Mental illness

PwD Sensitivity

PwD sensitivity promotes empathy, etiquette and equal participation of individuals and organizations while working with individuals with a disability, e.g. sensory, physical or intellectual.

Ways to be PwD Sensitive

To be sensitive to PwD, one should:
- Be respectful to all Persons with Disabilities (PwD) and communicate in a way that reflects PwD sensitivity.
- Always be supportive and kind towards a PwD with their daily chores.
- Be ready to assist a PwD to help them avail of any benefit/ livelihood opportunity/ training or any kind that helps them grow.
- Encourage and try to make things easier and accessible to PwD so that they can work without or with minimum help.
- Protest where feasible and report any wrong act/behaviour against any PwD to the appropriate authority.
- Learn and follow the laws, acts, and policies relevant to PwD.

Appropriate Verbal Communication

As part of appropriate verbal communication with all genders and PwD, one should:
- Talk to all genders and PwD respectfully, maintaining a normal tone of voice with appropriate politeness. It is important to ensure one's tone of voice does not have hints of sarcasm, anger, or unwelcome affection.
- Avoid being too self-conscious concerning the words to use while also ensuring not to use words that imply one's superiority over the other.
- Make no difference between a PwD and their caretaker. Treat PwD like adults and talk to them directly.
- Ask a PwD if they need any assistance instead of assuming they need it and offering assistance spontaneously.

Appropriate Non-verbal Communication

Non-verbal communication is essentially the way someone communicates through their body language. These include:
- **Facial expressions -** The human face is quite expressive, capable of conveying many emotions without using words. Facial expressions must usually be maintained neutral and should change according to the situation, e.g. smile as a gesture of greeting.
- **Body posture and movement -** One should be mindful of how to sit, stand, walk, or hold their head. For example - one should sit and walk straight in a composed manner. The way one moves and carries self, communicates a lot to others. This type of non-verbal communication includes one's posture, bearing, stance, and subtle movements.

- **Gestures -** One should be very careful with their gestures, e.g. waving, pointing, beckoning, or using one's hands while speaking. One should use appropriate and positive gestures to maintain respect for the other person while being aware that a gesture may have different meanings in different cultures.

- **Eye contact -** Eye contact is particularly significant in non-verbal communication. The way someone looks at someone else may communicate many things, such as interest, hostility, affection or attraction. Eye contact is vital for maintaining the flow of conversation and for understanding the other person's interest and response. One should maintain appropriate eye contact, ensuring not to stare or look over the shoulders. To maintain respect, one should sit or stand at the other person's eye level to make eye contact.

- **Touch -** Touch is a very sensitive type of non-verbal communication. Examples are - handshakes, hugs, pat on the back or head, gripping the arm, etc. A firm handshake indicates interest, while a weak handshake indicates the opposite. One should be extra cautious not to touch others inappropriately and avoid touching them inadvertently by maintaining a safe distance.

Rights of PwD

PwD have the right to respect and human dignity. Irrespective of the nature and seriousness of their disabilities, PwD have the same fundamental rights as others, such as:

- Disabled persons have the same civil and political rights as other people
- Disabled persons are entitled to the measures designed to enable them to become as self-dependent as possible
- Disabled persons have the right to economic and social security
- Disabled persons have the right to live with their families or foster parents and participate in all social and creative activities.
- Disabled persons are protected against all exploitation and treatment of discriminatory and abusive nature.

Making Workplace PwD Friendly

- One should not make PwD feel uncomfortable by giving too little or too much attention
- One should use a normal tone while communicating with a PwD and treat them as all others keeping in mind their limitations and type of disability
- Any help should be provided only when asked for by a PwD
- One should help in ensuring the health and well-being of PwD.

Expected Employer Behaviour

Some of the common behavioural traits that employees expect from their employers are:

• Cooperation: No work is successful without cooperation from the employer's side. Cooperation helps to understand the job role better and complete it within the given timeline.

• Polite language: Polite language is always welcomed at work. This is a basic aspect that everybody expects.

• Positive Attitude: Employers with a positive attitude can supervise the work of the employees and act as a helping hand to accomplish the given task. A person with a positive attitude looks at the best qualities in others and helps them gain success.

• Unbiased behaviour: Employers should always remain fair towards all their employees. One should not adopt practices to favour one employee while neglecting or ignoring the other. This might create animosity among co-workers.

• Decent behaviour: The employer should never improperly present oneself before the employee. One should always respect each other's presence and behave accordingly. The employer should not speak or act in a manner that may make the employee feel uneasy, insulted, and insecure.

Exercise ✏️

1. List down three examples of workplace ethics.
2. List down three examples of interpersonal skills.
3. Identify two reasons for workplace conflicts.
4. Identify two ways of resolving interpersonal conflicts
5. List down two ways of dealing with heightened emotions at work.
6. List down two types of non-verbal communication.

Notes

ESSCI
Skilling India in Electronics

12. Basic Health and Safety Practices

Unit 12.1 - Workplace Hazards

Unit 12.2 - Fire Safety

Unit 12.3 - First Aid

Unit 12.4 - Waste Management

ELE/N1002

Key Learning Outcomes

By the end of this module, participants will be able to:

1. Discuss job-site hazards, risks and accidents

2. Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials

3. Describe how to interpret warning signs while accessing sensitive work areas

4. Explain the importance of good housekeeping

5. Describe the importance of maintaining appropriate postures while lifting heavy objects

6. List the types of fire and fire extinguishers

7. Describe the concept of waste management and methods of disposing of hazardous waste

8. List the common sources of pollution and ways to minimize them

9. Elaborate on electronic waste disposal procedures

10. Explain how the administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning and also administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock

UNIT 12.1: Workplace Hazards

Unit Objectives ⊚

By the end of this unit, participants will be able to:

- Discuss job-site hazards, risks and accidents
- Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials
- Describe how to interpret warning signs while accessing sensitive work areas
- Explain the importance of good housekeeping
- Describe the importance of maintaining appropriate postures while lifting heavy objects
- Explain safe handling of tools and Personal Protective Equipment to be used.

12.1.1 Workplace Safety

Workplace safety is important to be established for creating a safe and secure working for the workers. The workplace has to be administered as per the rules of the Occupational Safety and Health Administration (OSHA). It refers to monitoring the working environment and all hazardous factors that impact employees' safety, health, and well-being. It is important to provide a safe working environment to the employees to increase their productivity, wellness, skills, etc.

The benefits of workplace safety are:

- Employee retention increases if they are provided with a safe working environment.
- Failure to follow OSHA's laws and guidelines can result in significant legal and financial consequences.
- A safe environment enables employees to stay invested in their work and increases productivity.
- Employer branding and company reputation can both benefit from a safe working environment.

12.1.2 Workplace Hazards

12.1.2. Workplace Hazards

A workplace is a situation that has the potential to cause harm or injury to the workers and damage the tools or property of the workplace. Hazards exist in every workplace and can come from a variety of sources. Finding and removing them is an important component of making a safe workplace.

Common Workplace Hazards

The common workplace hazards are:

·Biological: The threats caused by biological agents like viruses, bacteria, animals, plants, insects and also humans, are known as biological hazards.

- **Chemical:** Chemical hazard is the hazard of inhaling various chemicals, liquids and solvents. Skin irritation, respiratory system irritation, blindness, corrosion, and explosions are all possible health and physical consequences of these dangers.
- **Mechanical:** Mechanical Hazards comprise the injuries that can be caused by the moving parts of machinery, plant or equipment.
- **Psychological:** Psychological hazards are occupational hazards caused by stress, harassment, and violence.
- **Physical:** The threats that can cause physical damage to people is called physical hazard. These include unsafe conditions that can cause injury, illness and death.
- **Ergonomic:** Ergonomic Hazards are the hazards of the workplace caused due to awkward posture, forceful motion, stationary position, direct pressure, vibration, extreme temperature, noise, work stress, etc.

Workplace Hazards Analysis

A workplace hazard analysis is a method of identifying risks before they occur by focusing on occupational tasks. It focuses on the worker's relationship with the task, the tools, and the work environment. After identifying the hazards of the workplace, organisations shall try to eliminate or minimize them to an acceptable level of risk.

Control Measures of Workplace Hazards

Control measures are actions that can be taken to reduce the risk of being exposed to the hazard. Elimination, Substitution, Engineering Controls, Administrative Controls, and Personal Protective Equipment are the five general categories of control measures.

- **Elimination:** The most successful control technique is to eliminate a specific hazard or hazardous work procedure or prevent it from entering the workplace.

- **Substitution:** Substitution is the process of replacing something harmful with something less hazardous. While substituting the hazard may not eliminate all of the risks associated with the process or activity, it will reduce the overall harm or health impacts.

- **Engineering Controls:** Engineered controls protect workers by eliminating hazardous situations or creating a barrier between the worker and the hazard, or removing the hazard from the person.

- **Administrative Controls:** To reduce exposure to hazards, administrative controls limit the length of time spent working on a hazardous task that might be used in combination with other measures of control.

- **Personal Protective Equipment:** Personal protective equipment protects users from health and safety hazards at work. It includes items like safety helmets, gloves, eye protection, etc.

12.1.3 Risk for a Drone Technician

A drone technician may require to repair the propeller, motor and its mount, battery, mainboards, processor, booms, avionics, camera, sensors, chassis, wiring and landing gear. A technician may face some risks while repairing the drones' equipment.

• The technician is susceptible to being physically harmed by propellers.

• Direct contact with exposed electrical circuits can injure the person.

• If the skin gets in touch with the heat generated from electric arcs, it burns the internal tissues.

• Major electrical injuries can occur due to poorly installed electrical equipment, faulty wiring, overloaded or overheated outlets, use of extension cables, incorrect use of replacement fuses, use of equipment with wet hands, etc.

12.1.4 Workplace Warning Signs

A Hazard sign is defined as 'information or instruction about health and safety at work on a signboard, an illuminated sign or sound signal, a verbal communication or hand signal.'

There are four different types of safety signs:

• Prohibition / Danger Alarm Signs

• Mandatory Signs

• Warning Signs

• And Emergency

1. Prohibition Signs: A "prohibition sign" is a safety sign that prohibits behaviour that is likely to endanger one's health or safety. The colour red is necessary for these health and safety signs. Only what or who is forbidden should be displayed on a restriction sign.

Fig. 12.1.1. Prohibition arning Signs

2. Mandatory Signs:

Mandatory signs give clear directions that must be followed. The icons are white circles that have been reversed out of a blue circle. On a white background, the text is black.

Fig. 12.1.2. Mandatory Signs

3. Warning Signs

Warning signs are the safety informationcommunicaatiosigns. They are shown as a 'yellow colour triangle'.

Fig. 12.1.3. Warning Signs

4. Emergency Signs

The locationor routes to emergency ffacilitieare indicated by emergency signs. These signs have a green backdrop with a white emblem or writing.These signs convey basic informaatioand frequently refer to housekeeping, company procedures, or logistics.

Fig. 12.1.4. Emergency Signs

12.1.5 Cleanliness in the Workplace

Workplace cleanliness maintenance creates a healthy, efficient and productive environment for the employees. Cleanliness at the workplace is hindered by some elements like cluttered desks, leftover food, waste paper, etc. A tidy workplace is said to improve employee professionalism and enthusiasm while also encouraging a healthy working environment.

Benefits of cleanliness in the workplace:

1. Productivity: Cleanliness in the workplace can bring a sense of belonging to the employees, also motivating and boosting the morale of the employees. This results in increasing their productivity.

2. Employee Well-being: Employee well-being can be improved by providing a clean work environment. Employees use fewer sick days in a workplace where litter and waste are properly disposed of, and surfaces are cleaned regularly, resulting in increased overall productivity.

3. Positive Impression: Cleanliness and orderliness in the workplace provide a positive impression on both employees and visitors.

4. Cost saving: By maintaining acceptable levels of cleanliness in the workplace, businesses can save money on cleaning bills and renovations, which may become necessary if the premises are not properly kept.

Reasons for Cleaning the Workplace

- Cleaning of dry floors, mostly to prevent workplace slips and falls.
- Disinfectants stop bacteria in their tracks, preventing the spread of infections and illness.
- Proper air filtration decreases hazardous substance exposures such as dust and fumes.
- Light fixture cleaning improves lighting efficiency.
- Using environmentally friendly cleaning chemicals that are safer for both personnel and the environment.
- Work environments are kept clean by properly disposing of garbage and recyclable items.

12.1.6 Lifting and Handling of Heavy Loads

Musculoskeletal Injuries (MSIs), such as sprains and strains, can occur while lifting, handling, or carrying objects at work. When bending, twisting, uncomfortable postures and lifting heavy objects are involved, the risk of injury increases. Ergonomic controls can help to lower the risk of injury and potentially prevent it.

Types of injuries caused while lifting heavy objects:

- Cuts and abrasions are caused by rough surfaces.
- Crushing of feet or hands.
- Strain to muscles and joints

Fig. 12.1.5. Lifting loads echnique

Preparing to lift

A load that appears light enough to bear at first will grow increasingly heavier as one carries it further. The person carrying the weight should be able to see over or around it at all times.

The amount of weight a person can lift, depends on their age, physique, and health

It also depends on whether or not the person is used to lifting and moving hefty objects.

Common Causes of Back Injuries

The Most Common Causes of Back Injuries are:

1) **Inadequate Training:** The individual raising the load receives no sufficient training or guidance.

2) **Lack of awareness of technique:** The most common cause of back pain is incorrect twisting and posture, which causes back strain.

3) **Load size:** The load size to consider before lifting. If the burden is too much for one's capacity or handling, their back may be strained and damaged.

4) **Physical Strength:** Depending on their muscle power, various persons have varied physical strengths. One must be aware of their limitations.

5) **Teamwork:** The operation of a workplace is all about working together. When opposed to a single person lifting a load, two people can lift it more easily and without difficulty. If one of two people isn't lifting it properly, the other or both of them will suffer back injuries as a result of the extra strain.

Techniques for Lifting Heavy Objects

Technique	Demonstraton
1. Ensure one has a wide base of support before lifting the heavy object. Ensure one's feet are shoulder-width apart, and one foot is slightly ahead of the other at all times. This will help one maintain a good balance during the lifting of heavy objects. This is known as the Karate Stance.	
2. Squat down as near to the object as possible when one is ready to lift it, bending at the hips and knees with the buttocks out. If the object is really heavy, one may wish to place one leg on the floor and the other bent at a straight angle in front of them.	

3. Maintain proper posture as one begin to lift upward. To do so, one should keep their back straight, chest out, and shoulders back while gazing straight ahead.	
4. By straightening one's hips and knees, slowly elevate the thing (not the back). As one rises, they should extend their legs and exhale. Lift the heavy object without twisting the body or bending forward.	
5. Do not lift bending forward.	
6. Hold the load close to the body.	

7. Never lift heavy objects above the shoulder	
8. Use the feet (not the body) to change direction, taking slow, small steps.	
9. Set down the heavy object carefully, squatting with the knees and hips only.	

Table 12.1.1 Techniques for lifting hevy objects

[3]*Source:https://ww .braceability.com/blogs/articles/7-prop-heavavy-liftinechniques*

12.1.7 Safe Handling of Tools

Workers should be trained on how to use tools safely. When tools are misplaced or handled incorrectly by workers, they can be dangerous. The following are some suggestions from the National Safety Council for safe tool handling when they are not in use:

• Never carry tools up or down a ladder in a way that makes it difficult to grip them. Instead of being carried by the worker, tools should be lifted up and down using a bucket or strong bag.

• Tools should never be tossed but should be properly passed from one employee to the next. Pointed tools should be passed with the handles facing the receiver or in their carrier.

• When turning and moving around the workplace, workers carrying large tools or equipment on their shoulders should pay particular attention to clearances.

• Pointed tools such as chisels and screwdrivers should never be kept in a worker's pocket. They can be carried in a toolbox, pointing down in a tool belt or pocket tool bag, or in hand with the tip always held away from the body.

• Tools should always be stored while not in use. People below are put in danger when tools are left sitting around on an elevated structure, such as a scaffold. In situations when there is a lot of vibration, this risk increases.

12.1.8 Personal Protective Equipment

Personal protective equipment, or "PPE," is equipment worn to reduce exposure to risks that might result in significant occupational injuries or illnesses. Chemical, radiological, physical, electrical, mechanical, and other job dangers may cause these injuries and diseases.

PPE used for protection fom the following injuries are:

Injury Protecton	Protecton	PPE
Head Injury Protecton	Falling or flying objects, stationary objects, or contact with electrical wires can cause impact, penetration, and electrical injuries. Hard hats can protect one's head from these injuries. A common electrician's hard hat is shown in the figure below. This hard hat is made of nonconductive plastic and comes with a set of safety goggles.	
Foot and Leg Injury Protecton	In addition to foot protection and safety shoes, leggings (e.g., leather) can guard against risks such as falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards.	
Eye and Face Injury Protecton	Spectacles, goggles, special helmets or shields, and spectacles with side shields and face shields can protect against the hazards of flying fragments, large chips, hot sparks, radiation, and splashes from molten metals. They also offer protection from particles, sand, dirt, mists, dust, and glare.	

Protecton against Hearing Loss	Hearing protection can be obtained by wearing earplugs or earmuffs. High noise levels can result in permanent hearing loss or damage, as well as physical and mental stress. Self-forming earplugs composed of foam, waxed cotton, or fibreglass wool usually fit well. Workers should be fitted for moulded or prefabricated earplugs by a specialist.	
Hand Injury Protecton	Hand protection will aid workers who are exposed to dangerous substances by skin absorption, serious wounds, or thermal burns. Gloves are a frequent protective clothing item. When working on electrified circuits, electricians frequently use leather gloves with rubber inserts. When stripping cable with a sharp blade, Kevlar gloves are used to prevent cuts.	
Whole Body Protecton	Workers must protect their entire bodies from risks such as heat and radiation. Rubber, leather, synthetics, and plastic are among the materials used in whole-body PPE, in addition to fire-retardant wool and cotton. Maintenance staff who operate with high-power sources such as transformer installations and motor-control centres are frequently obliged to wear fire-resistant clothes.	

Table 12.1.2. Personal protective equipment

Notes

UNIT 12.2: Fire Safety

Unit Objectives ◎

By the end of this unit, participants will be able to:

1. List the types of fire and fire e extinguiss.

12.2.1 Fire Safety

Fire safety is a set of actions aimed at reducing the amount of damage caused by fire. Fire safety procedures include both those that are used to prevent an uncontrolled fire from starting and those that are used to minimise the spread and impact of a fire after it has started. Developing and implementing fire safety measures in the workplace is not only mandated by law but is also essential for the protection of everyone who may be present in the building during a fire emergency.

The basic Fire Safety Responsibilities are:

- To identify risks on the premises, a fire risk assessment must be carried out.
- Ascertain that fire safety measures are properly installed.
- Prepare for unexpected events.
- Fire safety instructions and training should be provided to the employees.

12.2.2 Respond to a Workplace Fire

- Workplace fire drills should be conducted on a regular basis.
- If one has a manual alarm, they should raise it.
- Close the doors and leave the fire-stricken area as soon as possible. Ensure that the evacuation is quick and painless.
- Turn off dangerous machines and don't stop to get personal items.
- Assemble at a central location. Ascertain that the assembly point is easily accessible to the employees.
- If one's clothing catches fire, one shouldn't rush about it. They should stop and descend on the ground and roll to smother the flames if their clothes catch fire.

12.2.3 Fire Extinguisher

Fire extinguishers are portable devices used to put out small flames or minimise their damage until fire-fighters arrive. These are maintained on hand in locations such as fire stations, buildings, workplaces, public transit, and so on. The types and quantity of extinguishers that are legally necessary for a given region are determined by the applicable safety standards.

Types of fire extinguishers are:

There are five main types of fire extinguishers:

1. Water.
2. Powder.
3. Foam.
4. Carbon Dioxide (CO2).
5. Wet chemical.

1. **Water:** Water fire extinguishers are one of the most common commercial and residential fire extinguishers on the market. They're meant to be used on class-A flames.

2. **Powder:** The L2 powder fire extinguisher is the most commonly recommended fire extinguisher in the Class D Specialist Powder category, and is designed to put out burning lithium metal fires.

3. **Foam:** Foam extinguishers are identified by a cream rectangle with the word "foam" printed on it. They're mostly water-based, but they also contain a foaming component that provides a quick knock-down and blanketing effect on flames. It suffocates the flames and seals the vapours, preventing re-ignition.

4. **Carbon Dioxide (CO2):** Class B and electrical fires are extinguished with carbon dioxide extinguishers, which suffocate the flames by removing oxygen from the air. They are particularly beneficial for workplaces and workshops where electrical fires may occur since, unlike conventional extinguishers, they do not leave any toxins behind and hence minimise equipment damage.

5. **Wet Chemical:** Wet chemical extinguishers are designed to put out fires that are classified as class F. They are successful because they can put out extremely high-temperature fires, such as those caused by cooking oils and fats.

Notes

UNIT 12.3: First Aid

Unit Objectives ⊙

By the end of this unit, participants will be able to:

1. Explain how the administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning

2. Explain how to administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock.

12.3.1 First Aid

First aid is the treatment or care given to someone who has sustained an injury or disease until more advanced care can be obtained or the person recovers.

The aim of first aid is to:

• Preserve life

• Prevent the worsening of a sickness or injury

• If at all possible, relieve pain

• Encourage recovery

• Keep the unconscious safe.

First aid can help to lessen the severity of an injury or disease, and in some situations, it can even save a person's life.

12.3.2 Need for First Aid at the Workplace

• In the workplace, first aid refers to providing immediate care and life support to persons who have been injured or become unwell at work.

• Many times, first aid can help to lessen the severity of an accident or disease.

• It can also help an injured or sick person relax. In life-or-death situations, prompt and appropriate first aid can make all the difference.

12.3.2 Need for First Aid at the Workplace

In the workplace, first aid refers to providing immediate care and life support to persons who have been injured or become unwell at work.

Many times, first aid can help to lessen the severity of an accident or disease.

It can also help an injured or sick person relax. In life-or-death situations, prompt and appropriate first aid can make all the difference.

12.3.3 Treating Minor Cuts and Scapes

Steps to keep cuts clean and prevent infectionsand scars:

- **Wash Hands:** Wash hands first with soap and water to avoid introducing bacteria into the cut and causing an infection. One should use the hand sanitiser if one is on the go.

- **Stop the bleeding:** Using a gauze pad or a clean towel, apply pressure to the wound. For a few minutes, keep the pressure on.

- **Clean Wounds:** Once the bleeding has stopped, clean the wound by rinsing it under cool running water or using a saline wound wash. Use soap and a moist washcloth to clean the area around the wound. Soap should not be used on the cut since it may irritate the skin. Also, avoid using hydrogen peroxide or iodine, as these may aggravate the wound.

- **Remove Dirt:** Remove any dirt or debris from the area. Pick out any dirt, gravel, glass, or other material in the cut with a pair of tweezers cleaned with alcohol.

12.3.4 Heart Atack

When the blood flow carrying oxygen to the heart is blocked, a heart attack occurs. The heart muscle runs out of oxygen and starts to die.

Symptoms of a heart attack can vary from person to person. They may be mild or severe. Women, older adults, and people with diabetes are more likely to have subtle or unusual symptoms.

Symptoms in adults may include:

- Changes in mental status, especially in older adults.
- Chest pain that feels like pressure, squeezing, or fullness. The pain is most often in the centre of the chest. It may also be felt in the jaw, shoulder, arms, back, and stomach. It can last for more than a few minutes or come and go.
- Cold sweat.
- Light-headedness.
- Nausea (more common in women).
- Indigestion.

- Vomiting.
- Numbness, aching or tingling in the arm (usually the left arm, but the right arm may be affected alone, or along with the left).
- Shortness of breath
- Weakness or fatigue, especially in older adults and in women.

First Aid for Heart Attack

If one thinks someone is experiencing a heart attack, they should:

- Have the person sit down, rest, and try to keep calm.
- Loosen any tight clothing.
- Ask if the person takes any chest pain medicine, such as nitro-glycerine for a known heart condition, and help them take it.
- If the pain does not go away promptly with rest or within 3 minutes of taking nitro-glycerine, call for emergency medical help.
- If the person is unconscious and unresponsive, call 911 or the local emergency number, then begin CPR.
- If an infant or child is unconscious and unresponsive, perform 1 minute of CPR, then call 911 or the local emergency number.

Notes

UNIT 12.4: Waste Management

Unit Objectives ◎

By the end of this unit, participants will be able to:

1. Describe the concept of waste management and methods of disposing of hazardous waste.
2. List the common sources of pollutionand ways to minimize them.
3. Elaborate on electronic waste disposal procedures.

12.4.1. Waste Management and Methods of Waste Disposal

The collection, disposal, monitoring, and processing of waste materials is known as waste management. These wastes affect living beings' health and the environment. For reducing their effects, they have to be managed properly. The waste is usually in solid, liquid or gaseous form.

The importance of waste management is:

Waste management is important because it decreases waste's impact on the environment, health, and other factors. It can also assist in the reuse or recycling of resources like paper, cans, and glass. The disposal of solid, liquid, gaseous, or dangerous substances is the example of waste management.

When it comes to trash management, there are numerous factors to consider, including waste disposal, recycling, waste avoidance and reduction, and garbage transportation. Treatment of solid and liquid wastes is part of the waste management process. It also provides a number of recycling options for goods that aren't classified as garbage during the process.

12.4.2 Methods of Waste Management

Non-biodegradable and toxic wastes, such as radioactive remains, can cause irreversible damage to the environment and human health if they are not properly disposed of. Waste disposal has long been a source of worry, with population increase and industrialisation being the primary causes. Here are a few garbage disposal options.

1. **Landfills:** The most common way of trash disposal today is to throw daily waste/garbage into landfills. This garbage disposal method relies on burying the material in the ground.

2. **Recycling:** Recycling is the process of transforming waste items into new products in order to reduce energy consumption and the use of fresh raw materials. Recycling reduces energy consumption, landfill volume, air and water pollution, greenhouse gas emissions, and the preservation of natural resources for future use.

3. **Composting:** Composting is a simple and natural bio-degradation process that converts organic wastes, such as plant remnants, garden garbage, and kitchen waste, into nutrient-rich food for plants.

4. **Incineration:** Incineration is the process of combusting garbage. The waste material is cooked to extremely high temperatures and turned into materials such as heat, gas, steam, and ash using this technology.

12.4.3 Recyclable, Non-Recyclable and Hazardous Waste

1. **Recyclable Waste:** The waste which can be reused or recycled further is known as recyclable waste.

2. **Non-recyclable Waste:** The waste which cannot be reused or recycled is known as non-recyclable waste. Polythene bags are a great example of non-recyclable waste.

3. **Hazardous Waste:** The waste which can create serious harm to the people and the environment is known as hazardous waste.

12.4.4 Sources of Pollution

Pollution is defined as the harm caused by the presence of a material or substances in places where they would not normally be found or at levels greater than normal. Polluting substances might be in the form of a solid, a liquid, or a gas.

- **Point source of pollution:** Pollution from a point source enters a water body at a precise location and can usually be identified. Effluent discharges from sewage treatment plants and industrial sites, power plants, landfill sites, fish farms, and oil leakage via a pipeline from industrial sites are all potential point sources of contamination.

  Point source pollution is often easy to prevent since it is feasible to identify where it originates, and once identified, individuals responsible for the pollution can take rapid corrective action or invest in longer-term treatment and control facilities.

- **Diffuse source of pollution:** As a result of land-use activities such as urban development, amenity, farming, and forestry, diffuse pollution occurs when pollutants are widely used and diffused over a large region. These activities could have occurred recently or in the past. It might be difficult to pinpoint specific sources of pollution and, as a result, take rapid action to prevent it because prevention often necessitates significant changes in land use and management methods.

Pollution Prevention

Pollution prevention entails acting at the source of pollutants to prevent or minimise their production. It saves natural resources, like water, by using materials and energy more efficiently.

Pollution prevention includes any practice that:

- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal;

- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants (these practices are known as "source reduction");

- Improved efficiency in the use of raw materials, energy, water, or other resources, or Conservation is a method of safeguarding natural resources.

- Improvements in housekeeping, maintenance, training, or inventory management; equipment or technology adjustments; process or method modifications; product reformulation or redesign; raw material substitution; or improvements in housekeeping, maintenance, training, or inventory control.

12.4.5 Electronic Waste

Lead, cadmium, beryllium, mercury, and brominated flame retardants are found in every piece of electronic waste. When gadgets and devices are disposed of illegally, these hazardous compounds are more likely to contaminate the earth, pollute the air, and leak into water bodies.

When e-waste is dumped in a landfill, it tends to leach trace metals as water runs through it. The contaminated landfill water then reaches natural groundwater with elevated toxic levels, which can be dangerous if it reaches any drinking water bodies. Despite having an environmentally benign approach, recycling generally results in international shipment and dumping of the gadgets in pits.

Some eco-friendly ways of disposing of e-waste are:

- Giving back the e-waste to the electronic companies and drop-off points

- Following guidelines issued by the government

- Selling or donating the outdated technology-based equipment

- Giving e-waste to a certified e-waste recycler

Exercise ✏️

1. Name all five types of fire extinguishers.

2. Explain PPE in brief.

3. List the common workplace hazards.

4. Fill in the blacks:

    i. A "_____ sign" is a safety sign that prohibits behaviour that is likely to endanger one's health or safety.

    ii. _____ entails acting at the source of pollutants to prevent or minimise their production.

    iii. _____ is the treatment or care given to someone who has sustained an injury or disease until more advanced care can be obtained or the person recovers.

    iv. The threats caused by biological agents like viruses, bacteria, animals, plants, insects and also humans, are known as _____.

    v. The workplace has to be administered as per the rules of the _____.

Notes

13. Employability & Entrepreneurship Skills

Key Learning Outcomes

At the end of this module, you will be able to:

1. Explain the meaning of health
2. List common health issues
3. Discuss tips to prevent common health issues
4. Explain the meaning of hygiene
5. Discuss the purpose of Swachh Bharat Abhiyan
6. Explain the meaning of habit
7. Discuss ways to set up a safe work environment
8. Discuss critical safety habits to be followed by employees
9. Explain the importance of self-analysis
10. Discuss motivation with the help of Maslow's Hierarchy of Needs
11. Discuss the meaning of achievement motivation
12. List the characteristics of entrepreneurs with achievement motivation
13. List the different factors that motivate you
14. Discuss the role of attitude in self-analysis
15. Discuss how to maintain a positive attitude
16. List your strengths and weaknesses
17. Discuss the qualities of honest people
18. Describe the importance of honesty in entrepreneurs
19. Discuss the elements of a strong work ethic
20. Discuss how to foster a good work ethic
21. List the characteristics of highly creative people
22. List the characteristics of highly innovative people
23. Discuss the benefits of time management
24. List the traits of effective time managers
25. Describe effective time management technique
26. Discuss the importance of anger management
27. Describe anger management strategies
28. Discuss tips for anger management
29. Discuss the causes of stress
30. Discuss the symptoms of stress
31. Discuss tips for stress management
32. Identify the basic parts of a computer
33. Identify the basic parts of a keyboard
34. Recall basic computer terminology
35. Recall the functions of basic computer keys
36. Discuss the main applications of MS Office
37. Discuss the benefits of Microsoft Outlook
38. Discuss the different types of e-commerce
39. List the benefits of e-commerce for retailers and customers
40. Discuss how the Digital India campaign will help boost e-commerce in India

41. Describe how you will sell a product or service on an e-commerce platform
42. Discuss the importance of saving money
43. Discuss the benefits of saving money
44. Discuss the main types of bank accounts
45. Describe the process of opening a bank account
46. Differentiate between fixed and variable costs
47. Describe the main types of investment options
48. Describe the different types of insurance products
49. Describe the different types of taxes
50. Discuss the uses of online banking
51. Discuss the main types of electronic funds transfers
52. Discuss the steps to prepare for an interview
53. Discuss the steps to create an effective Resume
54. Discuss the most frequently asked interview questions
55. Discuss how to answer the most frequently asked interview questions
56. Discuss basic workplace terminology
57. Discuss the concept of entrepreneurship
58. Discuss the importance of entrepreneurship
59. Describe the characteristics of an entrepreneur
60. Describe the different types of enterprises
61. List the qualities of an effective leader
62. Discuss the benefits of effective leadership
63. List the traits of an effective team
64. Discuss the importance of listening effectively
65. Discuss how to listen effectively
66. Discuss the importance of speaking effectively
67. Discuss how to speak effectively
68. Discuss how to solve problems
69. List important problem-solving traits
70. Discuss ways to assess problem solving skills
71. Discuss the importance of negotiation
72. Discuss how to negotiate
73. Discuss how to identify new business opportunities
74. Discuss how to identify business opportunities within your business
75. Explain the meaning of entrepreneur
76. Describe the different types of entrepreneurs
77. List the characteristics of entrepreneurs
78. Recall entrepreneur success stories
79. Discuss the entrepreneurial process
80. Describe the entrepreneurship ecosystem
81. Discuss the purpose of the Make in India campaign
82. Discuss key schemes to promote entrepreneurs

83. Discuss the relationship between entrepreneurship and risk appetite
84. Discuss the relationship between entrepreneurship and resilience
85. Describe the characteristics of a resilient entrepreneur
86. Discuss how to deal with failure
87. Discuss how market research is carried out
88. Describe the 4 Ps of marketing
89. Discuss the importance of idea generation
90. Recall basic business terminology
91. Discuss the need for CRM
92. Discuss the benefits of CRM
93. Discuss the need for networking
94. Discuss the benefits of networking
95. Discuss the importance of setting goals
96. Differentiate between short-term, medium-term and long-term goals
97. Discuss how to write a business plan
98. Explain the financial planning process
99. Discuss ways to manage your risk
100. Describe the procedure and formalities for applying for bank finance
101. Discuss how to manage your own enterprise
102. List important questions that every entrepreneur should ask before starting an enterprise

UNIT 13.1: Personal Strengths & Value Systems

Unit Objectives

At the end of this unit, participant will be able to:

1. Explain the meaning of health
2. List common health issues
3. Discuss tips to prevent common health issues
4. Explain the meaning of hygiene
5. Discuss the purpose of Swachh Bharat Abhiyan
6. Explain the meaning of habit
7. Discuss ways to set up a safe work environment
8. Discuss critical safety habits to be followed by employees
9. Explain the importance of self-analysis
10. Discuss motivation with the help of Maslow's Hierarchy of Needs
11. Discuss the meaning of achievement motivation
12. List the characteristics of entrepreneurs with achievement motivation
13. List the different factors that motivate you
14. Discuss the role of attitude in self-analysis
15. Discuss how to maintain a positive attitude
16. List your strengths and weaknesses
17. Discuss the qualities of honest people
18. Describe the importance of honesty in entrepreneurs
19. Discuss the elements of a strong work ethic
20. Discuss how to foster a good work ethic
21. List the characteristics of highly creative people
22. List the characteristics of highly innovative people
23. Discuss the benefits of time management
24. List the traits of effective time managers
25. Describe effective time management technique
26. Discuss the importance of anger management
27. Describe anger management strategies
28. Discuss tips for anger management
29. Discuss the causes of stress
30. Discuss the symptoms of stress
31. Discuss tips for stress management

13.1.1 Health, Habits, Hygiene: What is Health?

As per the World Health Organization (WHO), health is a "State of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity." This means being healthy does not simply mean not being unhealthy – it also means you need to be at peace emotionally and feel fit physically. For example, you cannot say you are healthy simply because you do not have any physical ailments like a cold or cough. You also need to think about whether you are feeling calm, relaxed and happy.

Common Health Issues

Some common health issues are:

- Allergies
- Asthma
- Skin Disorders
- Depression and Anxiety
- Diabetes
- Cough, Cold, Sore Throat
- Difficulty Sleeping
- Obesity

13.1.1.1 Tips to Prevent Health Issues

Taking measures to prevent ill health is always better than curing a disease or sickness. You can stay healthy by:

- Eating healthy foods like fruits, vegetables and nuts
- Cutting back on unhealthy and sugary foods
- Drinking enough water everyday
- Not smoking or drinking alcohol
- Exercising for at least 30 minutes a day, 4-5 times a week
- Taking vaccinations when required
- Practicing yoga exercises and meditation

How many of these health standards do you follow? Tick the ones that apply to you.

1. Get minimum 7-8 hours of sleep every night. ☐

2. Avoid checking email first thing in the morning and right before you go to bed at night. ☐

3. Don't skip meals – eat regular meals at correct meal times. ☐

4. Read a little bit every single day. ☐

5. Eat more home cooked food than junk food. ☐

6. Stand more than you sit. ☐

7. Drink a glass of water first thing in the morning and have at least 8 glasses of water through the day. ☐

8. Go to the doctor and dentist for regular check-ups. ☐

9. Exercise for 30 minutes at least 5 days a week. ☐

10. Avoid consuming lots of aerated beverages. ☐

13.1.1.2 What is Hygiene?

As per the World Health Organization (WHO), "Hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases." In other words, hygiene means ensuring that you do whatever is required to keep your surroundings clean, so that you reduce the chances of spreading germs and diseases.

For instance, think about the kitchen in your home. Good hygiene means ensuring that the kitchen is always spick and span, the food is put away, dishes are washed, and dustbins are not overflowing with garbage. Doing all this will reduce the chances of attracting pests like rats or cockroaches, and prevent the growth of fungus and other bacteria, which could spread disease.

How many of these health standards do you follow? Tick the ones that apply to you.

1. Have a bath or shower every day with soap – and wash your hair with shampoo 2-3 times a week. ☐

2. Wear a fresh pair of clean undergarments every day. ☐

3. Brush your teeth in the morning and before going to bed. ☐

4. Cut your fingernails and toenails regularly. ☐

5. Wash your hands with soap after going to the toilet. ☐

6. Use an anti-perspirant deodorant on your underarms if you sweat a lot. ☐

7. Wash your hands with soap before cooking or eating. ☐

8. Stay home when you are sick, so other people don't catch what you have. ☐

9. Wash dirty clothes with laundry soap before wearing them again. ☐

10. Cover your nose with a tissue/your hand when coughing or sneezing. ☐

See how healthy and hygienic you are, by giving yourself 1 point for every ticked statement! Then take a look at what your score means.

Your Score
- **0-7/20:** You need to work a lot harder to stay fit and fine! Make it a point to practice good habits daily and see how much better you feel!
- **7-14/20:** Not bad, but there is scope for improvement! Try and add a few more good habits to your daily routine.
- **14-20/20:** Great job! Keep up the good work! Your body and mind thank you!

13.1.1.3 Swachh Bharat Abhiyan

We have already discussed the importance of following good hygiene and health practices for ourselves. But, it is not enough for us to be healthy and hygienic. We must also extend this standard to our homes, our immediate surroundings and to our country as a whole.

The 'Swachh Bharat Abhiyan' (Clean India Mission) launched by Prime Minister Shri Narendra Modi on 2nd October 2014, believes in doing exactly this. The aim of this mission is to clean the streets and roads of India and raise the overall level of cleanliness. Currently this mission covers 4,041 cities and towns across the country. Millions of our people have taken the pledge for a clean India. You should take the pledge too and do everything possible to keep our country clean!

13.1.1.4 What are Habits?

A habit is a behaviour that is repeated frequently. All of us have good habits and bad habits. Keep in mind the phrase by John Dryden: "We first make our habits, and then our habits make us." Therefore, it is so important that you make good habits a way of life, and consciously avoid practicing bad habits.

Some good habits that you should make part of your daily routine are:

- Always having a positive attitude
- Making exercise a part of your daily routine
- Reading motivational and inspirational stories
- Smiling! Make it a habit to smile as often as possible
- Making time for family and friends
- Going to bed early and waking up early

Some bad habits that you should quit immediately are:

- Skipping breakfast
- Snacking frequently even when you are not hungry
- Eating too much fattening and sugary food
- Smoking, drinking alcohol and doing drugs
- Spending more money than you can afford
- Worrying about unimportant issues
- Staying up late and waking up late

Tips

- Following healthy and hygienic practices every day will make you feel good mentally and physically.
- Hygiene is two-thirds of health – so good hygiene will help you stay strong and healthy!

13.1.2: Safety: Tips to Design a Safe Workplace

Every employer is obligated to ensure that his workplace follows the highest possible safety protocol. When setting up a business, owners must make it a point to:

- Use ergonomically designed furniture and equipment to avoid stooping and twisting
- Provide mechanical aids to avoid lifting or carrying heavy objects
- Have protective equipment on hand for hazardous jobs
- Designate emergency exits and ensure they are easily accessible
- Set down health codes and ensure they are implemented
- Follow the practice of regular safety inspections in and around the workplace
- Ensure regular building inspections are conducted
- Get expert advice on workplace safety and follow it

13.1.2.1 Negotiable Employee Safety Habits

Every employer is obligated to ensure that his workplace follows the highest possible safety protocol. When setting up a business, owners must make it a point to:

- Immediately report unsafe conditions to a supervisor
- Recognize and report safety hazards that could lead to slips, trips and falls
- Report all injuries and accidents to a supervisor
- Wear the correct protective equipment when required
- Learn how to correctly use equipment provided for safety purposes
- Be aware of and avoid actions that could endanger other people
- Take rest breaks during the day and some time off from work during the week

Tips

- Be aware of what emergency number to call at the time of a workplace emergency
- Practice evacuation drills regularly to avoid chaotic evacuations

13.1.3 Self-Analysis – Attitude, Achievement Motivation

To truly achieve your full potential, you need to take a deep look inside yourself and find out what kind of person you really are. This attempt to understand your personality is known as self-analysis. Assessing yourself in this manner will help you grow and will also help you to identify areas within yourself that need to be further developed, changed or eliminated. You can better understand yourself by taking a deep look at what motivates you, what your attitude is like, and what your strengths and weaknesses are.

13.1.3.1 What is Motivation?

Very simply put, motivation is your reason for acting or behaving in a certain manner. It is important to understand that not everyone is motivated by the same desires – people are motivated by many, many different things. We can understand this better by looking at Maslow's Hierarchy of Needs.

13.1.3.2 Maslow's Hierarchy of Needs

Famous American psychologist Abraham Maslow wanted to understand what motivates people. He believed that people have five types of needs, ranging from very basic needs (called physiological needs) to more important needs that are required for self-growth (called
self-actualization needs). Between the physiological and self-actualization needs are three other needs – safety needs, belongingness and love need, and esteem needs.

These needs are usually shown as a pyramid with five levels and are known as Maslow's Hierarchy of Needs.

Fig. 13.1.1: Maslow's Hierarchy of Needs

The lowest level depicts the most basic needs. According to Maslow, our behaviour is driven by our basic needs, until those needs are fulfilled. Once they are fulfilled, we move to the next level and are motived by the next level of needs. Let's understand this better with an example.

Rupa comes from a very poor family. She never has enough food, water, warmth or rest. According to Maslow, until Rupa is sure that she will get these basic needs, she will not even think about the next level of needs – her safety needs. But, once Rupa is confident that her basic needs will be met, she will move to the next level, and her behaviour will then be motivated by her need for security and safety. Once these new needs are met, Rupa will once again move to the next level, and be motivated by her need for relationships and friends. Once this need is satisfied, Rupa will then focus on the fourth level of needs – her esteem needs, after which she will move up to the fifth and last level of needs – the desire to achieve her full potential.

13.1.3.3 Understanding Achievement Motivation

We now know that people are motivated by basic, psychological and self-fulfilment needs. However, certain people are also motivated by the achievement of highly challenging accomplishments. This is known as Achievement Motivation, or 'need for achievement'.

The level of motivation achievement in a person differs from individual to individual. It is important that entrepreneurs have a high level of achievement motivation – a deep desire

to accomplish something important and unique. It is equally important that they hire people who are also highly motivated by challenges and success.

What Motivates You?

What are the things that really motivate you? List down five things that really motivate you. Remember to answer honestly!

 I am motivated by:

_____

_____

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_____

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_____

Characteristics of Entrepreneurs with Achievement Motivation

Entrepreneurs with achievement motivation can be described as follows:

- Unafraid to take risks for personal accomplishment
- Love being challenged Future-oriented Flexible and adaptive
- Value negative feedback more than positive feedback
- Very persistent when it comes to achieving goals
- Extremely courageous
- Highly creative and innovative
- Restless - constantly looking to achieve more
- Feel personally responsible for solving problems

Think about it:

- How many of these traits do you have?
- Can you think of entrepreneurs who display these traits?

13.1.3.4 How to Cultivate a Positive Attitude?

The good news is attitude is a choice. So, it is possible to improve, control and change our attitude, if we decide we want to!

The following tips help foster a positive mindset:

- Remember that you control your attitude, not the other way around
- Devote at least 15 minutes a day towards reading, watching or listening to something positive
- Avoid negative people who only complain and stop complaining yourself
- Expand your vocabulary with positive words and delete negative phrases from your mind
- Be appreciative and focus on what's good in yourself, in your life, and in others
- Stop thinking of yourself as a victim and start being proactive
- Imagine yourself succeeding and achieving your goals

13.1.3.5 What is Attitude?

Now that we understand why motivation is so important for self-analysis, let's look at the role our attitude plays in better understanding ourselves. Attitude can be described as your tendency (positive or negative), to think and feel about someone or something. Attitude is the foundation for success in every aspect of life. Our attitude can be our best friend or our worst enemy. In other words:

"The only disability in life is a bad attitude."

When you start a business, you are sure to encounter a wide variety of emotions, from difficult times and failures to good times and successes. Your attitude is what will see you through the tough times and guide you towards success. Attitude is also infectious. It affects everyone around you, from your customers to your employees to your investors. A positive attitude helps build confidence in the workplace while a negative attitude is likely to result in the demotivation of your people.

13.1.3.6 What Are Your Strengths and Weaknesses?

Another way to analyse yourself is by honestly identifying your strengths and weaknesses. This will help you use your strengths to your best advantage and reduce your weaknesses. Note down all your strengths and weaknesses in the two columns below. Remember to be honest with yourself!

Strengths	Weaknesses

Tips

- Achievement motivation can be learned.
- Don't be afraid to make mistakes.
- Train yourself to finish what you start.
- Dream big.

13.1.4 Honesty & Work Ethics: What is Honesty?

Honesty is the quality of being fair and truthful. It means speaking and acting in a manner that inspires trust. A person who is described as honest is seen as truthful and sincere, and as someone who isn't deceitful or devious and doesn't steal or cheat. There are two dimensions of honesty – one is honesty in communication and the other is honesty in conduct.

Honesty is an extremely important trait because it results in peace of mind and builds relationships that are based on trust. Being dishonest, on the other hand, results in anxiety and leads to relationships full of distrust and conflict.

13.1.4.1 Qualities of Honest People

Honest individuals have certain distinct characteristics. Some common qualities among honest people are:

- They don't worry about what others think of them. They believe in being themselves – they don't bother about whether they are liked or disliked for their personalities.
- They stand up for their beliefs. They won't think twice about giving their honest opinion, even if they are aware that their point of view lies with the minority.
- They are think skinned. This means they are not affected by others judging them harshly for their honest opinions.
- They forge trusting, meaningful and healthy friendships. Honest people usually surround themselves with honest friends. They have faith that their friends will always be truthful and upfront with them.

They are trusted by their peers. They are seen as people who can be counted on for truthful and objective feedback and advice.

- **Honesty and employees:** When entrepreneurs build honest relationships with their employees, it leads to more transparency in the workplace, which results in higher work performance and better results.
- **Honesty and investors:** For entrepreneurs, being honest with investors means not only sharing strengths but also candidly disclosing current and potential weaknesses, problem areas and solution strategies. Keep in mind that investors have a lot of experience with start-ups and are aware that all new companies have problems. Claiming that everything is perfectly fine and running smoothly is a red flag for most investors.

- **Honesty with oneself:** The consequences of being dishonest with oneself can lead to dire results, especially in the case of entrepreneurs. For entrepreneurs to succeed, it is critical that they always remain realistic about their situation, and accurately judge every aspect of their enterprise for what it truly is.

13.1.4.2 Importance of Honesty in Entrepreneurs

One of the most important characteristics of entrepreneurs is honesty. When entrepreneurs are honest with their customers, employees and investors, it shows that they respect those that they work with. It is also important that entrepreneurs remain honest with themselves.

Let's look at how being honest would lead to great benefits for entrepreneurs.

- **Honesty and customers:** When entrepreneurs are honest with their customers it leads to stronger relationships, which in turn results in business growth and a stronger customer network.

13.1.4.3 What are Work Ethics?

Being ethical in the workplace means displaying values like honesty, integrity and respect in all your decisions and communications. It means not displaying negative qualities like lying, cheating and stealing.

Workplace ethics play a big role in the profitability of a company. It is as crucial to an enterprise as high morale and teamwork. Therefore, most companies lay down specific workplace ethic guidelines that must compulsorily be followed by their employees. These guidelines are typically outlined in a company's employee handbook.

13.1.4.4 Elements of a Strong Work Ethic

An entrepreneur must display strong work ethics, as well as hire only those individuals who believe in and display the same level of ethical behaviour in the workplace. Some elements of a strong work ethic are:

- **Professionalism:** This involves everything from how you present yourself in a corporate setting to the manner in which you treat others in the workplace.
- **Respectfulness:** This means remaining poised and diplomatic regardless of how stressful or volatile a situation is.
- **Dependability:** This means always keeping your word, whether it's arriving on time for a meeting or delivering work on time.
- **Dedication:** This means refusing to quit until the designated work is done and completing the work at the highest possible level of excellence.
- **Determination:** This means embracing obstacles as challenges rather than letting them stop you and pushing ahead with purpose and resilience to get the desired results.

- **Accountability:** This means taking responsibility for your actions and the consequences of your actions, and not making excuses for your mistakes.
- **Humility:** This means acknowledging everyone's efforts and had work and sharing the credit for accomplishments.

13.1.4.5 How to Foster a Good Work Ethic?

As an entrepreneur, it is important that you clearly define the kind of behaviour that you expect from each and every team member in the workplace. You should make it clear that you expect employees to display positive work ethics like:

- **Honesty:** All work assigned to a person should be done with complete honesty, without any deceit or lies.
- **Good attitude:** All team members should be optimistic, energetic, and positive.
- **Reliability:** Employees should show up where they are supposed to be, when they are supposed to be there.
- **Good work habits:** Employees should always be well groomed, never use inappropriate language, always conduct themselves professionally and so on.
- **Initiative:** Doing the bare minimum is not enough. Every team member needs to be proactive and show initiative.
- **Trustworthiness:** Trust is non-negotiable. If an employee cannot be trusted, it's time to let that employee go.
- **Respect:** Employees need to respect the company, the law, their work, their colleagues and themselves.
- **Integrity:** Each and every team member should be completely ethical and must display above board behaviour at all times.
- **Efficiency:** Efficient employees help a company grow while inefficient employees result in a waste of time and resources.

Tips

- Don't get angry when someone tells you the truth and you don't like what you hear.
- Always be willing to accept responsibility for your mistakes.

13.1.5 Creativity & Innovation

What is Creativity?

Creativity means thinking outside the box. It means viewing things in new ways or from different perspectives, and then converting these ideas into reality. Creativity involves two parts: thinking and producing. Simply having an idea makes you imaginative, not creative. However, having an idea and acting on it makes you creative.

Characteristics of Highly Creative People

Some characteristics of creative people are:

- They are imaginative and playful
- They see issues from different angles
- They notice small details
- They have very little tolerance for boredom
- They detest rules and routine
- They love to daydream
- They are very curious

What is Innovation?

There are many different definitions of innovation. In simple terms, innovation means turning an idea into a solution that adds value. It can also mean adding value by implementing a new product, service or process, or significantly improving on an existing product, service or process.

Characteristics of Highly Innovative People

Some characteristics of highly innovative people are:

- They embrace doing things differently
- They don't believe in taking shortcuts
- They are not afraid to be unconventional
- They are highly proactive and persistent
- They are organized, cautious and risk-averse

Tips

- Take regular breaks from your creative work to recharge yourself and gain fresh perspective.
- Build prototypes frequently, test them out, get feedback, and make the required changes.

13.1.6 Time Management

Time management is the process organizing your time and deciding how to allocate your time between different activities. Good time management is the difference between working smart (getting more done in less time) and working hard (working for more time to get more done).

Effective time management leads to an efficient work output, even when you are faced with tight deadlines and high-pressure situations. On the other hand, not managing your time effectively results in inefficient output and increases stress and anxiety.

Benefits of Time Management

Time management can lead to huge benefits like:

- Greater productivity
- Higher efficiency
- Better professional reputation
- Reduced stress
- Higher chances for career advancement
- Greater opportunities to achieve goals

Not managing time effectively can result in undesirable consequences like:

- Missing deadlines
- Inefficient work output
- Substandard work quality
- Poor professional reputation
- Stalled career
- Increase in stress and anxiety

13.1.6.1 Traits of Effective Time Managers

Some traits of effective time managers are:

- They begin projects early
- They set daily objectives
- They modify plans if required, to achieve better results
- They are flexible and open-minded
- They inform people in advance if their help will be required
- They know how to say no
- They break tasks into steps with specific deadlines
- They continually review long term goals
- They think of alternate solutions if and when required
- They ask for help when required
- They create backup plans

13.1.6.2 Effective Time Management Techniques

You can manage your time better by putting into practice certain time management techniques. Some helpful tips are:

- **Plan out your day as well as plan for interruptions.** Give yourself at least 30 minutes to figure out your time plan. In your plan, schedule some time for interruptions.
- **Put up a "Do Not Disturb" sign** when you absolutely have to complete a certain amount of work.
- **Close your mind to all distractions.** Train yourself to ignore ringing phones, don't reply to chat messages and disconnect from social media sites.
- **Delegate your work.** This will not only help your work get done faster but will also show you the unique skills and abilities of those around you.
- **Stop procrastinating.** Remind yourself that procrastination typically arises due to the fear of failure or the belief that you cannot do things as perfectly as you wish to do them.
- **Prioritize.** List each task to be completed in order of its urgency or importance level. Then focus on completing each task, one by one.
- **Maintain a log of your work activities.** Analyse the log to help you understand how efficient you are, and how much time is wasted every day.
- **Create time management goals** to reduce time wastage.

Tips

- Always complete the most important tasks first.
- Get at least 7 – 8 hours of sleep every day.
- Start your day early.
- Don't waste too much time on small, unimportant details.
- Set a time limit for every task that you will undertake.
- Give yourself some time to unwind between tasks.

13.1.7 Anger Management

Anger management is the process of:

1. Learning to recognize the signs that you, or someone else, is becoming angry
2. Taking the best course of action to calm down the situation in a positive way

Anger management does not mean suppressing anger.

Importance of Anger Management

Anger is a perfectly normal human emotion. In fact, when managed the right way, anger can be considered a healthy emotion. However, if it is not kept in check, anger can make us act inappropriately and can lead to us saying or doing things that we will likely later regret.

Extreme anger can:

- **Hurt you physically**: It leads to heart disease, diabetes, a weakened immune system, insomnia, and high blood pressure.
- **Hurt you mentally**: It can cloud your thinking and lead to stress, depression and mental health issues.
- **Hurt your career**: It can result in alienating your colleagues, bosses, clients and lead to the loss of respect.
- **Hurt your relationships**: It makes it hard for your family and friends to trust you, be honest with you and feel comfortable around you.

Therefore, anger management, or managing anger appropriately, is so important.

13.1.7.1 Anger Management Strategies

Here are some strategies that can help you control your anger:

Strategy 1: Relaxation

Something as simple as breathing deeply and looking at relaxing images works wonders in calming down angry feelings. Try this simple breathing exercise:

1. Take a deep breath from your diaphragm (don't breathe from your chest)
2. Visualize your breath coming up from your stomach
3. Keep repeating a calming word like 'relax' or 'take it easy' (remember to keep breathing deeply while repeating the word)
4. Picture a relaxing moment (this can be from your memory or your imagination)

Follow this relaxation technique daily, especially when you realize that you're starting to feel angry.

Strategy 2: Cognitive Restructuring

Cognitive restructuring means changing the manner in which you think. Anger can make you curse, swear, exaggerate and act very dramatically. When this happens, force yourself to replace your angry thoughts with more logical ones. For instance, instead of thinking 'Everything is ruined' change your mindset and tell yourself 'It's not the end of the world and getting angry won't solve this'.

Strategy 3: Problem Solving

Getting angry about a problem that you cannot control is a perfectly natural response. Sometimes, try as you may, there may not be a solution to the difficulty you are faced with. In such cases, stop focusing on solving the problem, and instead focus on handling and facing the problem. Remind yourself that you will do your best to deal with the situation, but that you will not blame yourself if you don't get the solution you desire.

Strategy 4: Better Communication

When you're angry, it is very easy to jump to inaccurate conclusions. In this case, you need to force yourself to stop reacting, and think carefully about what you want to say, before saying it. Avoid saying the first thing that enters your head. Force yourself to listen carefully to what the other person is saying. Then think about the conversation before responding.

Strategy 5: Changing Your Environment

If you find that your environment is the cause of your anger, try and give yourself a break from your surroundings. Make an active decision to schedule some personal time for yourself, especially on days that are very hectic and stressful. Having even a brief amount of quiet or alone time is sure to help calm you down.

13.1.7.2 Tips for Anger Management

The following tips will help you keep your anger in check:

- Take some time to collect your thoughts before you speak out in anger.
- Express the reason for your anger in an assertive, but non-confrontational manner once you have calmed down.
- Do some form of physical exercise like running or walking briskly when you feel yourself getting angry.
- Make short breaks part of your daily routine, especially during days that are stressful.
- Focus on how to solve a problem that's making you angry, rather than focusing on the fact that the problem is making you angry.

13.1.8 Stress Management

We say we are 'stressed' when we feel overloaded and unsure of our ability to deal with the pressures placed on us. Anything that challenges or threatens our well-being can be defined as a stress. It is important to note that stress can be good and bad. While good stress keeps us going, negative stress undermines our mental and physical health. Therefore, it is so important to manage negative stress effectively.

Causes of Stress

Stress can be caused by internal and external factors.

Internal causes of stress

- Constant worry
- Rigid thinking
- Unrealistic expectations
- Pessimism
- Negative self-talk
- All in or all out attitude

External causes of stress

- Major life changes
- Difficulties with relationships
- Having too much to do
- Difficulties at work or in school
- Financial difficulties
- Worrying about one's children and/or family

13.1.8.1 Symptoms of Stress

Stress can manifest itself in numerous ways. Take a look at the cognitive, emotional, physical and behavioural symptoms of stress.

Cognitive Symptoms	Emotional Symptoms
• Memory problems • Concentration issues • Lack of judgement • Pessimism • Anxiety • Constant worrying	• Depression • Agitation • Irritability • Loneliness • Anxiety • Anger

Physical Symptoms	Behavioural Symptoms
• Aches and pain • Diarrhoea or constipation • Nausea • Dizziness • Chest pain and/or rapid heartbeat • Frequent cold or flu like feelings	• Increase or decrease in appetite • Over sleeping or not sleeping enough • Withdrawing socially • Ignoring responsibilities • Consumption of alcohol or cigarettes • Nervous habits like nail biting and pacing

13.1.8.2 Tips to Manage Stress

The following tips can help you manage your stress better:

- Note down the different ways in which you can handle the various sources of your stress.

- Remember that you cannot control everything, but you can control how you respond.

- Discuss your feelings, opinions and beliefs rather than reacting angrily, defensively or passively.

- Practice relaxation techniques like meditation, yoga or tai chi when you start feeling stressed.

- Devote a part of your day towards exercise.

- Eat healthy foods like fruits and vegetables. Avoid unhealthy foods especially those containing large amounts of sugar.

- Plan your day so that you can manage your time better, with less stress.

- Say no to people and things when required.

- Schedule time to pursue your hobbies and interests.

- Ensure you get at least 7-8 hours of sleep.

- Reduce your caffeine intake.

- Increase the time spent with family and friends.

UNIT 13.2: Digital Literacy: A Recap

Unit Objectives ⊙

At the end of this unit, you will be able to:

1. Identify the basic parts of a computer
2. Identify the basic parts of a keyboard
3. Recall basic computer terminology
4. Recall the functions of basic computer keys
5. Discuss the main applications of MS Office
6. Discuss the benefits of Microsoft Outlook
7. Discuss the different types of e-commerce
8. List the benefits of e-commerce for retailers and customers
9. Discuss how the Digital India campaign will help boost e-commerce in India
10. Describe how you will sell a product or service on an e-commerce platform

13.2.1 Computer and Internet basics

Fig.13.2.1. Parts of a Computer

Fig.13.2.2. Parts of a Keyboard

Basic Parts of a Computer

1. **Central Processing Unit (CPU):** The brain of the computer. It interprets and carries out program instructions.
2. **Hard Drive:** A device that stores large amounts of data.
3. **Monitor:** The device that contains the computer screen where the information is visually displayed.

4. **Desktop:** The first screen displayed after the operating system loads.

5. **Background:** The image that fills the background of the desktop.

6. **Mouse:** A hand-held device used to point to items on the monitor.

7. **Speakers:** Devices that enable you to hear sound from the computer.

8. **Printer:** A device that converts output from a computer into printed paper documents.

9. **Icon:** A small picture or image that visually represents something on your computer.

10. **Cursor:** An arrow which indicates where you are positioned on the screen.

11. **Program Menu:** A list of programs on your computer that can be accessed from the Start menu.

12. **Taskbar:** The horizontal bar at the bottom of the computer screen that lists applications that are currently in use.

13. **Recycle Bin:** A temporary storage for deleted files.

Basic Internet Terms

- **The Internet:** A vast, international collection of computer networks that transfers information.

- **The World Wide Web:** A system that lets you access information on the Internet.

- **Website:** A location on the World Wide Web (and Internet) that contains information about a specific topic.

- **Homepage:** Provides information about a website and directs you to other pages on that website.

- **Link/Hyperlink:** A highlighted or underlined icon, graphic, or text that takes you to another file or object.

- **Web Address/URL:** The address for a website.

- **Address Box:** A box in the browser window where you can type in a web address.

Basic Computer Keys

- **Arrow Keys:** Press these keys to move your cursor.

- **Space bar:** Adds a space.

- **Enter/Return:** Moves your cursor to a new line.

- **Shift:** Press this key if you want to type a capital letter or the upper symbol of a key.

- **Caps Lock:** Press this key if you want all the letters you type to be capital letters. Press it again to revert to typing lowercase letters.

- **Backspace:** Deletes everything to the left of your cursor

Tips

- When visiting a .com address, there no need to type http://or even www. Just type the name of the website and then press Ctrl + Enter. (Example: Type 'apple' and press Ctrl + Enter to go to www.apple.com)

- Press the Ctrl key and press the + or - to increase and decrease the size of text.

- Press F5 or Ctrl + R to refresh or reload a web page.

13.2.2 MS Office and Email

About MS Office

MS Office or Microsoft Office is a suite of computer programs developed by Microsoft. Although meant for all users, it offers different versions that cater specifically to students, home users and business users. All the programs are compatible with both, Windows and Macintosh.

Most Popular Office Products

Some of the most popular and universally used MS Office applications are:

- **Microsoft Word**: Allows users to type text and add images to a document.
- **Microsoft Excel**: Allows users to enter data into a spreadsheet and create calculations and graphs.
- **Microsoft PowerPoint**: Allows users to add text, pictures and media and create slideshows and presentations.
- **Microsoft Outlook**: Allows users to send and receive email.
- **Microsoft OneNote**: Allows users to make drawings and notes with the feel of a pen on paper.
- **Microsoft Access**: Allows users to store data over many tables.

Why Choose Microsoft Outlook?

A popular email management choice especially in the workplace, Microsoft Outlook also includes an address book, notebook, web browser and calendar. Some major benefits of this program are:

- **Integrated search function**: You can use keywords to search for data across all Outlook programs.
- **Enhanced security**: Your email is safe from hackers, junk mail and phishing website email.
- **Email syncing**: Sync your mail with your calendar, contact list, notes in One Note and…your phone!
- **Offline access to email:** No Internet? No problem! Write emails offline and send them when you're connected again.

Tips

- Press Ctrl+R as a shortcut method to reply to email.
- Set your desktop notifications only for very important emails.
- Flag messages quickly by selecting messages and hitting the Insert key.
- Save frequently sent emails as a template to reuse again and again.
- Conveniently save important emails as files.

13.2.3 E-Commerce

What is E-Commerce?

E-commerce is the buying or selling of goods and services, or the transmitting of money or data, electronically on the internet. E-Commerce is the short form for "electronic commerce."

Examples of E-Commerce

Some examples of e-commerce are:
- Online shopping
- Online auctions
- Online ticketing
- Electronic payments
- Internet banking

Types of E-Commerce

E-commerce can be classified based on the types of participants in the transaction. The main types of e-commerce are:
- **Business to Business (B2B)**: Both the transacting parties are businesses.
- **Business to Consumer (B2C)**: Businesses sell electronically to end-consumers.
- **Consumer to Consumer (C2C):** Consumers come together to buy, sell or trade items to other consumers.
- **Consumer-to-Business (C2B)**: Consumers make products or services available for purchase to companies looking for exactly those services or products.
- **Business-to-Administration (B2A)**: Online transactions conducted between companies and public administration.
- **Consumer-to-Administration (C2A)**: Online transactions conducted between individual and public administration.

13.2.3.1 Benefits of E-Commerce

The e-commerce business provides some benefits for retailers and customers.

Benefits for retailers
- Establishes an online presence
- Reduces operational costs by removing overhead costs
- Increases brand awareness through the use of good keywords
- Increases sales by removing geographical and time constraints

Benefits for customers
- Offers a wider range of choice than any physical store
- Enables goods and services to be purchased from remote locations
- Enables consumers to perform price comparisons

13.2.3.2 Digital India Campaign

Prime Minister Narendra Modi launched the Digital India campaign in 2015, with the objective of offering every citizen of India access to digital services, knowledge and information. The campaign aims to improve the country's online infrastructure and increase internet connectivity, thus boosting the e-commerce industry.

Currently, the majority of online transactions come from tier 2 and tier 3 cities. Once the Digital India campaign is in place, the government will deliver services through mobile connectivity, which will help deliver internet to remote corners of the country. This will help the e-commerce market to enter India's tier 4 towns and rural areas.

E-Commerce Activity

Choose a product or service that you want to sell online. Write a brief note explaining how you will use existing e-commerce platforms, or create a new e-commerce platform, to sell your product or service.

Tips

- Before launching your e-commerce platform, test everything.
- Pay close and personal attention to your social media.

UNIT 13.3: Money Matters

Unit Objectives 🎯

At the end of this unit, you will be able to:

1. Discuss the importance of saving money
2. Discuss the benefits of saving money
3. Discuss the main types of bank accounts
4. Describe the process of opening a bank account
5. Differentiate between fixed and variable costs
6. Describe the main types of investment options
7. Describe the different types of insurance products
8. Describe the different types of taxes
9. Discuss the uses of online banking
10. Discuss the main types of electronic funds transfers

13.3.1 Personal Finance – Why to Save?

Importance of Saving

We all know that the future is unpredictable. You never know what will happen tomorrow, next week or next year. That's why saving money steadily through the years is so important. Saving money will help improve your financial situation over time. But more importantly, knowing that you have money stashed away for an emergency will give you peace of mind. Saving money also opens the door to many more options and possibilities.

Benefits of Saving

Inculcating the habit of saving leads to a vast number of benefits. Saving helps you:

*   **Become financially independent**: When you have enough money saved up to feel secure you can start making your choices, from taking a vacation whenever you want, to switching careers or starting your own business.
*   **Invest in yourself through education**: Through saving, you can earn enough to pay up for courses that will add to your professional experience and ultimately result in higher paying jobs.
*   **Get out of debt**: Once you have saved enough as a reserve fund, you can use your savings to pay off debts like loans or bills that have accumulated over time.
*   **Be prepared for surprise expenses:** Having money saved enables you to pay for unforeseen expenses like sudden car or house repairs, without feeling financially stressed.
*   **Pay for emergencies**: Saving helps you deal with emergencies like sudden health issues or emergency trips without feeling financially burdened.

- **Afford large purchases and achieve major goals**: Saving diligently makes it possible to place down payments towards major purchases and goals, like buying a home or a car.
- **Retire**: The money you have saved over the years will keep you comfortable when you no longer have the income you would get from your job.

Tips

- Break your spending habit. Try not spending on one expensive item per week, and put the money that you would have spent into your savings.
- Decide that you will not buy anything on certain days or weeks and stick to your word.

13.3.2 Types of Bank Accounts

In India, banks offer four main types of bank accounts. These are:
1. Current Accounts
2. Savings Accounts
3. Recurring Deposit Accounts
4. Fixed Deposit Accounts

Current Accounts

Current accounts offer the most liquid deposits and thus, are best suited for businessmen and companies. As these accounts are not meant for investments and savings, there is no imposed limit on the number or amount of transactions that can be made on any given day. Current account holders are not paid any interest on the amounts held in their accounts. They are charged for certain services offered on such accounts.

Saving Accounts

Savings accounts are meant to promote savings and are therefore the number one choice for salaried individuals, pensioners and students. While there is no restriction on the number and amount of deposits made, there are usually restrictions on the number and amount of withdrawals. Savings account holders are paid interest on their savings.

Recurring Deposit Accounts

Recurring Deposit accounts, also called RD accounts, are the accounts of choice for those who want to save an amount every month but are unable to invest a large sum at one time. Such account holders deposit a small, fixed amount every month for a pre-determined period (minimum 6 months). Defaulting on a monthly payment results in the account holder being charged a penalty amount. The total amount is repaid with interest at the end of the specified period.

Fixed Deposit Accounts

Fixed Deposit accounts, also called FD accounts, are ideal for those who wish to deposit their savings for a long term in return for a high rate of interest. The rate of interest offered depends on the amount deposited and the time period, and also differs from bank to bank. In the case of an FD, a certain amount of money is deposited by the account holder for a fixed period of time. The money can be withdrawn when the period expires. If necessary, the depositor can break the fixed deposit prematurely. However, this usually attracts a penalty amount which also differs from bank to bank.

13.3.2.1 Opening a Bank Account

Opening a bank account is quite a simple process. Take a look at the steps to open an account of your own:

Step 1: Fill in the Account Opening Form

This form requires you to provide the following information:
- Personal details (name, address, phone number, date of birth, gender, occupation, address)
- Method of receiving your account statement (hard copy/email)
- Details of your initial deposit (cash/cheque)
- Manner of operating your account (online/mobile banking/traditional via cheque, slip books)
- Ensure that you sign wherever required on the form.

Step 2: Affix your Photograph

Stick a recent photograph of yourself in the allotted space on the form.

Step 3: Provide your Know Your Customer (KYC) Details

KYC is a process that helps banks verify the identity and address of their customers. To open an account, every individual need to submit certain approved documents with respect to photo identity (ID) and address proof. Some Officially Valid Documents (OVDs) are:
- Passport
- Driving License
- Voters' Identity Card
- PAN Card
- UIDAI (Aadhar) Card

Step 4: Submit All your Documents

Submit the completed Account Opening Form and KYC documents. Then wait until the forms are processed and your account has been opened!

Tips

- Select the right type of account.
- Fill in complete nomination details.
- Ask about fees.
- Understand the rules.
- Check for online banking – it's convenient!
- Keep an eye on your bank balance.

13.3.3 Costs: Fixed vs Variable

What are Fixed and Variable Costs?

Fixed costs and variable costs together make up a company's total cost. These are the two types of costs that companies have to bear when producing goods and services. A fixed cost does not change with the volume of goods or services a company produces. It always remains the same.

A variable cost, on the other hand, increases and decreases depending on the volume of goods and services produced. In other words, it varies with the amount produced.

Differences between Fixed and Variable Costs

Let's take a look at some of the main differences between fixed and variable costs:

Criteria	Fixed Costs	Variable Costs
Meaning	A cost that stays the same, regardless of the output produced.	A cost that changes when the
Nature	Time related.	Volume related.
Incurred	Incurred irrespective of units being produced.	Incurred only when units are produced
Unit cost	Inversely proportional to the number of units produced	Remains the same, per unit.
Examples	Depreciation, rent, salary, insurance and tax	Material consumed, wages, commission on sales and packing expenses

Tips

- When trying to determine whether a cost is fixed or variable, simply ask the following question: Will the particular cost change if the company stopped its production activities? If the answer is no, then it is a fixed cost. If the answer is yes, then it is probably a variable cost.

13.3.4 Investment, Insurance and Taxes

Investment

Investment means that money is spent today with the aim of reaping financial gains at a future time. The main types of investment options are as follows:

- **Bonds:** Bonds are instruments used by public and private companies to raise large sums of money – too large to be borrowed from a bank. These bonds are then issued in the public market and are bought by lenders.
- **Stocks:** Stocks or equity are shares that are issued by companies and are bought by the general public.
- **Small Savings Schemes:** Small Savings Schemes are tools meant to save money in small amounts. Some popular schemes are the Employees Provident Fund, Sukanya Samriddhi Scheme and National Pension Scheme.
- **Mutual Funds:** Mutual Funds are professionally managed financial instruments that invest money in different securities on behalf of investors.
- **Fixed Deposits:** A fixed amount of money is kept aside with a financial institution for a fixed amount of time in return for interest on the money.
- **Real Estate:** Loans are taken from banks to purchase real estate, which is then leased or sold with the aim of making a profit on the appreciated property price.
- **Hedge Funds:** Hedge funds invest in both financial derivatives and/or publicly traded securities.
- **Private Equity:** Private Equity is trading in the shares of an operating company that is not publicly listed and whose shares are not available on the stock market.
- **Venture Capital:** Venture Capital involves investing substantial capital in a budding company in return for stocks in that company.

Insurance

There are two types of insurance, Life Insurance and General Insurance.

Life Insurance Products

The main life insurance products are:

- **Term Insurance:** This is the simplest and cheapest form of insurance. It offers financial protection for a specified tenure, say 15 to 20 years. In the case of your death, your family is paid the sum assured. In the case of your surviving the term, the insurer pays nothing.

- **Endowment Policy:** This offers the dual benefit of insurance and investment. Part of the premium is allocated towards the sum assured, while the remaining premium gets invested in equity and debt. It pays a lump sum amount after the specified duration or on the death of the policyholder, whichever is earlier.

- **Unit-Linked Insurance Plan (ULIP):** Here part of the premium is spent on the life cover, while the remaining amount is invested in equity and debt. It helps develop a regular saving habit.

- **Money Back Life Insurance:** While the policyholder is alive, periodic payments of the partial survival benefits are made during the policy tenure. On the death of the insured, the insurance company pays the full sum assured along with survival benefits.

- **Whole Life Insurance:** It offers the dual benefit of insurance and investment. It offers insurance cover for the whole life of the person or up to 100 years whichever is earlier.

General Insurance

General Insurance deals with all insurance covering assets like animals, agricultural crops, goods, factories, cars and so on.

General Insurance Products

The main general insurance products are:

- **Motor Insurance:** This can be divided into Four-Wheeler Insurance and Two-Wheeler insurance.

- **Health Insurance:** The main types of health insurance are individual health insurance, family floater health insurance, comprehensive health insurance and critical illness insurance.

- **Travel Insurance:** This can be categorised into Individual Travel Policy, Family Travel Policy, Student Travel Insurance and Senior Citizen Health Insurance.

- **Home Insurance:** This protects the house and its contents from risk.

- **Marine Insurance:** This insurance covers goods, freight and cargo against loss or damage during transit by rail, road, sea and/or air.

Taxes

There are two types of taxes:

1. Direct Taxes
2. Indirect Taxes.

Direct Tax

Direct taxes are levied directly on an entity or a person and are non-transferrable. Some examples of Direct Taxes are:

- **Income Tax:** This tax is levied on your earning in a financial year. It is applicable to both, individuals and companies.

- **Capital Gains Tax:** This tax is payable whenever you receive a sizable amount of money. It is usually of two types – short term capital gains from investments held for less than 36 months and long term capital gains from investments held for longer than 36 months.

- **Securities Transaction Tax:** This tax is added to the price of a share. It is levied every time you buy or sell shares.
- **Perquisite Tax:** This tax is levied is on perks that have been acquired by a company or used by an employee.
- **Corporate Tax:** Corporate tax is paid by companies from the revenue they earn.

Indirect Tax

Indirect taxes are levied on goods or services. Some examples of Indirect Taxes are:

- **Sales Tax:** Sales Tax is levied on the sale of a product.
- **Service Tax:** Service Tax is added to services provided in India.
- **Value Added Tax:** Value Added Tax is levied at the discretion of the state government. The tax is levied on goods sold in the state. The tax amount is decided by the state.
- **Customs Duty & Octroi:** Customs Duty is a charge that is applied on purchases that are imported from another country. Octroi is levied on goods that cross state borders within India.
- **Excise Duty:** Excise Duty is levied on all goods manufactured or produced in India

Tips

- Think about how quickly you need your money back and pick an investment option accordingly.
- Ensure that you are buying the right type of insurance policy for yourself.
- Remember, not paying taxes can result in penalties ranging from fines to imprisonment.

13.3.5 Online Banking, NEFT, RTGS etc.

What is Online Banking?

Internet or online banking allows account holders to access their account from a laptop at any location. In this way, instructions can be issued. To access an account, account holders simply need to use their unique customer ID number and password.

Internet banking can be used to:

- Find out an account balance
- Transfer amounts from one account to another
- Arrange for the issuance of cheques
- Instruct payments to be made
- Request for a cheque book
- Request for a statement of accounts
- Make a fixed deposit

Electronic Funds Transfers

Electronic funds transfer is a convenient way of transferring money from the comfort of one's own home, using integrated banking tools like internet and mobile banking.

Transferring funds via an electronic gateway is extremely convenient. With the help of online banking, you can choose transferring funds:

- Into your accounts of the same bank.
- Into other people's accounts of the same bank.
- Into accounts in different banks through NEFT.
- Into other bank accounts though RTGS.
- Into various accounts through IMPS.

NEFT

NEFT stands for National Electronic Funds Transfer. This money transfer system allows you to electronically transfer funds from your respective bank accounts to any other account, either in the same bank or belonging to any other bank. NEFT can be used by individuals, firms and corporate organizations to transfer funds between accounts.

In order to transfer funds via NEFT, two things are required:

- A transferring bank
- A destination banks

Before you can transfer funds through NEFT, you will need to register the beneficiary who will be receiving the funds. In order to complete this registration, you will require the following information:

- Recipient's name
- Recipient's account number
- Recipient's bank's name
- Recipient's bank's IFSC code

RTGS

RTGS stands for Real Time Gross Settlement. This is a real time funds transfer system which enables you to transfer funds from one bank to another, in real time or on a gross basis. The transferred amount is immediately deducted from the account of one bank, and instantly credited to the other bank's account. The RTGS payment gateway is maintained by the Reserve Bank of India. The transactions between banks are made electronically.

RTGS can be used by individuals, companies and firms to transfer large sums of money. Before remitting funds through RTGS, you will need to add the beneficiary and his bank account details via your online banking account.

In order to complete this registration, you will require the following information:

- Name of the beneficiary
- Beneficiary's account number
- Beneficiary's bank address
- Bank's IFSC code

IMPS

IMPS stand for Immediate Payment Service. This is a real-time, inter-bank, electronic funds transfer system used to transfer money instantly within banks across India. IMPS enable users to make instant electronic transfer payments using mobile phones through both, Mobile Banking and SMS. It can also be used through ATMs and online banking. IMPS is available 24 hours a day and 7 days a week. The system features a secure transfer gateway and immediately confirms orders that have been fulfilled.

To transfer money through IMPS, you need to:

- Register for IMPS with your bank
- Receive a Mobile Money Identifier (MMID) from the bank
- Receive a MPIN from the bank

Once you have both these, you can login or make a request through SMS to transfer an amount to a beneficiary.

In order for the beneficiary to receive the transferred money, he must:

- Link his mobile number with his respective account
- Receive the MMID from the bank

In order to initiate a money transfer through IMPS, you will need to enter the following information:

- The beneficiary's mobile number
- The beneficiary's MMID
- The transfer amount
- Your MPIN

As soon as money has been deducted from your account and credited into the beneficiary's account, you will be sent a confirmation SMS with a transaction reference number, for future reference.

13.3.5.1 Differences between NEFT, RTGS & IMPS

Criteria	NEFT	RTGS	IMPS
Settlement	Done in batches	Real-time	Real-time
Full form	National Electronic Fund Transfer	Real Time Gross Settlement	Immediate Payment Service
Timings on Monday – Friday	8:00 am – 6:30 pm	9:00 am – 4:30 pm	24x7
Timings on Saturday	8:00 am – 1:00 pm	9:00 am – 1:30 pm	24x7
Minimum amount of money transfer limit	₹1	₹2 lacs	₹1
Maximum amount of money transfer limit	₹10 lacs	₹10 lacs per day	₹2 lacs
Maximum charges as per RBI	Up to 10,000 – ₹2.5 above 10,000 – 1 lac - ₹5 above 1 – 2 lacs ₹15 above 2 – 5 lacs ₹25 above 5 – 10 lacs ₹25	above 2 – 5 lacs ₹25 above 5 – 10 lacs ₹50	Up to 10,000 – ₹5 above 10,000 – 1 lac – ₹5 above 1 – 2 lacs – ₹15

Fig.13.3.2: Differences Between NEFT, RTGS & IMPS

Tips

- Never click on any links in any e-mail message to access your online banking website.
- You will never be asked for your credit or debit card details while using online banking.
- Change your online banking password regularly.

UNIT 13.4: Preparing for Employment & Self-Employment

Unit Objectives

At the end of this unit, you will be able to:

1. Discuss the steps to prepare for an interview
2. Discuss the steps to create an effective Resume
3. Discuss the most frequently asked interview questions
4. Discuss how to answer the most frequently asked interview questions
5. Discuss basic workplace terminology

13.4.1 Interview Preparation: How to Prepare for an Interview?

The success of your getting the job that you want depends largely on how well your interview for that job goes. Therefore, before you go in for your interview, it is important that you prepare for it with a fair amount of research and planning. Take a look at the steps to follow in order to be well prepared for an interview:

1. **Research the organization that you are having the interview with.**
   - Studying the company beforehand will help you be more prepared at the time of the interview. Your knowledge of the organization will help you answer questions at the time of the interview and will leave you looking and feeling more confident. This is sure to make you stand out from other, not as well informed, candidates.
   - Look for background information on the company. Ty and find an overview of the company and its industry profile.
   - Visit the company website to get a good idea of what the company does. A company website offers a wealth of important information. Read and understand the company's mission statement. Pay attention to the company's products/services and client list. Read through any press releases to get an idea of the company's projected growth and stability.
   - Note down any questions that you have after your research has been completed.
2. **Think about whether your skills and qualifications match the job requirements.**
   - Carefully read through and analyse the job description.
   - Make a note of the knowledge, skills and abilities required to fulfil the job requirements.
   - Take a look at the organization hierarchy. Figure out where the position you are applying for fits into this hierarchy.

3. **Go through the most typical interview questions asked, and prepare your responses.**
    - Remember, in most interviews a mix of resume-based, behavioural and case study questions are asked.
    - Think about the kind of answers you would like to provide to typical questions asked in these three areas.
    - Practice these answers until you can express them confidently and clearly.

4. **Plan your attire for the interview.**
    - It is always safest to opt for formal business attire, unless expressly informed to dress in business casual (in which case you should use your best judgement).
    - Ensure that your clothes are clean and well-ironed. Pick neutral colours – nothing too bright or flashy.
    - The shoes you wear should match your clothes and should be clean and suitable for an interview.
    - Remember, your aim is to leave everyone you meet with the impression that you are a professional and highly efficient person.

5. **Ensure that you have packed everything that you may require during the interview.**
    - Carry a few copies of your resume. Use a good quality paper for your resume print outs.
    - Always take along a notepad and a pen.
    - Take along any information you may need to refer to, in order to fill out an application form.
    - Carry a few samples of your work, if relevant.

6. **Remember the importance of non-verbal communication.**
    - Practice projecting confidence. Remind yourself to smile and make eye contact. Practice giving a firm handshake.
    - Keep in mind the importance of posture. Practice sitting up straight. Train yourself to stop nervous gestures like fidgeting and foot-tapping.
    - Practice keeping your reactions in check. Remember, your facial expressions provide a good insight into your true feelings. Practice projecting a positive image.

7. **Make a list of questions to end the interview with.**
    - Most interviews will end with the interviewer(s) asking if you have any questions. This is your chance to show that you have done your research and are interested in learning more about the company.
    - If the interviewer does not ask you this question, you can inform him/her that you have some queries that you would like to discuss. This is the time for you to refer to the notes you made while studying the company.
    - Some good questions to ask at this point are:
        o   What do you consider the most important criteria for success in this job?
        o   How will my performance be evaluated?
        o   What are the opportunities for advancement?
        o   What are the next steps in the hiring process?
    - Remember, never ask for information that is easily available on the company website.

Tips

- Ask insightful and probing questions.
- When communicating, use effective forms of body language like smiling, making eye contact, and actively listening and nodding. Don't slouch, play with nearby items, fidget, chew gum, or mumble.

13.4.2 Preparing an Effective Resume

A resume is a formal document that lists a candidate's work experience, education and skills. A good resume gives a potential employer enough information to believe the applicant is worth interviewing. That's why it is so important to create a résumé that is effective. Take a look at the steps to create an effective resume:

Step 1: Write the Address Section

The Address section occupies the top of your resume. It includes information like your name, address, phone number and e-mail address. Insert a bold line under the section to separate it from rest of your resume.

Example:

Jasmine Watts
Breach Candy, Mumbai – India
Contact No: +91 2223678270
Email: jasmine.watts@gmail.com

Step 2: Add the Profile Summary Section

This part of your resume should list your overall experiences, achievements, awards, certifications and strengths. You can make your summary as short as 2-3 bullet points or as long as 8-10 bullet points.

Example:

Profile Summary

- A Content Writer graduated from University of Strathclyde having 6 years of experience in writing website copy.
- Core expertise lies in content creation for e-learning courses, specifically for the K-12 segment.

Step 3: Include Your Educational Qualifications

When listing your academic records, first list your highest degree. Then add the second highest qualification under the highest one and so on. To provide a clear and accurate picture of your educational background, it is critical that include information on your position, rank, percentage or CPI for every degree or certification that you have listed.

If you have done any certifications and trainings, you can add a Trainings & Certifications section under your Educational Qualifications section.

Example:

Educational Qualifications
- Masters in International Management (2007) from Columbia University with 8.8 CPI.
- Bachelor of Management Studies (2004) from Mumbai University with 87% marks.
- 10+2 with Math, Stats (2001) from Maharashtra Board with 91% marks.
- High School (1999) from Maharashtra Board with 93% marks.

Step 4: List Your Technical Skills

When listing your technical skills, start with the skills that you are most confident about. Then add the skills that you do not have as good a command over. It is perfectly acceptable to include just one skill, if you feel that particular skill adds tremendous value to your résumé. If you do not have any technical skills, you can omit this step.

Example:

Technical Skills
- Flash
- Photoshop

Step 5: Insert Your Academic Project Experience

List down all the important projects that you have worked on. Include the following information in this section:

• Project title	• Organization	• Platform used
• Contribution	• Description	

Example:

Academic Projects
Project Title: Different Communication Skills
Organization: True Blue Solutions
Platform used: Articulate
Contribution: Content writing and graphic visualization
Description: Development of storyboards for corporate induction & training programs

Step 6: List Your Strengths

This is where you list all your major strengths. This section should be in the form of a bulleted list.

Example:

Strengths
- Excellent oral, written and presentation skills
- Action-oriented and result-focused
- Great time management skills

Step 7: List Your Extracurricular Activities

It is very important to show that you have diverse interests and that your life consists of more than academics. Including your extracurricular activities can give you an added edge over other candidates who have similar academic scores and project experiences. This section should be in the form of a bulleted list.

Example:

Extracurricular Activities
- Member of the Debate Club
- Played tennis at a national level
- Won first prize in the All India Camel Contest, 2010

Step 8: Write Your Personal Details

The last section of your résumé must include the following personal information:

- Date of birth
- Gender & marital status
- Nationality
- Languages known

Example:

Personal Details
- Date of birth: 25th May, 1981
- Gender & marital status: Female, Single
- Nationality: Indian
- Languages known: English, Hindi, Tamil, French

Tips

- Keep your resume file name short, simple and informational.
- Make sure the resume is neat and free from typing errors.
- Always create your resume on plain white paper.

13.4.3 Interview FAQs

Take a look at some of the most frequently asked interview questions, and some helpful tips on how to answer them.

Q1. Can you tell me a little about yourself?

Tips to answer:
- Don't provide your full employment or personal history.
- Offer 2-3 specific experiences that you feel are most valuable and relevant.
- Conclude with how those experiences have made you perfect for this specific role.

Q2. How did you hear about the position?

Tips to answer:
- Tell the interviewer how you heard about the job – whether it was through a friend (name the friend), event or article (name them) or a job portal (say which one).
- Explain what excites you about the position and what in particular caught your eye about this role.

Q3. What do you know about the company?

Tips to answer:
- Don't recite the company's About Us page.
- Show that you understand and care about the company's goals.
- Explain why you believe in the company's mission and values.

Q4. Why do you want this job?

Tips to answer:
- Show that you are passionate about the job.
- Identify why the role is a great fit for you.
- Explain why you love the company.

Q5. Why should we hire you?

Tips to answer:
- Prove through your words that you can not only do the work, but can definitely deliver excellent results.
- Explain why you would be a great fit with the team and work culture.
- Explain why you should be chosen over any other candidate.

Q6. What are your greatest professional strengths?

Tips to answer:
- Be honest – share some of your real strengths, rather than give answers that you think sound good.
- Offer examples of specific strengths that are relevant to the position you are applying for.
- Provide examples of how you've demonstrated these strengths.

Q7. What do you consider to be your weaknesses?

Tips to answer:
- The purpose of this question is to gauge your self-awareness and honesty.
- Give an example of a trait that you struggle with, but that you're working on to improve.

Q8. What are your salary requirements?

Tips to answer:
- Do your research beforehand and find out the typical salary range for the job you are applying for.
- Figure out where you lie on the pay scale based on your experience, education, and skills.
- Be flexible. Tell the interviewer that you know your skills are valuable, but that you want the job and are willing to negotiate.

Q9. What do you like to do outside of work?

Tips to answer:
- The purpose of this question is to see if you will fit in with the company culture.
- Be honest – open up and share activities and hobbies that interest and excite you.

Q10. If you were an animal, which one would you want to be?

Tips to answer:
- The purpose of this question is to see if you are able to think on your feet.
- There's no wrong answer – but to make a great impression try to bring out your strengths or personality traits through your answer.

Q11: What do you think we could do better or differently?

Tips to answer:
- The purpose of this question is to see if you have done your research on the company, and to test whether you can think critically and come up with new ideas.
- Suggest new ideas. Show how your interests and expertise would help you execute these ideas.

Q12: Do you have any questions for us?

Tips to answer:
- Do not ask questions to which the answers can be easily found on the company website or through a quick online search.
- Ask intelligent questions that show your ability to think critically.

Tips

- Be honest and confident while answering.
- Use examples of your past experiences wherever possible to make your answers more impactful.

13.4.4 Work Readiness – Terms & Terminologies

Every employee should be well versed in the following terms:

- **Annual leave:** Paid vacation leave given by employers to employees.
- **Background Check:** A method used by employers to verify the accuracy of the information provided by potential candidates.
- **Benefits:** A part of an employee's compensation package.
- **Breaks:** Short periods of rest taken by employees during working hours.
- **Compensation Package:** The combination of salary and benefits that an employer provides to his/her employees.
- **Compensatory Time (Comp Time):** Time off in lieu of pay.
- **Contract Employee:** An employee who works for one organization that sells said employee's service to another company, either on a project or time basis.
- **Contract of Employment:** When an employee is offered work in exchange for wages or salary, and accepts the offer made by the employer, a contract of employment exists.
- **Corporate Culture:** The beliefs and values shared by all the members of a company, and imparted from one generation of employees to another.
- **Counter Offer/Counter Proposal:** A negotiation technique used by potential candidates to increase the amount of salary offered by a company.
- **Cover Letter:** A letter that accompanies a candidate's resume. It emphasizes the important points in the candidate's resume and provides real examples that prove the candidate's ability to perform the expected job role.
- **Curriculum Vitae (CV)/Resume:** A summary of a candidate's achievements, educational work experience, skills and strengths.
- **Declining Letter:** A letter sent by an employee to an employer, turning down the job offer employer to the employee.
- **Deductions:** Amounts subtracted from an employee's pay and listed on the employee's pay slip.
- **Discrimination:** The act of treating one person not as favourably as another person.
- **Employee:** A person who works for another person in exchange for payment.
- **Employee Training:** A workshop or in-house training that an employee is asked to attend by his or her superior, for the benefit of the employer.
- **Employment Gaps:** Periods of unemployed time between jobs.
- **Fixed-Term Contract:** A contract of employment which gets terminated on an agreed-upon date.
- **Follow-Up:** The act of contacting a potential employer after a candidate has submitted his or her resume.
- **Freelancer/Consultant/Independent Contractor:** A person who works for him or herself for temporary jobs and projects with different employers.
- **Holiday**: Paid time-off from work.
- **Hourly Rate**: The amount of salary or wages paid for 60 minutes of work.

- **Internship**: A job opportunity offered by an employer to a potential employee, called an at the employer's company for a fixed, limited time period.
- **Interview**: A conversation between a potential employee and a representative of an order to determine if the potential employee should be hired.
- **Job Application**: A form which asks for a candidate's information like the candidate's name, details and work experience. The purpose of a candidate submitting a job application, is to show that candidate's interest in working for a particular company.
- **Job Offer**: An offer of employment made by an employer to a potential employee.
- **Job Search Agent**: A program that enables candidates to search for employment opportunities by selecting criteria listed in the program, for job vacancies. background, made by the and pitches intern, to work employer, in address, contact
- **Lay Off**: A lay off occurs when an employee is temporarily let go from his or her job, due to the employer not having any work for that employee.
- **Leave**: Formal permission given to an employee, by his or her employer, to take a leave of absence from work.
- **Letter of Acceptance**: A letter given by an employer to an employee, confirming the offer of employment made by the employer, as well as the conditions of the offer.
- **Letter of Agreement**: A letter that outlines the terms of employment.
- **Letter of Recommendation**: A letter written for the purpose of validating the work skills o f a person.
- **Maternity Leave**: Leave taken from work by women who are pregnant, or who have just given birth.
- **Mentor**: A person who is employed at a higher level than you, who offers you advice and guides you in your career.
- **Minimum wage**: The minimum wage amount paid on an hourly basis.
- **Notice**: An announcement made by an employee or an employer, stating that the employment contract will end on a particular date.
- **Offer of Employment**: An offer made by an employer to a prospective employee that contains important information pertaining to the job being offered, like the starting date, salary, working conditions etc.
- **Open-Ended Contract**: A contract of employment that continues till the employer or terminates it.
- **Overqualified**: A person who is not suited for a particular job because he or she has too m any years of work experience, or a level of education that is much higher than required f or the job or is currently or was previously too highly paid.
- **Part-Time Worker**: An employee who works for fewer hours than the standard number of hours normally worked.
- **Paternity Leave**: Leave granted to a man who has recently become a father.
- **Recruiters/Head-hunters/Executive Search Firms**: Professionals who are paid by employers to search for people to fill particular positions.
- **Resigning/Resignations**: When an employee formally informs his or her employer that he or she is quitting his or her job.

- **Self-Employed**: A person who has his or her own business and does not work in the capacity of an employee.
- **Time Sheet**: A form that is submitted to an employer, by an employee, that contains the number of hours worked every day by the employee.

UNIT 13.5: Understanding Entrepreneurship

Unit Objectives ⊚

At the end of this unit, you will be able to:

1. Discuss the concept of entrepreneurship
2. Discuss the importance of entrepreneurship
3. Describe the characteristics of an entrepreneur
4. Describe the different types of enterprises
5. List the qualities of an effective leader
6. Discuss the benefits of effective leadership
7. List the traits of an effective team
8. Discuss the importance of listening effectively
9. Discuss how to listen effectively
10. Discuss the importance of speaking effectively
11. Discuss how to speak effectively
12. Discuss how to solve problems
13. List important problem-solving traits
14. Discuss ways to assess problem solving skills
15. Discuss the importance of negotiation
16. Discuss how to negotiate
17. Discuss how to identify new business opportunities
18. Discuss how to identify business opportunities within your business
19. Understand the meaning of entrepreneur
20. Describe the different types of entrepreneurs
21. List the characteristics of entrepreneurs
22. Recall entrepreneur success stories
23. Discuss the entrepreneurial process
24. Describe the entrepreneurship ecosystem
25. Discuss the government's role in the entrepreneurship ecosystem
26. Discuss the current entrepreneurship ecosystem in India
27. Understand the purpose of the Make in India campaign
28. Discuss the relationship between entrepreneurship and risk appetite
29. Discuss the relationship between entrepreneurship and resilience
30. Describe the characteristics of a resilient entrepreneur
31. Discuss how to deal with failure

13.5.1 Concept Introduction

Anyone who is determined to start a business, no matter what the risk, is an entrepreneur. Entrepreneurs run their own start-up, take responsibility for the financial risks and use creativity, innovation and vast reserves of self-motivation to achieve success. They dream big and are determined to do whatever it takes to turn their idea into a viable offering. The aim of an entrepreneur is to create an enterprise. The process of creating this enterprise is known as entrepreneurship.

13.5.1.1 Importance of Entrepreneurship

Entrepreneurship is very important for the following reasons:
1. It results in the creation of new organizations
2. It brings creativity into the marketplace
3. It leads to improved standards of living
4. It helps develop the economy of a country

13.5.1.2 Characteristics of Entrepreneurs

All successful entrepreneurs have certain characteristics in common.

They are all:
- Extremely passionate about their work
- Confident in themselves
- Disciplined and dedicated
- Motivated and driven
- Highly creative
- Visionaries
- Open-minded
- Decisive

Entrepreneurs also have a tendency to:
- Have a high-risk tolerance
- Thoroughly plan everything
- Manage their money wisely
- Make their customers their priority
- Understand their offering and their market in detail
- Ask for advice from experts when required
- Know when to cut their losses

13.5.1.3 Examples of Famous Entrepreneurs

Some famous entrepreneurs are:

- Bill Gates (Founder of Microsoft)
- Steve Jobs (Co-founder of Apple)
- Mark Zuckerberg (Founder of Facebook)
- Pierre Omidyar (Founder of eBay)

13.5.1.4 Types of Enterprises

As an entrepreneur in India, you can own and run any of the following types of enterprises:

Sole Proprietorship

In a sole proprietorship, a single individual owns, manages and controls the enterprise. This type of business is the easiest to form with respect to legal formalities. The business and the owner have no separate legal existence. All profit belongs to the proprietor, as do all the losses the liability of the entrepreneur is unlimited.

Partnership

A partnership firm is formed by two or more people. The owners of the enterprise are called partners. A partnership deed must be signed by all the partners. The firm and its partners have no separate legal existence. The profits are shared by the partners. With respect to losses, the liability of the partners is unlimited. A firm has a limited life span and must be dissolved when any one of the partners dies, retires, claims bankruptcy or goes insane.

Limited Liability Partnership (LLP)

In a Limited Liability Partnership or LLP, the partners of the firm enjoy perpetual existence as well as the advantage of limited liability. Each partner's liability is limited to their agreed contribution to the LLP. The partnership and its partners have a separate legal existence.

Tips

- Learn from others' failures.
- Be certain that this is what you want.
- Search for a problem to solve, rather than look for a problem to attach to your idea.

13.5.2 Leadership & Teamwork: Leadership and Leaders

Leadership means setting an example for others to follow. Setting a good example means not asking someone to do something that you wouldn't willingly want to do yourself. Leadership is about figuring out what to do in order to win as a team, and as a company.

Leaders believe in doing the right things. They also believe in helping others to do the right things. An effective leader is someone who:

- Creates an inspiring vision of the future.
- Motivates and inspires his team to pursue that vision.

13.5.2.1 Leadership Qualities That All Entrepreneurs Need

Building a successful enterprise is only possible if the entrepreneur in charge possesses excellent leadership qualities. Some critical leadership skills that every entrepreneur must have are:

1. **Pragmatism:** This means having the ability to highlight all obstacles and challenges, in order to resolve issues and reduce risks.
2. **Humility:** This means admitting to mistakes often and early and being quick to take responsibility for your actions. Mistakes should be viewed as challenges to overcome, not opportunities to point blame.
3. **Flexibility:** It is critical for a good leader to be very flexible and quickly adapt to change. It is equally critical to know when to adapt and when not to.
4. **Authenticity:** This means showing both, your strengths and your weaknesses. It means being human and showing others that you are human.
5. **Reinvention:** This means refreshing or changing your leadership style when necessary. To do this, it's important to learn where your leadership gaps lie and find out what resources are required to close them.
6. **Awareness:** This means taking the time to recognize how others view you. It means understanding how your presence affects those around you.

13.5.2.2 Benefits of Effective Leadership

Effective leadership results in numerous benefits. Great leadership leads to the leader successfully:

- Gaining the loyalty and commitment of the team members
- Motivating the team to work towards achieving the company's goals and objectives
- Building morale and instilling confidence in the team members
- Fostering mutual understanding and team-spirit among team members
- Convincing team members about the need to change when a situation requires adaptability

13.5.2.3 Teamwork and Teams

Teamwork occurs when the people in a workplace combine their individual skills to pursue a common goal. Effective teams are made up of individuals who work together to achieve this common goal. A great team is one who holds themselves accountable for the end result.

13.5.2.4 Importance of Teamwork in Entrepreneurial Success

For an entrepreneurial leader, building an effective team is critical to the success of a venture. An entrepreneur must ensure that the team he builds possesses certain crucial qualities, traits and characteristics. An effective team is one which has:

1. **Unity of purpose:** All the team members should clearly understand and be equally committed to the purpose, vision and goals of the team.

2. **Great communication skills:** Team members should have the ability to express their concerns, ask questions and use diagrams, and charts to convey complex information.

3. **The ability to collaborate:** Every member should feel entitled to provide regular feedback on new ideas.

4. **Initiative:** The team should consist of proactive individuals. The members should have the enthusiasm to come up with new ideas, improve existing ideas, and conduct their own research.

5. **Visionary members:** The team should have the ability to anticipate problems and act on these potential problems before they turn into real problems.

6. **Great adaptability skills:** The team must believe that change is a positive force. Change should be seen as the chance to improve and try new things.

7. **Excellent organizational skills:** The team should have the ability to develop standard work processes, balance responsibilities, properly plan projects, and set in place methods to measure progress and ROI.

Tips

-   Don't get too attached to your original idea. Allow it to evolve and change.
-   Be aware of your weaknesses and build a team that will complement your shortfalls.
-   Hiring the right people is not enough. You need to promote or incentivize your most talented people to keep them motivated.
-   Earn your team's respect.

13.5.3 Communication Skills

Listening is the ability to correctly receive and understand messages during the process of communication. Listening is critical for effective communication. Without effective listening skills, messages can easily be misunderstood. This results in a communication breakdown and can lead to the sender and the receiver of the message becoming frustrated or irritated.

It's very important to note that listening is not the same as hearing. Hearing just refers to sounds that you hear. Listening is a whole lot more than that. To listen, one requires focus. It means not only paying attention to the story, but also focusing on how the story is relayed, the way language and voice is used, and even how the speaker uses their body language. The ability to listen depends on how effectively one can perceive and understand both, verbal and non-verbal cues.

13.5.3.1 How to Listen Effectively?

To listen effectively you should:
- Stop talking
- Stop interrupting
- Focus completely on what is being said
- Nod and use encouraging words and gestures
- Be open-minded
- Think about the speaker's perspective
- Be very, very patient
- Pay attention to the tone that is being used
- Pay attention to the speaker's gestures, facial expressions and eye movements
- Not try and rush the person
- Not let the speaker's mannerisms or habits irritate or distract you

13.5.3.2 The Importance of Speaking Effectively

How successfully a message gets conveyed depends entirely on how effectively you are able to get it through. An effective speaker is one who enunciates properly, pronounces words correctly, chooses the right words and speaks at a pace that is easily understandable. Besides this, the words spoken out loud need to match the gestures, tone and body language used.

What you say, and the tone in which you say it, results in numerous perceptions being formed. A person who speaks hesitantly may be perceived as having low self-esteem or lacking in knowledge of the discussed topic. Those with a quiet voice may very well be labelled as shy. And those who speak in commanding tones with high levels of clarity, are usually considered to be extremely confident. This makes speaking a very critical communication skill.

13.5.3.3 How to Speak Effectively?

To speak effectively you should:
- Incorporate body language in your speech like eye contact, smiling, nodding, gesturing etc.
- Build a draft of your speech before actually making your speech.
- Ensure that all your emotions and feelings are under control.
- Pronounce your words distinctly with the correct pitch and intensity. Your speech should be crystal clear at all times. Use a pleasant and natural tone when speaking. Your audience should not feel like you are putting on an accent or being unnatural in any way.
- Use precise and specific words to drive your message home. Ambiguity should be avoided at all costs.
- Ensure that your speech has a logical flow.
- Be brief. Don't add any unnecessary information.
- Make a conscious effort to avoid irritating mannerisms like fidgeting, twitching etc.

- Choose your words carefully and use simple words that the majority of the audience will have no difficulty understanding.
- Use visual aids like slides or a whiteboard.
- Speak slowly so that your audience can easily understand what you're saying. However, be careful not to speak too slowly because this can come across as stiff, unprepared or even condescending.
- Remember to pause at the right moments.

Tips

- If you're finding it difficult to focus on what someone is saying, try repeating their words in your head.
- Always maintain eye contact with the person that you are communicating with, when speaking as well as listening. This conveys and also encourages interest in the conversation.

13.5.4 Problem Solving & Negotiation Skills

As per The Concise Oxford Dictionary (1995), a problem is, "A doubtful or difficult matter requiring a solution"

All problems contain two elements:

1. Goals
2. Obstacles

The aim of problem solving is to recognize the obstacles and remove them in order to achieve the goals.

13.5.4.1 How to Solve Problems?

Solving a problem requires a level of rational thinking. Here are some logical steps to follow when faced with an issue:

- **Step 1:** Identify the problem
- **Step 2:** Study the problem in detail
- **Step 3:** List all possible solutions
- **Step 4:** Select the best solution
- **Step 5:** Implement the chosen solution
- **Step 6:** Check that the problem has really been solved

13.5.4.2 Important Traits for Problem Solving

Highly developed problem-solving skills are critical for both, business owners and their employees. The following personality traits play a big role in how effectively problems are solved:

- Being open minded
- Asking the right questions
- Being proactive
- Not panicking
- Having a positive attitude
- Focusing on the right problem

13.5.4.3 How to Assess for Problem Solving Skills?

As an entrepreneur, it would be a good idea to assess the level of problem solving skills of potential candidates before hiring them. Some ways to assess this skill are through:

1. **Application forms:** Ask for proof of the candidate's problem-solving skills in the application form.
2. **Psychometric tests:** Give potential candidates logical reasoning and critical thinking tests and see how they fare.
3. **Interviews:** Create hypothetical problematic situations or raise ethical questions and see how the candidates respond.
4. **Technical questions:** Give candidates examples of real life problems and evaluate their thought process.

13.5.4.4 What is Negotiation?

Negotiation is a method used to settle differences. The aim of negotiation is to resolve differences through a compromise or agreement while avoiding disputes. Without negotiation, conflicts are likely to lead to resentment between people. Good negotiation skills help satisfy both parties and go a long way towards developing strong relationships.

Why Negotiate?

Starting a business requires many, many negotiations. Some negotiations are small while others are critical enough to make or break a start-up. Negotiation also plays a big role inside the workplace. As an entrepreneur, you need to know not only know how to negotiate yourself, but also how to train employees in the art of negotiation.

How to Negotiate?

Take a look at some steps to help you negotiate:

- **Step 1:** Pre-Negotiation Preparation: Agree on where to meet to discuss the problem, decide who all will be present and set a time limit for the discussion.

- **Step 2:** Discuss the problem: This involves asking questions, listening to the other side, putting your views forward and clarifying doubts.

- **Step 3:** Clarify the Objective: Ensure that both parties want to solve the same problem and reach the same goal.

- **Step 4:** Aim for a Win-Win Outcome: Try your best to be open minded when negotiating. Compromise and offer substitute solutions to arrive at an outcome where both wins.

- **Step 5:** Clearly Define the Agreement: When an agreement has been reached, the details of the agreement should be crystal clear to both sides, with no scope for misunderstandings.

- **Step 6:** Implement the Agreed Upon Solution: Agree on a course of action to set the solution in motion.

Tips

- Know exactly what you want before you work towards getting it
- Give more importance to listening and thinking, than speaking
- Focus on building a relationship rather than winning
- Remember that your people skills will affect the outcome
- Know when to walk away – sometimes reaching an agreement may not be possible

13.5.5 Business Opportunities Identification

"The entrepreneur always searches for change, responds to it and exploits it as an opportunity."

Peter Drucker

The ability to find good business opportunities is an important characteristic of an entrepreneur.

What is an Opportunity?

The word opportunity suggests a good chance or a favourable situation to do something offered by circumstances.

A business opportunity is typically a good/favourable change that can be used to run a business in a given environment, at a given point of time.

Common Questions Faced by Entrepreneurs

A critical question that all entrepreneurs face is how to go about finding the business opportunity that is right for them.

Some common questions that entrepreneurs constantly think about are:

- Should the new enterprise introduce a new product or service based on an unmet need?
- Should the new enterprise select an existing product or service from one market and offer it in another where it may not be available?
- Should the enterprise be based on a tried and tested formula that has worked elsewhere?

It is therefore extremely important that entrepreneurs must learn how to identify new and existing business opportunities and evaluate their chances of success.

When is an Idea an Opportunity?

An idea is an opportunity when:

- It creates or adds value to a customer
- It solves a significant problem, removes a pain point or meets a demand
- Has a robust market and profit margin
- Is a good fit with the founder and management team at the right time and place

Factors to Consider When Looking for Opportunities

Consider the following when looking for business opportunities:

- Economic trends
- Changes in funding
- Changing relationships between vendors, partners and suppliers
- Market trends
- Changes in political support
- Shift in target audience

Ways to Identify New Business Opportunities

- **Identify Market Inefficiencies:** When looking at a market, consider what inefficiencies are present in the market. Think about ways to correct these inefficiencies.
- **Remove Key Hassles:** Rather than create a new product or service, you can innovatively improve a product, service or process.
- **Create Something New:** Think about how you can create a new experience for customers, based on existing business models.
- **Pick a Growing Sector/Industry:** Research and find out which sectors or industries are growing and think about what opportunities you can tap in the same.
- **Think About Product Differentiation:** If you already have a product in mind, think about ways to set it apart from the existing ones.

Ways to Identify Business Opportunities within Your Business

1. **SWOT Analysis**

   An excellent way to identify opportunities inside your business is by creating a SWOT analysis. The acronym SWOT stands for strengths, weaknesses, opportunities, and threats. SWOT analysis framework:

STRENGTH
What are your strengths?
What unique capabilities do you posses?
What do you do better than others?
What do others percieve as your strengths?

WEAKNESSES
What are your weaknesses?
What do your competitors do better than you?

OPPORTUNITIES
What Trends may positively impact you?
What oppprtunities are available to you?

THREATS
Do you have solid financial support?
What trends may negatively impact you?

Fig.13.5.1. SWOT Analysis

   Consider the following when looking for business opportunities:

   By looking at yourself and your competitors using the SWOT framework, you can uncover opportunities that you can exploit, as well as manage and eliminate threats that could derail your success.

2. **Establishing Your USP**

   Establish your USP in such a way that positions you differently from your competitors. Identify the uniqueness about your product that will motivate customers to buy from you and then promote that reason.

Opportunity Analysis

Once you have identified an opportunity, you need to analyse it. To analyse an opportunity, you must:

- Focus on the idea
- Focus on the market of the idea
- Talk to industry leaders in the same space as the idea
- Talk to players in the same space as the idea

Tips

- Remember, opportunities are situational.
- Look for a proven track record.
- Avoid the latest craze.
- Love your idea.

13.5.6 Entrepreneurship Support Eco-System

An entrepreneur is a person who:
- Does not work for an employee
- Runs a small enterprise
- Assumes all the risks and rewards of the enterprise, idea, good or service

Types of Entrepreneurs

There are four main types of entrepreneurs:
1. **The Traditional Entrepreneur:** This type of entrepreneur usually has some kind of skill – they can be a carpenter, mechanic, cook etc. They have businesses that have been around for numerous years like restaurants, shops and carpenters. Typically, they gain plenty of experience in a particular industry before they begin their own business in a similar field.
2. **The Growth Potential Entrepreneur:** The desire of this type of entrepreneur is to start an enterprise that will grow, win many customers and make lots of money. Their ultimate aim is to eventually sell their enterprise for a nice profit. Such entrepreneurs usually have a science or technical background.
3. **The Project-Oriented Entrepreneur:** This type of entrepreneur generally has a background in the Arts or psychology. Their enterprises tend to be focus on something that they are very passionate about.
4. **The Lifestyle Entrepreneur:** This type of entrepreneur has usually worked as a teacher or a secretary. They are more interested in selling something that people will enjoy, rather than making lots of money.

Characteristics of an Entrepreneur

Successful entrepreneurs have the following characteristics:
- They are highly motivated
- They are creative and persuasive
- They are mentally prepared to handle each and every task
- They have excellent business skills – they know how to evaluate their cash flow, sales and revenue

- They are willing to take great risks
- They are very proactive – this means they are willing to do the work themselves, rather than wait for someone else to do it
- They have a vision – they are able to see the big picture
- They are flexible and open-minded
- They are good at making decisions

13.5.6.1 Entrepreneur Success Stories

Dhiru Bhai Ambani

Dhirubhai Ambani began his entrepreneurial career by selling "bhajias" to pilgrims in Mount Girnar on weekends. At 16, he moved to Yemen where he worked as a gas-station attendant, and as a clerk in an oil company. He returned to India with Rs. 50,000 and started a textile trading company. Reliance went on to become the first Indian company to raise money in global markets and the first Indian company to feature in Forbes 500 list.

Dr. Karsanbhai Patel

Karsanbhai Patel made detergent powder in the backyard of his house. He sold his product door-to door and offered a money back guarantee with every pack that was sold. He charged Rs.3 per kg when the cheapest detergent at that time was Rs.13 per kg. Dr. Patel eventually started Nirma which became a whole new segment in the Indian domestic detergent market.

13.5.6.2 The Entrepreneurial Process

Let's take a look at the stages of the entrepreneurial process.

- **Stage 1:** Idea Generation. The entrepreneurial process begins with an idea that has been thought of by the entrepreneur. The idea is a problem that has the potential to be solved.
- **Stage 2:** Germination or Recognition. In this stage a possible solution to the identified problem is thought of.
- **Stage 3:** Preparation or Rationalization. The problem is studied further, and research is done to find out how others have tried to solve the same problem.
- **Stage 4:** Incubation or Fantasizing. This stage involves creative thinking for the purpose of coming up with more ideas. Less thought is given to the problem areas.
- **Stage 5:** Feasibility Study: The next step is the creation of a feasibility study to determine if the idea will make a profit and if it should be seen through.
- **Stage 6:** Illumination or Realization. This is when all uncertain areas suddenly become clear. The entrepreneur feels confident that his idea has merit.
- **Stage 7:** Verification or Validation. In this final stage, the idea is verified to see if it works and if it is useful.

Take a look at the diagram below to get a better idea of this process.

Fig.13.5.2: Stages of the entrepreneurial process

13.5.6.3 What is an Entrepreneur?

The entrepreneurship support ecosystem signifies the collective and complete nature of entrepreneurship. New companies emerge and flourish not only because of the courageous, visionary entrepreneurs who launch them, but they thrive as they are set in an environment or 'ecosystem' made of private and public participants. These players nurture and sustain the new ventures, facilitating the entrepreneurs' efforts. An entrepreneurship ecosystem comprises of the following six domains:

1. **Favourable Culture:** This includes elements such as tolerance of risk and errors, valuable networking and positive social standing of the entrepreneur.

2. **Facilitating Policies & Leadership:** This includes regulatory framework incentives and existence of public research institutes.

3. **Financing Options:** Angel financing, venture capitalists and micro loans would be good examples of this.

4. **Human Capital:** This refers to trained and untrained labour, entrepreneurs and entrepreneurship training programmes, etc.

5. **Conducive Markets for Products & Services:** This refers to an existence or scope of existence of a market for the product/service.

6. **Institutional & Infrastructural Support:** This includes legal and financing advisers, telecommunications, digital and transportation infrastructure, and entrepreneurship networking programmes.

These domains indicate whether there is a strong entrepreneurship support ecosystem and what actions should the government put in place to further encourage this ecosystem.

The six domains and their various elements have been graphically depicted.

Fig.13.5.3. Entrepreneurship at a Glance

Every entrepreneurship support ecosystem is unique and all the elements of the ecosystem are interdependent. Although every region's entrepreneurship ecosystem can be broadly described by the above features, each ecosystem is the result of the hundred elements interacting in highly complex and particular ways.

Entrepreneurship ecosystems eventually become (largely) self-sustaining. When the six domains are resilient enough, they are mutually beneficial. At this point, government involvement can and should be significantly minimized. Public leaders do not need to invest a lot to sustain the ecosystem. It is imperative that the entrepreneurship ecosystem incentives are formulated to be self-liquidating, hence focusing on sustain ability of the environment.

13.5.6.4 Government's Role in the Entrepreneurship Ecosystem

Encouraging new ventures is a major focus for policymakers. Governments across the world are recognizing that new businesses flourish in distinctive types of supportive environments. Policymakers should study the scenario and take into account the following points whilst they formulate policies and regulations that enable successful entrepreneurship support ecosystems.

- Policymakers should avoid regulations that discourage new entrants and work towards building efficient methods for business start-ups. Policies and regulations which help existing, leading firms over entrepreneurial ventures, limit competition and obstruct growth/formation of new companies.

- Therefore, in place of developing policies that are intended to improve market failures, policymakers should interact with entrepreneurs and understand the challenges faced by them. The feedback is used to develop policies which encourage exploring ideas, developing new products and increase the rates of deal flow.

- Entrepreneurial supporters ideally need to create a database that enables identifying who the members in the ecosystem are and how they are connected. The ecosystem database are useful tools in developing engagement strategies.

- Disruptions are inevitable in economic as well as social life. However, it's important to note that economic disruption gives rise to entrepreneurial opportunities. Architects of the entrepreneurship ecosystems (entrepreneurs, mentors, policymakers and consumers,) should anticipate these dips, thus capitalizing on the opportunities they create.

13.5.6.5 Snapshot of the Entrepreneurship Ecosystem in India

Entrepreneurship has earned a newfound respect in India. Many Indians, with exposure to the world of business, who traditionally would have opted for a job, are setting up their own ventures. Many elements of the entrepreneurship ecosystem are beginning to come together. For example, increase in venture capitalists, government schemes and incubators, academia industry linkages, and emerging clusters and support to rural economy.

All these initiatives are effective but there is a need to scale up and enrich the ecosystem further in the following ways:

1. We need to review our attitude towards failures and accept them as learning experiences.
2. We must encourage the educated to become entrepreneurs and provide students in schools and colleges with entrepreneurship skills.
3. Universities, research labs and the government need to play the role of enablers in the entrepreneurship support ecosystem.
4. Policymakers need to focus on reducing the obstacles such as corruption, red tape and bureaucracy.
5. We need to improve our legal systems and court international venture capital firms and bring them to India.
6. We must devise policies and methods to reach the secondary and tertiary towns in India, where people do not have access to the same resources available in the cities.

Today, there is a huge opportunity in this country to introduce innovative solutions that are capable of scaling up and collaborating within the ecosystem as well as enriching it.

13.5.6.6 Make in India Campaign

Every entrepreneur has certain needs. Some of their important needs are:

- To easily get loans
- To easily find investors
- To get tax exemptions
- To easily access resources and good infrastructure
- To enjoy a procedure that is free of hassles and is quick
- To be able to easily partner with other firms

The Make in India campaign, launched by Prime Minister Modi aims to satisfy all these needs of young, aspiring entrepreneurs. Its objective is to:

- Make investment easy
- Support new ideas
- Enhance skill development
- Safeguard the ideas of entrepreneurs
- Create state-of-the-art facilities for manufacturing goods

Tips

- Research the existing market, network with other entrepreneurs, venture capitalists, angel investors, and thoroughly review the policies in place to enable your entrepreneurship.
- Failure is a stepping stone and not the end of the road. Review yours and your peers' errors and correct them in your future venture.
- Be proactive in your ecosystem. Identify the key features of your ecosystem and enrich them to ensure self-sustainability of your entrepreneurship support ecosystem.

13.5.7 Risk Appetite & Resilience

Entrepreneurship and Risk

Entrepreneurs are inherently risk takers. They are path-makers not path-takers. Unlike a normal, cautious person, an entrepreneur would not think twice about quitting his job (his sole income) and taking a risk on himself and his idea.

An entrepreneur is aware that while pursuing his dreams, assumptions can be proven wrong and unforeseen events may arise. He knows that after dealing with numerous problems, success is still not guaranteed. Entrepreneurship is synonymous with the ability to take risks. This ability, called risk-appetite, is an entrepreneurial trait that is partly genetic and partly acquired.

What is Risk Appetite?

Risk appetite is defined as the extent to which a company is equipped to take risk, in order to achieve its objectives. Essentially, it refers to the balance, struck by the company, between possible profits and the hazards caused by changes in the environment (economic ecosystem, policies, etc.). Taking on more risk may lead to higher rewards but have a high probability of losses as well. However, being too conservative may go against the company as it can miss out on good opportunities to grow and reach their objectives.

The levels of risk appetite can be broadly categorized as "low", "medium" and "high." The company's entrepreneur(s) need to assess all possible alternatives and choose the option most likely to succeed. Companies have varying levels of risk appetites for different objectives. The levels depend on:

- The type of industry
- Market pressures
- Company objectives

For example, a start-up with a revolutionary concept will have a very high-risk appetite. The start-up can afford short term failures before it achieves longer term success. This type of appetite will not remain constant and will be adjusted to account for the present circumstances of the company.

Risk Appetite Statement

Companies have to define and articulate their risk appetite in sync with decisions made about their objectives and opportunities. The point of having a risk appetite statement is to have a framework that clearly states the acceptance and management of risk in business. It sets risk taking limits within the company. The risk appetite statement should convey the following:

- The nature of risks the business faces.
- Which risks the company is comfortable taking on and which risks are unacceptable.
- How much risk to accept in all the risk categories.
- The desired trade-off between risk and reward.
- Measures of risk and methods of examining and regulating risk exposures.

Entrepreneurship and Resilience

Entrepreneurs are characterized by a set of qualities known as resilience. These qualities play an especially large role in the early stages of developing an enterprise. Risk resilience is an extremely valuable characteristic as it is believed to protect entrepreneurs against the threat of challenges and changes in the business environment.

What is Entrepreneurial Resilience?

Resilience is used to describe individuals who have the ability to overcome setbacks related to their life and career aspirations. A resilient person is someone who is capable of easily and quickly recovering from setbacks. For the entrepreneur, resilience is a critical trait. Entrepreneurial resilience can be enhanced in the following ways:

- By developing a professional network of coaches and mentors
- By accepting that change is a part of life
- By viewing obstacles as something that can be overcome

Characteristics of a Resilient Entrepreneur

The characteristics required to make an entrepreneur resilient enough to go the whole way in their business enterprise are:

- A strong internal sense of control
- Ability to diversify and expand
- Strong social connections
- Survivor attitude
- Skill to learn from setbacks
- Cash-flow conscious habits
- Ability to look at the bigger picture
- Attention to detail

Tips

- Cultivate a great network of clients, suppliers, peers, friends and family. This will not only help you promote your business, but will also help you learn, identify new opportunities and stay tuned to changes in the market.
- Don't dwell on setbacks. Focus on what you need to do next to get moving again.
- While you should try, and curtail expenses, ensure that it is not at the cost of your growth.

13.5.8 Success & Failures

Understanding Successes and Failures in Entrepreneurship

Shyam is a famous entrepreneur, known for his success story. But what most people don't know, is that Shyam failed numerous times before his enterprise became a success. Read his interview to get an idea of what entrepreneurship is really about, straight from an entrepreneur who has both, failed and succeeded.

Interviewer: Shyam, I have heard that entrepreneurs are great risk-takers who are never afraid of failing. Is this true?

Shyam: Ha ha, no of course it's not true! Most people believe that entrepreneurs need to be fearlessly enthusiastic. But the truth is, fear is a very normal and valid human reaction, especially when you are planning to start your own business! In fact, my biggest fear was the fear of failing. The reality is, entrepreneurs fail as much as they succeed. The trick is to not allow the fear of failing to stop you from going ahead with your plans. Remember, failures are lessons for future success!

Interviewer: What, according to you, is the reason that entrepreneurs fail?

Shyam: Well, there is no one single reason why entrepreneurs fail. An entrepreneur can fail due to numerous reasons. You could fail because you have allowed your fear of failure to defeat you. You could fail because you are unwilling to delegate (distribute) work. As the saying goes, "You can do anything, but not everything!" You could fail because you gave up too easily – maybe you were not persistent enough. You could fail because you were focusing your energy on small, insignificant tasks and ignoring the tasks that were most important. Other reasons for failing are partnering with the wrong people, not being able to sell your product to the right customers at the right time at the right price… and many more reasons!

Interviewer: As an entrepreneur, how do you feel failure should be looked at?

Shyam: I believe we should all look at failure as an asset, rather than as something negative. The way I see it, if you have an idea, you should try to make it work, even if there is a chance that you will fail. That's because not trying is failure right there, anyway! And failure is not the worst thing that can happen. I think having regrets because of not trying and wondering 'what if' is far worse than trying and actually failing.

Interviewer: How did you feel when you failed for the first time?

Shyam: I was completely heartbroken! It was a very painful experience. But the good news is, you do recover from the failure. And with every subsequent failure, the recovery process gets a lot easier. That's because you start to see each failure more as a lesson that will eventually help you succeed, rather than as an obstacle that you cannot overcome. You will start to realize that failure has many benefits.

Interviewer: Can you tell us about some of the benefits of failing?

Shyam: One of the benefits that I have experienced personally from failing is that the failure made me see things in a new light. It gave me answers that I didn't have before. Failure can make you a lot stronger. It also helps keep your ego in control.

Interviewer: What advice would you give entrepreneurs who are about to start their own enterprises?

Shyam: I would tell them to do their research and ensure that their product is something that is actually wanted by customers. I'd tell them to pick their partners and employees very wisely and cautiously. I'd tell them that it's very important to be aggressive – push and market your product as aggressively as possible. I would warn them that starting an enterprise is very expensive and that they should be prepared for a situation where they run out of money. I would tell them to create long term goals and put a plan in action to achieve that goal. I would tell them to build a product that is truly unique. Be very careful and ensure that you are not copying another start-up. Lastly, I'd tell them that it's very important that they find the right investors.

Interviewer: That's some really helpful advice, Shyam! I'm sure this will help all entrepreneurs to be more prepared before they begin their journey! Thank you for all your insight!

Tips

- Remember that nothing is impossible.
- Identify your mission and your purpose before you start.
- Plan your next steps – don't make decisions hastily.

UNIT 13.6: Preparing to be an Entrepreneur

Unit Objectives ◎

At the end of this unit, you will be able to:

1. Discuss how market research is carried out
2. Describe the 4 Ps of marketing
3. Discuss the importance of idea generation
4. Recall basic business terminology
5. Discuss the need for CRM
6. Discuss the benefits of CRM
7. Discuss the need for networking
8. Discuss the benefits of networking
9. Discuss the importance of setting goals
10. Differentiate between short-term, medium-term and long-term goals
11. Discuss how to write a business plan
12. Explain the financial planning process
13. Discuss ways to manage your risk
14. Describe the procedure and formalities for applying for bank finance
15. Discuss how to manage your own enterprise
16. List important questions that every entrepreneur should ask before starting an enterprise

13.6.1 Market Study/The 4 Ps of Marketing/Importance of an IDEA

Understanding Market Research

Market research is the process of gathering, analysing and interpreting market information on a product or service that is being sold in that market. It also includes information on:

- Past, present and prospective customers
- Customer characteristics and spending habits
- The location and needs of the target market
- The overall industry
- Relevant competitors

Market research involves two types of data:

- **Primary information.** This is research collected by yourself or by someone hired by you.
- **Secondary information.** This is research that already exists and is out there for you to find and use.

Primary research

Primary research can be of two types:

- **Exploratory:** This is open-ended and usually involves detailed, unstructured interviews.
- **Specific:** This is precise and involves structured, formal interviews. Conducting specific

Secondary research

Secondary research uses outside information. Some common secondary sources are:

- **Public sources:** These are usually free and have a lot of good information. Examples are government departments, business departments of public libraries etc.
- **Commercial sources:** These offer valuable information but usually require a fee to be paid. Examples are research and trade associations, banks and other financial institutions etc.
- **Educational institutions:** These offer a wealth of information. Examples are colleges, universities, technical institutes etc.

13.6.1.1 The 4 Ps of Marketing

The 4 Ps of marketing are Product, Price, Promotion and Place.

Let's look at each of these 4 Ps in detail.

Product

A product can be tangible, like a good or intangible, like a service.

Whatever your product is, it is critical that you have a clear understanding of what you are offering, and what its unique characteristics are, before you begin with the marketing process.

Some questions to ask yourself are:
- What need does the customer have for the product/service?
- What needs does it satisfy?
- Are there any more features that can be added?
- Does it have any expensive and unnecessary features?
- How will customers use it?
- What should it be called?
- How is it different from similar products?
- How much will it cost to produce?
- Can it be sold at a profit?

Price

Once all the elements of Product have been established, the Price factor needs to be considered. The Price of a Product will depend on several factors such as profit margins, supply, demand and the marketing strategy.

Some typical questions to ask yourself include:

- What is the value of the product/service to customers?
- Do local products/services have established price points?
- Is the customer price sensitive?
- Should discounts be offered?
- How is your price compared to that of your competitors?

Promotion

Once you are certain about your Product and your Price, the next step is to look at ways to promote it. Some key elements of promotion are advertising, public relations, social media marketing, email marketing, search engine marketing, video marketing and more.

Some questions to ask yourself are:

- Where should you promote your product or service?
- What is the best medium to use to reach your target audience
- When would be the best time to promote your product?
- How are your competitors promoting their products?

Place

According to most marketers, the basis of marketing is about offering the right product, at the right price, at the right place, at the right time. For this reason, selecting the best possible location is critical for converting prospective clients into actual clients.

Some questions to ask yourself are:

- Will your product or service be looked for in a physical store, online or both?
- What should you do to access the most appropriate distribution channels?
- Will you require a sales force?
- Where are your competitors offering their products or services?
- Should you follow in your competitors' footsteps?
- Should you do something different from your competitors?

Importance of an IDEA

Ideas are the foundation of progress. An idea can be small or ground-breaking, easy to accomplish or extremely complicated to implement. Whatever the case, the fact that it is an idea gives it merit. Without ideas, nothing is possible. Most people are afraid to speak out their ideas, out for fear of being ridiculed. However, if are an entrepreneur and want to remain competitive and innovative, you need to bring your ideas out into the light.

Some ways to do this are by:

- Establishing a culture of brainstorming where you invite all interested parties to contribute
- Discussing ideas out loud so that people can add their ideas, views, opinions to them

- Being open minded and not limiting your ideas, even if the idea who have seems ridiculous
- Not discarding ideas that you don't work on immediately, but instead making a note of them and shelving them so they can be revisited at a later date.

Tips

- Keep in mind that good ideas do not always have to be unique.
- Remember that timing plays a huge role in determining the success of your idea.
- Situations and circumstances will always change, so be flexible and adapt your idea accordingly.

13.6.2 Business Entity Concepts: Basic Business Terminology

If your aim is to start and run a business, it is crucial that you have a good understanding of basic business terms. Every entrepreneur should be well versed in the following terms:

- **Accounting:** A systematic method of recording and reporting financial transactions.
- **Accounts payable:** Money owed by a company to its creditors.
- **Accounts Receivable:** The amount a company is owed by its clients.
- **Assets:** The value of everything a company owns and uses to conduct its business.
- **Balance Sheet:** A snapshot of a company's assets, liabilities and owner's equity at a given moment.
- **Bottom Line:** The total amount a business has earned or lost at the end of a month.
- **Business:** An organization that operates with the aim of making a profit.
- **Business to Business (B2B):** A business that sells goods or services to another business.
- **Business to Consumer (B2C):** A business that sells goods or services directly to the end user.
- **Capital:** The money a business has in its accounts, assets and investments. The two main types of capital are debt and equity.
- **Cash Flow:** The overall movement of funds through a business each month, including income and expenses.
- **Cash Flow Statement:** A statement showing the money that entered and exited a business during a specific period of time.
- **Contract:** A formal agreement to do work for pay.
- **Depreciation:** The degrading value of an asset over time.
- **Expense:** The costs that a business incurs through its operations.
- **Finance:** The management and allocation of money and other assets.
- **Financial Report:** A comprehensive account of a business' transactions and expenses.
- **Fixed Cost:** A one-time expense.

- **Income Statement (Profit and Loss Statement):** Shows the profitability of a business during a period of time.
- **Liabilities:** The value of what a business owes to someone else.
- **Marketing:** The process of promoting, selling and distributing a product or service.
- **Net Income/Profit:** Revenues minus expenses.
- **Net Worth:** The total value of a business.
- **Payback Period:** The amount of time it takes to recover the initial investment of a business.
- **Profit Margin:** The ratio of profit, divided by revenue, displayed as a percentage.
- **Return on Investment (ROI):** The amount of money a business gets as return from an investment.
- **Revenue:** The total amount of income before expenses are subtracted.
- **Sales Prospect:** A potential customer.
- **Supplier:** A provider of supplies to a business.
- **Target Market:** A specific group of customers at which a company's products and services are aimed.
- **Valuation:** An estimate of the overall worth of the business.
- **Variable Cost:** Expenses that change in proportion to the activity of a business.
- **Working Capital:** Calculated as current assets minus current liabilities.

13.6.3 CRM & Networking

What is CRM?

CRM stands for Customer Relationship Management. Originally the expression Customer Relationship Management meant managing one's relationship with customers. However, today it refers to IT systems and software designed to help companies manage their relationships.

The Need for CRM

The better a company can manage its relationships with its customers, the higher the chances of the company's success. For any entrepreneur, the ability to successfully retain existing customers and expand the enterprise is paramount. Therefore, IT systems that focus on addressing the problems of dealing with customers on a daily basis are becoming more and more in demand.

Customer needs change over time, and technology can make it easier to understand what customers really want. This insight helps companies to be more responsive to the needs of their customers. It enables them to modify their business operations when required, so that their customers are always served in the best manner possible. Simply put, CRM helps companies recognize the value of their clients and enables them to capitalize on improved customer relations.

Benefits of CRM

CRM has a number of important benefits:

- It helps improve relations with existing customers which can lead to:
  - o Increased sales
  - o Identification of customer needs
  - o Cross-selling of products
- It results in better marketing of one's products or services
- It results in better marketing of one's products or services
- It enhances customer satisfaction and retention
- It improves profitability by identifying and focusing on the most profitable customers

13.6.3.1 What is Networking?

In business, networking means leveraging your business and personal connections in order to bring in a regular supply of new business. This marketing method is effective as well as low cost. It is a great way to develop sales opportunities and contacts. Networking can be based on referrals and introductions, or can take place via phone, email, and social and business networking websites.

The Need for Networking

Networking is an essential personal skill for business people, but it is even more important for entrepreneurs. The process of networking has its roots in relationship building. Networking results in greater communication and a stronger presence in the entrepreneurial ecosystem. This helps build strong relationships with other entrepreneurs.

Business networking events held across the globe play a huge role in connecting like-minded entrepreneurs who share the same fundamental beliefs in communication, exchanging ideas and converting ideas into realities. Such networking events also play a crucial role in connecting entrepreneurs with potential investors. Entrepreneurs may have vastly different experiences and backgrounds but they all have a common goal in mind – they all seek connection, inspiration, advice, opportunities and mentors. Networking offers them a platform to do just that.

Benefits of Networking

Networking offers numerous benefits for entrepreneurs. Some of the major benefits are:

- Getting high quality leads
- Increased business opportunities
- Good source of relevant connections
- Advice from like-minded entrepreneurs
- Gaining visibility and raising your profile
- Meeting positive and enthusiastic people

- Increased self-confidence
- Satisfaction from helping others
- Building strong and lasting friendships

Tips

- Use social media interactions to identify needs and gather feedback.
- When networking, ask open-ended questions rather than yes/no type questions.

13.6.4 Business Plan: Why Set Goals?

Setting goals is important because it gives you long-term vision and short-term motivation. Goals can be short term, medium term and long term.

Short-Term Goals

- These are specific goals for the immediate future.

Example: Repairing a machine that has failed.

Medium-Term Goals

- These goals are built on your short-term goals.
- They do not need to be as specific as your short-term goals.

Example: Arranging for a service contract to ensure that your machines don't fail again.

Long-Term Goals

These goals require time and planning.

They usually take a year or more to achieve.

Example: Planning your expenses so you can buy new machinery

Why Create a Business Plan?

A business plan is a tool for understanding how your business is put together. It can be used to monitor progress, foster accountable and control the fate of the business. It usually offers a 3-5year projection and outlines the plan that the company intends to follow to grow its revenues. A business plan is also a very important tool for getting the interest of key employees or future investors.

A business plan typically comprises of eight elements.

13.6.4.1 Elements of a Business Plan

Executive Summary

The executive summary follows the title page. The summary should clearly state your desires as the business owner in a short and business-like way. It is an overview of your business and your plans. Ideally this should not be more than 1-2 pages.

Your Executive Summary should include:

- **The Mission Statement:** Explain what your business is all about.
  Example: Nike's Mission Statement
  Nike's mission statement is "To bring inspiration and innovation to every athlete in the world."
- **Company Information:** Provide information like when your business was formed, the names and roles of the founders, the number of employees, your business location(s) etc.
- **Growth Highlights:** Mention examples of company growth. Use graphs and charts where possible.
- **Your Products/Services:** Describe the products or services provided.
- **Financial Information:** Provide details on current bank and investors.
- **Summarize future plans:** Describe where you see your business in the future.

Business Description

The second section of your business plan needs to provide a detailed review of the different elements of your business. This will help potential investors to correctly understand your business goal and the uniqueness of your offering.

Your Business Description should include:

- A description of the nature of your business
- The market needs that you are aiming to satisfy
- The ways in which your products and services meet these needs
- The specific consumers and organizations that you intend to serve
- Your specific competitive advantages

Market Analysis

The market analysis section usually follows the business description. The aim of this section is to showcase your industry and market knowledge. This is also the section where you should lay down your research findings and conclusions.

Your Market Analysis should include:

- Your industry description and outlook
- Information on your target market
- The needs and demographics of your target audience
- The size of your target market

- The amount of market shares you want to capture
- Your pricing structures
- Your competitive analysis
- Any regulatory requirements

Organization & Management

This section should come immediately after the Market Analysis. Your Organization & Management section should include:

- Your company's organizational structure
- Details of your company's ownership
- Details of your management team
- Qualifications of your board of directors
- Detailed descriptions of each division/department and its function
- The salary and benefits package that you offer your people

Service or Product Line

The next section is the service or product line section. This is where you describe your service or product, and stress on their benefits to potential and current customers. Explain in detail why your product of choice will fulfil the needs of your target audience.

Your Service or Product Line section should include:

- A description of your product/service
- A description of your product or service's life cycle
- A list of any copyright or patent filings
- A description of any R&D activities that you are involved in or planning

Marketing & Sales

Once the Service or Product Line section of your plan has been completed, you should start on the description of the marketing and sales management strategy for your business.

Your Marketing section should include the following strategies:

- **Market penetration strategy:** This strategy focuses on selling your existing products or services in existing markets, in order to increase your market share.
- **Growth strategy:** This strategy focuses on increasing the amount of market share, even if it reduces earnings in the short-term.
- **Channels of distribution strategy:** These can be wholesalers, retailers, distributers and even the internet.
- **Communication strategy:** These can be written strategies (e-mail, text, chat), oral strategies (phone calls, video chats, face-to-face conversations), non-verbal strategies (body language, facial expressions, tone of voice) and visual strategies (signs, webpages, illustrations).

Your Sales section should include the following information:

• **A salesforce strategy:** This strategy focuses on increasing the revenue of the enterprise.

• **A breakdown of your sales activities:** This means detailing out how you intend to sell your products or services – will you sell it offline or online, how many units do you intend to sell, what price do you plan to sell each unit at, etc.

Funding Request

This section is specifically for those who require funding for their venture. The Funding Request section should include the following information:

• How much funding you currently require.

• How much funding you will require over the next five years. This will depend on your long-term goals.

• The type of funding you want and how you plan to use it. Do you want funding that can be used only for a specific purpose, or funding that can be used for any kind of requirement?

• Strategic plans for the future. This will involve detailing out your long-term plans – what these plans are and how much money you will require to put these plans in motions.

• Historical and prospective financial information. This can be done by creating and maintaining all your financial records, right from the moment your enterprise started, to the present day. Documents required for this are your balance sheet which contains details of your company's assets and liabilities, your income statement which lists your company's revenues, expenses and net income for the year, your tax returns (usually for the last three years) and your cash flow budget which lists the cash that came in, the cash that went out and states whether you had a cash deficit (negative balance) or surplus (positive balance) at the end of each month.

Financial Planning

Before you begin building your enterprise, you need to plan your finances. Take a look at the steps for financial planning:

• **Step 1:** Create a financial plan. This should include your goals, strategies and timelines for accomplishing these goals.

• **Step 2:** Organize all your important financial documents. Maintain a file to hold your investment details, bank statements, tax papers, credit card bills, insurance papers and any other financial records.

• **Step 3:** Calculate your net worth. This means figure out what you own (assets like your house, bank accounts, investments etc.), and then subtract what you owe (liabilities like loans, pending credit card amounts etc.) the amount you are left with is your net worth.

• **Step 4:** Make a spending plan. This means write down in detail where your money will come from, and where it will go.

• **Step 5:** Build an emergency fund. A good emergency fund contains enough money to cover at least 6 months' worth of expenses.

• **Step 6:** Set up your insurance. Insurance provides long term financial security and protects you against risk.

Risk Management

As an entrepreneur, it is critical that you evaluate the risks involved with the type of enterprise that you want to start, before you begin setting up your company. Once you have identified potential risks, you can take steps to reduce them. Some ways to manage risks are:

- Research similar business and find out about their risks and how they were minimized.
- Evaluate current market trends and find out if similar products or services that launched a while ago are still being well received by the public.
- Think about whether you really have the required expertise to launch your product or service.
- Examine your finances and see if you have enough income to start your enterprise.
- Be aware of the current state of the economy, consider how the economy may change over time, and think about how your enterprise will be affected by any of those changes.
- Create a detailed business plan.

Tips

- Ensure all the important elements are covered in your plan.
- Scrutinize the numbers thoroughly.
- Be concise and realistic.
- Be conservative in your approach and your projections.
- Use visuals like charts, graphs and images wherever possible.

13.6.5 Procedure and Formalities for Bank Finance

The Need for Bank Finance

For entrepreneurs, one of the most difficult challenges faced involves securing funds for start-ups. With numerous funding options available, entrepreneurs need to take a close look at which funding methodology works best for them. In India, banks are one of the largest funders of start-ups, offering funding to thousands of start-ups every year.

13.6.5.1 What Information Should Entrepreneurs Offer Banks for Funding?

When approaching a bank, entrepreneurs must have a clear idea of the different criteria that banks use to screen, rate and process loan applications. Entrepreneurs must also be aware of the importance of providing banks with accurate and correct information. It is now easier than ever for financial institutions to track any default behaviour of loan applicants. Entrepreneurs looking for funding from banks must provide banks with information relating to their general credentials, financial situation and guarantees or collaterals that can be offered.

General Credentials

This is where you, as an entrepreneur, provide the bank with background information on yourself. Such information includes:

- **Letter(s) of Introduction:** This letter should be written by a respected business person who knows you well enough to introduce you. The aim of this letter is set across your achievements and vouch for your character and integrity.

- **Your Profile:** This is basically your resume. You need to give the bank a good idea of your educational achievements, professional training, qualifications, employment record and achievements.

- **Business Brochure:** A business brochure typically provides information on company products, clients, how long the business has been running for etc.

- **Bank and Other References:** If you have an account with another bank, providing those bank references is a good idea.

- **Proof of Company Ownership or Registration:** In some cases, you may need to provide the bank with proof of company ownership and registration. A list of assets and liabilities may also be required.

Financial Situation

Banks will expect current financial information on your enterprise. The standard financial reports you should be prepared with are:

- Balance Sheet
- Cash-Flow Statement
- Business Plan
- Profit-and-Loss Account
- Projected Sales and Revenues
- Feasibility Study

Guarantees or Collaterals

Usually banks will refuse to grant you a loan without security. You can offer assets which the bank can seize and sell off if you do not repay the loan. Fixed assets like machinery, equipment, vehicles etc. are also considered to be security for loans.

13.6.5.2 The Lending Criteria of Banks

Your request for funding will have a higher chance of success if you can satisfy the following lending criteria:

- Good cash flow
- Adequate shareholders' funds
- Adequate security
- Experience in business
- Good reputation

The Procedure

To apply for funding the following procedure will need to be followed.

- Submit your application form and all other required documents to the bank.
- The bank will carefully assess your credit worthiness and assign ratings by analysing your business information with respect to parameters like management, financial, operational and industry information as well as past loan performance.
- The bank will make a decision as to whether or not you should be given funding.

Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

13.6.6 Enterprise Management - An Overview

To manage your enterprise effectively you need to look at many different aspects, right from managing the day-to-day activities to figuring out how to handle a large-scale event. Let's take a look at some simple steps to manage your company effectively.

Step 1: Use your leadership skills and ask for advice when required.

Let's take the example of Ramu, an entrepreneur who has recently started his own enterprise. Ramu has good leadership skills – he is honest, communicates well, knows how to delegate work etc. These leadership skills definitely help Ramu in the management of his enterprise. However, sometimes Ramu comes across situations that he is unsure how to handle. What should Ramu do in this case? One solution is for him to find a more experienced manager who is willing to mentor him. Another solution is for Ramu to use his networking skills so that he can connect with managers from other organizations, who can give him advice on how to handle such situations.

Step 2: Divide your work amongst others – realize that you cannot handle everything yourself.

Even the most skilled manager in the world will not be able to manage every single task that an enterprise will demand of him. A smart manager needs to realize that the key to managing his enterprise lies in his dividing all his work between those around him. This is known as delegation. However, delegating is not enough. A manager must delegate effectively if he wants to see results. This is important because delegating, when done incorrectly, can result in you creating even more work for yourself. To delegate effectively, you can start by making two lists. One list should contain the things that you know you need to handle yourself. The second list should contain the things that you are confident can be given to others to manage and handle.

Besides incorrect delegation, another issue that may arise is over-delegation. This means giving away too many of your tasks to others. The problem with this is, the more tasks you delegate, the more time you will spend tracking and monitoring the work progress of those you have handed the tasks to. This will leave you with very little time to finish your own work.

Step 3: Hire the right people for the job.

Hiring the right people goes a long way towards effectively managing your enterprise. To hire the best people suited for the job, you need to be very careful with your interview process. You should ask potential candidates the right questions and evaluate their answers carefully. Carrying out background checks is always a good practice. Running a credit check is also a good idea, especially if the people you are planning to hire will be handling your money. Create a detailed job description for each role that you want filled and ensure that all candidates have a clear and correct understanding of the job description. You should also have an employee manual in place, where you put down every expectation that you have from your employees. All these actions will help ensure that the right people are approached for running your enterprise.

Step 4: Motivate your employees and train them well.

Your enterprise can only be managed effectively if your employees are motivated to work hard for your enterprise. Part of being motivated involves your employees believing in the vision and mission of your enterprise and genuinely wanting to make efforts towards pursuing the same. You can motivate your employees with recognition, bonuses and rewards for achievements. You can also motivate them by telling them about how their efforts have led to the company's success. This will help them feel pride and give them a sense of responsibility that will increase their motivation. Besides motivating your people, your employees should be constantly trained in new practices and technologies. Remember, training is not a one-time effort. It is a consistent effort that needs to be carried out regularly.

Step 5: Train your people to handle your customers well.

Your employees need to be well-versed in the art of customer management. This means they should be able to understand what their customers want, and also know how to satisfy their needs. For them to truly understand this, they need to see how you deal effectively with customers.

This is called leading by example. Show them how you sincerely listen to your clients and the efforts that you put into understand their requirements. Let them listen to the type of questions that you ask your clients, so they understand which questions are appropriate.

Step 6: Market your enterprise effectively.

Also, hire a marketing agency if you feel you need help in this area. Now that you know what is required to run your enterprise effectively, put these steps into play, and see how much easier managing your enterprise becomes!

Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

13.6.7 Considering Entrepreneurship

Questions to ask yourself before considering entrepreneurship.

1. Why am I starting a business?
2. What problem am I solving?
3. Have others attempted to solve this problem before? Did they succeed or fail?
4. Do I have a mentor1 or industry expert that I can call on?
5. Who is my ideal customer2?
6. Who are my competitors3?
7. What makes my business idea different from other business ideas?
8. What are the key features of my product or service?
9. Have I done a SWOT4 analysis?
10. What is the size of the market that will buy my product or service?
11. What would it take to build a minimum viable product5 to test the market?
12. How much money do I need to get started?
13. Will I need to get a loan?
14. How soon will my products or services be available?
15. When will I break even or make a profit?
16. How will those who invest in my idea make a profit?
17. How should I set up the legal structure7 of my business?
18. What taxes will I need to pay?
19. What kind of insurance9 will I need?
20. Have I reached out to potential customers for feedback

Tips

- It is very important to validate your business ideas before you invest significant time, money and resources into it.
- The more questions you ask yourself, the more prepared you will be to handle to highs and lows of starting an enterprise.

Footnotes:

1. A mentor is a trusted and experienced person who is willing to coach and guide you.

2. A customer is someone who buys goods and/or services.

3. A competitor is a person or company that sells products and/or services similar to your products and/or services.

4. SWOT stands for Strengths, Weaknesses, Opportunities and Threats. To conduct a SWOT analysis of your company, you need to list down all the strengths and weaknesses of your company, the opportunities that are present for your company and the threats faced by your company.

5. A minimum viable product is a product that has the fewest possible features, that can be sold to customers, for the purpose of getting feedback from customers on the product.

6. A company is said to break even when the profits of the company are equal to the costs.

7. The legal structure could be a sole proprietorship, partnership or limited liability partnership.

8. There are two types of taxes – direct taxes payable by a person or a company, or indirect taxes charged on goods and/or services.

9. There are two types of insurance – life insurance and general insurance. Life insurance overs human life while general insurance covers assets like animals, goods, cars etc.

Notes