Skill India
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सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
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Skilling India in Electronics

Participant Handbook

Sector
Electronics

Sub - Sector
E-Mobility & Battery

Occupation
After Sale Support – EM&B

Reference ID: **ELE/Q7003, Version 1.0**
NSQF Level 4

Drone Service Technician

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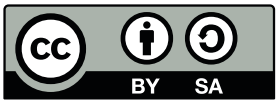
First Edition, June 2022



> 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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COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

ELECTRONICS SECTOR SKILL COUNCIL OF INDIA

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack **"Drone Service Technician'** QP No.**"ELE/Q7003,NSQF Level 4"**

Date of Issuance: 16th December, 2020
Valid up to*: 16th December, 2025

*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)

Authorized Signatory
Electronics Sector Skill Council of India

Acknowledgments

This participant's handbook meant for Drone Service Technicians is a sincere attempt to ensure the availability of all the relevant information to the existing and prospective job holders in this job role. We have compiled the content with inputs from the relevant Subject Matter Experts (SMEs) and industry members to ensure it is the latest and authentic. We express our sincere gratitude to all the SMEs and industry members who have made invaluable contributions to the completion of this participant's handbook.

I would like to thank the team of Feedback Advisory for their support to develop the content, the SME and the team at the ESSCI along with the industry partners for the tireless effort in bringing the handbook in the current format.

This handbook will help deliver skill-based training in the field of drone service and maintenance. We hope that it will benefit all the stakeholders, such as participants, trainers, and evaluators. We have made all efforts to ensure the publication meets the current quality standards for the successful delivery of QP/NOS-based training programs. We welcome and appreciate any suggestions for future improvements to this handbook.

About this book

This participant handbook has been designed to serve as a guide for participants who aim to obtain the required knowledge and skills to undertake various activities as a Drone Service Technician. Its content has been aligned with the latest Qualification Pack (QP) prepared for the job role. With a qualified trainer's guidance, the participants will be equipped with the following for working efficiently in the job role:

- Knowledge and Understanding: The relevant operational knowledge and understanding to perform the required tasks.
- Performance Criteria: The essential skills through hands-on training to perform the required operations to the applicable quality standards.
- Professional Skills: The Ability to make appropriate operational decisions about the field of work.

The handbook details the relevant activities to be carried out by a Drone Service Technician. After studying this handbook, job holders will be adequately skilled to carry out their duties efficiently according to the applicable quality standards, with minimum supervision.

The handbook has been divided into an appropriate number of units and sub-units based on the content of the relevant QP. We hope it will facilitate easy and structured learning for the participants. We sincerely hope that participants will obtain enhanced knowledge and skills after studying this handbook and make career progress in the relevant and senior job roles.

The Participant Handbook is designed based on the National Skill Qualification Framework (NSQF) aligned Qualification Pack (QP) and it comprises of the following National Occupation Standrads (NOS)/ topics:

- ELE/N7005: Repair and maintain a Drone
- ELE/N9905 Work effectively at the workplace
- ELE/N1002 Apply health and safety practices at workplace

Symbols Used


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1. Introduction and Orientation to the Role of a Drone Service Technician

Unit 1.1 - Introduction to the Electronics Sector in India

Unit 1.2 - Introduction to Drones

Unit 1.3 - Job Role and Responsibilities of a Drone Service Technician

Key Learning Outcomes

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

1. Explain the types and uses of drones.
2. State the role and responsibilities of a Drone service technician.

UNIT 1.1: Introduction to the Electronics Sector in India

Unit Objectives

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

1. Describe the size and scope of the Electronics industry.
2. Identify the sub-sectors of the Electronics industry.

1.1.1 Size and Scope of the Electronics Industry and Its Sub-Sectors

The Indian Electronics System Design & Manufacturing (ESDM) industry is one of the vital sectors of the Indian economy. The country has witnessed a substantial spike in demand for electronic products in the last few years. Today, India is positioned as the second-largest mobile phone manufacturer globally, with a surging internet penetration rate.

The ESDM sector is playing a vital role in the Indian government's goal of generating US$ 1 trillion of economic value from the digital economy by 2025. With several government initiatives aiming to boost domestic manufacturing, India is witnessing increased production and assembly activities across products, such as consumer electronics and mobile phones.

Market Size

- The Indian electronics manufacturing industry is projected to reach US$ 520 billion by 2025.
- In FY22 (until October 2021), imports of electronics goods stood at US$ 28.59 billion, whereas exports stood at US$ 7.89 billion.
- The demand for electronic products is expected to rise to US$ 400 billion by 2025 from US$ 33 billion in Fy20.
- The electronics market has witnessed a growth in demand, with market size increasing from US$ 145 billion in FY16 to US$ 215 billion in FY19—the market witnessed a growth of 14% CAGR from 2016-19.
- India's exports of electronic goods were valued at US$ 11.7 billion in FY21.
- Smartphone shipments in India increased by ~82% YoY to reach 33.0 million units in the second quarter of 2021.
- The Electronics System Design & Manufacturing (ESDM) is broadly segregated into—electronics system and electronics design.
- The electronics system market is expected to witness 2.3x demand of its current size (FY19) to reach US$ 160 billion by FY25.

- Electronics design segment, growing at 20.1%, was 22% of the ESDM market size in FY19; it is anticipated to be 27% of the ESDM market size in FY25.
- India's consumer electronics and appliances industry is expected to become the 5th largest globally by 2025.
- According to the Department for Promotion of Industry and Internal Trade, from April 2000 to June 2021, Foreign Direct Investment (FDI) equity inflows stood at US$ 3,176.29 million.

1.1.2 Sub-Sectors of the Electronics System Design & Manufacturing (ESDM) Industry

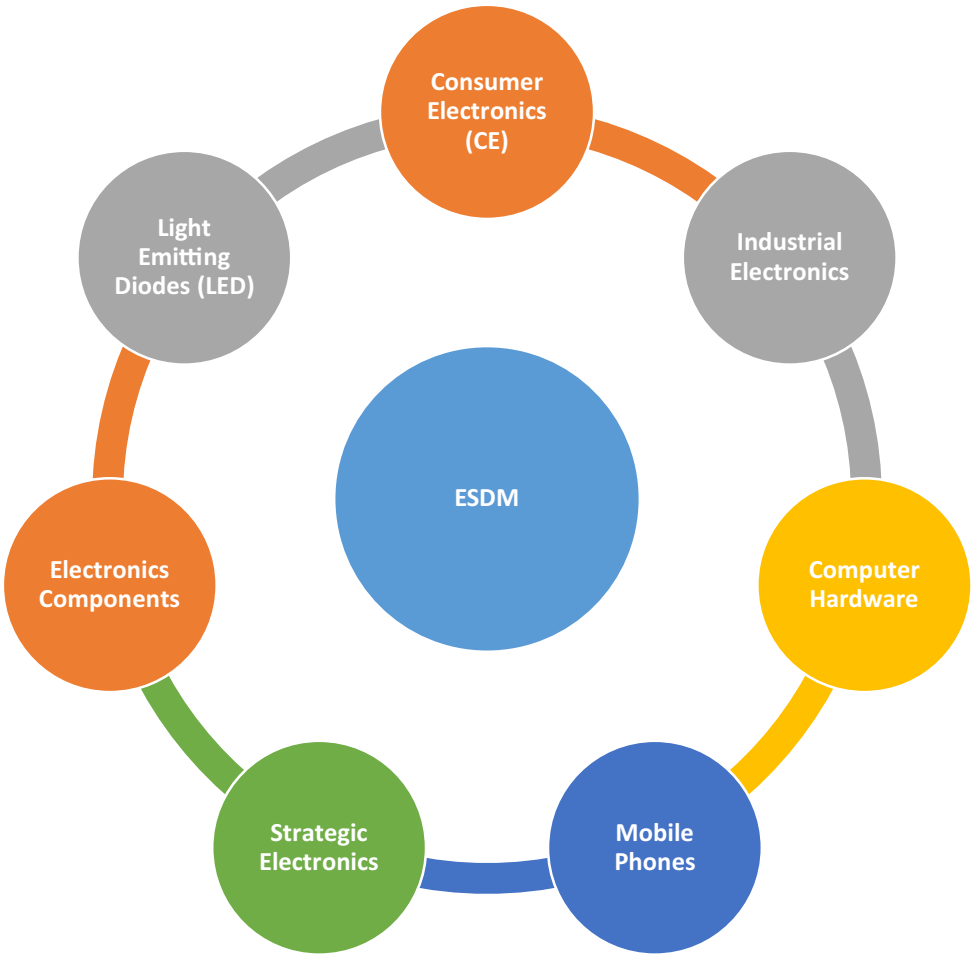

Fig. 1.1.1 Sub-sectors of the Electronics System Design & Manufacturing (ESDM) Industry

Notes

UNIT 1.2: Introduction to Drones

Unit Objectives

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

1. Define a drone.
2. Identify different types of drones.
3. Explain the industry uses for drones.

1.2.1 Drones

Unmanned Aerial Vehicles (UAVs), originally invented for military applications, are popularly known as drones today. Drones are airborne systems or aircrafts which are operated remotely by a human or autonomously by the onboard computer. Usually remote-controlled by humans, these flying vehicles are increasingly being utilized in civilian areas, such as commercial, logistics, agriculture, medical, recreation, etc.

Drones have become widely popular among adventurers, professional photographers, videographers, and tech and sports fans. It can be attributed to the advances in drone technology in the past decades, which now offer innovative technologies, such as flight technology, mobile technology, video technology, plus advanced software and ecosystems.

1.2.2 Types of Drones

Drones have lightweight frames which come equipped with different technologies. Drones vary in size, weight, payload capacity, flight time and functionality. This is dependent on the purpose for which they are deployed. The flight time of a drone is significantly impacted by its weight and the battery attached to it.

There are primarily two types of drones:

- Fixed-wing drones
- Rotary drones

Rotary drones can be both single-rotor drones and multirotor drones. Drones are often equipped with various sensors, such as TV cameras, radars, in-built GPS navigation systems, infrared imaging equipment, image intensifiers, and lasers. These help in the round-the-clock monitoring and targeting. Drones for military use are even equipped with laser-guided missiles.

1.2.3 Parameters of Different Types of Drones

Parameters	Fixed-Wing	Single Rotor	Multirotor
Weight	Heavy	Heavy	Light
Payload capacity	2 to 5 kg	3 to 15 kg	2 to 10 kg
Flight time	1 hour or more	1 hour or more	20–45 minutes
Hovering capabilities	Cannot hover	Can hover	Can hover
Expertise required	Hard to fly	Very hard to fly	Easy to use
Key uses	Large area survey and mapping	Area survey and mapping, spraying applications	Surveillance, photography, inspection

Table 1.2.1 Parameters of Different Types of Drones[1]

Due to continuous development, consumer drone models are available in a large range today, e.g.

- Tricopters
- Quadcopters
- Hexacopters
- Octocopters

These come equipped with 3, 4, 6, or 8 rotors, respectively. The price of drones varies according to the size and features, e.g. onboard cameras, batteries, sensing systems, flight modes, etc.

According to customer requirements, drones are available with high-definitions cameras, varying capacities of obstacle sensing systems, flight range, e.g. up to 5 kilometres, and flight time, e.g. 30 minutes.

Fig. 1.2.1 Tricopter

Fig. 1.2.2 Quadcopter

[1]*Source:https://www.pwc.in/assets/pdfs/research-insights/2020/preparing-for-takeoff.pdf*

Fig. 1.2.3 Hexacopter

Fig. 1.2.4 Octocopter

Classification as per the Drone Rules, 2021

According to the Drone Rules 2021 released by the Ministry of Civil Aviation, Government of India, drones are now classified based upon the maximum all-up weight, including payload, as given below:

1. Nano drone - Less than or equal to 250 grams
2. Micro drone - Greater than 250 grams and less than or equal to 2 Kilograms (Kgs)
3. Small drone - Greater than 2 Kgs and less than or equal to 25 Kgs
4. Medium drone - Greater than 25 Kgs and less than or equal to 150 Kgs
5. Large drone - Greater than 150 Kgs.

1.2.4 Industry Use Cases for Drones

Sector	Uses
Agriculture	• Precision farming – assessing the optimal quantity of water and fertilizers to be used • Spraying fertilizers and pesticides on crops • Detection of pests and diseases infestation in the crop • Land and crop health monitoring • Completion of plant count • Calculation of fair crop loss percentage • Crop maintenance
Media and Entertainment	• Aerial cinematography for film production and news reporting • Aerial documentary • Aerial photography
Energy and Utilities	• Remediation and site monitoring • Inspection of underwater intake pipes • Surveying grades map for siting transmission line

Urban development	• Industrial inspection • Land audit and Town planning • Site management • Developing 3D models for heritage sites to guide restoration work • 3D video mapping • Geo-referencing for land records management • Digital mapping for accurate property tax collection
Transport	• Inspection of railway lines under construction or maintenance • Railway infrastructure monitoring • Detecting and fixing potholes on roads • Road traffic surveillance to make a decongestion plan • Highway traffic monitoring and penalizing for traffic rules violations
Forest and wildlife	• Aerial monitoring to prevent illegal poaching • Surveillance of swimming spots to prevent unexpected shark attacks • Aerial monitoring of forests to control poaching and tree felling • Census of endangered wildlife
Healthcare	• Urgent delivery of medical supplies, such as blood units, vaccines, etc. • Transportation of blood samples to labs for testing • Monitoring and assessing disease vector habitats
Security	• Security monitoring at public places, music and sporting events, etc.
Mining	• Thermal imaging, terrain mapping and change detection • Monitoring and auditing mining firms • Inspecting mining equipment and mining pits • Monitoring inaccessible areas to track illegal sand mafia • Infrastructure and equipment inspection
Disaster management	• Monitoring for evacuations during typhoons, flooding, earthquake, etc. • Isolating people faster than traditional ground-based rescue teams
Oil and gas	• Inspection of gas processing plants using drones equipped with infrared cameras to identify leaks in gas pipelines • Surveillance of pipelines

Telecom	• Regular inspection of telecom towers • Inspecting cell sites in difficult to reach areas or disaster-affected areas for information on damaged equipment • Assessing damage to telecom infrastructure and managing repair efforts
Insurance	• Assessment of damage to cop and properties following natural disasters • Conducting home assessments for quick claim settlements • Identifying discrepancies and fraudulent claims • Risk-adjusted product pricing
Tourism	• Use of drone-based videos to showcase the tourist attractions • Monitoring of historically important and protected tourism spots • Monitoring of tourists to ensure minimal disturbance to wildlife in wildlife tourism spots

Table 1.2.2 Industry Use Cases for Drones[2]

[2]*Source:https://www.pwc.in/assets/pdfs/research-insights/2020/preparing-for-takeoff.pdf*

1.2.5 Certification and Compliance

Only drones with a certificate of airworthiness from the QCI (Quality Council of India) can be operated in India. QCI has been appointed as the official certification entity that is responsible for issuing an airworthiness certificate to manufacturers on the Digital Sky platform if the drone meets all the specified certification standards.

One must ensure any drone operations are carried out in compliance with the safety regulations and advisories issued by the Directorate General of Civil Aviation (DGCA), which is the statutory body of the Government of India that regulates civil aviation in India.

1.2.6 Registering a Drone

Every drone that is operated in India, except nano drones, must have a Unique Identification Number (UIN). Generating a drone's UIN is a simple process.

- First, one should purchase a drone that has been certified by the QCI.
- The manufacturer will provide the buyer with a set of unique serial numbers for the drone and its control station module.
- Using the details provided by the manufacturer, one needs to fill in the D-2 form on the Digital Sky platform to generate the UIN.

Remote Pilot License

Unless one operates a nano drone or a micro drone for non-commercial purposes, every drone pilot must have a valid remote pilot license in India. The remote pilot license must mention the class of the drone, which the pilot can operate, and the successful completion of training.

According to the Drone Rules 2021, an applicant can receive their remote pilot license on Digital Sky within 15-20 days of completing their drone pilot training. Applicants must meet the following eligibility criteria to receive a remote pilot license:

- Age between 18-65 years
- Minimum educational qualification of the class 10th or equivalent from a recognized board
- Completion of remote pilot training from a DGCA-authorised drone pilot training school for the applicable class of remote pilot licence.

Once granted, the remote pilot license is valid for 10 years.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=s3OWevhrXpo&ab_channel=DeepakTechTimes

Drone Introduction

https://www.youtube.com/watch?v=7qnm_okFRnE

Types of Drones

https://www.youtube.com/watch?v=PxQckEYjN-k

Industry Use Cases for Drones

https://www.youtube.com/watch?v=kBH2D2sOkrA

Certification and Compliance

https://www.youtube.com/watch?v=-FYGvQeU-cY&ab_channel=ManWomanAndDog

Registering a Drone

UNIT 1.3: Job Role and Responsibilities of a Drone Service Technician

Unit Objectives

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

1. State the role and responsibilities of a Drone Service Technician.
2. Discuss various employment opportunities for a Drone Service Technician in the Electronics industry.
3. State the organization's policies on incentives, personnel management reporting structure etc.

1.3.1 Job Role and Responsibilities of a Drone Service Technician

A Drone Service Technician has the following primary job responsibilities:

1. **Understanding the drone-related issues faced by the customer**
   - Collecting information about the customer's issues.
   - Selecting relevant troubleshooting-instruction sheets, tools, equipment and verified replaceable parts based on standard operating procedures and analysis of customer complaints.
   - Perform preliminary check-up of the drone.
   - Evaluating the replacement or repair of modules on the field or at the company's workshop.

2. **Performing repair and maintenance of the drone**
   - Reviewing the recommended practices for switching on the drone and the remote controller.
   - Reviewing the standard work practices to disassemble the defective components.
   - Inspecting the functional components of a drone thoroughly by connecting to an external power source, using multimetre, etc.
   - Identifying electronic components that are malfunctioning and need to be repaired/replaced.
   - Performing repair of the defective components as per company specified maintenance guidelines.
   - Installing repaired / fresh electronic components using appropriate tools and equipment.
   - Assembling the drone components as per the industry practices.
   - Assessing the drone works effectively after repair and maintenance.
   - Disposing of waste as per standard operating procedure.

3. **Commissioning the Drone**
   - Performing standard safety checks of the drone after repair and maintenance.
   - Performing a demo run of the drone to ensure customer satisfaction.
   - Communicating with the customer to provide product and maintenance related information.

4. **Reporting to Supervisor**
   - Informing the supervisor of the workload and completion status.
   - Reporting the work status through proper documentation as per the organizational standards.
   - Intimating the problems that cannot be resolved at the field level with reason.
   - Reporting on the completion of field repair or hardware part replacement with reference to the agreed target and time or reasons for not meeting the target.
   - Preparing the feedback form on customer satisfaction level with respect to the product repair.

In addition, the individual has the following responsibilities:

- Communicating effectively at the workplace.
- Working effectively.
- Maintaining and enhancing professional competence.
- Working in a disciplined and ethical manner.
- Upholding social diversity in the workplace.
- Dealing with workplace hazards.
- Following fire safety practices.
- Following emergencies, rescue and first-aid procedures.
- Following effective waste management/recycling practices.

1.3.2 Personal Attributes of a Drone Service Technician

A Drone Service Technician needs to have some essential personal attributes for performing various activities effectively. The individual should have attention to detail and problem-solving skills to quickly identify any malfunctioning or problems with drones for their timely resolution. The person should have logical thinking to analyze a situation/problem logically to find an appropriate solution and appropriate technical expertise to perform repair and maintenance activities efficiently. Good decision-making skills are also important for the individual to ensure the correct decision is taken concerning the corrective measures to be taken for drone repair.

The person usually caters to clients who experience issues with their drones. For this reason, the individual needs to have good client-dealing skills and the ability to work as per their requirement. It also includes effective communication skills, i.e. talking courteously and listening attentively.

In a dynamic technological environment, it is also vital for the individual to stay updated with the latest developments in the field of work by reading the relevant literature and staying in contact with relevant persons.

1.3.3 Career Progression for a Drone Service Technician

There are different career pathways that a Drone Service Technician can take. Following are some of them:

- Lateral movement in the aviation industry or other related sectors where drones are used. The individual can work as an employee with such a company.
- With appropriate knowledge and adequate years of experience, the individual may also become a Senior Technician.
- Later, the individual may become a Supervisor and even progress to a manager's level.
- The person can even work as an entrepreneur and start a drone service centre.
- Similarly, with strong technical expertise in different types of drones, one can even become a trainer at a training institute or start own drone training centre.

1.3.4 Organizational Policies on Incentives, Personnel Management and Reporting Structure

The organizational policies on incentives, personnel management, and reporting structure depend on the organization the individual joins. These vary across organizations.

For example, a public sector company may offer different kinds of incentives for work performance as compared to a private company. The same is the case with the reporting structure.

Personnel management policies also tend to differ from organization to organization. The individual should conduct proper research before interviewing for a job at a particular company to ensure that they are satisfied with the company policies on remuneration, human resource management, career progression, etc.

Exercise

1. List down three sub-sectors of the Electronics System Design & Manufacturing (ESDM) Industry.
2. List down two primary classifications of drones.
3. Match the drone type with its correct description.

Drone Type	Description
Tricopter	Comes equipped with four rotors.
Quadcopter	Comes equipped with six rotors.
Hexacopter	Comes equipped with eight rotors.
Octocopter	Comes equipped with three rotors.

4. List down two industry uses of drones in the agriculture sector.

Notes

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2. Routine Repair and Maintenance of a Drone

Unit 2.1 - Basic Principles of Electricity

Unit 2.2 - Take-off and Landing of Drones

Unit 2.3 - Repair and Maintenance of Drones

ELE/N7005

Key Learning Outcomes

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

1. Explain the basic principles governing the Alternating Current, Direct Current (DC) and electronic circuits.
2. Explain the use of various types of electronic components such as a resistor, capacitors, coil, diode, transistor, integrated circuit (IC) etc.
3. Explain the importance of electric safety.
4. Describe the functions of various Drone components such as propeller, electric motor, camera, GPS, etc.
5. Describe the various parts of a Drone controller.
6. State the manufacturer guidelines for starting and shutting down a Drone safely.
7. Explain the process of conducting a preliminary check on a Drone to determine its modules' repair or replacement needs.
8. List various tools and equipment required for the repair and maintenance of a Drone.
9. Explain the procedure of assembling/ disassembling different types of Drone.
10. Explain the relevant troubleshooting and maintenance procedures for different components of a Drone.
11. Describe the standard procedure for repairing and replacing any faulty components of a Drone.

UNIT 2.1: Basic Principles of Electricity

Unit Objectives

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

1. Explain the basic principles governing the Alternating Current, Direct Current (DC) and electronic circuits.
2. Explain the use of various types of electronic components such as a resistor, capacitors, coil, diode, transistor, integrated circuit (IC) etc.
3. Explain the importance of electric safety.

2.1.1 Electric Current

The flow of electricity in an electronic circuit, as well as the amount of electricity flowing through it, is referred to as electric current. It is measured in amperes (A). The higher the ampere value, the more electricity flows across the circuit. Imagining electricity as the flow of water in a river makes it simple to understand. Particles called electrons come together, and the number of electrons flowing each second is the current.

Voltage is a word that is used in electrical circuits almost as frequently as current. Volts are the unit of measurement for voltage (V). Voltage is connected to the passage of electrons in a circuit, just like the current. The flow of electrons is referred to as current, and the amount of force driving the electrons is referred to as voltage.

The two types of electric current flow are:

Direct Current: The one direction flow of an electric charge is known as direct current. Direct current can flow via conductors like wires, but it can also flow through semiconductors and even a vacuum.

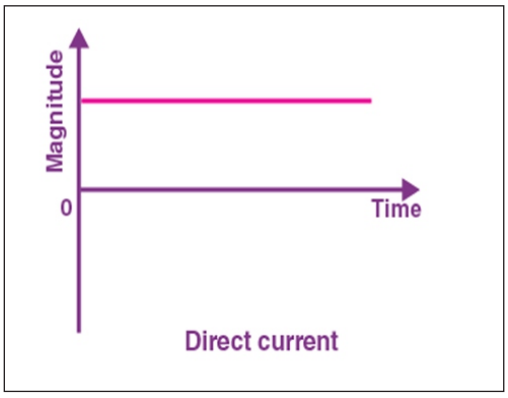


Fig. 2.1.1. Direct Current

Alternating Current

An electrical current that repeatedly changes or reverses its direction is called an alternating current. AC changes its magnitude and polarity at regular intervals of time.

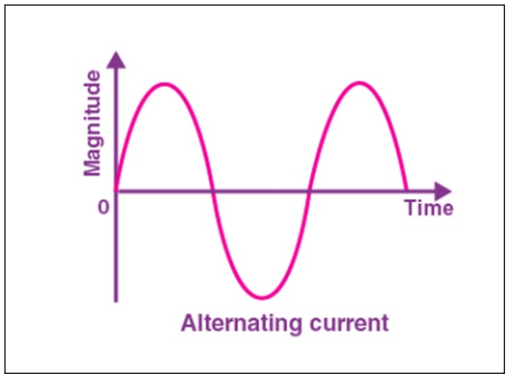


Fig. 2.1.2. Alternating Current

2.1.2 Electric Circuit

A channel through which electric current flows is known as an electric circuit. An electric circuit can also be a loop if it is a closed path (both ends are connected). Because of the closed circuit, electric current may flow freely. An open circuit is one in which the passage of electrons is interrupted because the circuit is broken. An open circuit does not allow an electric current to flow.

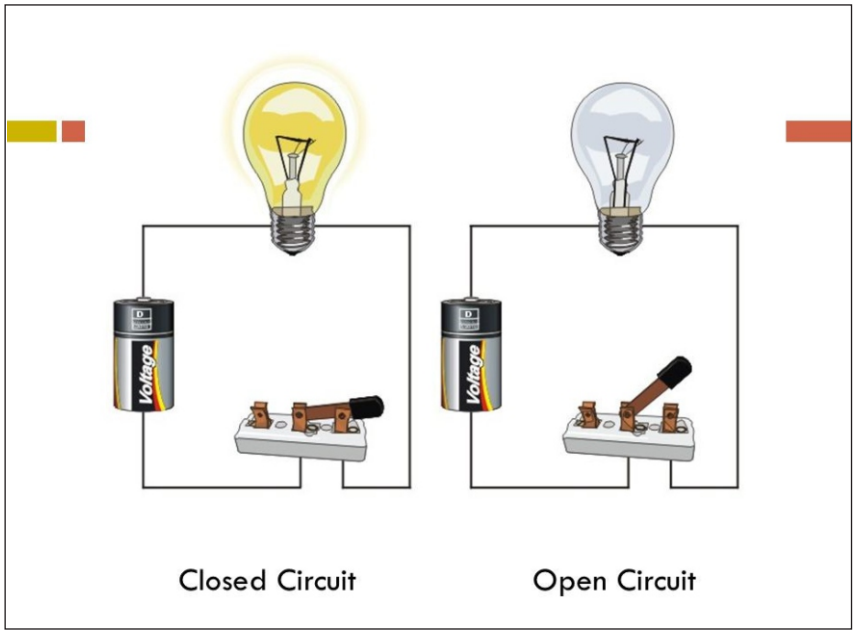


Fig. 2.1.3. Electric Circuit

Parts of Electric Circuit

The functions of parts of an electric circuit are:

- **Cell or electric source:** It is used as a source to supply electric current.
- **Load:** It is a resistor. It is basically a light bulb, which glows when the circuit is turned on.
- **Conductors:** Copper wires are used as conductors with no insulation. One end of the wire carries current from the power source to the load and the other end from the power source.
- **Switch:** It is a part of the circuit that controls the supply of current in the circuit. It is used to open or close the circuit.

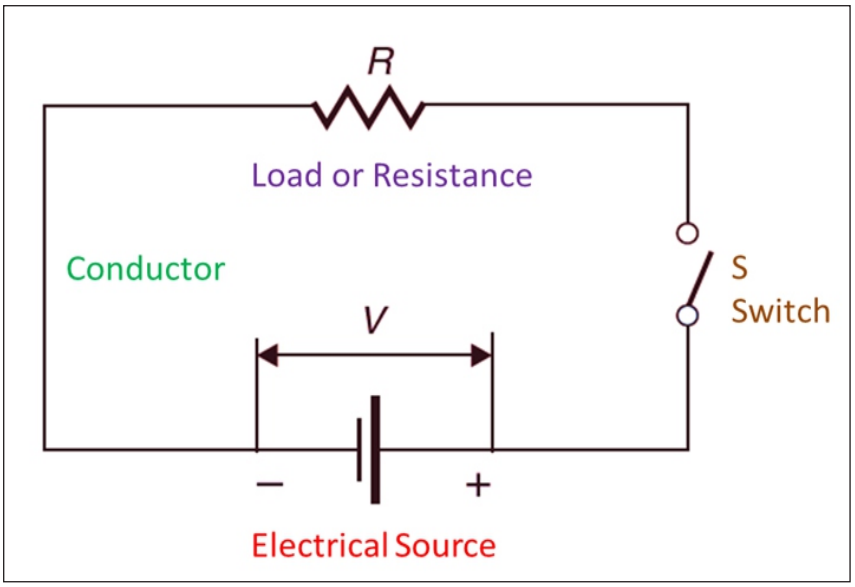


Fig. 2.1.4. Parts of Electric Circuit

Types of Electric Circuit

There are two types of electric circuits.

- Series circuit.
- Parallel circuit.

1. Series Circuit

In a series circuit, electrons can only flow in one direction. At the same moment, the circuit is closed or open. The fundamental drawback of a series circuit is that no current flows in the circuit in the event of a circuit break since the whole circuit is open. If any light bulbs are linked in a series circuit, for example, if one goes out, the others will likewise go out.

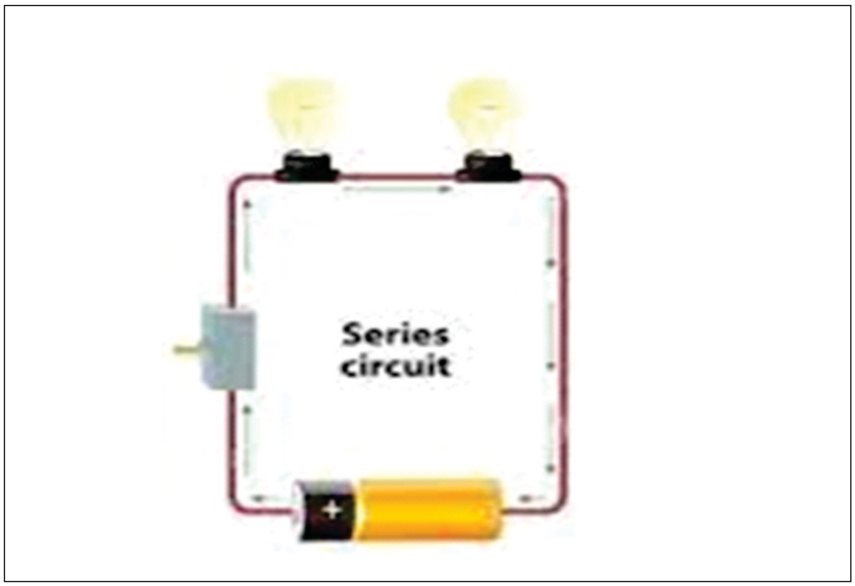


Fig. 2.1.5. Series Circuit

2. Parallel circuit

In a parallel type of electric circuit, different parts of the circuit are connected across different branches. Hence, electron flow occurs in several parts. If in one path a circuit break occurs, electric current still flows in other paths. Parallel circuits are used in household appliance wiring, so if one light bulb fails, the other will continue to operate.

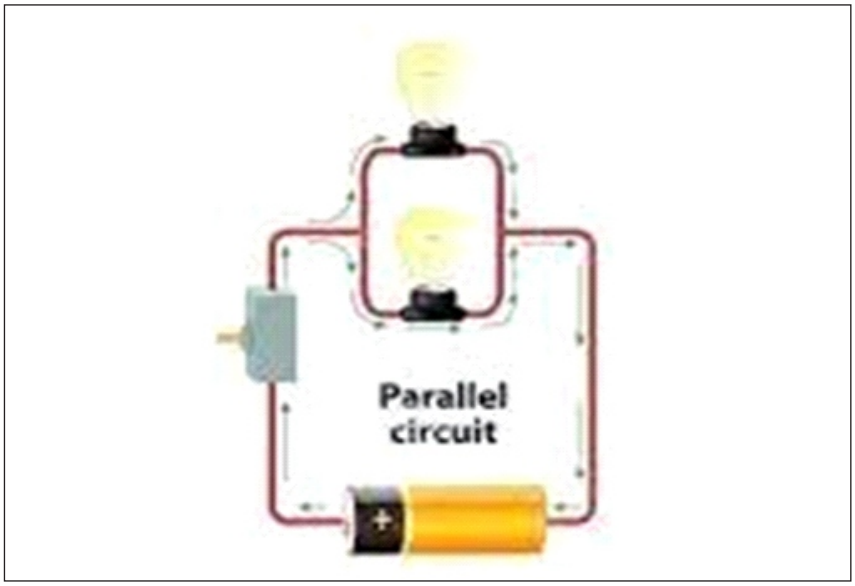


Fig. 2.1.6. Parallel Circuit

2.1.3 Electronic Components

Electronic components are the elements of the circuit that help in its functioning. They can be classified into two types, i.e. Active Components and Passive Components. Active components include transistors, batteries, etc., while passive components include transformers, inductors, resistors, capacitors, etc.

The electronic components and their functions are:

1. Resistors

A resistor is one of the components one will come across in an integrated circuit. As the name suggests, the device resists the flow of current. Resistors are graded based on their power ratings (amount of power they can handle without exploding) and resistance values (capacity to resist current). The measurement is done in units known as ohms. The electronic symbol of the unit is O.

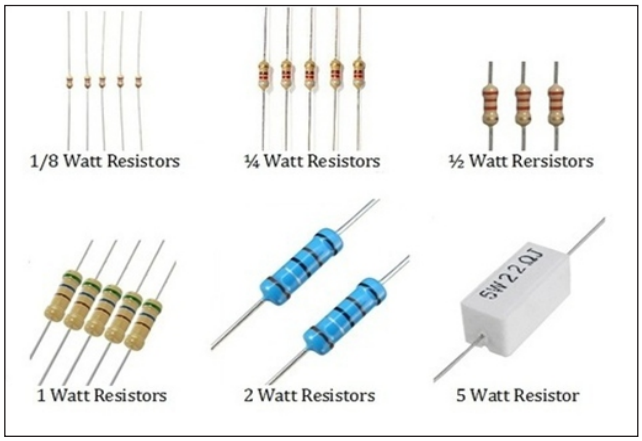


Fig. 2.1.7. Resistors

2. Capacitors

These components can store electric charge temporarily. The components come in different varieties, with the most common ones being electrolytic and ceramic disks. The capacity of a component is usually measured in microfarads (ÂµF).

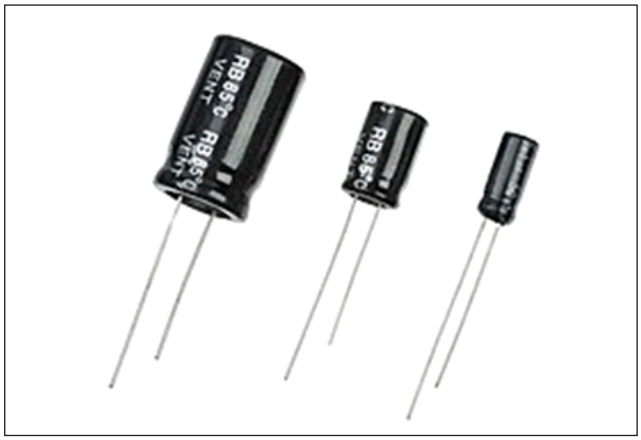


Fig. 2.1.8. Capacitor

3. Diodes

Diodes allow an electric current to flow in a single direction only. Each diode has two terminals known as the anode and cathode. When the anode is charged with a positive voltage and the cathode with a negative one, an electric current can flow. Reversing these voltages will prevent the current from flowing.

Fig. 2.1.9. Diode

4. Transistors

These components are easy to identify through their three terminals. For the components to work, voltage has to be applied to one of them; the base terminal. The base can then control the current flow in the two other terminals (the emitter and collector).

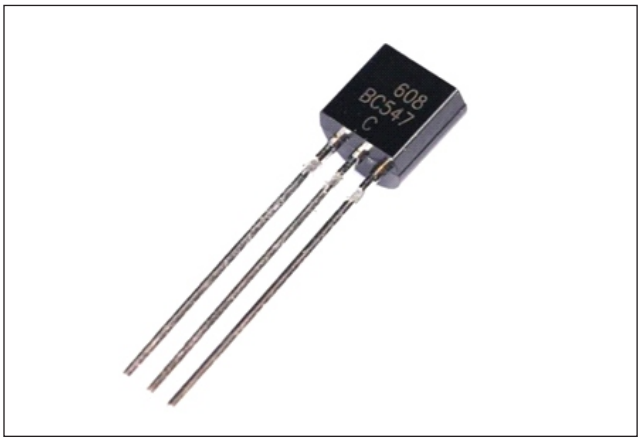


Fig. 2.1.10. Transistors

5. Inductors

These are passive components that store energy in the form of a magnetic field. An inductor simply consists of a coil of wire wound around some kind of core. The core could be a magnet or air. When current passes through the inductor, a magnetic field is created around it. The magnetic field is stronger if a magnet is used as the core.

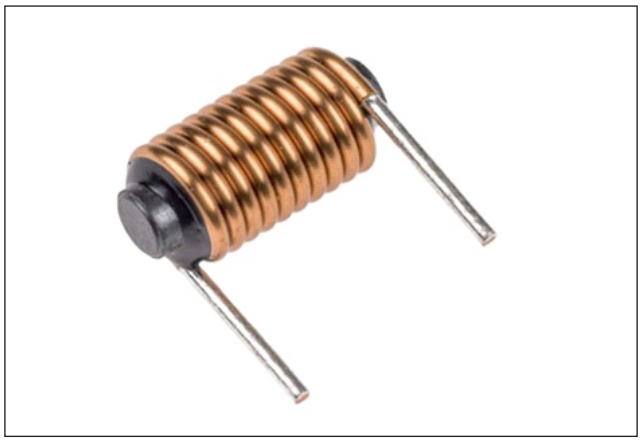


Fig. 2.1.11. Inductors

6. Integrated Circuits

An integrated circuit refers to a special device that has all the components required in an electronic circuit. The component has diodes, transistors, and other devices, all of which are etched on a tiny piece of silicon. The components are used in many electronic devices, including watches and computers.

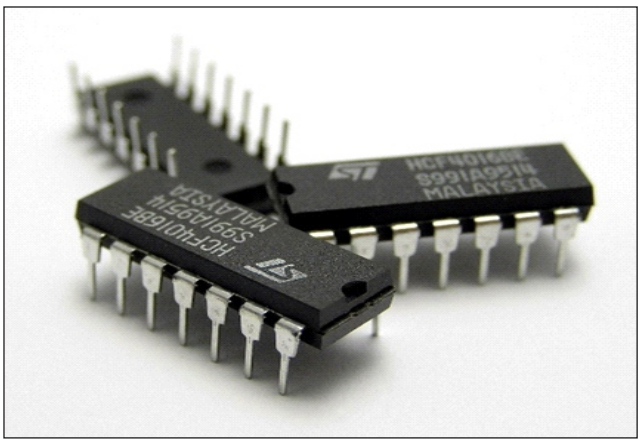


Fig. 2.1.12. Integrated Circuits

7. Microcontrollers

Microcontrollers are small computers used to control a multitude of devices, such as power tools, remote controls, medical equipment and office machines.

Fig. 2.1.13. Microcontrollers

8. Transformers

Built with two coils of wire, transformers are commonly used to step up or step down power.

Fig. 2.1.14. Transformers

9. Batteries

Batteries convert chemical energy to electrical energy. The two different cells of a battery are anode (+) and cathode (-).

Fig. 2.1.15. Batteries

10. Fuses

Fuses help preserve components from overloading with excessive current. A fuse consists of a connection body, support, contacts, and metal-fuse material such as zinc or copper.

Fig. 2.1.16. Fuse

11. Relays

These electromechanical switches shut power on or off. A relay includes an electromagnet, an armature, a series of electrical contacts and a spring.

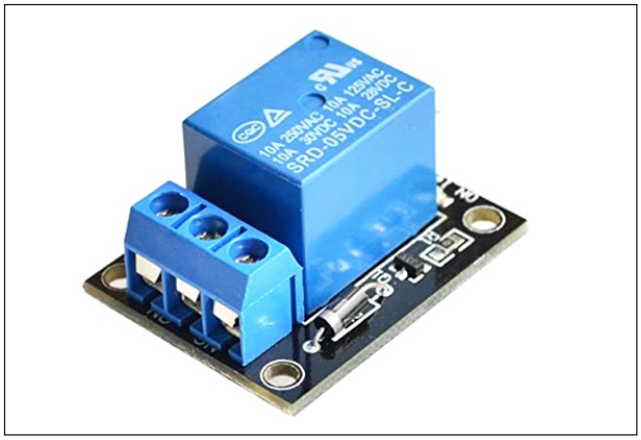


Fig. 2.1.17. Relays

12. Switches

Switches interrupt current. The four types of switches are single pole single throw (SPST), single pole double throw (SPDT), double pole single throw (DPST), and double pole double throw (DPDT).

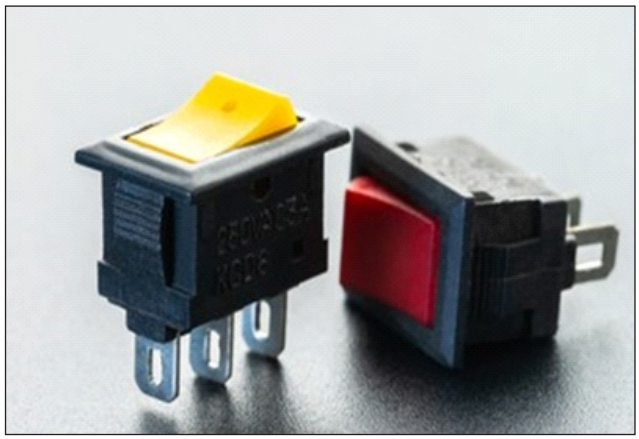


Fig. 2.1.18. Switches

13. Motors

Motors convert electrical energy into mechanical energy. Key components include a rotor, stator, bearings, conduit box, enclosure, and eye bolt.

Fig. 2.1.19. Motors

14. Circuit Breakers

As a protective device, a circuit breaker can be controlled with a remote switch. It is designed to protect the circuit from overloading or a short circuit.

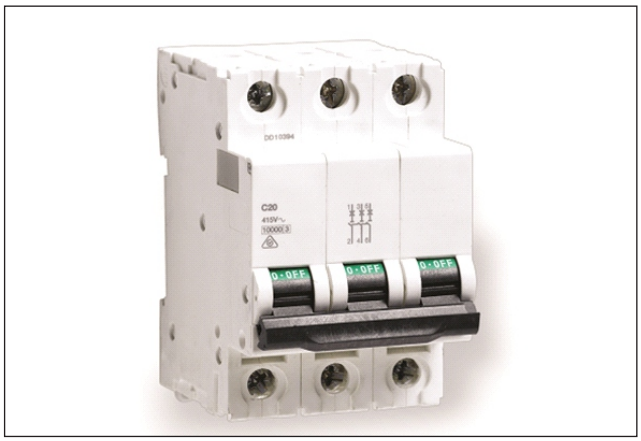


Fig. 2.1.20. Circuit Breakers

2.1.4 Electrical Safety

Electrical safety refers to any type of precaution taken to protect against electric currents.

Contact with electricity can cause serious injuries, including:

- Electrical shocks
- Electrical burns
- Electrocution

If severe enough, electrocution can be fatal. Employers are responsible for ensuring workplace safety by mandating workers to follow the correct safety procedures while dealing with electricity.

The basics of electric safety are:

- Working with exposed conductors carrying 50 volts or more is not recommended.
- Ensure that all electrical equipment is properly connected, grounded, and functional.
- Extension cables should not be utilised as permanent wiring and should be discarded after a single activity or event.
- Surge suppressors with built-in circuit breakers may be used for a long time and come in chord lengths of three, six, and fifteen feet.
- Space heaters, portable air conditioners, and other high-amperage devices must be connected directly to permanent wall sockets.
- Unless one is explicitly certified and permitted, one should not enter, utilise, or change any building's electrical service, including circuit breaker panels.
- Electrical shocks are more likely in wet situations.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=MysDRKXDp0A

Electric Current

https://www.youtube.com/watch?v=ouOJW_ozx6Q

Electric Circuit

https://www.youtube.com/watch?v=iHmSj6v7LOE

Eectronic Components

UNIT 2.2: Take-off and Landing of Drones

Unit Objectives

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

1. Describe the functions of various Drone components such as propeller, electric motor, camera, GPS, etc.
2. Describe the various parts of a Drone controller
3. State the manufacturer guidelines for starting and shutting down a Drone safely.

2.2.1 Components of a Drone

Drones may perform a wide range of tasks, including monitoring climate change, conducting search and rescue operations after natural disasters, and taking photographs, filming, and delivering goods. However, the military uses them for reconnaissance, surveillance, and targeted assaults, which is the most well-known and controversial use.

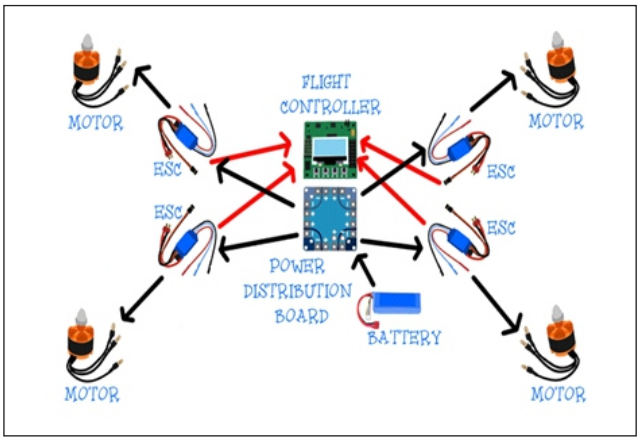


Fig. 2.2.1. Drone Components

The body of a drone comprises the following components:

1. **Propellers:** The drone's propellers are normally seen in the front. In terms of size and substance, propellers come in a wide range of sizes and materials. The majority of them, especially the smaller ones, are constructed of plastic, while the more expensive ones are made of carbon fibre. Propellers are responsible for the direction and motion of the drone.
2. **Motor:** The most prevalent usage of motors in drones and unmanned aerial vehicles (UAVs) is to allow multirotor drones to fly by spinning their propellers. Other unmanned vehicle components that use drone motors include camera and payload gimbals, flight surfaces, antenna rotators, and landing gear. Brush motors are utilized in smaller drones, whereas brushless motors are used in large drones and UAVs.

3. **Landing Gear:** Some drones include landing gear that resembles that of a helicopter. This helps in landing the drone. Drones that require a lot of ground clearance while landing will need to have their landing gear modified in order to land safely. Furthermore, delivery drones carrying goods or things may require a large landing gear due to the area needed to hold the objects when they touch the ground. However, the landing gear is not required for all drones. Some smaller drones can fly without landing gear and land safely on their stomachs once they make contact with the ground.

4. **Electronic Speed Controllers:** An electronic speed controller (ESC) is an electric circuit tasked with monitoring and varying the drone's speed during flight. It is also in charge of the drone's flight direction and variations in brakes. The ESC is also in charge of converting DC battery power to AC power, which is used to propel brushless motors. For all of their flight demands and performance, modern drones rely totally on the ESC.

5. **Flight Controller:** The flight controller serves as the drone's motherboard. It is in charge of all the orders that the pilot issues to the drone. It decodes information from the receiver, GPS module, battery monitor, and onboard sensors. The flight controller is also in charge of regulating motor speeds through the ESC and controlling the drone's direction. The flight controller is in charge of all commands, including camera triggering, autopilot mode control, and other autonomous operations.

6. **Receiver:** The receiver is the component in charge of receiving radio signals supplied to the drone through the controller. The minimum amount of channels required to operate a drone is generally 4. It is recommended, however, that a total of 5 channels be made available.

7. **Transmitter:** The transmitter is in charge of transferring radio signals from the controller to the drone in order to issue flight and navigation commands. The transmitter, like the receiver, requires to have 4 channels for a drone, but five are generally suggested. To communicate with the drone while in flight, the receiver and transmitter must use a single radio signal. Each radio broadcast has a unique code that allows it to be distinguished from other radio signals in the air.

8. **GPS Module:** The GPS module is in charge of calculating the drone's longitude, latitude, and elevation. It is a very vital part of the drone. Drones would not be as essential as they are now if not for the GPS module. The components assist the drone in navigating longer distances and capturing specific details of land areas. Even without the use of the FPV, the GPS module aids in securely returning the drone "home." In most current drones, the GPS module helps in the safe return of the drone to the controller if it loses contact with it. This contributes to the drone's safety.

9. **Battery:** The drone's battery is the component that enables all motions and reactions. The drone would not be able to fly without the battery since it would be powerless. The battery requirements for different drones are different. Due to their lower power requirements, smaller drones may require smaller batteries. Larger drones, on the other hand, may need a larger battery with a higher capacity in order to power all of the drone operations. On the drone, there is a battery monitor that lets the pilot monitor the battery's performance by displaying battery information.

10. **Camera:** Some drones feature a built-in camera, while others have a camera that can be detached. The camera aids in the shooting of photographs and images from the air, which forms an important use of drones.

11. **Obstacle Avoidance Sensors:** On the front and bottom of the drone are vision sensors that function in pairs, exactly like the eyes. The depth of these sensors is determined by determining which picture pixels from each sensor belong to the same spot. Because the distance between the sensors is constant, the drone can determine the distance it is from the item in front of it.
12. **Gimbal:** Gimbal helps the drone to keep the footage still and stabilized.
13. **Frame:** This is a structure (frame) in which all the other parts fit. It acts as a skeleton in which different components are placed.

2.2.2 Drone Controller

Drones are often controlled by a transmitter or a remote controller. With buttons and joysticks that perform various functions, this useful gadget resembles gaming or toy remote controls.

Parts of a Drone Controller

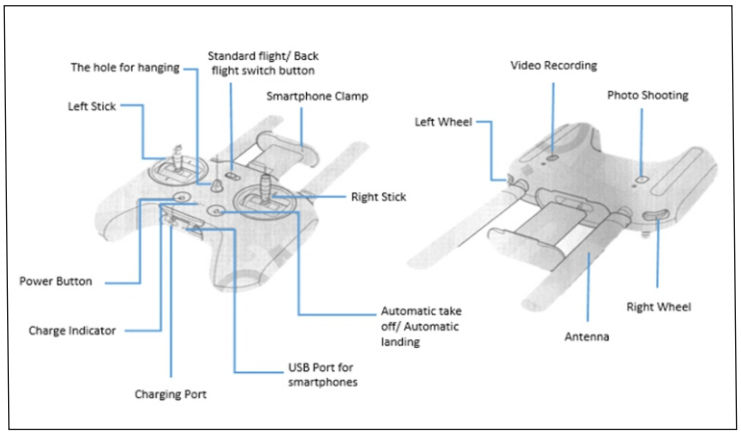


Fig. 2.2.2. Parts of Drone Controller

Main Functions of a Drone Controller

The four main functions and most important aspects of any drones' controller are:

- Yaw: Yaw refers to a clockwise or counter-clockwise rotation of the drone.
- Throttle: The throttle controls the amount of power sent to the drone's motors, allowing for faster or slower flight speeds.
- Roll: Roll refers to the left or right movement of a drone.
- Pitch: Pitch refers to the tilt of a drone, either forward or backwards.

Right Stick: The right stick lets one control the roll and pitch of the drone, allowing one to move the drone right/left as well as forward and backward.

Left Stick: The left stick lets one control the yaw and throttle of the drone, allowing one to control the height at which one flies the drone and letting one rotate the drone clockwise or counter-clockwise in flight.

2.2.3 Take-off and Landing of a Drone

The basic flying rules are to find an open area, place the drone, connect the transmitter, take off, hover, rotate, and landing. The rules for taking off and landing a drone are discussed below.

Take off of a drone

The steps to be followed during the take-off of a drone:

- To get the drone in the air, the only control one needs is the throttle.
- Push the throttle (left stick) up very slowly, just to get the propellers going. Then stop.
- Repeat this multiple times until comfortable with the throttle's sensitivity.
- Slowly push the throttle further than before until the copter lifts off the ground. Then pull the throttle back down to zero and let the drone land.

Hovering in Mid-air and Landing Drone

The steps are:

- To hover, one needs to use the throttle to get airborne. One then needs to use small adjustments of the right stick to keep the drone hovering in place.
- One may also need to adjust the left stick (yaw) slightly to keep it from turning.
- Use the throttle to get the drone about a foot to a foot-and-a-half off the ground.
- Make tiny adjustments with the right stick (and the left, if necessary) to keep the drone hovering in position.
- When one is ready to land the drone, they should cut back the throttle slowly.
- When the drone is an inch or two off the ground, go ahead and cut the throttle completely and let the UAV drop to the ground.
- One should repeat this until they get comfortable hovering off the ground and landing gently.

2.2.4 Turning On and Off a Drone

It's generally recommended to turn on the controller first before turning on the drone. It gives the pilot control of the drone from the moment it powers up.

- To turn on the controller, press and hold the power button located in the top right corner of the controller. The first press will indicate the battery level, and the second press and hold will power up the controller, ready for use.
- To turn it off, press and hold the power button located on the bottom of the drone. The first press will indicate battery level, and the second press and hold will power down the drone.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=OUHSWBQg3rI&ab_channel=OmHobby

Components of a Drone

https://www.youtube.com/watch?v=Cf2K_VUoGZA

Drone Controller

UNIT 2.3: Repair and Maintenance of Drones

Unit Objectives

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

1. Explain the process of conducting a preliminary check on a drone to determine its modules' repair or replacement needs
2. List various tools and equipment required for the repair and maintenance of a drone
3. Explain the procedure of assembling/ disassembling different types of drone
4. Explain the relevant troubleshooting and maintenance procedures for different components of a drone
5. Describe the standard procedure for repairing and replacing any faulty components of a drone.

2.3.1 Preliminary Check on a Drone

UAV systems, particularly those deployed as part of a larger fleet, are subject to wear and tear from constant usage, requiring routine maintenance checks to ensure everything is in working condition.

This checklist is meant to meet the demands of routine maintenance inspections and may be used as often as necessary; however, performing maintenance on a per-flight basis rather than a defined schedule is the most effective. As a result, scheduling reflects the possibility of the drone requiring servicing more precisely.

The checklist is as follows:

1. Record Basic Details: Before starting the checklist, record pilot identification and drone model details for the unit being serviced, date of maintenance, and technician name.
2. Make sure all battery packs are disconnected, and the drone is fully powered down before completing any structural checks.
3. **Structural Inspection:**

- **Clean chassis of mud and dirt:** by removing the majority of the dust and build-up with an air duster, a microfiber cloth, and a little water. More extensive cleaning solutions may be required for tougher stains, but be cautious when working with delicate electrical components.
- **Inspect chassis for cracks:** Carefully inspect the chassis for damage. Even the smallest crack can cause critical problems if left unnoticed. Note down if any damage is found.
- **Check for loose screws:** Ensure that each component is securely fastened. Check the fastenings and bolts twice. Excessive tightening can put undue strain on joints, causing even more harm.
- **Check propellers for damage:** The propellers are among the system's most delicate components. Check them carefully for cracks and make sure they're not loose. Damage to propellers can go unnoticed until it's very critical.

- **Check propellers are free-spinning:** Rotate each propeller, in turn, to see if there are any other obstacles that are preventing the propeller from moving to its full range of motion.
- **Check motors for debris and obstructions:** Debris such as grit or dirt, as well as organic matter stuck in the holes surrounding the top of the armature, can clog the motor chamber. Make sure there's nothing stuck in the gap between the propeller and the engine, as well as wipe off the casing. To get direct access to the motor chamber, remove the propellers and wipe away any foreign materials.
- **Check the state of wiring and solder joints:** If the machine has any exposed wiring, one should inspect it first because it is the most vulnerable to harm. Look for any areas that are noticeably worn or frayed, and ensure sure nothing is loose. Examine the internal wiring by opening the chassis. Solder any loose connections; if soldered incorrectly, electronics may be damaged or broken.
- **Check landing gear condition:** Make sure the legs and feet of the unit are not bent or cracked and that all rubber shock absorbers are intact. If any part is missing, the drone would not be able to perform a safe landing. If any parts are damaged or missing, they will need to be ordered from the manufacturer and re-fitted
- **Inspect antennae:** The antenna ensures that a wireless signal is maintained between the ground control station and the mobile drone unit. An antenna that is damaged or incorrectly installed can reduce connectivity and result in a deadly loss of control. Ensure that each antenna is in good working order and is securely fastened to the device.
- **Check the control station for faulty components:** The control station is a complex modular system with many points of failure. Maintaining and servicing these modules is just as important as the drone.

4. Battery check:

- **Inspect charger for visible damage:** Often overlooked is the docking station for each battery pack. This component can often go for years without being properly serviced and is a surprisingly common cause of battery-related issues.
- **Inspect battery packs for bulges or leakage:** Carefully inspect each battery pack. Bulges or deformities signify leaking, and affected packs must be changed as soon as possible. Battery pack maintenance should not be overlooked, and proper care should be done to ensure that their lifespan is preserved and extended. Active packs, as well as spares, should be inspected and changed as needed.

Fig. 2.3.1. Bulging of battery

5. **Software/firmware:**

   - **Update drone software:** By updating the drone's firmware, one can be assured that everything is up to date and working properly. Keeping the system up-to-date reduces risk from security vulnerabilities and will generally mean everything runs smoother.
   - **Update control station software:** A drone's control station also relies on custom software to keep things working smoothly. Upgrading this is similar to updating the drone unit, and most control stations have built-in software update mechanisms.

6. **Reporting:** A drone technician shall report all the findings, the repair and replacement of all the components to their supervisor.

2.3.2 Tools and Equipment Required for the Repair and Maintenance of a Drone

The tools and equipment required are:

- Phillips screwdriver

Fig. 2.3.2. Phillips Screwdriver

A metal spade for separating the case and separating the heated elements of the board (if there is little experience, it would be better to use a spade made of plastic to separate the case).

- Technical tweezers

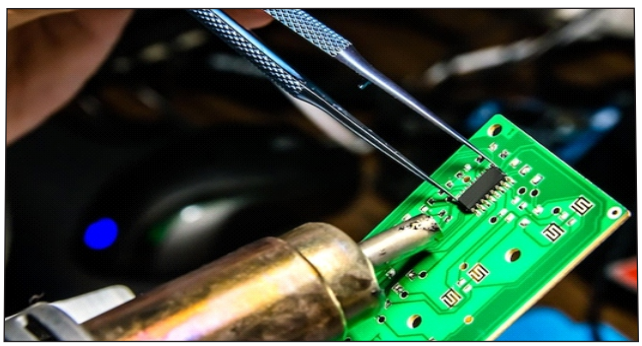


Fig. 2.3.3. Technical tweezers

- Low-power professional soldering iron with a working range from 3 to 10W.

Fig. 2.3.4. Soldering Irons

- Technical hair dryer with temperature controller for soldering microcircuits.

Fig. 2.3.5. Technical Hair Dryer

2.3.3 Assembling/Disassembling of Drone

Disassembling a Drone

The disassembling process of a drone:

- Remove the battery from the drone.
- Gently unstick the sticker from the body of the drone.

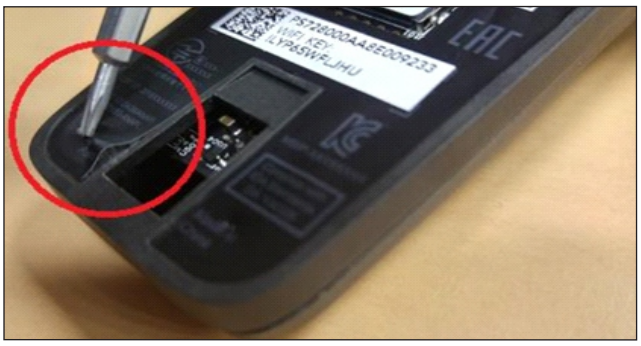
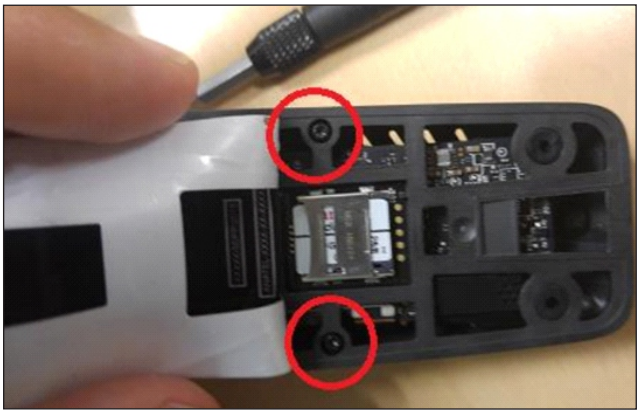


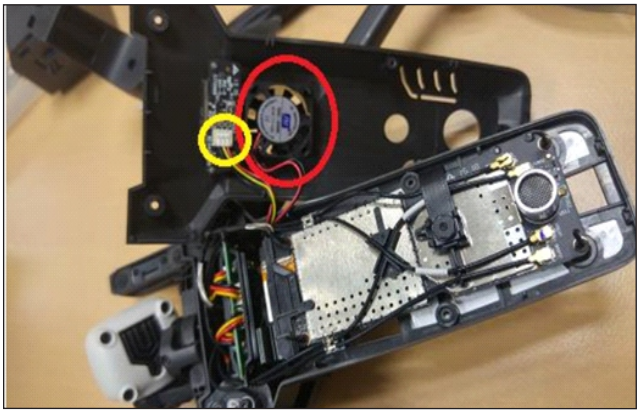
Fig. 2.3.6.

- Remove both screws under the sticker and then quickly put the sticker back in position to stop the glue from drying.

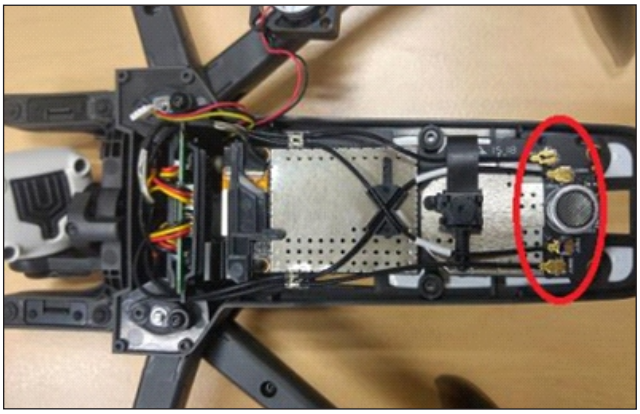


- Remove both screws from the bottom of the drone at the arms junction.

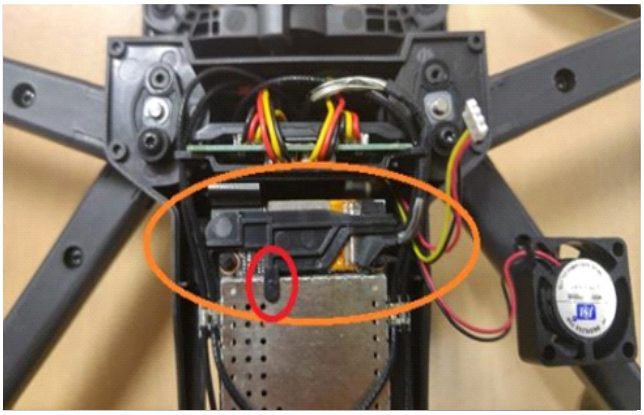
- Lift the bottom cover from the front of the drone, then push it toward the rear to remove it.
- Pull the ventilator to remove it from its slot and remove the LED connector, near the ventilator.



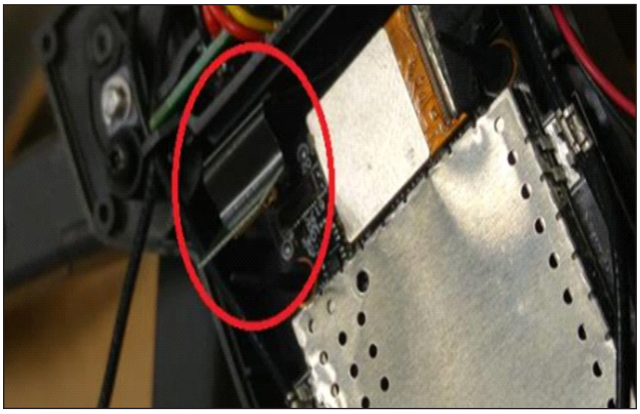
- Remove antennas from the motherboard. Antennas on the middle of the motherboard are linked to the rear feet; the side antennas are plugged into the front feet.



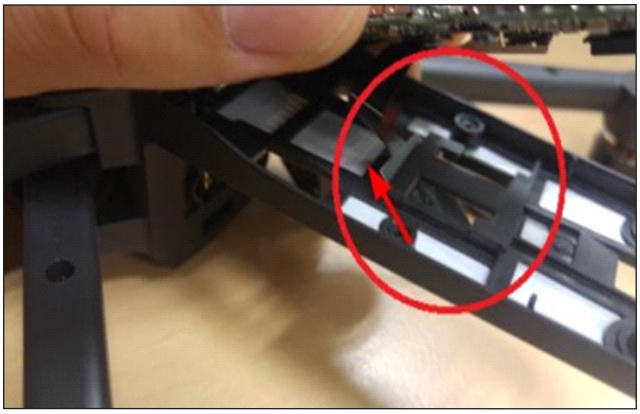
- Remove the plastic holder from the motherboard by pulling on the plastic stamp, then slide the holder.



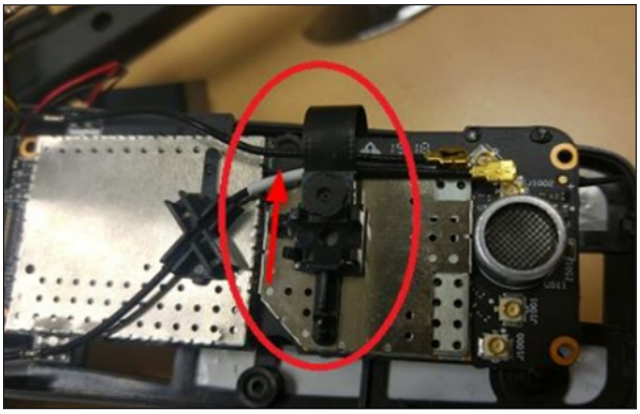
- Remove the gimbal connector from the motherboard.



- Unstick the SD slot, then remove it by pulling it through the plastic structure's hole.



- Remove the vertical camera from the support by pushing gently on it.



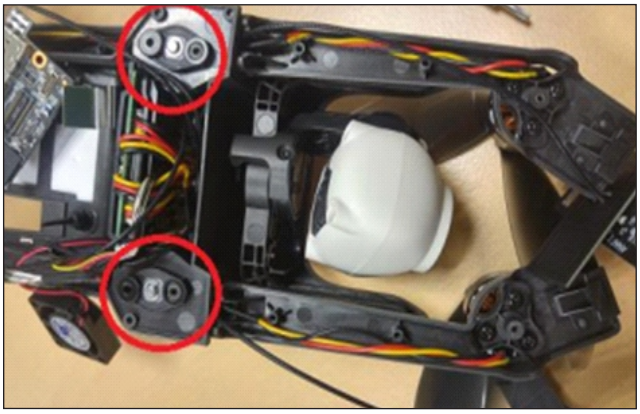
- Remove the three screws under each arm of the drone.

- Pull on the bottom cover of each arm to remove them.

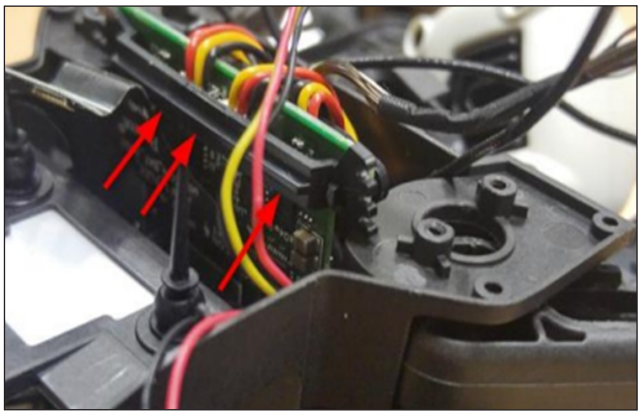
- Remove the two screws from the GPS cover (orange circle), then push on the button above located the gimbal to remove the cover (red circle).

- Remove the screws closest to the centre of the GPS card.

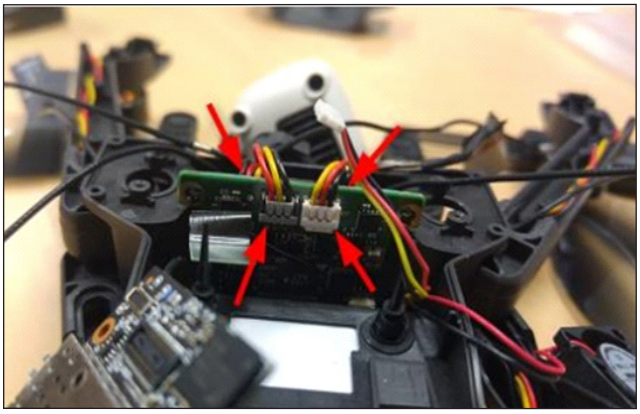
- Remove the screws holding the hinges: a screw can be found at each extremity of the GPS card. Do not forget to remove screws from the bottom of the drone as well.
- Retract the arms towards the body of the drone before removing the black plastic holder of each hinge.



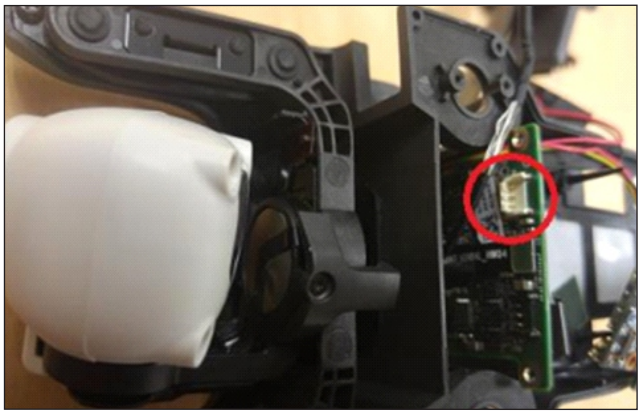
- Push the lower side of each hinge to remove them.
- Caution: a washer will fall off from each hinge when removed; ensure not to lose them.
- Remove the plastic part which holds antennas by pulling the clips on each side of the part.



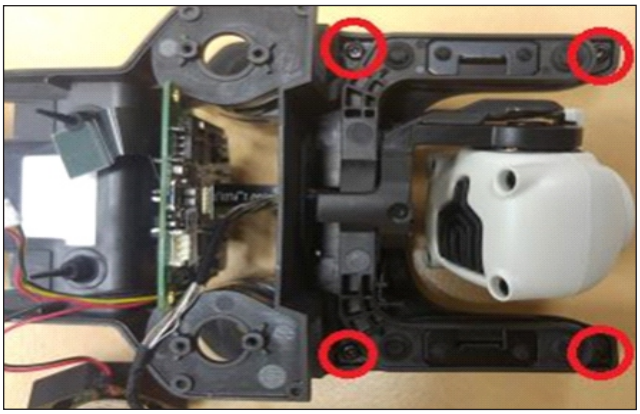
- Unplug motors by pulling the connectors out of their sockets.
- Caution: Do not pull on the wires.



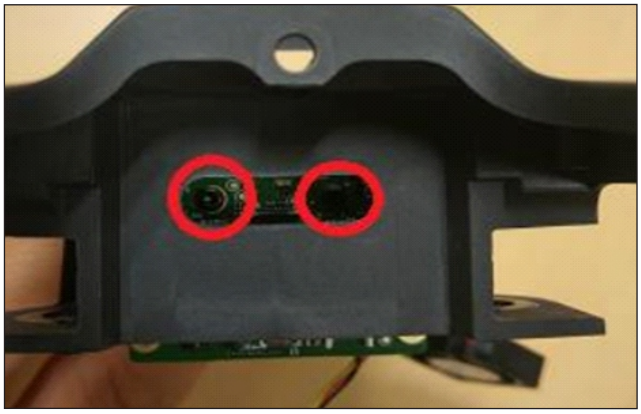
- Remove the arms carefully, one after the other: make sure that antenna cables do not get stuck with other cables.
- Unplug the gimbal's motor wire from the motor card. It is easier to remove the Gimbal before removing the motor card.



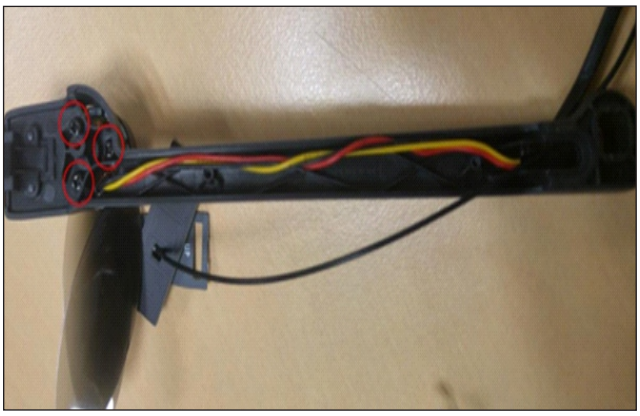
- Remove the four screws on the lower side of the Gimbal.



- There is a rubber part with holes letting wires go through to connect it from the gimbal to the motor card: the small hole is dedicated to the flex wire; the larger one is meant to receive the micro coaxial wire.
- Remove the gimbal from the body.
- Remove the three screws from the motor card; two of them are visible once one removes the plastic part between the gimbal and the motor card.



- Remove the motor card by pushing it slightly toward the bottom of the drone
- If one needs to change the motor, remove both antennas and the reflector simultaneously. Then, unscrew the three screws from under the motor to remove it and replace it.



Assembling a Drone

- Plug the ventilator into the motor card before putting the card back in its slot.
- Insert the motor card from the bottom of the drone.
- Screw the motor card to the centre body.

- The LED wire and the ventilator must be placed between the motor card and the support.

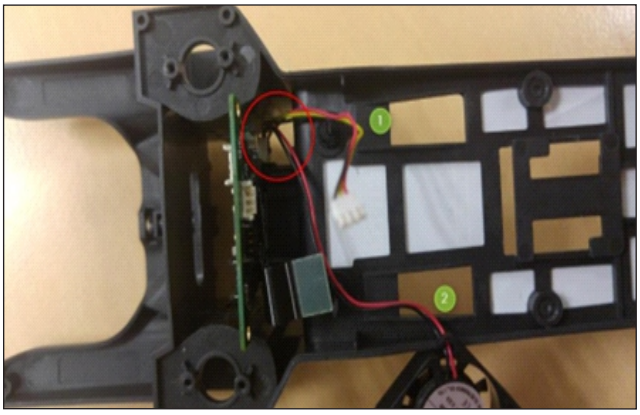
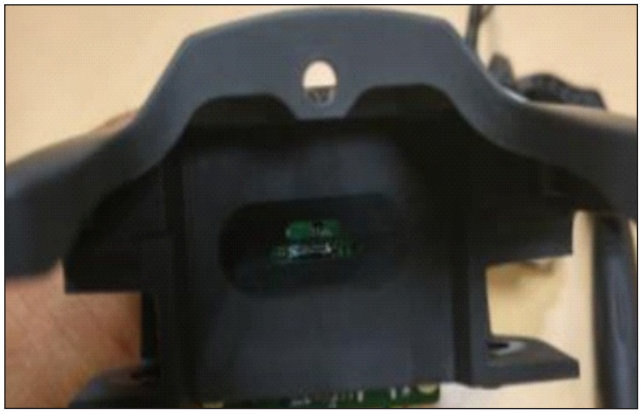


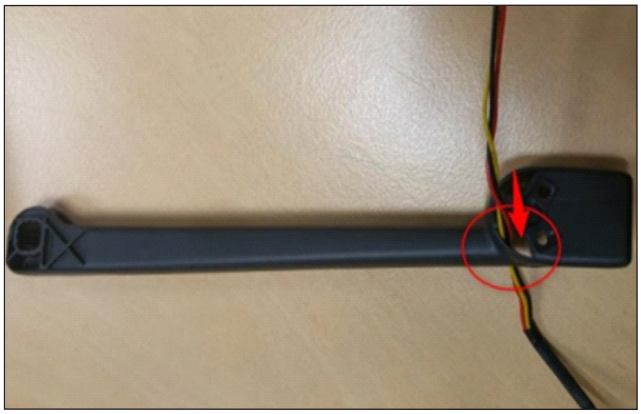
Fig. 2.3.6. LED Wire & Ventilator

- Position the rubber part back, next to the motor card (smaller hole on the top side).



Arms:

- Slide the motor wire inside the large hole of the top part of the arm.



- On the low part of the arm, insert the antenna and the reflector in their respective slots simultaneously. One can let the antenna wire-free for now.

Fig. 2.3.7. Antenna & Reflector

- Slide the antenna wire and the motor wire inside the same hole, then assemble both parts of the arm by clipping the top part inside the bottom part, then pushing the top part to the bottom part.

- Put the screws back to stick the upper and bottom parts together.
- Insert arms in their dedicated slots on the central body and insert both antenna wire and motor wire in the bottom part of the drone.

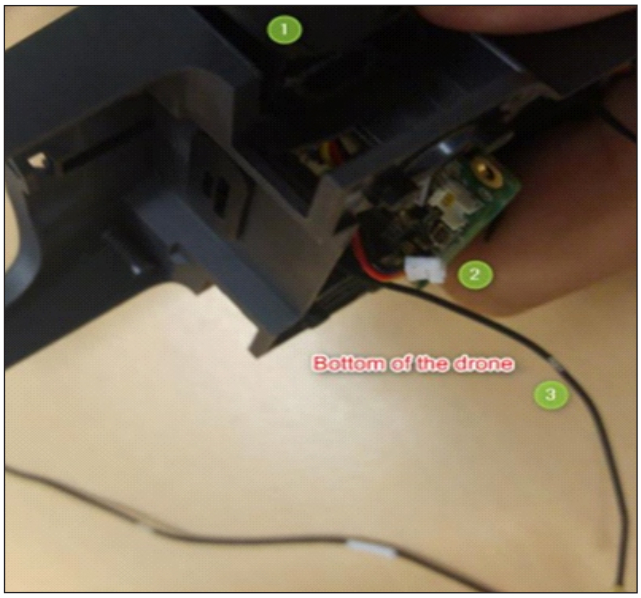
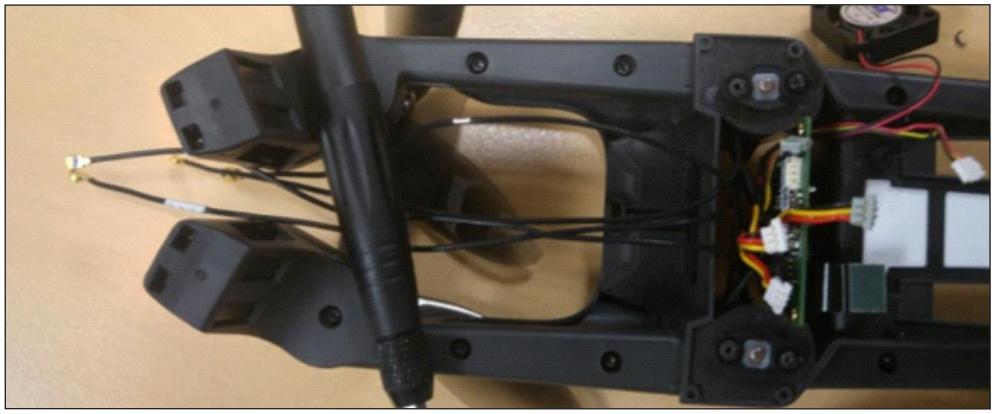


Fig 2.3.8 Arm, Motor Wire, Antenna Wire

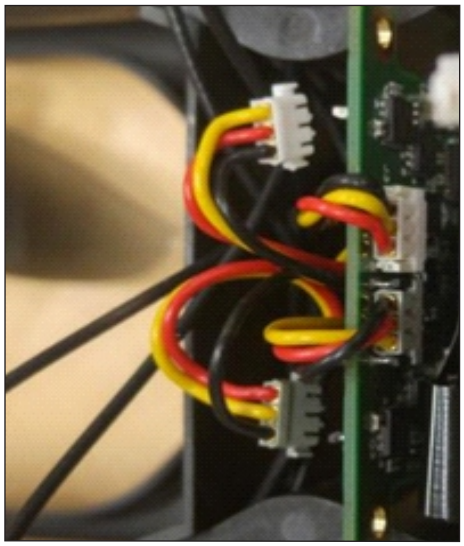
- Insert the other arm from the same side (there is no priority order between the front and back arms).
- Insert the washer between the arms and make sure it is well centred (one can use a screwdriver to align the washer through the hinge hole).
- Insert the top side hinge (the larger white part must be placed at the rear of the drone), and make sure the hinge is completely inserted by pushing on it.

- Position the plastic holder on the lower part of the hinge with the larger extremity on the rear side of the drone.
- Put the screws back on the larger extremities of the hinge (one on the top side; one on the lower side).
- Repeat to install each arm.
- Position antenna wires toward the front of the drone and the motor wires toward the back of the drone.

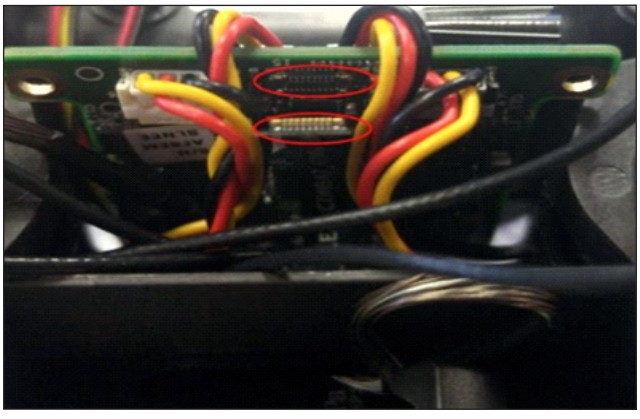


Motor wiring:

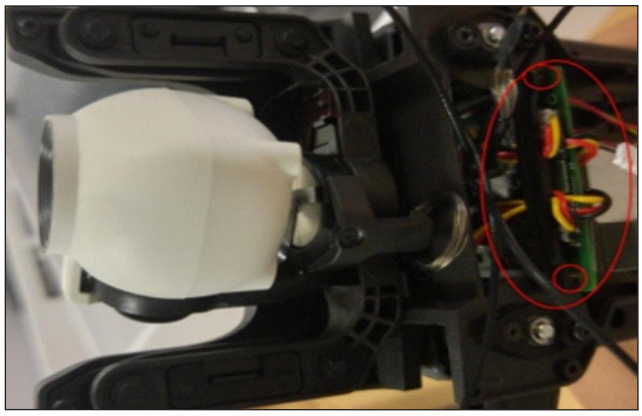
- Front motor connectors are plugged on the rear side of the motor card; rear motor connectors must be plugged on the front side of the card. Apply a torsion on the wires to plug the rear motors on the card.



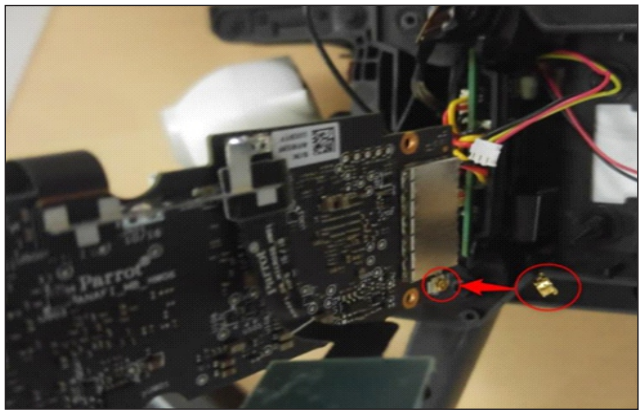
- Push wires gently toward the inside of the drone.
- Position the gimbal and slide wires through the rubber support (coaxial wire slides through the large hole and flex cable through the small one). Pull the coaxial wire gently to keep enough length to plug it.
- Screw the two screws on the front side of the gimbal before plugging the flex wire.



- Hold the drone with the gimbal oriented upward and position the first part of the motor holder (the one with the holes). Then, position the other part of the support by clipping it (the part including the antenna holders). The part with three slots must be on the right side of the drone.

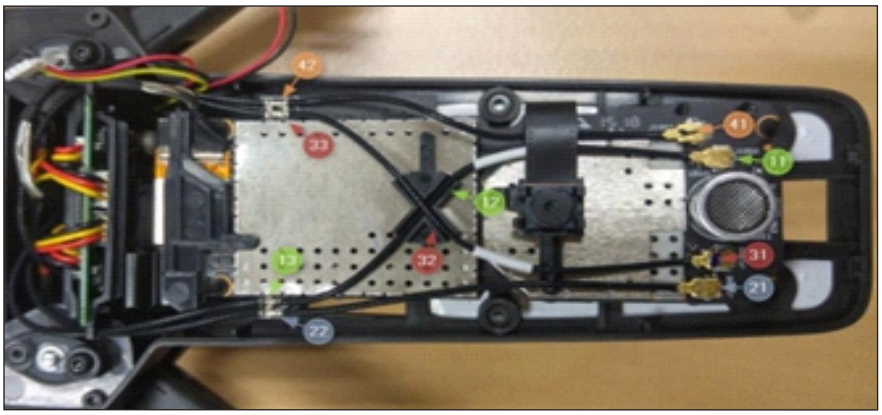


- Position the GPS card back and screw it; check that the antenna wire is not stuck. Position the GPS cover back and screw it.
- To place the motherboard back correctly, start by plugging back the GPS antenna.



- Insert the micro SD PCB through the hole on the centre body and press on it to stick it in the dedicated slot.

- Position the motherboard back in place by placing it on the two rubbers of the front of the drone, then on the two rubbers on the rear of the drone.
- Make sure antenna wires are above the LED wire and ventilator.
- Looking at the drone from the bottom, position the left side antennas, take the rear foot antenna (rear antennas have a white fool-proof device), slide it under the vertical camera and plug it into the second connector on the right side. Insert the wire into the cross-shaped slot (step 12). Finish the process by plugging the wire into the ground reminder (step 13).
- Connect the front antenna (left side) to the first connector on the left, then connect it on the ground reminder.
- Connect the right rear antenna to the second connector on the left side before inserting the wire in the cross-shaped slot and plugging it into the ground reminder.
- Finally, connect the right front antenna to the first connector on the right side, after sliding it under the vertical camera, and connect the ground reminder.



Follow those steps: 11 → 12 → 13 → 21 → 22 → 31 → 32 → 33 → 41 → 42

- Once every antenna wire has been positioned, conclude the process by plugging them into the holders near the vertical camera.
- Insert the plastic holder which holds the flex cable to the motherboard by attaching the left side first, then the right side. Make sure the stamp is positioned on the dedicated hole.
- Insert the ventilator in the dedicated slot of the bottom cover. The sticker on the ventilator must be turned toward the inside of the drone.
- Connect the LED card.
- Make sure there is enough free wire to let the gimbal move in any direction. –
- Insert the bottom cover, starting from the front side, before clipping it; make sure no wire is visible.
- Conclude the assembly process by screwing the bottom protection back.

2.3.4 Troubleshooting and Maintenance of a Drone

When it is difficult for technicians to find out the actual problem, it is advisable to run through an extensive troubleshooting routine to isolate those problematic components and repair them.

- **Record basic details:** For future reference, note down information about the technician performing the troubleshooting, the date of troubleshooting, or forward the results of the checklist to anyone else.
- **Equipment check:**
  i. Inspect all components for visible damage
  ii. Replace or repair damaged components
  iii. Ensure all components are properly fitted
  iv. Ensure all batteries are charged

1. **System reset:**
   i. Power off drone
   ii. Power off control station
   iii. Remove batteries and re-insert them
   iv. Power on drone
   v. Power on control station

2. **Calibration:**
   i. Check for local interference
   ii. Check Global Positioning System (GPS) signal
   iii. Calibrate Inertial Measurement Unit (IMU)
   iv. Calibrate compass
   v. Calibrate gimbal
   vi. Upgrade/downgrade drone firmware

3. **Motor troubleshooting:**
   i. Check propellers are installed correctly
   ii. Check motors are spinning in the correct direction

4. **Signal troubleshooting:**
   i. Check antennae are positioned correctly
   ii. Ensure radio amplifiers are installed correctly

5. **Reporting:** Send troubleshooting report to the supervisor

2.3.5 Repair and Replacement of Components of a Drone

Drone repair and maintenance is carried out to ensure all systems are in working order and that any repairs or replacements can be carried out.

- **Record basic details:** For future reference, note down information about the technician performing the repair, the date of repair, and the record of the findings.
- **Declare repairs needed:** Through troubleshooting, a technician can find the problems in a drone and determine a proper process in place for determining what repairs are needed.
- **Gather tools and equipment:** The tools and equipment required for the repair and maintenance of a drone should be gathered.
- **Check spare components:** One should ensure they have all the spare components required to perform the repairs.
- **Review safety procedure:** The technician should be fully aware of the safety procedure for working with electronics and drone systems.

1. Repairing Components

i. **Service chassis:** The largest component of a drone, the chassis, is complicated to replace. The process of fully disassembling chassis and installing a new shell is:

- Remove drone battery
- Remove all propellers
- Detach non-fixed components from the frame
- Remove all screws from the frame
- Check the underside of the frame for additional components
- Detach non-soldered wires from inside frame
- Transfer components from old frame to new (if absent)
- Route wires through a new frame
- To re-assemble with the new frame, follow the sub-task checklist in reverse. Be sure to refer to the manual for proper wiring guides and advice on how to route cables inside of the shell.

2. Service propellers: Before servicing propellers, be sure that the system is completely shut down and the motors are not connected to any power source. The steps are:

- Power off the drone unit
- Disconnect the battery
- Be sure all motors are run-down completely
- Remove propellers

Either fix the propeller if possible or assemble a new one. The assembling process is:

- Remove damaged propellers
- Observe propeller orientation
- Retrieve matching replacement
- Install new propeller

3. **Service motors:** Drone motor replacement may appear to be a difficult procedure, but it is actually rather simple. Because there is less area to work with, motor replacement on units with broader bodies is easier than on those with smaller, more packed frames. Always keep in mind which way the motors are rotating. The proper rotation of the propellers is required for multi-propeller flying. The steps are:
   - Power off the drone unit
   - Disconnect the battery
   - Be sure all motors are run-down completely
   - Remove propellers
   - Disassemble frame
   - Disconnect component wires
   - Identify faulty motors
   - Make a note of which direction each motor is spinning
   - Install new motor

4. **Service gimbal:** The steps are:
   - Power off the drone unit
   - Disconnect the battery
   - Be sure all motors are run-down completely
   - Remove propellers
   - Unscrew gimbal frame
   - Remove the camera and additional connections
   - Remove defective gimbal
   - Align new gimbal
   - Screw the gimbal onto the frame
   - Reconnect additional components

i. **Service batteries:** Batteries are relatively simple to replace. Their installation is generally very straightforward and often will not even require additional tools. The process is:

- Power off the drone unit
- Be sure all motors are run-down completely
- Remove propellers
- Disconnect the battery
- Check new battery for damage
- Connect new battery

ii. **Service Electronic Speed Controller (ESC):** The Electronic Speed Controller (ESC) is the component that translates the pilot's commands into instructions that the motors can understand and use to control movement. The ESC is connected to the mainboard from which it receives power and signal information. In most drone systems, there is one ESC for each motor. The steps are:

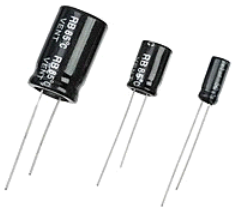
- Turn drone upside-down
- Place drone on firm, flat surface
- Remove main casing screws
- Carefully disconnect internal wiring
- Open drone frame
- Make a note of which motor connections are wired to the old ESC board
- De-solder all motor wires from old ESC board
- Unscrew motors
- Remove motors
- De-solder ground and voltage wires of old ESC board
- Unscrew the old ESC board from the mainboard
- Disconnect the old ESC board from the mainboard
- Install new ESC module

iii. **Service Wiring:** The steps to be followed are:

- Turn drone upside-down
- Place drone on firm, flat surface
- Remove main casing screws
- Carefully disconnect internal wiring
- Open drone frame
- Check each connection point

Exercise

1. Explain in brief the direct current, alternating current, and electric circuit.
2. Identify and match the following electric components:

	Capacitors
	Resistors
	Diodes
	Transistors

3. List down the main components of a drone.
4. List down tools and equipment required for the repair and maintenance of a drone.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=FEBHwzUJ4yU

Preliminary Check on a Drone

https://www.youtube.com/watch?v=43PZ7izoFGs

Tools and Equipment Required for the Repair and Maintenance of a Drone

https://www.youtube.com/watch?v=OOvqVDjFmIs

Assembling / Disassembling of Drone

https://www.youtube.com/watch?v=lAH8wrZnkdk

Troubleshooting and Maintenance of a Drone

https://www.youtube.com/watch?v=nqUl7ChTcek

Repair and Replacement of Components of a Drone

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N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ESSCI
Skilling India in Electronics

3. Soft Skills and Work Ethics

Unit 3.1 - Effective Communication and Coordination at Work

Unit 3.2 - Working Effectively and Maintaining Discipline at Work

Unit 3.3 - Maintaining Social Diversity at Work

ELE/N9905

Key Learning Outcomes

By the end of this module, 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 3.1: Effective Communication and Coordination at Work

Unit Objectives

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

1. Work effectively at the workplace.
2. Demonstrate practices related to gender and PwD sensitization.

3.1.1 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

Fig. 3.1.1 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:

Fig. 3.1.2 Benefits of Workplace Ethics

3.1.2 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

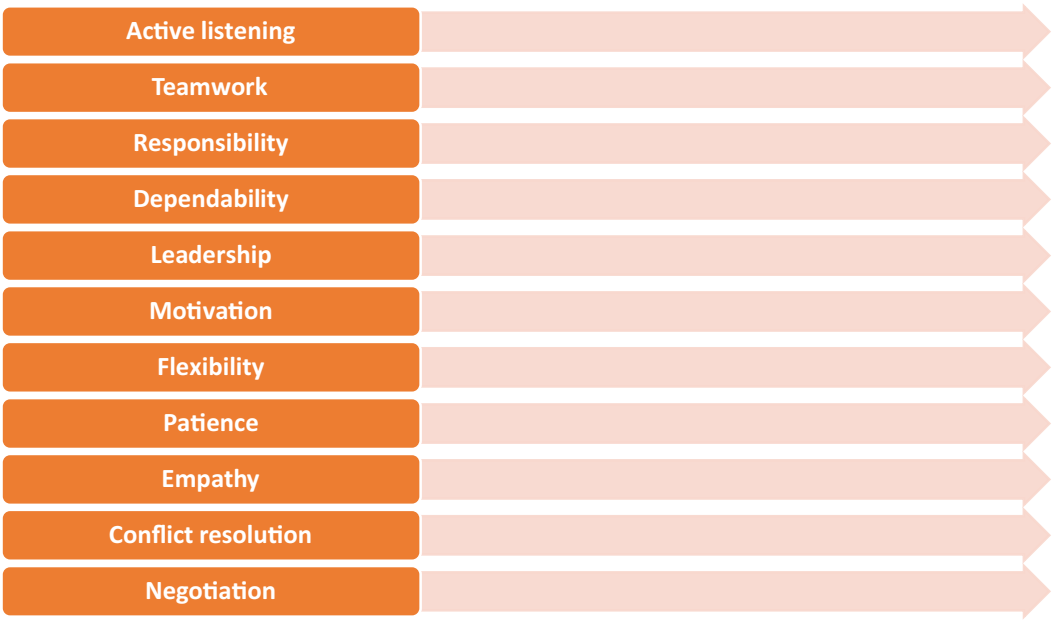

Fig 3.1.3 Examples of Interpersonal Skills

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 communication is the key to working in a team environment and working collectively to achieve shared goals. Following are the interpersonal communication skills that vital for success at work:

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.

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.

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.

Notes

UNIT 3.2: Working Effectively and Maintaining Discipline at Work

Unit Objectives

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

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

3.2.1 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 action to take while initiating disciplinary action

With well-defined and enforced disciplinary rules, an organization can avoid various safety, security, rupational risks

Fig 3.2.1 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:

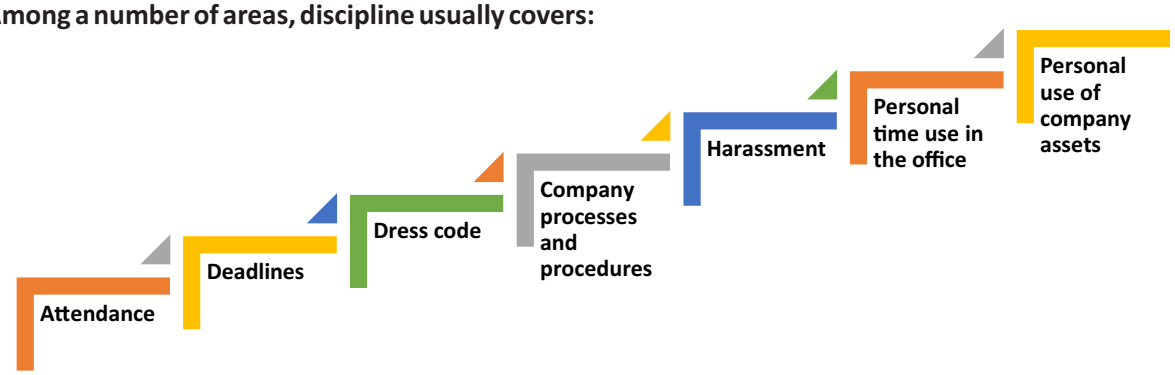

Fig 3.2.2 Examples of Workplace Discipline

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.

3.2.2 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.

3.2.3 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:

1. **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.

2. **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.

3. **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.

4. **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.

3.2.4 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.

3.2.5 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.

3.2.6 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.

3.2.7 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.

3.2.8 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.

3.2.9 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 3.3: 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 sensitivity and equality.
2. Discuss ways to create sensitivity for different genders and Persons with Disabilities (PwD).

3.3.1 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 3.3.1 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.

3.3.2 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.4. Basic Health and Safety Practices.

Notes

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Corporation
Transforming the skill landscape

ESSCI
Skilling India in Electronics

4. Basic Health and Safety Practices

Unit 4.1 - Workplace Hazards

Unit 4.2 - Fire Safety

Unit 4.3 - First Aid

Unit 4.4 - 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 4.1: Workplace Hazards

Unit Objectives

By the end of this unit, 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. Explain safe handling of tools and Personal Protective Equipment to be used.

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.1.4 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. 4.1.1. Prohibition Warning 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. 4.1.2. Mandatory Signs

3. Warning Signs

Warning signs are the safety information communication signs. They are shown as a 'yellow colour triangle'.

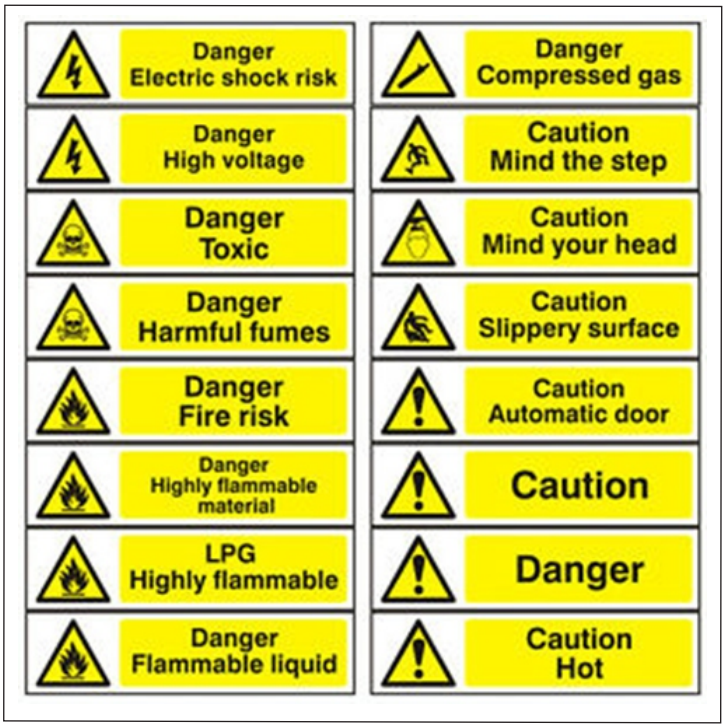


Fig. 4.1.3. Warning Signs

4. Emergency Signs

The location or routes to emergency facilities are indicated by emergency signs. These signs have a green backdrop with a white emblem or writing. These signs convey basic information and frequently refer to housekeeping, company procedures, or logistics.

Fig. 4.1.4. Emergency Signs

4.1.5 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.

4.1.6 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.

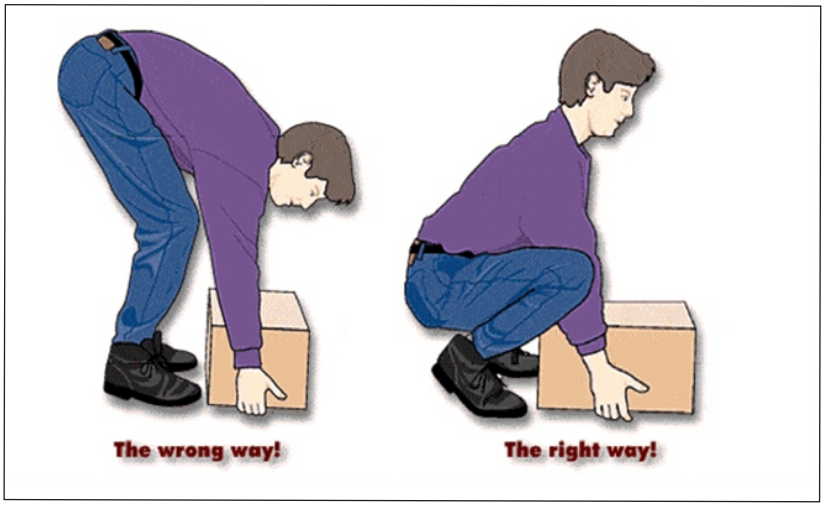


Fig. 4.1.5. Lifting loads technique

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.

Technique	Demonstration
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.	

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	

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 4.1.1 Techniques for lifting heavy objects

[3]*Source:https://www.braceability.com/blogs/articles/7-proper-heavy-lifting-techniques*

4.1.7 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:

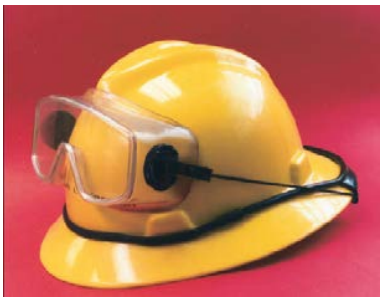
- Never carry tools up or down a ladder in a way that makes it difficult to grip them. Instead of being carried by the worker, tools should be lifted up and down using a bucket or strong bag.
- Tools should never be tossed but should be properly passed from one employee to the next. Pointed tools should 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.

4.1.8 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 from the following injuries are:

Injury Protection	Protection	PPE
Head Injury Protection	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 Protection	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 Protection	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.	

Protection 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 Protection	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 Protection	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 4.1.2 Personal protective equipment

Notes

UNIT 4.2: Fire Safety

Unit Objectives

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

1. List the types of fire and fire extinguishers.

4.2.1 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.

4.2.2 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.

4.2.3 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 soon. 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 4.3: 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.

4.3.1 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.

4.3.2 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.

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4.3.3 Treating Minor Cuts and Scrapes

Steps to keep cuts clean and prevent infections and 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.

4.3.4 Heart Attack

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 4.4: 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 pollution and ways to minimize them.
3. Elaborate on electronic waste disposal procedures.

4.4.1. 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.

4.4.2 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.

- **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.
- **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.

4.4.3 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.

4.4.4 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.

4.4.5 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

Annexure of QR Codes for Drone Service Technician

Chapter No.	Unit No.	Topic	Page No.	QR Code Links	QR code (s)	Video Duration
Chapter 1: Introduction and Orientation to the Role of a Drone Service Technician	Unit 1.2 - Introduction of Drones	1.2.1 Drone Introduction	12	https://www.youtube.com/watch?v=s3OWevhrXpo&ab_channel=DeepakTechTimes	Drone Introduction	00:03:57
		1.2.2 Types of Drones		https://www.youtube.com/watch?v=7qnm_okFRnE	Types of Drones	00:06:29
		1.2.4 Industry Use Cases for Drones		https://www.youtube.com/watch?v=PxQckEYjN-k	Industry Use Cases for Drones	00:11:44
		1.2.5 Certification and Compliance		https://www.youtube.com/watch?v=kBH2D2sOkrA	Certification and Compliance	00:08:13
		1.2.6 Registering a Drone		https://www.youtube.com/watch?v=-FYGvQeU-cY&ab_channel=ManWomanAndDog	Registering a Drone	00:12:01
Chapter 2: Routine Repair and Maintenance of a Drone	Unit 2.1 - Basic Principles of Electricity	2.1.1 Electric Current	32	https://www.youtube.com/watch?v=MysDRKXDp0A	Electric Current	00:12:17
		2.1.2 Electric Circuit		https://www.youtube.com/watch?v=ouOJW_ozx6Q	Electric Circuit	00:17:55
		2.1.3 Eectronic Components		https://www.youtube.com/watch?v=iHmSj6v7LOE	Eectronic Components	00:19:27
	Unit 2.2 - Take off and Landings of Drone	2.2.1 Components of a Drone	37	https://www.youtube.com/watch?v=OUHSWBQg3rI&ab_channel=OmHobby	Components of a Drone	00:15:31

Annexure of QR Codes for Drone Service Technician

Chapter No.	Unit No.	Topic	Page No.	QR Code Links	QR code (s)	Video Duration
		2.2.2 Drone Controller		https://www.youtube.com/watch?v=Cf2K_VUoGZA	Drone Controller	00:17:30
	Unit 2.3 - Repair and Maintenance of Drones	2.3.1 Preliminary Check on a Drone	60	https://www.youtube.com/watch?v=FEBHwzUJ4yU	Preliminary Check on a Drone	00:05:43
		2.3.2 Tools and Equipment Required for the Repair and Maintenance of a Drone		https://www.youtube.com/watch?v=43PZ7izoFGs	Tools and Equipment Required for the Repair and Maintenance of a Drone	00:10:37
		2.3.3 Assembling /Disassembling of Drone		https://www.youtube.com/watch?v=OOvqVDjFmIs	Assembling / Disassembling of Drone	00:23:06
		2.3.4 Troubleshooting and Maintenance of a Drone		https://www.youtube.com/watch?v=lAH8wrZnkdk	Troubleshooting and Maintenance of a Drone	00:05:52
		2.3.5 Repair and Replacement of Components of a Drone		https://www.youtube.com/watch?v=nqUl7ChTcek	Repair and Replacement of Components of a Drone	00:09:00

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