# SMARTPHONE TECHNICIAN CUM APP TESTER

## NSQF LEVEL - 3

## TRADE THEORY

**SECTOR :** ELECTRONICS & HARDWARE

**(As per revised syllabus July 2022 - 1200 Hrs)**



Directorate General of Training

**DIRECTORATE GENERAL OF TRAINING**
**MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP**
**GOVERNMENT OF INDIA**

**NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI**

**Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032**

**Sector : Electronics & Hardware**

**Duration : Six Months**

**Trade : Smartphone Technician Cum App Tester - Trade Theory - NSQF level - 3 (Revised 2022)**

**Developed & Published by**

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# FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Smartphone Technician Cum App Tester - Trade Theory - NSQF Level - 3 (Revised 2022) in Electronics & Hardware Sector.** The NSQF Level - 3 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Addl.Secretary / Director General (Training)
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

# PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of Federal Republic of Germany. The prime objective of this Institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

**Chennai - 600 032** **EXECUTIVE DIRECTOR**

# ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Theory)** for the trade of **Smartphone Technician Cum App Tester** under the **Electronics & Hardware** Sector for ITIs.

**MEDIA DEVELOPMENT COMMITTEE MEMBERS**

| | | |
|---|---|---|
| Smt. V. Monisha | - | Junior Training Officer,<br>Govt. I.T.I, Arakkonam. |

**NIMI - CO-ORDINATORS**

| | | |
|---|---|---|
| Shri. Nirmalya Nath | - | Deputy Director<br>NIMI - Chennai - 32 |
| Shri. S. Gopalakrishnan | - | Assistant Manager,<br>NIMI, Chennai - 32 |

NIMI records its appreciation of the Data Entry, CAD, DTP Operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks, the invaluable efforts rendered by all other staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

# INTRODUCTION

**TRADE PRACTICAL**

The trade practical manual is intented to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the course of the **Smartphone Technician Cum App Tester** Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 3 (Revised 2022) syllabus are covered.

This manual is divided into ten modules. The ten modules are given below

| | |
|---|---|
| Module 1 | Safety |
| Module 2 | Basic Electronics |
| Module 3 | Multimedia Handsets & Troubleshooting |
| Module 4 | Functions of Smartphone |
| Module 5 | Repair & Replacement of Mobile Phone Components |
| Module 6 | Software in Smartphone |
| Module 7 | Troubleshooting in Smartphone |
| Module 8 | Tablet and its Functions |
| Module 9 | Perform App Testing in Smartphone |
| Module 10 | Basic Security Features and Settings |

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI looks forward to the suggestions from the experienced training faculty for improving the manual.

**TRADE THEORY**

The manual of trade theory consists of theoretical information for the Course of the **Smartphone Technician Cum App Tester** Trade Theory NSQF LEVEL - 3 (Revised 2022) in Construction. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 3 (Revised 2022) syllabus on TradeTheory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indications about the corresponding practical exercises are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise at least one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not for the purpose of self learning and should be considered as supplementary to class room instruction.

## CONTENTS

# LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

| Sl.No. | Learning / Outcome | Refer Ex:No |
|---|---|---|
| 1 | Identify and check basic electronic components for their functioning following safety precautions. | 1.1.01 - 1.2.17 |
| 2 | Identify different sections of various mobile phones and explain concept of Mobile Network. | 1.3.18 - 1.3.25 |
| 3 | Identify defects in Multimedia handset (Non-android based), replace faulty components and perform testing. | 1.3.26 - 1.3.29 |
| 4 | Disassemble and assemble various Smartphones, identify different types of ICs and perform basic editing in different apps, OS installation, reboot procedure, password cracking, etc | 1.4.30 - 1.4.35 |
| 5 | Identify defects in Smartphones, replace faulty components and perform testing. | 1.5.36 - 1.5.44 |
| 6 | Perform removing of virus, Install firmware, encryption/ decryption, use third party software, flash different android dead phones etc. | 1.6.45 - 1.6.52 |
| 7 | Troubleshoot Software problems using internet, backup data, update and provide hard drive solutions. | 1.6.53 & 1.6.54 |
| 8 | Trace the PCB through jumper/ schematic diagrams, repair track using jumpering techniques, Perform flashing and troubleshooting of high end software. | 1.7.55 - 1.7.60 |
| 9 | Disassemble and assemble various Tablets, identify defects, replace faulty components and perform testing. | 1.8.61 - 1.8.66 |
| 10 | Identify functionality of different types of apps, their settings, parameters & various sources. | 1.9.67 |
| 11 | Test different functional parameters such as purpose, performance, storage, compatibility of different mobile apps. | 1.9.68 & 1.9.69 |
| 12 | Check different functionality parameters of mobile Apps such as memory leakage, load, backup, power consumption etc. | 1.9.70 |
| 13 | Examine defects in smartphone/ software, using Graphical User Interface. | 1.9.71 & 1.9.72 |
| 14 | Set & test network connections, check SD Card Interactions, mobile App settings on different platforms. | 1.10.73 & 1.10.74 |
| 15 | Comply basic security features of mobile app testing. | 1.10.75 & 1.10.76 |

# SYLLABUS

| Duration | Reference Learning Outcome | Professional Skill (Trade Practical) (With indicative hour) | Professional Knowledge (Trade Theory) |
|---|---|---|---|
| Professional Skill 48 Hrs;<br><br>Professional Knowledge 12 Hrs | Identify and check basic electronic components for their functioning following safety precautions. (Maps NOS: ELE/N1002) | 1 Visit to various sections of the institute and identify location of various installations. (07 hrs)<br>2 Identify safety signs for danger, warning, caution & personal safety message. (04 hrs)<br>3 Perform Use of Personal Protective Equipment (PPE). (06 hrs)<br>4 Perform elementary first aid. (03 hrs)<br>5 Perform Preventive measures for electrical accidents & steps to be taken in such accidents. (05 hrs)<br>6 Perform Use of Fire extinguishers. (04 hrs) | Familiarization with the working of Industrial Training Institute system.<br>Importance of safety and precautions to be taken in the industry/ shop floor.<br>Introduction to PPEs.<br>Introduction to First Aid.<br>Importance of housekeeping & good shop floor practices.<br>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. (06 hrs) |
| | | 7 Identify various electronic components. (02 hrs)<br>8 Check Value of resistance & capacitance by using appropriate procedures. (03hrs)<br>9 Identify conductors, Semiconductors & Insulators. (02 hrs)<br>10 Identify all types of diodes & verify their characteristics. (02 hrs)<br>11 Perform testing of Transistor & verify their characteristics. (02 hrs)<br>12 Demonstrate use of transistor as a switch and amplifier. (03 hrs)<br>13 Identify various transformers & checking procedure of step-up & step-down transformer. (02 hrs)<br>14 Identify various types of Multimeters. (02 hrs).<br>15 Perform checking of all components using Multimeter. (02 hrs)<br>16 Perform Soldering & de-soldering of various Electronic components. (02 hrs)<br>17 Identify different types of digital ICs. (02 hrs) | Introduction to the trade and future scope.<br>Overview of current, Voltages, Resistance (including color code), Conductors, semiconductors, insulator, Diodes (PN Junction, Zener, LED, Varactor), Rectifiers, Various types Capacitors (including color code), Transistors (Transistor as a switch and amplifier)<br>Concept of open and close circuit, Brief knowledge about RELAY,<br>Overview of Transformer (step up and step down);<br>Overview of Multimeter (Analog & Digital), Soldering technique,<br>numbering system (Binary, Hexadecimal, BCD),<br>Overview of Digital IC & T-T-L,<br>Concept of CMOS<br>Familiarization of different types of Logic gates. (basic & universal gates) (06 hrs) |

| | | | |
|---|---|---|---|
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Identify different sections of various mobile phones and explain concept of Mobile Network.<br>(Maps NOS: ELE/N8107) | 18 Demonstrate block diagram, circuit diagram of basic mobile phone. (03 hrs)<br>19 Disassemble and assemble different mobile phones. (04 hrs)<br>20 Identify basic faults in different mobiles. (02 hrs)<br>21 Identify GSM/ WCDMA mobile handset and check functionality. (03 hrs)<br>22 Identify Network connection problem and solve it. (01 hr)<br>23 Practice lock/ unlock of SIM and check mobile IMEI number. (01 hr)<br>24 Demonstrate working process of USB and Ethernet port. (03 hrs)<br>25 Demonstrate different types of network/ data cables. (01hr) | History of Mobile Phone and common features of mobile phone (DCT 3, 4, BB 5 etc.).<br>Basics of Mobile Communication<br>Familiarization with generation of mobiles viz., GSM/CDMA/ WCDMA etc.<br>Mobile phone structure, Frequency, Channels, GPS, EDGE, HSPA.<br>Overview of SIM & IMEI numbers.<br>Introduction of GPRS, Bluetooth & Infrared technology and working principle.<br>Circuit Tracing of Different Section of Mobile Phone.<br>Description of USB, Ethernet port and different types of network/ data cables.<br>Concept of mobile Network, LAN, MAN, WAN.<br>2G/3G/4G network protocols. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Identify defects in Multimedia handset (Non-android based), replace faulty components and perform testing.<br>(Maps NOS: ELE/N8107) | 26 Identify different multimedia handsets. (05 hrs)<br>27 Identify the different functional areas/ blocks of motherboard of basic multimedia handset. (04 hrs)<br>28 Perform replacement of components viz., speaker, mic, vibrartor, earphone connector, charging connector, data cable connector, etc. (04 hrs)<br>29 Identify problems and replace display and keypad of basic mobile handset. (05 hrs) | Concept of multimedia. Battery system & different type of Cells/ Batteries uses.<br>Circuit Diagram and block diagram of basic multimedia handset and different types of antenna used in handsets.<br>Standard safety precautions while repairing handsets.<br>PCB and concept of its connections.<br>Overview and working process of speaker, mic, vibrartor, earphone connector, charging connector, data cable connector.<br>Concept of Display change procedure.<br>Concept of keypad change procedure. (06 hrs) |
| Professional Skill 48 Hrs;<br><br>Professional Knowledge 12 Hrs | Disassemble and assemble various Smartphones, identify different types of ICs and perform basic editing in different apps, OS installation, reboot procedure, password cracking, etc.<br>(Maps NOS: ELE/N8107) | 30 Identify popular applications used in android mobile system. (10 hrs)<br>31 Demonstrate downloading procedure, registration procedure via banking, sharing internet via hotspot, file sharing procedure of | Difference between SmartPhone and basic mobile phone.<br>Study various part of Smartphone architecture.<br>Overview of mobile operating system and types of OS. |

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|---|---|---|---|
| | | Bluetooth, data cable, OTG, card reader, etc. (10 hrs)<br>32 Perform assembling and disassembling of Smartphone using different tools. (10 hrs)<br>33 Demonstrate process of password cracking. (08 hrs)<br>34 Install various Operating Systems (OS) in mobile phones. (05 hrs)<br>35 Perform Reboot procedure. (05 hrs) | Concept of Android and windows technology in mobile system.<br>Basic features of Android & windows and its applications.<br>Functions of Smartphone components.<br>Concept of Wi-Fi.<br>Downloading through internet, share with Blue tooth, share internet via hotspot, Data cable & Card reader, concept of OTG, NFC.<br>Study Various tools and equipment used in Smartphone repairing.<br>Concept of different type of IC that is used in Smartphone (windows and android).<br>Different kind of application that is used in windows and android.<br>Android Mobile recovery procedure through coding.<br>Windows mobile recovery procedure through coding.<br>Techniques of crack password code of windows and android mobile phone.<br>Procedure of reboot (window and android). Overview of BTS, MTS (12 hrs) |
| Professional Skill 48 Hrs;<br><br>Professional Knowledge 12 Hrs | Identify defects in Smartphones, replace faulty components and perform testing.<br>(Maps NOS: ELE/N8107) | 36 Practice setting different parameters for proper use of various machine viz., blower, DC power supply, charging booster machine etc. (07 hrs)<br>37 Demonstrate SMD rework station and BGA IC Reballing and Installing. (07 hrs)<br>38 De-solder and remove the BGA IC from the PCB and clean the solder from the bottom of the IC. (08 hrs)<br>39 Practice use of different soldering iron (10W & 25W) and de-soldering wire or wick. (06 hrs)<br>40 Replace various ICs on mobile handsets. (05 hrs)<br>41 Identify damages from ingress of water and practice to resolve. (04 hrs)<br>42 Analyze the hanging issues and practice to resolve it. (03 hrs) | Testing of various parts and components that are used in mobile phone for hardware repairing.<br>Recognize and troubleshoot common handset problems like hanging issues, camera problems.<br>Study various radiation<br>Levels of Smartphone.<br>Study Compliance standards for mobile phones in India.<br>Study Mobile phone hardware troubleshooting procedure (hanging, USB charging & touch sensor problems).<br>Concept of Ultrasonic cleaning.<br>Overview of SMD rework station<br>Overview of BGA, BGA Soldering.<br>IC Reballing and Installation.<br>Concept of Power failure of mobile phone and process to solve it. (dead handsets) (12 hrs) |

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|---|---|---|---|
| | | 43 Perform replacement of touch sensor and finger print sensor in Smartphones. (04 hrs)<br>44 Replace camera of faulty Smartphones. (04 hrs) | |
| Professional Skill 48 Hrs;<br><br>Professional Knowledge 12 Hrs | Perform removing of virus, Install firmware, encryption/ decryption, use third party software, flash different android dead phones etc. (Maps NOS: ELE/N8107) | 45 Use different flashing box and flashing tools for flashing software. (07 hrs)<br>46 Identify different tools and boxes as per specific handsets. (07 hrs)<br>47 Identify & select software for various handsets, used for security, locking & blocking adds. (07 hrs)<br>48 Perform process of locking and unlocking system. (07 hrs)<br>49 Perform encryption and decryption of password in mobile phone. (05 hrs)<br>50 Apply procedure of flash android specific software for working phone with Odin. (05 hrs)<br>51 Apply procedure of flash android specific software for dead phone with UFI. (05 hrs)<br>52 Apply procedure of flash Android phone with MTK, SPD, Qualcomm etc. Flash tool. (05 hrs) | Concept of third party software.<br>Procedure of removing virus from infected codes.<br>Knowledge about locking system (lock & unlock).<br>Role of firmware in a mobile handset.<br>Steps to install a new firmware.<br>Overview of encryption and decryption of password in mobile phone.<br>Flashing of various brands of handsets. (12 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Troubleshoot Software problems using internet, backup data, update and provide hard drive solutions. (Maps NOS: ELE/N8107) | 53 Create & restore backup data from mobile phone to a computer. (10 hrs)<br>54 Establish secure Wi-Fi protection from unauthorized users. (08 hrs) | Use of internet for trouble shooting faults.<br>Overview of handling troubleshooting procedure.<br>Steps to update the software of popular mobiles and create a backup of data to a computer.<br>Knowledge of defragmentation of hard drive.<br>Defragmentation of hard drive.<br>Wi-Fi protection. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Trace the PCB through jumper/ schematic diagrams, repair track using jumpering techniques, Perform flashing and troubleshooting of high end software. (Maps NOS: ELE/N8107) | 55 Disassemble mobile phone and place it on a PCB holder. (07 hrs)<br>56 Check PCB tracks using multimeter and find the fault/ missing tracks that need jumper. (02 hrs)<br>57 Perform soldering of jumper wire by applying liquid soldering flux. (03 hrs) | Circuit Diagram Reading<br>Circuit tracing, Description of Jumpering techniques and solutions.<br>Study of Phone Upgradation.<br>Flashing Map Problem.<br>Concept of heat-sink and working principle. (06 hrs) |

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|---|---|---|---|
| | | 58 Check the continuity of jumper using multimeter. (02 hrs)<br>59 Identify and practice troubleshooting of network issues. (01 hr)<br>60 Demonstrate working process of heat-sink. (03 hrs) | |
| Professional Skill 48 Hrs;<br><br>Professional Knowledge 12 Hrs | Disassemble and assemble various Tablets, identify defects, replace faulty components and perform testing.<br>(Maps NOS: ELE/N8107) | 61 Identify various Tablets and perform installation of different software & different Operating Systems. (06 hrs)<br>62 Create & restore backup data from tablet to a computer. (06 hrs)<br>63 Identify Different connectors and sockets. (06 hrs)<br>64 Repair motherboard and hard disk of tablet. (05 hrs)<br>65 Identify & indicate ICs, test the damaged and working component, detect fault using multimeter. (05 hrs)<br>66 Check different sections viz., SIM detection, mic, speaker, camera, Bluetooth, wi-fi section, touch screen section, Display light problem, Touchpad problem, Finger prints module and replace components. (20 hrs) | Introduction to Tablet type Computer.<br>Procedures of Assembling and Dissembling Tablet.<br>Functions and block diagrams of Tablet. Study of parts of Tablet. Working of Tablet Motherboard. Identification of ICs detail and its functions. Damaged and working components. Study of Initial failure identification procedure.<br>Overview of troubleshooting & replacing methods of sections like SIM detection, mic , speaker, Bluetooth, wi-fi section, touch screen section, etc. (12 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Identify functionality of different types of apps, their settings, parameters & various sources. (Maps NOS: ELE/N8104) | 67 Install and check functionality of different govt. Promotional app. (18 hrs) | Introduction to different types of Mobile Apps – Native (one time download from app store), web (Every time downloaded from Mobile Bowser), Study of Importance of Mobile App Testing – Phones getting truly smarter, more mobile usages, faster networks.<br>Introduction to app testing and sources of app (such as Play store, App store etc.)<br>Familiarization with govt. promotional apps such as BHIM, IRCTC etc. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Test different functional parameters such as purpose, performance, storage, compatibility of different mobile apps.<br>(Maps NOS: ELE/N8104) | 68 Perform functional test to check if the App meets its purpose. (09 hrs)<br>69 Demonstrate Storage testing, compatibility testing and application response testing. (09hrs) | Overview of different types of mobile testing procedures & methods.<br>Familiarization with different types of mobile application testing. (06 hrs) |

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|---|---|---|---|
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Check different functionality parameters of mobile Apps such as memory leakage, load, backup, power consumption etc.<br>(Maps NOS: ELE/N8104) | 70 Perform memory leakage testing, interrupt testing, usability testing, Installation testing, certification testing, location testing, upgrading existing software, load testing, uninstallation testing, backup & restore testing, power consumption testing. (18 hrs) | Familiarization with memory leakage testing, interrupt testing, usability testing, Installation testing, certification testing, location testing, upgrading existing software, load testing, uninstallation testing, backup & restore testing, power consumption testing. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Examine defects in smartphone/ software, using Graphical User Interface.<br>(Maps NOS: ELE/N8107) | 71 Test download, Installation, Execution, Integration, Auto Updates, Cross OS, cross Device, cross versions. (10 hrs)<br>72 Check screen validations and verify all navigations. (08 hrs) | Overview of user interface testing, defect in a product/ software, screen validation and navigation system. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Set & test network connections, check SD Card Interactions, mobile App settings on different platforms.<br>(Maps NOS: ELE/N8107) | 73 Perform network connections, SD Card Interactions and Bluetooth testing. (10 hrs)<br>74 Apply Best Practices in Mobile app & setting testing. (08 hrs) | Different SD cards and their features and best practices related to mobile app and setting testing. (06 hrs) |
| Professional Skill 18 Hrs;<br><br>Professional Knowledge 06 Hrs | Comply basic security features of mobile app testing.<br>(Maps NOS: ELE/N8107) | 75 Perrform web security testing. (10 hrs)<br>76 Boost the Look and Feel of the application with UI Testing. ( 08 hrs) | Overview of security features related to mobile app testing. (06 hrs) |

**Project/ Industrial Visit:**

**Broad Area:**

a Multimedia handset (Non-android based)

b Hardware/ software of Smartphone/ tablet.

c Removal of virus.

d Mobile App testing.

# Familiarization of the Industrial Training Institute

**Objectives:** At the end of this lesson you shall be able to
- **identify the staff structure of the institute**
- **list the available trades in the institute and their functions**
- **describe the ITI training system in india.**

Industrial Training Institutes (ITI) plays a vital role in the economic development of the country, especially in terms of providing skilled manpower requirements by training competent, quality craftsmen.

The Directorate General of Training (DGT) comes under the Ministry of Skill Development and Entrepreneurship (MSDE) offers a range of vocational training under engineering and non engineering trades affiliated with the National Council for Vocational Training (NCVT) NewDelhi. NCVT is the Govt of India body responsible for framing the polices, approving the syllabus for Craftsman Training System (CTS), carrying out the All India Trade Test and issuing the National Trade Certificates (NTC) to the successful candidates.

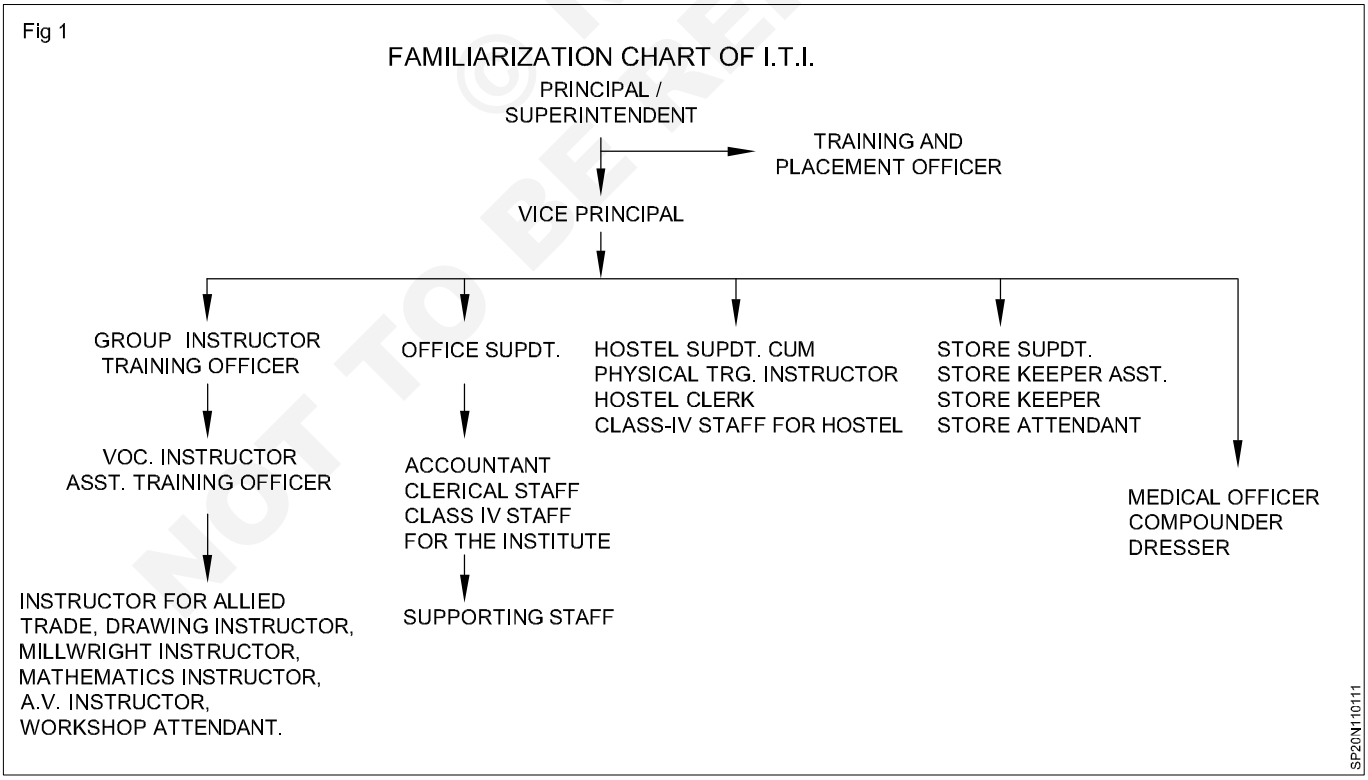
In India there are about 2293 Govt. ITIs and 10872 Private ITIs. (Based on the Govt.of India, Ministry of Labour Annual report of 2016-2017). The Govt. ITIs in each state functioning under the Directorate of Employment and Training Dept (DET) under the state Govts.

The head of the **ITI** is the Principal, under whom there is one Vice-Principal, Group Instructor/ Training officer/ A.T.O and a number of trade instructors as shown in the Organisation chart of ITI.

There are133 trades selected for vocational training and 261 trades identified for Apprentice training, according to the requirement of industrial needs and the duration of the training is from 1 year to 2 years.

At present the Electronic Mechanic trade has been included under National Skill Qualification Frame work (NSQF) with level - 5 competency. The trainees are advised to make a list of othe trades available in their ITI, the type of training and the scope of these trades in getting self employment or job opportunity in the rural and urban areas and also identify the location of the ITI, nearby hospital, fire station and police station ect.

Fig 1



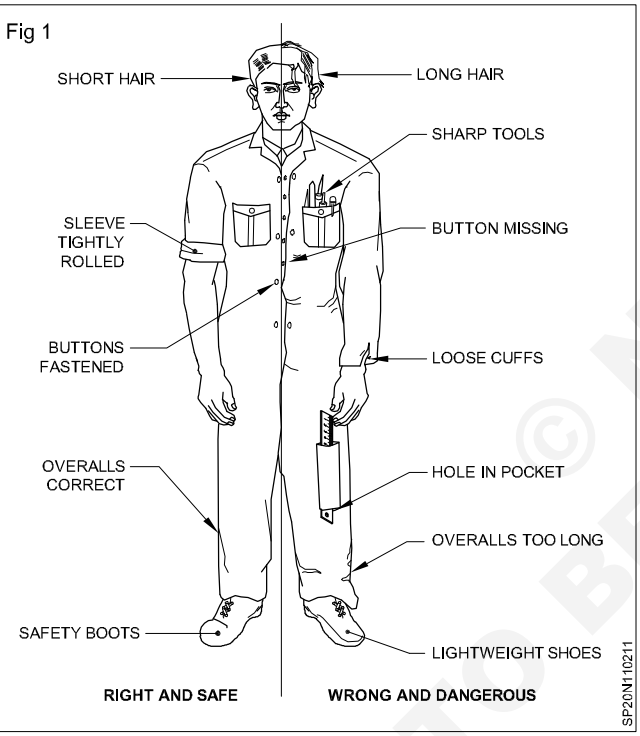
# Importance of safety and precautions to be taken in the industry/ shop floor

**Objectives:** At the end of this lesson you shall be able to
- **state the importance of safety**
- **state the personal safety precautions to be observed**
- **list out the safety precautions to be observed while working on the machines.**

### Importance of safety

Generally accidents do not happen; they are caused. Most accidents are avoidable. A Good craftsman, having a knowledge of various safety precautions, can avoid accidents to himself and to his fellow workers and protect the equipment from any damage. To achieve this, it is essential that every person should follow safety procedure. (Fig 1)

Fig 1




Safety in a workshop can be broadly classified into 3 categories.

- General safety
- Personal safety
- Machine safety

### General safety

Keep the floor and gangways clean and clear.

Move with care in the worksop, do not run.

Don't leave the machine which is in motion.

Don't touch or handle any equipment/ machine unless authorised to do so.

Don't walk under suspended loads.

Don't cut practical jokes while on work.

Use the correct tools for the job.

Keep the tools at their proper place.

Wipe out split oil immediately.

Replace worn out or damaged tools immediately.

Never direct compressed air at yourself or at your co-worker.

Ensure adequate light in the workshop.

Clean the machine only when it is not in motion.

Sweep away the metal cuttings.

Know everything about the machine before you start it.

### Personal safety

Wear a one piece overall or boiler suit.

Keep the overall buttons fastened.

Don't use ties and scarves.

Roll up the sleeves tightly above the elbow.

Wear safety shoes or boots or chain.

Cut the hair short.

Don't wear a ring, watch or chain.

Never lean on the machine.

Don't clean hands in the coolant fluid.

Don't remove guards when the machine is in motion.

Don't use cracked or chipped tools.

Don's start the machine until

- the workpiece is securely mounted
- the feed machinery is in the neutral
- the work area is clear.

Don't adjust clamps or holdig devices while the machine is in motion.

Never touch the electrical equipment with wet hands.

Don't use any faulty electrical equipment.

Ensure that electrical connections are made by an authorised electrician only.

Concentrate on your work.

Have a calm attitude.

Do things in a methodical way.

Don't engage yourself in conversation with others while concentrating on your job.

Don't distract the attention of others.

Don't try to stop a running machine with hands.

**Machine safety**

Switch off the machine immediately if something goes wrong.

Keep the machine clean.

Replace any worn out or damaged accessories, holding devices, nuts, bolts, etc., as soon as possible.

Do not attempt operating the machine until you know how to operate it properly.

Do not adjust tool or the workpiece unless the power is off.

Stop the machine before changing the speed.

Disengage the automatic feeds before switching off.

Check the oil level before starting the machine.

Never start a machine unless all the safety guards are in position.

Take measurements only after stopping the machine.

Use wooden planks over the bed while loading and unloading heavy jobs.

Safety is a concept, understand it.

Safety is a habit, cultivate it.

**Safety Sign Boards**

Signboards are a common sight in almost all places such as roadways, railways, hospitals, offices, instituition, industrial units and so on.

Signboards are visual indicators. The signs on the signboards may be just a symbol, a small text, a figure or a combination of these.

Signboards carry a single clear message. These messages are to ensure safety.

Sigboards can be classified into four basic categories.

**a Prohibition signs**

Indicating a behaviour which is prohibited (not allowed) in that situation or environment. Refer to chart 1 for examples.

**b Mandatory signs**

Indicating a behaviour which is a must, which when not obeyed may cause accidents. Refer to chart 1 for examples.

**c Warning signs**

Indicating a warning such tht suitable precatution is taken. Refer to chart 1 for examples.

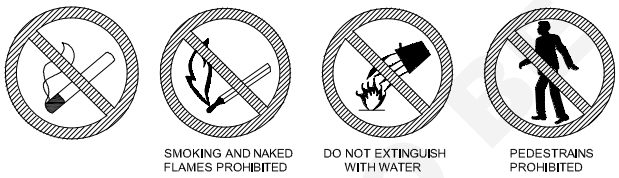
**d Information signs**

Giving information which is very useful and reduces waste of time. Refer to chart 1 for examples.



**Chart 1**

**a) Prohibition signs**




| | |
|---|---|
| **Shape** | Circular. |
| **Colour** | Red border and crossbar. Black symbol on white background. |
| **Meaning** | Shows what must not be done. |
| **Example** | No smoking and naked flames |

**b) Mandatory signs**


| | |
|---|---|
| **Shape** | Circular. |
| **Colour** | White symbol on blue background. |
| **Meaning** | Shows what must not be done. |
| **Example** | Wear hand protection. |

**c) Warning signs**

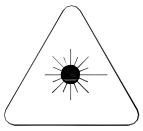

RISK OF FIRE


RISK OF ELECTRIC SHOCK


TOXIC HAZARD


CORROSIVE SUBSTANCES


RISK OF IONIZING RADIATION


LASER BEAM


RISK OF EXPLOSION


OVERHEAD (FIXED) HAZARD


GENERAL WARNING RISK OF DANGER

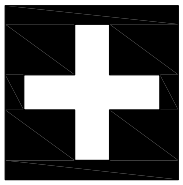

OVERHEAD LOAD


FRAGILE ROOF


FORK LIFT TRUCK

| | |
|---|---|
| **Shape** | Triangular. |
| **Colour** | Yellow background with black border and symbols. |
| **Meaning** | Warns of hazard or danger. |
| **Example** | Caution, risk of electric shock. |

**d) Information signs**


FIRST AID POINT

| | |
|---|---|
| **Shape** | Square or oblong |
| **Colour** | White symbols on green background. |
| **Meaning** | Indicates or gives information of safety provision/First aid |
| **Example** | Caution, risk of electric shock. |

# Personal Protective Equipment (PPE)

**Objectives:** At the end of this lesson you shall be able to
- **state what is personal protective equipment and its purpose**
- **list the most common type of personal protective equipment**
- **list the conditions for selection of personal protective equipment.**

**Personal protective equipment (PPE)**

Devices, equipments, or clothing used or worn by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or controlled by engineering methods rather than protecting the workmen through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution, ventilation, mechanical handling, automation, etc. In situations where it is not possible to introduce any effective engineering methods for controlling hazards, the workman shall use appropriate types of PPE.

As changing times have modernized the workplace, government and advocacy groups have brought more safety standards to all sorts of work environments. The Factories Act, 1948 and several other labour legislations 1996 have provisions for effective use of appropriate types of PPE. Use of PPE is an important.

**Ways to ensure workplace safety and use personal protective equipment (PPE) effectively.**

- Workers to get up-to-date safety information from the regulatory agencies that oversees workplace safety in their specific area.
- To use all available text resources that may be in work area and for applicable safety information on how to use PPE best.
- When it comes to the most common types of personal protective equipment, like goggles, gloves or bodysuits, these items are much less effective if they are not worn at all times, or whenever a specific danger exists in a work process. Using PPE consistently will help to avoid some common kinds of industrial accidents.
- Personal protective gear is not always enough to protect workers against workplace dangers. Knowing more about the overall context of your work activity can help to fully protect from anything that might threaten health and safety on the job.
- Inspection of gear thoroughly to make sure that it has the standard of quality and adequately protect the user should be continuously carried out.

**Categories of PPEs**

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories:

1 **Non-respiratory:** Those used for protection against injury from outside the body, i.e. for protecting the head, eye, face, hand, arm, foot, leg and other body parts

2 **Respiratory:** Those used for protection from harm due to inhalation of contaminated air.

They are to meet the applicable BIS (Bureau of Indian Standards) standards for different types of PPE.

The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in table 1.

**Table 1**

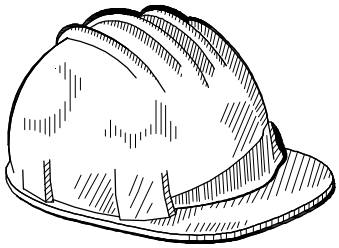
| No. | Title |
|---|---|
| PPE1 | Helmet |
| PPE2 | Safety footwear |
| PPE3 | Respiratory protective equipment |
| PPE4 | Arms and hands protection |
| PPE5 | Eyes and face protection |
| PPE6 | Protective clothing and cover all |
| PPE7 | Ears protection |
| PPE8 | Safety belt and harnesses |

Personal protective equipments and their uses and hazards are as follows

| Types of protection | Hazards | PPE to be used |
|---|---|---|
| Head Protection (Fig 1) | 1 Falling objects<br>2 Striking against objects<br>3 Spatter | Helmets |

| | | |
|---|---|---|
| Foot protection (Fig 2) | 1 Hot spatter<br>2 Falling objects<br>3 Working wet area | eather leg guards<br>Safety shoes<br>Gum boots |
| Nose (Fig 3) | 1 Dust particles<br>2 Fumes/ gases/ vapours | Nose mask |
| Hand protecion (Fig 4) | 1 Heat burn due to direct contact<br>2 Blows sparks moderate heat<br>3 Electric shock | Hand gloves |
| Eye protection (Fig 5&6) | 1 Flying dust particles<br>2 UV rays, IR rays heat and High amount of visible radiation | Goggles<br>Face shield<br>Hand shield<br>Head shield |
| Face Protection (Fig 6&7) | 1 Spark generated during Welding, grinding<br>2 Welding spatter striking<br>3 Face protection from UV rays | Face shield<br>Head shield with or without ear muff<br>Helmets with welders screen for welders |
| Ear protection (Fig 7) | 1 High noise level | Ear plug<br>Ear muff |
| Body protection (Fig 8&9) | 1 Hot particles | Leather aprons |

Fig 1



HELMET

SP20N110311

Fig 2

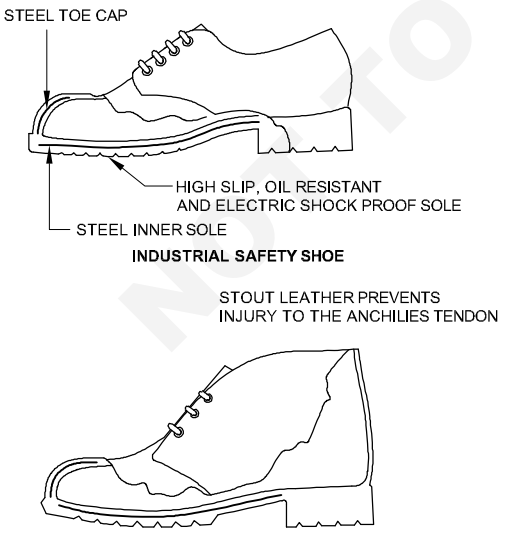



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Fig 3

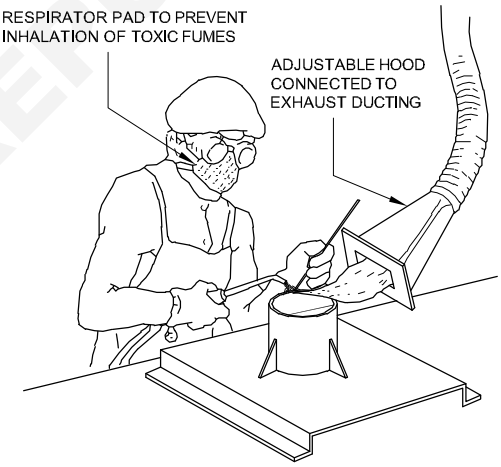


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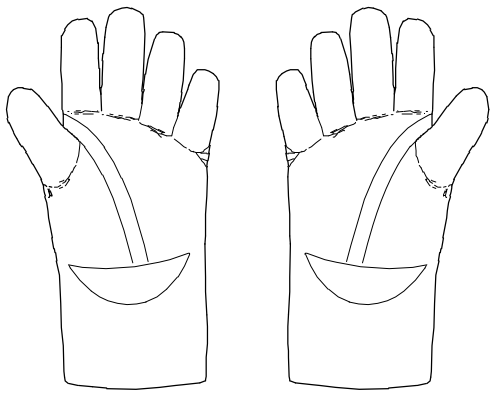
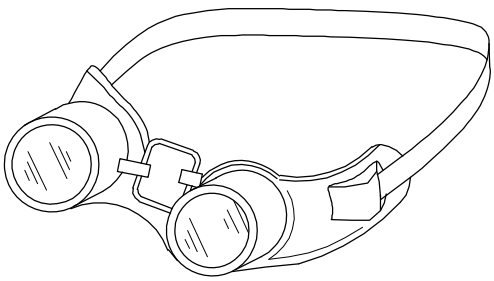
Fig 4



GLOVES

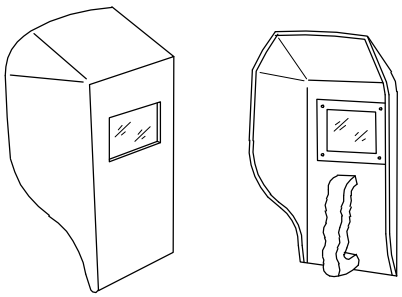
SP20N110314

Fig 5



SP20N110315

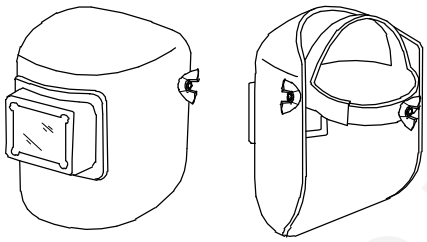
Fig 6



HAND SCREEN

SP20N110316

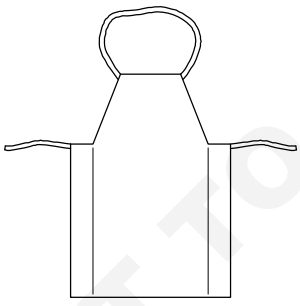
Fig 7



WELDING HELMET

SP20N110317

Fig 8



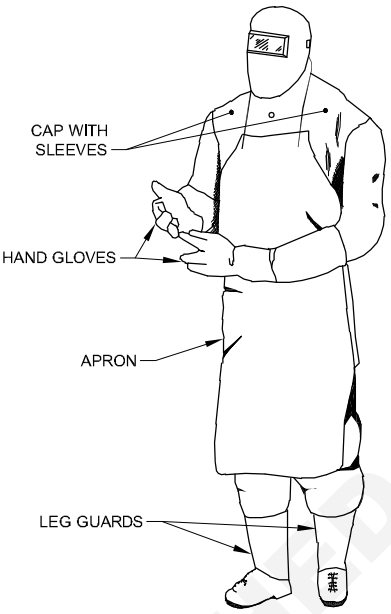
APRON

SP20N110318

**Quality of PPE's**

PPE must meet the following criteria with regard to its quality-provide absolute and full protection against possible hazard and PPE's be so designed and manufactured out of materials that it can withstand the hazards against which it is intended to be used.

Fig 9




LEG GUARDS

SP20N110319

**Selection of PPE's requires certain conditions**

- Nature and severity of the hazard.
- Type of contaminant, its concentration and location of contaminated area with respect to the source of respirable air.
- Expected activity of workman and duration of work, comfort of workman when using PPE.
- Operating characteristics and limitations of PPE.
- Ease of maintenance and cleaning.
- Conformity to Indian/ International standards and availability of test certificate.

**Proper use of PPEs**

Having selected the proper type of PPE, it is essential that the workman wears it. Often the workman avoids using PPE. The following factors influence the solution to this problem.

- The extent to which the workman understands the necessity of using PPE.
- The ease and comfort with which PPE can be worn with least interference in normal work procedures.
- The available economic, social and disciplinary sanctions which can be used to influence the attitude of the workman.
- The best solution to this problem is to make 'wearing of PPE' mandatory for every employee.
- In other places, education and supervision need to be intensified. When a group of workmen are issued PPE for the first time.

# First Aid

**Objectives:** At the end of this lesson you shall be able to
- **state the first aid**
- **explain the ABC of the first aid**
- **explain the first-aid treatment for a victim**
- **state the importance of house keeping**
- **explain environment, health and safety**
- **state the importance of safety and safety signs.**

**First aid** is defined as the immediate care and support given to an acutely injured or ill person, primarily to save life, prevent further deterioration or injury, plan to shift the victim to safer place, provide best possible comfort and finally help them to reach the medical centre/ hospital through all available means. It is an immediate life-saving procedure using all resources available within reach.

Imparting knowledge and skill through institutional teaching at younger age group in schools, colleges, entry point at industry level is now given much importance. Inculcating such habits at early age, helps to build good healthcare habits among people.

First aid procedure often consists of simple and basic life saving techniques that an individual performs with proper training and knowledge.

The key aims of first aid can be summarized in three key points:

- **Preserve life:** If the patient was breathing, a first aider would normally then place them in the recovery position, with the patient leant over on their side, which also has the effect of clearing the tongue from the pharynx. It also avoids a common cause of death inunconscious patients, which is choking on regurgitated stomach contents. The airway can also become blocked through a foreign object becoming lodged in the pharynx or larynx, commonly called choking. The first aider will be taught to deal with this through a combination of 'back slaps' and 'abdominal thrusts'. Once the airway has been opened, the first aider would assess to see if the patient is breathing.
- **Prevent further harm:** Also sometimes called prevent the condition from worsening, or danger of further injury, this covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- **Promote recovery:** First aid also involves trying to start the recovery process from the illness or injury, and in some cases might involve completing a treatment, such as in the case of applying a plaster to a small wound.

**Training**

Basic principles, such as knowing to use an adhesive bandage or applying direct pressure on a bleed, are often acquired passively through life experiences. However, to provide effective, life-saving first aid interventions requires instruction and practical training. This is especially true where it relates to potentially fatal illnesses and injuries, such as those that require cardiopulmonary resuscitation (CPR); these procedures may be invasive, and carry a risk of further injury to the patient and the provider. As with any training, it is more useful if it occurs before an actual emergency, and in many countries, emergency ambulance dispatchers may give basic first aid instructions over the phone while the ambulance is on the way. Training is generally provided by attending a course, typically leading to certification. Due to regular changes in procedures and protocols, based on updated clinical knowledge, and to maintain skill, attendance at regular refresher courses or re-certification is often necessary. First aid training is often available through community organization such as the Red cross and St. John ambulance.

**ABC of first aid**

ABC stands for airway, breathing and circulation.

- **Airway:** Attention must first be brought to the airway to ensure it is clear. Obstruction (choking) is a life-threatening emergency.
- **Breathing:** Breathing if stops, the victim may die soon. Hence means of providing support for breathing is an important next steps. There are several methods practiced in first aid.
- **Circulation:** Blood circulation is vital to keep person alive. The first aiders now trained to go straight to chest compressions through CPR methods.

When providing first aid one needs to follow some rule. There are certain basic norms in teaching and training students in the approach and administration of first aid to sick and injured.

**Not to get panic**

Panic is one emotion that can make the situation more worse. People often make mistake because they get panic. Panic clouds thinking may cause mistakes. First aider need calm and collective approach. If the first aider himself is in a state of fear and panic gross mistakes may result.

It's far easier to help the suffering, when they know what they are doing, even if unprepared to encounter a situation. Emotional approach and response always lead to wrong doing and may lead one to do wrong procedures. Hence be calm and focus on the given institution. Quick and confident approach can lessen the effect of injury.

**Call medical emergencies**

If the situation demands, quickly call for medical assistance. Prompt approach may save the life.

**Surroundings play vital role**

Different surroundings require different approach. Hence first aider should study the surrounding carefully. In other words, one need to make sure that they are safe and are not in any danger as it would be of no help that the first aider himself get injured.

**Do no harm**

Most often over enthusiastically practiced first aid viz. administering water when the victim is unconscious, wiping clotted blood (which acts as plug to reduce bleeding), correcting fractures, mishandling injured parts etc., would leads to more complication. Patients often die due to wrong FIRST AID methods, who may otherwise easily survive. Do not move the injured person unless the situation demands. It is best to make him lie wherever he is because if the patient has back, head or neck injury, moving him would causes more harm.

This does not mean do nothing. It means to make sure that to do something the care gives feel confident through training would make matters safe. If the first aider is not confident of correct handling it is better not to intervene of doing it. Hence moving a trauma victim, especially an unconscious one, needs very careful assessment. Removal of an embedded objects (Like a knife, nail) from the wound may precipitate more harm (e.g. increased bleeding). Always it is better to call for help.

**Reassurance**

Reassure the victim by speaking encouragingly with him.

**Stop the bleeding**

If the victim is bleeding, try to stop the bleeding by applying pressure over the injured part.

**Golden hours**

India have best of technology made available in hospitals to treat devastating medical problem viz. head injury, multiple trauma, heart attack, strokes etc, but patients often do poorly because they don't gain access to that technology in time. The risk of dying from these conditions, is greatest in the first 30 minutes, often instantly. This period is referred to as Golden period. By the time the patient reach the hospital, they would have passed that critical period. First aid care come handy to save lives. It helps to get to the nearest emergency room as quickly as possible through safe handling and transportation. The shorter that time, the more likely the best treatment applied.

**Maintain the hygiene**

Most important, the first aider need to wash hands and dry before giving any first aid treatment to the patient or wear gloves in order to prevent infection.

**Cleaning and dressing**

Always clean the wound thoroughly before applying the bandage gently wash the wound with clean water.

**Not to use local medications on cuts or open wounds**

They are more irritating to tissue than it is helpful. Simple dry cleaning or with water and some kind of bandage are best.

**CPR (Cardio-Pulmonary Resuscitation) can be life-sustaining**

CPR can be life sustaining. If one is trained in PR and the person is suffering from choking or finds difficulty in breathing, immediately begin CPR. However, if one is not trained in CPR, do not attempt as you can cause further injury. But some people do it wrong. This is a difficult procedure to do in a crowded area. Also there are many studies to suggest that no survival advantage when bystanders deliver breaths to victims compared to when they only do chest compressions. Second, it is very difficult to carry right maneuver in wrong places. But CPR, if carefully done by highly skilled first aiders is a bridge that keeps vital organs oxygenated until medical team arrives.

**Declaring death**

It is not correct to declare the victim's death at the accident site. It has to be done by qualified medical doctors.

**How to report an emergency?**

Reporting an emergency is one of those things that seems simple enough, until actually when put to use in emergency situations. A sense of shock prevail at the accident sites. Large crowd gather around only with inquisitive nature, but not to extend helping hands to the victims. This is common in road side injuries. No passer-by would like to get involved to assist the victims. Hence first aid management is often very difficult to attend to the injured persons. The first aiders need to adapt multi-task strategy to control the crowd around, communicate

to the rescue team, call ambulance etc., all to be done simultaneously. The mobile phones helps to a greater extent for such emergencies. Few guidelines are given below to approach the problems.

Assess the urgency of the situation. Before you report an emergency, make sure the situation is genuinely urgent. Call for emergency services if you believe that a situation is life-threatening or otherwise extremely critical.

- A crime, especially one that is currently in progress. If you're reporting a crime, give a physical description of the person committing the crime.
- A fire - If you're reporting a fire, describe how the fire started and where exactly it is located. If someone has already been injured or is missing, report that as well.

- A life-threatening medical emergency, explain how the incident occurred and what symptoms the person currently displays.
- A car crash - Location, serious nature of injures, vehicle's details and registration, number of people involved etc.

**Call emergency number**

The emergency number varies - 100 for Police & Fire, 108 for Ambulance.

**Report your location**

The first thing the emergency dispatcher will ask is where you are located, so the emergency services can get there as quickly as possible. Give the exact street address, if you're not sure of the exact address, give approximate information.

**Give the dispatcher your phone number**

This information is also imperative for the dispatcher to have, so that he or she is able to call back if necessary.

**Describe the nature of the emergency**

Speak in a calm, clear voice and tell the dispatcher why you are calling. Give the most important details first, then answer the dispatcher's follow-up question as best as you can.

**Do not hang up the phone** until you are instructed to do so. Then follow the instructions you were given.

**How to do basic first aid?**

Basic first aid refers to the initial process of assessing and addressing the needs of someone who has been injured or is in physiological distress due to choking, a heart attack, allergic reactions, drugs or other medical emergencies. Basic first aid allows one to quickly determine a person's physical condition and the correct course of treatment.

**Important guideline for first aiders**

**Evaluate the situation**

Are there things that might put the first aider at risk. When faced with accidents like fire, toxic smoke, gasses, an unstable building, live electrical wires or other dangerous scenario, the first aider should be very careful not to rush into a situation, which may prove to be fatal.

**Remember A-B-Cs**

The ABCs of first aid refer to the three critical things the first aiders need to look for.

- Airway - Does the person have an unobstructed airway?
- Breathing - Is the person breathing?
- Circulation - Does the person show a pulse at major pulse points (wrist, carotid artery, groin)

**Avoid moving the victim**

Avoid moving the victim unless they are immediate danger. Moving a victim will often make injuries worse, especially in the case of spinal cord injuries.

**Call emergency services**

Call for help or tell someone else to call for help as soon as possible. If alone at the accident scene, try to establish breathing before calling for help, and do not leave the victim alone unattended.

**Determine responsiveness**

If a person is unconscious, try to rouse them by gently shaking and speaking to them.

**If the person remains unresponsive, carefully roll them on the side (recovery position) and open his airway.**

- Keep head and neck aligned.
- Carefully roll them onto their back while holding his head.
- Open the airway by lifting the chin.

**Look, listen and feel for signs of breathing**

Look for the victim's chest to raise and fall, listen for sounds of breathing.

If the victim is not breathing, see the section below

- If the victim is breathing, but unconscious, roll them onto their side, keeping the head and neck aligned with the body. This will help drain the mouth and prevent the tongue or vomit from blocking the airway.

**Check the victim's circulation**

Look at the victim's colour and check their pulse (the carotid artery is a good option; it is located on either side of the neck, below the jaw bone). If the victim does not have a pulse, start CPR.

**Treat bleeding, shock and other problems as needed**

After establishing that the victim is breathing and has a pulse, next priority should be to control any bleeding. Particularly in the case of trauma, preventing shock is the priority.

- **Stop bleeding:** Control of bleeding is one of the most important things to save a trauma victim. Use direct pressure on a wound before trying any other method of managing bleeding.
- **Treat shock:** Shock may causes loss of blood flow from the body, frequently follows physical and occasionally psychological trauma. A person in shock will frequently have ice cold skin, be agitated or have an altered mental status, and have pale colour to the skin around the face and lips. Untreated, shock can be fatal. Anyone who has suffered a severe injury or life-threatening situation is at risk for shock.
- **Choking victim:** Choking can cause death or permanent brain damage within minutes.
- **Treat a burn:** Treat first and second degree burns by immersing or flushing with cool water. Don't use creams, butter or other ointments, and do not pop blisters. Third degree burns should be covered with a damp cloth. Remove clothing and jewellery from the burn, but do not try to remove charred clothing that is stuck to burns.

- **Treat a concussion:** If the victim has suffered a blow to the head, look for signs of concussion. Common symptoms are: loss of consciousness following the injury, disorientation or memory impairment, vertigo, nausea, and lethargy.
- **Treat a spinal injury victim:** If a spinal injury is suspected, it is especially critical, not move the victim's head, neck or back unless they are in immediate danger.

**Stay with the victim until help arrives**

Try to be a calming presence for the victim until assistance can arrive.

**Unconsciousness (COMA)**

Unconscious also referred as Coma, is a serious life threatening condition, when a person lie totally senseless and do not respond to calls, external stimulus. But the basic heart, breathing, blood circulation may be still intact, or they may also be failing. If unattended it may lead to death.

The condition arises due to interruption of normal brain activity. The causes are too many.

The following symptoms may occur after a person has been unconscious:

- Confusion
- Drowsiness
- Headache
- Inability to speak or move parts of his or her body (see stroke symptoms)
- Light headedness
- Loss of bowel or bladder control (incontinence)
- Rapid heartbeat (palpitation)
- Stupor

**First aid**

- Call EMERGENCY number.
- Check the person's airway, breathing, and pulse frequently. If necessary, begin rescue breathing and CPR.
- If the person is breathing and lying on the back and after ruling out spinal injury, carefully roll the person onto the side, preferably left side. Bend the top leg so both hip and knee are at right angles. Gently tilt the head back to keep the airway open. If breathing or pulse stops at any time, roll the person on to his back and begin CPR.
- If there is a spinal injury, the victims position may have to be carefully assessed. If the person vomits, roll the entire body at one time to the side. Support the neck and back to keep the head and body in the same position while you roll.
- Keep the person warm until medical help arrives.
- If you see a person fainting, try to prevent a fall. Lay the person flat on the floor and raise the level of feet above and support.
- If fainting is likely due to low blood sugar, give the person something sweet to eat or drink when they become conscious.

**Do not**

- Do not give any food or drink of an unconscious person
- Do not leave the person alone.
- Do not place a pillow under the head of an unconscious person.
- Do not slap an unconscious person's face or splash water on the face and try to revive him.

**Loss of consciousness may threaten life if the person is on his back and the tongue has dropped to the back of the throat, blocking the airway. Make certain that the person is breathing before looking for the cause of unconsciousness. If the injuries permit, place the casualty in the recovery position with the neck extended. Never give any thing by mouth to an unconscious casualty.**

**How to diagnose an unconscious injured person**

- Consider alcohol: look for signs of drinking, like empty bottles or the smell of alcohol.
- Consider epilepsy: are there signs of a violent seizure, such as saliva around the mouth or a generally dishevelled scene?
- Think insulin: might the person be suffering from insulin shock (see 'How to diagnose and treat insulin shock")?
- Think about drugs: was there an overdose? Or might the person have under dosed - that is not taken enough of a prescribed medication?
- Consider trauma: is the person physically injured?
- Look for signs of infection: redness and/ or red streaks around a wound.
- Look around for signs of Poison: an empty bottle of pills or a snakebite wound.
- Consider the possibility of psychological trauma: might the person have a psychological disorder of some sort?
- Consider stroke, particularly for elderly people.
- Treat according to what you diagnose.

**Shock**

A severe loss of body fluid will lead to a drop in blood pressure. Eventually the blood's circulation will deteriorate and the remaining blood flow will be directed to the vital organs such as the brain. Blood will therefore be directed away from the outer area of the body, so the victim will appear pale and the skin will feel ice cold.

As blood flow slows, so does the amount of oxygen reaching the brain. The victim may appear to be confused, weak, and dizzy and may eventually deteriorate into unconsciousness. Try to compensate for this lack of oxygen, the heart and breathing rates both speed up, gradually becoming weaker, and may eventually cease.

Potential causes of shock include: sever internal or external bleeding; burns; severe vomiting and diarrohea, especially in children and the elderly; problems with the heart.

**Symptoms of shock**

Victims appear pale, ice cold, pulse appear initially faster and gets slower, breathing becomes shallow. Weakness, dizziness, confusion continue. If unattended the patient may become unconscious and die.

Shock kills, so it is vital that you can recognize these signs and symptoms. With internal bleeding in particular, shock can occur sometime after an accident, so if a person with a history of injury starts to display these symptoms coupled with any of the symptoms of internal bleeding, advise them to seek urgent medical attention. Or take or send them to hospital.

**First aid**

Keep the patient warm and at mental rest. Assure of good air circulation and comfort. Call for help to shift the patient to safer place/ hospital.

- **Warmth:** Keep the victim warm but do not allow them to get overheated. If you are outside, try to get something underneath her if you can do easily. Wrap blankets and coats around her, paying particular attention to the head, through which much body heat is lost.
- **Air:** Maintain careful eye on the victim's airway and be prepared to turn them into the recovery position if necessary, or even to resuscitate if breathing stops. Try to keep back bystanders and loosen tight clothing to allow maximum air to victim.
- **Rest:** Keep the victim still and preferably sitting or lying down. If the victim is very giddy, lay them down with there legs raised to ensure that maximum blood and therefore maximum oxygen is sent to the brain.

**Power Failure**

Minor electric shock, fire, or product failure may occasionally occur. Do not disassemble, modify, or repair the product or touch the interior of the product.

Minor injury due to electric shock may occasionally occur. Do not touch the terminals while power is being supplied.

Minor burns may occasionally occur. Do not touch the product while power is beinng supplied or immediately after power is turned OFF.

Fire may occasionally occur. Tighten the terminal screws with the specified torque.

Minor electric shock, fire, or product failure may occasionally occur. Do not allow any pieces of metal or conductors or any clippings or cuttings resulting from installation work to enter the product.

**Precautions for Safe Use**

**Input Voltage**

Use a commercial power supply for the power supply voltage input to models with AC inputs.

Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the power supply may result in ignition or burning. Do not use an inverter outpur for the power supply of the product.

**Grounding**

Connect the ground completely. Electric shock occur if te the ground is not connected completely.

**Operating Environment**

Use each product within the rated range for ambient operating temperature, ambient operating humidity, and storage temperature specified for that product.

Use the power supply within the ranges specifed for vibration and shock reistance.

Do not use the power supply in locations subjects to excessive amount of dust or where liquids, foreign matter, or corrosive gases may enter the interior of the product.

Install the power supply well away from devices that produce strong, high-frequency noise and surge.

Do not use the power supply in locations subject to direct sunlight.

**Mounting**

The installation screws can be tightened into the power supply only to a limited depth. Make sure that the lengths of the screws protruding into the power supply are within the specified dimensions.

**Wiring**

Use caution when connecting the input cable to the power supply.

The power supply unit may be destroyed if the input cable is connected to the wrong terminals. Use caution when using a model with a DC input. The power supply unit may be destroyed if the polarity is reversed.

Do not apply more than 75-N force to the terminal block when tightening the terminals.

**Wiring materials**

Use a wire size that suits the rated ouput current of the power supply to be used in order to prevent smoking or ignition caused by abnormal loads.

Caution is particularly required if the output current from one power supply is distributed to multiple loads. If thin wiring is used to branch wiring, the power supply's overload protection circuit may fail to operate depending on factors such as the impedence of the load wiring even the load is short-circuited.

Therefore insertion of a fuse in the line or other protective measures must be considered.

**Precautions against ingress of metal fragments (Fillings)**

Drilling on the upper section of an installed power supply may cause drilling fragments to fall onto the PCB, thereby short-circuiting and destroying the internal circuits. Whether

the power supply cover is attached or not, cover the power supply with a sheet to prevent ingress of fragments when performing work on the upper sector of the power supply.

Be sure to remove the sheet covering the power supply for machining before power-ON so that it does not interface with heat dissipation.

**Load**

Internal parts may possibly deteriorate or be damaged if a short-circuited or over current state continues during operation.

**Charging a battery**

When connection a battery at the load, connect an overcurrent limiting circuit and overvoltage protection circuit.

**Output and Ground connections**

The power supply output is a floating output (i.e., the primary side and secondary side are separated). so the output line (i.e., +V or -V) can be connected externally directly to a ground. Though the ground, however, the insulation between the primary side and secondary side will be lost. Confirm that no loops are created in which the power supply output is short-circuited through the internal circuits of the load.

Example: When the +V side of the power supply is connected directly to a ground and a load is used for which the internal 0-V line uses the same ground.

**Fire safety**

**Prepare before a fire:**

Always familiarize yourself to "where you are" and be sure to know how to reach the two nearest exits.

Remember that in a fire situation, smoke is blinding and will bank down in the rooms and hallways. This condition may force you to crouch or crawl to escape to safety. By always being aware of your surroundings, your knowledge of the nearest exits and having a plan will greatly increase your ability to deal with sudden

If you are notified of, or discover a fire:

- Move quickly to the nearest accessible exit.
- Notify, and assist others to evacuate along the way.
- If the building fire alarm is not yet sounding, manually activate the alarm pull station located near the exit.
- Exit the building and proceed to the " Area of gathering"

**Evacuation procedures for persons with mobility issues:**

In the event of an actual emergency incident, persons with mobility issues or who are unable to safely self-evacuate should follow this procedure:

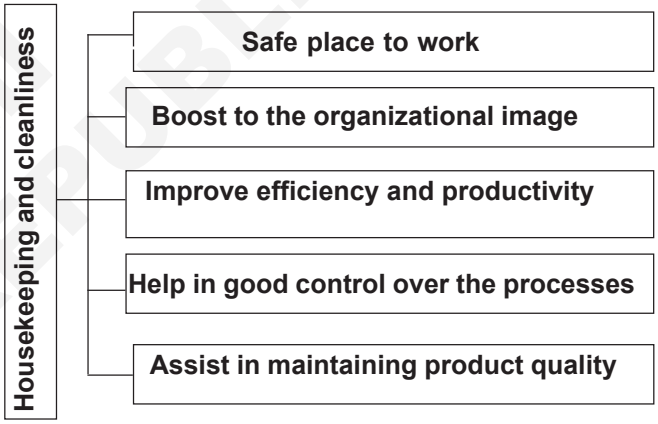
- Relocate to an entry to an evacuation stairwell, marked by a red exit sign.
- Wait near the enclosed exit stairwell if there is no smoke or other threats to your safety. Most fire alarm activations are brief, allowing occupants to return within a few minutes.

If smoke, fire, or other threat is imminent, move into the stairwell:

- After the stairwell crowd has passed below your floor level, enter the stairwell with assistant(s) and wait on the stair landing. Make sure that the door is securely closed.

**Housekeeping and cleanliness at workplace**

Housekeeping and cleanliness at the workplace are closely linked to the industrial safety. the degree, to which these activities are effectively managed, is an indicator of the safety culture of the organization. House keeping and cleanliness not only make the organization a safer place to work in but also provide a big boost to the image of the organization. These activities also (i) improve efficiency and productivity, (ii) helps in maintaining good control over the processes, and (iii) assist in maintaining the quality of the product. These important aspects of housekeeping and cleanliness are furnished below.




There are several signs which reflect poor housekeeping and cleanliness at the workplace in the organization. Some of these signs are (i) cluttered and poorly arranged work areas, (ii) untidy or dangerous storage of materials (such as materials stuffed in corners and overcrowded shelves etc.), (iii) dusty and dirty floors and work surfaces, (iv) items lying on the shop floor which are in excess or no longer needed, (v) blocked or cluttered aisels and exits, (vi) tools and equipment left in work areas instead of being returned to proper storage places, (vii) broken containers and damaged materials, (viii) overflowing waste bins and containers, and (ix) spills and leaks etc.

Housekeeping and cleanliness is crucial to a safe workplace. It can help prevent injuries and improve productivity and morale, as well as make a good imprint on the people visiting the workplace.

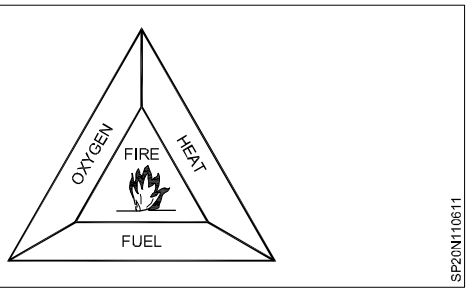
# Fire extinguishers

**Objectives:** At the end of this lesson you shall be able to
- **state the effects of a fire break out**
- **state the conditions required for combustion relevant to fire prevention**
- **state the general precautionary measures to be taken for fire prevention**
- **determine the correct type of fire extinguisher required for a particular function**
- **state environment, health and safety.**

### Fire

Fire is nothing but burning of a combustible material. For combustion the three main requirements are shown in Fig 1.

Fig 1




### Fuel

Fuel can be any combustible substance in the form of a solid, liquid or gas. Examples; wood, paper, petrol, kerosene, LPG etc., The fuel will catch fire and burn provided a high enough temperature(heat) is brought about and a continuous supply of oxygen is given. It is important to note that without fuel, combustion cannot take place.

### Heat

Fuels will begin to burn at a certain temperature. Different types of fuels need different temperatures to catch fire and burn. For example, wood needs a higher temperature to catch fire and burn than paper. Petrol needs much lesser temperature to catch fire and burn than paper. Generally liquid fuels give off vapour when heated. It is this vapour which ignites. Some liquids such as petrol do not have to be heated as they give off vapour at room temperature (15$^{o}$C - 25$^{o}$C) itself. It is important to note that without heat, fuel cannot get ignited(catch fire) and hence combustion cannot take place.

### Oxygen

Oxygen exists in air. The amount of oxygen in air is sufficient to continue the combustion once it occurs. Hence to keep a fire burning, oxygen is a must. It is important to note that without oxygen, combustion cannot continue to take place.

### Controlled and uncontrolled fire

Fire is a boon to mankind. Without fire, there would not be cooked food or hot water for bath as and when we want it. At the same time if the fire does not get constrained to a place of requirement, fire can become a bane(curse) to mankind. An uncontrolled fire can cause such a disaster which not only leads to destruction of material but also endanger the life of persons. Hence, the lesson one must never forget is, keep the fire under control. Every effort must be made to prevent uncontrolled fire. When there is a fire outbreak, it must be controlled and extinguished immediately without any delay.

### Preventing fire

The majority of fires begin with small outbreaks. If this is not noticed, fire goes out of control and will be on its way of destruction. Hence, most fires could be prevented if suitable care is taken by following some simple common sense rules as given below.

– Do not accumulate combustible refuse such as cotton waste, waste or cloth soaked with oil, scrap wood, paper, etc. in odd corners. These refuse should be in their collection bins or points.

– Do not misuse or neglect electrical equipments or electrical wiring as this may cause electrical fire. Loose connections, low rated fuses, overloaded circuits causes over heating which may in turn lead to fire. Damaged insulation between conductors in cables cause electrical short circuit and cause fire.

– Keep away clothing and other materials which might catch fire from heating appliances. Make sure the soldering iron is disconnected from power supply and is kept safe in its stand at the end of the working day.

– Store highly flammable liquids and petroleum mixtures such as thinner, adhesive solutions, solvents, kerosene, spirit, LPG gas etc. in the storage area exclusively meant for storage of flammable materials.

– Turn off blowlamps and torches when they are not in use.

### Controlling and Extinguishing fire

Isolating or removing any of three factors illustrated in Fig1, will control and extinguish fire. There are three basic ways of achieving this.

- **Starving the fire of fuel**

  To remove the fuel which is burning or cut further supply of fuel to the fire.

- **Smothering**

  To stop the supply of oxygen to the fire by blanketing the fire with foam, sand etc.

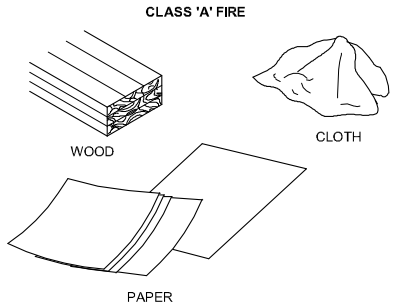
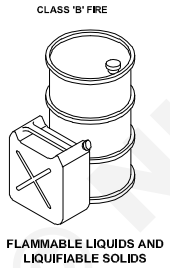
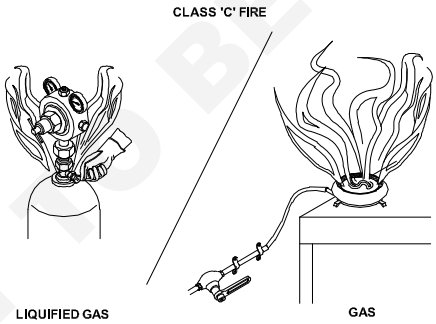
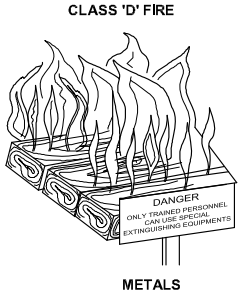
- **Cooling**

  To reduce the temperature of the fire by spraying water and thus cooling the fire.

By any one of the above three methods, fire can be first controlled and then extinguished.

**For the purpose of determining the best method of extinguishing different types of fires, fires are classified under four main classes based on the type of fuel as given in Table 1.**

TABLE 1

| Classification of Fire | Fuel involved | Precautions and extinguishing |
|---|---|---|
| **Class A Fire** | Wood, paper cloth etc.<br>Solid materials<br>  | Most effective method is cooling with water. Jets of water should be sprayed on the base |
| **Class B Fire** | Flammable liquids & liquefiable solids<br>  | Should be smothered. The aim is to cover the entire surface of the burning liquid. This has the effect of cutting off the supply of oxygen to the fire.<br>Water should never be used on burning liquids.<br>Foam, dry powder or $CO_2$ may be used on this type of fire. |
| **Class C Fire** | Gas and liquefied gas<br>  | Extreme caution is necessary in dealing withliquefied gases. There is a risk of explosion and sudden outbreak of fire in the entire vicinity. If an appliance fed from a cylinder catches fire -shut off the supply of gas. The safest course is to raise an alarm and leave the fire to be dealt with by trained personnel.<br>Dry powdered extinguishers are used on this type of fire. |
| **Class D Fire** | Involving metals<br>  | The standard range of fire extinguishing agents is inadequate or dangerous when dealing with metal fires.<br>**Fire in electrical equipment**:<br>Carbon -di-oxide, dry powder, and vapourising liquid(CTC) extinguishers can be used to deal with fires in electrical equipment.<br>Foam or liquid (eg. water) extinguishers must not be used on electrical equipment at all. |

## Fire extinguishers

Different fire extinguishing agents should be used for different types of fires as listed in Table 1. Using a wrong type of extinguishing agent can make things worse.

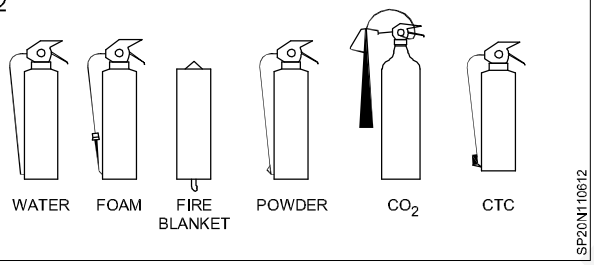
A fire extinguishing agent is the material or substance used to put out the fire. These extinguishing materials are usually (but not always) contained in a container called the 'fire extinguisher' with a mechanism for spraying into the fire when needed.

There is no classification for **electrical fires** as these are only fires in materials where electricity is present. To control electrical fire in a building the electrical supply should be cut off first.

## Types of fire extinguishers

Many types of fire extinguishers are available with different extinguishing agents to deal with different classes of fires as shown in Fig 2. Always check the operating instructions on the extinguisher before use.

Fig 2



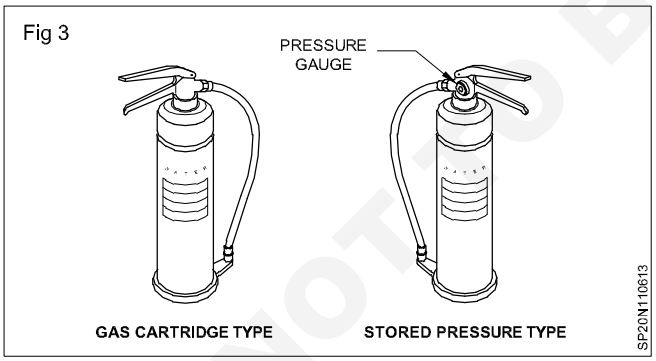

### i Water-filled extinguishers

In water-filled extinguishers, as shown in Fig 3, there are two types based on the method of operating the extinguisher.

a Cartridge type

b Stored pressure type

Fig 3




In both the methods of operation, the discharge can be interrupted as required. This is to conserve the contact area and to prevent unnecessary damage to the material due to water.

### ii Foam extinguishers

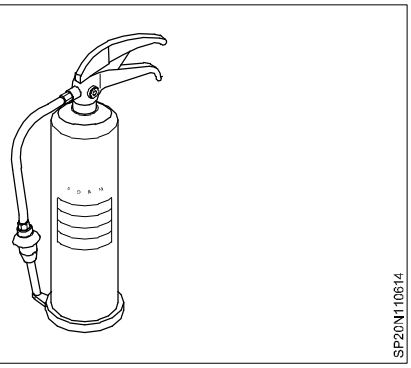
These may be stored pressure or gas cartridge types as shown in Fig 4.

Most suitable for:

- flammable liquid fires
- running liquid fires.

Not to be used in fires where electrical equipment is involved.

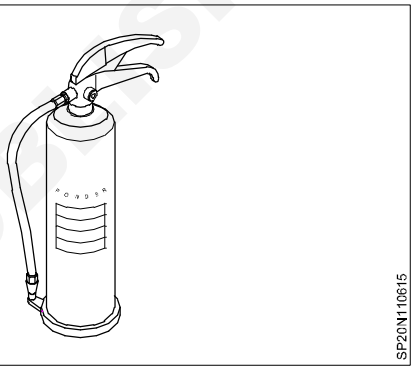
Fig 4




### iii Dry powder extinguishers

Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type as shown in Fig 5. Appearance and the method of operation is the same as that of water-filled one. The main distinguishing feature is the fork-shaped nozzle. Powders have been specially developed to deal with Class D fires.

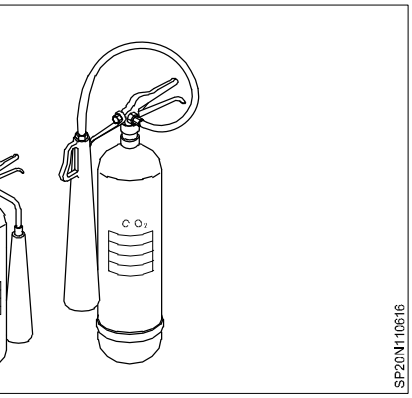
Fig 5




### iv Carbon-di-oxide ($CO_2$)

This type is easily distinguished by the distinctively shaped discharge horn as shown in Fig 6. These extinguishers are suitable for fires on flammable liquids and liquefiable solids. Best suited where contamination by deposits must be avoided. Not generally effective in the open air.

Fig 6

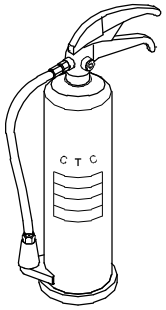



### v Halon Extinguishers (Fig 7)

Carbontetrachloride(CTC) and Bromochlorodifluoro methane (BCF). They may be either gas cartridge or non-conductive.

**The fumes given off by these extinguishers are dangerous especially in confined space.**

Fig 7

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**General procedure to be adopted in the event of a fire**

- Raise a loud alarm by using any of the following.

  Adopt any one method of giving an alarm signal for fire breaking in your institute/ workshop.

  – Raising your voice and shouting Fire! Fire!Fire! .... to call the attention of others.

  – Running towards the fire shouting Fire! Fire! and actuate fire alarm/bell/siren. This alarm/bell/siren to be actuated only in case of fire.

  – Any other means by which the attention of others can be called and are made to understand there is a fire break out.

- On receipt of the fire alarm signal, do the following:

  – stop the normal work you are doing

  – turn OFF the power for all machinery and equipments

  – switch OFF fans/air circulators/exhaust fans

  – switch OFF the mains if accessible.

- If you are not involved in fire fighting team, then,

  – evacuate the working premises

  – close the doors and windows, but do not lock or bolt

  – assemble at a safe open place along with the others

  – if you are in the room/place where the fire has broken out, leave the place calmly through the emergency exit.

- If you are involved in the fire fighting team,

  – take instructions/give instructions for an organized way of fighting the fire.

  If you are taking instructions,

  – follow the instructions systematically. Do not be panic. Do not get trapped in fire or smoke in a hurry.

  If you are giving instructions,

  – assess the class of fire(class A,B,C or D)

  – send for sufficient assistance and fire brigade

  – judge the magnitude of the fire. Locate locally available suitable means to put-out the fire.

  – ensure emergency exit paths are clear of obstructions. Attempt to evacuate the people and explosive materials, substances that can serve as further fuel for fire within the vicinity of the fire break.

  – Allot clear activity to persons involved in firefighting by name to avoid confusion.

  – Control and extinguish the fire using the right type of fire extinguisher and making use of the available assistance effectively.

- After fully extinguishing the fire, make a report of the fire accident and the measures taken to put out the fire, to the authorities concerned.

**Reporting all fires however small they are, helps in the investigation of the cause of the fire. It helps in preventing the same kind of accident occurring again.**

**Environment, health and safety (EHS) :** is a discipline and specialty that studies and implements practical aspects of environmental protection and safety at work. In simple terms it is what organizations must do to make sure that their activities do not cause harm to anyone.

Regulatory requirements play an important role in EHS discipline and EHS managers must identify and understand relevant EHS regulations, the implications of which must be communicated to executive management so the company can implement suitable measures. Organizations based in the United states are subject to EHS regulations in the code of federal regulations particularly CFR 29,40, and 49. Still, EHS management is not limited to legal compliance and companies should be encouraged to do more than is required by law, if appropriate.

From a health and safety standpoint, it involves creating organized efforts and procedures for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances. It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment.

From an environmental standpoint, it involves creating a systematic approach to complying with environmental regulations, such as managing waste or air emissions all the way to helping site's reduce the company's carbon footprint.

Sucessful HSE programs also include measures to address ergonomics, air quality, and other aspects of workplace safety that could affect the health and well-being of employees and the overall community.

## Introduction to the trade & future scope

**Objectives:** At the end of this lesson you shall be able to
- **explain about the trade**
- **explain furture scope of the trade.**

**Introduction to the Trade**

In this trade, trainees will be skilled in the field of servicing smartphone.

Learn mobile reparing with mordern tools & equipment and latest technology.

The trainee will be well equipped in the field of App Testing, Assemble and Disassemble various components in smartphone.

The trainee will get wide knowledge about OS installation and different functionality parameters.

**Furture scope of the Trade**

- The trainee can own a service shop.
- The trainee can also join as a technician in mobile phone service centre.
- The trainee can find job in mobile phone industry.

## Overview of current

**Objectives:** At the end of this lesson you shall be able to
- **explain what electricity**
- **explain the types of electricity**
- **differentiate between AC and DC**
- **state the parameter of electricity.**

**Basic Electricity**

The word "electricity" is sometimes used to mean "Electrical energy". It is a form of energy which we use to power machines and electrical devices, Shown in Fig 1. Electricity is the presence and flow of electric charge that can be carried by wires. Movement of electric charge is electric current.

This electrical energy can be formed into another form of energy for example conversion of electrical energy to-:

- Light
- Heat
- Pressure
- Sound, etc.

It is a secondary energy source which means that we get it from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources.

**Did you know that most of the electricity generated in India comes from burning coal? Nearly 72% of the country's electricity is generated by using coal only.**

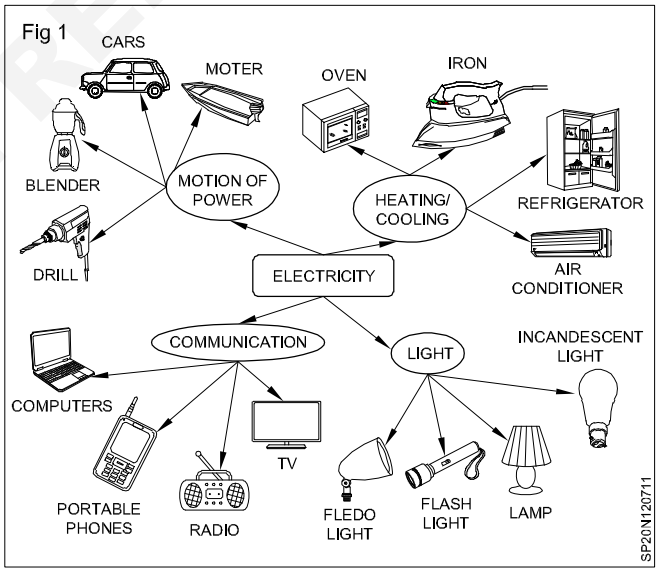
**Types of electricity**

Irrespective of how the electricity is generated it can be classified into two types:

1 Alternating Current

2 Direct Current

Fig 1



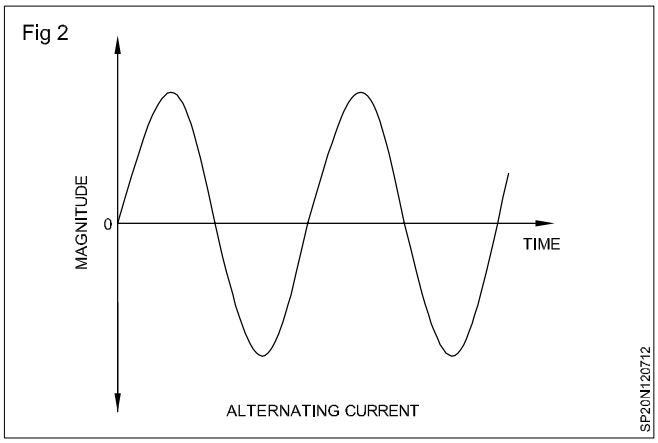

**1 Alternating Current**

In alternating current, the electric charges flow changes its direction periodically. The number of times that the current alternates in a period of one second is called the frequency 50Hz of alternation.The domestic voltage of 230 volts AC is called the Low tension (LT) voltage. AC is the most commonly used and most preferred electric power for household equipment, office, and buildings, etc.

Alternating current can be identified in waveform called a sine wave as shown in Fig 2.

In any electric Circuit the close path is required and, if current get the close path only then the current flows. Phase acts as main supply line while neutral acts like a return path for the circuit to be completed.

Fig 2

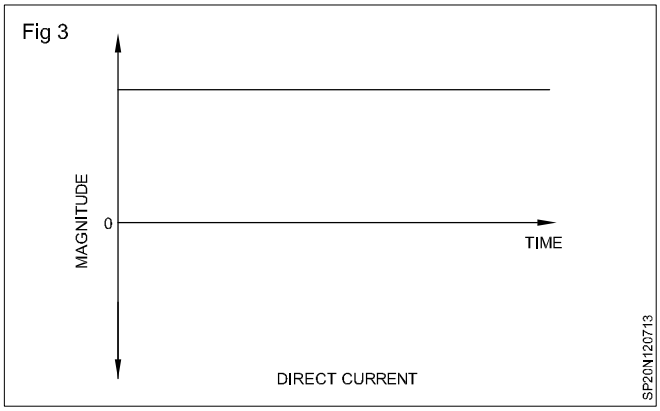



## 2 Direct Current

Unlike alternating current, the flow of direct current does not change periodically. The current electricity flows in a single direction in a steady voltage. The major use of DC is to supply power for electrical devices and also to charge batteries. Example: mobile phone batteries, flashlights, flat-screen television, and electric vehicles.Every DC source will always have polarity like positive and negative, where positive is denoted by red colour and negative is black colour.

Direct current can be identified in waveform as shown in Fig 3.

Fig 3




### Application circuits of AC and DC (Figs 4&5)

Fig 4

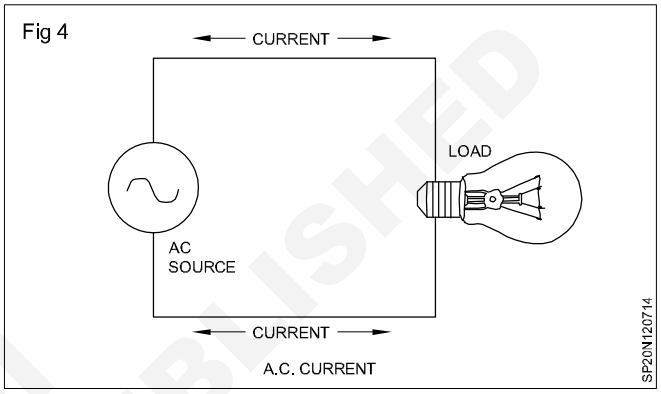



Fig 5

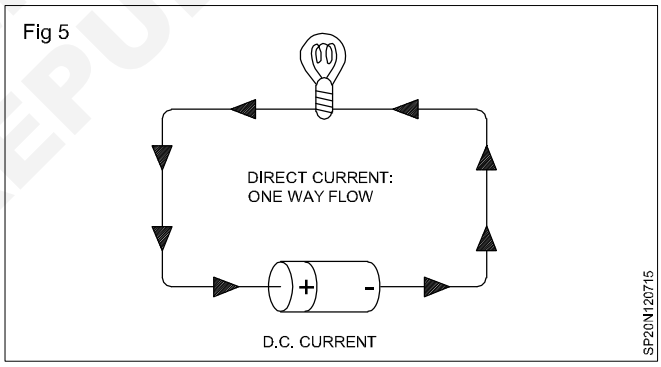





**Table 1**

**Differences between Alternating Current and Direct Current**

| Alternating Current | Direct Current |
|---|---|
| AC is safe to transfer longer distance even between two cities, and maintain the electric power. | DC cannot travel for a very long distance. It loses electric power. |
| The rotating magnets cause the change in direction of electric flow. | The steady magnetism makes DC flow in a single direction. |
| The frequency of AC is depended upon the country. But generally, the frequency is 50 Hz or 60 Hz. | DC has no frequency of zero frequency. |
| In AC the flow of current changes its direction backwards periodically. | It flows in a single direction steadily. |

| Alternating Current | Direct Current |
|---|---|
| Electrons in AC keep changing its directions – backward and forward | Electrons only move in one direction – that is forward. |
| **Symbol**  | **Symbol**  |

**Parameters of Electricity**

**Voltage**

Voltage is the pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop, enabling them to do work such as illuminating a light. In brief,

Voltage = Pressure, and it is measured in Volts (V).

We define voltage as the amount of potential energy between two points on a circuit. One point has more charge than another. This difference in charge between the two points is called voltage.

**Current**

Electric Current is the rate of flow of electrons in a conductor. The SI Unit of electric current is the Ampere. The symbolic representation of current is ( I).

Fig 7

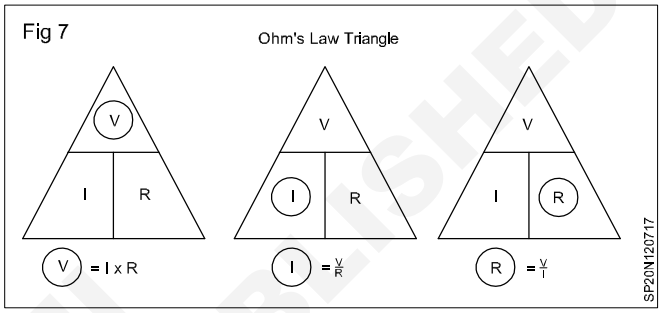
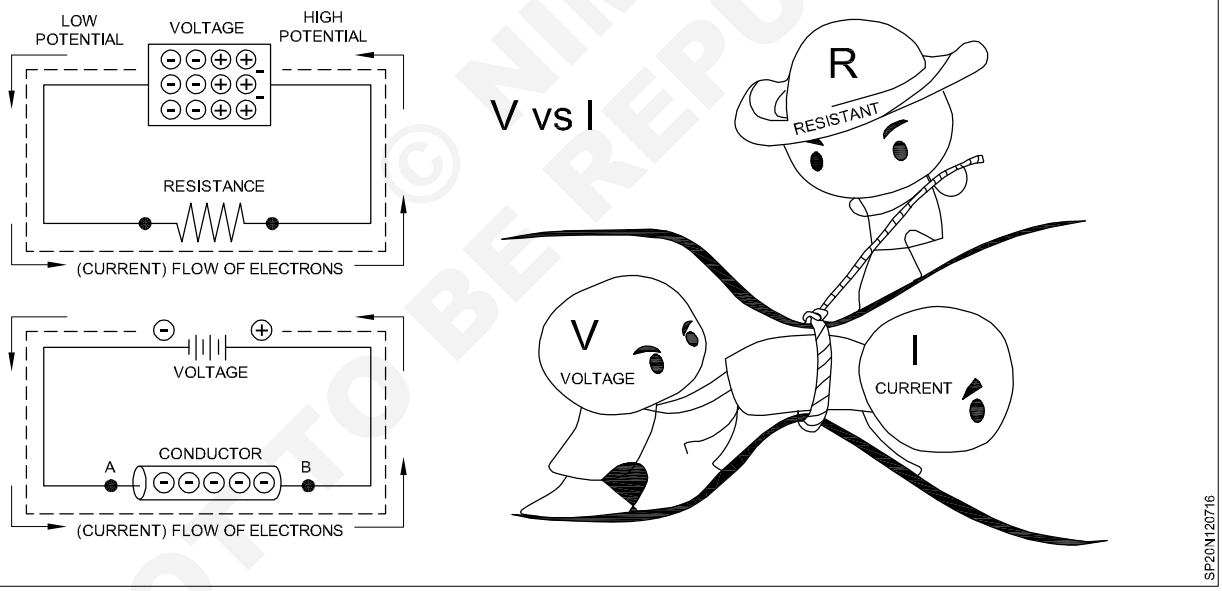



Fig 6






## Introduction to resistor

**Objectives:** At the end of this lesson you shall be able to
- **explain what resistor is**
- **explain the color code of resistor**
- **calculation of resistor values.**

**Resistance**

Resistance describes how easily charges flow through one object in comparison to any other object.

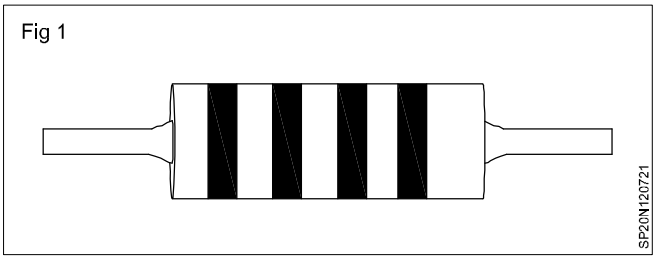
- High resistance equal to difficult for current to flow.
- Low resistance equal to easy flow of current.

There are many different types of Resistor available which can be used in both electrical and electronic circuits to control the flow of current or to produce a voltage drop in

many different ways. But in order to do this the actual resistor needs to have some form of “resistive” or “resistance” value. Resistors are available in a range of different resistance values from fractions of an Ohm (Ù) to millions of Ohms.

Resistors are manufactured in what are called “preferred values” with their resistance value printed onto their body in coloured ink. (Fig 1)

Fig 1



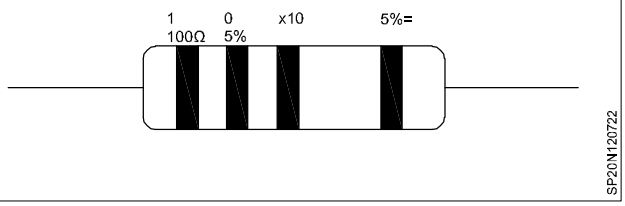

The “left-hand” or the most significant coloured band is the band which is nearest to a connecting lead with the colour coded bands being read from left-to-right as follows:

Digit, Digit, Multiplier = Colour, Colour x 10 $^{colour}$ in Ohm

For example, a resistor has the following-coloured markings; (Fig 2)

Yellow Violet Red = 4 7 2 = 4 7 x $10^2$ = 4700Ù or 4k7 Ohm.

Fig 2




| Color | 1st Digit | 2nd Digit | Multiplier | Tolerance |
|---|---|---|---|---|
| Black | 0 | 0 | x1 | |
| Brown | 1 | 1 | x10 | 1% |
| Red | 2 | 2 | x100 | 2% |
| Orange | 3 | 3 | x1000 | |
| Yellow | 4 | 4 | x10000 | |
| Green | 5 | 5 | x100000 | |
| Blue | | 6 | x1000000 | |
| Violet | 7 | 7 | | |
| Grey | 8 | 8 | Gold x0.1 | Gold 5% |
| White | 9 | 9 | Silver x0.01 | Silver 10% |

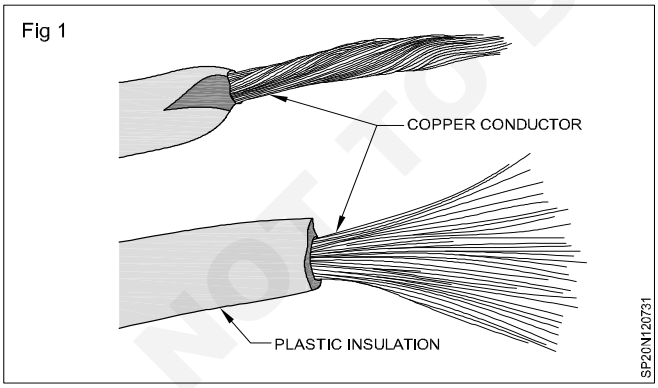
## Introduction to conductor, insulator & semi conductor

**Objectives:** At the end of this lesson you shall be able to
- **explain what is conductor, insulator & semiconductor**
- **identifying conductor, insulator & semiconductor.**

### Conductors (Fig 1)

The materials which can easily allow the flow of electric current through them are called as conductors. Material such as metals like copper, iron, silver aluminium etc, these are of good conductors of electricity.

Fig 1




### Insulators (Fig 2)

The materials which do not allow the flow of electric current through them are called as insulators. These insulators are also called as poor conductors of electricity

### Semiconductors (Fig 3)

The materials which have electrical conductivity between that of a conductor and an insulator is called as semiconductor. Silicon, Germanium and graphite are some examples of semiconductors.

Fig 2

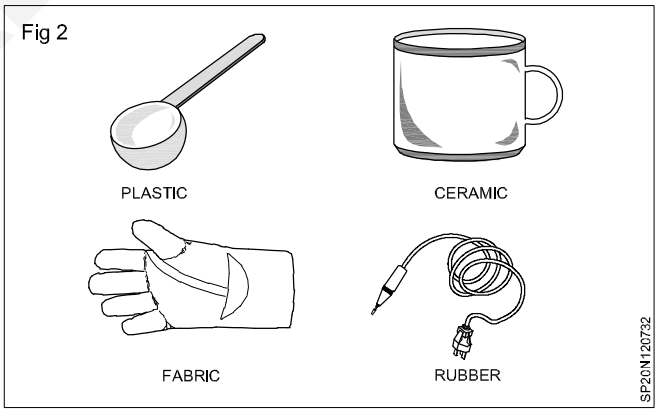
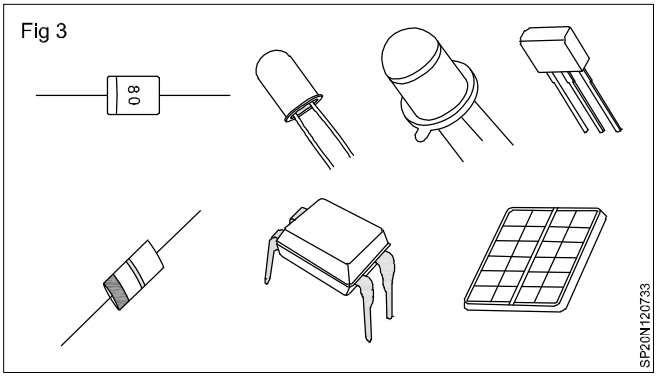



Fig 3



# Introduction to diode

**Objectives:** At the end of this lesson you shall be able to
- **explain what is diode**
- **types of diode.**

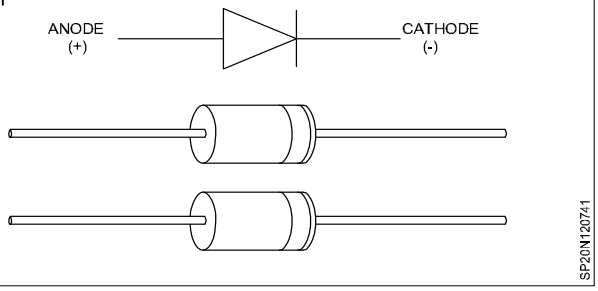
### Diodes (Fig 1)

Made from a combination of 2 extrinsic semiconductors, P-type and N-type material. The joint between the P-type and N-type material is called PN

junction. These diodes have two terminals (anode as "A" and cathode as "K"). These diodes are manufactured from the silicon wafer.

Diodes are commonly used in DC power supply units as a rectifiers and voltage regulators circuit. It comes in different shape and sizes.

Fig 1




### The PN junction

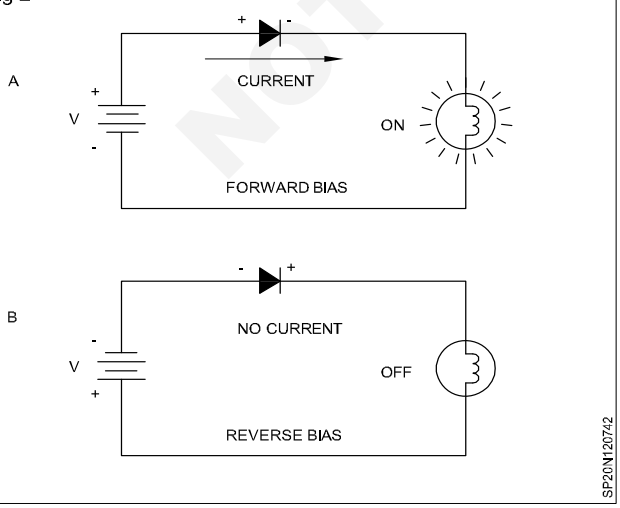
A Semiconductor diode consists of an N material region and a Pmaterial region separated by a PN junction.

- The N region has many conduction electrons.
- The P region has many holes.

As a result of recombination, a large number of positive (in the n region) and negative (in the p region) ions builds up near the PN junction, essentially depleting the region of any conduction electrons or holes.

- Forward bias is the condition that permits current through a diode. (Fig 2)
- Reverse bias is the condition that prevents current through the diode. (Fig 2)

Fig 2

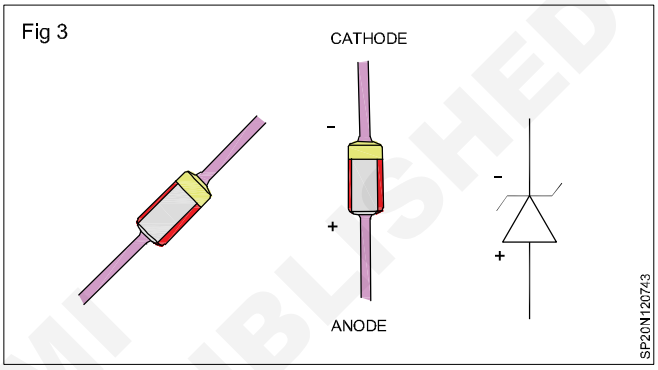



### Zener diodes

The Zener diode is used to provide an output reference voltage that is stable despite changes in input voltage. (Fig 3)

- Used as a reference in regulated power supplies.
- The Zener diode is designed for operation in the reverse breakdown region, where the voltage remains almost constant over a wide range of reverse current values.

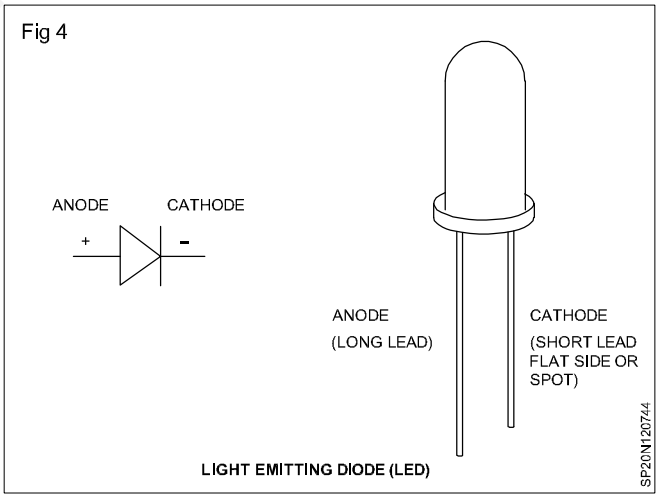
Fig 3




### Llight emitting diodes (LED)

A Light Emitting Diode (LED) generates light in a semi-conductor material, which is an electronic component. Using the right materials, a diode may produce visible light of various wavelengths. LED technology is a sensible alternative to traditional light sources in many applications. (Fig 4)

Fig 4

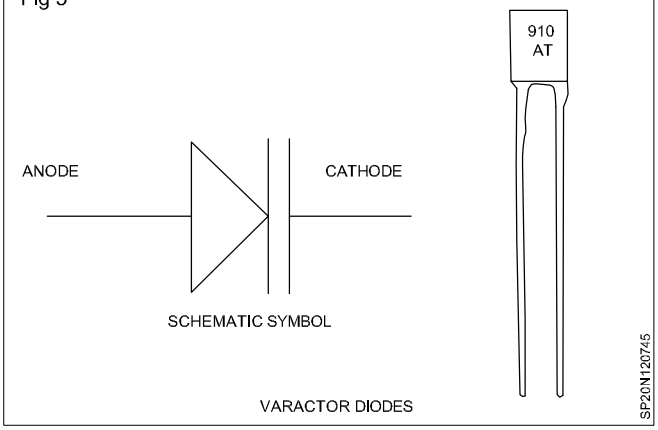



### Varactors diodes

A varactor diode utilizes the inherent capacitance of the depletion region of a reverse-biased pn junction to vary capacitance by changing the reverse voltage. (Fig 5)

- The p and n regions are conductive, and act as the capacitor plates.
- The depletion layer created by the reverse bias acts as a capacitor dielectric because it is nonconductive.
- As the reverse bias increases, the depletion region widens, and the capacitance across the diode decreases.
- As the reverse bias decreases, the depletion region narrows, and the capacitance across the diode increases.

Fig 5




## Introduction to rectifiers

**Objectives:** At the end of this lesson you shall be able to
- **explain what are rectifiers**
- **types of rectifiers**
- **understand the working principle of half, full and bridge rectifier.**

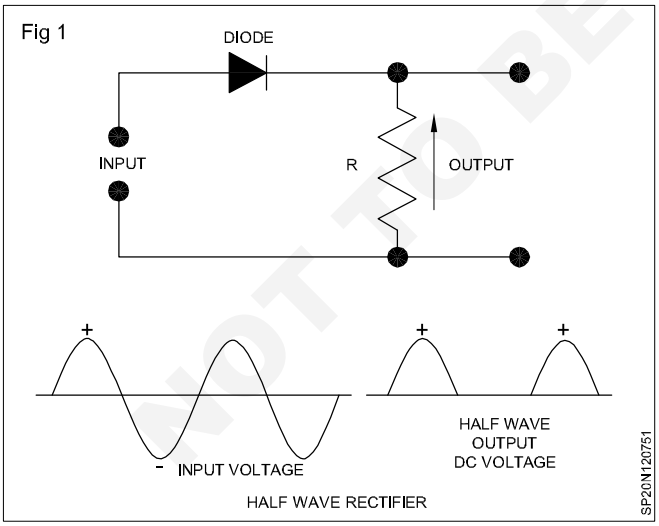
### Rectifiers

- **Half Wave Rectifier (Fig 1)**

A diode is connected to an ac source that provides the input voltage, V, and to a in load resistor, RL, forming a half-wave rectifier.

- On the positive half cycle, the diode is forward biased.
- This results in a half-wave output voltage with a peak value that is 0.7 V less than the peak value of the input voltage.

Fig 1




- **Full Wave Rectifier (Fig 2)**

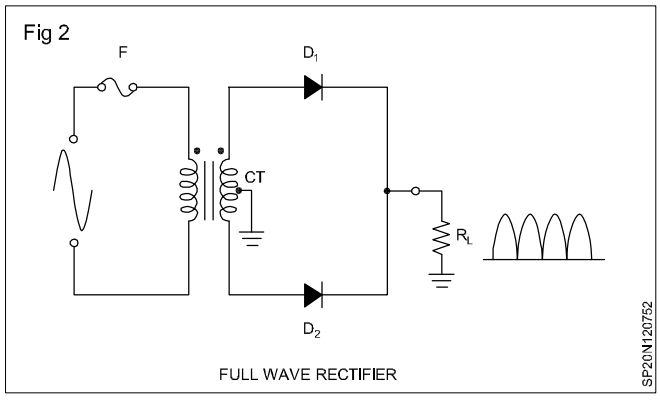
Can produce ripple voltage during both positive and negative input cycle. There are 2 types of full wave rectifier:

- Two diodes full wave rectifier.
- Bridge rectifier.

The full-wave rectifier is the equivalent of two half-wave rectifiers.

According to the circuit of two diodes full wave rectifier, diode no. 1 will allow current to flow during the positive half of the AC sine wave, and diode no. 2 will allow current to flow during the negative half of the AC sine wave. Both diodes will provide a positive going peak voltage to the load ($R_L$).

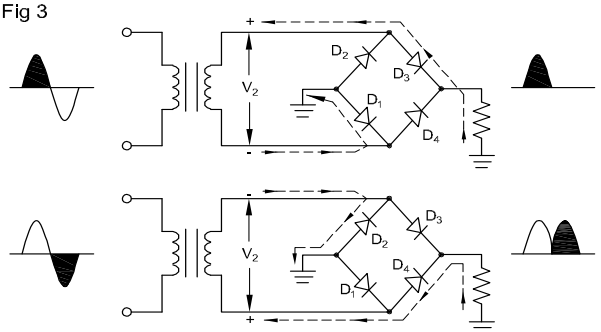
Fig 2



- **Full wave bridge rectifier (Fig 3)**

The full-wave bridge rectifier is designed to convert an AC sine-wave to a full-wave pulsating DC signal. The bridge is normally connected to the secondary of the transformer. The construction of a bridge rectifier is shown in the figure below. The bridge rectifier circuit is made of four diodes $D_1$, $D_2$, $D_3$, $D_4$. The four diodes are connected in a closed-loop configuration to efficiently convert the alternating current (AC) into Direct Current (DC). The main advantage of this configuration is the absence of the expensive centre-tapped transformer. Therefore, the size and cost are reduced.

Fig 3




FULL WAVE BRIDGE RECTIFIER

## Introduction to capacitor

**Objectives:** At the end of this lesson you shall be able to
- **explain what are capacitors**
- **types of capacitors**
- **calculation of capacitor value**

### Capacitors

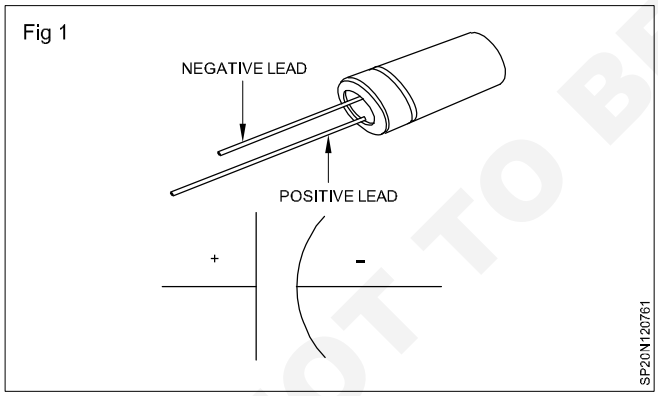
In every electronic or electrical circuit, a capacitor plays a key role. So, every day, the production of different types of capacitors can be done from thousands to millions. Each kind of capacitor includes its benefits, drawbacks, functions & applications.

### Types of capacitors

- **Electrolytic Capacitors**

  These are generally used in DC power supply circuits due to their large capacitances and small size to help reduce the ripple voltage or for coupling and decoupling applications. (Fig 1)

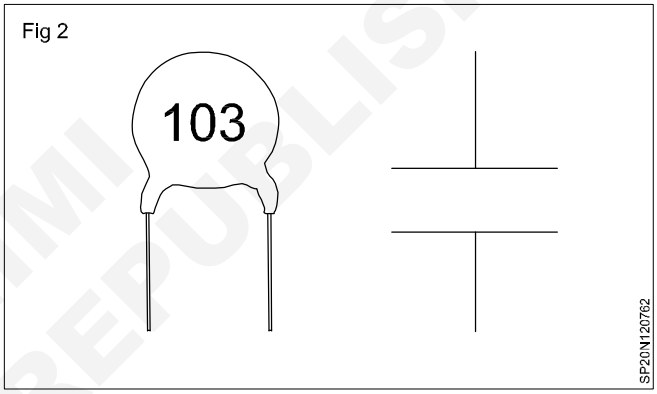
Fig 1




- **Ceramic Capacitors**

  Also known as disc capacitors, these capacitors are made by coating two sides of a small porcelain or ceramic disc with silver and are then stacked together to make a capacitor. (Fig 2)

Fig 2




**Ceramic Disc Capacitor Values (Fig 3)**

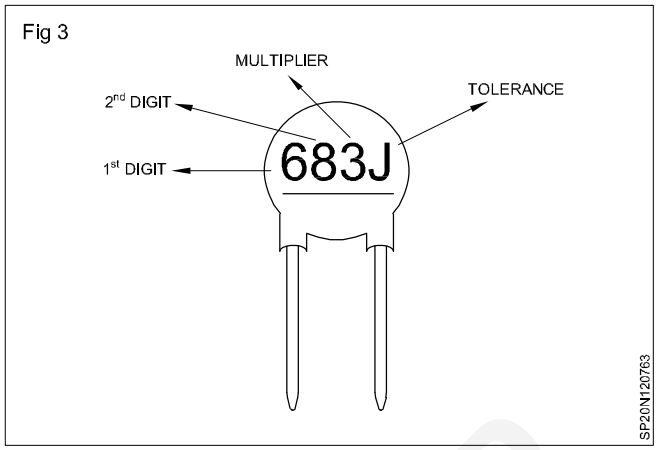
Ceramic disc capacitor code normally consists of a three-digit number followed by a letter. It is very easy to decode to find the capacitor value.

The first two significant digits signify the first two digits of the actual capacitance value, which is 47. The third digit is the multiplier (3), which is ×1000. The letter J implies the tolerance of ±5 %. Since this is the EIA coding system, the value will be in picofarads. Therefore, the value of the capacitor above is 47000 pF ±5 %.

| 1st Digit | 2nd Digit | 3rd Digit (Multiplier x) | Tolerance Letter |
|---|---|---|---|
| 0 | 0 | 0 x1 | C ±0.25 pF |
| 1 | 1 | 1 x10 | D ±0.5 pF |
| 2 | 2 | 2 x100 | E ±1 pF |
| 3 | 3 | 3 x1000 | G ±2 % |
| 4 | 4 | 4 x10000 | J ±5 % |
| 5 | 5 | 5 x100000 | K ±10 % |
| 6 | 6 | 6 x1000000 | L ±15 % |
| 7 | 7 | 7 x10000000 | M ±20 % |
| 8 | 8 | 8 x100000000 | N ±30 % |
| 9 | 9 | 9 x1000000000 | Z+80% to 20% |

For example, if a capacitor is marked as 683J, its value is 68000 pF ±5%.

Fig 3



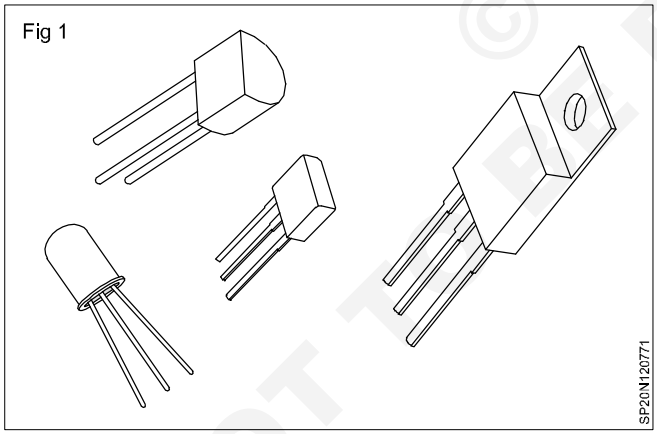

## Introduction to transistor

**Objectives:** At the end of this lesson you shall be able to
- **explain what are transistors**
- **types of transistors**
- **applications off transistors.**

### Transistor

Beside diodes, the most popular semiconductor devices are transistors, for example Bipolar Junction Transistor (BJT). Transistors are more complex and can be used in many ways. Most important feature of transistor is that it can amplify signals and can also be used as switch. (Fig 1)

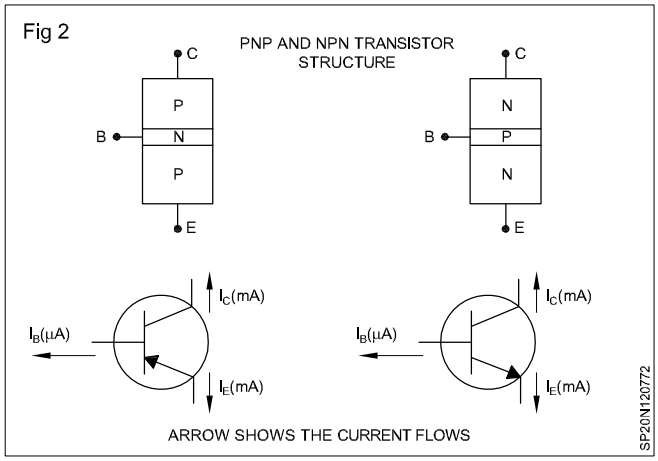
Fig 1




### Transistor Structure (Fig 2)

- BJT is bipolar because both holes (+) and electrons (-) will take part in the current flow through the device.
  - N-type regions contains free electrons (negative carriers).
  - P-type regions contains free holes (positive carriers).
- 2 types of BJT
  - NPN transistor
  - PNP transistor
- The transistor regions are:
  - Emitter (E) – send the carriers into the base region and then on to the collector.
  - Base (B) – acts as control region. It can allow none, some or many carriers to flow.
  - Collector (C) – collects the carriers

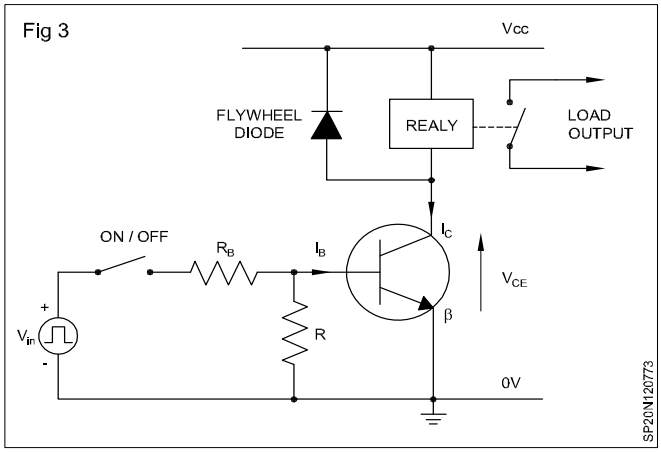
Fig 2




### Transistor as a switch (Fig 3)

- Transistor switches can be used to switch and control lamps, relays or even motors.
- When using the bipolar transistor as a switch they must be either “fully-OFF” or “fully-ON”.
- When using the transistor as a switch, a small Base current controls a much larger Collector load current.
- When using transistors to switch inductive loads such as relays and solenoids, a “Flywheel Diode” is used.

- When large currents or voltages need to be controlled, Darlington Transistors can be used.




**Transistor as an amplifier (Fig 4)**

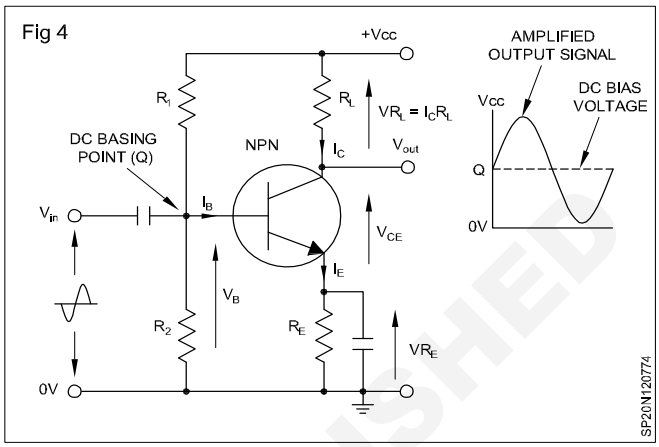
A transistor acts as an amplifier by raising the strength of a weak signal. The DC bias voltage applied to the emitter base junction, makes it remain in forward biased condition. This forward bias is maintained regardless of the polarity of the signal.

For a transistor to act as an amplifier, it should be properly biased.

As the common emitter mode of connection is mostly adopted.

The gain in terms of current when the changes in input and output currents are observed, is called as Current gain.

The gain in terms of voltage when the changes in input and output currents are observed, is called as Voltage gain.



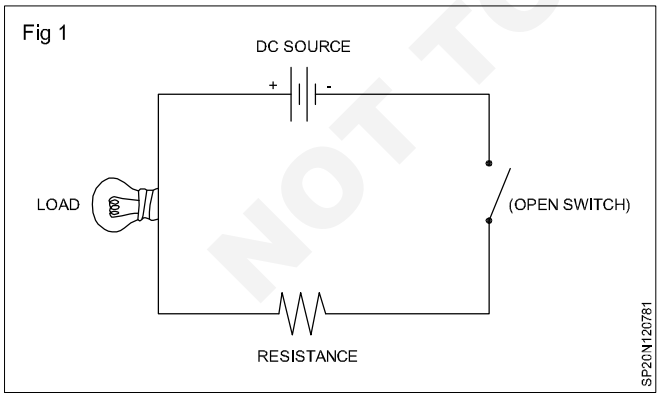

## Open and closed circuit

**Objectives:** At the end of this lesson you shall be able to
- **explain what are open and closed circuit**
- **what is relay**
- **applications of relay.**

**Open Circuit**

In Open Circuit, the electric current (charged particles) does not flow from an active energy source to the connected load or other components due to the incomplete path. (Fig 1)

If any components disconnect or break from the circuit, this circuit works as the open circuit. Sometimes, the open circuit shows like OFF condition or fault condition.




**Example of Open Circuit**

Suppose we have connected DC supply battery with the connected bulb as load, resistance and switch. When the switch is open, the electric current does not flow from the source (battery) to the desired load (light) Thus, this circuit does not conduct the electricity and zero potential difference occurs between two terminals of open switch due to the incomplete the path.

**Closed Circuit**

In a closed circuit, the electric current (charged particles) flows from an active energy source to the connected load or other components due to the closed-loop path. (Fig 2)

**Example of Closed Circuit**

Suppose, DC voltage supply battery is connected with the light (like load) and closed switch. Due to closed switch, the circuit makes the complete path to flow electric current.

**Relay**

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet a coil of wire that becomes a temporary magnet when electricity flows through it. It is the device that open or closes the contacts to cause the operation of the other electric control. (Fig 3)

Fig 2

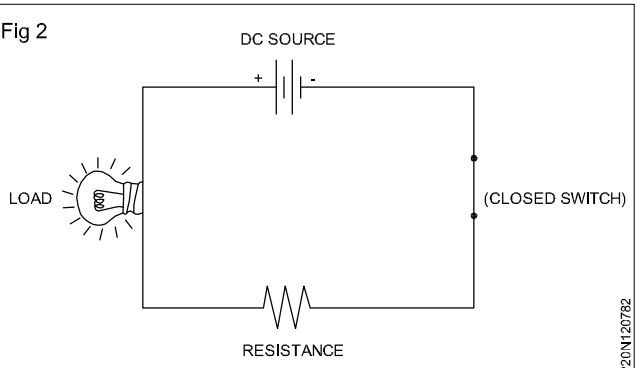
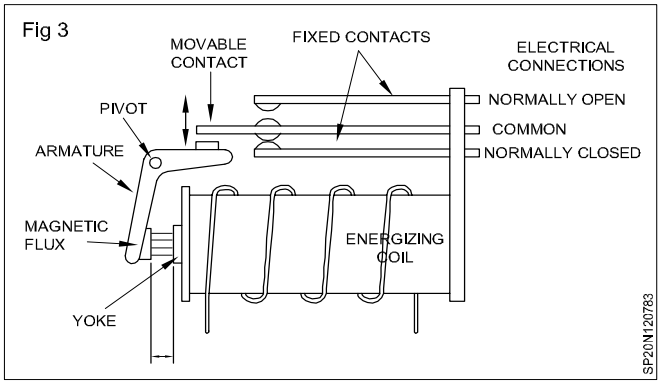



Fig 3




**Application of Relay**

They are used for controlling multiple circuits.

## Introduction to transformer

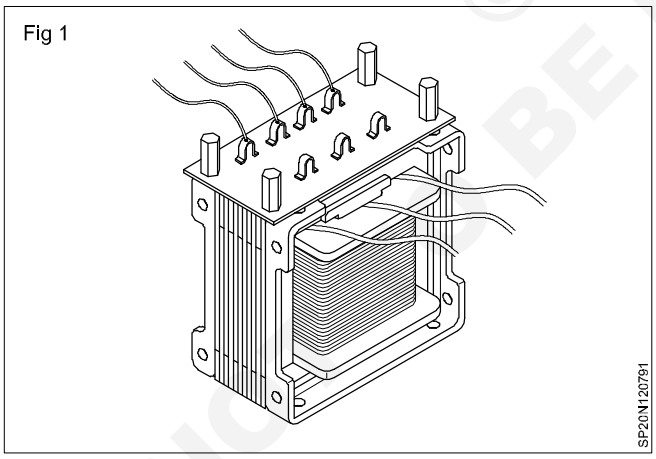
**Objectives:** At the end of this lesson you shall be able to

- **explain what are transformers**
- **working of transformer**
- **construction of a transformer.**

### Transformer

In most cases, appliances are manufactured to work under some specific voltages. Transformers are used to adjust the voltages to a proper level. The transformers are the basic components for the transmission of the electricity. Transformer is used to increase the voltage at the power generating station (Step up) and used to decrease the voltage (Step down) for household purpose. By increasing the voltages, the loss of the electricity in the transmission purpose is minimized. (Fig 1)

Fig 1




Transformer is a static device. It transfers electrical energy from one part of the electrical or electronic circuit to other part of circuit without changing the frequency. It works on the principle Faradays law of Electromagnetic Mutual Induction. (Fig 2)

### Working principle of Transformer

It works on the principle of Electromagnetic Mutual Induction. (Fig 3)

When the current is provided to the Primary Winding it behaves as electromagnet due to this the EMF is induced in the Secondary winding as it comes in the area having magnetic field lines due to primary Winding.

Fig 2

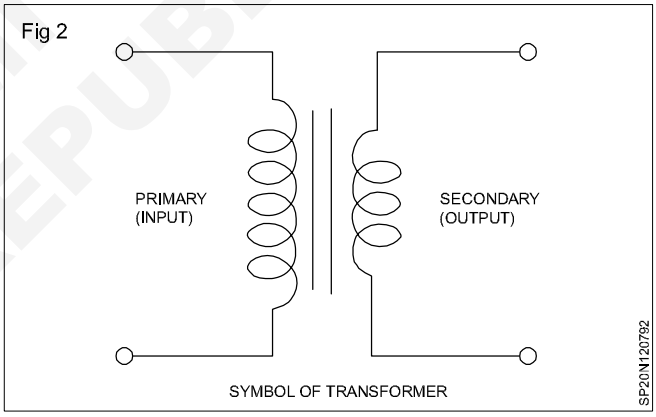
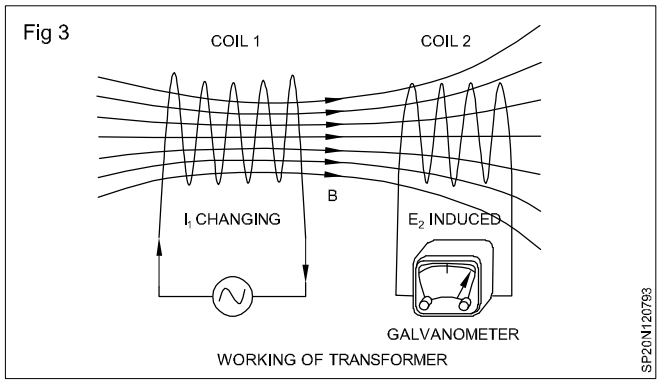


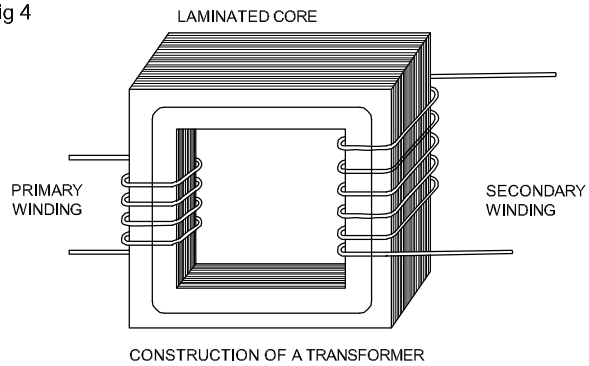

Fig 3




### Construction of Transformer (Fig 4)

- Laminated Core.
- Windings or coil of wires.
- (Primary and Secondary)

Fig 4




CONSTRUCTION OF A TRANSFORMER

**Basis of Windings**

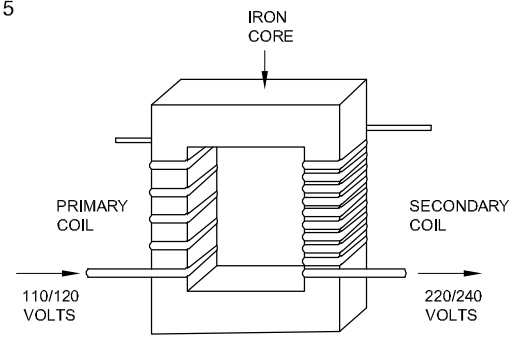
**1 Step up Transformer (Fig 5)**

The number of windings or turns on the Primary side of the transformer are less than the number of windings on the secondary side.

**2 Step down Transformer (Fig 6)**

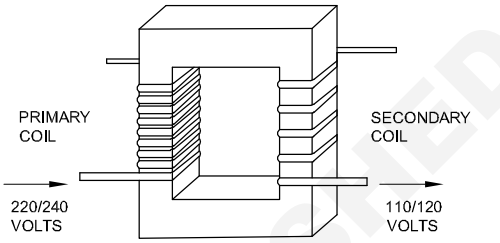
The number of windings or turns on the Primary side of the transformer are more than the number of windings on the secondary side.

Fig 5




STEP UP TRANSFORMER

Fig 6




STEP DOWN TRANSFORMER



# Introduction to multimeters

**Objectives:** At the end of this lesson you shall be able to
- **explain what mulitmeters**
- **distinguish between multimeters**
- **express the features of multimeters.**

**Multimeteres**

Multimeter is a measuring instrument that is practically essential in electronics.It is also known as a multitester or VOM (Volt-Ohm Mili ammeter). It is an all-in-one electronic measuring instrument that combines several measurement functions. Thus, it'll be able to troubleshoot issues with your circuit or electronic designs.

There are two types of multimeter, but a typical multimeter is capable of measuring voltage, current and resistance.

**1 Analog Multimeter (Fig 1)**

The analog multimeters are more responsive to changes than digital multimeters, thus it is able to give a more accurate reading. However, because it is so sensitive, this makes it hard to read and gives delays.

**2 Digital Multimeter (Fig 2)**

Digital Multimeter is used to compute various electrical quantities like voltage, current, capacitance, resistance, values of diode and impedance, etc. This meter provides the reading in the form of numeric on an LCD. Digital multimeters are very accurate in displaying measurements. This multimeter shows a negative quantity once the polarity is reversed.

Fig 1

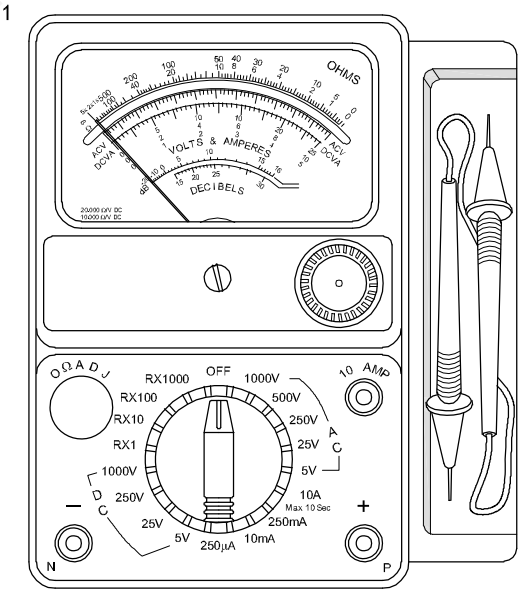


Fig 2


Some of the features that makes the Digital Multimeter more usable for measuring electrical values.

- Auto Range.
- A Back Lit LCD Display.
- Auto OFF.
- Decent Probes.
- Auto Polarity.
- Low Battery Indicator.

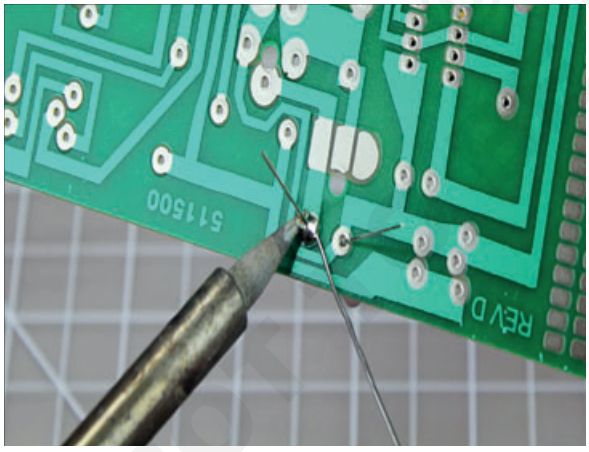
## Tools and materials required for soldering and desoldering

**Objectives:** At the end of this lesson you shall be able to
- **explain what is soldering and desoldering**
- **state basic tools and materials required for soldering and desoldering.**

### What is soldering?

Soldering is a joining process used to join different types of metals together by melting solder. Solder is a metal alloy usually made of tin and lead which is melted using a hot iron. The iron is heated to temperatures above 600 degrees Fahrenheit which then cools to create a strong electrical bond. (Fig 1)

Fig 1



In soldering, there are four key elements:

Soldering Iron, Solder,Flux, And Component, they all are important.Flux cored solder wire is used for hand soldering.

### Basic tools required for soldering

### Soldering Iron with stand (Fig 2)

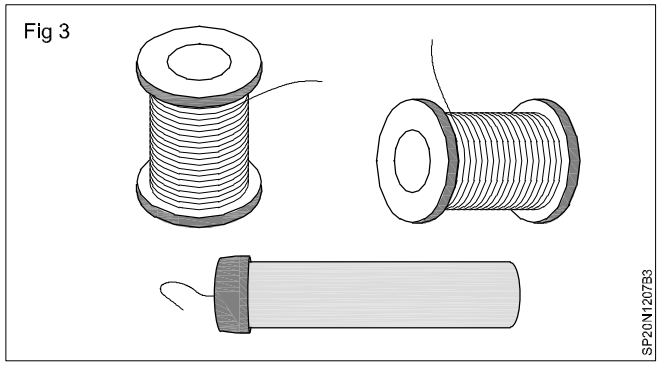
A soldering iron is a hand tool that plugs into a standard AC outlet and heats up in order to melt solder around electrical connections. The voltage can be adjusted from (0V to 12V) which is the soldering voltage used for mobile PCB.

Fig 2

### Solder (Fig 3)

Solder is a metal alloy material that is melted to create a permanent bond between electrical parts. It comes in both lead and lead-free variations.

Fig 3

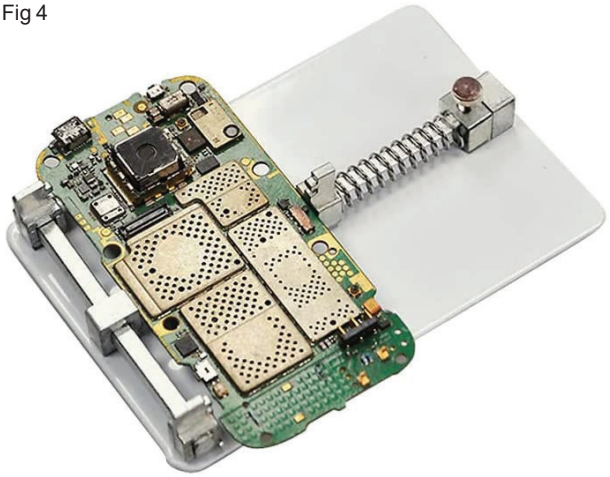


Inside the solder core is a material known as flux which helps improve electrical contact and its mechanical strength.

**PCB or Holder (Fig 4)**

A PCB holder is a device that has 2 or more alligator clips and sometimes a magnifying glass/light attached. These clips will assist you by holding the items you are trying to solder while you use the soldering iron and solder. A very helpful tool to have at your work station

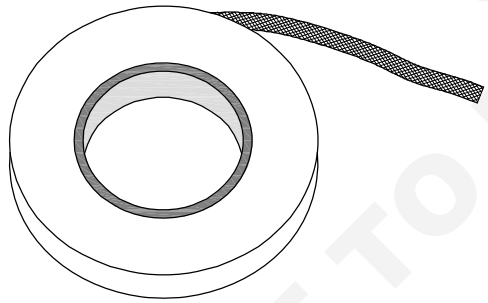
Fig 4



**Desoldering Wick (Fig 5)**

To desolder a joint, you will need solder wick which is also known as desoldering braid. Place a piece of the desoldering braid on top of the joint/solder you want removed. Heat your soldering iron and touch the tip to the top of the braid. This will heat the solder below which will then be absorbed into the desoldering braid.

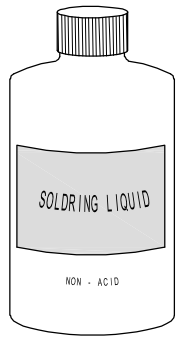
Fig 5




**Liquid flux (Fig 6)**

Liduid flux used for soldering SMD components. It is used to clean PCB track and legs (or) pins of electronic components while soldering.

Fig 6




**Soldering Safety - Smoke absorber (Fig 7)**

It's time to briefly discuss ways of staying safe while soldering. Make sure you are soldering in a well-ventilated area. When solder is heated, there are fumes released that are harmful to your eyes and lungs. It's recommended to use a fume extractor which is a fan with a charcoal filter that absorbs the harmful solder smoke.

Fig 7


## Number system

**Objectives:** At the end of this lesson you shall be able to
- **explain what are number system**
- **types of number system**
- **overview of digital IC & T-T-L, concept of CMOS.**

**Number System**

In a digital system, the system can understand only the optional number system. In these systems, digits symbols are used to represent different values, depending on the index from which it settled in the number system. In simple terms, for representing the information, we use the number system in the digital system.

**Types of Number System (Fig 1)**

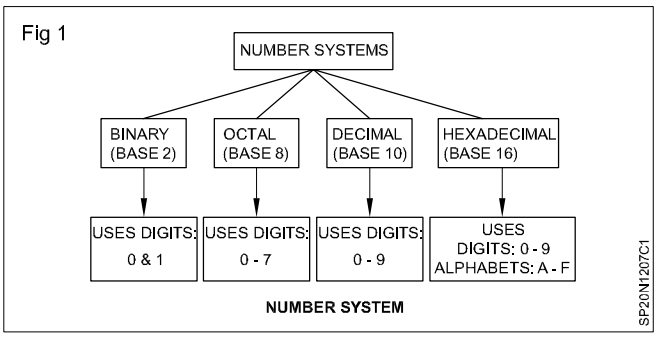
In the digital computer, there are various types of number systems used for representing information.

1 Binary Number System

2 Octal Number System

3 Decimal Number System

4 Hexadecimal Number System




**1 Binary Number System**

Generally, a binary number system is used in the digital computers. In this number system, it carries only two digits, either 0 or 1. There are two types of electronic pulses present in a binary number system. The first one is the absence of an electronic pulse representing '0'and second one is the presence of electronic pulse representing '1'. Each digit is known as a bit. A four-bit collection (1101) is known as a nibble, and a collection of eight bits (11001010) is known as a byte. The location of a digit in a binary number represents a specific power of the base (2) of the number system.

**Characteristics**

- It holds only two values, i.e., either 0 or 1.
- It is also known as the base 2 number system.
- The position of a digit represents the 0 power of the base (2). Example: $2^0$
- The position of the last digit represents the x power of the base (2). Example: $2^x$, where x represents the last position, i.e., 1

Examples:

$(10100)_2, (11011)_2, (11001)_2, (000101)_2, (011010)_2$.

**2 Octal Number System**

The octal number system has base 8(means it has only eight digits from 0 to 7). There are only eight possible digit values to represent a number. With the help of only three bits, an octal number is represented. Each set of bits has a distinct value between 0 and 7.

Below, we have described certain characteristics of the octal number system:

**Characteristics**

- An octal number system carries eight digits starting from 0, 1, 2, 3, 4, 5, 6, and 7.
- It is also known as the base 8 number system.
- The position of a digit represents the 0 power of the base (8). Example: $8^0$
- The position of the last digit represents the x power of the base (8). Example: $8^x$, where x represents the last position, i.e., 1

Examples:

(273)8, (5644)8, (0.5365)8, (1123)8, (1223)8.

**3 Decimal Number System**

The decimal numbers are used in our day-to-day life. The decimal number system contains ten digits from 0 to 9(base 10). Here, the successive place value or position, left to the decimal point holds units, tens, hundreds, thousands, and so on.

The position in the decimal number system specifies the power of the base (10). The 0 is the minimum value of the digit, and 9 is the maximum value of the digit. For example, the decimal number 2541 consist of the digit 1 in the unit position, 4 in the tens position, 5 in the hundreds position, and 2 in the thousand positions and the value will be written as:

$(2\times1000) + (5\times100) + (4\times10) + (1\times1)$

$(2\times10^3) + (5\times10^2) + (4\times10^1) + (1\times10^0)$

2000 + 500 + 40 + 1

2541

**4 Hexadecimal Number System**

It is another technique to represent the number in the digital system called the hexadecimal number system. The number system has a base of 16 means there are total 16 symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F) used for representing a number. The single-bit representation of decimal values10, 11, 12, 13, 14, and 15 are represented by A, B, C, D, E, and F. Only 4 bits are required for representing a number in a hexadecimal number. Each set of bits has a distinct value between 0 and 15. There are the following characteristics of the octal number system:

**Characteristics**

- It has ten digits from 0 to 9 and 6 letters from A to F.
- The letters from A to F defines numbers from 10 to 15.
- It is also known as the base 16number system.
- In hexadecimal number, the position of a digit represents the 0 power of the base (16). Example: $16^0$
- In hexadecimal number, the position of the last digit represents the x power of the base (16). Example: $16^x$, where x represents the last position, i.e., 1

Examples:

$(FAC2)_{16}, (564)_{16}, (0ABD5)_{16}, (1123)_{16}, (11F3)_{16}$.

**Overview of Digital IC & T-T-L, Concept of CMOS**

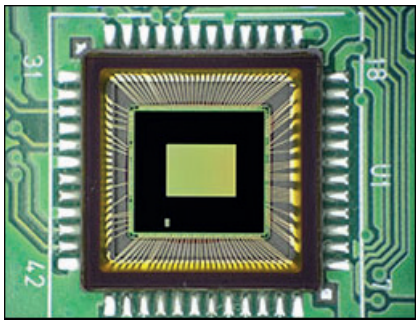
This invention spread like wild fire since ICs were more reliable, compact and could also save power compared to

the conventional circuits used then. Soon this spread like wild fire and every company started fabricating and adapting Integrated circuits which lead to the modern electronics as we know today. There are many fabrication techniques used in IC manufacturing the two most popular types are the Transistor Transistor Logic (TTL) which got introduced in 1963 and the Complementary Metal Oxide Semiconductor (CMOS) which got introduced in 1968.

**What is CMOS?**

CMOS is the shortened form for Complementary Metal Oxide Semiconductor and it is a technology for fabricating the IC's which are used in various applications. CMOS is the most common MOSFET fabrication type, it uses the complementary and symmetrical pairs of the P-type and N-type Metal Oxide Field effect transistors for performing the logic functions. (Fig 2)

Fig 2

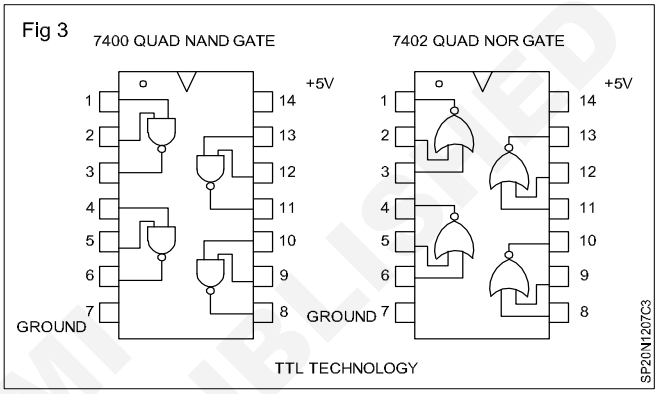


Various types of Integrated circuits are constructed using the CMOS technology like the microprocessors, microcontrollers, memory chips and several other digital logic circuits. In static analog circuits like the data converters, image sensors, and transceivers, this technology is used widely. CMOS propagates both logics, high and low or the 0 and 1.

**What is TTL?**

TTL stands for Transistor-transistor Logic. It is a logic family made up of bipolar junction transistors (BJTs). Here, both the functions (logic and amplifying) are performed by the transistors; therefore, it is named as the Transistor-Transistor Logic. An ideal example of TTL logic IC would be Logic Gate ICs like the 7400 NAND or the 7402 NOR Gate. (Fig 3)

Fig 3




## Logic gates

**Objectives:** At the end of this lesson you shall be able to

- **familiarize different types of logic gates**
- **types of logic gates IC**
- **state the truth table.**

**Logic Gates**

A logic gate is a basic building block of a digital circuit that has two inputs and one output. The relationship between the i/p and the o/p is based on a certain logic. These gates are implemented using electronic switches like transistors, diodes. But, in practice, basic logic gates are built using CMOS technology, FETS, and MOSFET (Metal Oxide Semiconductor FET) s. Logic gates are used in microprocessors, microcontrollers, embedded system applications, and in electronic and electrical project circuits. The basic logic gates are categorized into seven: AND, OR, XOR, NAND, NOR, XNOR, and NOT. These logic gates with their logic gate symbols and truth tables are explained below.

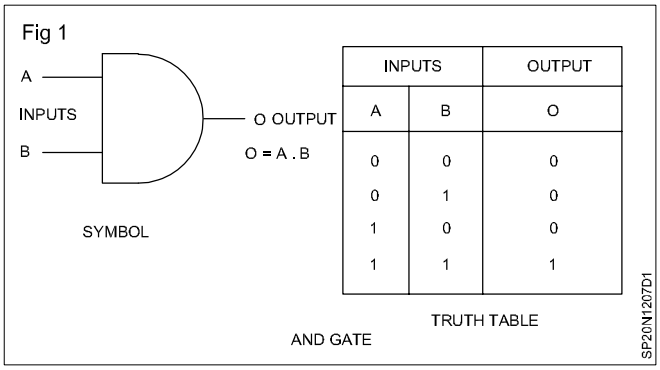
**Types of Logic Gates**

The different types of logic gates and symbols with truth tables are discussed below.

**1 AND Gate**

The AND gate is a digital logic gate with 'n' i/ps one o/p, which performs logical conjunction based on the combinations of its inputs. The output of this gate is true only when all the inputs are true. When one or more inputs of the AND gate's i/ps are false, then only the output of the AND gate is false. The symbol and truth table of an AND gate with two inputs is shown in Fig 1.

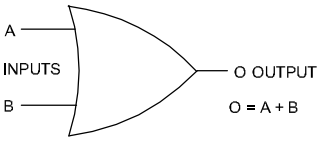
Fig 1




**2 OR Gate**

The OR gate is a digital logic gate with 'n' i/ps and one o/p, that performs logical conjunction based on the combinations of its inputs. The output of the OR gate is true only when one or more inputs are true. If all the i/ps of the gate are false, then only the output of the OR gate is false. The symbol and truth table of an OR gate with two inputs is shown in Fig 2.

Fig 2




SYMBOL

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | O |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

TRUTH TABLE

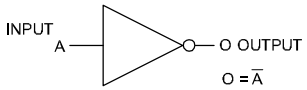
OR GATE

SP20N1207D2

## 3 NOT Gate

The NOT gate is a digital logic gate with one input and one output that operates an inverter operation of the input. The output of the NOT gate is the reverse of the input. When the input of the NOT gate is true then the output will be false and vice versa. The symbol and truth table of a NOT gate with one input is shown in Fig 3. By using this gate, we can implement NOR and NAND gates

Fig 3




SYMBOL

| INPUTS | OUTPUT |
|---|---|
| A | O |
| 0 | 1 |
| 1 | 0 |

TRUTH TABLE

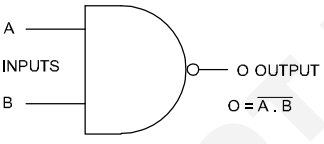
NOT GATE

SP20N1207D3

## 4 NAND Gate

The NAND gate is a digital logic gate with 'n' i/ps and one o/p, that performs the operation of the AND gate followed by the operation of the NOT gate. AND gate is designed by combining the AND and NOT gates. If the input of the NAND gate high, then the output of the gate will be low. The symbol and truth table of the NAND gate with two inputs is shown in Fig 4.

Fig 4




SYMBOL

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | O |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

TRUTH TABLE

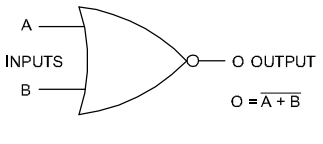
NAND GATE

SP20N1207D4

## 5 NOR Gate

The NOR gate is a digital logic gate with n inputs and one output, that performs the operation of the OR gate followed by the NOT gate. NOR gate is designed by combining the OR and NOT gate. When any one of the i/ps of the NOR gate is true, then the output of the NOR gate will be false. The symbol and truth table of the NOR gate with the truth table is shown in Fig 5.

Fig 5




SYMBOL

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | O |
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

TRUTH TABLE

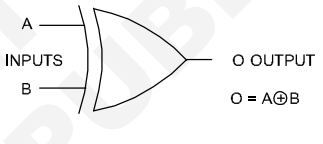
NOR GATE

SP20N1207D5

## 6 Exclusive-OR Gate

The Exclusive-OR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-OR. It performs based on the operation of the OR gate. If any one of the inputs of this gate is high, then the output of the EX-OR gate will be high. The symbol and truth table of the EX-OR are shown in Fig 6.

Fig 6




SYMBOL

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | O |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

TRUTH TABLE

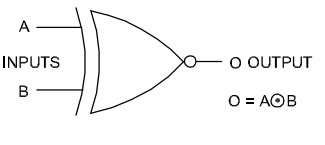
EX - OR GATE

SP20N1207D6

## 7 Exclusive-NOR Gate

The Exclusive-NOR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-NOR. It performs based on the operation of the NOR gate. When both the inputs of this gate are high, then the output of the EX-NOR gate will be high. But, if any one of the inputs is high (but not both), then the output will be low. The symbol and truth table of the EX-NOR are shown in Fig 7.

Fig 7




SYMBOL

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | O |
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

TRUTH TABLE

EX - NOR GATE

SP20N1207D7

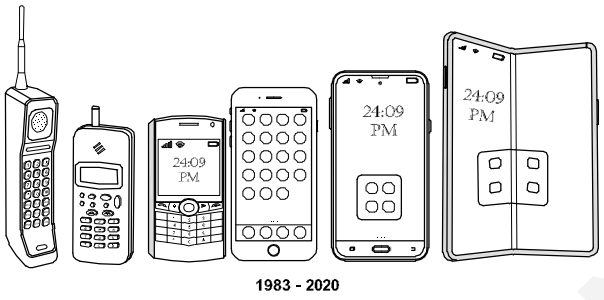
# Evolution of mobile phone and basics of mobile communication

**Objectives:** At the end of this lesson you shall be able to
- **describe the history of mobile phone**
- **state the features of various mobile phone**
- **define the basic of mobile communication**
- **state the features of mobile communication.**

### Evolution of the Mobile Phone

From simple to smart, mobile phones have transformed dramatically to become information and communication hubs fundamental to modern life. But how did they get to be this advanced? Scroll through the timeline to see how and when phone technology evolved. (Fig 1)

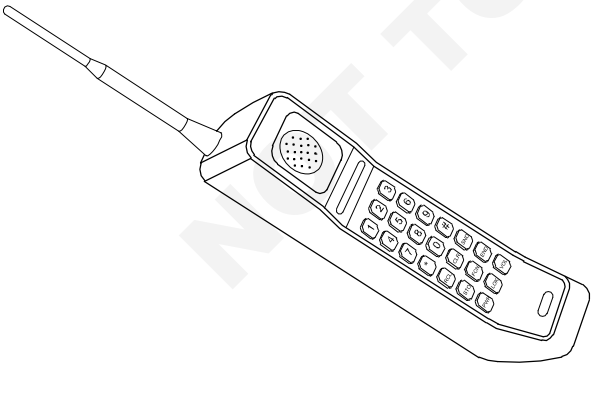
Fig 1




### The First Ever Portable Mobile Phone.(1983–1990)

In 1983 the world got the first ever portable mobile phone in the shape of the Motorola DynaTAC 8000X. It cost an eye-watering $4000 USD and was a huge status symbol at the time. Two years later the first mobile phone call on UK soil was made, the then Vodafone Chairman Sir Ernest Harrison, the lucky recipient. (Fig 2)

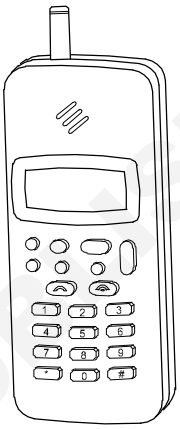
Fig 2




### Dawn of Consumer Handsets. (1991–1994)

GSM first launched in Europe 1991 with the Orbitel TPU 900 first to market, but it wasn't until 1992 that mobiles were no longer restricted to business use. Mass production paved the way for cost-effective consumer handsets with digital displays. Nokia was one of the first to take advantage of this transition, with the Nokia 1011 arriving that year as shown in Fig 3.

Fig 3




### A Splash of Colour. (1995–1998)

Although it only offered four colours, the Siemens S10 brought mobile phone displays to life for the first time in 1997. The same year Hagenuk launched the Global Handy, the first device without an external antenna. Customisation also added as a feature in a big way with Ericcson offering swappable coloured front keyboard panels. The following year Nokia launched a range of 'Xpress-on' interchangeable covers on the 5100 series, making it the first fashion orientated phone. (Fig 4)

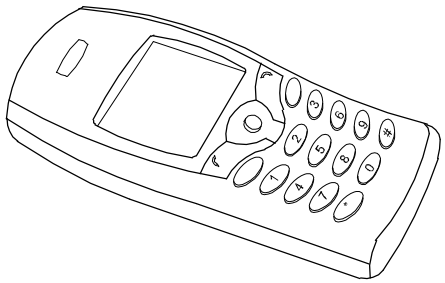
Fig 4

**Growth of the Feature Phone. (1999–2002)**

In the year 1999 Nokia unveil the 7110 which was the first device to take advantage of WAP (means accessing information over a mobile wireless network).

A year later Sharp launched the world's very first camera phone, the J-SH04. It was only available in Japan but signaled the start of the public's obsession with phone photography. However, it wasn't until 2002 and the release of the Sony Ericsson T68i and its clip-on camera, that western markets started to take an interest in the camera phone. (Fig 5)

Fig 5

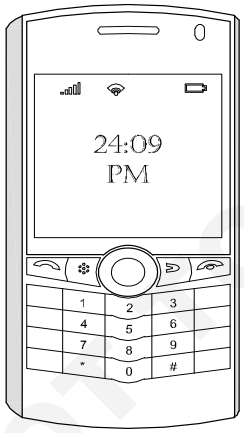


SP20N131815

**Mobile Data Revolution. (2003–2006)**

The implementation of 3G took download speeds up to 2MBS in March 2003 with "3" the first to offer the service in the UK. RIM brought mobile email to the masses with its range of popular BlackBerry devices like the 8100 Pearl. The advent of front facing cameras in 2003 on devices such as the Sony Ericsson Z1010 meant video calling became possible, but not popular. (Fig 6)

Fig 6




SP20N131816

**Getting Smarter. (2007–2010)**

Swiping and scrolling replaced the traditional button method of input. The LG Prada being the first touchscreen to market ahead of the Apple iPhone in May 2007. However, Apple proved to have both the stronger brand and superior knowledge of capacitive touchscreen's potential. (Fig 7)

**Introducing 4G to Smart Phones. (2011–2014)**

Smartphones became increasingly central to modern life, offering much more than just communication features. The first 4G service launched taking download speeds up to 12mbps. Voice recognition became common place first with Google Voice before Apple launched Siri into the market. Samsung added a built-in heart rate monitor to their flagship Galaxy S5 to capitalise on growth in mobile health & fitness. (Fig 8)

Fig 7

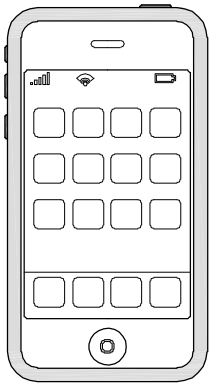


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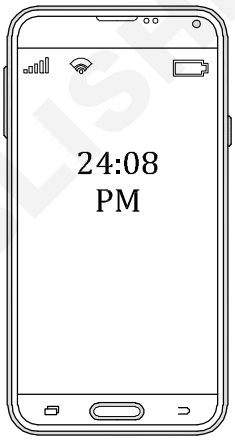
Fig 8

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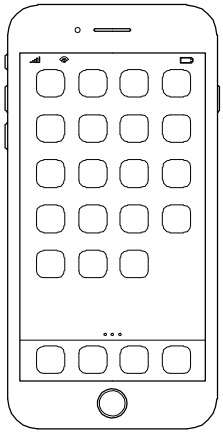
**Size of Smart Phones. (2015–2018)**

The global adoption of 4G vastly improves video streaming and video calling capabilities. Screen sizes continue to grow to maximize the experience of these features, with the iPhone 7 Plus display now 57% larger than the original iPhone from 2007. Mobile payments also emerge with Apple Pay and Android Pay offering users the possibility of buying things with their smartphone. (Fig 9) (Fig 10)

Fig 9



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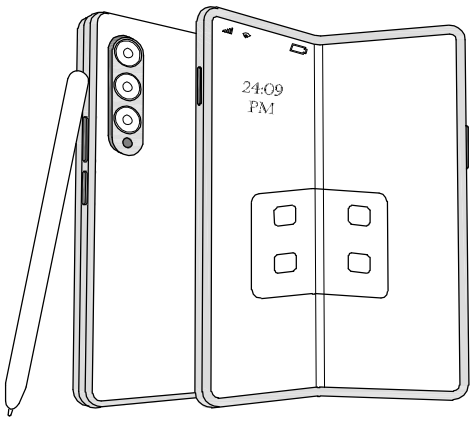
**The Superfast World**

The launch of the first 5G service smart phones on May 2019. The fifth-generation network promises vastly superior data speeds and reliability, boosting ultra-high-resolution video streaming and mobile gaming. Handset design trends continue to push for an all-screen experience, with OnePlus introducing the pop-up selfie camera to its flagship 7 Pro device to do away with the notch altogether. (Fig 10)

Fig 10

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**Basics of Mobile Communication**

Mobile Communication is the use of technology that allows us to communicate with others in different locations without the use of any physical connection (wires or cables). Mobile communication makes our life easier, and it saves time and effort.

A mobile phone (also called mobile cellular network, cell phone or hand-heldphone) is an example of mobile communication in the form of wireless communication. It is an electric device used for full duplex two-way radio telecommunication over a cellular network of base stations known as cell site. (Fig 11)

Fig 11

SP20N13181B

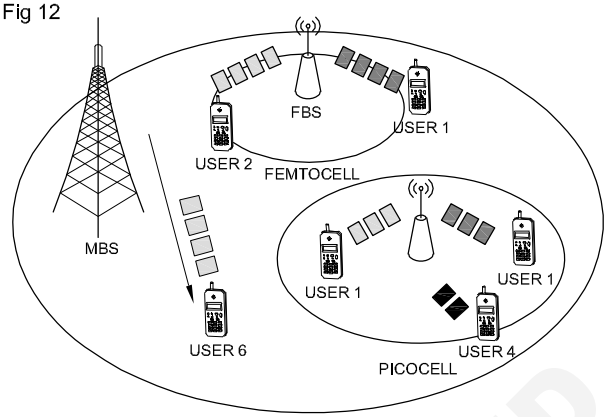
**Features of Mobile Communication:**

The following are the features of mobile communication:

**1 High-capacity load balancing (Fig 12)**

Each wired or wireless infrastructure must incorporate high-capacity load balancing. High-capacity load balancing means, when one access point is overloaded, the system will actively shift users from one access point to another depending on the capacity which is available.

Fig 12

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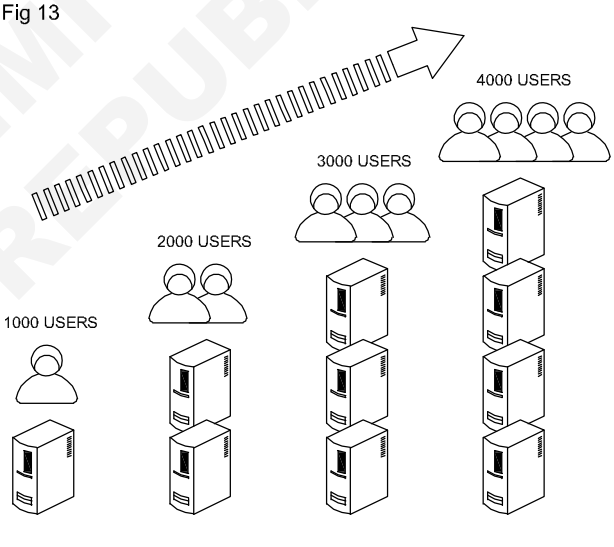
**2 Scalability (Fig 13)**

The growth in popularity of new wireless devices continuously increasing day by day. The wireless networks have the ability to start small if necessary, but expand in terms of coverage and capacity as needed - without having to overhaul or build an entirely new network.

Fig 13

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**3 Network management system (Fig 14)**

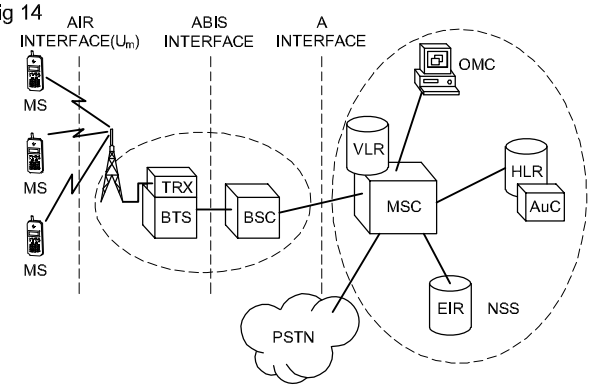
Wireless networks are much more complex and may consist of hundreds or even thousands of access points, firewalls, switches, managed power and various other components.

The wireless networks have a smarter way of managing the entire network from a centralized point.

**4 Roaming (Fig 15)**

You don't need to worry about dropped connections, slower speeds or any disruption in service as you move throughout your office or even from building to building wireless needs to be mobile first. Roaming allows your end-users to successfully move from one access point to another without ever noticing a dip in a performance

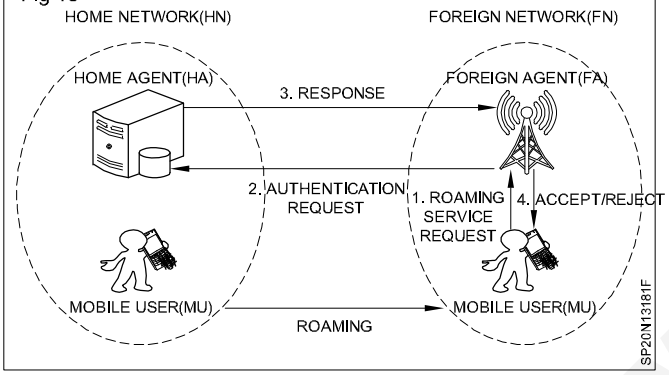
Fig 14




GSM ARCHIECTURE OVERVIEW

SP20N13181E

Fig 15

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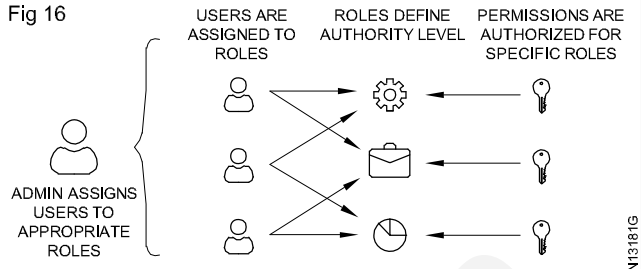
### 5 Role based access control (Fig 16)

Role based access control (RBAC) allows you to assign roles based on what, who, where, when and how a user or device is trying to access your network. Once the end user or role of the devices is defined, access control policies or rules can be enforced.

Fig 16




ROLE-BASED ACCESS CONTROL

SP20N13181G

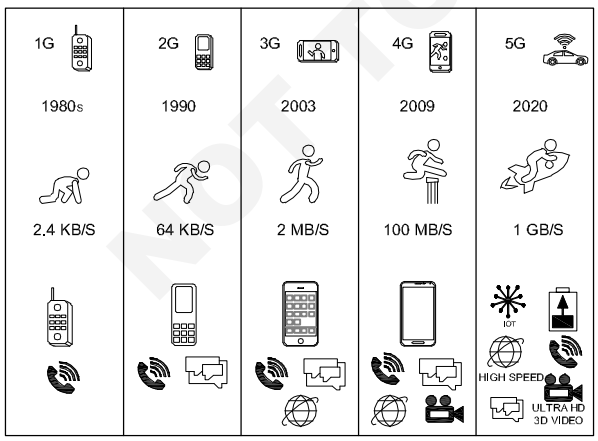
## Generation of mobile network

**Objectives:** At the end of this lesson you shall be able to
- **explain the generation of mobile network**
- **express the difference between each generation.**

### Generation of Mobile Network

Each generation of network brought with it a significant milestone in the development of mobile communications, the benefits of which are outlined in Fig 1.

Fig 1

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### 1 1G Technology

1G refers to the first generation of wireless mobile communication where analog signals were used to transmit data. It was introduced in the US in early 1980s and designed exclusively for voice communication.

Some characteristics of 1G communication are:

- Speeds up to 2.4 kbps
- Poor voice quality
- Large phones with limited battery life
- No data security

### 2 2G Technology

2G refers to the second generation of mobile which used digital signals for the first time. It was launched in Finland in 1991 and used GSM technology. Some prominent characteristics of 2G communication are “

- Data speeds up to 64 kbps
- Text and multimedia messaging possible
- Better quality than 1G

When GPRS technology was introduced, it enabled web browsing, e-mail services and fast upload/download speeds. 2G with GPRS is also referred as 2.5G, a step short of next mobile generation.

### 3 3G Technology

Third generation (3G) of mobile began with the start of the new millennium and offered major advancement over previous generations. Some of the characteristics of this generation are "

- Data speeds of 144 kbps to 2 Mbps.
- High speed web browsing.
- Running web-based applications like video conferencing, multimedia e-mails, etc.
- Fast and easy transfer of audio and video files.
- 3D gaming.
- Here are some limitations of 3G technology "
- Expensive mobile phones.
- High infrastructure costs like licensing fees and mobile towers.
- Trained personnel required for infrastructure set up.

### 4 4G Technology

Keeping up the trend of a new mobile generation every decade, fourth generation (4G) of mobile communication was introduced in 2011. Its major characteristics are "

- Speeds of 100 Mbps to 1 Gbps.
- Mobile web access.
- High-definition mobile TV.
- Cloud computing.
- IP telephony.

### 5 5G Technology

5G was the next major phase of mobile telecommunications standards beyond the current 4G standards.

Its major characteristics are "

- Data rates of several tens of megabits per second (Mbit/s) should be supported for tens of thousands of users.
- Several hundreds of thousands of simultaneous connections to be supported for massive sensor deployments.
- Spectral efficiency is enhanced compared to 4G.
- Coverage area is improved.
- Signaling efficiency enhanced.
- Latency is significantly reduced compared to LTE.

**GSM**

GSM stands for Global System for Mobile communications. GSM is one of the most widely used digital wireless telephony system. It was developed in Europe in 1980s and is now international standard in Europe, Australia, Asia and Africa. Any GSM handset with a SIM (Subscriber

Identity Module) card can be used in any country that uses this standard. Every SIM card has a unique identification number. It has memory to store applications and data like phone numbers, processor to carry out its functions and software to send and receive messages

GSM technology uses TDMA (Time Division Multiple Access) to support up to eight calls simultaneously. It also uses encryption to make the data more secure. The frequencies used by the international standard is 900 MHz to 1800 MHz

**CDMA**

CDMA stands for Code Division Multiple Access. It was first used by the British military during World War II. After the war its use spread to civilian areas due to high service quality. As each user gets the entire spectrum all the time, voice quality is very high. Also, it is automatically encrypted and hence provides high security against signal interception and eavesdropping.

**WCDMA**

Wideband CDMA is a third-generation (3G) wireless standard which allows use of both voice and data and offers data speeds of up to 384 Kbps.

The frequency bands for WCDMA are as follows: Europe and Asia - 2100MHz, North America - 1900MHz and 850MHz.

WCDMA is also called UMTS and the two terms have become interchangeable.

Some parts of the WCDMA are based on GSM technology and the networks are designed to integrate the GSM networks at some levels.

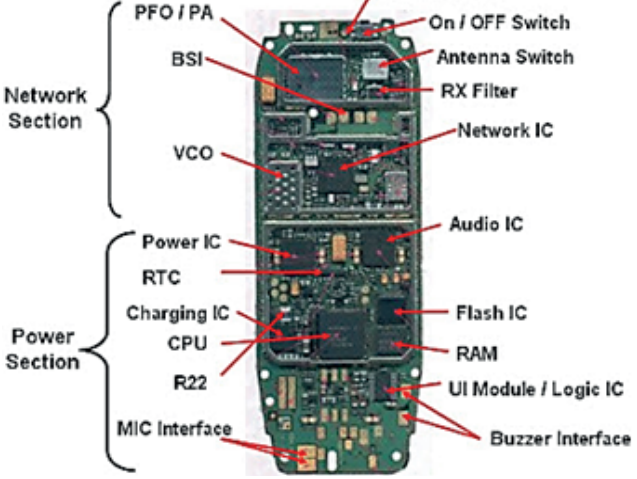
## Introduction to mobile phone structure, and frequencies of cellular communication

**Objectives:** At the end of this lesson you shall be able to
- **illustrate the structure of mobile phone**
- **define frequency, channel, GPS, EDGE, HSPA.**

**Mobile phone structure**

When we say a mobile, it is not just a piece of plastic/ metallic body, as it looks from outside, there are lots of different components/modules inside that mobile.There are all kinds of parts and electronic components in a mobile cell phone. These parts and components can be divided into Big Parts and Small Parts. When learning how to repair a mobile cell phone, it is important to identify its parts and understand their function. (Fig 1)

Fig 1




**Parts and Functions of Mobile components.**

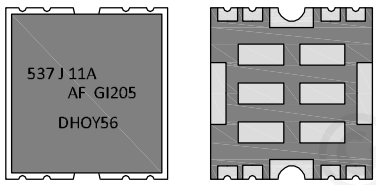
### 1 Antenna Switch (Fig 2)

It is found in the Network Section of a mobile phone and is made up of metal and non-metal. In GSM sets it is found in white colour and in CDMA sets it is found in golden metal.

**Work / Function**

It searches network and passes forward after tuning

Fig 2



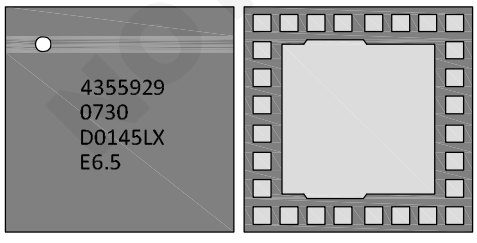

### 2 P.F.O. (Fig 3)

It is found near the Antenna Switch in the Network Section of the PCB of Mobile Phone. It is also called P.A (*Power Amplifier*) and Band Pass Filter.

**Work / Function**

It filters and amplifies network frequency and selects the home network.

Fig 3



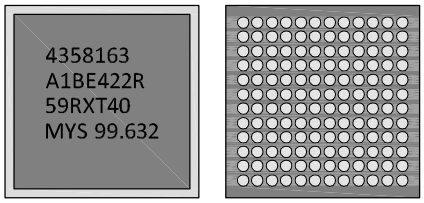

### 3 Network IC. (Fig 4)

This electronic component found near the PFO in the Network Section of a Mobile Phone. It is also called RF signal processor.

**Work / Function**

It works as transmitter and receiver of audio and radio waves according to the instruction from the CPU.

Fig 4



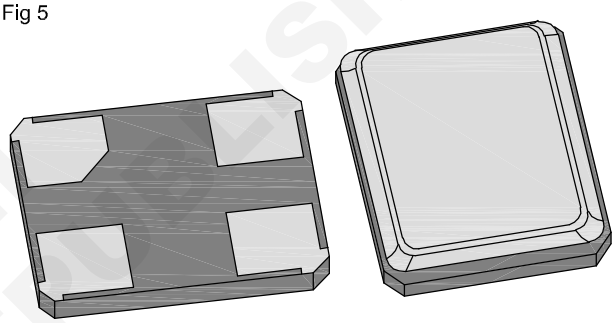

### 4 26 MHz Crystal Oscillator (Fig 5)

It is found near the PFO in the Network Section of a Mobile Phone. It is also called Network Crystal. It is made up of metal.

**Work / Function**

It creates frequency during outgoing calls.

Fig 5



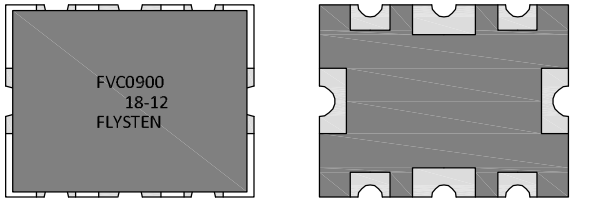

### 5 VCO (Fig 6)

It is found near the Network IC in the Network Section of a Mobile Phone.

**Work / Function**

It sends time, date and voltage to the RF IC / Hager and the CPU. It also creates frequency after taking command from the CPU.

Fig 6



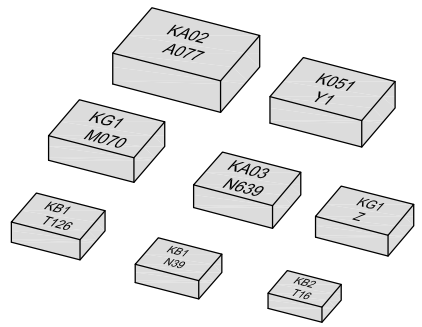

### 6 RX Filter (Fig 7)

It is found in the Network Section of a Mobile Phone.

**Work / Function**

It filters frequency during incoming calls.

Fig 7



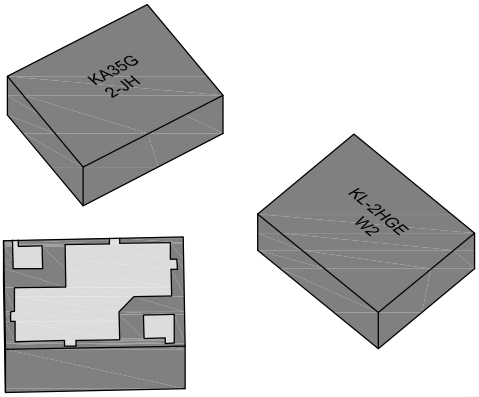

### 7 TX Filter (Fig 8)

It is found in the Network Section of a Mobile Phone.

**Work / Function**

It filters frequency during outgoing calls.

Fig 8



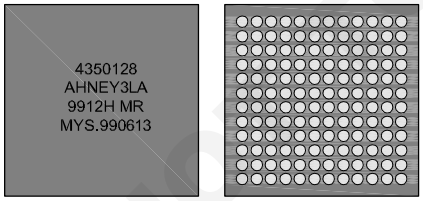

### 8 ROM (Fig 9)

It is found in the Power Section of a Mobile Phone.

**Work / Function**

It loads current operating program in a Mobile Phone.

Fig 9




### 9 RAM (Fig 10)

It is found in the Power Section of a Mobile Phone.

**Work / Function**

It sends and receives commands of the operating program in a mobile phone.

### 10 Flash IC (Fig 11)

It is found in the Power Section of a Mobile Phone. It is also called EEPROM IC, Memory IC, RAM IC and ROM IC.

**Work / Function**

Software and IMEI Number of the mobile phone is installed in the Flash IC.

Fig 10

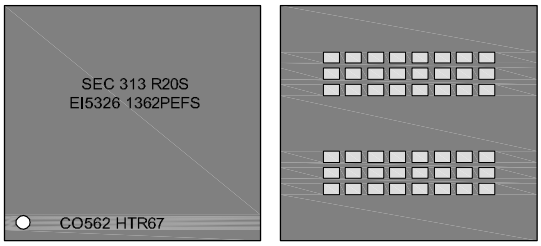
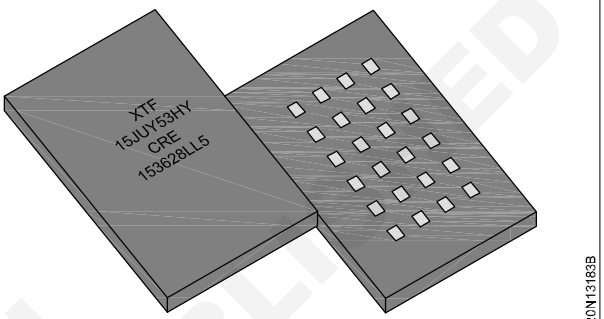



Fig 11



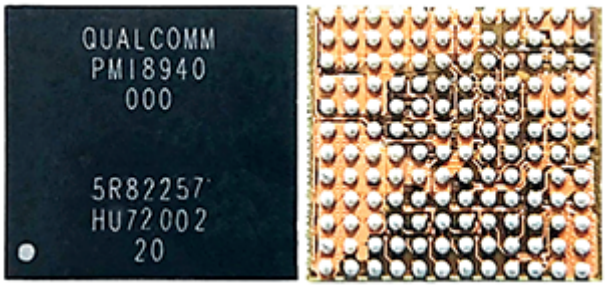

### 11 Power IC (Fig 12)

It is found in the Power Section of a Mobile Phone. There are many small components mainly SMD capacitor around this IC. RTC is near the Power IC.

**Work / Function**

It takes power from the battery and supplies to all other parts of a mobile phone.

Fig 12




### 12 Charging IC (Fig 13)

It is found in the Power Section near R22.

**Work / Function**

It takes current from the charger and charges the battery.

### 13 RTC (Simple Silicon Crystal) (Fig 14)

It is Real Time Clock and is found in the Power Section near Power IC. It is made up of either metal or non-metal. It is of long shape

**Work / Function**

It helps to run the date and time in a mobile phone.

Fig 13

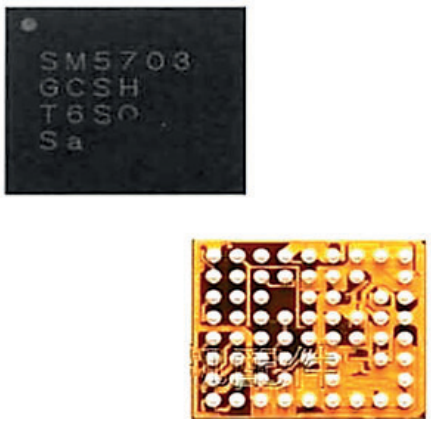
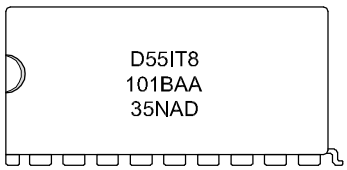



Fig 14

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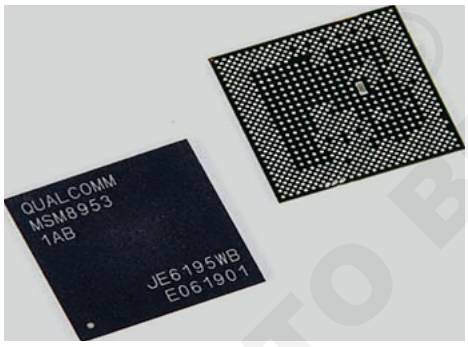
**14 CPU (Fig 15)**

It is Central Procession Unit of the Phone and is found in the Power Section. It is also called MAD IC, RAP IC and UPP. It is the largest IC on the PCB of a Mobile Phone and it looks different from all other ICs.

**Work / Function**

It controls all sections of a mobile phone.

Fig 15




**15 Logic IC / UI IC (Fig 16)**

It is found in any section of a mobile phone. It has 20 pins or legs. It is also called UI IC and Interface IC.

**Work / Function**

It controls Ringer, Vibrator and LED of a mobile phone.

**16 Audio IC (Fig 17)**

It is found in Power Section of a mobile phone. It is also called Cobba IC and Melody IC.

**Work / Function**

It controls Speaker and Microphone of a mobile phone.

Fig 16

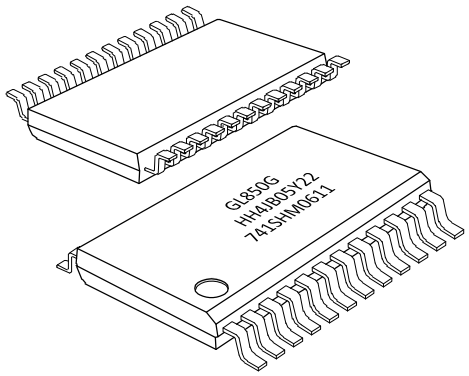



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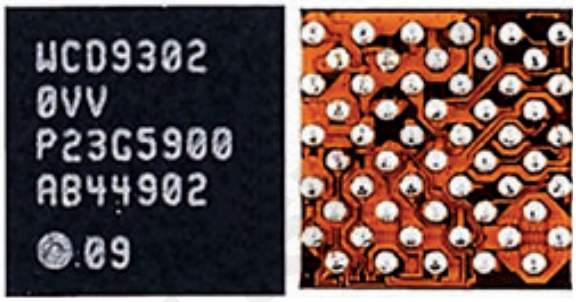
Fig 17



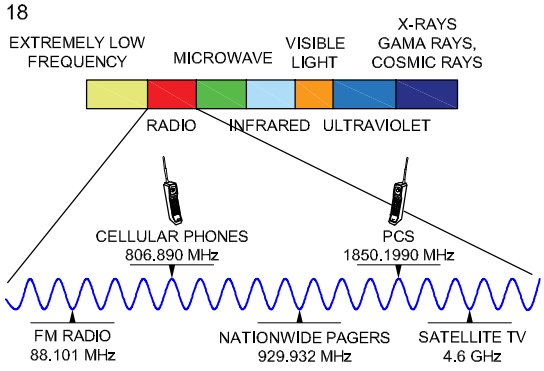

**Signal Frequency in Cell Phone (Fig 18)**

The cellular system is the division of an area into small cells. This allows extensive frequency reuse across that area, so that many people can use cell phones simultaneously. Cellular networks have a number of advantages like increased capacity, reduced power usage, larger coverage area, reduced interference from other signals etc.

Frequency Division Multiple Access (FDMA) and Code Division Multiple Access (CDMA) were developed to distinguish signals from several different transmitters. In FDMA, the transmitting and receiving frequencies used in each cell are different from the frequencies used in the neighbouring cells.

When we use one frequency for talking, a second separate frequency is used for listening. So that both the people on the call can talk at once. The Mobile phone can communicate on 1,664 channels or more.

Fig 18

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### Control channels

These are responsible for housekeeping tasks such as telling the mobile when a call is coming in and which frequency to use. To ensure this handover works, the phone constantly monitors the broadcast control channel of up to 16 neighboring cells. In normal operation, phones continually adjust the power of the radio waves they send out to be the minimum needed for the base station to receive a clear signal. If a phone moves far away from its base station and if the signal is weak, the network consults the list and triggers a handover to a neighboring cell with best signal.

### GPS System (Fig 19)

In recent times, Global Positioning System

GPS technology has gained more popularity because of its wide range of applications like navigation systems, maps and tracking devices. Especially applications like mobile navigation system have taken a massive leap among them.

GPS is a satellite-based radio navigation system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.[3] Obstacles such as mountains and buildings block the relatively weak GPS signals.

Fig 19

### EDGE (Fig 20)

Enhanced Data rates for Global Evolution (EDGE) introduces a new modulation technique, as well as protocol enhancements for transmitting packets over the radio.

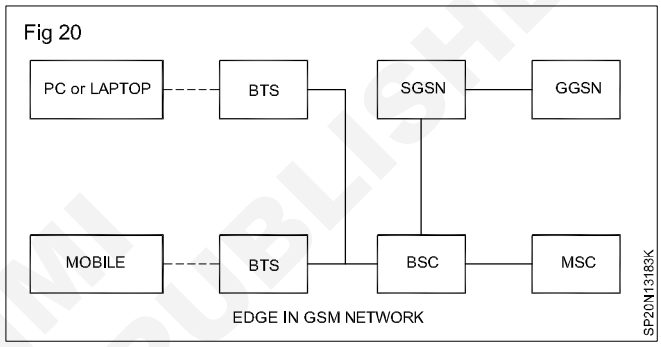
The use of the new modulation and the protocol enhancements, result in dramatically increased throughput and capacity gains enabling 3G services in the existing GSM/GPRS networks. No changes are needed to the existing core network infrastructure to support EDGE. This emphasizes the fact that EDGE is only an “add-on” for BSS.

For EDGE, nine Modulation and Coding Schemes (MCS) are introduced (MCS1 to MCS9) and optimized for different radio environment. Four EDGE coding schemes are using GMSK and five are using 8 PSK Modulation.

### Advantages of EDGE

- It has higher speed.
- It is more reliable and efficient.
- It is cost efficient.
- It is an “always - on connection”.

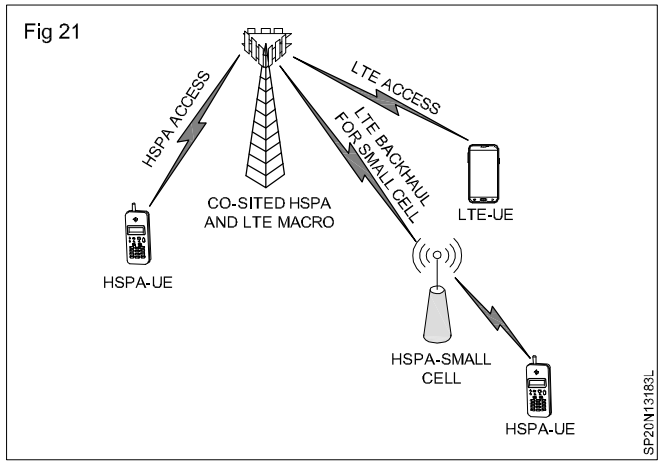
Fig 20




### HSPA (Fig 21)

High speed packet access, HSPA is an upgrade to 3G UMTS to provide very high higher data rates in both uplink and downlink. To overcome this 3G UMTS was upgraded with high-speed packet access, HSPA to provide a major leap in performance and make it suitable to cover its requirements.

Fig 21



# Overview of SIM and IMEI number

**Objectives:** At the end of this lesson you shall be able to
- **explain what are SIM and the types of SIM**
- **state what is IMEI number.**

### An Overview of SIM

A SIM card, also known as a subscriber Identity Module, is a smart card that stores identification information that pinpoints a smart phone to a specific mobile network. Data that SIM cards contain include user identity, location and phone number, network authorization data, personal security keys, contact listxs and stored text messages. SIM cards allow a mobile user to use this data and the features that come with them.

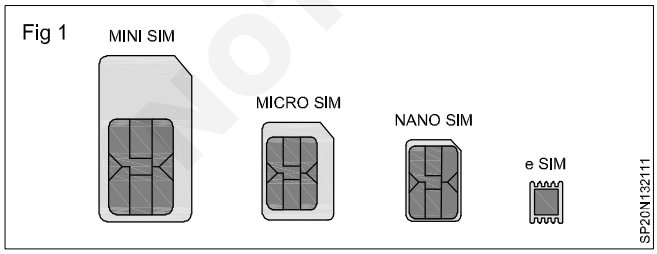
Without a SIM card, some phones would not be able to make calls, connect to internet services such as 4G LTE or send SMS messages. SIM cards are removable and have anywhere from, 32KB to 128KB.

Not all phones with SIM cards work the same. However, There are two distinct technologies used; GSM (Global System for Mobile communication) and CDMA (Code Division Multiple Access).

### Types of SIM cards (Fig 1)

- SIM cards have come in a variety of different sizes over time. Types of SIM cards include:
- Standard Mini SIM cards measure 25x15mm and are used in older and basic phones.
- Micro SIM cards measure 15x12mm, and are more likely to be found in phones from the 2010s and up.
- Nano SIM cards measure 12.3x8.8mm and are used in newer smartphones.
- eSIM, or embedded SIM's, measure 6x5mm, and has the SIM card installed in the phone already. eSIM's are activated remotely by the network carrier.

Fig 1




### IMEI number

IMEI is stands for International Mobile Equipment Identity and is a unique number given to every single mobile phone, typically found behind the battery. The IMEI is only used for identifying the device and has no permanent or semi-permanent relation to the subscriber. Instead, the subscriber is identified by transmission of an IMEI number,which is stored on a SIM card that can be transferred to any handset. However, many network and security features are enabled by knowing the current device being used by a subscriber.IMEI numbers of cellular phones connected to a GSM network are stored in a database (EIR – Equipment Identity Register) containing all valid mobile phone equipment.When a phone is reported stolen or is not type approved,the number is marked invalid.The number consists of four groups that look similar to this:

AA-BBBBBB-CCCCCC-D

AA - BBBBBB - CCCCCC - D

TAC Serial # Checksum

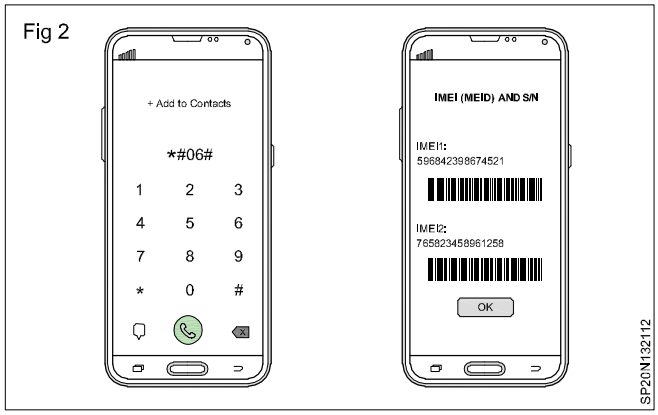
The Type Allocation Code (TAC) is the initial eight-digit portion of the 15-digit IMEI code used to uniquely identify wireless devices. The first two digits represent the country code. The second group of numbers identifies the manufacturer. The third set is the serial number and the last single digit is an additional number (usually 0).

For example, 99-000033-792410-8:

- 99 is country
- 000033 is manufacturer
- 792410 is the serial number
- 8 is the checksum value

**How to check IMEI Number for your mobile:*06# (Fig 2)**

Fig 2



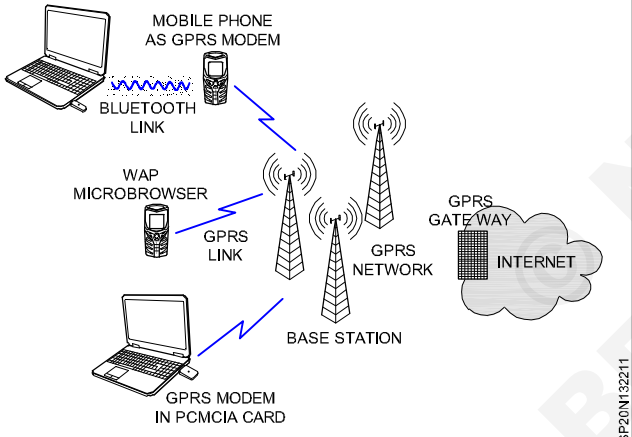
# Introduction of GPRS, bluetooth and infrared technology

**Objectives:** At the end of this lesson you shall be able to
- **explain GPRS**
- **explain the bluetooth technology, advantages and disadvantages**
- **explain infrared technology.**

## GPRS

GPRS stands for General Packet Radio Services. It is a packet based wireless communication technology that charges users based on the volume of data they send rather than the time duration for which they are using the service. This is possible because GPRS sends data over the network in packets and its throughput depends on network traffic. As traffic increases, service quality may go down due to congestion, hence it is logical to charge the users as per data volume transmitted. (Fig 1)

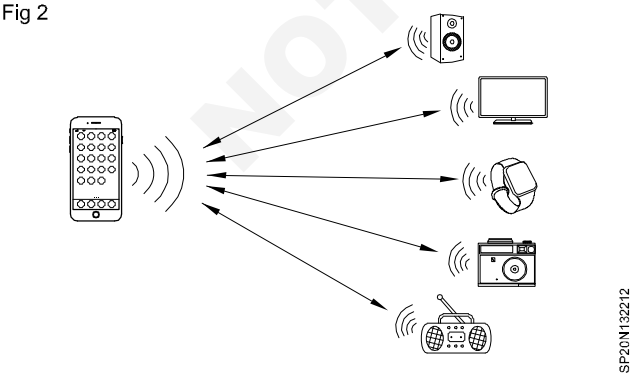
Fig 1




## Bluetooth Technology (Fig 2)

Bluetooth employs Radio Frequency (RF) for communication. It makes use of frequency modulation to generate radio waves in the ISM band.

Fig 2




The usage of Bluetooth has widely increased for its special features.

- Bluetooth offers a uniform structure for a wide range of devices to connect and communicate with each other.
- Bluetooth technology has achieved global acceptance such that any Bluetooth enabled device, almost everywhere in the world, can be connected with Bluetooth enabled devices.
- Low power consumption of Bluetooth technology and an offered range of up to ten meters has paved the way for several usage models.
- Bluetooth offers interactive conference by establishing an adhoc network of laptops.
- Bluetooth usage model includes cordless computer, intercom, cordless phone and mobile phones.

## Advantages of Bluetooth Technology

- Bluetooth Technology is based on Wireless technology. That's why it is cheap because it doesn't need any transmission wire that reduces the cost.
- It is very simple to form a Piconet in Bluetooth technology.
- It removes the problem of radio interference by using the Speed Frequency Hopping technique.

**When more than two Bluetooth devices communicate with one another, this is called a PICONET.**

- The energy or power consumption is very low, about 0.3mW. It makes it possible for the least utilization of battery life.
- It is robust because it guarantees security at a bit level. The authentication is controlled using a 128bit key.
- You can use it for transferring the data, and verbal communication as Bluetooth can support data channels of up to 3 similar voice channels.
- It doesn't require line of sight and one to one communication as used in other modes of wireless communications such as infrared.

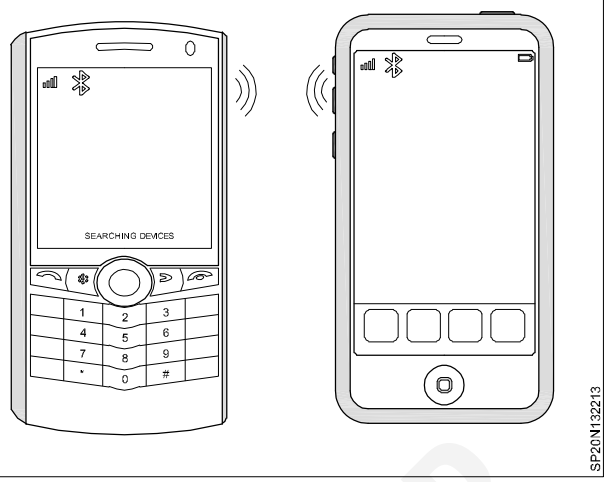
### Disadvantages of Bluetooth Technology

- In Bluetooth technology, the bandwidth is low.
- The data transmission range may also be an issue because it is also less.

### Infrared Technology (Fig 3)

As the name indicates, the communication is established via infrared signals. This technology is used by most of the remote controls. This technology is device specific and there should be direct line of sight between (max 3 feet) transmitter and receiver. This communication is more secure since it can be intercepted by a device and it's one-to-one. I'm not going to more details about this technology since it is not used in mobile devices anymore.

Fig 3



## Sections of mobile phone

**Objectives:** At the end of this lesson you shall be able to
- **enumerate the tracing of different section of mobile phone**
- **explain the function of all parts of mobile phone.**

**Circuit tracing of different section of mobile phone**

A Mobile Phone PCB is Divided into 3 Main Sections:

1 Network Section.

2 Power Section.

3 Audio Section.

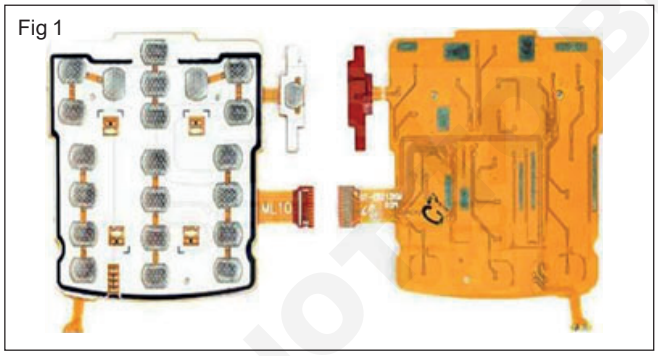
Now, these Broad Sections can again be Divided in Several Small Sections for Easy of Understanding.

### 1 Network Section (Fig 1)

The keyboard section of any mobile cell phone is directly connected with the CPU. This means that rows and columns of keys are directly connected with the CPU. Protector IC or Interface IC or varactor diode is connected in the row or column line for the protection of key section. In modern mobile cell phones which have qwerty keys, a separate control IC is connected with the CPU for extra protection to the keys.

In Latest Android Smartphones and Apple iPhone, there is No Physical Keypad. The Keys are Displayed and Controlled by the Operating System (OS) and Apps. These Virtual Keys on the Display are Controlled by a Touch Screen Connected Separately to the PCB / Logic Board.

Fig 1



### 2 Display Section (Fig 2)

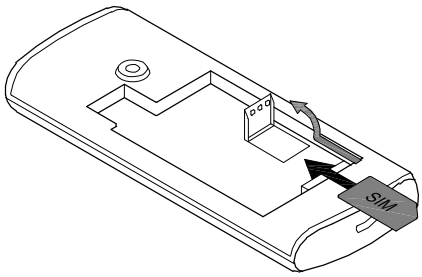
The display section is directly connected with the CPU to receive following signals – LCD Data Signal, LCD Reset Signal, LCD WR Signal, LCD RD Signal, LCD FLM Signal, LCD HSYN Signal etc. These signals are given to the LCD Module through the CPU. 2.8V power supply or 1.8V power supply is given to the LCD for functioning. LCD signal interface filter are connected in many mobile cell phones for interfacing these signals of LCD Module

Fig 2

### 3 SIM Card Section (Fig 3)

The SIM Card Interface section is directly connected with the CPU in most mobile cell phones. If there is no power supply in a mobile phone then the SIM section is connected with the CPU through the Power IC. Mainly V-SIM (*3.0V*), SIM-RST (*2.85V*), SIM CLK, SIM-Data (*2.5V*), and SIM GND are made in the SIM Section. These four pins (*Beside SIM GND*) are directly connected with the SIM interface / control section and V-SIM volt are given to the SIM data pin from V-SIM pin through the 10-18 Kilo Ohms Resistance.

Fig 3




### 4 Memory Card Section (Fig 4)

Micro SD Card is connected in almost all the mobile phones which is connected with micro card section through an8-pin socket. Memory card section is made inside the CPU. Description of these 8 pins are as follows:

1 MMC-Data-2

2 MMC Data

3 MMC CMD (*Command*)

4 VMMC / VSD (*Positive Supply Pin*)

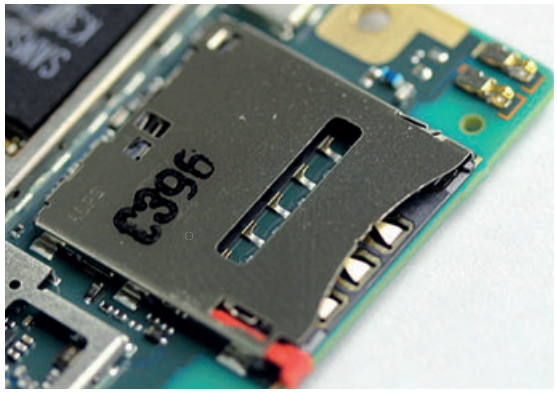
5 MMC-CLK

6 GND

7 MMC-Dta0

8 MMC Data-1

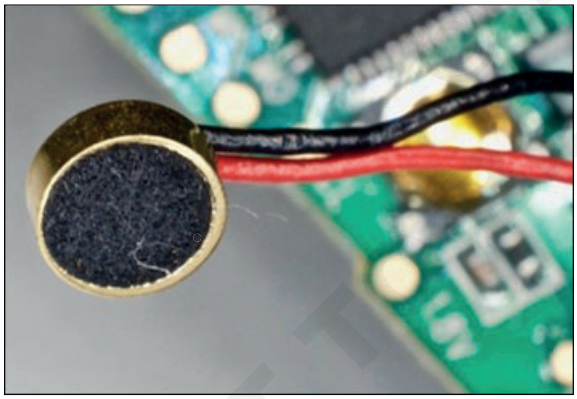
Fig 4



## 5 MIC Interface Section

MIC interface section is directly connected with the CPU in most mobile phones. Working voltage (*MIC Bios*) (*1.8 to 2.8 V*) is supplied from the CPU or the Power Supply Section for functioning of the MIC and MIC Positive and Negative Volt are input through two SMD Capacitors.

Fig 5



## 6 Ear Speaker Section (Fig 6)

In most modern mobile cell phones, in which there is a separate ear speaker, it is directly related to the CPU. It receives sound via signals directly from the CPU or from the audio section inbuilt within the CPU. In some mobile phones, these sound signals are received via SMD Coil / SMD Resistance. Some mobile phones have audio IC in the audio section. Some mobile phones have audio amplifier.

## 7 Ringer Section (Fig 7)

Ringer, Buzzer or Speaker in most mobile phones are connected with the audio amplifier IC to obtain loud sound. The amplifier IC amplifies the sound or audio signal received from the CPU of the audio section.

Fig 6

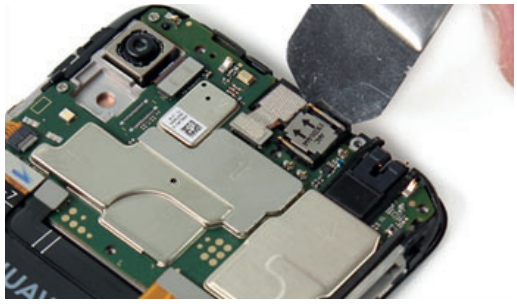
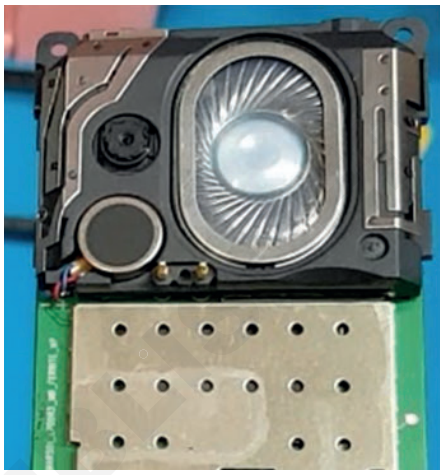


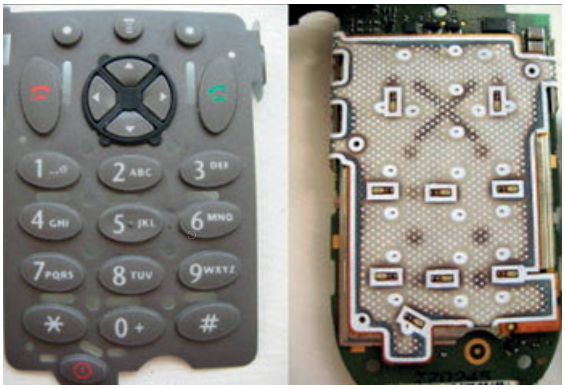
Fig 7



## 8 Key Backlight Section (Fig 8)

LED Lights are connected according to the parallel circuit in the key backlight section. Anode ends of all the LEDs are connected to each other and all the cathode ends are connected to each other. 3 to 3.3 V is supplied for the functioning of these Key LED Lights. This power supply is given to the cathode ends of LEDs from the ground ends. Power supply to the anode ends of LED Lights is controlled by using LED-Driver or PNR IC.

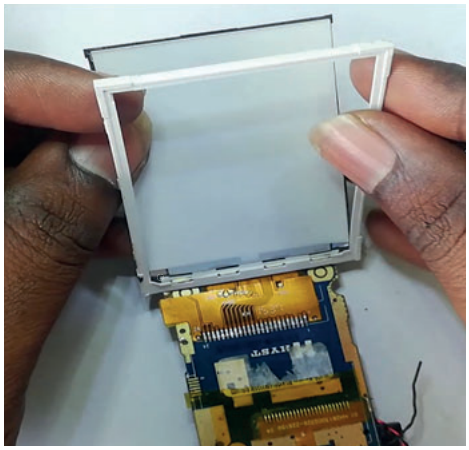
Fig 8



## 9 LCD Backlight Section (Fig 9)

LCD Backlight in mobile cell phones is made according to the series circuit. A Boost Voltage Generator Section is built for the supply of high voltage (*10 to 18V*) for the functioning of the LCD LED. Boost coil, Boost Volt Driver IC, Rectifier Diode etc. are present in this section.

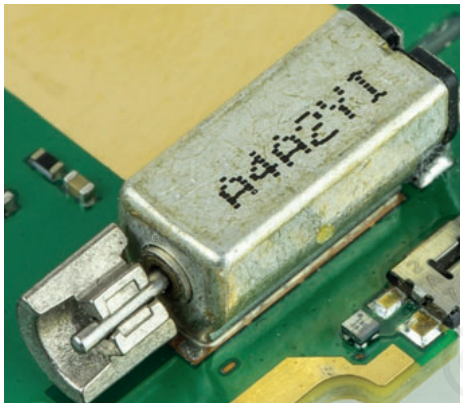
Fig 9



### 10 Vibrator Motor Section (Fig 10)

Positive power supply is given to this section directly from the positive end of the battery. Negative power supply is given through a NPN transistor or from the ground of any circuit.

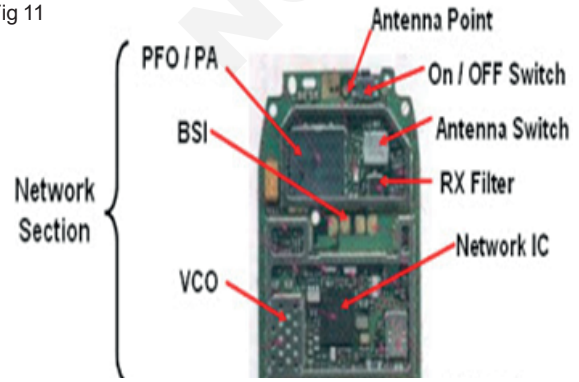
Fig 10



### 11 Network Section (Fig 11)

Antenna, External Antenna Socket, RX-Band Pass Filter, RF Crystal, FEM, PFO, TX-Band Pass Filter, RF IC, CPU are connected in the Network Section. Signal received at the antenna during the RX is given to the antenna switch or FEM through the antenna socket where the next processing is completed by selecting a frequency of proper band and is passed on to the RF IC through RX-Band Pass Filter. RF Signal out from the RF IC during TX is given to the FEM or PFO to amplify the signal. After the Band Selection Process, the signal is passed through the antenna.

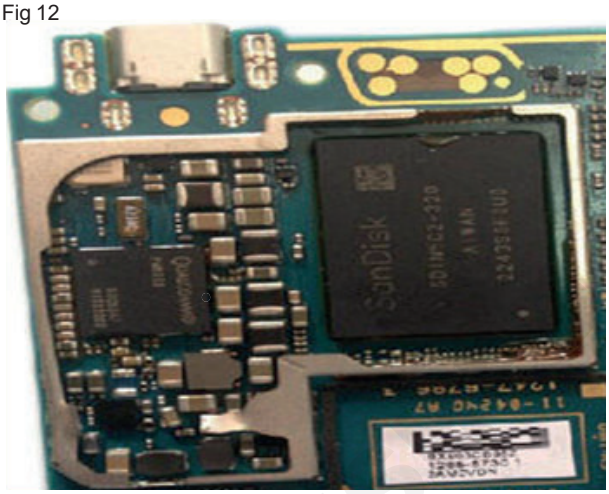
Fig 11




### 12 Battery Charging Section (Fig 12)

Charger and system interface connector is made together in most modern mobile cell phones. Regulator section is made separately for the battery charging section. In some mobile phones, the battery charging section is made inside the Power IC.

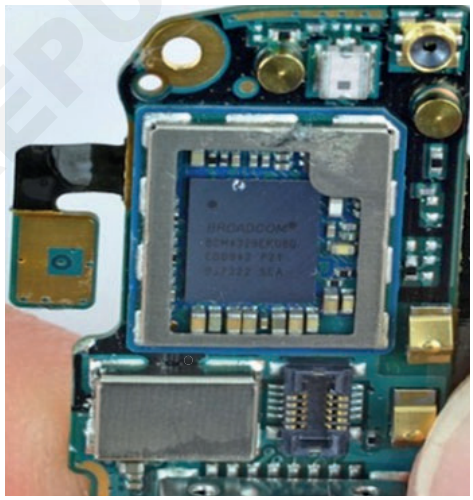
Fig 12



### 13 FM Radio Section (Fig 13)

FM Radio Driver IC, FM Antenna, Signal and Supply Components are made in the FM Radio Section.

Fig 13



### 14 Bluetooth Section (Fig 14)

Bluetooth Antenna, Bluetooth RF Signal Filter, Bluetooth Driver IC, Supply and Signal Components are made in this section. The Bluetooth sections functions like the Network Section. RF-CLK signal is given to the Bluetooth driver IC during signal processing.

### 15 Hands-free / Earphone Section (Fig 15)

Mainly hands-free jack, hands free MIC, speaker signal component and hands-free audio amplifier are present in this section. Hands free symbol is displayed after connection the Hands-free jack.

Fig 14

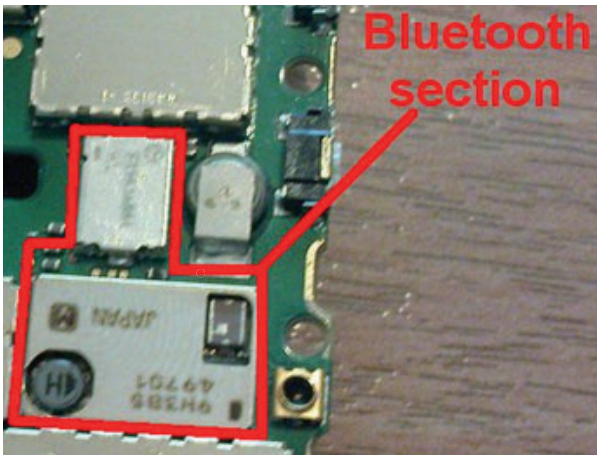
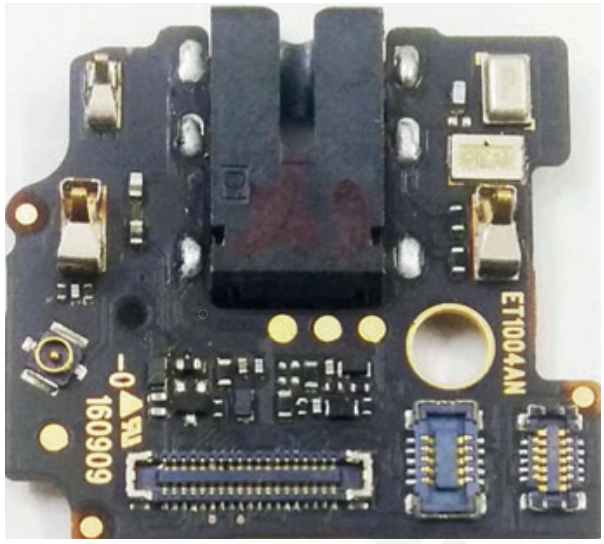



Fig 15



## Data cables used for mobile phone

**Objectives:** At the end of this lesson you shall be able to
- **explain what are USB**
- **explain the types of USB data cables and their applications.**

### Universal Serial Bus

A Universal Serial Bus (USB) is a common interface that enables communication between devices and a host controller such as a personal computer (PC) or smart phone. It connects peripheral devices such as digital cameras, mice, keyboards, printers, scanners, media devices, external hard drives and flash drives. Because of its wide variety of uses, including support for electrical power, the USB has replaced a wide range of interfaces like the parallel and serial port.

### Types of USB connector

There are several types of USB connectors. In the past the majority of USB cables were one of two types, type A and type B. The USB 2.0 standard is type A; it has a flat rectangle interface that inserts into a hub or USB host which transmits data and supplies power. A keyboard or mouse are common examples of a type A USB connector. (Fig 1)

Fig 1

A type B USB connector (Fig 2) is square with slanted exterior corners. It is connected to an upstream port that uses a removable cable such as a printer. The type B connector also transmits data and supplies power. Some type B connectors do not have a data connection and are used only as a power connection Today, newer connectors have replaced old ones, such as the Mini-USB (or Mini-B) (Fig 3), that has been abandoned in favour of the Micro-USB and USB-C cables. Micro-USB - B cables (Fig 4) are usually used for charging and data transfer between smart phones, video game controllers, and some computer peripherals. Micro-USB are being slowly replaced by USB type-C connectors (Fig 5), which are becoming the new standard for Android smart phones and tablets.

Fig 2

Fig 3

Fig 4

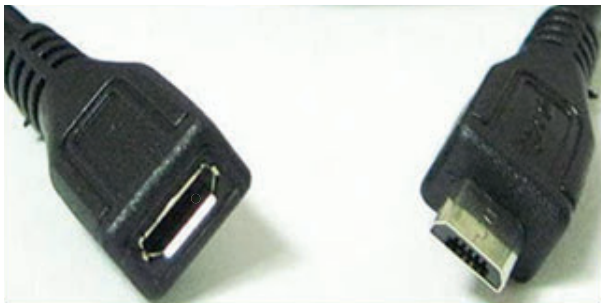


Fig 5

# Introduction to ethernet

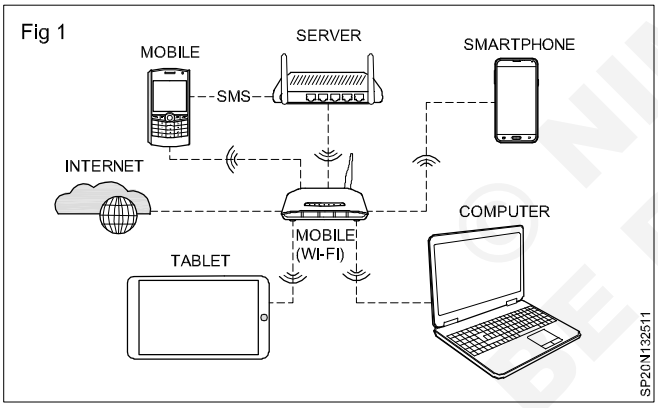
**Objectives:** At the end of this lesson you shall be able to
- **explain the concept of ethernet network and types of network cables**
- **illustrate types of computer network.**

### Ethernet network (Fig 1)

Ethernet is primarily a standard communication protocol used to create local area networks. It transmits and receives data through cables. This facilitates network communication between two or more different types of network cables such as from copper to fibre optic and vice versa.

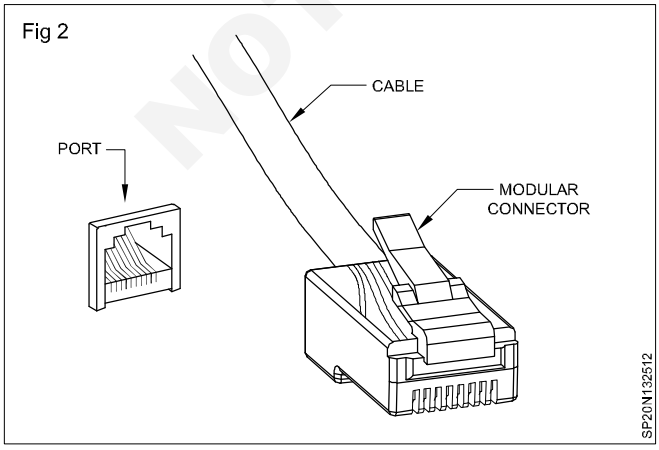
Ethernet network is used to create local area network and connect multiple computers or other devices such as printers, scanners, and so on. In a wired network, this is done with the help of fibre optic cables, while in a wireless network, it is done through wireless network technology. An Ethernet network uses various topologies such as star, bus, ring, and more.

Fig 1




An Ethernet port also called a jack or socket is an opening on computer network equipment that Ethernet cables plug into. Their purpose is to connect wired network hardware in an Ethernet LAN, metropolitan area network (MAN), or wide area network (WAN). (Fig 2)

Fig 2



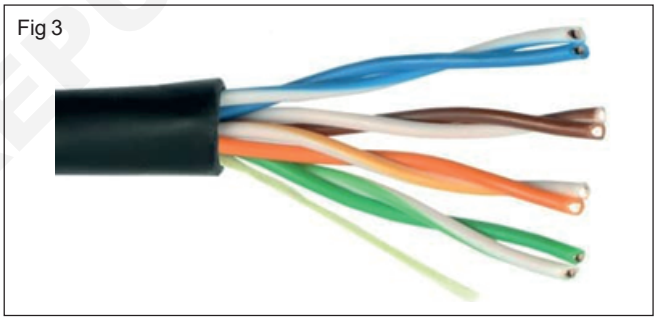

### Data Cable Types

Data cables are used to transmit information between systems such as servers, personal computers and other hardware. There are three main types of data cables used to transmit data: twisted pair, coax and fibre optic cables.

- **Twisted pair cables** are used in telephony and computer networking. Most cable networks are wired using shielded twisted pair, which is a type of data cable that has a covering to eliminate the amount of signal degradation from other sources. Twisted pair gets its name from the twists in the wires that span throughout the cabling. The twists in the cables also help protect the data communications from signal degradation. (Fig 3)

  The average length for a twisted pair wire before signal degradation is 300 feet.

Fig 3

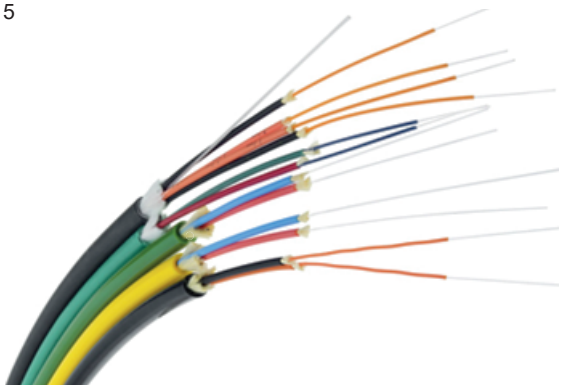


- **Coaxial (coax) cable** is used in older computer networks. Coax cable was replaced by shielded twisted pair as a standard for computer networking. Coax is still used for cable networks to provide television communication data. Coax cable is a large, round cable with an inner core wire that transmits the data. Surrounding the core is an insulator and shield to protect the data communication signal. Surrounding these parts is the casing. Coax cabling requires a special connector called a BNC connector. (Fig 4)

Fig 4

- **Fibre optic cable** is the preferred option for fast data connections. Fibre is used by cable and telephony companies to provide fast connections to the Internet. Fibre optics uses light and glass as the mechanics for data communications. Fibre optic cable is very fragile due to the glass parts of the cable. Fibre optic cable is light weight, and it does not have the signal degradation problems that the other two data cables suffer. However, fibre optic networking is more expensive. (Fig 5)

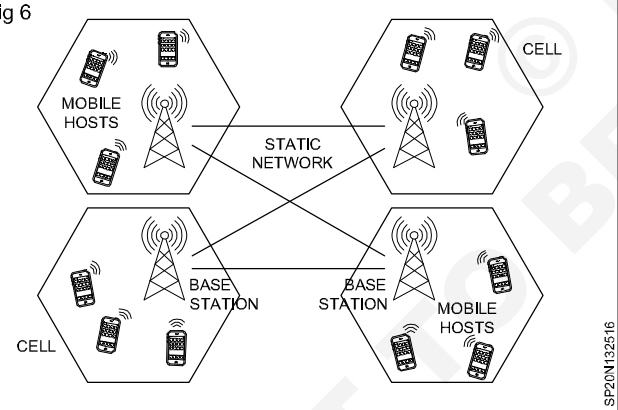
Fig 5



### Concept of Mobile Network

A mobile network is a communications network that is spread out over an immense land area around the world and connected wirelessly by transceivers at fixed locations that are known as cell sites, or base stations. Each Base stations are hexagonal in shape. (Fig 6)

Fig 6



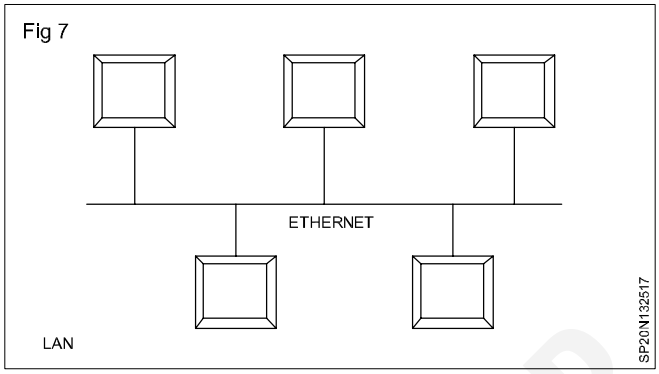

Transceivers communicate wirelessly based on the old principle of radio signals. Radio signals are electromagnetic radiation that includes light and infrared waves. These signals are considered to be transverse waves in that they have a frequency and a wavelength.

### Types of Computer Network

- **Local Area Network (LAN) (Fig 7)**

Local area network is a group of computers connected with each other in a small area such as school, hospital, apartment etc.LAN is secure because there is no outside connection with the local area network thus the data which is shared is safe on the local area network and can't be accessed outside.LAN due to their small size are considerably faster, their speed can range anywhere from 100 to 100Mbps.LANs are not limited to wire connection, there is a new evolution to the LANs that allows local area network to work on a wireless connection.

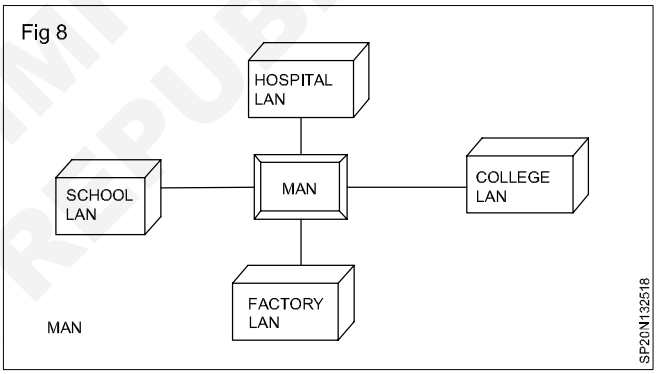
Fig 7




- **Metropolitan Area Network (MAN) (Fig 8)**

MAN network covers larger area by connections LANs to a larger network of computers. In Metropolitan area network various Local area networks are connected with each other through telephone lines. The size of the Metropolitan area network is larger than LANs and smaller than WANs (wide area networks), a MANs covers the larger area of a city or town.

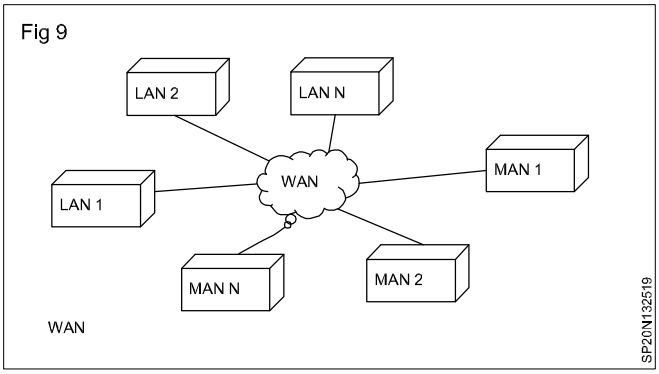
Fig 8




- **Wide Area Network (WAN) (Fig 9)**

Wide area network provides long distance transmission of data. The size of the WAN is larger than LAN and MAN. A WAN can cover country, continent or even a whole world. Internet connection is an example of WAN. Other examples of WAN are mobile broadband connections such as 3G, 4G etc.

Fig 9



## Multimedia and battery system

**Objectives:** At the end of this lesson you shall be able to
- **explain the concept of multimedia**
- **describe battery system and types of batteries.**

### Concept of Multimedia

The concept of multimedia in mobile communication is defined as a set of protocols and standards for multimedia information exchange over wireless networks. It enables information systems to process and transmit multimedia data to provide the end user with services from various areas, such as the mobile working place, mobile entertainment, mobile information retrieval and context-based services. Multimedia information as combined information presented by more than one media type like for example, text, pictures, graphics, sounds, animations, videos which enriches the quality of the information and is a way to represent reality as adequate as possible. Multimedia allows the user to enhance users understanding of the provided information and increases the potential of person to person and person to system communication. (Fig 1)

Fig 1

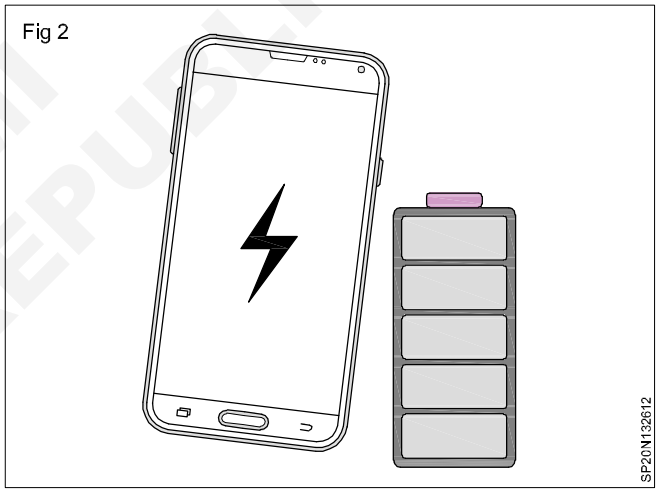
### Battery System

a lithium-ion battery simply converts chemical energy to electrical energy by the movement of lithium ions from a negative electrode to a positive electrode. The number of ions available at the negative electrode is an indication of the energy available in the battery for use, and it is the very variable sought to be controlled (increased) by chargers. It is quantified as the “state of charge” by phone manufacturers and displayed in percentage on the phone screen. (Fig 2)

Theoretically, and in reality, the amount of ions at the negative electrode could go to absolute limits of 0% and 100%, however such repeated cycles damage the battery.

By letting the number of ions in the electrodes go to absolute limits repeatedly, the structure of the electrodes degrades with time, and this reduces the number of ions each electrode can accept, and therefore reduces the battery capacity. To prevent the above, most phone systems display non-absolute limits within 10% of the absolute limits for the state of charge. In other words, a phone battery displaying 0% still has some ions at the negative electrode and could go less than 0% if it weren’t designed otherwise, and a phone battery displaying 100% can still accept ions at the positive electrode and go above 100% if the voltage limit was higher.

Fig 2




### Technical terms used while dealing with batteries

- **Power capacity**

It is the energy stored in a battery which is measured in Watt-hour.

Watt-hour = $V_x I_x$ hours {since voltage is kept constant, so it is measured in Ah/mAh}

We generally see the battery ratings as 2500 mAh or 4000 mAh while reading the specifications of a smart phone.

**Example**

2500 mAh it means that the battery has a capability to deliver 2.5A/2500mA of current to the load for 1 hour. The time that the battery works continuously depends upon the load current that it consumes.

- **Charging voltage**

It is the maximum voltage that should be applied to the battery to efficiently charge a battery. Basically 4.2 V is the best/standard charging voltage. Though we apply 5 V to the battery it accepts only 4.2 V.

- **Charging current**

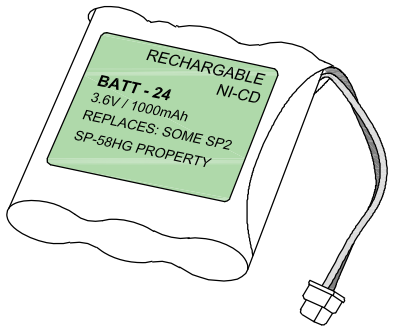
It is the maximum current that can be applied to charge the battery i.e., practically maximum of 1A/2A can be applied if a battery protecting circuit is in-built but still 500 mA is the best range for charging the battery.

**Types of Batteries used in mobile phones**

**1 Nickel Cadmium (Ni-Cd) (Fig 3)**

This type of battery is generally only used in older cell phones and is the least powerful.The chemicals used in Ni-Cd batteries are not environmentally friendly, and the disposal of cadmium-rich waste is an increasing problem. They are the cheapest variety of phone batteries.

Fig 3

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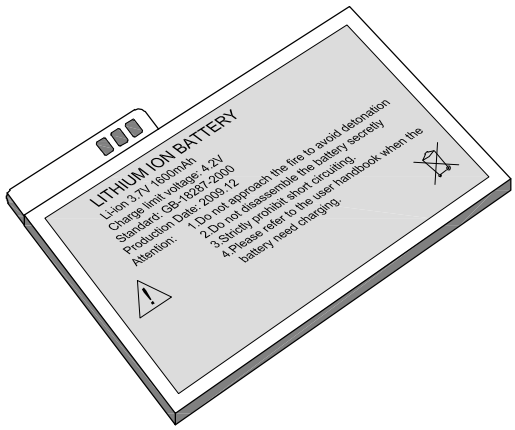
**2 Lithium Ion (Li-Ion) (Fig 4)**

This is the older and most popular technology for cell phone batteries. The only real drawback of Lithium-Ion cell phone batteries is that they are expensive. However, they have higher energy density compared to Li-Polymer.

Fig 4

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**Lithium Polymer (Li-Poly) Batteries (Fig 5)**

Li-Poly is the latest and most advanced technology for cell phone batteries. This makes the batteries ultra-lightweight; they do not suffer from memory effect and will deliver up to 40 per cent more battery capacity than a Nickel Metal Hybrid (NiMH) (one that you use in your camera) of the same size.

Fig 5


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# Block diagram of mobile phone, antennas used in mobile phones

**Objectives:** At the end of this lesson you shall be able to
- **explain the block diagram of basic multimedia handset**
- **describe the types of antenna used in handset.**

### Block diagram and features of cell phones

Now-a-days cell phone become more popular for SMS/ MMS and internet applications due to GPRS feature. After the introduction of Smartphone many applications such as face book, Orkut, Twitter, Various games comes built-in the phone. Now mobile phone has slowly taken the place of laptop for many of the applications. Fig 1 shows the block diagram of a cell phone with respect to GSM standard.

- **RF Part**

As shown in the figure 1, every mobile phone will have RF part which consists of RF frequency up converter and RF frequency down converter. There are two approaches employed in GSM Mobile phone receiver, i.e., heterodyne or homodyne. The basic component used for frequency conversion is RF mixer.

- **Antenna**

Antenna is the metallic object which converts electromagnetic signal to electric signal and vice versa. Commonly used antennas in the mobile phone are helix type, planar inverted F type, and whip or patch type. Micro strip-based patch type of antennas is popular among mobile phones due to its size, easy integration on the PCB and multi frequency band of operation and supports various GSM bands and also various technologies such as CDMA, LTE, WiMAX (Worldwide Interoperability for Microwave Access) and also WLAN, Bluetooth and so on.

- **Tx/Rx Switch**

As there is only one antenna used for both transmit and receive at different times, Tx/Rx Switch is used to connect both Tx path and Rx path with antenna. Tx/Rx Switch is controlled automatically by DSP (digital signal processor) based on GSM. For FDD (Frequency Division Duplexing) systems diplexer is used in place of switch which acts as filter to separate various frequency bands.

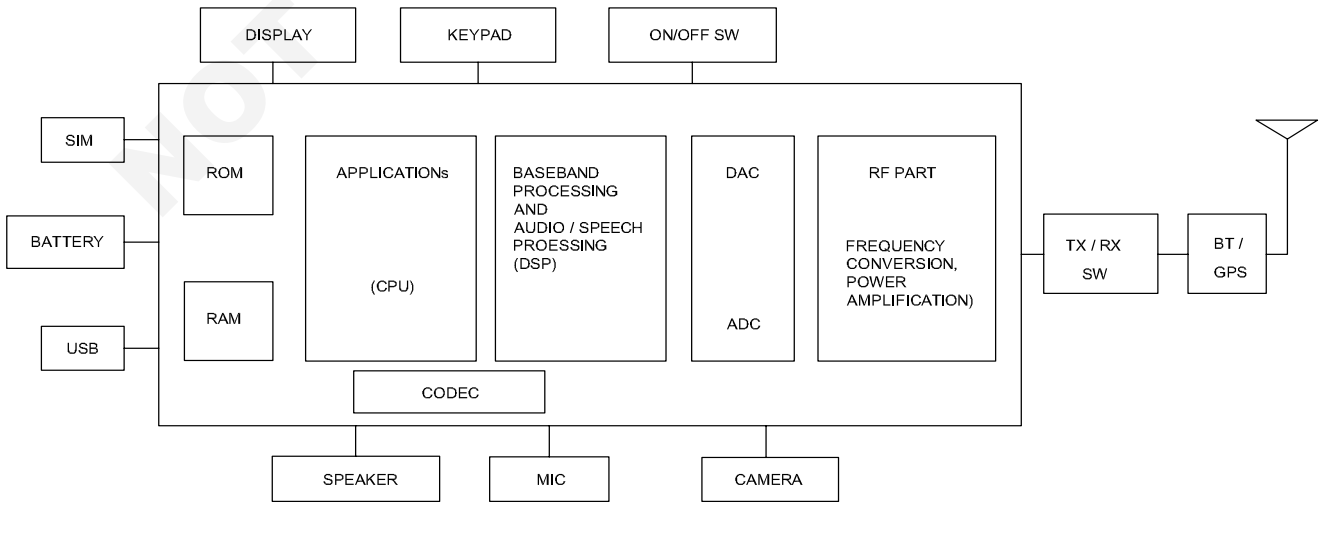
- **Baseband Part**

This part is used to convert voice/data to be carried over GSM air interface to baseband signal. This is the core part which changes for various air interface standards viz. CDMA, Wimax, LT E, and more. For speech/audio, codec is used to compress and decompress the signal to match the rate to the frame it has to fit in. CODEC converts speech at 8 KHz sampling rate to kbps rate for full rate speech traffic channel.

- **ADC and DAC**

ADC (Analog to Digital Converter) and DAC (digital to analog converter) is used to convert analog speech signal to digital signal and vice versa in the mobile handset. At transmit path, ADC converted digital signal is given to speech coder. AGC (Automatic Gain Control) and AFC (Automatic Frequency Control) is used in the receiver path to control gain and frequency. AGC helps maintain working of DAC satisfactorily, as it keeps signal within the dynamic range of DAC. AFC keeps frequency error within limit to achieve better receiver performance

Fig 1



- **Application layer**

It also runs on CPU. Various applications run in GSM mobile phone. It includes audio, video and image/ graphics applications. It supports various audio formats such as MP3, MP4, WAV, RM, JPEG image formats are usually available. It supports video formats e.g., MPEG1 to MPEG-5.

- **Operating system**

Various operating systems are supported in mobile phone such as Symbian, java, android, RT-Linux, Palm. It runs on CPU of different manufacturers. For time critical application RTOS (real -time operating system) is used.

- **Battery**

It is the major source of power to make/to keep mobile phone functional. There are various types of batteries made of Nickel Cadmium (Ni-Cd), Nickel Metal Hydride (NiMH), based on lithium, Li-ion and so on. Battery comes usually with 3.6 or 3.7 voltage and 600 mAh or 960 mAh ratings. Li-ion is long lasting and lighter, but more expensive.

- **Connectivity (WLAN, Bluetooth, USB, GPS)**

To make data transfer fast enough between mobile phone and other computing devices (laptop, desktop, tablet) or between mobile and mobile various technologies are evolved which include WLAN, Bluetooth, USB, GPS (global positioning system) is used for location assistance and will enable google map to work efficiently. Bluetooth and wi-fi uses 2.4 GHz frequency band. This band is the most favourite and it is license free band.

- **Microphone**

Microphone or mic converts sound signal variations to electrical signal to couple on the PCB for further processing. Usually in mobile phone mics having different types such as condenser, dynamic, carbon or ribbon.

- **Speaker**

It converts electrical signal to sound signal (pressure vibrations) for human being to hear. This is often coupled with audio amplifier to get required amplification of audio signal. It also tied with volume control circuit to change the amplitude of the audio signal.

- **Camera**

The mobile phone camera feature is available for one to click pictures at various occasions. It is the major specifications in increasing cost of mobile phone. There are various mega pixel cameras for mobile phones are available such as 12 mega pixel, 14 mega pixel and even 41 mega pixel available in smart phones. This has become evident because of advancement in sensor technology.

- **Display**

  Displays are used to viewing the various information. There are various display devices used in mobile phone such as LCD (liquid crystal display), TFT (Thin-film transistor) screen, OLED (organic light emitting diode), TFD (thin film diode), touch screen of capacitive and resistive type.

- **Keypad**

Earlier days keypad was simple matrix type keypad which contains numeric digits (0 to 9), alphabets (a to z), special characters and specific function keys. These has been designed for various applications such as accepting call, rejecting call, cursor movement (left, right, up, down) dialling number, typing name/SMS/MMS and so on. Now-a day's keypad has been removed from the phone design and it has become part of mobile phone software. It loops on the display screen itself which can be operated by user using touch of a fingertip.

**Antenna used in Cell Phone**

An Antenna converts electromagnetic radiation into electric current, or vice versa.

**Need of Antenna**

- For transmission and reception of the radio signal.
- Antennas are required by any radio receiver or transmitter to couple its electrical connection to the electromagnetic field.

**Following are some of the antennas used in cellular phones:**

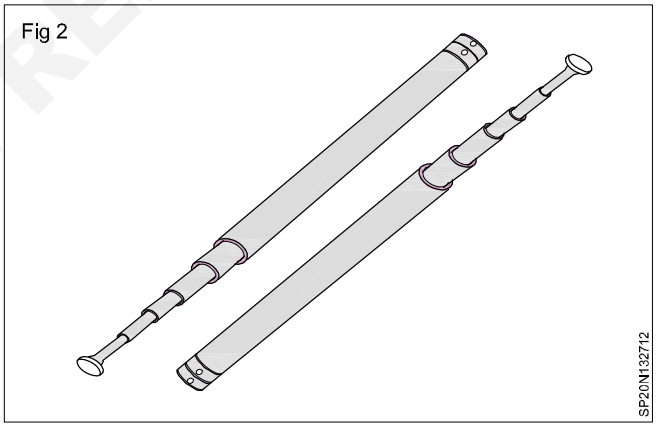
**External Antennas.**

**1 Retractable Monopole (whips) antennas**

An antenna that we can retract.

Basically, a dipole antenna with top loading (looks like a hat) (Fig 2)

Fig 2




**2 Helical antennas (Fig 3)**

When we open a cap, we can see a helical antenna. (looks like a spring). We don't have to retract. ! It is convenient for users. High permittivity small antenna size

**Internal Antennas**

Internal antenna: The antenna is embedded inside the phone which is not visible to us. A phone case is strongly related to an antenna.

**1 Microstrip antennas (MSA) (Fig 4)**

A microstrip antenna also known as a printed antenna usually means an antenna fabricated using photolithographic techniques on a printed circuit board (PCB). It is also called as patch antenna.

Fig 3

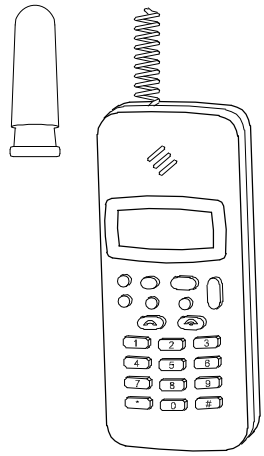


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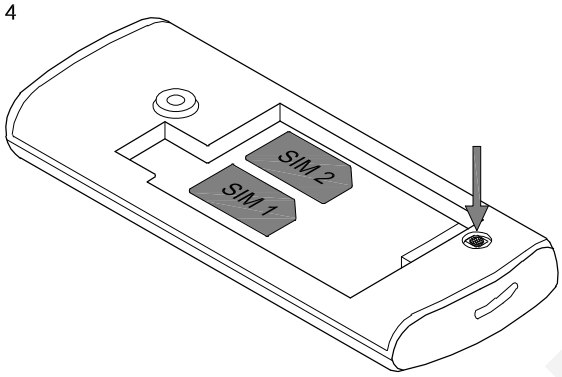
Fig 4

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## 2 Planar inverted-F antennas (PIFA) (Fig 5)

The Planar Inverted-F antenna (PIFA) is increasingly used in the mobile phone market. The antenna is resonant at a quarter-wavelength (thus reducing the required space needed on the phone), and also typically has good SAR properties. This antenna resembles an inverted F, which explains the PIFA name. The Planar Inverted-F Antenna is popular because it has a low profile and an omnidirectional pattern.

Fig 5

## Safety precautions and PCB concept

**Objectives:** At the end of this lesson you shall be able to
- **state the standard safety precautions while repairing handset**
- **explain the concept of PCB and types of PCB.**

**Standard safety precautions while repairing handsets**

Whenever you commence to repair any device or a gadget, it is utmost important that you follow a few necessary safety guidelines.

Fig 1


**1 A Clean Work Station**

Always keep your work station clean and remove any unwanted items and also keep all your regular tools within your arms reach and at appropriate place so that with time you get so well versed with the setting that when need arises for a particular tool your hand reaches out to it on its own and you do not even have to see with your eyes to locate it.

**2 Use correct tools**

To work as a professional technician, it is a must that you should have all the tools that are normally required. Additionally, you should have all the specialized tools for the particular device you want to fix. Never make do with substitutes even if you are well in hurry. For instance, you will need a Philips screwdriver to open a screw with a Phillips (plus) head. Do not attempt to open it with a slotted (minus) screwdriver because you will definitely damage the head of the screw.

Also do not attempt to separate the front or back cover of a handset with your thumb's nail. Instead use a plastic mobile phone opener because attempting to do the former way will hurt your thumb and this may stop you from carrying on your work for a long time because of the injury.

**3 ESD Protection**

ESD (Electro Static Discharge) is the sudden flow of electricity between two electrically charged objects caused by any contact between them. The intensity of this current can never be said as it differs from one device to another. It all depends on a person as well so as how much one can absorb it; in some cases, it might give you a tingling sensation or even stun you or maybe it is possible that you may not feel it at all.

For ESD protection, you need to use an anti-static wrist strap. The anti-static wrist strap is to ground any static build-up in the human body. Additionally, you can also use anti-static gloves and an anti-static mat and ESD safe tools.

**4 Accumulate all small parts into a tray**

Whenever you disassemble any handset, always make it a point that you gather all the detached parts in a separate tray (or container) so that you do not have to remember and look for the parts when you reassemble the handset. This way you will not leave out any part to be reassembled and this will also keep you informed about all the screws you have replaced and have not left out any of them.

**5 Take care of delicate parts**

Most of the parts in smartphones are delicate. Hence it is a must that care has to be taken while disassembling these delicate devices. Any attempt to forcefully remove a part can damage the part or the motherboard to an irreparable situation.

While handling the LCD, make sure you do not have a sharp metallic object in your hand which might cause an ugly scratch on the screen or may even break it.

**6 Care while using heating equipment**

All equipment such as soldering iron, rework station, hot air gun, etc. which are used manually while doing repairs have to be used with utmost caution so that the user does not get scalded or burnt by them. A split second of distraction can cause an accident. So be very much alert while using these tools and have your total concentration into the job.

**7 Take care of customer's data**

When you perform a factory reset or reinstall the operating system in a phone, all the data stored in it is compulsorily deleted. The data may be very important for some customers, so it is best advised that you inform the customer before doing it.

**PCB Concept**

A printed circuit board or PCB, is a plate or board used for placing the different elements that conform an electrical circuit that contains the electrical interconnections between them. (Fig 2)

Fig 2

The simplest printed circuit boards are the ones that contains copper tracks or interconnects only on one of its surfaces. These kinds of boards are known as Single layer printed circuit board or single layer PCB.

The most common PCB's manufactured today are the ones that contain 2 layers, that is, you can find interconnects in both surfaces of the board. However, depending on the physical complexity of the design (PCBlayout), the boards can be manufactured of 8 or more layers.

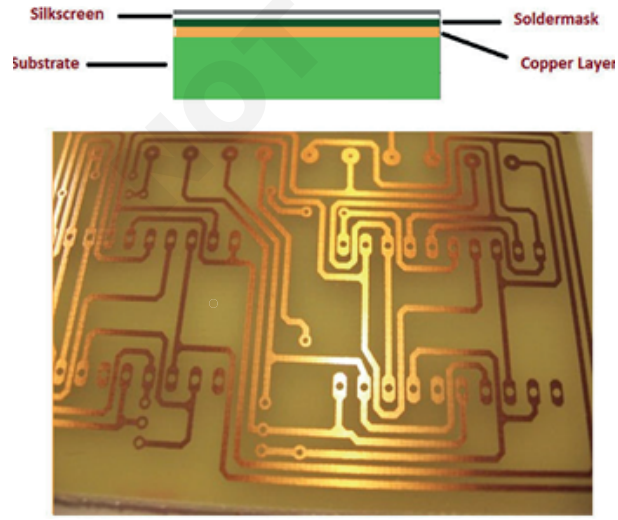
### Types of PCBs

There are several types of circuit boards in use today. Printed circuit boards may be characterized by their construction methodology, which includes single-sided, double-sided, and multilayer board configurations.

### 1 Single-Sided PCBs

Single-sided PCBs have only one layer of substrate. The substrate is covered with a thin layer of metal on one side. Generally, copper is used because of its high electrical conductivity. This layer creates a conductive path for power and signals between various electronic components. A protective solder mask layer comes next, and a silkscreen coating may be added as a final layer to label the parts of the board. Single-sided PCBs are used for simple electronics and are mass-produced at a lower cost than other types of PCBs. (Fig 3)

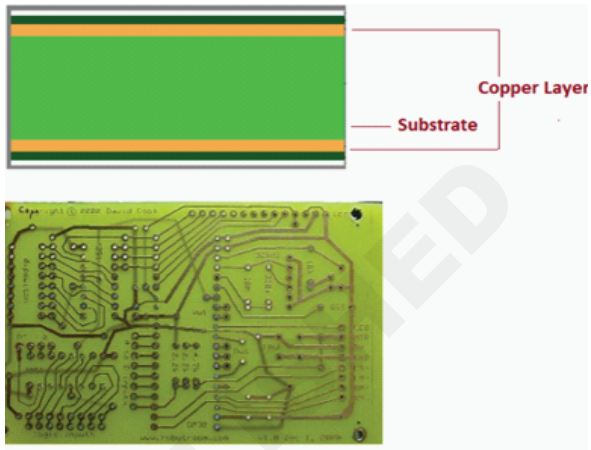
Fig 3




### 2 Double-Sided PCBs

Double-sided PCBs are much more commonly used than single-sided boards because the two sides allow for the introduction of more complex circuitry. Like single-sided PCBs, they have only one layer of substrate, but both sides are covered with conductive metal and the circuit components. Either through-hole mounting or surface mounting is then used to connect the components. (Fig 4)

Fig 4

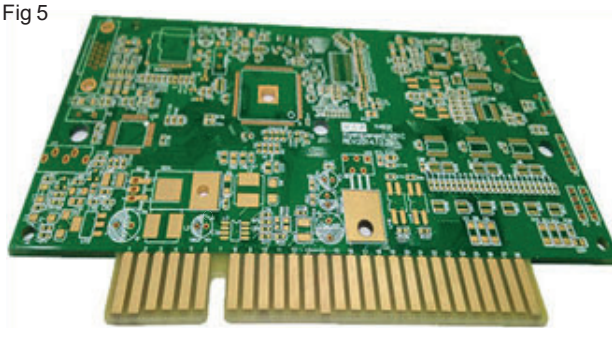



- Through-hole technology, sometimes spelled "thru-hole," uses small wires, called leads, that go through the holes in the board to connect components. The leads are soldered on each end to the exact component or circuit.
- Surface mounting doesn't require holes to be drilled in the board. Components are mounted directly onto the PCB. This method uses smaller leads or no leads at all.

### 3 Multilayer PCBs

Multilayer PCBs have multiple layers of substrate, with insulating materials separating the layers. They use the same technology as double-sided PCBs, with the components on multi-layer boards being connected by either through-hole or surface mounting. Multilayer boards usually have four to 10 layers, but can have more if the product demands it. They are usually used for computers, servers, and are often used in specialized applications such as medical specifications PCBs. (Fig 5)

Fig 5



## Overview of mobile phone parts

**Objectives:** At the end of this lesson you shall be able to
- **explain the working principle of various parts used in mobile phone**
- **state the procedure for changing the mobile phones display and keypad.**

**Overview and working process of various parts**

- **Speakers (Fig 1)**

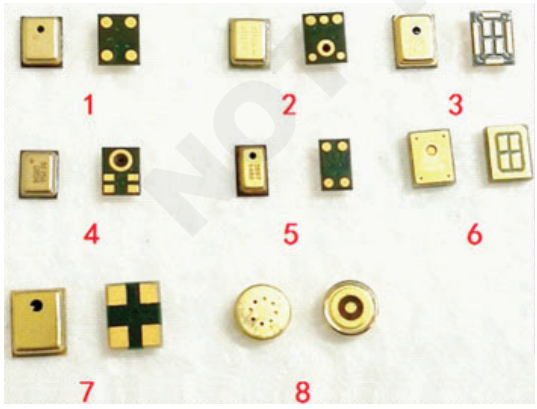
Speakers work by converting electrical energy into mechanical energy (motion). The mechanical energy compresses air and converts the motion into sound energy or sound pressure level (SPL). When an electric current is sent through a coil of wire, it induces a magnetic field. In speakers, a current is sent through the voice coil which produces an electric field that interacts with the magnetic field of the permanent magnet attached to the speaker

Fig 1

- **Microphones (Fig 2)**

Microphones are a type of transducer - a device which converts energy from one form to another. Microphones convert acoustical energy (sound waves) into electrical energy (the audio signal).

Fig 2




Different types of microphone have different ways of converting energy but they all share one thing in common: The diaphragm. This is a thin piece of material (such as paper, plastic or aluminium) which vibrates when it is struck by sound waves. In a typical hand-held mic like the one below, the diaphragm is located in the head of the microphone.

- **Vibrator (Fig 3)**

Now, all modern smart phones and phones are equipped with a vibration motor. It is a small electric motor, on the axis of which a metal cylinder is mounted. The axis of the engine intentionally does not coincide with the axis of the cylinder, which allows the latter to vibrate during rotation. When a call is received, the motor starts to work and rapidly unwinds the cylinder. Vibrations are transmitted to the phone's case and it starts to vibrate

Fig 3

- **Earphone connector (Fig 4)**

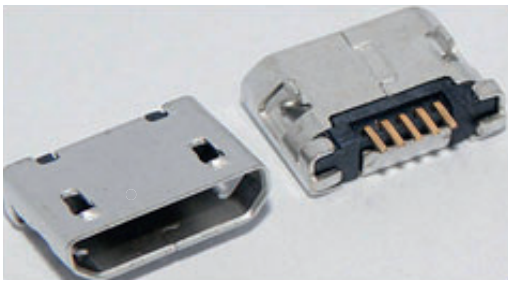
An earphone connector, also known as phone jack, audio jack, headphone jack or jack plug, is a family of electrical connectors typically used for analog audio signals. The standard is that a plug (described as the male connector) will connect with a jack (described as female).

Fig 4

- **Charging Connector (Fig 5)**

Now the charging of your mobiles has been made easy with the help of USB outlets present in the Laptop and PC. For the charging of your mobile phone, this circuit provides you a regulated voltage of 4.7 volts.

Fig 5



**Data cable connectors (Fig 6)**

The data cable connector is mainly used for transferring data from your phone to PC / Laptop. It is also known as USB cable.

Fig 6

**Concept of Display change procedure**

As mobile phone displays are much tougher than they used to be, it seems like they're indestructible. Sadly, they're not. Dropping your phone can often break the display. Your phone can no longer be considered useful.

The Tools for Replacing Your Phone Screen (Fig 7)

Fig 7

- Mini screwdrivers
- Mini TORX drivers
- Plastic tweezers
- Plastic wedges
- A guitar pick/plectrum
- Curved tweezers
- Precision knife or craft scalpel
- Hairdryer or heat gun

Most smartphones are essentially made up of several layers of components. Each layer must be carefully detached for the glass display to be replaced.

These guides typically follow this procedure for replacing your smartphone display:

**Step 1: Open the Phone (Fig 8)**

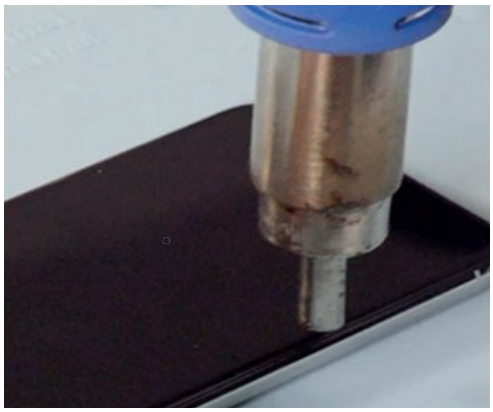
To begin, remove (where possible) the rear cover, battery and identify where the TORX (or standard) screws might be hidden. Look under labels and beside USB ports. You might find screws in the battery cavity if you have a device with a removable cell. Watch out for ribbon cables, which require careful unlatching from their connectors. Use a flat plastic blade or plectrum for this.

Fig 8

**Step 2: Remove the Screen (Fig 9)**

By now you should have the front of the phone in your hand, empty, with the glass display ready to remove. Soften the adhesive with the heat gun.

Fig 9



**Step 3: Replace the Adhesive**

Narrow rolls of replacement adhesive can be bought online. Have some double-sided sticky tapes laying around? Cut this into narrow 1 mm slivers, then apply the adhesive to the phone's frame, rather than the glass as shown in Fig 10.

Fig 10

**Step 4: Install the New Screen (Fig 11)**

Once the adhesive is in place remove the protective strips on the adhesive and push the glass into place.
Apply light pressure where the display meets the adhesive. Take care not to put pressure on the middle of the glass display. Excessive force can break even the strongest Gorilla glass.

Fig 11

**Step 5: Ensure Correct Cable Connections (Fig 12)**

Reconnect the relevant cables, locking them down where necessary. Place the components back in the case with care, checking that there are no cables or screws left over. Test the phone to check that it works.You should be able to switch the phone on without securing the final screws in order to check functionality.

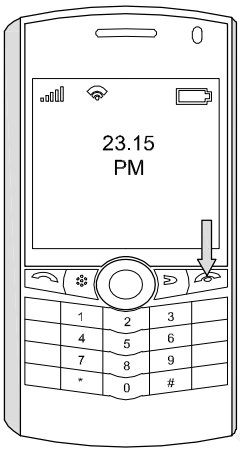
Fig 12

**Concept of keypad change procedure**

**Step 1**

Power the device off and then back on. Sometimes software glitches will cause problems with normal keypad functionality, such as certain key-presses not registering. Power cycling the phone will resolve any random, non-serious software issue that may be causing the problem. (Fig 13)

Fig 13




**Step 2**

Pull off the back panel of the phone. Make sure you pull the cover off carefully in order to prevent damage to the back cover.

**Step 3**

Locate and unscrew the circled screw using a Philips head #2 screw driver or screw driver hea**d.**

**Step 4**

Lift the motherboard away from the phone housing.

Be careful when lifting the motherboard. To prevent damage to the motherboard, gradually lift it from its place in the assembly.

**Step 5**

Now that the motherboard has been lifted out of place, the keypad can be accessed. Using your fingers push the buttons from the phone toward the lifted motherboard. Now replace the old keypad with new keypad, and then reassemble the phone. (Fig 14)

Fig 14

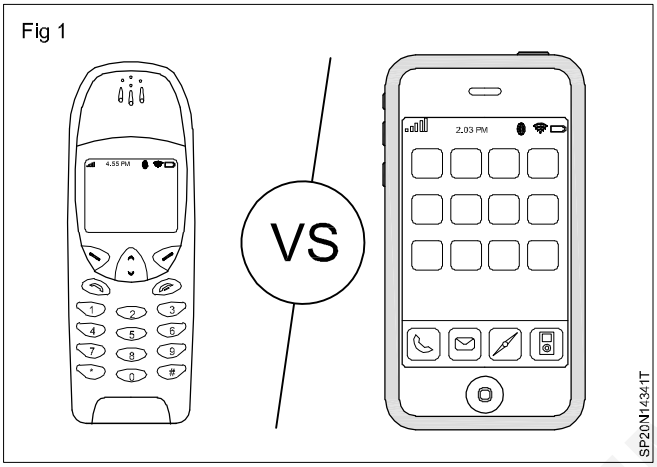
# Smartphone vs mobile phone

**Objectives:** At the end of this lesson you shall be able to
- **distinguish between smart phone and basic mobile phone.**

### Smartphone vs Cell phone (Fig 1)

A smartphone is a cell phone with advanced features. Technically, a smartphone is a cell phone, but a cell phone is not always smart.

Fig 1




Think of a smartphone as a miniature computer that can place and receive calls. Most smartphones connect to a virtual store with thousands of apps that turn the phone into something much smarter than a regular cell phone.

Cell phones place and receive voice calls and send text messages. Smartphones do those things and more. How much more depends on the smartphone's operating system.

### Basic Phones

- Price! The phones are cheaper, as well as the plans.
- Battery. Longer battery life, as you are not surfing the web or having multiple apps open.
- Durability. More durable in regards to being dropped or exposed to moisture.
- Simplicity. Basic phones are usually quite user friendly.
- Size. Basic phones are considerably smaller than smartphones.
- Privacy & Security. Older basic phones do not have the ability to access the internet, therefore decreasing the amount of personal information on the web. Please note: New basic phones have the potential to access the internet & certain apps–please talk with your salesperson when purchasing a basic phone
- Less Addictive. Much easier to break away from technology on a basic phone, less access to pornography, cyber bullying, and developing poor media habits.
- Easier to monitor basic phones with fewer apps, limited internet abilities, etc.
- In emergencies, it's easier to call "911" with buttons than with a touch screen.
- A note on Verizon plans. Verizon has set up a new "4G" network. Right now, the older basic and smartphones (which use "3G") are grandfathered in on your plan, but news has it that Verizon will drop the "3G" network completely this year, forcing those with the older phones to get new ones that are compatible with the new "4G" network.

### Smartphones

- Increased user efficiency. Especially important for most business-oriented persons, acting as a "small" computer.
- Camera. Most smartphones have high quality cameras with editing capabilities.
- Staying connected more easily with family and friends.
- Ease of access to emails and messaging.
- GPS/location ability.
- Abundant apps to make to-do lists easier & staying organized (i.e., banking, ordering groceries, prescription refills, comparison pricing, etc)
- Parental controls: Can disable or limit built in apps (such as internet, voice recognition, ability to download new apps, etc) and lock these settings with a passcode.
- Can utilize accountability software to track all text messages and phone activity.
- Entertainment features.
- Education tools for students & teachers.

# Smart phone architecture and OS

**Objectives:** At the end of this lesson you shall be able to
- **state the various parts of smart phone architecture**
- **describe the operating system used in mobile phone**
- **state the basic features of android and windows and its applications.**

### Smartphone architecture

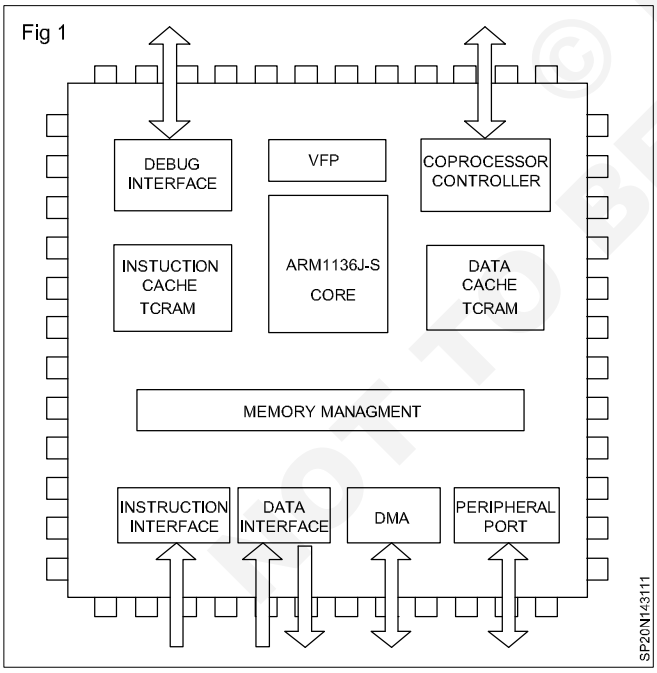
No standard exists to define what makes a phone a smartphone.

- GSM/CDMA/etc mobile phones.
- run a high-level operating system
- **Features**
  - Wi-Fi.
  - Bluetooth.
  - Internet access.
  - Custom application software.
  - Cameras

### Architecture - ARM (Fig 1)

An ARM processor is one of a family of CPUs based on the RISC (reduced instruction set computer) architecture developed by Advanced RISC Machines

Fig 1

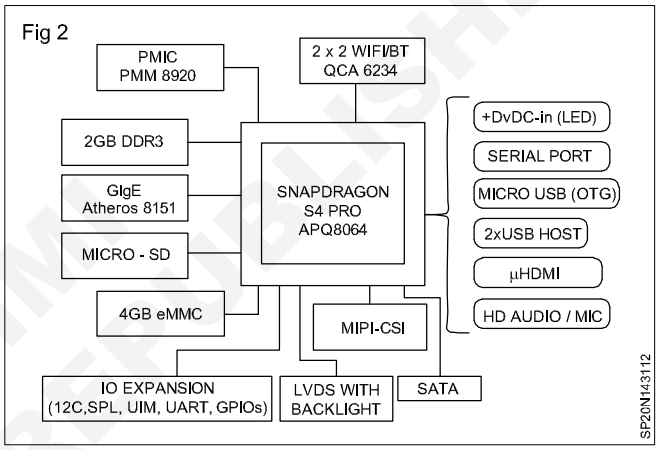



- RISC Based Processor conceived in the 80s.
- Android first utilized ARM in 2008.
- Since 2008, 190 million Android devices shipped with ARM.
- Great performance with low power costs.
- NVIDIA Tegra 3 - 4 ARM Cortex A9 cores at 1.5 GHz on HTC One X Device.

### Architecture - Snapdragon (Fig 2)

Snapdragon is a suite of system on a chip (SoC) semiconductor product for mobile devices designed and marketed by Qualcomm Technologies Inc. The Snapdragon central processing unit (CPU) uses the ARM architecture.

Fig 2




- Similar to ARM processors, ARM Cortex A15.
- Developed by Qualcomm.
- Built with 28 nm process.
- Uses ARMv7 ISA.
- Up to 1.7 GHz quad core with 2MB L2

### Developments - SoC

- **System on a Chip**
  - Whole-system ICs.
  - Reduced cost.
- **Contrast with microcontrollers**
  - Generalized.
  - Higher performance.
  - Matter of scale.

### Developments - Cores

- **Dual and Quad core**
  - Qualcomm Snapdragon.
  - Nvidia Tegra 3.

## Mobile Operating Systems

An OS is a software interface that is responsible for managing and operating hardware units and assisting the user to use those units. For mobile phones, OSs have been developed to enable users to use phones in much the same way as personal computers. The most well-known mobile OSs are Android, iOS, Windows phone OS, and Symbian. The market share ratios of those OSs are Android 47.51%, iOS 41.97%, Symbian 3.31%, and Windows phone OS 2.57%. There are some other mobile OSs that are less used (BlackBerry, Samsung, etc.).

### Android Operating System (Fig 3)

Fig 3


Android is an open-source mobile OS developed by Google and launched in 2008. Android is a Linux-based OS that uses Linux 2.6 to provide core services such as security, memory management, process management, network stack, and a driver model. It offers a wide range of libraries that enable the app developers to build different applications. Android applications are usually written in Java programming language.

### Apple iOS (Fig 4)

Fig 4


Apple iOS is a closed-source code mobile phone OS developed by Apple in 2007; it is used by Apple-only products (iPhone, iPod, and iPad). The iOS architecture is based on three layers incorporated with each other. Cocoa touch is a layer that provides some basic infrastructure used by applications. The second layer is the media layer, which provides audio services, animation video, image formats, and documents in addition to providing two-dimensional (2D) and 3D drawings and audio and video support. The third layer is the core OS, which provides core services such as low-level data types, start-up services, network connection, and access.

### Windows Phone Operating System (Fig 5)

Windows phone OS is a closed-source code mobile OS developed by Microsoft Corporation and used by multiple smart devices (personal digital assistants, smartphones, and touch devices). Windows phone OS is based on a compact version of .Net framework, which gives it an advantage in developing .Net-oriented mobile applications.

Fig 5


### Basic features of Android phones

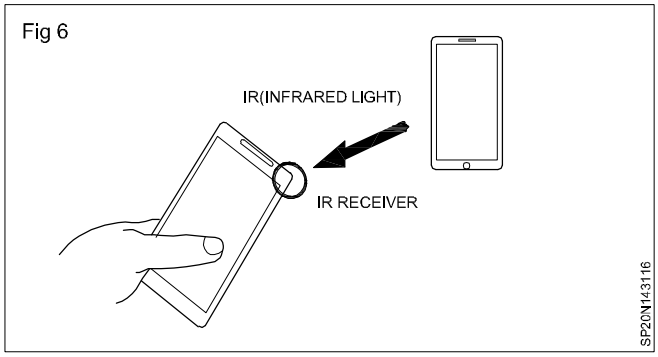
#### 1 Alternate Keyboards

Android supports multiple keyboards and makes them easy to install; the SwiftKey, Skype, and 8pen apps all offer ways to quickly change up your keyboard style. Other mobile operating systems either don't permit extra keyboards at all, or the process to install and use them are tedious and time-consuming.

#### 2 Infrared Transmission (Fig 6)

The Android operating system supports a built-in infrared transmitter, allowing you to use your phone or tablet as a remote control.

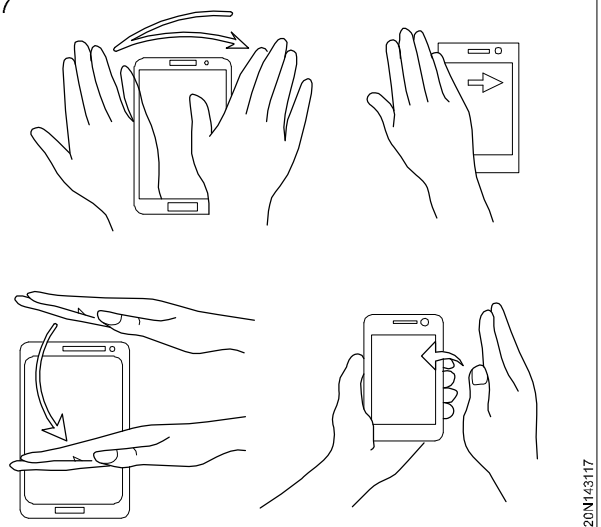
Fig 6




#### 3 No-Touch Control (Fig 7)

Using Android apps such as Wave Control, users can control their phones touch-free, using only gestures. Have messy hands but need to turn off your screen or change a song? Simple. This could prove especially useful if you're driving, so you can keep both eyes on the road.

Fig 7



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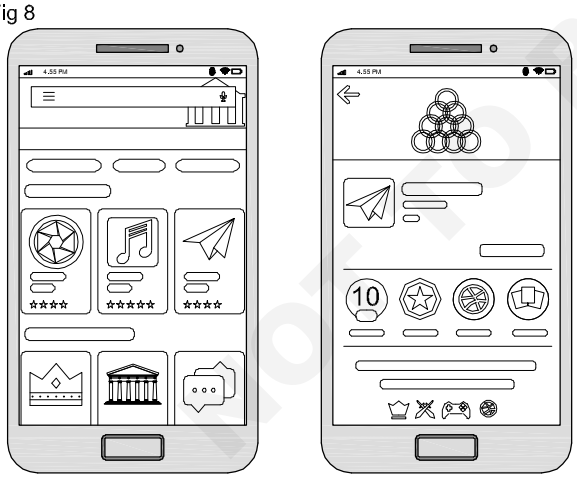
## 4 Automation

The Tasker app lets you not only control app permissions but also automate them. Do you only want your location services to be active during the day? Want to create a customized way to start your music for example, with a voice command and at a certain volume? Tasker can help.

## 6 Wireless App Downloads (Fig 8)

Accessing app stores on any mobile device can be frustrating, but iOS makes it a little more difficult—download an app on your computer, and it won't sync to your mobile device until you plug in and access iTunes. Using the Android Market or third-party options like AppBrain, meanwhile, let you download apps on your PC and then automatically sync them your Droid, no plugging required.

Fig 8



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## 7 Storage and Battery Swap

Android phones also have unique hardware capabilities. Google's OS makes it possible to remove and upgrade your battery or to replace one that no longer holds a charge. In addition, Android phones come with SD card slots for expandable storage.

## 8 Custom Home Screens (Fig 9)

While it's possible to hack certain phones to customize the home screen, Android comes with this capability from the get-go. Download a third-party launcher like Nova, Apex or Slide and you can add gestures, new shortcuts, or even performance enhancements for older-model devices.

Fig 9


## 9 Widgets

Apps are versatile, but sometimes you want information at a glance instead of having to open an app and wait for it to load. Android widgets let you display just about any feature you choose, right on the home screen—including weather apps, music widgets, or productivity tools that helpfully remind you of upcoming meetings or approaching deadlines.

## 10 Custom ROMs

This is a big one. Because the Android operating system is open source, developers can tweak the current OS and build their own versions, which users can download and install in place of the stock OS. Some are filled with features, while others change the look and feel of a device. Chances are if there's a feature you want, someone has already built a custom ROM for it.

### Basic features of Windows phones

## 1 Customizable live tiles (Fig 10)

Users of Windows Phone love the dynamic Live Tiles on the start screen. In Windows Phone 8, these tiles are more customizable than before – you get to choose how big the tiles are. This is perfect when deciding exactly what's important to you and setting up your start screen in a way that fits your needs.

Fig 10


## 2 Nokia Maps

All Windows Phone 8 smartphones make use of Nokia's Location Platform. If it's a Nokia Lumia smartphone, the default mapping application is Nokia Maps. However, if you're using a non-Nokia Windows Phone 8 smartphone, your default mapping application is Windows Phone Maps.

## 3 Integrated VoIP apps

It's now possible for third-party developers to integrate VoIP apps with the Windows Phone 8 dialer and contact list. This means you'll be able to make VoIP calls right from the People Hub, just like you would a normal phone call.

## 4 Lenses

Microsoft has been working on making a tighter integration of apps in the new OS. That's why all apps that are camera-based will now be found within the camera app itself. Pressing the camera button will launch the camera and installed 'Lens apps' can be found when you've pressed the Lens icon.

## 5 Data storage and syncing

In a world where cloud-storage seems to be the future, everything we own (digitally) can be stored elsewhere – not actually on our devices. What this means is that we needn't throw any of these digital assets away, instead, keep them for safekeeping.

## 6 Shared Windows core

Windows Phone and Windows 8 share the same core. This means that when it comes to development, whether it is software or hardware, as a consumer, your experience across phone and PC will be exceptional.

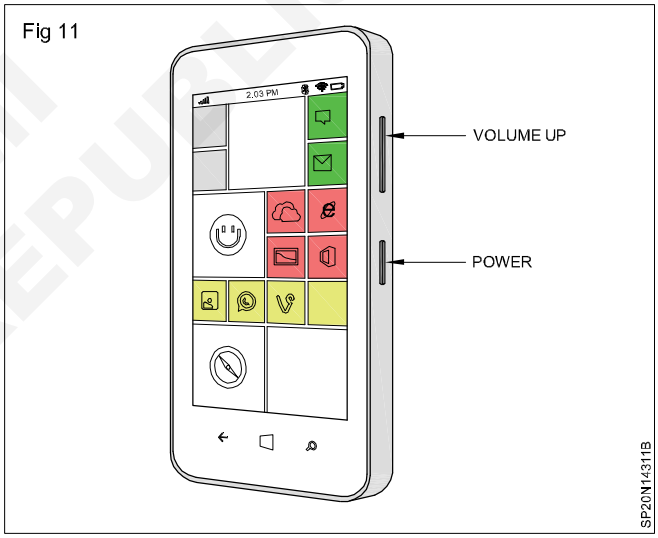
## 7 Internet Explorer 10

The Internet browser in Windows Phone 8 matches the experience you receive when using IE10 on a Windows 8 PC. When it comes to rendering webpages based on JavaScript, IE10 on Windows Phone 8 is up to seven times faster than the version in Windows Phone 7.5 and offers more support when it comes to HTML5.

## 8 Screenshots (Fig 11)

Now, this won't be for everybody, but for people like me (writers/bloggers/journalists), this is invaluable. If you're writing about an app, a game or just want to show what the start screen looks like, you'll need a way of capturing the screen so that other people can see it.

Fig 11



# Concept of Wi-Fi, bluetooth, hotspot, card reader & OTG, NFC

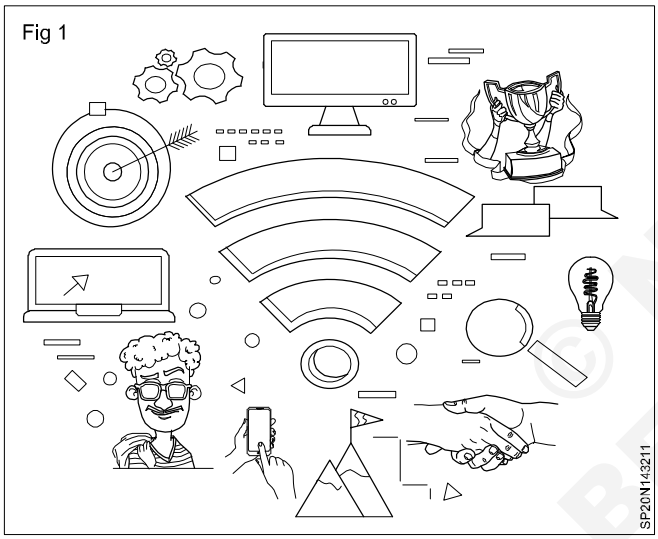
**Objectives:** At the end of this lesson you shall be able to
- **explain the concept of Wi-Fi**
- **describe how to download and share files through various method.**

### Concept of Wi-Fi

Wi-Fi is a wireless networking technology that allows devices such as computers (laptops and desktops), mobile devices (smart phones and wearables), and other equipment (printers and video cameras) to interface with the Internet. It allows these devices—and many more—to exchange information with one another, creating a network.

Internet connectivity occurs through a wireless router. When you access Wi-Fi, you are connecting to a wireless router that allows your Wi-Fi-compatible devices to interface with the Internet. (Fig 1)

Fig 1




### Downloading through internet (Fig 2)

There are a variety of ways to add media and programs to your Android or iOS device. Given below are the steps shows you how to get your mobile phone turned into a true multimedia device.

- **Visit the Google Play Store**

  You can access the store from your phone's Application list, or you can visit it on your computer here. There are many free applications, games, songs, and videos available for download.

- **Download apps from other sources**

  In order to install apps from sources other than the Google Play Store, you will need to set your phone to allow non-market apps.

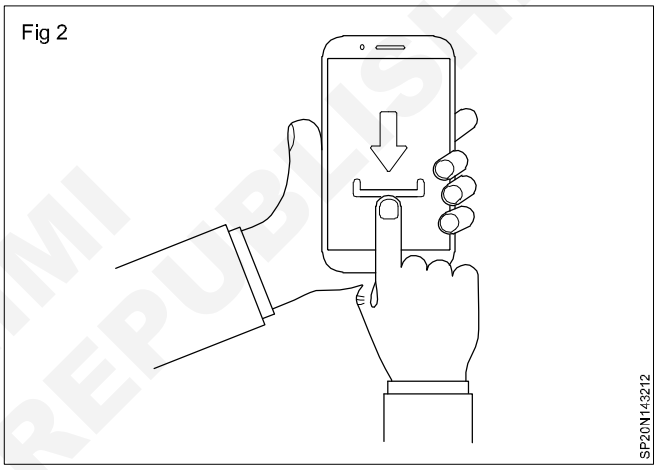
- **Download files from the web.**

  When browsing the web on your phone, you can download files directly to your phone's storage.

i To download an image, tap and hold the image in your phone's browser for a second, and then release. A menu will open and you will have the option to save the image to your phone.

ii Downloaded files will be stored in your Downloads folder on your phone. You can move these around by either attaching your phone to your computer or moving the files using Windows, or by installing a File Manager app.

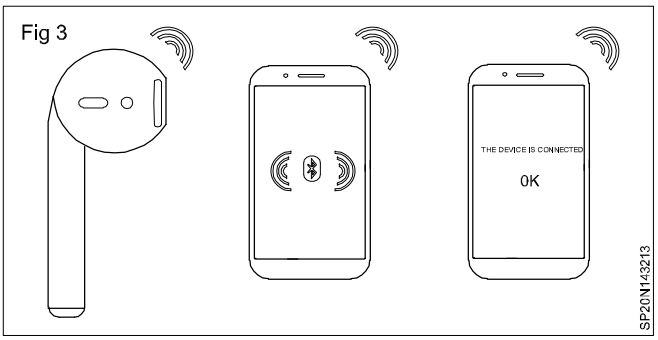
Fig 2




### Bluetooth Technology (Fig 3)

Bluetooth technology is a short-range wireless communications technology to replace the cables connecting electronic devices, allowing a person to have a phone conversation via a headset, use a wireless mouse and synchronize information from a mobile phone to a PC, all using the same core system.

Fig 3




Steps to connect Bluetooth devices:

- Open the Activities overview and start typing Bluetooth.
- Click on Bluetooth to open the panel.
- Make sure Bluetooth is enabled: the switch in the title bar should be set to on.

- In the Devices list, select the device to which to send the files. If the desired device is not shown as Connected in the list, you need to connect to it. A panel specific to the external device appears.
- Click Send Files… and the file selection option will appear.
- Select the file you want to send and click Select. To send more than one file in a folder you can simply long press any one particular file and then you can make multiple selections.
- The owner of the receiving device usually has to press a button to accept the file. The Bluetooth File Transfer dialog will show the progress bar. Click Close when the transfer is complete.

**Share internet via Hotspot and Data cable**

You can use your phone's mobile data to connect another phone, tablet, or computer to the internet.

Sharing phone's data this way is called tethering or using a hotspot. Most Android phones can share mobile data through Wi-Fi Hotspot or USB.

Here are the steps you can follow to share a mobile connection by tethering or hotspot on Android

- **Tether by Wi-Fi hotspot (Fig 4)**

This is one of the easiest and most used methods. Follow the below-given steps to turn on your phone's hotspot.

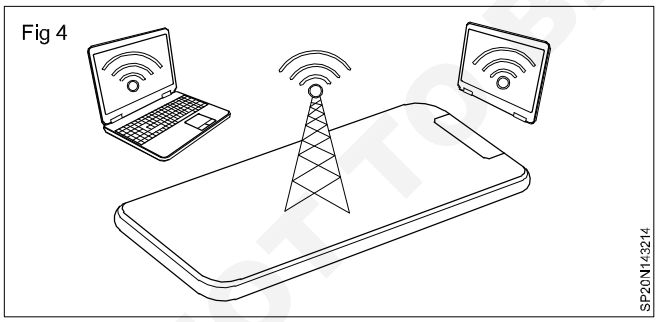
**Step 1:** Open your phone's Settings app.

**Step 2:** Next, tap Network & Internet.

**Step 3:** From the given options select Hotspot & tethering.

**Step 4:** On the next page you need to turn on Wi-Fi hotspot.

Fig 4




- **Tether by USB cable (Fig 5)**

Before you follow steps remember that Mac computers can't tether with Android by USB.

**Step 1:** Using a USB cable, connect your phone to the other device. A notification, "Connected as a" will be displayed on the top of the screen.

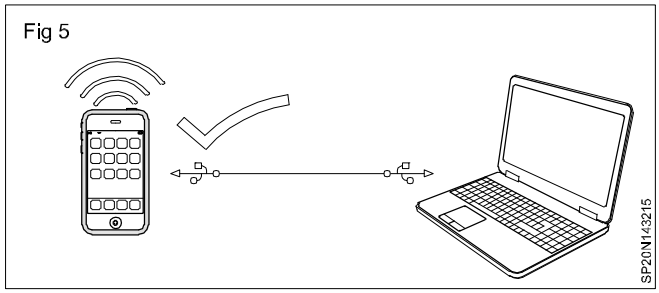
**Step 2:** Open your phone's Settings app.

**Step 3:** From the given option tap Network & Internet.

**Step 4:** On the new page select Hotspot & tethering.

**Step 5:** Next, turn on USB tethering.

Fig 5




- **Card reader (Fig 6)**

As a new type of storage device based on semiconductor flash memory, SD (Secure Digital) memory card is produced to increase the capacity of digital devices. And it is favoured and used by a lot of people due to its excellent characteristics of small size, fast data transfer and hot swap.

Fig 6

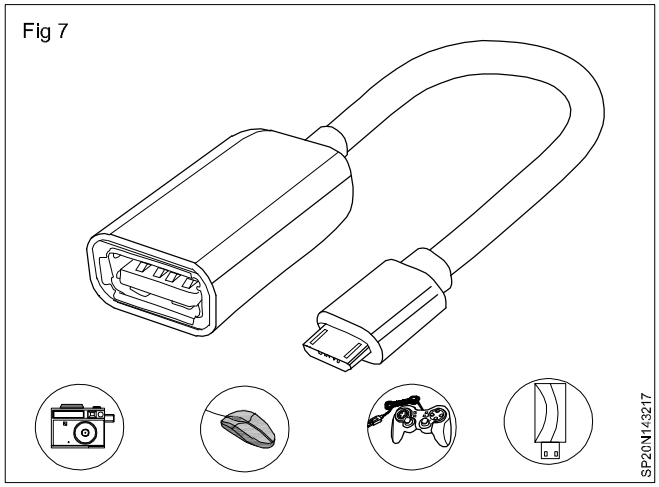
At present, SD card is the most common memory card on the market. It is now widely used in digital camera, DV, MP4, MP3, PDA and smart phone.

Well, SD card reader is a kind of device used specially for reading SD card. It's an external device with corresponding SD card slot and USB interface. Besides, it supports reading & writing data and allows the access to SD card files.

- **On-The-Go (OTG) (Fig 7)**

USB drives are convenient, but you can't use one with your phone. Well, unless you have an Android phone and know what USB OTG is?

Fig 7



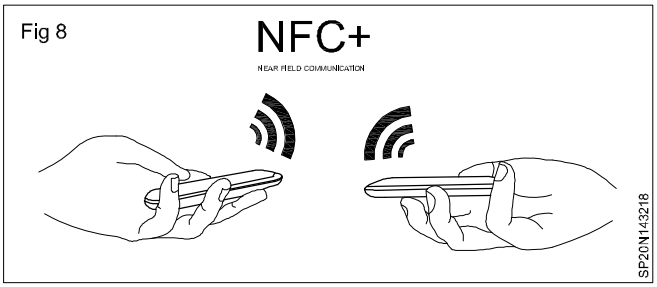
USB On-The-Go (OTG) is a standardized specification that allows a device to read data from a USB device without requiring a PC. The device basically becomes a USB host, which isn't an ability every gadget has. You will need an OTG cable or OTG connector.

You can do a lot with this, For example, you might connect a USB flash drive to your phone, or use a video game controller with an Android device.

**Near Field Communication (NFC) (Fig 8)**

Most Android devices support NFC, which allows electronic devices to easily interact across short distances. The main aim here is to create a payment option that is simpler than carrying credit cards or cash, and while the market hasn't exploded as many experts had predicted, there may be an alternative in the works, in the form of Bluetooth Low Energy (BLE).

Fig 8



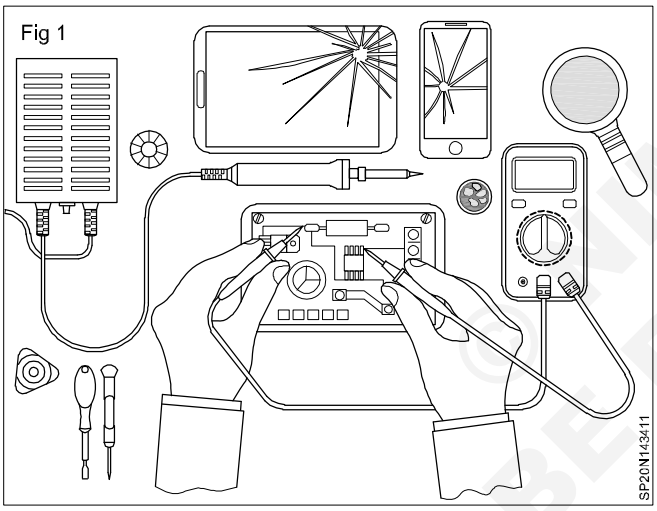
# Tools for smartphone repairing

**Objectives:** At the end of this lesson you shall be able to
- **explain what is smart phone repairing**
- **enumerate the types of tool, equipment and materials required for mobile phone repairing.**

**Smartphone repairing (Fig 1)**

Today, smartphones and other handheld devices are almost a necessity rather than a luxury. These digital devices are expensive and it costs significant amount to obtain one. Unfortunately, most of them are susceptible to damage ranging from screen related damages to motherboard related issues, which result due to age and other factors such as accidental drops. There are hundreds of tools for mobile phone repairing available in the market. It is important to select the best brand. Below is list of all the professional tools and equipment needed for mobile cell phone repairing:

Fig 1




**1 Soldering Iron (Fig 2)**

A soldering iron is used to solder small components like capacitor, resistor, diode, transistor, regulator, speaker, microphone, display etc. A 30-watt soldering iron is good enough for most mobile phone repairing job.

When buying a soldering iron, select the one that is easy to hold and does not burn you hand. The soldering iron must have option to choose and select different types and shapes of soldering tips or bits. These tips or bits must be replaceable

**2 Soldering Station (Fig 3)**

A soldering station has 2 units – a station and an iron. It has option to control temperature depending on the heat requirement of the soldering job being done. The soldering iron is attached with the soldering station. It is better and more convenient than traditional soldering iron. It makes soldering work much easier and faster. When buying a soldering station for mobile phone repairing one must always select an ESD-Safe (*Antistatic*) model.

Fig 2

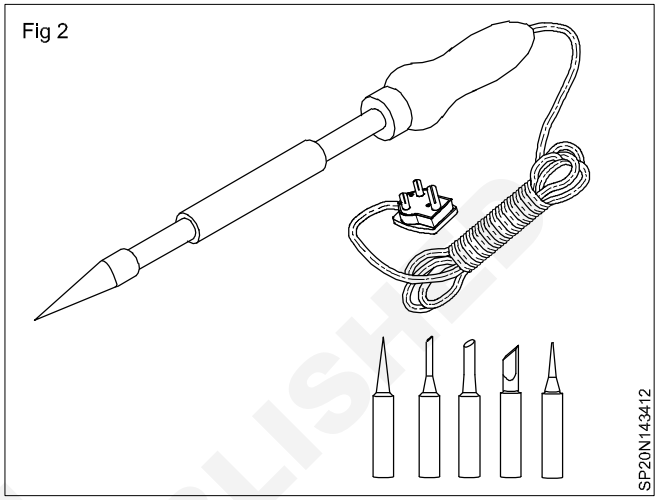
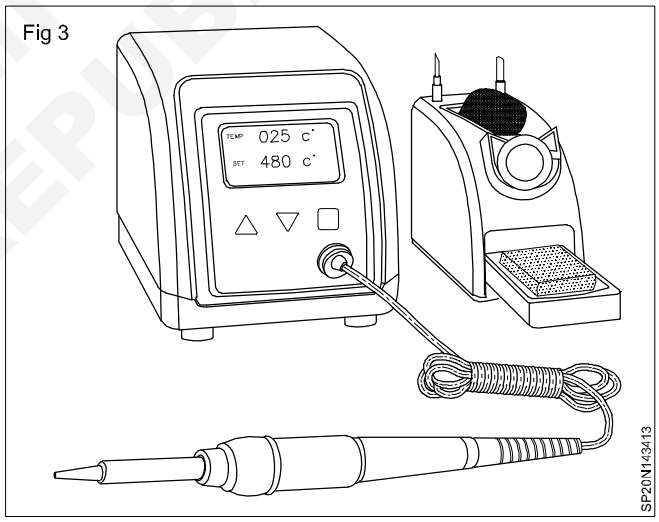



Fig 3




**3 PCB Holder (Fig 4)**

A PCB (Printed Circuit Board) holder or PCB is used to hold different types of PCB of a mobile phone while soldering or repairing. It holds the PCB very strongly and doesn't allows it to move thus helping in repairing.

**4 Solder Wire (Fig 5)**

Solder wire is used to solder electronic components, ICs or jumper. Composition of most solder wire is Tin / Lead in the ratio 60:40 or 63:37. Since the introduction of RoHS (Restriction of Hazardous Substances) from electronics, more and more companies are using lead-free solder. Lead-free solder wire is available in many compositions but the most common composition is Tin / Silver / Copper in the Ratio 96.5% / 3.0% / 0.5. Solder wire is available in different diameters such 2.0mm, 1.5mm, 1.0mm, 0.5mm, 0.2mm etc. For mobile phone repairing 0.5mm solder wire is best suitable.

Fig 4

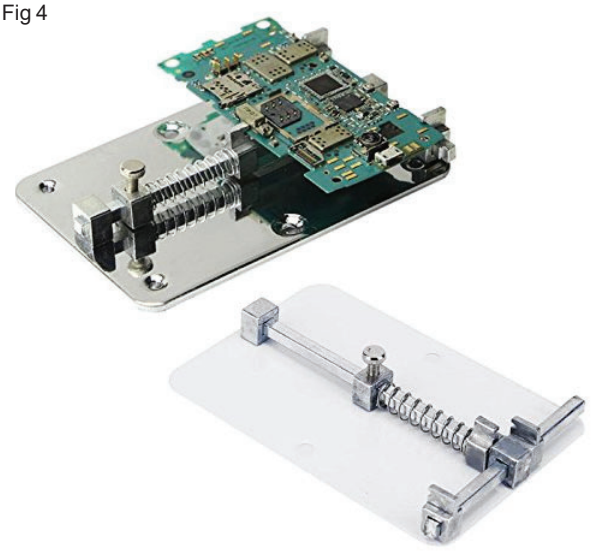
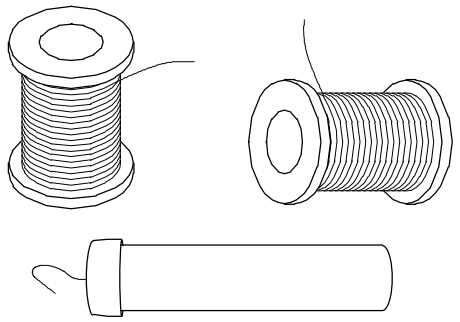


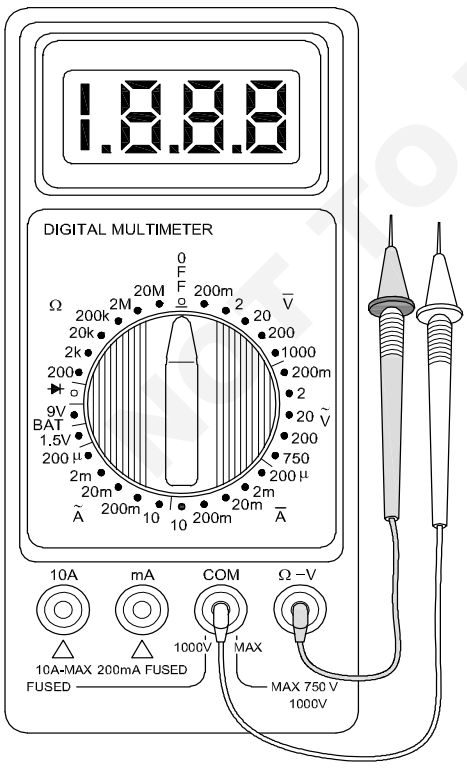
Fig 5




## 5 Multimeter (Fig 6)

A multimeter can be analog or digital. In mobile phone repairing, mostly a digital multimeter is used to find faults, check track and components.

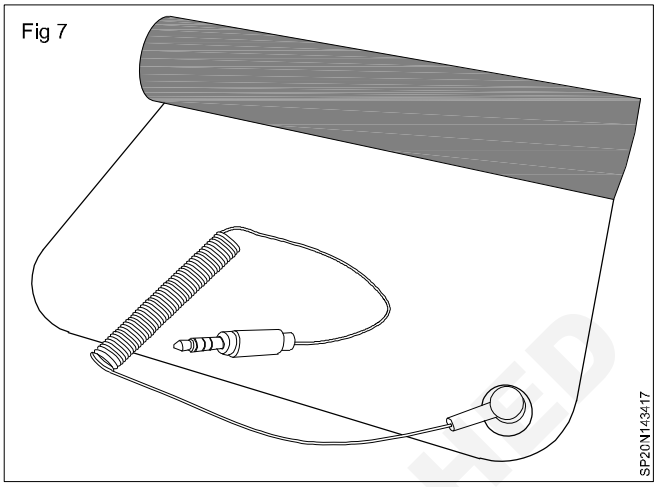
Fig 6




## 6 Antistatic Mat (ESD Mat) (Fig 7)

An ESD Mat or Antistatic Mat is laid or placed on the table or workbench where mobile repairing is done. The mat is grounded using a grounding cord or normal grounding wire. This prevents damage from static electricity.

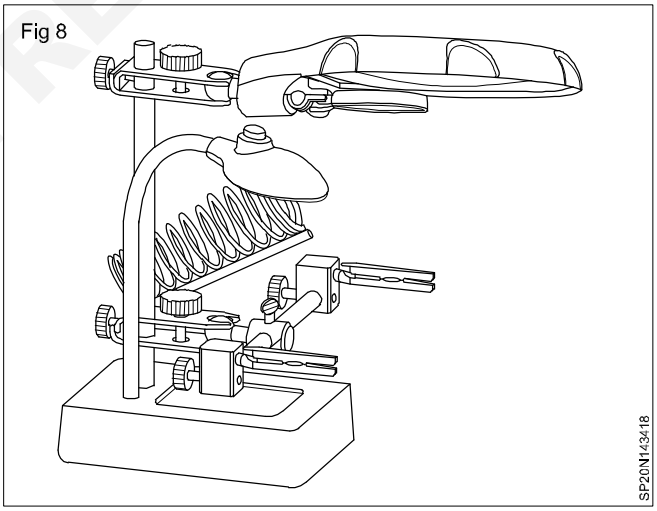
Fig 7




## 7 Magnifier with Light (Fig 8)

It is used to see the magnified view of the PCB of a mobile phone. Most magnifying lamps also have light. Magnifying lamps are available in different magnification such as 3x, 4x, 5x, 10x, 50x etc. Because SMD components on a Mobile Phone PCB are very tine, we need a magnification equipment tool or equipment to see the PCB and Components enlarged. There are Tools and Equipment like Microscope, USB Microscope, Table Top Magnifying Lamp and Head Magnifier with LED Light.

Fig 8




## 8 Hot Air Blower (Fig 9)

A hot air blower is also called SMD (Surface Mount Device) rework station and SMD repair system. It has control to regulate or manage temperature and flow of hot air as shown in Fig 9.

## 9 Precision Screwdriver Kit (Fig 10)

A screwdriver kit has several screwdrivers of different shapes and sizes to dissemble and assemble a mobile phone.Precision screwdriver is used to unscrew and remove and tighten screws while assembling and dissembling a mobile phone. Precision screwdrivers of

sizes T4, T5, T6 and forehead are good and sufficient for most mobile repairing job.

Fig 9

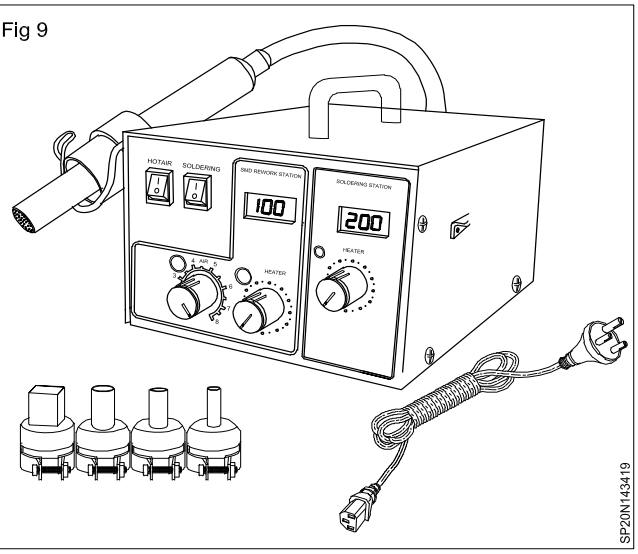



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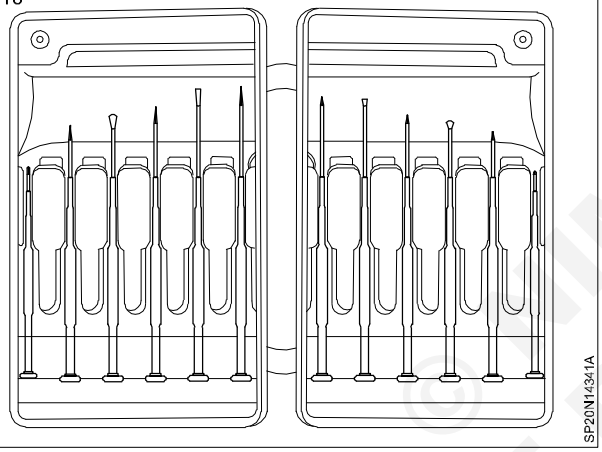
Fig 10



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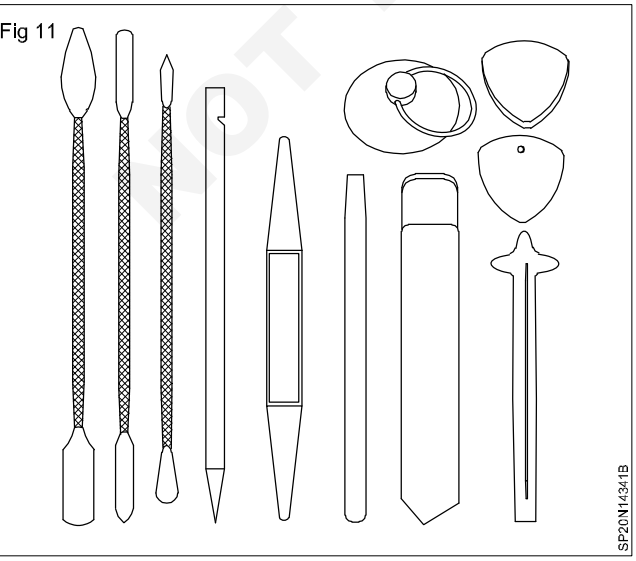
**10 Mobile Phone Opener (Fig 11)**

These are used to open the housing or body of a mobile phone. Mobile phone openers are available in different shapes and are made of different material like tough plastic or metal. You must always use a non-metallic and ESD-Safe mobile phone opener to avoid any damage due to static electricity.

Fig 11



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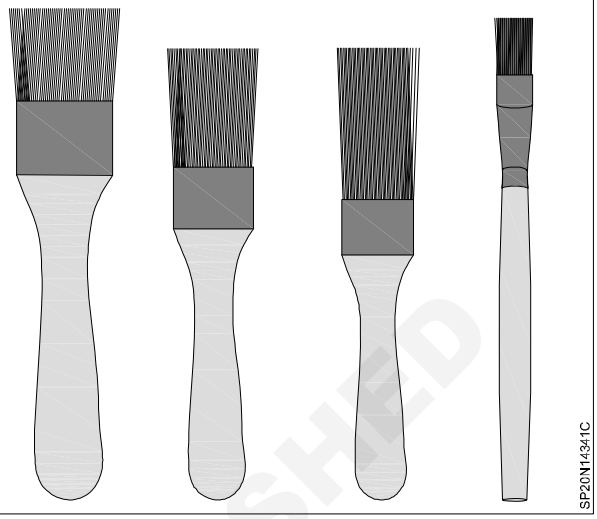
**11 ESD-Safe Cleaning Brush (Fig 12)**

These are used for cleaning the PCB of a mobile phone while repairing. It is important to use only ESD-Safe cleaning brushes.

Fig 12



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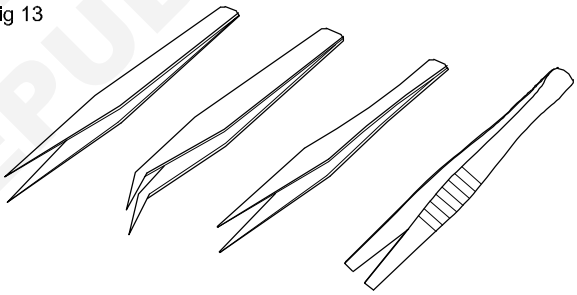
**Tweezers (Fig 13)**

Tweezers are needed to hold electronic components, ICs, jumper wire etc while soldering and desoldering

Fig 13

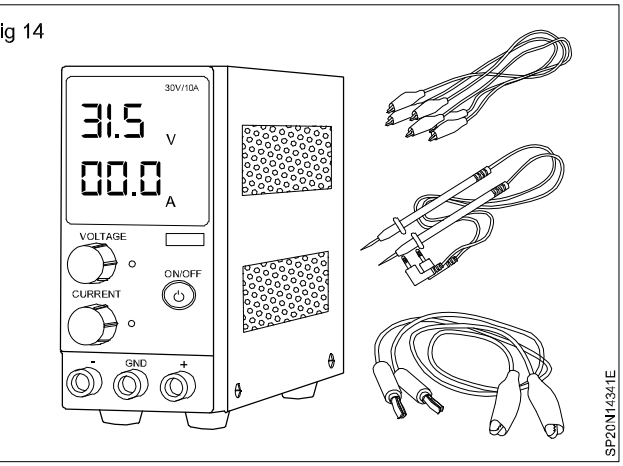


SP20N14341D

**13 DC Power Supply (Fig 14)**

Regulated DC (Direct Current) power supply is used to supply DC current to a mobile phone. Most repair person used DC power supply to switch ON a mobile phone without battery. It can also be used as a battery booster to boost battery of a cell phone. It can also be used as a multimeter.

Fig 14

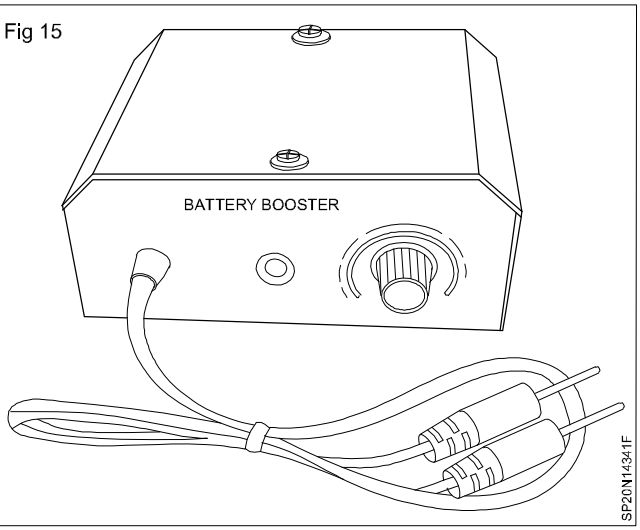



SP20N14341E

### 14 Battery Booster (Fig 15)

A battery booster is used to boost the power of battery of a mobile phone.

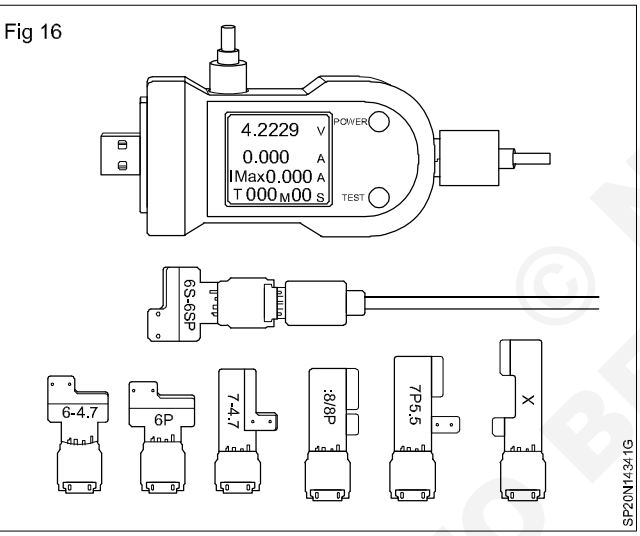
Fig 15




### 15 Battery Tester (Fig 16)

This device is used to test and analyze status or condition of battery of a mobile cell phone.

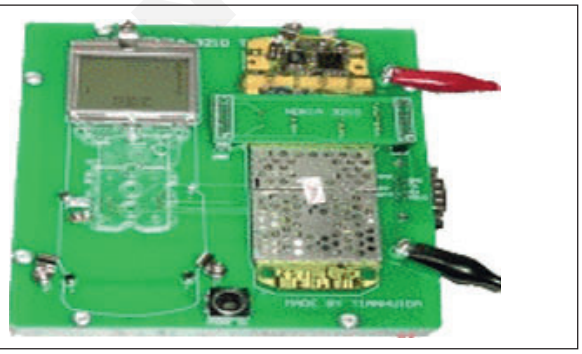
Fig 16




### 16 Test JIG Box (Fig 17)

This device is used to diagnose and find fault or problem in a mobile phone. It helps the mobile phone to work and function normally outside its case or housing. This helps to test and check voltage and other test points on the PCB. It simple words it helps a mobile phone to work without battery.

Fig 17



### 17 LCD Tester (Fig 18)

LCD Tester is used to check whether LCD screen of a mobile phone is faulty or not.

Fig 18

### 18 BGA Kit (Fig 19)

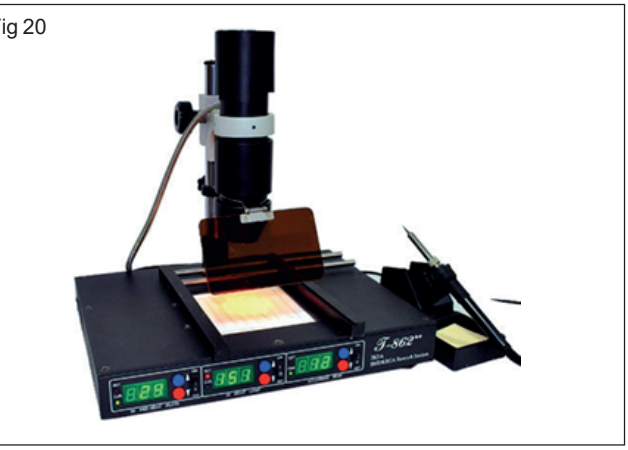
A BGA Repair Kit is used to Re-ball and repair ball-type ICs. BGA stands for Ball Grid Array.

Fig 19

### 19 IRDA or Infrared Workstation (Fig 20)

This machine is similar to hot air blower. Only difference is that it gives heat through infrared. It is very precise and gives heat only where it is needed thus preventing any damage to nearby electronic components on a PCB.

Fig 20



### 20 Ultrasonic Cleaner (Fig 21)

Used to clean PCB of a mobile phone and electronic components.

Fig 21

### Jumper Wire (Fig 22)

Jumper wire is a thin laminated or coated copper wire used to jumper from one point to another on the track of a mobile phone while repairing. Most people doing the work of mobile repairing do jumper to solve many problems.

Fig 22

### Solder Paste (Fig 23)

This is solder in molted semi-solid form. It looks like paste. Solder paste is mainly used for Reballing of ICs.

Fig 23

### Paste Flux (Fig 24)

This is flux in paste form. Paste flux is used while soldering and desoldering. Main purpose of flux is to remove oxides and other impurities from the PCB Track and from leads of electronic components for better soldering and electrical conductivity.

### Liquid Flux (Fig 25)

It is used to clean PCB track and legs or pins of electronic components while soldering. Liquid flux improves quality of soldering.

Fig 24

Fig 25

### Thinner or PCB Cleaner (Fig 26)

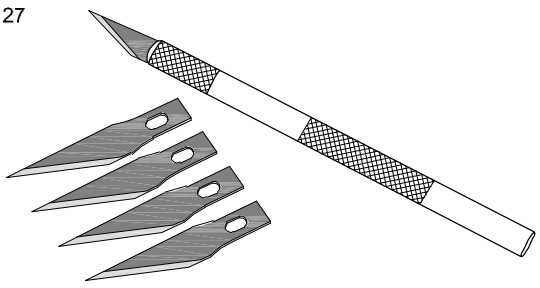
Thinner or PCB cleaner is used to clean the PCB of a mobile phone. The most common PCB cleaner used in mobile phone repairing is IPA or Isopropyl Alcohol. It is important to use only good quality PCB cleaner as poor-quality PCB cleaners can damage the board.

Fig 26


### Blade Cutter (Fig 27)

This is used to remove lamination from jumper wire. It can also be used for several other purposes.

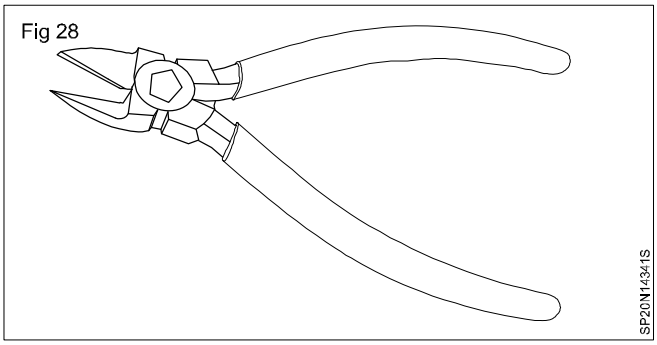
Fig 27



**Point Cutter (Fig 28)**

It is used for cutting leads, wire etc.

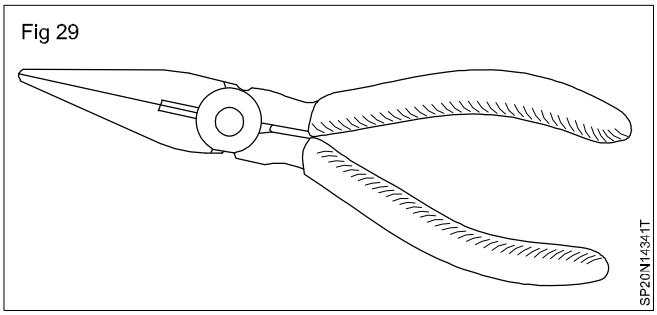
Fig 28




**Nose Plier (Fig 29)**

It is used for holding leads, wire etc

Fig 29




**Desoldering Wire (Fig 30)**

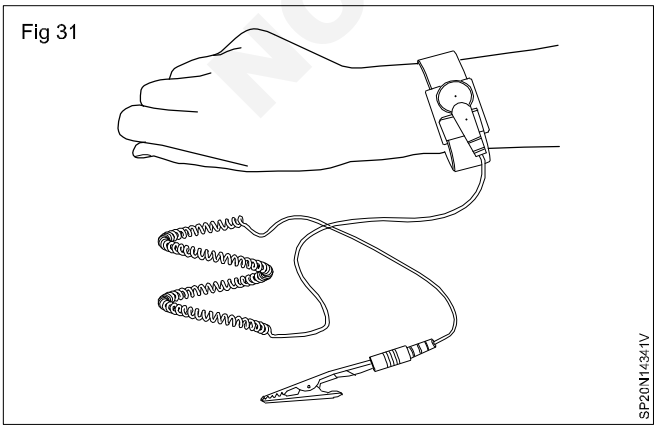
Desoldering wire or Desolder wire is used to remove excess solder from track of PCB.

Fig 30


**Wrist Strap (Fig 31)**

It is worn in the wrist of the person who is repairing a mobile phone. It is used for ESD Prevention and helps to discharge or ground static charge thus preventing the PCB or electronic components from any damage.

Fig 31




**Antistatic Hand Gloves (Fig 32)**

It is important to wear ESD-Safe hand gloves while repairing a mobile phone to prevent PCB and electronic components from static charge.

Fig 32

**Antistatic Apron (Fig 33)**

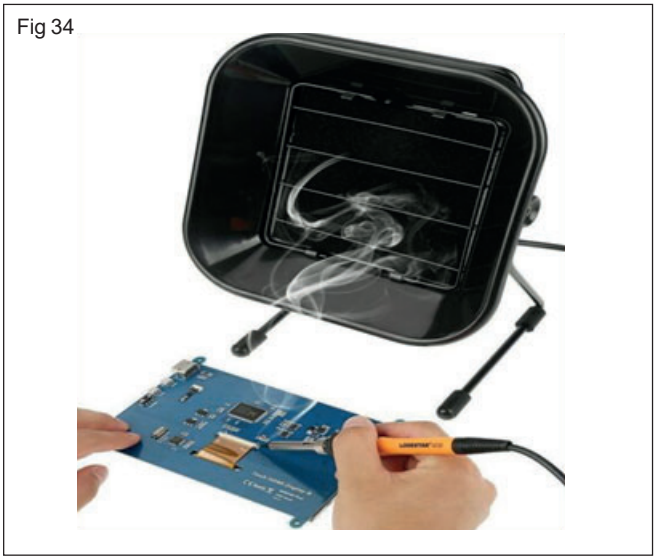
It is a dress worn by people who repair mobile phones and in mobile phone manufacturing factories. This also helps to discharge static electricity

Fig 33

**Smoke Absorber (Fig 34)**

This is like an exhaust fan that helps to filter smoke that comes out while soldering and Desoldering.

Fig 34



# Introduction to integrated circuit and applications used in smartphone

**Objectives:** At the end of this lesson you shall be able to
- **explain what is integrated circuits and the types of IC on the basis of package and technology**
- **describe the types of applications used in android and windows mobile phone.**

### What is an IC or Integrated Circuit?

Integrated Circuit or IC is an SMD Electronic Component made up of combination of several transistors, diode, resistor, capacitors in a tiny semiconductor chip. Integrated Circuit Electronic Components or IC are of small size and very light weight. They produce excellent results at low power.

Components used in an IC are not visible from outside. These are built in a semiconductor chip and cannot be removed.

### Types of Integrated Circuit (IC) (Fig 1)

On the basis of external structure, ICs or SMD can be classified as follows:

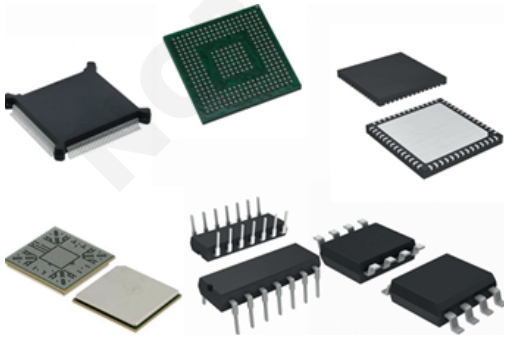
- Single in-line pin package (SIPP).
- Dual in-line pin package (DIPP).
- Quad pin package (QPP).
- Pin Grid Array Package (PGA).
- Ball Grid Array Package (BGA).
- Leadless Chip Carrier (LCC) Package.

### On Basis of Technology

There are two types of IC on the basis of technology:

- Linear IC – This type of IC works on analog signal where output signal varies according to the variable input signal.
- Digital IC – This type of IC works on digital signal. A defined output signal is received from a defined input signal.

Fig 1



### 1 CPU

It is Central Procession Unit of the Phone and is found in the Power Section. It is also called MAD IC, RAP IC and UPP. It is the largest IC on the PCB of a Mobile Phone and it looks different from all other ICs.

### 2 RAM

It is found in the Power Section of a Mobile Phone. Work / Function: It sends and receives commands of the operating program in a mobile phone. Faults: If RAM is faulty then there will be software problem in the mobile phone and it will get frequently get hanged and the set can even get dead.

### 3 Flash IC

It is found in the Power Section of a Mobile Phone. It is also called EEPROM IC, Memory IC, RAM IC and ROM IC. Software and IMEI Number of the mobile phone is installed in the Flash IC.

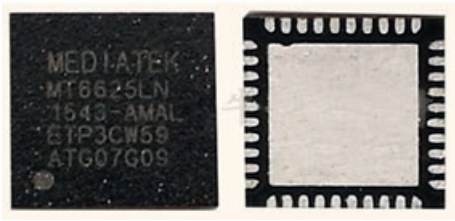
### 4 Network IC

Network Section in a Mobile Phone (Android, iPhone, feature Phone) is the section that controls the incoming and outgoing calls.

### 5 Bluetooth IC (Fig 2)

Bluetooth Antenna, Bluetooth RF Signal Filter, Supply and Signal Components are made in this Bluetooth Driver IC. The Bluetooth IC functions like the Network IC. RF-CLK signal is given to the Bluetooth driver IC during signal processing.

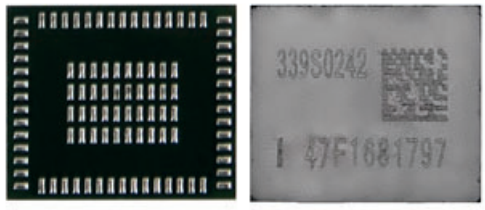
Fig 2




### 6 Wi-Fi IC (Fig 3)

Wi-Fi IC brings connectivity solutions for embedded Wi-Fi and Internet.

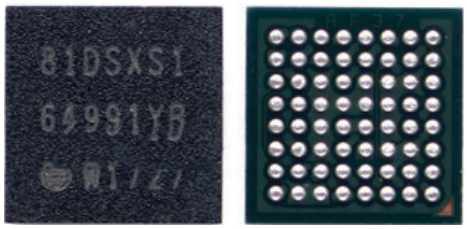
Fig 3




### 7 NFC IC (Fig 4)

NFC is a method of wireless data transfer that allows smartphones, laptops, tablets, and other devices to share data when in close proximity. NFC technology powers contactless payments via mobile wallets like Apple Pay, Android Pay, as well as contactless cards

Fig 4




### 8 GPS (GNSS) IC (Fig 5)

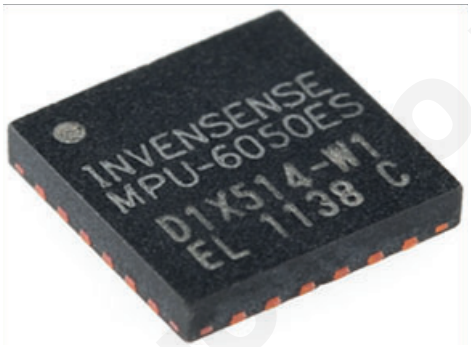
Two different L1 GNSS receiver ICs are used to illustrate our points. Both receivers can track satellites from GPS, GLONASS, SBAS and QZSS constellations. One of the receivers is part of a combination IC that also adds Bluetooth (BT) and FM functionality in the same die.

Fig 5


### 9 Accelerometer IC (Fig 6)

Accelerometers in mobile phones are used to detect the orientation of the phone. An accelerometer measures linear acceleration of movement, while a gyro on the other hand measures the angular rotational velocity. Both sensors measure rate of change; they just measure the rate of change for different things.

Fig 6




### 10 Power Management IC (Fig 7)

The PM ic is a system power supply IC developed for cellular phones, containing a high-precision battery charger (standalone), six 2.85 V voltage output terminals, an LDO (low drop out) regulator for maxi- mum output current of 150 mA, a speaker amplifier, various drivers LED (light emitting diode)

### 11 Audio IC (Fig 8)

It is found in Power Section of a mobile phone. It is also called Cobba IC and Melody IC. It controls Speaker and Microphone of a mobile phone.

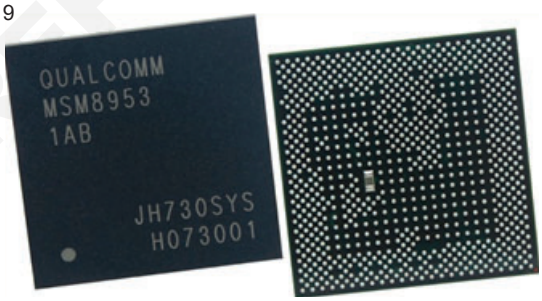
Fig 7


Fig 8


### 12 CPU (Fig 9)

It is Central Procession Unit of the Phone and is found in the Power Section. It is also called MAD IC, RAP IC and UPP. It is the largest IC on the PCB of a Mobile Phone and it looks different from all other ICs.

Fig 9




### Different kind of application that is used in smart phones

A mobile application, also referred to as a mobile app or simply an app, is a computer program or software application designed to run on a mobile device such as a phone, tablet, or watch.

**There are 3 types of apps**

**1 Native apps (Fig 10)**

- iOS by Apple.
- Android OS by Google.
- Windows OS by Microsoft

Such apps are developed for a single mobile operating system exclusively, therefore they are "native" for a particular platform or device. App built for systems like iOS, Android, Windows phone, Symbian, Blackberry cannot be used on a platform other than their own. In other words, you won't be able to use Android app on iPhone. Main advantage of

native apps is high performance and ensuring good user experience as developers use native device UI. Moreover, an access to wide range of APIs that puts no limitation on app usage. (Fig 10)

Fig 10


### 2 Hybrid apps (Fig 11)

They are built using multi-platform web technologies (for example HTML5, CSS and JavaScript). So-called hybrid apps are mainly website applications disguised in a native wrapper. Apps possess usual pros and cons of both native and web mobile applications. Hybrid multi-platform apps are fast and relatively easy to develop – a clear advantage. Single code base for all platforms ensures low-cost maintenance and smooth updates. (Fig 11)

Fig 11


Widely used APIs, like gyroscope, accelerometer, and geo location are available. On the other hand, hybrid applications lack in performance, speed and overall optimization in comparison to native apps for instance. Also, there are certain design issues due to app inability to look in exactly same way on two or more platforms.

### 3 Web apps (Fig 12)

As responsive versions of website to work on any mobile device. These are software applications that behave in a fashion similar to native applications. Web apps use a browser to run and are usually written in HTML5, JavaScript or CSS. These apps redirect a user to URL and offer "install" option by simply creating a bookmark to their page. Web applications require minimum of device memory, as a rule. As all personal databases are saved on a server, users can get access from any device whenever there is internet connection. That is why the use of web apps with poor connection would result in bad user experience. The drawback is access to not that many APIs for developers, with exception of geo location and few others. (Fig 12)

Fig 12


## Categories of apps

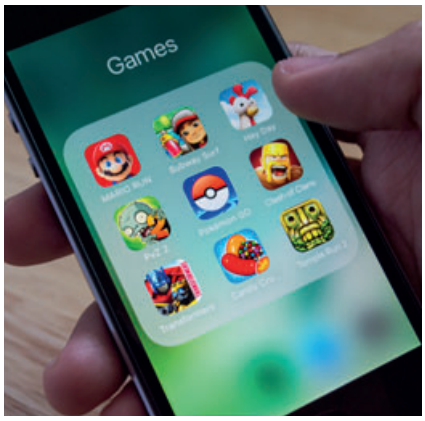
### 1 Gaming apps (Fig 13)

Mobile gaming has always been thriving, prompting app developers to invest more time and resources into creating new games and mobile versions of well-known stationary games. From user perspective gaming apps offer the sense of achievement and high engagement in the process – an average gaming session is about 8 minutes long. For developers game apps category is the most profitable one.

**Examples of game apps**

- Clash of Clans.
- Candy Crush Saga.
- Angry Birds Go.
- Temple Run.
- Trivial Crack.
- PUBG, etc.

Fig 13




### 2 Educational apps (Fig 14)

Kids can learn while playing educational game apps. Students may learn out of the class and adjust individual

learning pace. Moreover, according to recent reviews many educational apps are useful for teachers as well – organizing a teaching process better, educating themselves, etc.

**Examples of educational apps**

- Khan Academy
- Byju's Learning App
- Vedantu Live Learning App
- Unacademy Learning App

Fig 14


### 3 Lifestyle apps (Fig 15)

Probably, the widest category in 'types of apps' topic, as it covers plenty of common human activities and interests. From shopping, fitness and workout tracker to fashion, virtual fitting room and even weight loss. Such applications for personal lifestyle often are the ones that push technical innovations the most and developers constantly get requests to create a solution for personal or working tasks, or leisure and fun.

**Examples of lifestyle apps**

- Facebook.
- Tweeter.
- Instagram.
- Amazon.in
- Spotify.

Fig 15

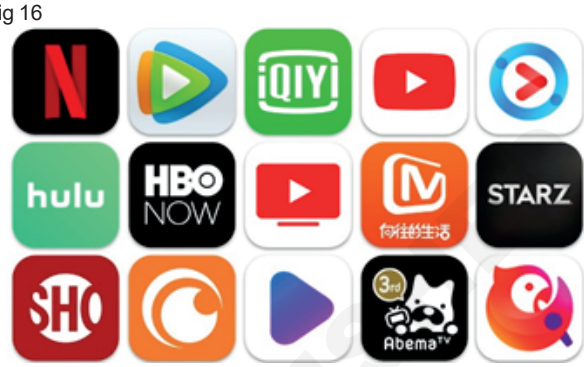
### 4 Entertainment apps (Fig 16)

These are the apps that have a tendency to invoke a kind of dependency, they keep us engaged, logged in, always checking for updates. On the bright side, imagination and talent of app creators bring lots of fresh and fun things to our lives, so we will never be bored again, that's for sure.

**Examples of entertainment apps**

- Netflix
- YouTube
- Talking Tom Cat
- Amazon Prime Video
- Disney Hotstar, etc.

Fig 16



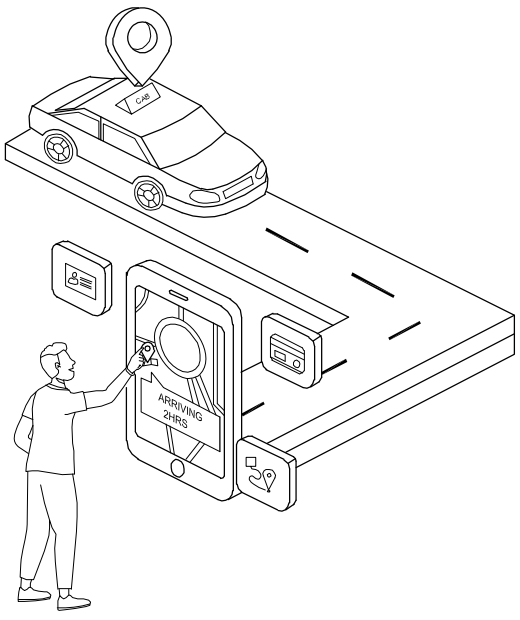

### 5 Travel apps (Fig 17)

Travel apps' purpose is 100% crisp and clear, as the title suggests – to make your traveling easier, more comfortable, fun and informative. Some of them turn your smartphone into universal travel diary, some can literally guide you through the unknown sites abroad using maps, and some provide translation assistance. That's why most of today's tourists seem to be digitally-savvy all-knowing travellers.

**Examples of travel apps**

- Uber
- OLA
- Make My Trip
- Red Bus, etc.

Fig 17



### 6 Social Media apps (Fig 18)

It give the opportunity to the peoples connect and communicate together. These app are mainly used for sharing purposes. Many people use social media apps for influence, marketing/business, entrepreneurship, etc.,

**Examples of Social media apps**

- Instagram
- Facebook
- Whatsapp
- LinkedIn
- Youtube, etc.,

Fig 18


## Android mobile phone recovery

**Objectives:** At the end of this lesson you shall be able to

- **explain what is recovery mode**
- **state the procedure for mobile phone recovery for android and windows**
- **describe the procedure for cracking password code for android and windows**
- **enumerate the process of rebooting android and window mobile phone**
- **state the purpose of BTS and MTS in mobile communication.**

**Android Mobile recovery procedure through coding**

**What Is Recovery Mode Android?**

Android devices have a feature called Android Recovery Mode, which allows users to fix some problems in their phones or tablets. It may be useful if you notice that your device is not acting right. Technically, Recovery Mode Android refers to a special bootable partition, which contains a recovery application installed in it. (Fig 1)

Fig 1


**Access Android Recovery Mode**

The access method varies from device to device. For example, recovery mode galaxy S7, recovery mode android tablet, and Google Nexus recovery mode are all similar, but use different sets of keys. In general, it consists of holding and pressing a combination of keys.

Here is a guide on how to access Android Recovery Mode for the most common devices:

- Power off your device.
- Press the right key combination.

The key combination depends on the device. Here are the ones for Samsung cell phones.

Recovery Mode Galaxy S7, Recovery Mode Galaxy S6, Recovery Mode Galaxy S5, Recovery Mode Galaxy S4, and Recovery Mode Galaxy S3: press and hold Volume Up, Power Key and Home button.

Google Nexus Recovery Mode: press and hold Power key, Volume Up, Volume Down simultaneously.

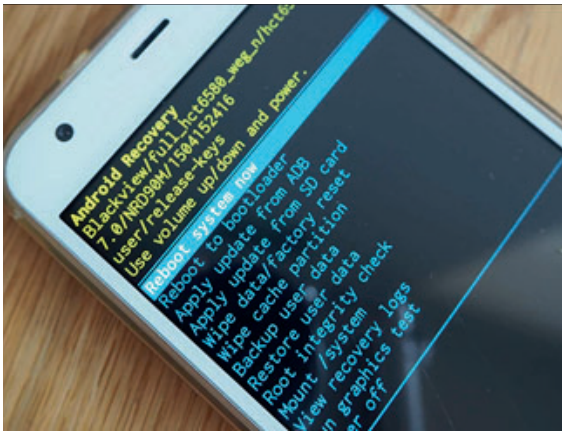
For other devices, the user can consult the manufacturer's website or make a quick Google search.

While pressing the key combination, the system will boot and prompt the user to the Android Recovery Menu.

**Android Recovery Mode Menu**

Once the Android Recovery Mode menu appears you can navigate your options with the Volume Keys and select an option with the Power Key. (Fig 2)

Fig 2



**The options are**

- Reboot system: will restart the device normally.
- Apply update from ADB: the ADB or Android Debug Bridge helps the user to connect the Android device to a computer. This feature is designed for Android developers, and therefore requires the Android SDK (Software Development Kit) to be installed in the computer.
- Apply from external storage: this will update from a memory card. The user can use a computer to save the information in the memory card, and then by inserting it in the cell phone, save the data in the cell phone.
- Wipe data from / factory reset: this will wipe the data and the cache partition, and reset the cell phone to its initial factory conditions. Useful when you want to safely sell or give away your old cell phone.
- Wipe cache partition: this will wipe all data from the cache partition. The cache partition is a partition in the hard drive, which is used as a memory, to temporarily store data.
- Apply update from cache: useful when no computer or memory card is available. It requires that the file is first uploaded through a Wi-Fi or an internet connection.

**Windows mobile recovery procedure through coding**

There are two different types of resets for your Windows Phone. Soft reset and hard reset also known as factory reset. There is a big difference between the two: The hard reset will return your phone to factory settings while the soft reset is more like an extended reboot.

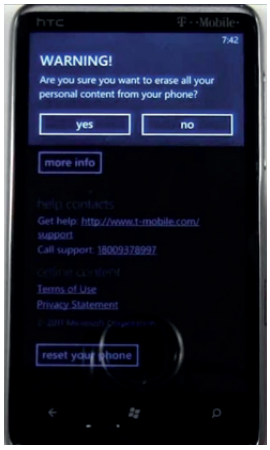
**Hard Reset by coding**

The hard reset will bring your phone back to factory settings, the same state as when the device was first turned on. All apps, messages, media, personal settings, etc. will be removed from the phone. If backup is turned on under Settings, you can restore your apps and settings after performing a hard reset (as long as you initialize the phone with the same Microsoft Account). Note that resetting your device will not remove any OS or firmware updates. You will remain on the same version of Windows Phone after the reset.

Here is a guide on how to access Windows Recovery Mode for the most common devices shown in Fig 3:

- At first power OFF your mobile.
- Then press and hold the volume down and Power buttons at the same time until you feel a vibration (about 10–15 seconds).
- When you feel the vibration, release the buttons, and then immediately press and hold the volume down button until you see a large exclamation mark.
- Once the exclamation mark appears, press the following four buttons in this order:
- volume up, volume down, Power, volume down. Your phone should now reset and restart itself. (It might take a while for the reset to finish.)

Fig 3




**Techniques of cracking password code of any mobile phone**

Password cracking is the process of attempting to gain Unauthorized access to restricted systems using common passwords or algorithms that guess passwords. In other words, it's an art of obtaining the correct password that gives access to a system protected by an authentication method. There are many techniques to crack the password for any of the given phone.

**For Android Phones**

**1 Unlock Pattern Lock via Factory Reset.**

This is the simplest trick to unlock locked Android device. However, the risk here is this method deletes all the data which are saved in phone memory. If you are willing to go for this here are the steps to be followed:

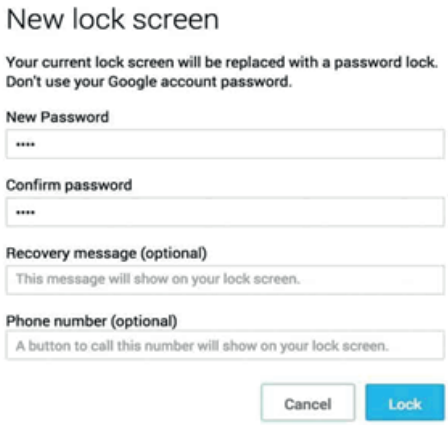
- **Step 1:** Switch off your Android handset and wait for some time.
- **Step 2:** Now Press '+' volume button and power button at the same time.
- **Step 3:** It will open your Android device in Recovery mode. Now select Factory Reset button from the menu.
- **Step 4:** Next when you get a list of options, tap on the 'Wipe Cache Partition to Clean Data'.
- **Step 5:** Finally, switch on your Android device and you are done!

**2 Unlock Password Using ADM**

ADM is known as Android Device Manager. You can easily unlock your mobile using this from any desktop or laptop (Fig 4). Here's what you have to do-

- **Step 1:** Go to Android device manager site.
- **Step 2:** Sign in to your google account.
- **Step 3:** Now click on 'Lock' option.
- **Step 4:** Enter a new Password and confirm your new password.
- **Step 5:** Now reboot your locked phone and enter the newly set password. Voila! You've unlocked your phone successfully!

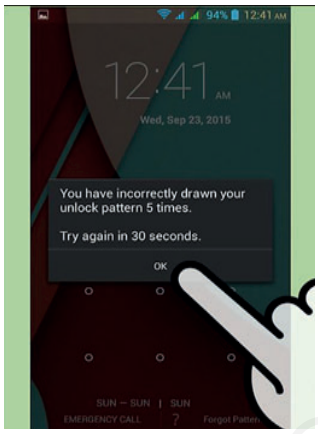
Fig 4




### 3 Bypassing the Pattern Lock

This trick only works when you have an active data connection in your locked mobile. (Fig 5)

Fig 5




- **Step 1:** Draw the wrong pattern lock 5 times.
- **Step 2:** It'll show a notification and where it says 'Try Again in 30 Seconds'.
- **Step 3:** Now, it will show an option 'Forgot Password'. Tap on it.
- **Step 4:** At last, enter your Gmail address and password which you've used on the locked device and setup a new pattern lock.

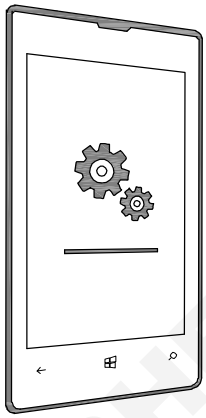
**For Windows Phone**

Comparing with iOS and Android, Windows Phone is less popular in the terms of the number of users. Windows Phone users also are subject to get into trouble of password forgotten and be locked out of their phones. So, there are two simple methods of cracking password of your windows phone. (Fig 6)

### 1 To Crack Windows Phone Password by Hard Reset

- **Step 1:** Turn off your Windows Phone by pressing Power button.
- **Step 2:** Press and hold Volume down key and connect the changer to Phone. You will see a big exclamation mark on the screen.
- **Step 3:** Press the keys one after another in the same sequence. Volume Up, Volume Down, Power, Volume Down.
- **Step 4:** Now you can see clearly the Phone reset and boot normally and wheel gears works on the screen.

Fig 6



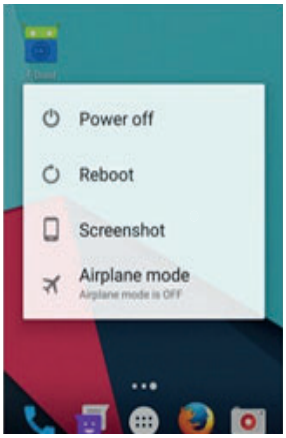

### 2 To Hack Windows Phone Password Online

Like Windows computer Microsoft Password recovery, Microsoft, Inc allows its users to perform Windows phone password recovery online. One of the features of Find My Phone on Windows Phone site is to remove everything from smartphone, exactly including password, therefore you can erase or reset phone remotely by logging into Windows Phone account on computer.

- **Step 1:** Go to Windows Phone – Find My Phone and log into your Windows account that you used on your Windows Phone, and its corresponding password such as Microsoft, Hotmail, Xbox, Outlook.
- **Step 2:** Then you will see the option to Erase your Phone. Click that and Microsoft will send a message to your Phone to erase.
- **Step 3:** Slide down notification and click Message. Then you can remove password from windows Phone.

**Procedure of rebooting Android phone (Fig 7)**

Fig 7

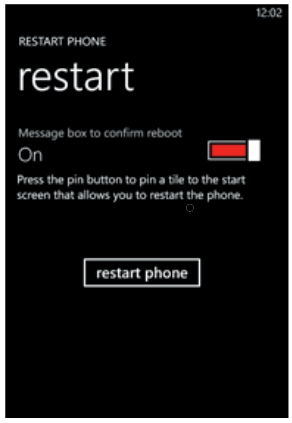


- Hold the power button on the side of the phone. A menu will pop up, giving the option to Shut Down or Reboot.
- If the phone's unresponsive, press and hold the power button and volume up for up to 20 seconds.
- When all else fails, you can remove the battery to kill power to the phone. This is your last resort.

**Procedure of rebooting Windows phone (Fig 8)**

- To reboot your windows phone, press and hold the POWER button on the side of the phone.
- Popup will appear with the option of Shut Down or Reboot, press the reboot option.
- And if the above method is unresponsive then press the POWER button and the VOLUME DOWN button for 4-5 seconds and the phone will reboot automatically.

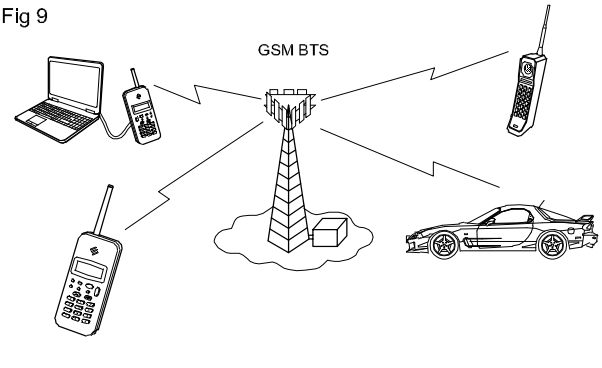
Fig 8




**Base Transceiver Station (BTS) (Fig 9)**

A base transceiver station (BTS) is a fixed radio transceiver in any mobile network. The BTS connects mobile devices to the network. It sends and receives radio signals to mobile devices and converts them to digital signals that it passes on the network to route to other terminals in the network or to the Internet. The BTS equipment are usually housed in a shelter which protects the telecoms equipment from external conditions such as dust, corrosion, rust, theft etc. The shelter thus comprises of the BTS equipment already mentioned, an air conditioner which is used to cool the space as a result of the heat generated by the equipment, a battery bank that supplies the equipment with electrical power and security lights.

Fig 9



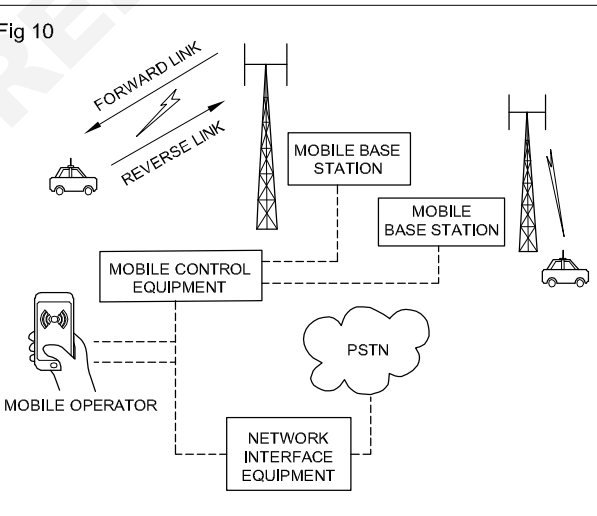

**Mobile Telephone Service (Fig 10)**

The Mobile Telephone Service (MTS) was a pre-cellular VHF radio system that linked to the Public Switched Telephone Network (PSTN). MTS was the radiotelephone equivalent of land dial phone service.

The Mobile Telephone Service was one of the earliest mobile telephone standards. It was operator assisted in both directions, meaning that if one were called from a land line the call would be routed to a mobile operator, who would route it to one's phone. Similarly, to make an outbound call one had to go through the mobile operator, who would ask for the mobile number and the number to be called, and would then place the call.

All calls were placed by a suitably equipped telephone operator. Outgoing calls were placed when the operator connected to a base station then announced the call over the channel.

Fig 10



## Testing and troubleshooting of mobile phone

**Objectives:** At the end of this lesson you shall be to
- **explain the testing of various parts used in mobile phone**
- **state the process of troubleshooting mobile phone problems.**

**Testing of various parts and components that are used in mobile phone for hardware repairing**

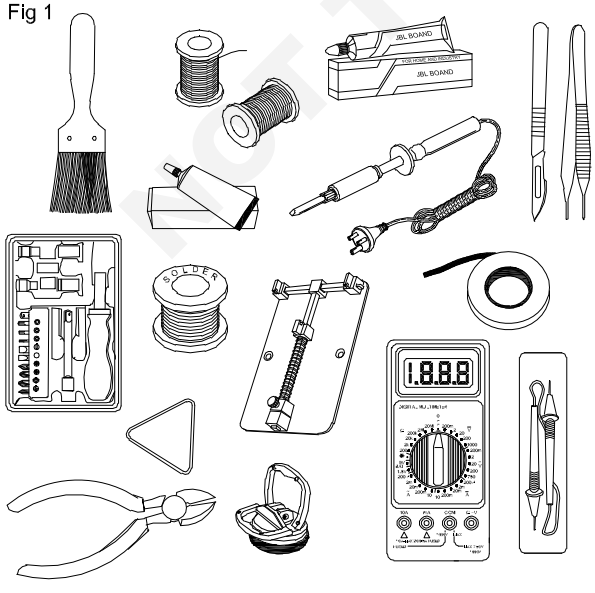
This topic covers mobile phone hardware testing and mobile phone repairing. It describes major hardware components in a mobile phone. This mobile phone hardware testing covers major mobile faults with possible solutions.

There are different types of mobile phones viz. bar phone, flip phone, slider phone, touch screen phone etc. Different phones will have slightly different hardware layout and mounting of panel and other components. In this article, we will understand generic components used in a typical mobile phone hardware and their repairing based on common faults. As we have already discussed earlier the various section of a mobile phone and their functions.

**Steps for hardware testing are as follows**

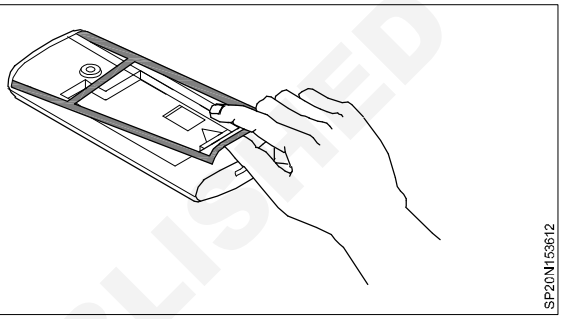
1 The first requirement in mobile phone repairing is tools and equipment. Following tools and equipment are needed to repair and troubleshoot mobile phone. (Fig 1)
   - Soldering Iron and Wire
   - Thinner or cleaner
   - Jumper wire and cutter
   - Screwdriver and tweezer
   - Multimeter and Hot Air Blower

Fig 1



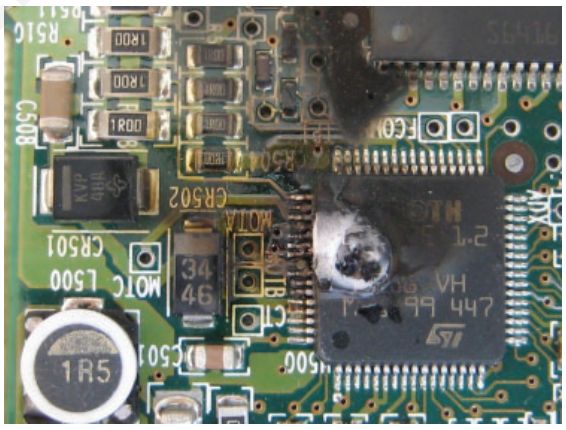

2 The second requirement in mobile phone repairing is one should be familiar with disassembling and assembling of mobile phones of various brands. (Fig 2)

Fig 2




3 The third requirement is after disassembling, do the spot inspection and check for any burned components or over heating of components or loose wires or broken wires etc. (Fig 3)

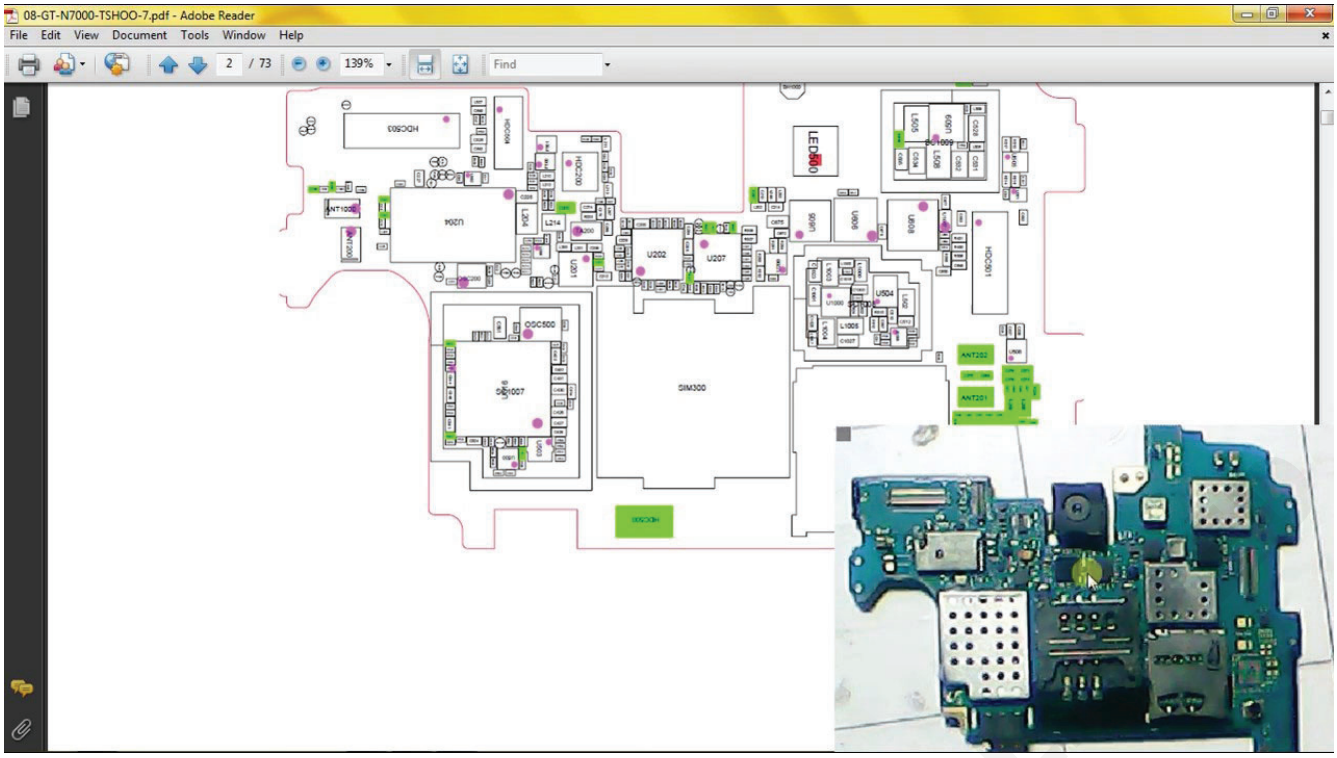
Fig 3




4 The fourth requirement is segregate the main problem by narrowing your fault finding to the main issue and attack it to solve. Often the circuit diagram of a mobile hardware PCB will help to diagnose the PCB related or critical issue. (Fig 4)

5 Use cold testing and hot testing methods using multimeter to test hardware components mounted on the PCB or motherboard of a mobile phone. Resistance is measured using cold testing where in power supply is not given to the phone. Voltage and Current is measured using hot testing where in mobile is powered on either using charger or using bench power supply. As current is measured by inserting multimeter in the series, path need to be broken or created to do the measurement. (Fig 5)

Fig 4




During the fault finding and repairing process of each part, SMD Electronic Component or Mobile Phone Section, following correct values will be received:

| | | |
|---|---|---|
| 1 | Ear Phone Connector Tip (+ , -): | 500 to 700 |
| 2 | Ringer Connector Tip (+,-): | 300 to 600 |
| 3 | Battery Connector Tip (+): | 400 to 500 |
| 4 | Battery Connector Tip (Sense): | above 800 |
| 5 | Display Connector Supply Pins: | 250 to 400 |
| 6 | Display Connector Signal Pins: | 500 to 800 |
| 7 | Camera Connector Supply Pins: | 250 to 400 |
| 8 | Camera Connector Signal Pins: | 600 to 900 |
| 9 | Key Tip (Row and Column): | 400 to 800 |
| 10 | Charger Connector Tip: | 600 to 700 |
| 11 | Vibrator Motor Connector: | 400 to 500 |
| 12 | Power ON / OFF Switch Point (+): | 600 to 900 |
| 13 | MIC Tip (Analog MIC) (+,-): | 700 to 900 |
| 14 | Battery Charging Out Point (+,-): | 300 to 400 |
| 15 | SIM Card Connector Pin 1 (VSim): | 500 to 700 |
| 16 | SIM Card Connector Pin 2,3,6: | 400 to 800 |
| 17 | SIM Card Connector Pin 4 (GND): | 00 (Beep) |
| 18 | Micro SD Card Connector Pin 4: | 500 to 600 |
| 19 | Micro Card Connector Pin 6 (GND): | 00 (Beep) |
| 20 | Micro Card Connector Pin 1,2,3,5,7,8: | 600 to 800 |
| 21 | RTC: | 400 to 500 |
| 22 | Data RX and TX Pins: | 600 to 700 |

During Hot Testing method, Voltage of different part or sections should be as follows (All Values in Volt): (Fig 6)

| | | |
|---|---|---|
| 1 | Ear Phone Connector Tip (+ , -): | 0 to 2.5 |
| 2 | Ringer Connector Tip (+,-): | 0 to 2.5 |
| 3 | Battery Connector Tip (+): | 3.7 |
| 4 | Display Connector Supply Pins: | 1.8 to 2.9 |
| 5 | Display Connector Signal Pins: | 0 to 1.8 |
| 6 | Camera Connector Supply Pins: | 1.8 to 2.9 |
| 7 | Camera Connector Signal Pins: | 0 to 1.8 |
| 8 | Key Tip One Side: | 1.8 to 2.8 |
| 9 | Charger Connector Tip: | 5 to 6 |
| 10 | Vibrator Motor Connector Tip: | 1.9 to 3.6 |
| 11 | Power ON / OFF Switch Point (+): | 3 to 3.6 |
| 12 | MIC Connector Tip (Analog MIC) (+,-): | 1.8 to 3.0 |
| 13 | Battery Charging Out Point (+,-): | 3.7 to 4.2 |
| 14 | SIM Card Connector Pin 1: | 1.8 to 3.0 |
| 15 | SIM Card Connector Pin 2,3,6: | 0 to 2.8 |
| 16 | Micro SD Card Connector Pin: | 2.8 |
| 17 | Micro Card Connector Pin 1,2,3,5,7,8: | 0 to 2.8 |
| 18 | Data RX and TX Pins: | 1.8 to 2.8 |

Fig 5

Recognize and troubleshoot common handset problems, this section of mobile phone hardware testing mentions common hardware and software faults found typically in a mobile phone.

**Table 1**

| Common Hardware fault | Description | Solution |
|---|---|---|
| Battery charging related issues | • Battery does not charge.<br>• mobile gets hot when connected with charger. | • In order to test such issue, one has to first find out whether the mobile battery has problem or charger has the problem. So, use other working charger unit or battery and replace and check. One can easily narrow down the issue using this method.<br>• If the charger unit has the problem, one need to test the voltage using multimeter. It should be typically between 5-7 Volt as written on the unit. Similarly, battery voltage can also be verified.<br>• If the battery and charger units are alright then charging IC on the mobile phone is the culprit which need to be tested and to be replaced after through testing. |
| Network related issues | • No network in mobile<br>• Weak network signal | • First check for improvement in the network signal by taking the phone in the open air if there is weak signal inside the house.<br>• If there is no improvement then manually search the network operators and set it manually to your cellular service provider.<br>• If the problem still persists check for respective network IC and troubleshoot as per its specifications. Often other nearby ICs such as crystal oscillator IC, power IC or CPU IC also might have become faulty so if required change them also one by one and see the result. |

| Common Hardware fault | Description | Solution |
|---|---|---|
| Overheating | Phone may overheat either due to hardware or software (applications). | • Check whether one particular application is causing the issue.<br>• Sometimes phone may overheat by running multiple applications simultaneously.<br>• Mobile phone PCB can also cause this problem, if required change and see the result. |
| Sound related faults | • Earpiece or microphone problem<br>• ringer issue<br>• vibration issue etc.<br>• Common issues are low sound or no sound etc. | • Check for speaker volume level in the phone and increase it.<br>• Replace the Audio IC or power IC (UEM).<br>• Change the ringer or buzzer or I.H.F. speaker. |
| Display fault | Display not working | • First check for software setting such as brightness level etc.<br>• Next check for display IC located between display unit and CPU. |
| Touchscreen related issues | • The touchscreen does not work<br>• Some key works and some do not.<br>• half of screen works. | • Check for touch screen sensors.<br>• Replace touch screen and check.<br>• Replace PDA or screen touch IC.<br>• Touch screen is controlled using CPU, check the interface between them. |
| Keypad issues | • Keys do not work<br>• requires more pressure to insert key etc. | Check whether keypad is properly fixed on the motherboard, also check contact of keys as desired. if required change keypad or keypad IC or interface IC to see the result. |
| SIM issue | • Insert SIM<br>• Invalid SIM | • Check for valid SIM, if required insert other SIM and try.<br>• If SIM IC gets heated then replace it.<br>• Check also for SIM connector and SIM position with it. |
| Wi-Fi or internet related problems | • Internet is not available<br>• Low Wi-Fi signal strength<br>• Wi-Fi not getting enabled. | • Check for Wi-Fi security password and username are valid.<br>• Check Wi-Fi AP or router on the other side is powered on and antenna is properly inserted.<br>• If the problem persists, check the WiFi IC and its location on the mobile phone PCB. |
| Software or application fault | • Phone is not getting powered on<br>• Phone went to test mode | • Download Operating System and install it. |

| Common Hardware fault | Description | Solution |
|---|---|---|
| | • Phone not charging<br>• Phone gives message to contact service provider<br>• Phone hangs etc. | • Check whether any one particular application is causing the issue. If required download fresh copy and install it after uninstalling earlier one.<br>• Reset the phone to its original factory settings. |
| Hanging issues | • phone is not getting slow<br>• phone stops while performing multiple tasks.<br>• data transfer is lagging. | • Check the phone memory, if it is too full to cause hanging, delete some files/images that are not in use and uninstall the app that is too large or useless.<br>• Move Large Files/Photos/Video to SD card.<br>• Use Cloud Storage. |
| Camera problems | • Camera showing a black screen. | • Simply power your phone off for 10 seconds.<br>• Remove any third-party camera apps.<br>• Check camera app permissions. |

## Smart phone radiation

**Objectives:** At the end of this lesson you shall be to
- **explain the various radiation levels of smartphone**
- **state the compliance standards for mobile phone in india.**

### Study various radiation Levels of Smartphone

Mobile phones and tablets have become the most effective communication tools especially in metropolitan cities. Exposure of the general population to radiofrequency (RF) fields from mobile phones and other communication tools has become universal and continuous in recent years. (Fig 1)

Fig 1

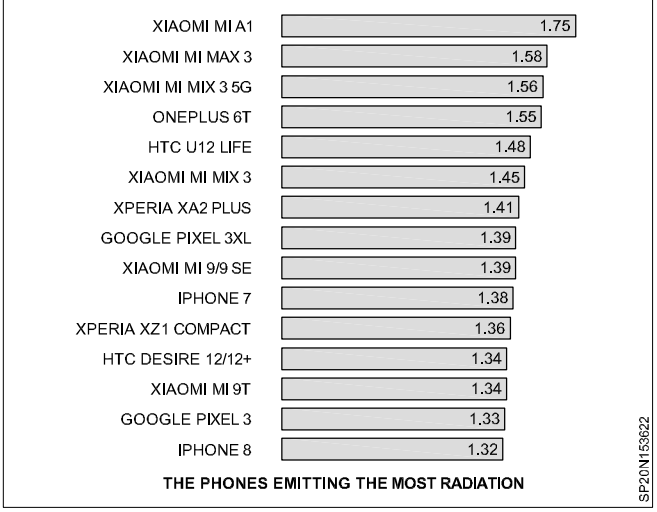
Development of using mobile phones has increased concerns about the safety of health, in recent years. The studies reflected public concerns about childhood and adult cancers. The possibility that some individuals experience hypersensitivity or other symptoms in response to mobile exposure was a high priority for research.

The emitted radiation in mobile phone and tablet is electromagnetic ray in the microwave range (850–1800) [1]. Collected evidence indicates that the frequency produced by mobile phones or base stations may affect the health of the people (Fig 2). Among the factors that are related to skin diseases, less attention has been paid to environmental factors. Most studies have been done on these factors, in animals. The results indicate that exposure to radiation emitted by mobile phones caused skin changes in rats, as, increased thickness of surface layer, atrophy of epidermis, deep layer proliferation, vascular proliferation, impairment in collagen tissue and protein expression in human skin in proteomics approach.

To be safe, experts suggest the following practices to limit unnecessary exposure to radiation from mobile devices:

- Unplug from your usual device usage as much as possible.
- Don't keep your phone next to your body, such as in a pocket.
- Use speakerphone or a headset when making calls.
- Don't sleep next to your phone or other devices.
- Keep the phone on airplane mode when you're not using it.

Fig 2




**Study Compliance standards for mobile phones in India**

India has adopted one of the most stringent Electro Magnetic Field (EMF) exposure norms in the world. The measures taken by the Department of Telecommunications, Government of India, are:

**1 Mobile Towers EMF Radiation Norms:**

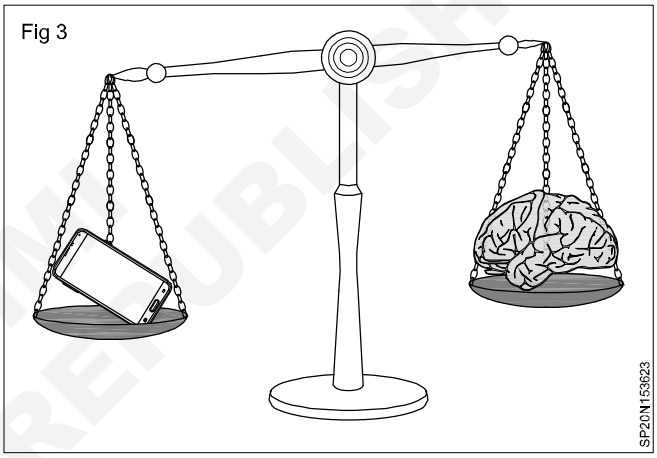
- EMF exposure limit (Base Station Emissions) is lowered to 1/10th of the existing ICNIRP exposure level effective from 1st Sept. 2012. India now has one of the most stringent EMF exposure norms in the world.
- Telecom Enforcement Resource & Monitoring (TERM) Cells of DOT have been entrusted with the job of conducting audit on the self-certification furnished by the Service Providers. TERM Cell shall carry out test audit up to 10% of the BTS site on random basis and on all cases where there is a public complaint.
- Telecom Engineering Centre (TEC) has revised the Test Procedure for measurement of EMF for verification of EMF compliance for BTS towers in accordance with new standards effective from 1st Sept.2012.
- For noncompliance of EMF standards, a penalty of Rs.5 lac is liable to be levied per BTS per Service Provider.

**2 Mobile Handsets**

- India has adopted the most stringent international norms for mobile handsets.
- All the new designs of mobile handsets shall comply with the SAR values of 1.6W/kg averaged over 1 gram of human tissue w.e.f. 1st Sept.2012.
- The mobile handsets with existing designs which are compliant with 2.0 W/kg averaged over 10 grams of human tissue, continue to coexist up to 31st August 2013. From 1st Sept. 2013, only the mobile handsets with revised SAR value of 1.6W/kg would be permitted to be manufactured or imported in India.
- Specific Absorption Rate (SAR) value information display on the mobile handsets like IMEI (International Mobile Equipment Identity) display. The information on SAR values to be made available to the consumer at the point of sale.
- Mobile handset manufactured and sold in India or imported from other countries shall be checked on random basis for compliance of SAR limit after TECSAR Laboratory is setup by end of year 2012. Test results from International accredited labs shall be acceptable in the Interim period.
- All cell phone handsets sold in the market in India shall comply with relevant standards and shall be available in hand Free mode.

**Precautionary Guidelines for mobile users: (Fig 3)**

Fig 3




- Keep distance– Hold the cell phone away from body to the extent possible.
- Use a headset (wired or Bluetooth) to keep the handset away from your head.
- Do not press the phone handset against your head. Radio Frequency (RF) energy is inversely proportional to the square of the distance from the source.
- Limit the length of mobile calls.
- Use text as compared to voice wherever possible.
- If the radio signal is weak, a mobile phone will increase its transmission power. Find a strong signal and avoid movement, use your phone where reception is good.
- Let the call connect before putting the handset on your ear or start speaking and listening– A mobile phone first makes the communication at higher power and then reduces power to an adequate level. More power is radiated during call connecting time.
- If you have a choice, use a landline (wired) phone, not a mobile phone.

- People having active medical implants should preferablyKeepthecellphoneatleast15cmaway from the implant.
- While Purchasing a Mobile Handset check the SAR value of the mobile phone. It can be searched on internet if its model number & make is known.

**Study Mobile phone hardware Troubleshooting procedure-(Hanging):**

1 Check the phone memory, if it is too full to cause hanging, delete some files / images that are not in use and uninstall the app that is too large or useless.

2 Move large files / photos / videos to SD card.

3 Use cloud storage.

**Use charging**

1 In order to test such issue, one has to first find out wheather the mobile battery has problem. So, use other working charger unit or battery, replace and check.

2 If the charger unit has the problem, use multimeter to test the voltage which should be (5-7) volts.

3 If the batteru and charging units are alright, finally replace the charging IC.

**Touch Sensor problem**

1 Tap on Reset sensor (or) clear sensor.

2 Replace the touch sensor.

## PCB ultrasonic cleaning

**Objectives:** At the end of this lesson you shall be to
- **explain the concept of ultrasonic cleaning**
- **state the compliance standards or mobile phone in india.**

**Concept of Ultrasonic cleaning**

Printed circuit boards, especially those used in PDAs (personal digital assistants) like cell phones, get a lot of abuse. In addition to collecting dust and dirt that penetrates the cases of cell phones, e-book readers and similar hand-held devices PCBs have been known to suffer from immersion in and splashing from liquids in day-to-day use. As a result, a service industry has emerged to provide cleaning and repair services for PCBs subjected to contaminants but not physical breakage in PDAs and larger devices.

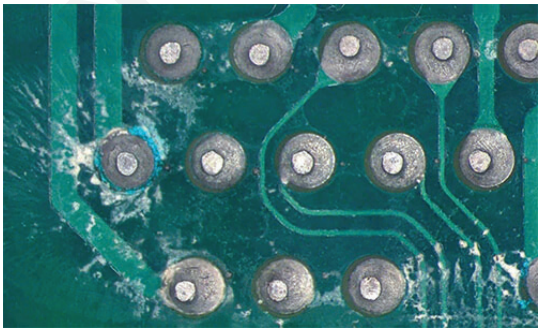
**Different Types of Contaminants**

There are a variety of contaminants that can accumulate on a PCB.

- **Dry Contaminants (Dust, Dirt) (Fig 1)**

  One of the most common occurrences is the accumulation of dirt or dust in or around the PCB. Gently using a small, delicate brush, such as a horsehair paint brush, can remove dirt and dust without affecting the components. There are limitations on where even the smallest brush can reach, such as beneath a component.

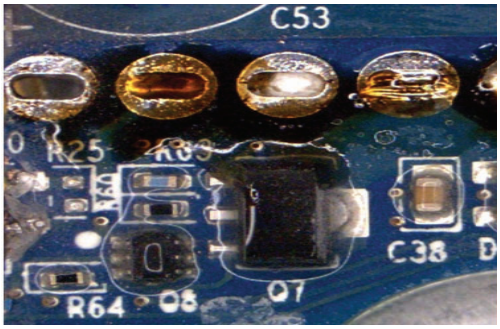
Fig 1



- **Wet Contaminants (Grime, Oil, Flux, Soda) (Fig 2)**

  High temperature operations can cause some components that are coated in wax to become magnets for dust and dirt, causing tacky grime that cannot be removed with a brush or vacuum. Or a product gets a bath of sticky soda, making the board a mess. Either way, these substances should be tackled before it builds up and affects performance.

Fig 2

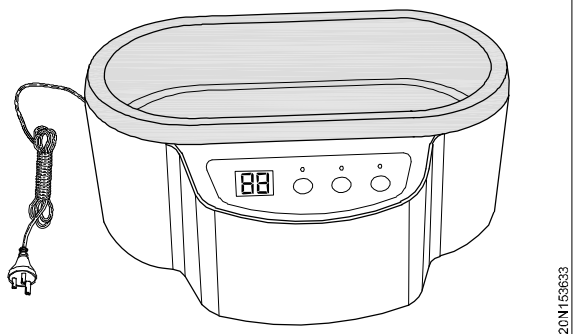



- **Ultrasonic PCB Cleaning (Fig 3)**

  Ultrasonic cleaning machines use high-frequencies to cause cavitation; the violent implosion of billions of minute bubbles in the cleaning solution contained in an ultrasonic cleaner tank. The bubbles are created by transducers bonded to the bottom of the tank and excited to ultrasonic frequencies by generators. The implosion of these bubbles blasts away contaminants on the surface of parts being cleaned.

  Ultrasonic can be defined as sound waves that have frequencies above the upper limit of the normal range of human hearing, which is about 20 kilohertz (20 kHz or 20,000 cycles per second). While that is true, ultrasonic cleaners when operating can be heard due to the action created by what we call ultrasonic cavitation.

Fig 3



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There are many ultrasonic cleaners on the market. Selecting one for cleaning PCB requires a bit of intelligence on features that should be offered.

A good frequency for cleaning PCB is 37 kHz. The cleaner should have a feature called “sweep” which causes a slight variation in ultrasonic frequency to eliminate potentially damaging harmonic vibration and what are called “standing waves” of cavitation that can damage components.

A thermostat to set cleaning temperature and a timer that automatically starts cavitation when the temperature is reached are other desirable PCB features.

## SMD rework station and BGA technology

**Objectives:** At the end of this lesson you shall be to

- **describe rework station**
- **explain BGA and soldering of BGA by reballing and installation process**
- **state the problems of power failure in smartphone and process to solve it.**

### Overview of SMD rework station

Rework (or re-work) is the term for the refinishing operation or repair of an electronic printed circuit board (PCB) assembly, usually involving desoldering.

and re-soldering of surface-mounted electronic components (SMD). Mass processing techniques are not applicable to single device repair or replacement, and specialized manual techniques by expert personnel using appropriate equipment are required to replace defective components; area array packages such as ball grid array (BGA) devices particularly require expertise and appropriate tools. A hot air gun or hot air station is used to heat devices and melt solder, and specialised tools are used to pick up and position often tiny components. (Fig 1)

Fig 1

A rework station is a place to do this work the tools and supplies for this work, typically on a workbench. Other kinds of rework require other tools.

### Why is rework important?

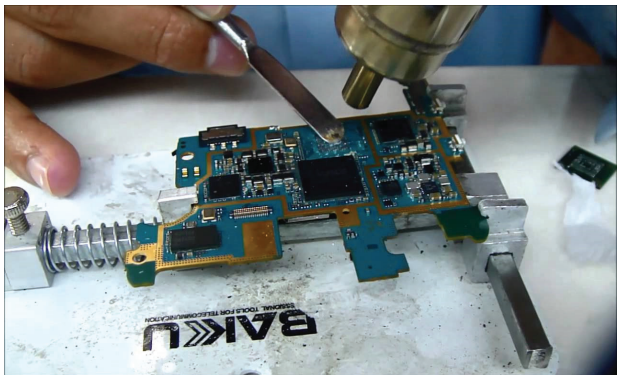
- Poor solder joints because of faulty assembly or thermal cycling.
- Solder bridges unwanted drops of solder that connect points that should be isolated from each other.
- Faulty components.
- Engineering parts changes, upgrades, etc.
- Components broken due to natural wear, physical stress or excessive current.
- Components damaged due to liquid ingress, leading to corrosion, weak solder joints or physical damage.

### Working Process of Rework Station

The rework may involve several components, which surrounding parts or the PCB itself. All parts not being worked on are protected from heat and damage. Thermal stress on the electronic assembly is kept as low as possible to prevent unnecessary contractions of the board which might cause immediate or future damage.

- Heating a single SMD with a hot-air gun to melt all solder joints between it and the PCB is usually the first step, followed by removing the SMD while the solder is molten. The pad array on the conductor board should then be cleaned of old solder. It is quite easy to remove these residues by heating them to melting temperature. A soldering iron or hot air gun can be used with desoldering braid. (Fig 2)
- The precise placement of the new unit onto the prepared pad array requires skillful use of a highly accurate vision-alignment system with high resolution and magnification. The smaller the pitch and size of the components, the more precise working must be.
- Finally, the newly placed SMD is soldered onto the board. Reliable solder joints are facilitated by use of a solder profile which preheats the board, heats all the connections between the unit and the PCB to the melting temperature of the solder used, then properly cools them must be worked on one by one without damage to.

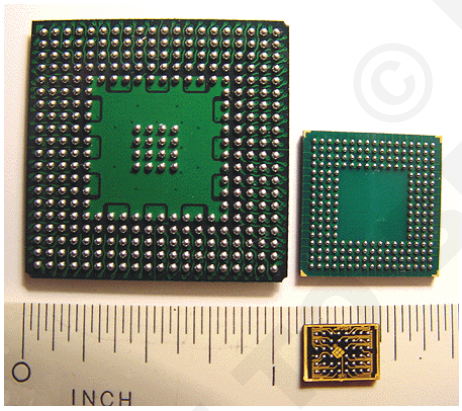
Fig 2



## Overview of BGA Technology

Ball Grid Array (BGA) technology is one of the leading-edge technologies in surface mount manufacturing. The driving force behind the advancement of BGA technology is the lead spacing of standard surface mount devices. As lead pitches drop below 20 mil, manufacturing becomes exponentially more difficult. BGA technology provides the same I/O count in the same body size with a significant increase in pitch. Manufacturing BGAs is comparable to standard surface mount device manufacturing. Standard equipment for paste application, placement, reflow and cleaning will work with first generation BGAs. The paper discusses BGA manufacturing using 20 mil SMT manufacturing as a baseline. (Fig 3)

Fig 3




## Advantages:

- Reducing component size
- Minimizing overall cost
- Reducing board complexity

## Features of BGA

High lead count

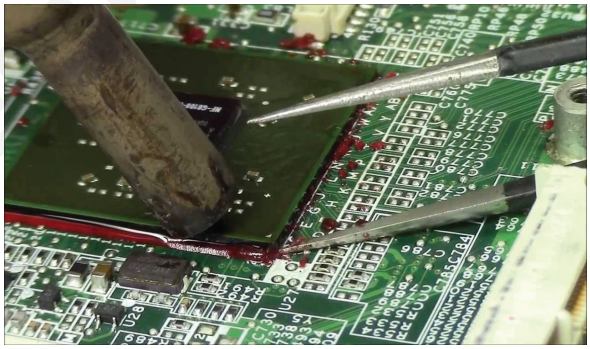
- No leads to bend
- High interconnection density
- Occupies lesser space on the board
- Low inductance
- Self-centring during the reflow process which reduces placement problems during surface mount soldering
- Lower thermal resistance between the package and the PCB. This allows heat generated by the integrated circuit inside the package to flow more easily to the PCB, preventing the chip from over heating.

## The BGA soldering technique

In the PCB assembly process, the BGA is soldered on to the circuit board by the solder reflow process, using a reflow oven. During this process, the solder balls melt in the reflow oven.

- Sufficient heat must be applied to ensure that all the balls in the grid melt sufficiently for every BGA solder joint to establish a strong bond.
- The surface tension of the molten balls helps hold the package in place on the PCB until the solder cools and solidifies. An optimum temperature controlled BGA soldering process is necessary for solid solder joints and also to prevent solder balls from short-circuiting each other.
- The composition of the solder alloy and soldering temperature are precisely chosen so that the solder doesn't completely melt but stay semi-liquid, allowing each ball to stay separate from its neighbours. (Fig 4)

Fig 4



## BGA Solder Joint inspection

Optical techniques cannot be used to inspect BGAs since the solder joints are hidden from sight beneath the BGA components. Also, electrical tests aren't very reliable since the tests reveal the electrical conductivity of the BGA at that particular instant. This test doesn't predict if the solder will last long enough. The solder joint may in fact fail over a period of time.

The BGA solder joint bonds are inspected using X-rays. The X-ray inspection helps to look through the device solder joint underneath the components. Due to this ability, the Automated X-ray Inspection (AXI) technology is widely used for BGA inspection.

## IC Reballing and Installation

Reballing is a process of putting all of the pins on the BGA, after it is removed from a PCB with the help of an appropriate soldering station. As a result, if the chip works it may be used again, if not then the pins are put on the new chip that works.

Two factors play an important role in the success of reballing:

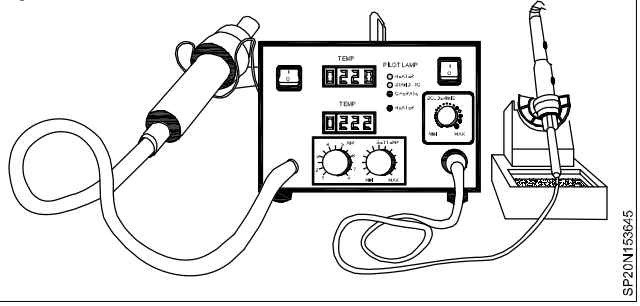
- Engineer's skillfulness overheating.
- Equipment and consumables used.

**What is needed for Reballing**

**1 An appropriate soldering station (Fig 5)**

For successful soldering/ desoldering small BGA chips (for example, the ones that are used in cellphones) a hot air soldering station Lukey 852D+FAN will be sufficient. A portable infrared soldering station Tornado Infra Pro can provide a more convenient alternative.

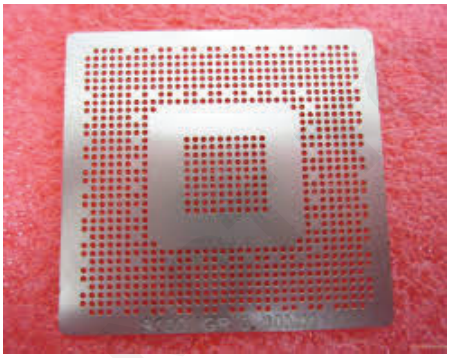
Fig 5




**2 Reballing stand and a stencil set (Fig 6)**

Placing BGA solder balls on the pin surfaces without a stencil is very difficult and can take hours to complete. Matrix stencils were created to make this process quicker and less difficult. A stencil is basically a metal plate with holes in it. The holes' size corresponds to the diameter of BGA solder balls that are used ("diameter" parameter) while the spacing between the stencil holes corresponds to the spacing between pin surfaces of the chip ("pitch" parameter).

Fig 6



**3 BGA solder balls or solder paste (Fig 7)**

As we have mentioned before, both BGA balls and BGA paste may be used as solders. This being said, the process of reballing will be completely different in each case.BGA balls are commonly used in motherboard reballing.

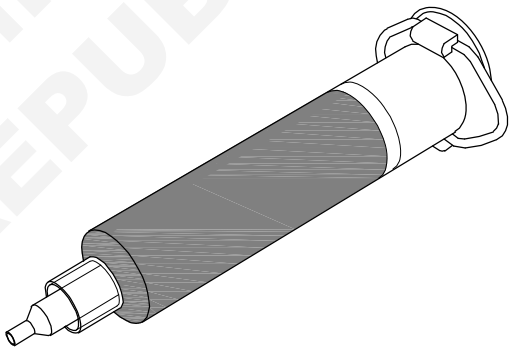
Fig 7

**4 BGA flux (Fig 8)**

One of the most important factors for successful reballing is choosing the correct flux. A lot of things depend on the properties of the flux: whether the balls will stick to the chip before heating, whether the flux will boil and foam during heating and if there will be a need to wash it off after the chip was installed on the PCB.

Both BGA balls and BGA paste can be lead or lead free. Use of lead free consumables is only justified in authorized service centers.

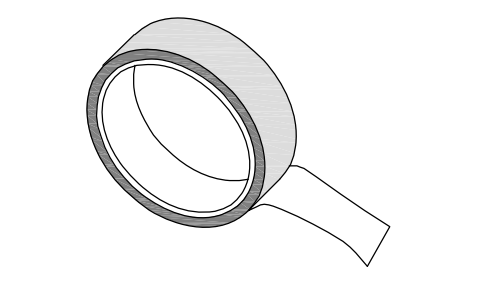
Fig 8




**5 Adhesive foil and thermal protective tape (Fig 9)**

Adhesive foil is a great insulator for unwanted heating. It can help avoid desoldering of the components that are close to the chip that is being removed.Thermal protective tape is mainly used for fixing a thermocouple in the soldering area. It is also often placed on the surface of the crystal of the chip when soldering with an infrared soldering station for better thermal conductivity. Another function that it may serve is combining a BGA stencil and a BGA chip when working without a reballing stand.

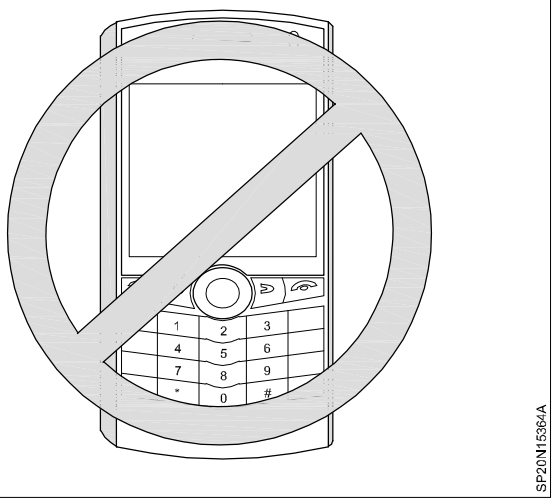
Fig 9



**Concept of Power failure of mobile phone and process to solve it**

A Dead Mobile Phone is a Cell Phone that does not get switched ON. It won't turn ON and won't Charge. (Fig 10)

Fig 10




These problem and solution apply to all brands and make of Android Smartphone or Feature Mobile Phone.

A mobile phone can get Dead for several reasons:

1 If the mobile phone gets dropped down on the floor or on some hard surface.

2 If the mobile phone gets wet or is dropped in rain or water.

3 If there is any kind of short in ( + and – ) or shorting in the Mobile Phone PCB.

For troubleshooting a dead Cell Phone, following testing procedure can be carried out:

1 Remove the battery and see if it gets charged or not. Check voltage using a Multimeter. Voltage must be 3.7-4.2 Volt DC. Use a Battery Booster to Boost the Power of the Battery and Charge it again.

2 Check Battery Point and Battery Connector. Clean Battery Point and Battery Connector to remove any carbon deposits.

3 Resold or change the Battery Connector.

4 Insert charger and see if the "Battery Charging" appears or not. If there is icon of "BatteryCharging" but the mobile phone does not gets switched ON then check ON / OFF Switch. Voltage of ON / OFF Switch must be 2.5 to 3.5 Volt (DC). Clean or change the ON / OFF Switch. Check track of ON / OFF Switch and Jumper if required.

5 If the charging icon is not there then check voltage of ON / OFF Switch. If the voltage is between 2.5 to 3.7 Volts DC, then RELOAD Software in the Phone (Software Flashing).

6 If the phone won't get switched ON even after reloading software, then Heat the C.P.U, Power IC and Flash IC.

7 If there is no voltage on the ON / OFF Switch then check track of the ON / OFF Switch. Jumper if required.

8 If the problem is not solved then heat, Reball or change the Power IC and CPU to fix the problem.

9 Keep the Multimeter on Buzzer Mode and Check + and – of the Battery Connector. If there is Buzzer Sound then the Phone is short. If there is short at the Battery Connector then clean the PCB with thinner. Apply Flux and Heat the PCB.

10 If this does not fix the Mobile Phone Dead problem then remove the PFO and check for short. If there is short then replace the PFO.

11 Remove the charging connector and check for shorting. If there is short then change the connector.

12 Remove the charging IC and check for shorting. Change if required.

13 Remove the Bluetooth IC and check for shorting. Replace if required.

14 Remove the Power IC and check for shorting and replace it with a new one if required.

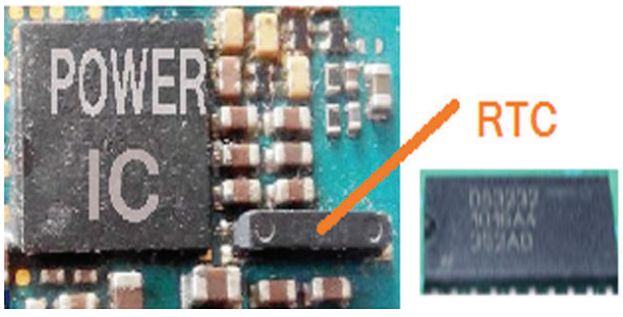
15 Remove the CPU and check for shorting. Replace if required.

16 Remove all the Big Electrolytic Capacitors and check one by one. Replace capacitors if required.

**Important Note:**

- Some mobile phone gets dead if the RTC (Real Time Clock) is faulty. This happens mostly in China Mobile Phones. Change the RTC to fix the problem.
- If the mobile phone gets hang after reloading software, then change the RTC. (Fig 11)

Fig 11



# Third party software in smartphone, viruses and malwares

**Objectives:** At the end of this lesson you shall be to
- **explain the concept of third-party software**
- **explain the concept of third party software**
- **state the procedure for removing virus from infected codes.**

### Concept of third-party software

Third Party Software means software which is proprietary to any third party which is or will be used by the Contractor for the purposes of providing the Services including the software and which is specified as such in Schedule 6 (Third Party Software) to this Contract. (Fig 1)

Fig 1


- Any and all software products and content licensed to Licensee under this Agreement as specified in Software Order Forms hereto, all as developed by companies other than SAP, SAP SE and/or any of their affiliated companies and delivered to Licensee hereunder.
- Any new releases, updates or versions thereof made available through SAP Support or warranty obligations.
- Any complete or partial copies of any of the foregoing.

### Official app stores vs. third-party app stores

- Apple® AppStore and Google Play™ are the two biggest official app stores. You can go there to download mobile applications for your iPhone or Android device.
- Each distribution platform includes native applications the apps Apple built for its iOS operating system and Google built for Android devices.
- Both platforms also include third-party apps millions of them. Developers or companies third parties, not Apple or Google create the apps to work on iOS or Android devices.
- Third-party apps in the official app stores usually follow strict development criteria. The stores also vet the applications for bad stuff like malware.
- Third-party app stores may not apply the same level of scrutiny toward the apps they allow to be listed in their app stores. Still, it can get tricky. Third-party app stores might offer plenty of safe applications. But there's also a higher chance they might offer dangerous ones.
- And those apps can infect your mobile device with malicious codes like ransomware and adware. That's because the ads or codes can be "injected" into popular apps you might buy through a third-party store.
- The stores might sell popular apps for cheaper prices, which may sound appealing. But that bargain buy can put user privacy at risk.
- Bad apps are out there, and some of them can be found in third-party app stores. (Fig 2)

Fig 2


### Signs your phone may have a virus or other malware

- Your phone is too slow.
- Apps take longer to load.
- The battery drains faster than expected.
- There is an abundance of pop-up ads.
- Your phone has apps you don't remember downloading.
- Unexplained data usage occurs.
- Higher phone bills arrive.

**Simple steps to follow for removing viruses and other malware from your device**

If you think you have malware on your phone, it's important to stop the malware from causing any further damage. Here are a few steps you can take.

- Power off the phone and reboot in safe mode. Press the power button to access the Power Off options. Most Android phones come with the option to restart in Safe Mode. Here's how, according to Google, although Safe Mode can vary by phone: Press your phone's power button. When the animation starts, press and hold your phone's volume down button. Hold it until the animation ends and your phone restarts. You'll see "Safe mode" at the bottom of your screen.
- Uninstall the suspicious app. Find the app in Settings and uninstall or force close it. This may not completely remove the malware, but it could prevent further damage to your device, or from it transmitting the malware to other devices on your network.
- Look for other apps you think may be infected. There's a chance that some apps may have been infected by the malware. If you think you can identify those apps, delete them immediately.
- Install a robust mobile security app on your phone.

**Tips to help protect your Android device against viruses and other malware**

- Invest in and use robust security software to protect your Android device.
- Keep all operating systems and software updated with the latest versions.
- Don't click on suspicious or unfamiliar links in emails and text messages.
- Use strong, complicated passwords or a password manager.
- Never use unsecure Wi-Fi connections. Always use a VPN when connecting to public Wi-Fi.
- Always use strong cyber safety protection on all devices that connect to the internet.
- Always install apps from trusted sources, such as the Google Play Store. Read the fine print and permissions on the apps to understand how much access you are giving the app developers.

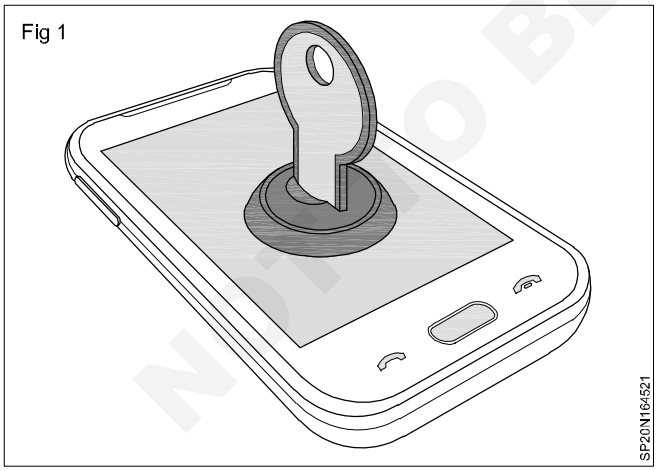
## Locking and unlocking of mobile phone

**Objectives:** At the end of this lesson you shall be to
- **describe what are cell phone locks and unlocks**
- **explain the types of locks used in a cell phone.**

**Cell phone locks (Fig 1)**

Following are some of the locks which can be used in cell phone. The various lock of the mobile handset is used for safety purpose.

Fig 1




**1 Keypad Lock**

Keypad Lock As the name suggests, this lock will lock the handset's keypad, one will not be able to use the keypad for any type of number or text entry Even when the keypad lock is active one can answer incoming call by pressing the keypad keys. Different handsets use different method to enter into keypad lock mode and to remove the lock. When the phone is in keypad lock mode, pressing of any key on the keypad will display a message on the screen, explaining the process to unlock the keypad.

**2 Phone Lock**

In this mode the handset cannot be used to make/ receive any call, even though the keypad stays active during this lock. In this mode, when the handset is switched on, it asks for an unlocking code known as PIN or Personal Identity Number". If this PIN is entered only it will work.

**3 Security Lock**

Security lock is used to lock all the functions of the mobile handset. When the security lock is on, the phone asks for the PIN code when it is switched on. Some handset may ask for the PIN number even when the SIM card of the phone is changed. This facility is not provided on all handsets.

**4 SIM Lock**

When one buys a mobile handset from mobile service provider under some scheme, the provider may lock the handset with the SIM card in the phone. This prevents the user from using the handset with SIM card from some other service provider. Currently, phones can be locked to accept only SIM cards from one or more of the following: 1 Countries (your phone will work in one country, but not another) 2 Network/Service providers

(e.g., T-Mobile, Jio, Vodafone, etc.) 3 SIM types (i.e., only specific SIM cards can be used with the phone).

**5 Password Lock**

This is the most efficient way to secure our cell-phones as there is nothing more complex than a password. Moreover, it is very much difficult to guess a password is set correctly. We can use a large combination of letters, numerals and symbols.

**6 Smart Lock**

It is an additional feature in android phones and it seems to be more convenient than other options. Smart lock is used along with the most secure method i.e., password unlock. It keeps the cell-phone unlocked at particular times awhile connected to Wi-Fi, Bluetooth device or while in our pocket or touching our body. Apart from these moments, the cell-phone gets locked and to unlock, a pre-set password needs to be entered.

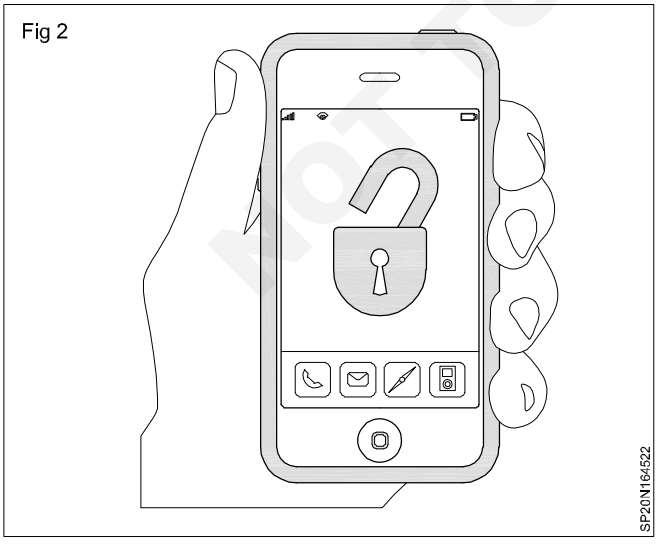
**7 Pin Lock**

It is most widely used because it is easy to remember and enter. But the efficiency of a pin depends on its length and complexity. The pin must be a combination of different numbers and a minimum length of 6 digits.

**Unlocking technology (Fig 2)**

A handset can be unlocked by entering a special code, or in some cases, over-the-air by the carrier. Typically, a locked phone will display a message if a restricted SIM is used, requesting the unlock code. For example, in some mobile phone, “Insert correct SIM card” will appear on the phone’s display if the wrong SIM is used. Once a valid unlocking code is entered, the phone will display “Network unlocked”. In some cases, the phone will simply display a message explaining that it is locked. The code required to remove all SIM locks from a phone is called the master code or network code key. The unlock code is verified by the phone itself, and is either stored in a database or calculated using an obscure mathematical formula by the provider.

Fig 2




**1 Fingerprint Unlock**

It is seen in almost every touch phone, either on the rare side or on the home button and recently in-display fingerprint sensors have been introduced in many phones. It is most liked by the users as it works fast and is unique to a person. Nowadays payments are also done with the help of fingerprint confirmation which makes it unsafe for use. To get increased protection, it should be used along with a pin, pattern or password.

**2 Face Unlock**

It is the latest addition to the security options recently introduced by Apple. This is the fastest way to unlock a cell-phone as we need to put it in front of us to unlock it instantly. The front camera of the cell-phone emits infra-red radiations and captures the structure of the face which is used for verification next time when we look into the camera to unlock.

**3 Swipe**

The most simple and easy method to access our cell-phones and hence very low secure. Studies reveal that in the current times 28% of people use this option in their cell-phones just because of its simplicity and speed which in turn puts the privacy at stake.

**5 Unlocking via computer**

One of the most popular way of phones are unlocked is using the USB, RS-232 or LPT port of a computer using software usually written specifically for the model of phone being unlocked. In some cases, special “unlocking clips” or “unlocking boxes” are used which re-program the software that controls the phone, removing the SIM lock. However, such clips are usually very expensive.

**6 Unlocking via Mail**

Some companies have begun to offer a “mail-in” service, such as travelinsider.com. These services allow the user to send their phone in and have it sent back in an unlocked condition.

**Regulations on unlocking**

Unlocking a phone without the permission or unlocking code from the provider is usually in breach of the agreement with the provider, though most countries do not make specific laws prohibiting the removal of SIM locks.

**Security lock**

A security code is for the safety and security of your mobile phone. If you activate it in the security settings, the phone will ask it while booting it every time or when you lock the keypad and want to unlock the keypad. The default security codes of major brands of cell phones are as follows: Samsung: 0000 / 00 00 00 / 00 00 00 00 Nokia: 12345 All other brands of cell phones: 0000 / 1234 Chinese brands: 1122 / 0000 / 1234 / 4321 So it is advisable to change the security code for safety.

So, if you change the security code, you should never forget it. If you forget and put the wrong security code, the handset will not accept it. So, if you forget it and are unable to put the right code, your phone will be considered as locked. You will have to get it unlocked by special software.

**Pattern Unlock**

The patterns can be simple as well as complex, depending upon our concern about our privacy. The complex patterns may take time to unlock a cell-phone but are recommended for security purposes. Simple patterns are easy to guess. It is better to draw a logo instead of drawing letters and numerals.

## Concept of frimware and flashing of smartphone

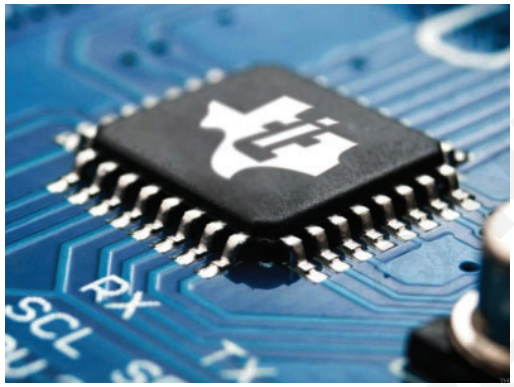
**Objectives:** At the end of this lesson you shall be to

- **describe the role of firmware in mobile phone**
- **enumerate the steps to install the new firmware**
- **describe encryption and decryption of password in mobile phone**
- **explain what is flashing, and the process of flashing a mobile phone.**

**What is firmware?**

Firmware is a small piece of software that makes hardware work as its manufacturer intended it to. It consists of programs written by software developers to make hardware devices "tick." Without firmware, most of the electronic devices we use daily wouldn't be able to work. They would not do anything. (Fig 1)

Fig 1




**What is firmware in mobile?**

How would you define firmware in devices with complex hardware such as smartphones, tablets, smartwatches, or even smart TVs? In this case, a fairly good firmware definition would be this: the firmware is the middleman between the hardware and the operating system.

On such devices, the firmware contains only the necessary instructions for the hardware to be able to work with the operating system installed on the device. For example, on a Samsung Galaxy smartphone with Android, the smartphone's firmware allows the hardware to communicate correctly with the Android operating system and do what is requested by the user.

**Where is the firmware stored?**

We now know the firmware definition and have a better grasp of the meaning of firmware. Its software written directly into our hardware devices, mandatory for them to power on and start working. But how exactly is it stored on a device? Firmware is usually stored in special types of memory, called flash ROM.

**Reasons to upgrade Smartphones:**

- It adds up new functionalities of the latest software version.
- It will remove the bugs from your Samsung Smartphones.
- Firmware is also used to add new features.

If there is any problem regarding software or the Operating System of your device, or directly related to the device such as not powering on or shutting itself off.

**Android Firmware Contain**

Firmware installed on an Android device by its manufacturer contains a build of the Android operating system and two additional closed source programs that are usually irreplaceable, a bootloader and radio firmware.

**Steps to install a new firmware**

**Step 1:** Locating the latest version of the firmware.

You'll find the latest version of the firmware for your phone on the manufacturer's websites. The advantage of using the manufacturer's site is that it assures you of the latest and official update for your Android phone. Popular manufacturers such as Samsung, Sony, LG, Huawei, and Motorola regularly upload updates for their devices on their sites.

**Step 2:** Installing the firmware

Installing your firmware requires that you locate the program applicable to your phone brand.

**Samsung Devices**

KIES If you have a Samsung branded device, this program will allow you to download and install the firmware into your mobile device.

**Sony Devices**

Flash Tool– This is a tool used to install firmware in Sony Xperia devices. One crucial thing to note is that this tool only works on those devices whose boot loader is unlocked.

### HTC Devices

HTC Sync Manager-HTC devices run on Android firmware and HTC Sync Manager is the most appropriate tool to install updates on these devices.

### LG Devices

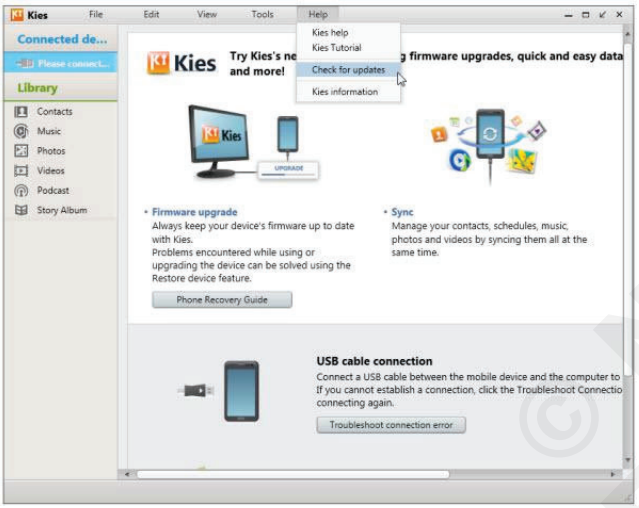
LG PC Suite-This is an LG device software update tool. To get it, just hit the LG search page and type in PC suite. Make sure you download the right software for your device.

### Motorola Devices

RSD Lite: Even though Motorola devices have no problem receiving and installing updates, RSD Lite helps you to flash stock firmware on your device in case there are issues.

**Step 3:** Connecting to your PC and Installing Updates (Fig 2)

Fig 2




After you install the ROM, you can now connect your smartphone to the PC using a USB cable. Open the application we've described above – for example, on a Samsung, open 'KIES'. Search the menus at the top for the 'update firmware' option. (In KIES, it's in the 'Tools' menu.)

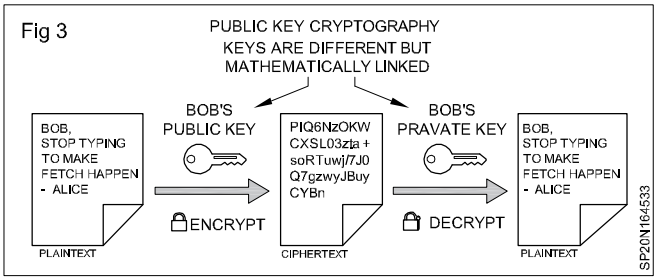
### What is encryption?

Encryption is a way of scrambling data so that only authorized parties can understand the information. In technical terms, it is the process of converting human-readable plaintext to incomprehensible text, also known as ciphertext. In simpler terms, encryption takes readable data and alters it so that it appears random. Encryption requires the use of a cryptographic key: a set of mathematical values that both the sender and the recipient of an encrypted message agree on. (Fig 3)

### What is decryption?

The conversion of encrypted data into its original form is called Decryption. It is generally a reverse process of encryption. It decodes the encrypted information so that an authorized user can only decrypt the data because decryption requires a secret key or password. (Fig 3)

Fig 3




### Steps to encrypt your Android device

1 Plug in the device to charge the battery(required).

2 Make sure a password or PIN is set in Security -> Screen lock.

3 Go to Settings -> Security.

4 Press the "Encrypt phone" option.

5 Read the notice and press "Encrypt phone" to start the encryption process.

6 Remember to keep the phone plugged in until complete.

### Steps to decrypt your Android device

1 Launch the Andrognito 2 app from your app drawer.

2 Enter your four-digit PIN to access the safeguarded data.

3 You should be able to see all the files that you have encrypted so far. Tap and hold on the ones you wish to decrypt, then tap on the unlock icon given in the top-right corner. It should decrypt the selected files for you.

4 Your files are now decrypted, and they are no longer a part of your vault. They can now be accessed as normal files just like you were accessing them before.

### Flashing A Phone

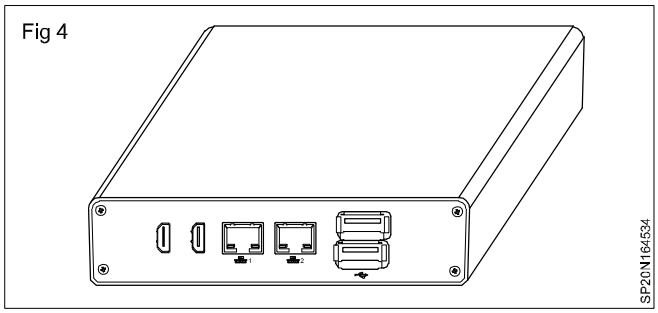
Flashing your phone can mean one of many things, but they all revolve around erasing your phone's memory or operating system and replacing it with another.

- **Upgrading Your Software:** Upgrading your software to the latest version is the most common form of flashing a phone.
- **Erasing the Memory:** Phone flashing can also mean erasing the phone's memory and taking it back to the manufacturer's default setting.
- **Changing Your Carrier:** Flashing can also mean replacing the operating system on your phone so that it can work on a different carrier, like flashing a Verizon Razr to work on Sprint's network.
- **Erasing Your Operating System:** If a software glitch has eroded your phone's performance, or an upgrade has had negative consequences on your phone, you can flash it to remove the operating system, making it a blank slate. From there you can load the software package that you want.

**Basic Requirements for Flashing**

- Firmware or Stock ROM: OS files
- Driver software.
- Flash Tool / Flash Box (Fig 4)

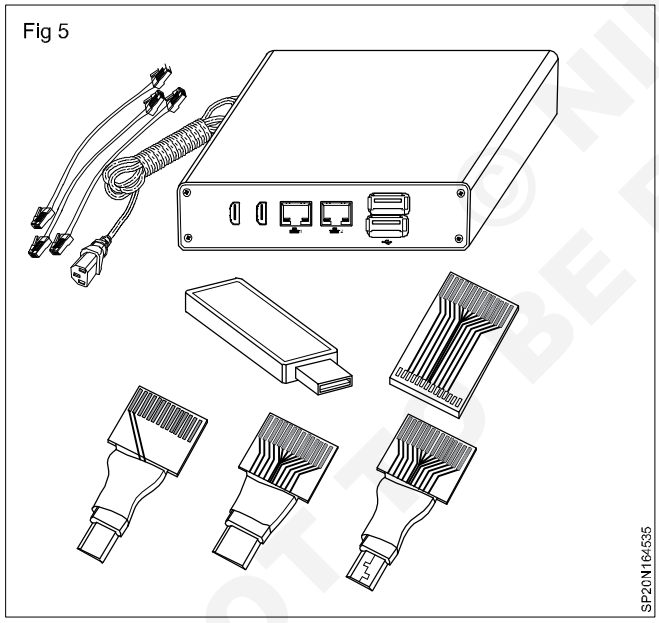
Fig 4




**Different Flash Tool / Box (Fig 5)**

- Phoenix USB Pro
- SP Flash Tool
- Upgrade Download Tool
- RK Tool
- Odin Tool
- ATF Box
- Z3X Box

Fig 5




**Flashing procedure of a Cell Phone**

- **Step 1**

  Download a free software flash program to your computer. You want to make sure before you download that the software is compatible with your operating system, such as Windows 7; otherwise, the software will not work. The software will come with all the required files and reprogramming tools to flash the phone.

- **Step 2**

  Right-click on the zip file you downloaded and select the option for “Unzip” to unpack the files from the zip folder. Save them to your desktop.

- **Step 3**

  Hook up your cell phone to your computer using the USB cable that came with your phone.

- **Step 4**

  Read the user’s manual that comes with your software, usually a “Read Me” text file that will detail how to use the software. User instructions vary according to flash programs; therefore, it is important to know what steps to take and when, in order to complete the flash process. The flash procedure will disable your current provider’s settings and reprogram them to your new provider.

- **Step 5**

  Click your “Start” button once your flash procedure completes, then go to “My Computer” and select “Systems Task.” Click on the option for “View System Information.” Select the “Hardware” tab and click on “Device Manager.” Click on “USB Controllers and Ports” to view your cell phone and make sure your new provider shows up as evidence of a successful flash.

## Software update and defragmentation

**Objectives:** At the end of this lesson you shall be to
- **explain what is software update on phone**
- **enumerate the steps to backup phone data to computer**
- **explain defragmention and the process of defragmentation of hard drive.**

**Use of internet for Troubleshooting faults:**

1 To check the software problem.

2 To check the hardware related problem using circuit / schematic diagram.

3 To flash your device.

**Overview of handling troubleshooting procedure:**

1 Perform a hard reset on the App.

2 Try running the app in Airplane mode or on Wifi only.

3 Restart your device.

4 Check for updates for your device.

5 Reset your network connection.

6 Reinstall the App.

**Steps to update Software on phone**

**(For Android)**

1 Goto Settings.

2 Tap About phone.

3 Tap System Update.

4 Tap Download and Install.

**(For iOS)**

1 Goto Settings –> General –> Tap Software Update.

2 Download and Install the available version for update (using your passcode).

3 If not, Turn “ON” Automatic updates, in Software Update.

**What happens after downloading a Software Update?**

When your phone downloads an update, it will prompt you to install it immediately. Tap on the available notification to see the update details such as change log, size, and version number. Only when you give permission, your phone will install it. If your phone doesn’t have sufficient charge, then you will be informed to charge your phone before applying the update.

After that, your phone will restart to complete the installation process of the update.

**Backing up data to Computer before update**

Backup is the process of creating a copy of the data on your system that you use for recovery in case your original data is lost or corrupted. You can also use backup to recover copies of older files if you have deleted them from your system.

**Four alternative Backup methods**

As an Android user, you can take a backup of the data via:

**Backup via USB (Fig 1)**

While many of you would prefer to opt for wireless connectivity and cloud storage option, at times it’s good to opt for the old classic USB connectivity as it’s an ideal choice to go in for if you have a lot of data or content to transfer and save at once. That being said, it’s quite easy to transfer data from your Android device to the PC via USB cable.

**Step 1:** Connect your Android device with a USB cable to your PC or Laptop.

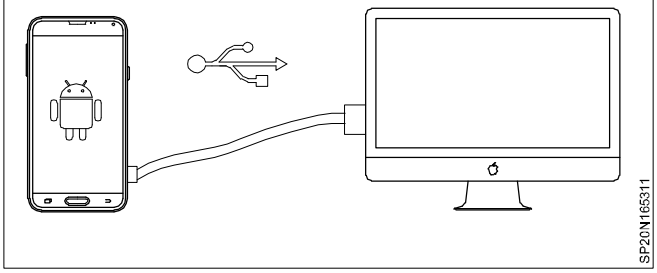
**Step 2:** Scroll the screen down from top to check the USB connectivity notification –>Click on the Charging via USB.

**Step 3:** Select the File transfer option under the “Use USB for”

**Step 4:** Open the file explorer on your Windows PC, you will find the now be able to view the files on the screen of your PC or Laptop –>Drag and transfer the files or data you intent to take a backup of.

**Step 5:** Once done, locate the safe remove hardware icon on the system to unplug the USB connectivity of your device from the PC

Fig 1



### Backup via Google Account (Fig 2)

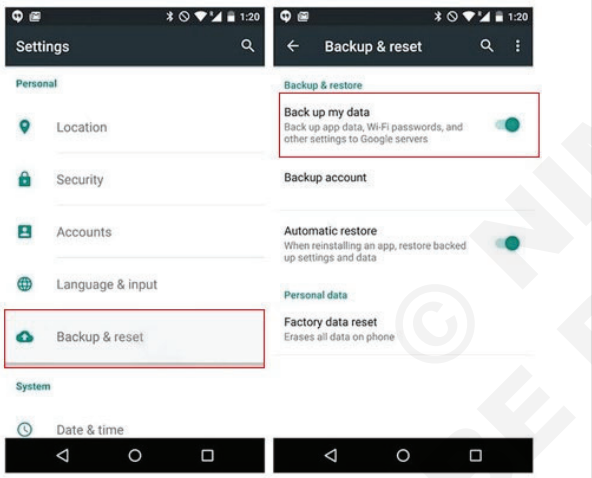
One of the perks of owing an Android smartphone is that most of the backing up of the data is done automatically within certain intervals. But that's only when you are signed into your Google Account on your Android smartphone. Through this signed in account, Google automatically backs up most of your data – including the details of your Android settings, display preferences, Wi-Fi networks, passwords. Wait that's not all, Google also saves all those precious photos and videos! If you haven't yet… here's how you can enable this setting and take backup of your data via Google account.

**Step 1:** Go to Settings –>Tap on Backup & Restore or Backup & reset.

**Step 2:** If your phone has both "Back up my data" and "Automatic restore," make sure to enable both by swiping the toggle on.

**Step 3:** Tap and select all the options listed to ensure that the data is synced with your Google Account.

Fig 2




### Backup via Wi-Fi

Wi-Fi connectivity is the easiest and quickest way to transfer those thousands of images, videos and more from your Android device to your PC, Mac or Laptop. That being said, you can easily download third party apps like AirDroid to transfer data in a matter of moments. AirDroid app is a specially designed app for Android smartphones and is compatible with both Windows and Mac desktop.

**Step 1:** Download and install the AirDroid App for free from Google Play store.

**Step 2:** Once installed, you need to sign up (create a username and password) If you have already signed up, Tap on the 'Sign In' option to go further.

**Step 3:** On signing in, tap on the My Device option you will come across the Web IP Address Now open the AirDriod App in Android.

**Step 4:** Enter this URL on the browser of your PC or Mac.

**Step 5:** Tap on the QR code in the AirDroid app on the device, as shown above. The camera is activated. Aim the camera at the QR code on the PC screen under "Scan QR code", as shown below. Your device will automatically read the QR code and connect to the PC.

**Step 6:** A Request to view all app and notification from your phone on your PC in real time –>Tap on the Enable option

**Step 7:** You can now easily control certain features of your Android smartphone with the help your mouse and keyboard.

### Backup via Bluetooth

If you are facing Wi-Fi connectivity issues you can always turn on connecting your Android device to your desktop or laptop via Bluetooth. But here's a word of caution- Comparative to Wi-Fi, transferring files through Bluetooth could be time consuming as pairing the devices isn't that quick.

### Well to enable Bluetooth

**Step 1:** On you Android device, tap on Settings –> Tap on the Bluetooth option under connections (Ensure to set your Android device on discoverable mode via Bluetooth).

**Step 2:** Next, from Windows 10 PC, click on the Start button –> Click on Settings –> Toggle to enable Bluetooth. Once done, your computer will automatically start detecting any nearby Bluetooth enabled devices –>Select the Pair button besides on your device's Bluetooth name to connect either the PC with your Smartphone.

**Step 3:** You can then select the files you wish to transfer from your Android Smartphone to your PC.

### Defragmentation and why do I need it?

Defragmentation, also known as "defrag" or "defragging", is the process of reorganizing the data stored on the hard drive so that related pieces of data are put back together, all lined up in a continuous fashion. You could say that defragmentation is like cleaning house for your Servers or PCs, it picks up all of the pieces of data that are spread across your hard drive and puts them back together again, nice and neat and clean. Defragmentation increases computer performance.

Here are instructions to perform a Disk Defragmenter from Windows. The Disk Defragmenter is a tool that reorganizes and regroups data to help improve the performance of the computer and is beneficial to optimize the performance of the external hard drives.

### Defragmentation of hard drive (Fig 3)

1 On the keyboard, press the Windows Key.


+ E

2 Once the (MY) Computer / This PC is open, hover over the drive you want to perform the Defragmentation and right-click on the Seagate drive.

3 Click on Properties

4 Click on Tools

5 Click on Defragment now (Optimize in Windows 8/8.1/10)

6 To determine if the disk needs defragmentation, select Analyze disk.

**Note: If the percentage is above 10 %, the defragmentation is needed.**

7 To start the defragmentation, click on Defragment disk

8 Click Close when it is concluded.

Fig 3

**Wi-Fi protection**

Wireless security is the prevention of unauthorized access or damage to computers or data using wireless networks, which include Wi-Fi networks. The most common type is Wi-Fi security, which includes Wired Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA). WEP is a notoriously weak security standard: the password it uses can often be cracked in a few minutes with a basic laptop computer and widely available software tools.

**The following tips can help secure your home Wi-Fi network against unauthorized access.**

- **Change the default name of your home Wi-Fi**

The first step towards a safer home Wi-Fi is to change the SSID (service set identifier). SSID is the network's name. Many manufactures give all their wireless routers a default SSID. In most cases it is the company's name.

- **Make your wireless network password unique and strong**

Most wireless routers come pre-set with a default password. This default password is easy to guess by hackers, especially if they know the router manufacturer.

- **Enabling network encryption**

Almost all wireless routers come with an encryption feature. By default it is turned off. Turning on your wireless router's encryption setting can help secure your network. Make sure you turn it on immediately after your broadband provider installs the router. Of the many types of encryption available, the most recent and effective is "WPA2."

- **Turn off network name broadcasting**

When using a wireless router at home, it is highly recommended that you disable network name broadcasting to the general public. This feature is often useful for businesses, libraries, hotels and restaurants that want to offer wireless Internet access to customers, but it is usually unnecessary for a private wireless network.

- **Keep your router's software up to date**

Sometimes router's firmware, like any other software, contains flaws that can become major vulnerabilities unless they are quickly fixed by firmware releases from the manufacturer.

- **Make sure you have a good firewall**

A "firewall" is designed to protect computers from harmful intrusions. Wireless routers generally contain built-in firewalls but are sometimes shipped with the firewall turned off. Be sure to check that the wireless router's firewall is turned on.

- **Use VPNs to access your network**

A virtual private network, or VPN, is a group of computers or networks that work together over the Internet. It should be devices in place of computer.

## Concept of circuit reading, jumpering and heatsink

**Objectives:** At the end of this lesson you shall be able to
- **explain how to read and trace the mobile circuit**
- **describe jumpering and the techniques of jumpering**
- **state the process of phone upgradation**
- **explain the concept of heat-sink and its working principle.**

### Circuit Diagram Reading

When reading smartphone schematic, first is important to learn how to identify Printed Circuit Board Design, Original parts and components on the PCB Diagrams of a smartphone.

Identification of external and internal Apple, Samsung Galaxy mobile parts components is not that difficult. Now latest mobile phone PCB diagram with parts is easily available on Wholesale Cell Phone Parts Supplier Shop in Asia and Europe. How to Identify Parts and Components on the PCB of a Mobile Cell Phone.

### Circuit Tracing

Circuit-tracing' or 'Line-checking' is a term used by mobile phone repair technicians to check broken tracks on the green coloured PCB (Printed Circuit Board). Many of the times problems come in cell phones, if the tracks get broken. These tracks are not visible as they are drawn inside the circuit boards.

### PCB Diagram of a cell Phone (Fig 1a & 1b)

Fig 1a

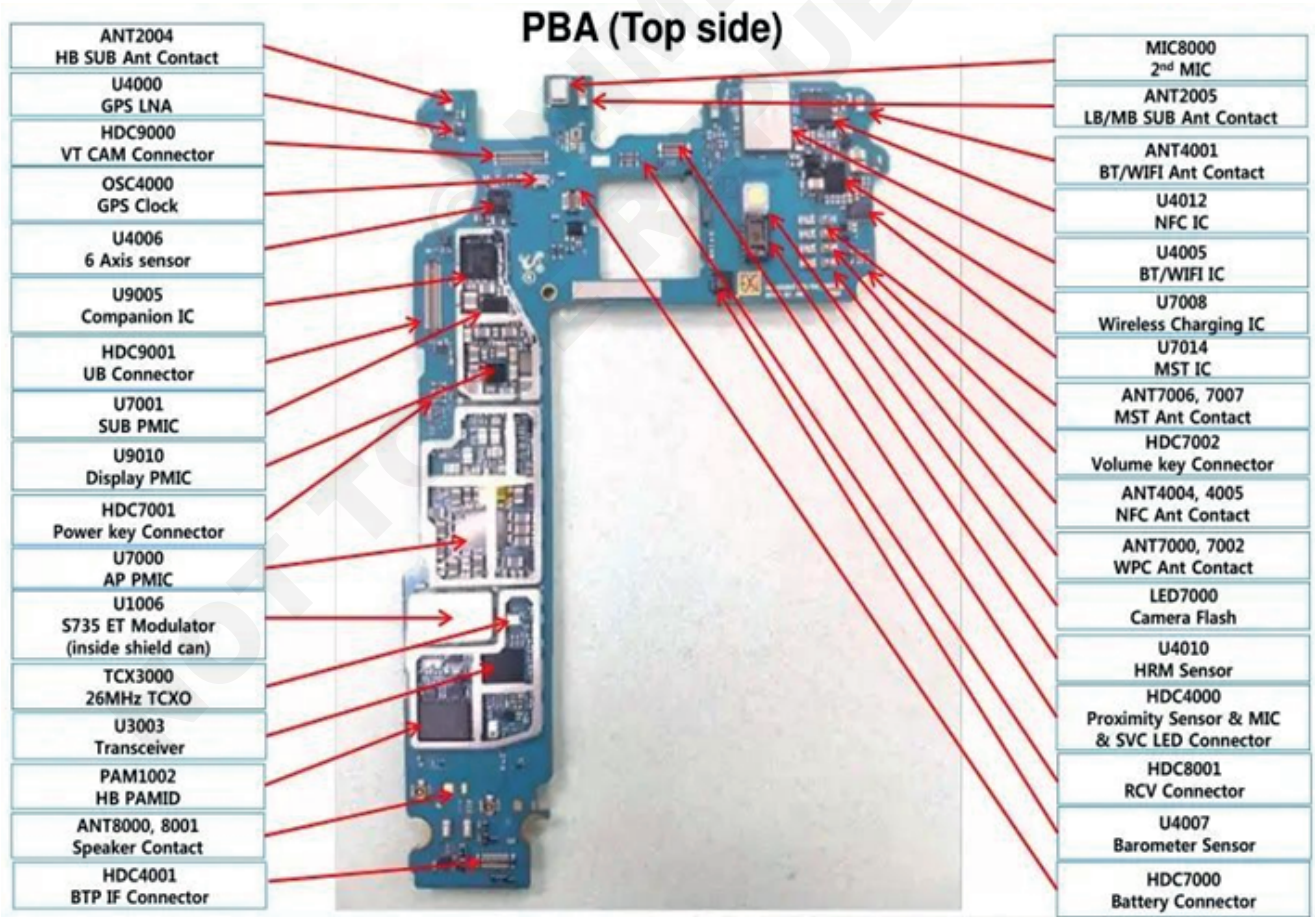
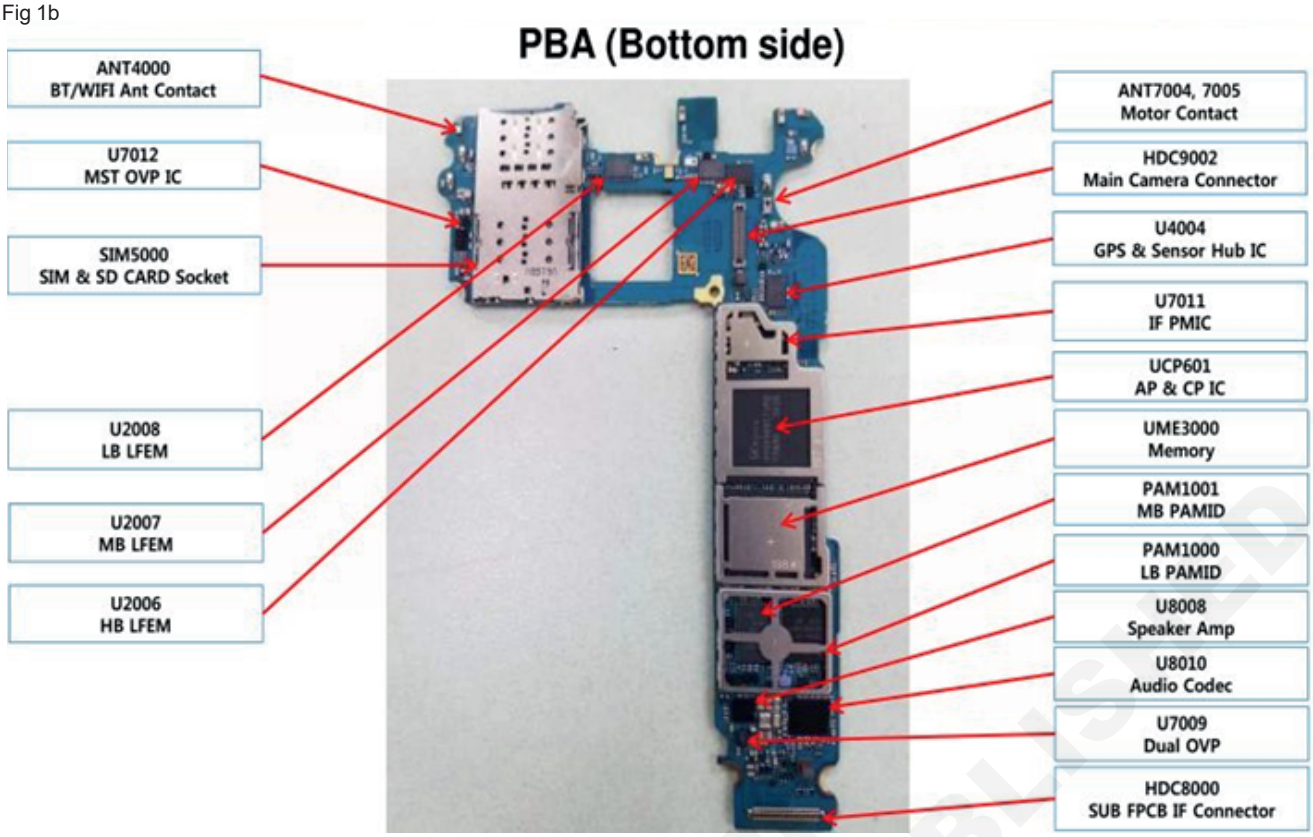


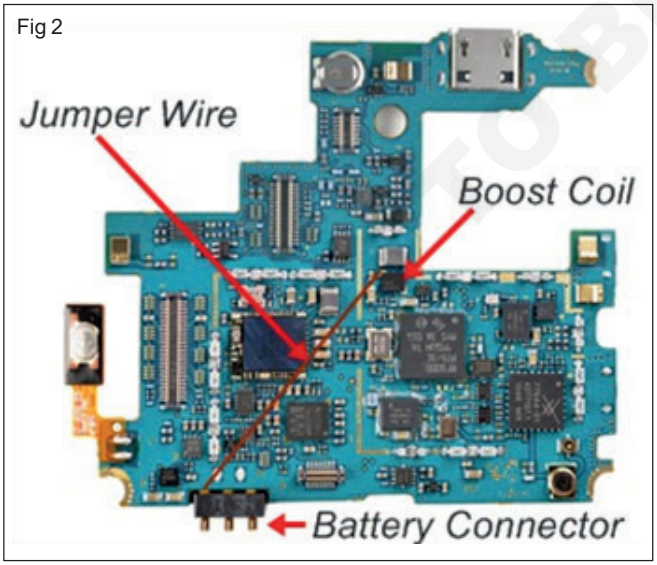
Fig 1b




### Basic Jumpering Techniques

Mobile technicians should be aware of various techniques that are used for repairing mobiles, smartphones, tablets and other electronic gadgets. Jumpering technique is one of the techniques used to get rid of the faults that are present in mobile, smartphone or any other tablets. In (Fig 2) Battery coil and battery connector is connected using jumper wire.

Fig 2




### How to Jumper

- Disassemble the mobile phone and place and hold it on a PCB holder.
- Using a multimeter, check track and find the fault or the missing track that need to be jumpered.
- Apply liquid soldering flux to the points where you need to solder jumper wire.
- Cut the wire to desired length and remove its lamination using blade cutter.
- Hold one end of the wire and solder it to one point of the faulty circuit track. Use a good quality tweezers to hold the wire and good quality of soldering iron and solder wire to solder.
- Now hold the other end of the wire and solder to the other point of the track
- Using a multimeter check the track.

### Study of Phone Upgradation

Over the last few years, Android OS has come to dominate the mobile OS landscape with over 86% market share as of 2019. The system provides high-performing and secure usage and comes with regular version updates with new features.

### A Brief History of the Android Operating System

Google first introduced the revolutionary Android operating system as an alternative to Apple's iOS in late 2008. For much of its lifetime, the OS version was designated by a number and a codename.

- Android 1.0 to 1.1 - Google's original mobile OS offered basic capability with integrated apps like Gmail, Maps, Calendar, and YouTube.
- Android 1.5 or Cupcake - Released in early 2009, this was the first-named version of the OS. It included an on-screen keyboard and introduced the framework for third-party apps to be run on mobile devices.

- Android 2.0-2.1 or Eclair - Version 2.0 added real-time traffic information, voice-guided navigation, and pinch-to-zoom capability to the OS.
- Android 2.3 or Gingerbread - The 2010 release of this OS focused on the black and green interface as Android began to develop a distinctive look.
- Android 3.0-3.2 or Honeycomb - Released in 2011, this version of the operating system was specifically for tablet devices and introduced on-screen buttons.
- Android 4.0 or Ice Cream Sandwich - This was a unified OS for phones and tablets all released in 2011 which featured a holographic appearance and made extensive use of swiping when using the system.
- Android 4.4 or Kit-Kat - Late 2013 saw this update which lightened the interface's colour scheme and introduced the world to "OK, Google" support.
- Android 5.0-5.1 or Lollipop - Major changes were made with 2014's upgrade. Google introduced the card-based Material Design standard employed to unify the appearance of items displayed by the OS.
- Android 6.0 or Marshmallow - This relatively minor update in 2015 was the beginning of Google's patterns of relaying a new, numbered version every year.
- Android 7.0-7.1 or Nougat - 2016's entry in the Android OS lexicon added native split-screen mode and launched Google Assistant.
- Android 9 or Pie - Google released this last-named version of Android in August of 2018. The most visible updates of this version for users were the large Home and small Back buttons to the user interface and new security features.
- Android 10 or 10, Released on 2019, Android 10 introduces a revamped full-screen gesture navigation system and new app open and close animations, with gestures. It includes a system-level dark mode.
- Android 11 or 11, Released on 2020, Android 11 contains new APIs for handling devices with hinged displays (such as foldable smartphones) and ultra-curved "waterfall" displays.
- Android 12, 12L or 12, Released on 2021 , An increased amount of animation, and a new style for home screen widgets.
- Android 13 or 13, Released on 2022, The number of active apps is now shown at the bottom of the notifications panel, a tap on it opens a detailed panel which lets the user stop each of them

**Flashing Map Problem**

Flashing Map usually known as "Flickering" which is caused by a software issue which can be caused by glitches in apps or software bugs. To best protect your device, make sure to update the software so that it is running the latest operating system and has the latest security updates installed.

**What to do if the screen on your device is flickering**

If the screen on your device is flickering, there are a few steps you can follow to find out whether the issue is software or hardware related. Flickering is usually caused by a software issue which can be caused by glitches in apps or software bugs.

To best protect your device, make sure to update the software so that it is running the latest operating system and has the latest security updates installed.

- Is the screen of your device smashed or cracked? If there is damage to your screen, this could be causing your screen to flicker.
- If the screen on your device is flickering, the first step is to restart your device. This is often the quickest and easiest way to resolve software issues. Follow the steps below to perform a soft reset on your device.
  - Press and hold the power button or button combination you use to power off your device for around 15 seconds
  - Press and hold the power button or button combination you use to power off your device for around 15 seconds.
- If your screen is still flickering, try adjusting your brightness settings, and disabling the adaptive brightness feature.
- Corrupted data in the system on your device can sometimes cause the screen to flicker. Clear the cache on your device, then check if the flickering continues.

**Concept of Heat Sink (Fig 3)**

Fig 3


Every electrical and electronic component in a circuit generates some amount of heat while the circuit is executed by providing power supply. Typically, high-power semiconducting devices like power transistors and the opto electronics such as diodes, lasers generate heat in considerable amounts and these components are inadequate to dissipate heat, as their dissipation capability is significantly low.

Due to this, heating up of the components leads to premature failure and may cause failure of the entire circuit or system's performance. So, to conquer these negative aspects, heat sinks must be provided for cooling purpose.

Heat sink is an electronic component or a device of an electronic circuit which disperses heat from other components (mainly from the power transistors) of a circuit into the surrounding medium and cools them for improving their performance, reliability and also avoids the premature failure of the components. For the cooling purpose, it incorporates a fan or cooling device.

Heat sinks are generally made of metals; and, aluminium is the most common metal used in heat sink. We are aware of the fact that the thermal conductivity of each metal is different. The thermal conductivity of metal is proportional to the heat transfer in heat sink. Thus, if the thermal conductivity of the metal increases, then the heat transferring capacity of the heat sink will also increase.

**Heat Sink Working Principle**

Whenever two objects with different temperature come in contact with each other, conduction occurs causing the fast-moving molecules of the high-heat object to collide with the slow-moving molecules of the cooler objects, and thus, transfers thermal energy to the cooler object, and this is termed as thermal conductivity.

Similarly, heat sink transfers the heat or thermal energy from a high-temperature component to a low-temperature medium like air, water, oil, etc. Usually, air is used as a low-temperature medium; and, if water is used as medium, then it is termed as cold plate.

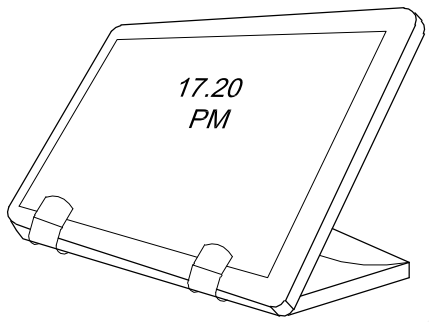
# Introduction to tablet

**Objectives:** At the end of this lesson you shall be able to
- **explain what tablet type computer are**
- **describe the procedure of deassembling and assembling of tablet**
- **describe the functions of block diagram of tablet**
- **identification of IC's**
- **troubleshooting and replacing different selection of tablet.**

### Introduction to Tablet type Computer

A tablet is a wireless, portable personal computer with a touch screen interface. The tablet form factor is typically smaller than a notebook computer, but larger than a smartphone. (Fig 1)

Fig 1




The idea of tablet computing is generally credited to Alan Kay of Xerox, who sketched out the idea in 1971. The first widely sold tablet computer was Apple Computer's Newton, which was not a commercial success. Technological advances in battery life, display resolution, handwriting recognition software, memory and wireless internet access have since made tablets a viable computing option.

Today, the most common type of tablet is the slate style, like Apple's iPad, Microsoft's Surface or Amazon's Kindle Fire. External keyboards are available for most slate-style tablets, and some keyboards also function as docking stations for the devices.

### Procedures of Dissembling and Assembling Tablet

These guides typically follow the procedure for Dissembling your Tablet:

**Step 1: Open the Tablet.**

- Open the card slot cover on the rear cover using a guitar pick.
- Remove screw 1 in the card slot recess.
- Hold the tablet in one hand and use a guitar pick to unlock the rear cover from the tablet along the joint line as shown in the Fig 2.
- Remove the rear cover.

Fig 2

**Step 2: Remove Battery pack**

- Remove screw 1 for fixing the steel frame on the battery connector.
- Remove the steel frame from the front module as shown in the fig 3.
- Detach the battery FPC from its connector on the PCBA using a guitar pick.
- Detach the battery pack from its seat by inserting a guitar pick into the joint surface and then cutting along the joint line in the direction shown in the fig 3.

- Remove the battery pack from the front module of the tablet.

Fig 3

These guides typically follow the procedure for Assembling your Tablet:

**Steps: Assembling Battery pack**

- Place the battery pack into the front module of the tablet.
- Attach the battery pack to its seat by using a guitar pick to the joint surface and then pushing along the joint line to properly set the battery pack.
- Attach the battery FPC to its connector on the PCBA using a guitar pick.
- Place the steel frame from the front module as shown in the fig 4.
- With help of screw driver screw 1 to fix the steel frame on the battery connector.

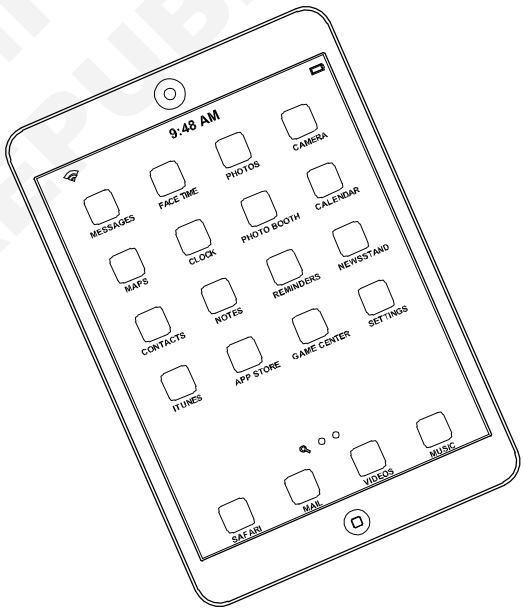
**Steps: Assembling the Tablet**

- Place the rear cover of the tablet.
- Hold the tablet in one hand and use your finger tips to gently press lock the rear cover to the tablet along the joint line as shown in the fig 5.

- Place the screw 1 in the card slot recess.
- Close the card slot cover on the rear cover using your fingers.

Fig 4

Fig 5

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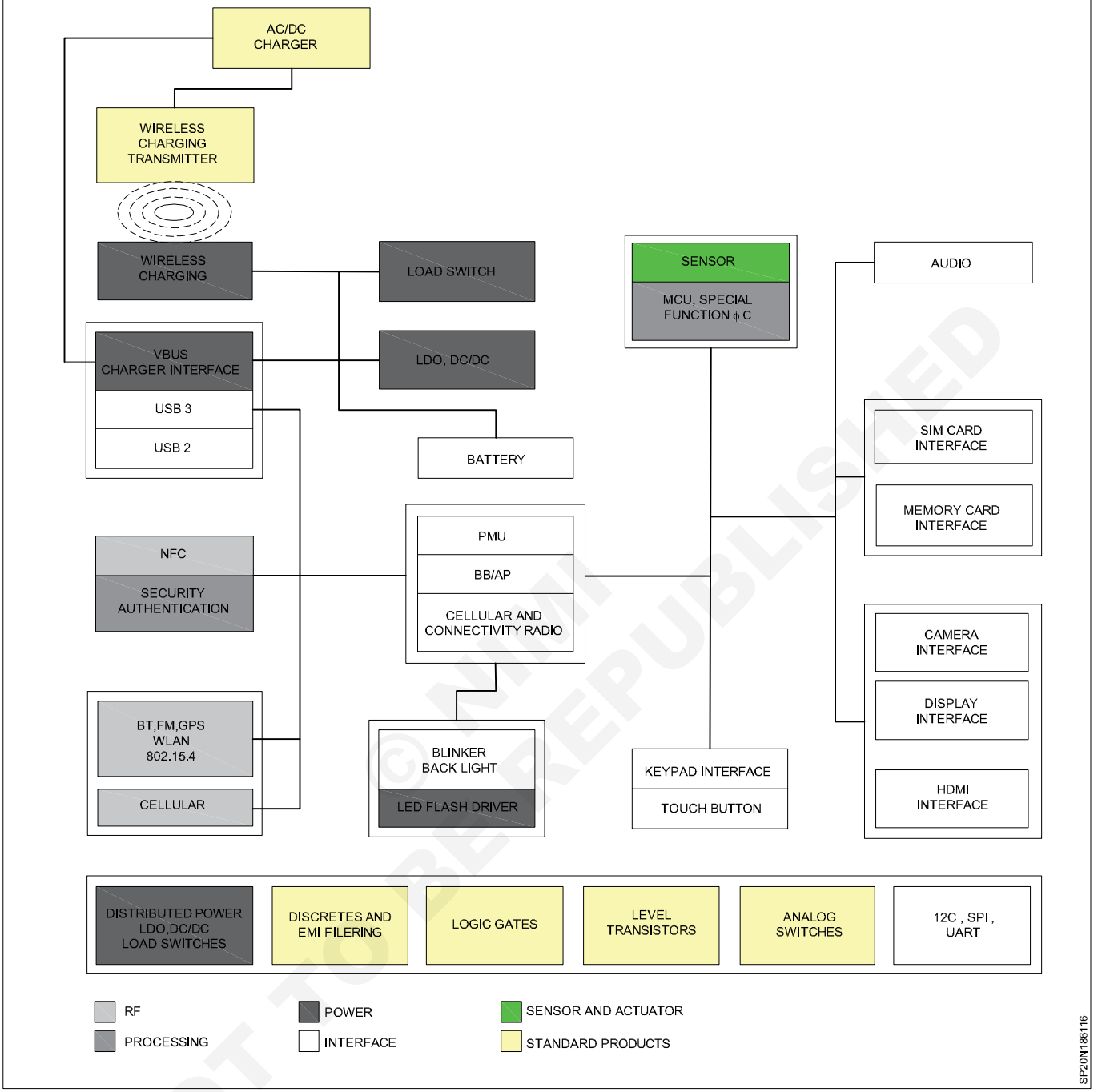
## Block Diagram and function of Tablet

Fig 6



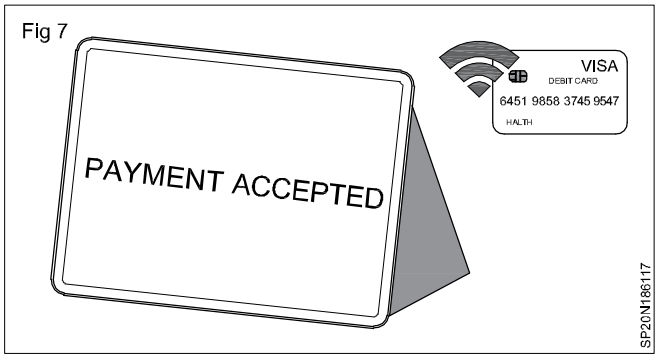

Mobile internet devices, such as tablets and PDAs, must be able to withstand long periods of use as users increasingly use them for mobile internet access, multimedia viewing, navigation, video conferencing, personal organizing and secure transactions. NXP enables all of the required functionality with the support of NFC and security technology. Our portfolio includes energy efficient audio solutions, enhanced GPS performance, ESD&EMI protection with the smallest footprint and a wide range of application specific interface solutions.

### NFC

Near Field Communication (NFC) is the latest trend in mobile devices. The communication is based on a short range RF link (up to 10-20 cm) working at 13.56 MHz with a data speed of 106 kbit/s to 848 kbit/s. Only the initiator part of two way communication is required to be driven actively, while the other side can be passively powered by the RF-field.

Applications that use this communication channel include contactless payment, ticketing, access control, easy device association, profile exchange (business card transfer), device authentication and many more. The NXP NFC related product portfolio embraces all components related to NFC including the RF-interface supporting all released NFC standards, the secure element enabling contactless payment and certified software stacks. (Fig 6)

Fig 7




**EMI-filter with ESD-protection**

The increasing complexity in mobile applications has led to an increase in interface signal frequencies, external interfaces and, especially, an increase in consumers who rely on their in mobile devices. For user accessible interfaces, a rugged ESD protection is mandatory to avoid damage or failure of the mobile.

**GPS LNA**

There is an increase in multiple RF frequency and RF system integration into portable appliances at the request of the consumers. The need for higher performance requires maximum sensitivity from receiver antennas without being disturbed by jammers and other disturbances from different RF systems. NXP's LNA require an industry minimum in external components, while offering a top noise and jammer suppression performance.

Housed in an extremely small package, NXPs latest LNA requires only one external matching inductor and one external decoupling capacitor. It adapts itself to the changing environment in response to the presence of different radio systems.

**Memory Card Interfaces**

According the IEC61000-4-2 standard, SD host interfaces require additional high-level ESD protection, in addition to the integrated ESD protection which is typically very weak. Other strict EMI regulations and system requirements, as specified in GSM mobile phones, strongly request filters that reduce the radiated/conducted EMI. However, they must still comply with the electrical requirements of the interface specification.

The continuing trend of miniaturization of portable appliances implies that interface devices offering ESD protection and EMI filtering should also integrate biasing circuits/resistors into a single small-sized package. NXP's memory card interface solutions fully support this continuing trend and offer interface conditioning functions such as high-level ESD protection according the IEC61000-4-2 standard. They also support EMI filtering, integrated biasing resistor networks, regulated power supply to supply SD-memory cards directly from a battery, and voltage level translation to enable the use of low-voltage host processors to communicate with 2.7 V to 3.6 V compliant SD-memory card devices.

**Charger interface**

Whether your device is charged via the USB port or a separate charger, it is exposed to incorrect polarity or abnormally high voltages. Any of these two occurrences poses a threat to the charger circuit and the PMU of the mobile device. In addition, the USB/charger port can be subject to ESD strikes and other transient discharges. NXP offers an application specific portfolio of TVS diodes and ESD arrays, which enable cost efficient protection solutions – ESD, reverse polarity, overvoltage, other transient discharges – with the smallest footprint.

**Li-Ion battery charging topologies**

Battery chargers using external pass elements can be grouped into two main paths – Bipolar Junction Transistor (BJT) and MOSFET – with additional back drive protection. NXP is offering cost efficient pass elements such as bipolar transistors, MOSFET & FET for all use cases related to battery charging.

**HDMI**

The impedance matched (100 ohm differential) TMDS lines are critical for the design of an HDMI interface, with minimal line capacitance to allow maximized EYE openings of the differential signals and robust system level ESD protection. The EYE open pattern test is actively supported by NXP, which is a founding member of the HDMI consortium.

**Mobilized multimedia**

NXP offers comprehensive software solutions for mobilized multimedia, simplifying the user interface, enhancing the user experience and shortening the design cycle. Ease of use, image and audio quality are all key considerations during the manufacture of our mobilized multimedia products.

# Various parts of tablet

**Objectives:** At the end of this lesson you shall be able to
- **explain various parts of tablet**
- **enumerate and identify types of ICs under in tablet**
- **describe what damaged and working components are.**

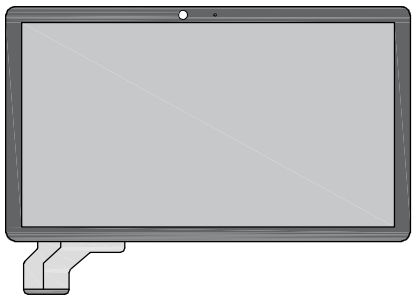
**Various parts of Tablet**

**The key components of a tablet PC**

- **The touchscreen (Fig 1)**

It is the input device responding to finger tips that allows the user to communicate with the device in a user-friendly manner. The growing popularity of the mobile device touchscreens has eliminated conventional mechanic keyboard while provided the tablets with bigger screens, as well as made web surfing substantially simple, thus increasing multimedia characteristics of the devices.

Fig 1




- **The LCD (Fig 2)**

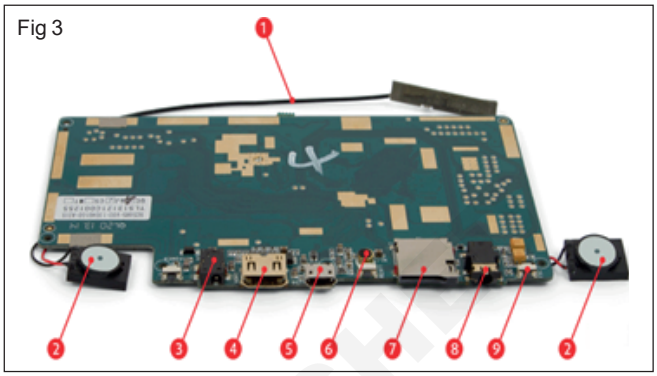
While the touchscreen is an input device, the LCD is an output device. The LCD uses graphic media to display information in a human readable form. The bigger resolution LCD is used – the more details will be displayed.The most frequent problem of tablet LCDs will always be mechanical damage, in other words – the screens that suffer of fractures. Should you have experienced such problem, our store will always help you. In our store you can find the variety of LCDs for tablets supplied in various sets: LCDs separately, LCDs with touchscreens, as well as LCDs with binding frames.

Fig 2

- **The motherboard (Fig 3)**

Motherboard is a “skeleton” that connects all the tablets’ components. This is the complex multi-layer plate made of the dielectric material, its inner surface hosts conducting circuits of the electric network. The motherboard holds many soldered electronic components, such as various unit connectors as well as the user interface.

Fig 3




1 **Coaxial cable:** These cables are used for connecting antenna and motherboard that are usually soldered together or connected with a special connector.

2 **Speaker (buzzer):** The small size speaker, which main purpose is playing tunes, speech, movie soundtracks, games sound as well as any other sounds reproduced by your device.

3 **Charge connector:** Some manufacturers install this unit separately to clear up some space for the USB connector, when the operation of the device is necessary during the charging process, and, in some cases, charging may be conducted only through micro-USB port (Item No.5 on the illustration)

4 **Mini-HDMI connector:** This unit is specifically designed to transmit video signals to other devices, such as TV set, computer display or projector.

5 **Micro-USB connector:** The connector which is typically used to connect external keyboard, mouse, memory card, as well as used to connect tablet to PC and for other purposes.

6 **Microphone:** This device is used to convert mechanical (sonic) waves into electric signals to record or transmit your speech.

7 **Memory card connector:** Typically, this unit is used to increase memory volume for data storage. Looks similar to the SIM-card connector. This module is missing on the disassembled tablet body shown on the picture.

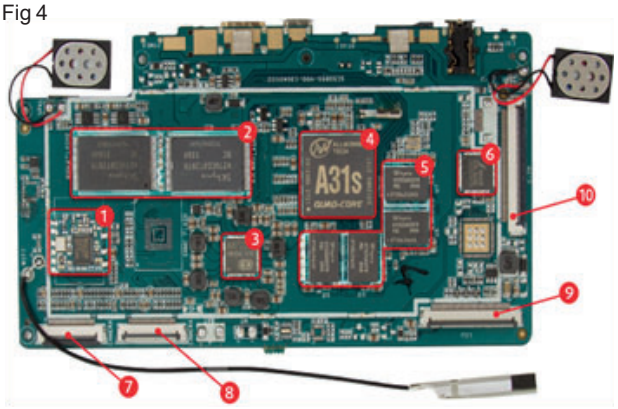
8 **Hands-free connector:** Holding a tablet to your ear is so much inconvenient, that is why, you may opt to use external headset with a microphone.

9 **Tablet power button**

The other side of the motherboard hosts various electric elements, micro electric circuits and connectors for LCD,

touchscreen, and cameras. Micro electric circuit, in other words, microelectronic integrated circuit or chip (microchip) – is the miniature electronic circuit, printed on a semiconductor substrate or seal, and is usually installed into the un-dismountable casing. (Fig 4)

Fig 4




1 Bluetooth operation module, Wi-Fi and FM-radio units.

2 ROM – read only memory, which stores information saved by user, photo, video, documents and programs.

3 Power management chip, in other words, power supply unit, designed for charging tablet as well as conducting power to other internal components.

4 CPU – central processing unit, which is basically the "brain" of the device that computes data with performing arithmetical and logic operations as well as operates other devices. The main characteristics of the device are processor speed and productivity. Another important feature is the CPU's power consumption.

5 RAM – random access memory unit, that is, basically, working memory. This memory type is designed to provide short-time storage for variable data while CPU performs operations on the data. This is the place to keep all the running programs and their data.

6 Touchscreen controller. This micro electric circuit, with the algorithm recorded in it, allows the CPU to perform floating point operations and converts them into digital code read by the CPU. Also, there are cases where micro-controller may be attached directly to the touchscreen's flat cable.

7 Primary camera connector.

8 Front camera connector.

9 Display connector.

10 Touchscreen connector.

- **The rechargeable battery (Fig 5)**

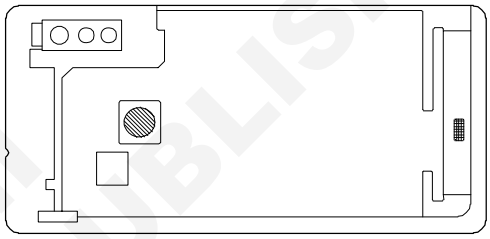
The device's portability is provided, first and foremost, by a rechargeable battery. Rechargeable batteries are different in their chemical makeup, voltage, capacity and size. We offer the variety of the rechargeable batteries for tablets.

Fig 5

- **The rear panel (Fig 6)**

Manufacturer's main design accent is made on the rear panel of tablet - the biggest component of the device. The rear panel design defines comfortable holding in hands, mechanical crash resistance of the device, and, of course, the device's overall appearance.

Fig 6

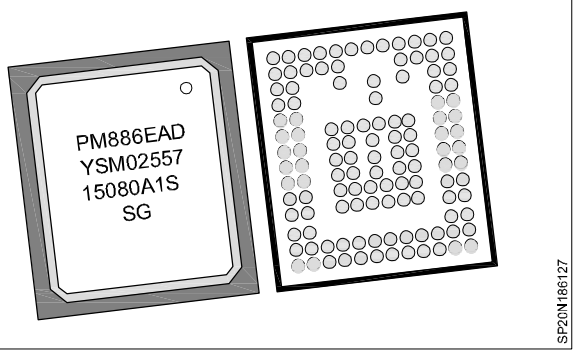



**Identification of ICs in Tablet and its functions**

- **Power IC (Fig 7)**

The power IC is an important micro-chip found in the power section of all tablets. The power integrated circuit is the component electronic chip that distributes required value or measure of current voltage to all other parts of the tablet. Though manufacturer architecture may differ, you will mostly find the power IC close to the battery terminal in tablet with inbuilt battery and most times you find it either behind or at the top of the PCB in SIM facing up position when the PCB is screwed. It is mostly protected by a silver-plated metal. You will observe that the power IC normally have so many capacitors, resistors, and a good number of coils etc of varied shapes and sizes which helps in proper and accurate distribution of current needed for healthy functioning.

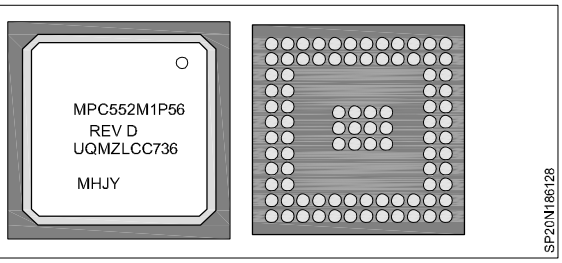
Fig 7



- **CPU (Fig 8)**

Just like the Computers, tablets too have CPU known as central process unit. This IC controls and co-ordinates program instructions and all other activities that goes on while the tablet is being operated just like how we have got a brain in body that determines how every other thing goes on. If the CPU gets shorted or affected by a hard fall from height or a water damage, or corrupted software file, it may result in a dead tablet! The CPU is also referred to as RAP, UPP or MAD IC. The CPU can be found in black color. The CPU is unique in its size in most cases as it appears to be the largest IC chip on the PCB. Just like every other crucial ICs, the CPU is protected with a silver coated iron plate.

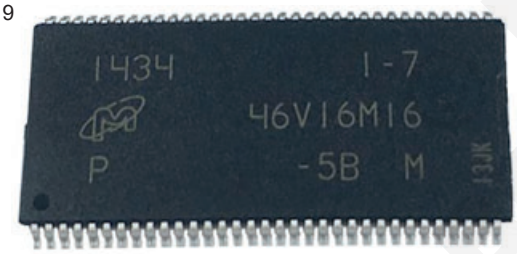
Fig 8




- **ROM (Fig 9)**

Read Only Memory; this is where the operating system software program instruction is resident. The program instruction in this section is also coordinated by the CPU making sure that all programs load correctly. If the ROM IC is faulty, the tablet will not function properly

Fig 9




- **RAM (Fig 10)**

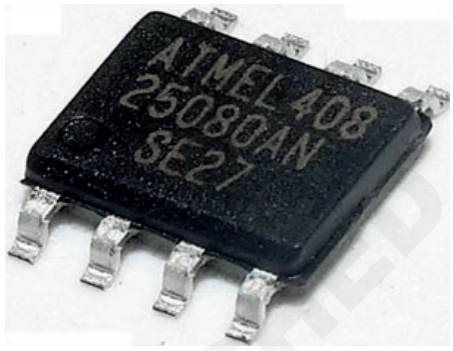
The Random Access Memory is mainly responsible for sending and receiving operating system command while the tablet is being operated. It can be found in the power section. The RAM IC can be affected by a hard fall on the floor or water damage etc. the RAM can go dead if the problem persists and nothing is done about it.

Fig 10


- **Flash IC (Fig 11)**

This integrated circuit can be found in the power section of a tablet and is also referred to as EEPROM, Memory IC, ROM and RAM. When flashing of software is done on a tablet, this is the software hardware component that accommodates the system software. A faulty Flash IC results mainly in software problem or power. If this IC is not replaced, even if you flash the phone a million times, your tablet will not operate properly.

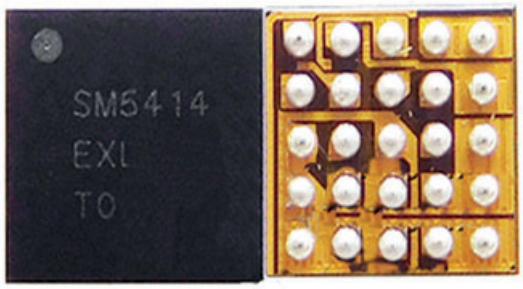
Fig 11




- **Charging IC (Fig 12)**

This IC is found in the power section of a tablet; it receives electrical charges from the charger to charge the battery which is passed on to power IC after passing through the power and Zener diode, resistors and caps for further distribution to other parts in specific values. If the charging IC is bad the tablet will not charge properly or may not even charge at all. If the phone's charging IC gets a short circuit, the phone won't be able to power ON. Some shorted diode in the power section can also cause power problem when they get shorted as well.

Fig 12




- **Logic IC /UI IC (Fig 13)**

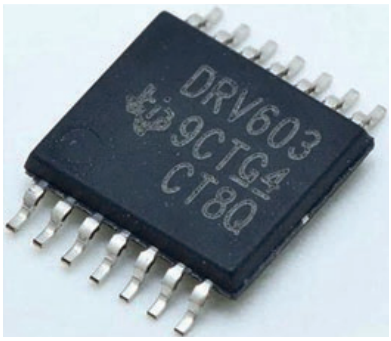
The Logic or user interface IC found in any part of a tablet controls the operation of internal parts like the tablet vibrator, ringer and the LED. If the logic IC is bad, there will be problem with the listed parts which it controls.

Fig 13

- **Audio IC (Fig 14)**

This is also referred to as the Melody or Cobba IC. This IC controls the tablet's mouthpiece and ringer. When this IC is shorted or faulty, the speaker and mic will not work.This may even cause the phone to go dead as a result of this IC problem.

Fig 14




- **RF (Radio Frequency) IC (Fig 15)**

RF signal processor or Network IC as it is called, can be found in the network section on the PCB. While controlled by the CPU, it works as both transmitter and receiver which makes user communication possible. When this component is faulty, network will not be stable or strong and can result in power problem when the IC is shorted.

Fig 15


- **VCO (Fig 16)**

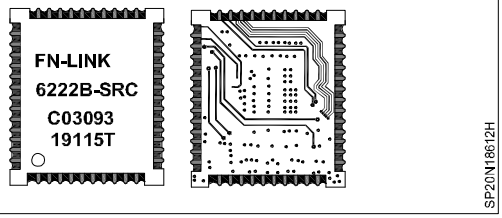
Voltage Controlled Oscillator is found close to the network IC of the network section in mobile phones. The VCO controls and regulates the sending of time, date and current voltage to the radio frequency IC as it receives signals or command from the CPU of the tablet. When this component is faulty, it results in "call end" or "call failed" as you can find this problem in phones as well.

Fig 16


- **Antenna Switch (Fig 17)**

This component has both metallic and non-metallic structure. It can be found in the network section of a tablet. You can identify it by its color which is either silver or golden. It usually performs the function of searching network, tuning and then sending forward. When the antenna switch is faulty, there will be network problem in the tablet.

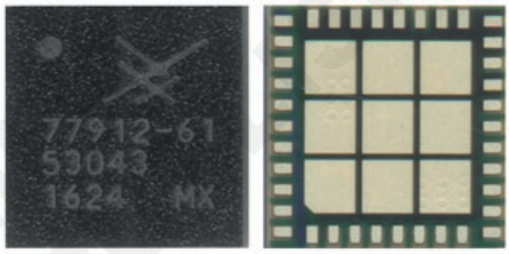
Fig 17




- **Power Amplifier or P.F.O (Fig 18)**

This component is also found in the network section of a mobile phone. It is also referred to as the P.A. (Power Amplifier). This component is responsible for filtering, amplifying and selecting the country home network of a tablet; e.g. MTN, Airtel, Glo etc. When the Power amplifier is faulty, a network problem will also surface and calls will be difficult or impossible due to network problem. When this problem happens, replace the PA.

Fig 18




**Damaged and working components**

- **The Screen**

Although brands increasingly manufacture screens that are more resistant to shocks and scratches, these pieces are not yet unbreakable. The screen is the component of the mobile that always takes the worst part if the mobile falls to the ground. Most of us try to protect our mobile phone with rigid or silicone cases (which fully load the aesthetics of the mobile) or we put a tempered glass screen. However, sometimes that protection is not enough.

In addition, the screen is one of the most expensive components of a mobile, hence its repair is also.

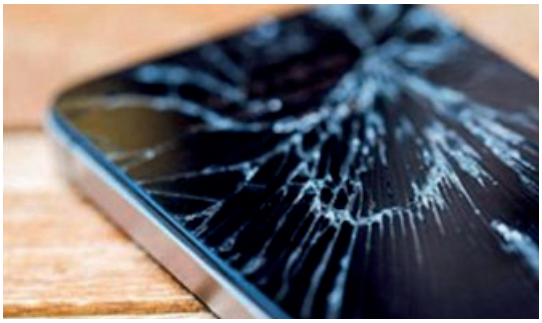
Keep in mind that the glass is not the same as the screen. It may happen that the glass has broken but not the screen. For that reason, on some occasions you can see how it continues to work without problem.

The opposite can also happen, the screen may have broken and then it will not respond when you touch it will stop working, although there are cases in which it continues to work.

If the screen and the glass have been broken (Fig 19), or even if only one of the two things has been broken, you should probably change both since in some mobile models, they are assembled and not sold separately.

In some cases you also have to change the entire front part where the buttons or the camera are located.

Fig 19



## 2 Charging connector (Fig 20)

It is subject to great wear because we are continuously connecting and disconnecting the mobile charger and many times “we give it a good pull”.

In addition to the great use that is given to this component, being a slot is a piece that is usually filled with dirt (dirt, dust …) and even moisture.

It is important to clean the charging connector from time to time and avoid plugging the charger without checking that this port is clean and free of impurities.

Fig 20

## 3 Problems with the battery (Fig 21)

The cell phone battery is another component that breaks down the most.

The main reason for its deterioration is due to the high temperatures. In general, the extreme temperatures are not friends with the batteries and, therefore, it should not surprise us if our phone suddenly turns off when we leave the phone in the car forgotten in the middle of summer.

Fig 21

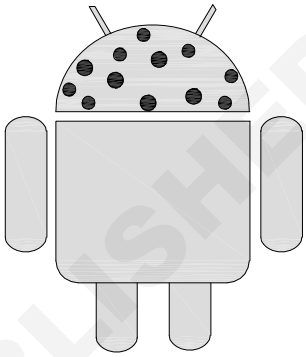
Another reason that causes damage to the batteries is to use a charger not suitable for your mobile. Many times, we use the same charger for mobile, tablet or headphones as they have the same port and this is a mistake.

The battery of each device has a different amperage, so if we use the same charger for everyone it may be, in some cases, too powerful or insufficient.

## 4 Software Issues (Fig 22)

Updates of the operating system, how many joys and dislikes have caused since the arrival of smartphones. Every day we receive phones with software problems, most of them are the fault of software updates.

Fig 22




The two most frequent problems that updates can cause are:

That our smartphone works extremely slowly and / or with many errors. Directly after updating it, it does not even turnon, which is called Boot loop.

Many software problems also occur after installing applications, as we know many are plagued by viruses and malware.

## 5 Problems Speakers and Microphone (Fig 23)

Problems with the audio are very frequent. The symptoms of a broken microphone are that the caller does not hear you when you make a call.

Interferences or “clicks” may also appear. You cannot record audios either or they are heard with very high quality. Something may be blocking the sound so you must confirm that the microphone has no residue or dirt or that it is not blocked. Otherwise, you must change the piece.

The speaker is another piece that is subject to great wear. When a mobile phone has a speaker fault, it obviously does not play any sound when you receive a call. It also does not emit sound when you receive a notification or it is very slight or distorted. When activating the hands-free, the mobile will not ring either.

When you play a song or put a video, the mobile does not emit any sound. You can check if with headphones if you hear sound.

If you also don’t hear anything with them, you may have a sotware or board failure. There may also be a chance that the audio jack is also damaged (it is the headphone jack).

Fig 23


### 6 Water damage (Fig 24)

Every day we receive several mobiles that have suffered water damage. Many people do not even know that their cell phone has suffered water damage since it is not necessary for the phone to fall into the water.

It is enough that the mobile has been in a place with a lot of humidity, for example in the bathroom while we shower.

There are also many people who exercise with the mobile and sweat itself can even damage the device.

That is why it is important to protect our device with a waterproof bag while we shower.

Fig 24

## Initial failure identification procedure

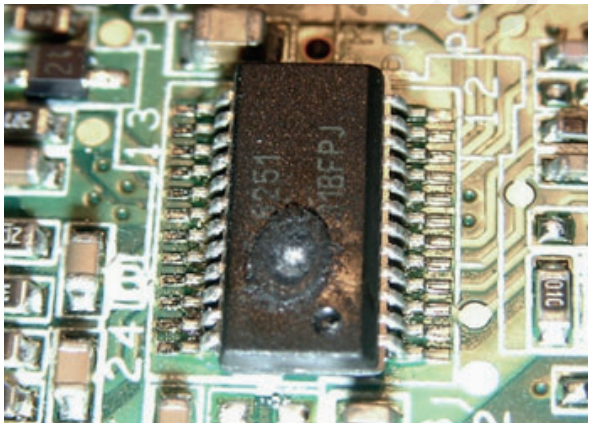
**Objectives:** At the end of this lesson you shall be able to
- **describe the procedure of initial failure identification.**

### Study of Initial failure identification procedure

Electronic components have a wide range of failure modes. These can be classified in various ways, such as by time or cause. Failures can be caused by excess temperature, excess current or voltage, ionizing radiation, mechanical shock, stress or impact, and many other causes. In semiconductor devices, problems in the device package may cause failures due to contamination, mechanical stress of the device, or open or short circuits.

### 1 Packaging failures (Fig 1)

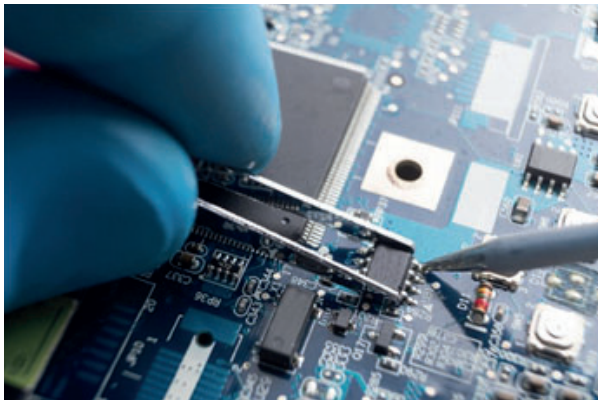
Fig 1



The majority of electronic parts failures are packaging-related. Packaging, as the barrier between electronic parts and the environment, is very susceptible to environmental factors. Thermal expansion produces mechanical stresses that may cause material fatigue, especially when the thermal expansion coefficients of the materials are different. Humidity and aggressive chemicals can cause corrosion of the packaging materials and leads, potentially breaking them and damaging the inside parts, leading to electrical failure. Exceeding the allowed environmental temperature range can cause overstressing of wire bonds, thus tearing the connections loose, cracking the semiconductor dies, or causing packaging cracks. Humidity and subsequent high temperature heating may also cause cracking, as may mechanical damage or shock.

### 2 Contact failures (Fig 2)

Fig 2

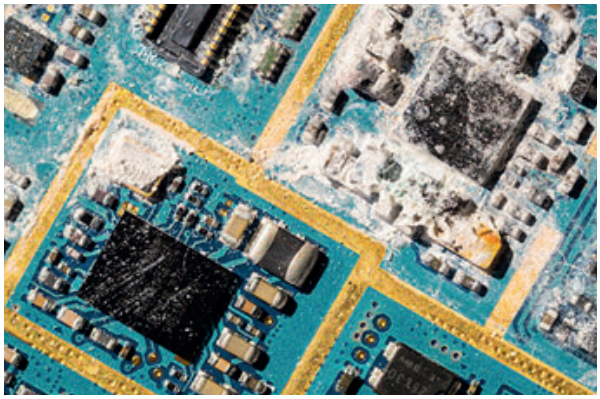


Electrical contacts exhibit ubiquitous contact resistance, the magnitude of which is governed by surface structure and the composition of surface layers. Ideally contact resistance should be low and stable, however weak

contact pressure, mechanical vibration, corrosion, and the formation of passivizing oxide layers and contacts can alter contact resistance significantly, leading to resistance heating and circuit failure.

### 3 PCB Failure (Fig 3)

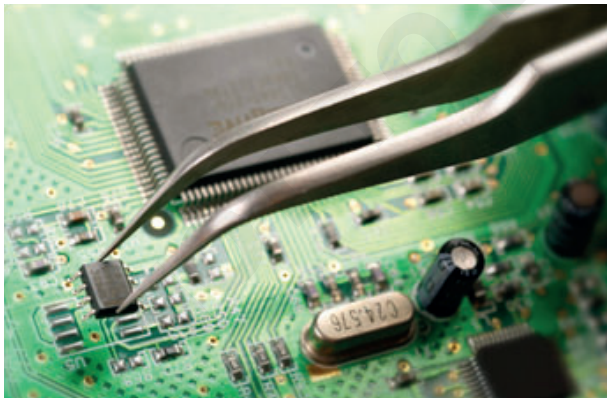
Fig 3



Printed circuit boards (PCBs) are vulnerable to environmental influences; for example, the traces are corrosion-prone and may be improperly etched leaving partial shorts, while the vias may be insufficiently plated through or filled with solder. The traces may crack under mechanical loads, often resulting in unreliable PCB operation. Residues of solder flux may facilitate corrosion; those of other materials on PCBs can cause electrical leaks. Polar covalent compounds can attract moisture like antistatic agents, forming a thin layer of conductive moisture between the traces; ionic compounds like chlorides tend to facilitate corrosion. Alkali metal ions may migrate through plastic packaging and influence the functioning of semiconductors.

### 4 Semiconductor failures (Fig 4)

Fig 4



Many failures result in generation of hot electrons. These are observable under an optical microscope, as they generate near-infrared photons detectable by a CCD camera. Latchups can be observed this way. If visible, the location of failure may present clues to the nature of the overstress. Liquid crystal coatings can be used for localization of faults: cholesteric liquid crystals are thermochromics and are used for visualisation of locations of heat production on the chips, while neumatic liquid crystals respond to voltage and are used for visualising current leaks through oxide defects and of charge states on the chip surface (particularly logical states). Laser marking of plastic-encapsulated packages may damage the chip if glass spheres in the packaging line up and direct the laser to the chip.

### 5 Parameter failures (Fig 5)

Fig 5

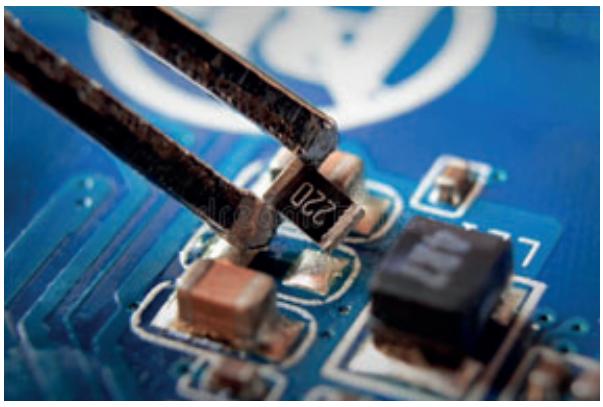
Vias are a common source of unwanted serial resistance on chips; defective vias show unacceptably high resistance and therefore increase propagation delays. As their resistivity drops with increasing temperature, degradation of the maximum operating frequency of the chip the other way is an indicator of such a fault. Mouse bites are regions where metallization has a decreased width; such defects usually do not show during electrical testing but present a major reliability risk. Increased current density in the mouse bite can aggravate electro migration problems; a large degree of voiding is needed to create a temperature-sensitive propagation delay.

### 6 Passive element failures

- **Resistors (Fig 6)**

  Resistors can fail open or short, alongside their value changing under environmental conditions and outside performance limits. Examples of resistor failures include:

Fig 6

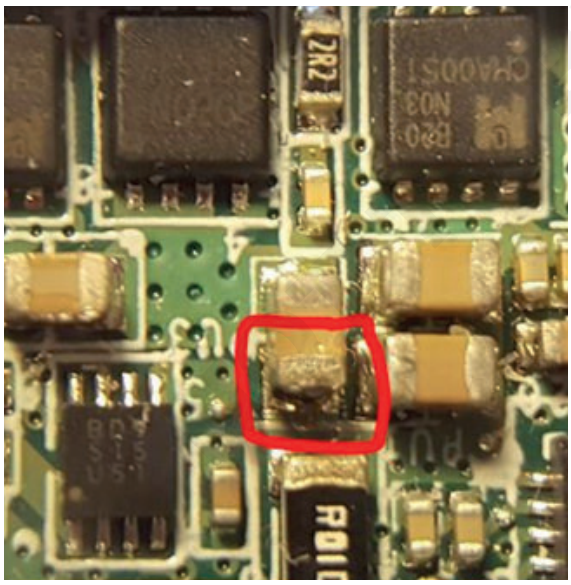


- Manufacturing defects causing intermittent problems. For example, improperly crimped caps on carbon or metal resistors can loosen and lose contact, and the resistor-to-cap resistance can change the values of the resistor.
- Surface-mount resistors delaminating where dissimilar materials join, like between the ceramic substrate and the resistive layer.
- Ni-chrome thin-film resistors in integrated circuits attacked by phosphorus from the passivation glass, corroding them and increasing their resistance.
- SMD resistors with silver metallization of contacts suffering open-circuit failure in a sulfuric-rich environment, due to build-up of silver sulphide.
- Copper dendrites growing from Copper (II) oxide present in some materials (like the layer facilitating adhesion of metallization to a ceramic substrate) and bridging the trimming kerf slot.

- **Capacitors (Fig 7)**

Capacitors are characterized by their capacitance, parasitic resistance in series and parallel, breakdown voltage and dissipation factor; both parasitic parameters are often frequency- and voltage-dependent. Structurally, capacitors consist of electrodes separated by a dielectric, connecting leads, and housing; deterioration of any of these may cause parameter shifts or failure. Shorted failures and leakage due to increase of parallel parasitic resistance are the most common failure modes of capacitors, followed by open failures. Some examples of capacitor failures include:

Fig 7



- Dielectric breakdown due to over voltage or aging of the dielectric, occurring when breakdown voltage falls below operating voltage. Some types of capacitors "self-heal", as internal arcing vaporizes parts of the electrodes around the failed spot. Others form a conductive pathway through the dielectric, leading to shorting or partial loss of dielectric resistance.
- Electrode materials migrating across the dielectric, forming conductive paths.
- Leads separated from the capacitor by rough handling during storage, assembly or operation, leading to an open failure. The failure can occur invisibly inside the packaging and is measurable.
- Increase of dissipation factor due to contamination of capacitor materials, particularly from flux and solvent residues.

**Overview of Troubleshooting and replacing methods of sections**

**SIM detection**

1 Check for valid SIM, if required insert other SIM and try.
2 Check SIM connector and SIM position.
3 If SIM IC gets heated then replace it.

**MIC**

1 Check MIC using multimeter.
2 Replace MIC if needed.

**Speaker**

1 Check speaker using multimeter.
2 Replace speaker if needed.

**Bluetooth section**

1 Check wheather Bluethooth icon is ON.
2 Allow the device to pair.
3 Keep both device within the limited range.

**Wifi section**

1 Check for Wifi security password and username.
2 Check wifi router is powered ON.
3 If problem persists, check the wifi IC in PCB and replace it.

**Touch screen section**

1 Check for touch screen sensor.
2 Replace touch screen and check.
3 Replace PDA (or) Touch screen IC.
4 Check the interface between CPU and touch screen sensor and do jumpering if needed.

# Introduction to types of mobile app its importance and testing

**Objectives:** At the end of this lesson you shall be able to
- **know the different types of mobile apps**
- **know the importance of mobile app testing**
- **types of security testing.**
- **check the mobile screen validation and navigation system.**

**Different types of Mobile Apps**

**Native App**

Examples of Native App

- Android on Java
- Windows phone on Net
- iOS on Objective - C or Swift

These Apps are developed for a single mobile operating system exclusively, therefore they are 'native' for a particular platform or device. You cannot use Android App in iphone.

**Advantages**

1 High performance

2 User friendly

3 Wide range of API

4 Easily accessible from App store of their kind.

**Web App**

Examples of Web App are,

- Shopping carts
- email programs
- File scanning
- Online form

These can be downloaded from browser. All users can access the same version thus compatibility issues are eliminated.

**Advantages**

1 It can run on multiple platform.

2 Space limitation are eliminated.

3 User friendly

**Importance of Mobile App Testing**

Mobile app testing is the process of running tests against a mobile application to make sure that it is functionality and usability meet the requirements and the application is ready for launch. Mobile app testing includes general types of testing (functional, performance, usability, security, load) as well as mobile-specific ones (interruption, memory leakage, location, certification, installation, etc.).

Here are a couple of things to catch up with before getting down to mobile app testing:

- Choose your testing method: mobile apps can be tested on either real devices or emulators. There are also real device clouds that allow you to use hundreds of devices remotely, testing concurrently and record the results
- Make sure your test coverage is sufficient. If you don't think it is, there are sure-fire ways to enhance it.
- You might not be new to mobile app testing, but there's always room for improvement. Having a plan, going for continuous testing and mobile app test automation are just some of the tips you can use to make testing more efficient.
- Speaking of test automation, you need to decide which testing processes you would like to automate and which are better left to be tested manually. From the get-go, it might be a good idea to test your app manually. Later on, you might want to test it across various devices and platforms, changing codes and test scripts. Automated testing is a good fit for this scenario. Just keep in mind that manual and automated testing are not rivals but rather two colleagues working together to make your app best of the best.
- Mobile games deserve special attention too, so don't forget to give them a proper test.

**Introduction to App Testing**

App Testing is done to make sure that functionality and usability meet the requirement and the app is ready to launch.

**Source of App**

Here we can download the App we require, for the device we use. (i.e.) Android OS has playstore as source and iOS has appstore as source.

**Familiarization with govt. promotional apps**

A few years ago, there used to be a website for almost everything. Now, thanks to the advent of smartphones, there is an app for almost everything. The Indian Government and related agencies have also come up with several apps as part of the Digital India initiative. They can prove beneficial during the Lockdown period, while social distancing, as well as during normal situations.

## List of Government Mobile Apps

### AarogyaSetu App (Fig 1)

The Indian government has launched its AarogyaSetu app as an effort to help people during the COVID-19 pandemic. It connects Indian citizens with essential health-related information. The app is developed to fight the ongoing pandemic and help the Department of Health to reach out to more people.

Fig 1


### BHIM UPI App (Fig 2)

The tagline of this app is – Making India Cashless. This is the essence of the Bharat Interface For Money (BHIM) app. It can be viewed as a digital wallet. You can use this app to transfer money or receive money from one bank account to another.

Fig 2


### ePathshala App (Fig 3)

This app facilitates learning on the go. The traditional classroom set-up gets an upgrade in this mobile learning app. You can access textbooks and periodicals via this app. It works on different devices such as mobile phones, tablets, and laptops.

Fig 3


### mAadhaar App (Fig 4)

Nowadays, the Aadhaar Card has become the go-to Know Your Customer (KYC) or identity verification document. With this app, you do not have to carry your Aadhaar card everywhere with you.

Fig 4


### IRCTC (Fig 5)

This app can be used to book, view (or) cancel train e-ticket. New users can register and login by using ID and password.

The entire detail of particular train can be viewed in this app.

Fig 5

### Overview familiarization of different types of mobile app testing

### Types of Mobile App Testing

#### 1 Usability testing

This test is used to evaluate how easy it is for users to reach their goals.Users are given realistic scenarios to complete while being observed to see where they encounter problems or experience confusion. The goal is to identify whether participants are able to complete specified tasks and how long it takes them.In usability testing feedback is collected directly from the end user. This removes any bias and helps highlight areas that could be improved. Ensuring that the design is intuitive & easy to use provides a positive user experience. Which in turn increases product use.

#### 2 Compatibility Testing

Test the application/software to see if it is capable of running on the different hardware specifications, devices, operating systems, browsers and varying networks as per requirement.

The different types of Compatibility tests include:

- **Browser -** compatibility with Chrome, Firefox, Internet Explorer and Safari.
- **Device** - compatibility with different Screen size, resolution, storage etc
- **Hardware** - compatibility with different hardware configuration
- **Mobile** - compatibility with Android, iOS, Windows etc.
- **Network** - performance of the app in networks with varying bandwidth, operating speed and capacity.
- **Operating Systems** - compatibility with Windows, Os etc.
- **Versions of software -** compatibility with older and newer versions of software.

### 3 Performance testing

It is used to determine the speed, responsiveness and stability of the application under various workloads (i.e., varying number of users).

The goal of this test is to:

- Eliminate performance bottlenecks before the application goes live. Bottlenecks are process/processes within the systems overall function that slows or stalls down overall performance
- Ensure the application meets the performance objectives.

The different types of performance tests include:

- **Load Testing:**

  Conducted to verify that the application can handle the expected number of users i.e., during real life conditions. Helps to set the benchmark for the application.

- **Stress Testing:**

  Is used to check the stability of the application under higher-than-expected workload, during peak periods.

  Helps determine the:

  - Breaking point of an application i.e. How long the system is stable under heavy loads and its response time from the failure
  - Application's behaviour when the system is pushed beyond what it was designed for.

- **Soak testing aka Endurance Testing**

  The objective is to ensure that the performance level does not drop with sustained activity over a long period of time.

- **Spike testing**

  Used to determine the performance/behaviour of the system when there is a sudden large increase in the number of users.

- **Volume testing**

  Used to check the system performance when there is a large volume of data in the database. This testing is focused on the database.

- **On Android Memory testing**

  you can use Memory section in Settings. Use app for a bit and then check memory usage for it in settings. If it looks way higher than it should compared to other apps of similar complexity, then there are probably memory leaks. For example, I've had a case where a light-weighted app used almost 1.5GB of RAM, which is obviously due to leaks since most other apps use up to 150MB and Android system uses around 800MB. After fixing leaks it now uses around 50MB.

- **Interrupt Testing** applies to any application type- Web, Mobile, Stand Alone, etc. The variety of devices, networks, configurations, etc. makes it more prominent for Mobile applications than the others like,
  - Device shut off
  - Application Update reminders
  - Network connection loss
  - Network connection restoration
- **Usability tests** for mobile apps are designed to observe test-subject users while they use your app. The purpose of testing is to measure the app's user-friendliness and learn about how it can better support your brand's key marketing objectives.
- **Mobile testing** certification is critical because mobile phones, tablets, and other mobile devices require special mobile testing knowledge – the kind of knowledge that you can prove you have as an ASTQB Certified Mobile Tester. If you are interested in mobile phone testing, mobile app testing, or tablet testing, and you want any of these:
  - a promotion.
  - a career changes.
  - a job.
- **Testing a location-based app using mock location**

  To make the testing possible, you need a location simulator. XCode is a popular simulator, which is used to test iOS apps. You can also use Location file formats called GPX and KML.

  GPX or GPS Exchange Format is a document available in XML data format used to exchange location information of GPS data between your mobile application and the web service.

- **Battery Power Testing**

  The evolution of smartphones has changed mobile application testing. Today's "smartphone" necessity means that app developers need to create a mobile app strategy that includes battery-life testing.

  However, that isn't the only problem you might face regarding your mobile app and battery consumption: Apps can perform worse when running on low power, and you must always consider users with aging mobile devices that can't even last 24 hours on a single charge.

### 4 Security Testing (Fig 6)

Ensures applications are free from vulnerabilities so that the data is protected and access to it is restricted. Aims to find all the possible loopholes and weaknesses.

Fig 6

**Familiarization with different testing in smartphone**

**1 Memory leakage testing**

The process of testing the increase of unused and occupied memory, which causes applications to crash because of less memory.

**2 Interrupt testing**

While using an app, if an interruption occurs then an app should be able to resume its state. To test that an app is able to resume work in case of an interruption is Interrupt testing.

**3 Usability testing**

The users should be able to perform tasks on the application quickly without any effort. It requires **real devices** to perform and **user** to gain insights into the user experience.

**4 Installation testing**

To test the ease and success of installation an app in various environments.

**5 Location testing**

This type of testing provides the GUI of the app appropriately and customised to make it relevant to the country of use.

**6 Upgrading testing**

This testing involves, testing an upgrade to existing software. It is done to test that an upgrade can be installed on an existing user's device.

**7 Load testing**

The Testing evaluates, if an app's performance can handle the required number of users and still operate and perform at an optimal level.

**8 Uninstallation testing**

To verify if all the components of the app is removed. All the files related to the app have to be removed upon successful uninstallation.

**9 Backup and Restore testing**

The process of assessing the effectiveness of an organization's software and methods of replicating data for security and its ability to reliably retrieve the data when need arise.

**10 Power consumption testing**

The process of testing, measure power usage in real-time, to improve battery life of device.

**11 Certification testing**

It verifies the app meets the requirements of the most popular stores like Google Play, the App Store and Windows Phone.

**Overview of User Interface Testing**

UI Testing, also known as GUI Testing is basically a mechanism meant to test the aspects of any software that a user will come into contact with. This usually means testing the visual elements to verify that they are functioning according to requirements – in terms of functionality and performance.

- **Validation** is the check that you put in your program to see if the data inputted by the user is valid or not. There are various ways you can do it. You can verify that the inputted values are one of the values in the domain for that datatype.

**Screen Validation Check:**

- Is the general screen background the correct color?
- Are the field prompts the correct color?
- Are the field backgrounds the correct color?
- In read-only mode, are the field prompts the correct color?
- In read-only mode, are the field backgrounds the correct color?
- Are all the screen prompts specified in the correct screen font?
- Is the text in all fields specified in the correct screen font?
- Are all the field prompts aligned perfectly on the screen?
- Are all the field edit boxes aligned perfectly on the screen?
- Are all group boxes aligned correctly on the screen?
- Should the screen be resizable?
- Should the screen be able to be minimized?
- Are all the field prompts spelt correctly?
- Are all character or alphanumeric fields left justified? This is the default unless otherwise specified.
- Are all numeric fields right justified? This is the default unless otherwise specified.
- Is all the micro-help text spelt correctly on this screen?
- Is all the error message text spelt correctly on this screen?
- Is all user input captured in UPPER case or lower case consistently?

**Screen Validation Check Points related to Navigation Conditions**

- Can the screen be accessed correctly from the menu?
- Can the screen be accessed correctly from the toolbar?
- Can the screen be accessed correctly by double clicking on a list control on the previous screen?
- Can all screens accessible via buttons on this screen be accessed correctly?
- Can all screens accessible by double clicking on a list control be accessed correctly?
- Is the screen modal. I.e., Is the user prevented from accessing other functions when this screen is active and is this correct?
- Can a number of instances of this screen be opened at the same time and is this correct?

## SD card and features

**Objectives:** At the end of this lesson you shall be able to
- **explain what SD cards are**
- **describe the types of features in SD cards used in mobile phone.**

### SD cards and their features

When you go to purchase an SD memory card for your device, you face with a confusing collection of acronyms and jargon. Here's a breakdown of what the symbols and terminology mean so you can order the right one for your device and situation. There are many different memory cards you can purchase, though. The type will depend on what card device supports.

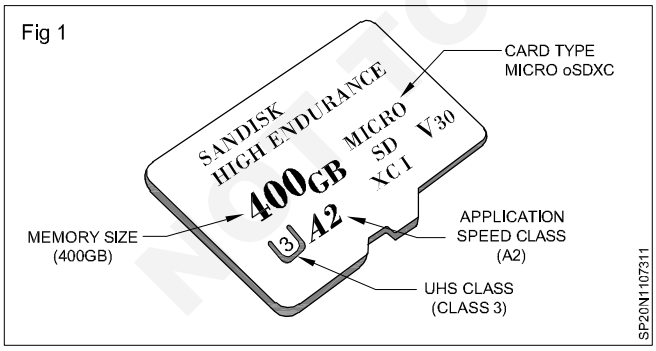
Standard SD cards all come with a small locking toggle that enables/disables the ability to write or delete data on the card; however, mini and microSD cards don't have this feature. There are further 5 categories within the size classes, that indicate the connection system and data capacity of the card:

- SD or SDSC (Secure Digital Standard Capacity): maximum storage of 2 GB
- SDHC (Secure Digital High Capacity): More than 2 to 32 GB of storage
- SDXC (Secure Digital Extended Capacity): More than 32 GB to 2 TB of storage
- SDUC (Secure Digital Ultra Capacity): More than 2 to 128 TB of storage

### Micro Secure Digital (Fig 1)

A Micro Secure Digital (MicroSD) card is a micro version of the SD card, as the name indicates.

Fig 1




Their physical size is 15 mm x 11 mm and 1 mm thick.

Here are a few tips to help you make sure you're choosing the best one for your device and your needs.

### Capacity

You'll most often come across two types of microSD cards — SDHC and SDXC. The difference between the two is the range in capacities they provide.

SDHC cards have a capacity of 2GB to 32GB. Alternatively, SDXC cards can range from 32GB to 2TB. To put this in perspective, one photo taken on a 16MP camera is about 7MB worth of data. If you purchase a 32GB card, you could store 4,500 or more photos on it. (This number would differ if you're using a different device with much larger file sizes.)

### Speed

Once you choose a card capacity, it's time to choose its speed. The speed class of your card determines how quickly it can write data. When you're working with video, or bursts of photos, the faster the better.

Newer mobile devices will support three primary speed classes: Class 10, UHS-1 Class 1, and UHS-1 Class 3. UHS stands for Ultra High Speed, and currently has two bus types (the connection between card and phone hardware), labelled I and II, which help determine the card's maximum speed. UHS-2 cards — which feature an extra row of pins — are being produced, but a limited number of mobile devices support them.

MicroSDHC and microSDXC cards can be any of these three classes, since capacity and speed are not directly related. Since maximum speed is only provided by some manufacturers on packaging, here are the minimum speeds and intended purposes of each class:

**Class 10:** 10MB/s; burst photos and up to 1080p video files.

**UHS-1 Class 1:** 10MB/s; live video and 1080p video files.

**UHS-1 Class 3:** 30MB/s; live video and up to 4K video files.

## Overview of security features related to mobile app testing

**Objectives:** At the end of this lesson you shall be able to
- **state the importance of security testing in mobile app**
- **types of mobile app testing tools.**

**Mobile App Security Testing (Fig 1)**

Ensures applications are free from vulnerabilities so that the data is protected and access to it is restricted. Aims to find all the possible loopholes and weaknesses.

Fig 1


The different types of security testing include:

- **Vulnerability scanning**

  Detects and classifies system weaknesses in computers, networks and other hardware/software.

  An automated software scans all the potential points that can be exploited on systems in a network to identify vulnerabilities that may need attention.

- **Penetration testing**

  It involves attempting to Exploit vulnerabilities.to determine whether unauthorised access to the system or data is possible. Can be done both manually and automated.

- **Security Scanning**

  It involves finding weaknesses in the security of a system and providing solution to reduce these risks. Can be done both manually and automated.

- **Security Auditing**

  Evaluating an applications risk level against a set of standards which are specific to each industry or technology. This ensures the baseline requirements are met.

- **Installation Testing**

  Installation testing checks whether the mobile app installs, un-installs, updates properly without any interruption. And works as expected after installation.

- **Localisation Testing**

  Used to check whether appropriate language and cultural aspects of a particular region are taken into account while adapting the product to the region.

  Some of the important areas that have to be customized include:

  - Usage of proper time zone Date and time formats (including numeric formats)
  - Local Currency
  - Text and User Interface
  - Diverse local regulations requirements.

The main goal of localisation testing is making it look and feel like it was created specifically to meet their needs. Once all the changes are made, all the functions of the app are tested to make sure it is functioning as designed.

**Which Mobile Testing Tools are the Best for Creating Tests?**

The top three mobile testing tools for test creation.

1 Appium

2 Espresso

3 Calabash

**1 Appium**

**Benefits**

- It supports Android, iOS and Windows.
- Supports cross-platform testing and code reuse.
- Supports writing tests with multiple programming languages (Java, Python, Ruby, JavaScript, PHP).
- Appium Desktop has a recording feature which allows recording gestures as code.
- Easily integrates with Jenkins and other CI/CD tools.

**2 Espresso**

**Benefits**

- Supports all Android instrumentation.
- Supports manual creation of tests using Kotlin and Java.
- Has a simple and flexible API.
- Espresso UI tests can be executed on emulators as well as real devices.

- With Espresso Test Recorder, you can record your tests instead of writing code.

**3 Calabash**

**Benefits**

- It is available for both iOS and Android.
- Its tests are written with Cucumber, its code is extremely easy to read.
- Extremely useful for running various ios automation tests.
- It is necessary to reinstall the app on the device for every test.
- **The goal of a mobile app security testing are:**
- To confirm a management control framework exists.
- To check if there are right configurations set.
- To check if the application has been tested in each stage and with different test cases.
- To check all communication between a user and the application and server is encrypted.
- To check proper authentication process is implemented.
- To check the secure data storing process is implemented.

**Mobile UI Testing**

Mobile App UI Testing Guide teaches you how to perform iOS and Android UI Testing.

Just by running functional tests on a mobile application, you cannot sign off the app. There are few other testing types like field testing, network testing, UI testing, battery life testing, etc., that need to be done.

Fig 2


UI testing is one of the important tests in mobile application testing and it should not be taken lightly.

**Following are some of the characteristics that should be tested for every app:**

- **Screen Resolution**

  Following are some of the common screen resolutions that are considered while creating testbeds:

  - 640 × 480
  - 800 × 600
  - 1024 × 768
  - 1280 × 800
  - 1366 × 768
  - 1400 × 900
  - 1680 × 1050

  All of these resolutions are a must for testing when you have a multi-column layout in your app. Hence verification needs to be done starting from the smallest to the biggest resolution.

- **Screen Size**

  There are too many variations in screen sizes and available resolutions. In smart devices especially, controls sizes are not static, they have relation to the available screen size.

  While testing, make sure that controls size looks aesthetically good and control is completely visible on the screen without any scrolling. Test the GUI on different devices with different screen sizes and resolutions.

- **Different UI Elements**

  The UI elements like buttons, headings, icons, images, selection fields, text fields, checkboxes, etc., are some of the different elements that need to be verified for their appearance and size on the screen.

  Specifically for text fields, if the soft keyboard shows up on tap in the text field should be tested and verified.

- **Style: Colour and Theme Scheme of the Device**

  The app UI and colour scheme should be consistent with different colours and theme schemes of the phone. The colour and theme of a Samsung phone are very different from that of Nokia or the MI phone.

  Hence you need to verify if the app is looking consistent across such phones.

  Your application has a specific design. And the style of the controls should match with that design. You might have seen many applications where some controls e.g., panels have round edges and other controls e.g., text boxes have sharp edges.

- **Multi-touch or Single touch**

  If your app is supporting the multi-touch feature like pinch to zoom or pinch to shrink etc., then you need to thoroughly test this feature and create a lot of test cases for this for all the applicable screens.

- **Long or Short Press**

  A long press on an icon shows the context menu while a short touch performs the very first action of the menu. If this feature is provided in your app, then you need to verify this functionality and all the functionalities around it.

- **Location**

  Location and position are the two words that are used alternatively and, interestingly, they are further used to convey two different concepts that are explained below:

  a Sometimes it is the area on the screen where a control appears.

  For example: Header is located on top of the page, Labels are Left Aligned, and Textboxes are Right Aligned, etc. Here, 'top', 'left Aligned', and 'Right Aligned' are relative positions of the controls.

  b Sometimes it is the order of control among the other controls.

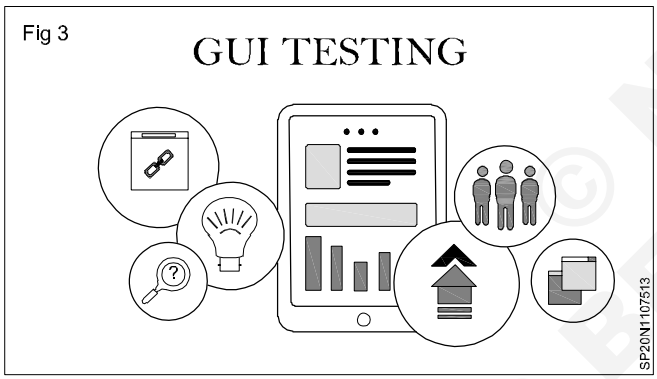
  For example: while getting personal info, First Name is followed by the last name. Or, the format of controls to ask for a US address should be in order– ZIP, City, State.

**User Interface (UI) TestCases**

There are two types of interfaces for a computer application. Command Line Interface is where you type text and computer responds to that command. GUI stands for Graphical User Interface where you interact with the computer using images rather than text.

**GUI Testing (Fig 3)**

Fig 3




GUI Testing is a software testing type that checks the Graphical User Interface of the Software. The purpose of Graphical User Interface (GUI) Testing is to ensure the functionalities of software application work as per specifications by checking screens and controls like menus, buttons, icons, etc.

A user does not see the source code. The interface is visible to the user. Especially the focus is on the design structure, images that they are working properly or not.

**What do you Check-in GUI Testing?**

The following checklist will ensure detailed GUI Testing in Software Testing.

- Check all the GUI elements for size, position, width, length, and acceptance of characters or numbers. For instance, you must be able to provide inputs to the input fields.
- Check you can execute the intended functionality of the application using the GUI
- Check Error Messages are displayed correctly
- Check for Clear demarcation of different sections on screen
- Check Font used in an application is readable
- Check the alignment of the text is proper
- Check the Colour of the font and warning messages is aesthetically pleasing
- Check that the images have good clarity
- Check that the images are properly aligned
- Check the positioning of GUI elements for different screen resolution.

**UI Testing Examples.**

Here are some examples of possible test cases:

- **Required fields**

  Verify whether the "description" and the "assigned to" fields have validation against leaving them blank. Also, it's a best practice to identify required fields with an asterisk.

- **Data**

  Verify that only allowable data types are accepted. If it requires a phone number, does it prevent letters? Verify that users can't exceed the acceptable number of characters for a given field. Verify that "assigned to" only includes appropriate personnel.

- **Spelling**

  Check for spelling mistakes in the interface (in this case, there's a typo in "issue.")

- **Interaction**

  Verify all buttons are clickable, and the dropdown list works as expected. Verify that data entered on the first panel is properly reflected on the results panel (description, severity, and assignee).

**Following are list of popular GUI Testing Tools:**

1 Selenium

2 QTP

3 Cucumber

4 SilkTest

5 TestComplete

6 Squish GUI Tester