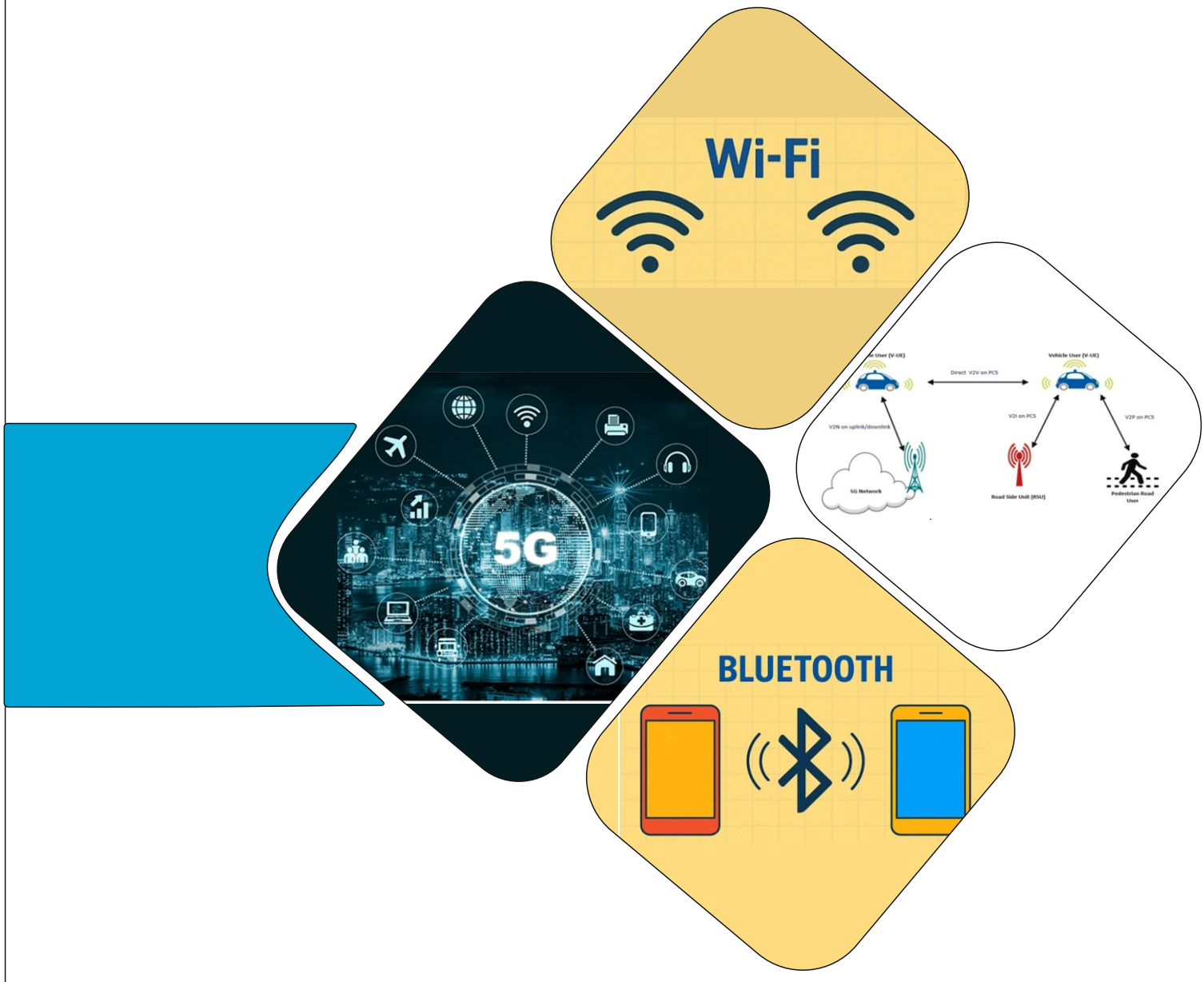
SCHEME :K

Name :_____
Roll No.:_____ Year : 20 ___ 20 __
Exam Seat No. :_____

LABORATORY MANUAL FOR

MOBILE & WIRELESS COMMUNICATION (315339)



ELECTRONICS ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous)(ISO21001:2018)(ISO/IEC27001:2013)

VISION:

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION:

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the following:

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education

A Laboratory Manual for

Mobile & Wireless Communication

(315339)

Semester-V

(DE/ EJ/ ET/ EX/ IE)

Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO 21001:2018) (ISO/IEC 27001:2013)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous) (ISO 21001:2018) (ISO/IEC 27001:2013)

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MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr./Ms ...…… Roll No.…….……., of……. Semester of Diploma in ……..... of **Institute Name**……...……...…… (**Inst. Code:** ……...) has completed the term work satisfactorily in Course**…… (Course Code: ...……)** for the academic year 20…...-20…...as prescribed in the curriculum.

Place…… Enrolment No.……

Date…… Exam Seat No…….

Course Teacher **Head of the Department** **Principal**

Seal of Institute

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programs with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'K' scheme laboratory manual development team designed the practical to focus on the outcomes, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that atleast a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical.

Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

This course MOBILE & WIRELESS COMMUNICATION next generation of mobile communications technology, provides a platform for students to understand working of 4G and 5G mobile technology. Students are introduced with various recent applications as V2V, Industrial Automation Application (in detail) & other application such as Media and entertainment, Retail Industry, Education, Industrial Automation, Smart Cities, Internet of Things (IoT)Application.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

Program outcomes (POs) to be achieved through practical

1. Basic and Discipline Knowledge:

Students will apply basic principles of electronics and communication engineering to identify and test various mobile phone hardware components such as RF section, microphone, speaker, and power circuits.

2. Problem Analysis:

Students will identify and analyze faults in mobile phone units using diagnostic methods, apps, mustimeters, and signal strength measurement tools.

3. Design Development and Solution:

Students will develop solutions to mobile connectivity problems by configuring hotspot networks, installing eSIM, and optimizing signal conditions.

4. Engineering Tools:

Students will use appropriate tools such as mustimeters, eSIM activation software, NetMonster, Cell Mapper, and speed testing apps to carry out experiments effectively.

5. Engineering Practices for Society, Sustainability and Environment:

Students will demonstrate responsible use of communication devices, follow safe handling practices, and understand the impact of mobile and wireless systems on society and environment.

6. Project Management:

Students will plan and complete mobile testing tasks such as hotspot configuration or eSIM installation in a structured manner, working efficiently as individuals or in teams.

7. Life-long Learning:

Students will engage in continuous learning by exploring advanced communication technologies like 5G, embedded SIMs, and wireless testing applications.

List of Relevant Skills

The following industry relevant skills of the competency " Maintain mobile and wireless communication system" are expected to be developed in the student by undertaking the practical of this laboratory manual.

1. Identify and test hardware sections of mobile phones using tools and apps.
2. Install and activate eSIM profiles using QR codes and carrier apps.
3. Measure mobile signal strength (RSSI, RSRP, SINR) using smartphone apps.
4. Set up and manage mobile hotspots and Wi-Fi connections.
5. Analyze internet speed and wireless performance.
6. Disassemble and handle smartphones using proper tools and precautions.
7. Interpret mobile block diagrams and internal circuits.
8. Work in teams, follow lab safety, and maintain ethical practices.
9. Understand 2G to 5G technologies and apply in practical scenarios.
10. Understand recent 5 G applications.

Practical Course Outcome Matrix

Sr.No.	Title of practical	CO1	CO2	CO3	CO4	CO5
1	*Identification of different sections of mobile phone	✓				
2	*Measurement of different sections of mobile phone unit	✓				
3	*Testing of different sections of mobile phone unit	✓				
4	*Finding out Relevant information of the mobile using relevant software's		✓			
5	Installation of eSim on mobile Handset			✓		
6	Identification of different parts of smartphones using 4G or 5G experimental setup				✓	
7	*Location of nearby tower and find internet connection strength				✓	
8	Check performance of user interface section of smartphone(4G/5G)				✓	
9	Make Hotspot connection on Wi-Fi on any two devices.					✓
10	*Establish Personal Area Network of at least two devices					✓

Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with
2. Teacher shall explain prior concepts to the students before starting of each experiment. all features.
3. Involve students in performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in. the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.
9. Teacher is expected to refer complete curriculum document and follow guidelines for implementation
10. At the beginning of the practical which is based on the simulation, teacher should make the students acquainted with any simulation software environment.

Instructions for Students

1.Listen carefully the lecture given by teacher about subject, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record all programs.
3. Students shall develop maintenance skill as expected by industries,
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual.
6. Student shall refer technical magazines.
7. Student should develop habit to submit the practical on date and time.
8. Student should well prepare while submitting write-up of exercise.
9.Attach/paste separate papers wherever necessary.

CONTENT PAGE

Practical No. 1: Identification of different sections of mobile phone

I Practical significance

Mobile phones are essential tools in today's communication. Understanding internal sections helps with troubleshooting, repair, and further innovation. This practical aims to develop skills to **identify various functional blocks** of a mobile handset.

II Industry / Employer Expected outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

"Maintain mobile and wireless communication system"

III Course Level Learning outcome(s)

Describe the concept of cellular mobile communication systems.

IV Laboratory Learning outcome(s)

Identify different sections and components of mobile phones such as ringer section, dialer section, receiver section and transmitter section, camera, microphone, speaker, Dash light.

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background:

Mobile phone is a phone that can make and receive telephone calls or radio link while moving around a wide Geographic area. It does so by connecting to a cellular network provided by a mobile phone operator allowing access to the public Telephone Network.

Fig 1.1 Different parts of smart phone

RF section:

RF image is filtered and down converted to analogue base band signal in RF section. The analog baseband signals are filtered and then up converted an amplified to RF full stop consist of two main circuit transmitter and receiver.

Analog baseband /voice band codec:

Analog baseband signals from receiver section are filtered sample and digitised before being fed to DSP section. the coded speech Digital information from DSP section is sample and converted to analogue based on signals which is the infield to the transmitter section. the voice speech from the microphone is digitised and coded to certain bit rate.

DSP/ microprocessor:

The Digital Signal processor (DSP) is designed to perform signal manipulation calculations at high speed. The micro handles all signal in for the keyboard and display, deals with command-and-control signalling with the base station and coordinates the rest of the functions on the board.

Flash memory, RAM, SRAM (SIM card):

The ROM, SRAM and flash memory chips provide Storage for the phones operating system and customisable features, such as phone dictionary. the same card stores the subscriber's identification number and other network information.

Power management/ DC to DC:

From the battery all the voltages required to different phone sections.

VII Actual Circuit diagram used in laboratory with equipment specifications/rating:

A) Sample set up diagram:

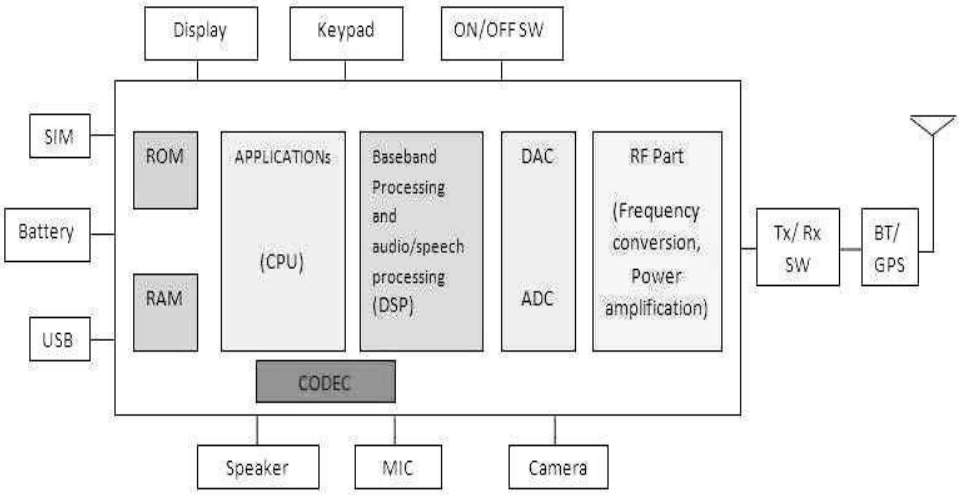

Fig 1. 2 Block diagram of mobile unit

B) Actual set up diagram:

VIII Required Resources/apparatus/equipment with specifications:

S. No.	Instrument / Component	Specification	Quantity
1.	GSM Trainer Kit	2G/3G/4G compatible	1
2.	SIM Card	Any size	1
3.	Digital Storage Oscilloscope (DSO)/CRO	Dual channel, 20 MHz	1
4.	Spectrum Analyzer	Up to 1 GHz	1
5.	Digital Multimeter (DMM)	3½ Digit	1
6.	Connecting Wires	Banana Plug	4

IX Precautions to be followed:

1. Do not short circuit test points.
2. Power off device before changing SIM.
3. Follow lab safety protocols and handle trainers with care.

X Procedure:

1. Observe the block diagram of mobile handset available in the laboratory.
2. Identify various sections on the mobile trainer kit and list its specifications.
3. Insert the SIM card in the slot provided in the mobile trainer kit .

XI Resources used:

Sr. No.	Name of the Resource	Specification	Quantity
1.			
2.			
3.			
4.			
5.			
6.			

XII Actual Procedure:

XIII Observation table:

Sr. No.	Features	Availability in trainer kit
1.	Name of the Blocks	
2.	Hands free facility	

3.	Type of antenna used	
4.	RF Frequency Band	
5.	Number of SIM card Slots available	
6.	Type of SIM card used	
7.	IC's used in Trainer Kit	

XIV Result(s):

1. The function of transmitter / receiver section is: -- -
2. Various types of SIM: -
3. Major sections observed: -

XV Interpretation of results:

XVI Conclusions and recommendation

XVII Practical related questions:

1. State the number of SIM pins and their function.
2. What is the role of Power Management Unit?
3. Explain the function of DSP in a mobile phone.
4. What is the operating voltage of LCD logic?
5. List the voltages at V_{CPU}, V_{IO}, and V_{RF} test points.

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XVIII References:

- YouTube: Mobile Hardware Sections
- Mobile Repair Website
- GSM Trainer Kit Manual / Lab Guide

XIX Assessment scheme

Performance Indicators		Weightage
Process Related : (15 Marks)		**60 %**
1	Proper handling of the equipment	20%
2	Identifying the various blocks	20%
3	Inserting SIM card properly	10%
4	working in teams	10%
Product Related: (10 Marks)		**40%**
5	Result	20%
6	Practical related questions	10%
7	Submitting the journal in time	10%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No.2: *Measurement of different sections of mobile phone unit

I Practical Significance

Today we can connect to the network from anywhere, with anybody, at any time. Mobile phones play a very important role in making this connectivity possible. A knowledge of the various components of the mobile handset helps in troubleshooting and maintenance of the handsets. A mobile phone consists of various sections that include transmitter/receiver section, buzzer and vibrator section, power supply section, display section, SIM card section. This practical will help the students to test different sections of the mobile phone unit.

II Industry/Employer Expected Outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

Maintain mobile and wireless communication system

III Course Level Learning Outcome(s)

Describe concept of cellular mobile communication systems

IV Laboratory Learning Outcome(s)

Measure voltages of various sections of mobile handset (such as supply of the transmitter /receiver section, battery charger section and power management unit of mobile phone unit).

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background

1. Keyboard or Keypad Section

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.

2. Display Section

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.

3. **SIM Card Section**
   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.
4. **Memory Card Section**
   Now mostly Micro SD Card is connected in most mobile cell phones which is connected with micro card section through a 8 pin socket. Memory card section is made inside the CPU.2.8 Volt Power is supplied to Pin Number 4 from Power Supply for functioning of the MMC Card and connection the 50 to 100 Kilo Ohms resistance in this power supply. This power supply is given to Pin Numbers – 1,2,3,7,8 of MMC Socket. One MMC detector switch or pin is made in MMC socket at which, if there is no MMC Card then 1.8 V power is continuously received and after the MMC is connected, it becomes zero.
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.
6. **Ear Speaker Section**
   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. Speaker / Ringer Section

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.

8. Key Backlight Section

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 using LED-Driver or PNR IC.

9. LCD Backlight Section

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.

10. Vibrator Motor Section

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.

11. Network Section

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.

12.Battery Charging Section

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.

VII Actual Circuit diagram used in laboratory with related equipment rating.

A) Sample Set Up Block diagram

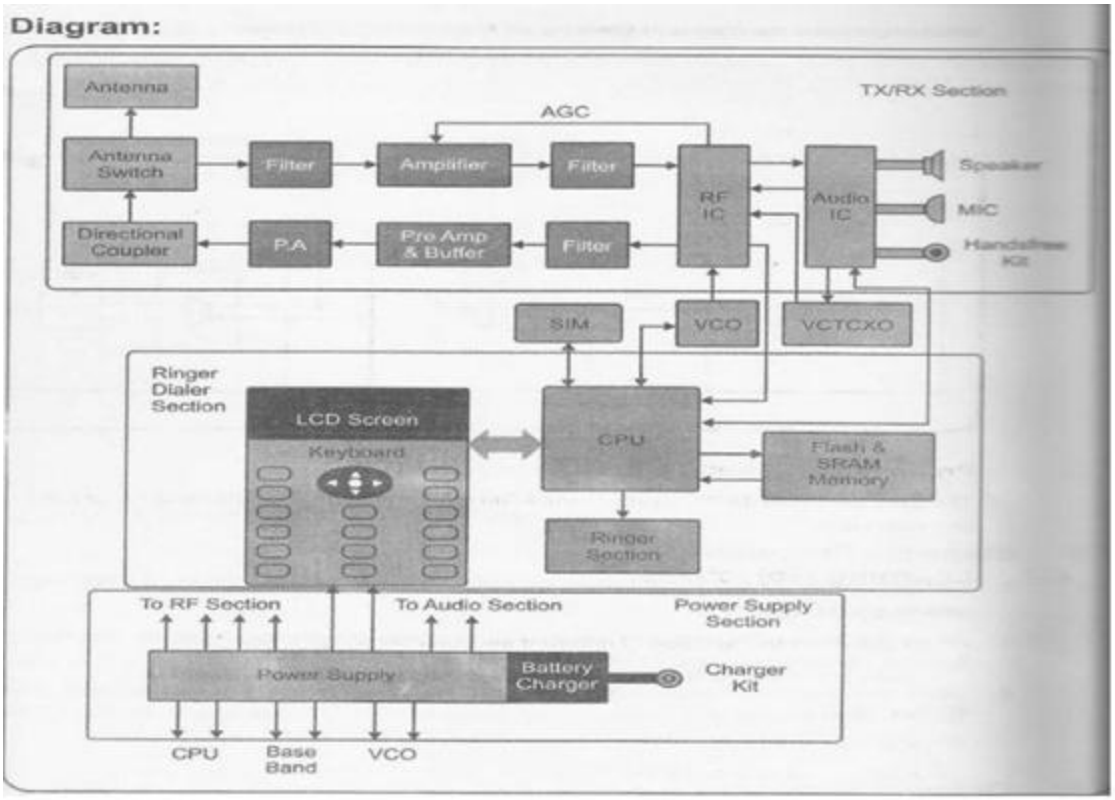

Fig 2.1 Different Sections of Mobile Phone Unit

B) Actual setup diagram used in Laboratory

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Instruments / Components	Specifications	Quantity
1	GSM trainer kit	3G/4G/5G TRAINER KIT	**1**
2	SIM CARD	ANY SIM	**1**
3	DMM	3 1/2 digit	**1**
4	Spectrum Analyzer	1 GHz	**1**
5	CRO	20MHz,dual trace, dual beam	**1**
6	Connecting wires		**1**

IX Precautions to be followed

1) Read the instruction manual of GSM trainer kit before applying power.
2) Install the SIM with care.

X Procedure

a) Testing of Tx/Rx Section:

1. Make a call from trainer to the trainer from other mobile or landline phone and keep it ON.
2. Check the signal on spectrum analyser and record the same.
3. Make a call from trainer to other mobile or landline phone and keep it ON.
4. Check the signals on spectrum analyzer and record the same

b) Testing of Battery and Battery charger section:

1. Measure the Battery voltages at different test points using multimeter and record it.
2. Measure the Battery charger voltage on multimeter and record it.

c) Testing of Power Management Unit:

1. Measure the voltages at different test points of power management unit of mobile phone on multimeter and record it.

XI Resources used

Sr. No.	Name of Resources	Specifications	Quantity

XII Actual Procedure

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XIII Observation Table

Table 1: Tx/Rx Section

Sr.No.	Test Points	Waveform
1	Tx signal at Antenna	
2	Rx signal at Antenna	
3	Tx IQ signals	
4	Rx IQ signals	

Table 2: Battery and Battery Charger Section

Sr.No.	Test points	Standard voltage	Observed voltage
1	Battery Voltage	3.7V approx.	
2	Battery Status Indicator when battery is discharge	0V	
3	Battery Status Indicator when battery is charging	0.5V approx.	
4	Battery Ground	0V	
5	Battery Charger Supply	6V approx.	
6	Charger Voltage	6V approx.	

Table 3: Power Management Unit

Sr.No.	Test point	Standard voltage	Observed voltage
1	VCC	3.7V approx.	
2	V RF	2.8V approx.	
3	VDD IO	1.8V approx.	
4	VDD INT	2.8V approx.	

5	V_CPU	1.8V approx.	
6	VCTCXO	2.8V approx.	

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions to ensure the achievement of identified CO.

1. State the different types of SIM available in a mobile phone. Give pin diagram of SIM
2. State the contents of SIM used in mobile phones.
3. State the frequency spectrum allocated for GSM and the bandwidth of forward and reverse channel.
4. Define IMSI. State the use of IMSI with its significance.

[Space for Answers]

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XVIII References/Suggestions for further reading

1 https://scientechworld.com/wp-content/uploads/2024/10/Scientech-2140-5G.pdf?srsltid=AfmBOooK-w5qQXWIyHLUoJRR8aWOvYmlRMlWU9uQl4Mxf6iiKlt7UVJ

2. https://scientechworld.com/product/global-system-for-mobile-communication-3/?srsltid=AfmBOoraszUsdBDpaU53Be9IvcDePCfX3jadYQ759eAQwdhciXF60Jz1

XVIII Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Proper Handling of the Equipment	10%
2	Identifying the Test points	20%
3	Measuring of test point voltages	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Result	20%
6	Practical related questions	15%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 3: Testing of different sections of mobile phone unit

I Practical significance

This experiment familiarizes students with various hardware sections inside a mobile phone unit and tells techniques to test each part using standard diagnostic tools. It also improves fault-identification skills essential for mobile technicians. This practical will help the students to develop skills to test different sections of mobile phone unit.

II Industry / Employer Expected outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

"Maintain mobile and wireless communication system"

III Course Level Learning outcome(s)

Describe the concept of cellular mobile communication systems.

IV Laboratory Learning outcome(s)

Test user Interface section (Keyboard Buzzer, Vibrator, LED, Mic and Speaker) of Mobile phone unit.

V Relevant Affective Domain related outcome(s)

- Handle equipment carefully.
- Demonstrate working as a leader / a team member.
- Follow ethical practices
- Follow safety practices.

VI Relevant Theoretical Background

The keyboard or touchscreen is used for input and is based on mechanical switches or capacitive sensing. The buzzer is a small piezoelectric or magnetic component that generates alert sounds. The vibrator motor provides tactile feedback via rotation or oscillation. LEDs (Light Emitting Diodes) are used for notification lights or the camera flash. The microphone converts sound waves into electrical signals, while the speaker converts electrical signals into audio output. Each of these components is connected through circuit traces to the baseband processor or respective control ICs and is powered and managed via the Power Management IC (PMIC).

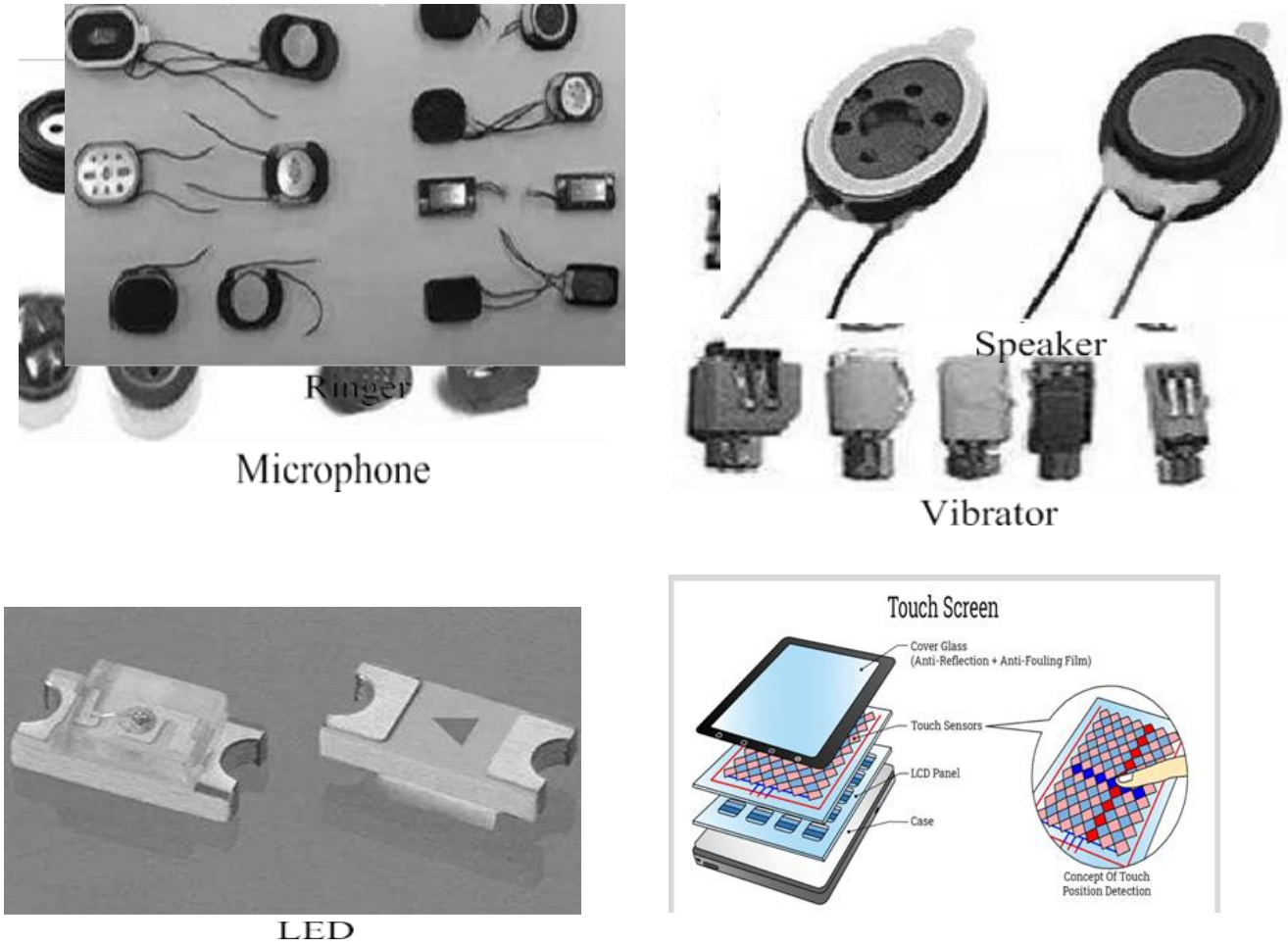

Fig 3.1 Ringer, Speaker, Microphone, Vibrator, LED and Touch screen

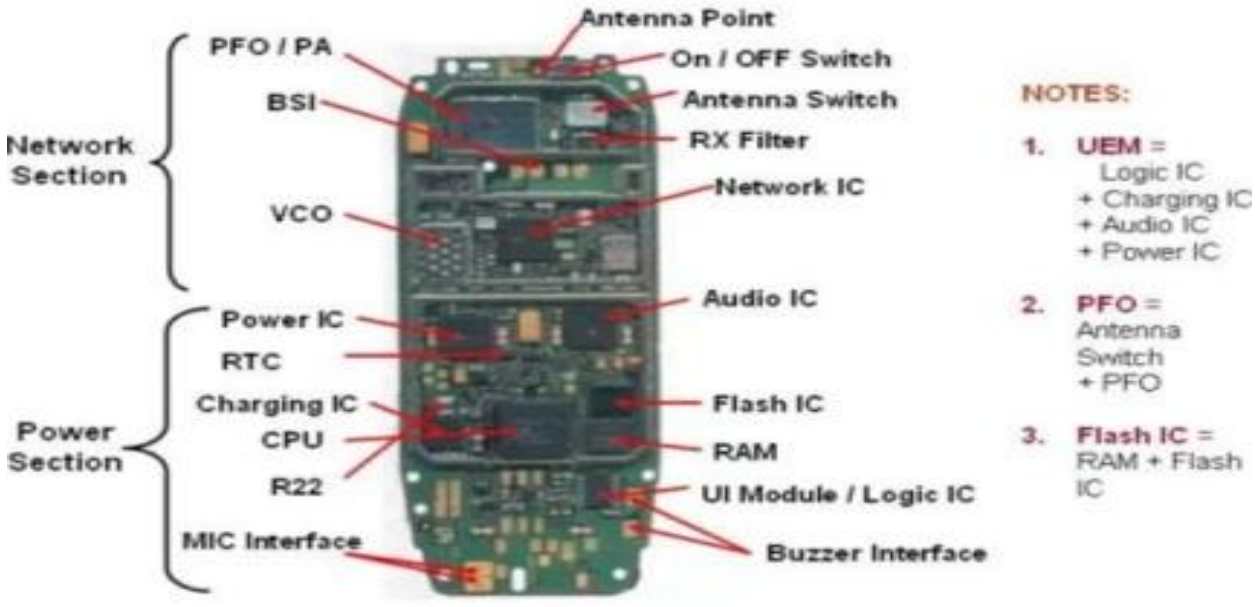

Fig 3.2 Different parts of smart phone

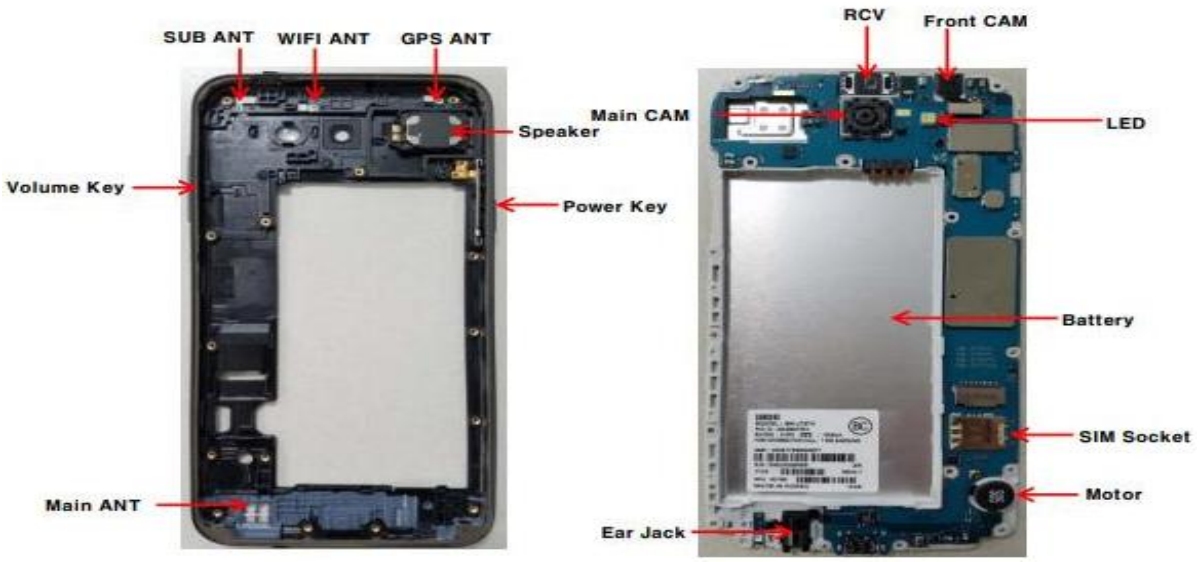

Fig 3.3 Internal components /parts of (Android based) smartphone

A mobile phone is composed of multiple interconnected hardware sections:

1. **Power Section** – Includes the battery, charging IC, power management IC (PMIC), and voltage regulators.
2. **Audio Section** – Comprises the microphone, speaker, and audio IC. Responsible for input/output audio signals.
3. **Network Section** – Handles communication through GSM, LTE, and Wi-Fi modules. Includes RF section, antenna, and baseband processor.
4. **Display Section** – Contains LCD/LED screen, touch panel, and related driver ICs.
5. **Motherboard** – Hosts the CPU, RAM, ROM, sensors, and interconnecting tracks for all hardware modules.
6. **Input Section** – Includes touch sensors or keypads for user interaction.

Each section can be individually tested using basic tools such as a multimeter or through visual inspection.

VII Actual Circuit diagram used in laboratory with equipment specifications/rating:

A) Sample Set up diagram:

Fig 3.4 Different parts of smartphone

B) Actual set up diagram:

VIII Required Resources/apparatus/equipment with specifications:

Sr. No.	Instruments / Components	Specification	Quantity
1.	Mobile Phone Unit	Preferably Android; used for testing UI components	1
2.	Digital Multimeter	With diode and continuity testing modes	1
3.	DC Power Supply	Adjustable output range from 3.7V to 4.2V	1
4.	Plastic Opening Tools	Used for safe disassembly of the phone without damaging components	**1**
5.	Tweezers	Precision tool for handling small components	**1**
6.	Suction Cup	Used to lift touch screens or back panels without causing damage	**1**
7	Antistatic Gloves/Wristband	Prevents electrostatic discharge during handling of electronic components	**1**
8	Screwdriver Set	Includes T4/T5/T6 Torx and mini Philips screwdrivers	**1**
9	Mobile Diagnostic Apps	Apps like TestM or Phone Doctor Plus used for functional testing	**-**
10	Service Codes	Inbuilt mobile codes such as *#0#* used for accessing diagnostic menus	**-**

IX Precautions to be followed:

1. Do not short circuit test points.
2. Power off device before changing SIM.
3. Follow lab safety protocols and handle trainers with care.

X Procedure:

1. Open the back cover and carefully disassemble the phone
2. Locate all user interface elements on the main board.
3. Use multimeter or software diagnostics to test each component.
4. Note responses and functionality.
5. **Keyboard/Touchscreen Test:**

a. Turn on the device.
b. Access dialer, notes or testing mode (##0*#*# or similar).
c. Test each key / region for response.

6. **Buzzer Test:**
   a. Play a ringtone or set an alarm.
   b. Verify sound output from buzzer area.
   c. If silent, check the buzzer coil using continuity mode.
7. **Vibrator Test:**
   a. Enable vibration mode.
   b. Call the device and feel for vibration.
   c. Use a multimeter to test vibrator motor terminals (~1.5–3V DC when active).
8. **LED Test:**
   a. Test status LED or flashlight.
   b. Use a camera/torch app for testing flash.
   c. Measure voltage at LED terminals (~2–3V depending on type).
9. **Mic Test:**
   a. Record audio and play it back.
   b. Use diagnostic code or app to test mic.
   c. Use an oscilloscope if needed for signal strength.
10. **Speaker Test:**
    a. Play music or make a call.
    b. Listen for clear audio.
    c. Test speaker terminals using a mustimeter for resistance (~4–8Ω).

XI Resources used:

Sr. No.	Name of the Resource	Specifications	Quantity
1.			
2.			
3.			
4.			
5.			
6.			

XII Actual Procedure:

XIII Observation table:

Sr. No.	Component	Test Method	Working (Yes/No)	Fault Observed / Notes
1.	Keyboard	Manual Input		
2.	Buzzer	Alarm/Ringtone		
3.	Vibrator	Call on Vibration Mode		
4.	LED	Flashlight/Status LED		
5.	Microphone	Voice Recorder Test		
6.	Speaker	Audio Playback		

XIV Result:

XV Interpretation of results:

XVI Conclusions and recommendation

XVII Practical related questions:

1. How can you test a speaker using a multimeter?
2. What is the typical resistance of a working mobile phone speaker?
3. How do you identify a faulty mic in a smartphone?
4. Which diagnostic codes are used for inbuilt hardware testing?
5. Why is the vibrator motor connected with a flyback diode?

XVIII References:

- YouTube: Mobile Hardware Sections
- Mobile Repair Website
- GSM Trainer Kit Manual / Lab Guide

XIX Assessment scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Proper Handling of the Equipment	10%
2	Identifying the Test points	20%
3	Measuring of test point voltages	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Result	20%
6	Practical related questions	15%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No.4: *Finding out Relevant information of the mobile using relevant software's

I Practical Significance

Understanding the internal specifications and system parameters of a smartphone is essential in today's technology-driven world. By using diagnostic software like AIDA64 /CPU-Z, users can retrieve detailed information about their device's hardware and software components such as the processor, RAM, battery health, sensors, and operating system. This experiment improves awareness about different hardware components and system configurations of smartphones and also helps to understand how performance varies across different devices based on CPU type, memory, and thermal statistics**.** In this practical the students will be able to find out information of mobile using relevant software**.**

II Industry/Employer Expected Outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

Maintain mobile and wireless communication system

III Course Level Learning Outcome(s)

Describe terminologies used in GSM systems, features and its architecture.

IV Laboratory Learning Outcome(s)

Find out relevant information of mobile phone using open-source software applications

a) Detect the hardware details of mobile handset.
b) Find out operating system
c) Locating the tower.

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background

AIDA64 can be used on Android devices to gather detailed information about the phone's hardware and software. It provides insights into CPU, screen, battery, network, and other aspects of the device.
Here's how you can use it:
Install AIDA64: Download and install the AIDA64 app from the Google Play Store.

Access Information: Open the app and explore the different sections to access information like:
CPU: See details like CPU model, clock speed, and core count.
Screen: View screen dimensions, pixel density, and camera information.
Battery: Monitor battery level, temperature, and charging status.
Network: Check Wi-Fi and cellular network information.

Operating System: View Android version, bootloader details, and other system information.
GPU: Get details about the GPU and its performance.
Sensors: View sensor data like accelerometer, gyroscope, and compass.
Memory and Storage: See how much RAM and storage space is available.
Analyze the Information: Use the detailed information to understand your device's capabilities, troubleshoot potential issues, or simply learn more about its hardware and software.

Key features of AIDA64 for Android:

- Comprehensive System Information: Provides detailed information about hardware, software, and installed applications.
- Real-time Monitoring: Allows you to monitor real-time CPU and GPU clock speeds.
- Diagnostic Tools: Can be used to identify and troubleshoot issues with your device.
- User-Friendly Interface: Designed to be easy to use for both Android users and those familiar with the PC version of AIDA64

Features of AIDA64 mobile apps include:

- CPU and GPU detection
- Screen dimensions, pixel density and camera information
- Battery level and state monitoring
- Wi-Fi and cellular network information
- Operating system properties
- SoC and device model identification
- Memory and storage utilization
- Sensor polling

System Requirements

- AIDA64 for Android: Android 4.4 or later
- AIDA64 for iOS: iPhone 5s and iOS12 or later
- AIDA64 for Windows Phone: Windows Phone 8.1 or later
- AIDA64 for Sailfish: Sailfish OS 1.0.2 or later
- AIDA64 for Ubuntu Touch: Ubuntu Touch 15.04 or later

VII Actual Circuit diagram used in laboratory with related equipment rating.

a. Sample diagram (Sample screenshots of App)

Fig 4.1: Screenshot 1

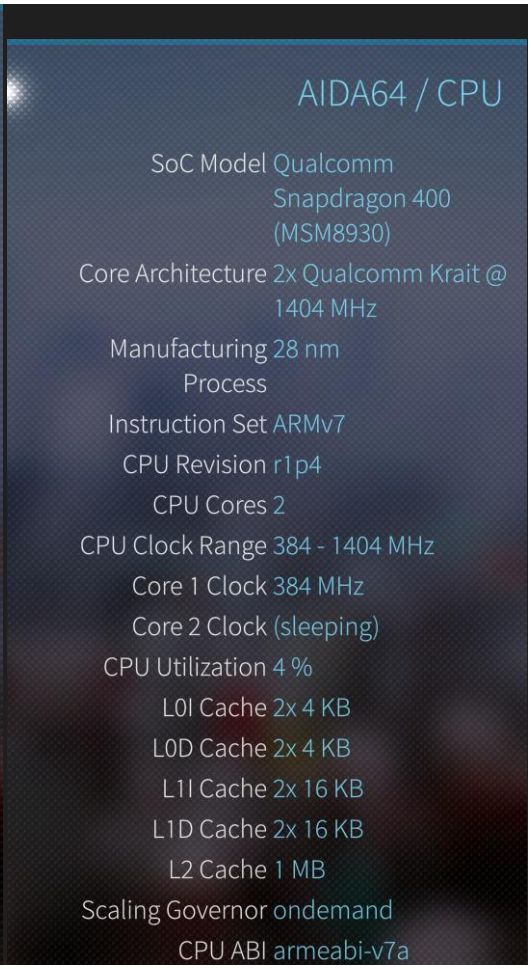

Fig 4. 2: Screenshot 2

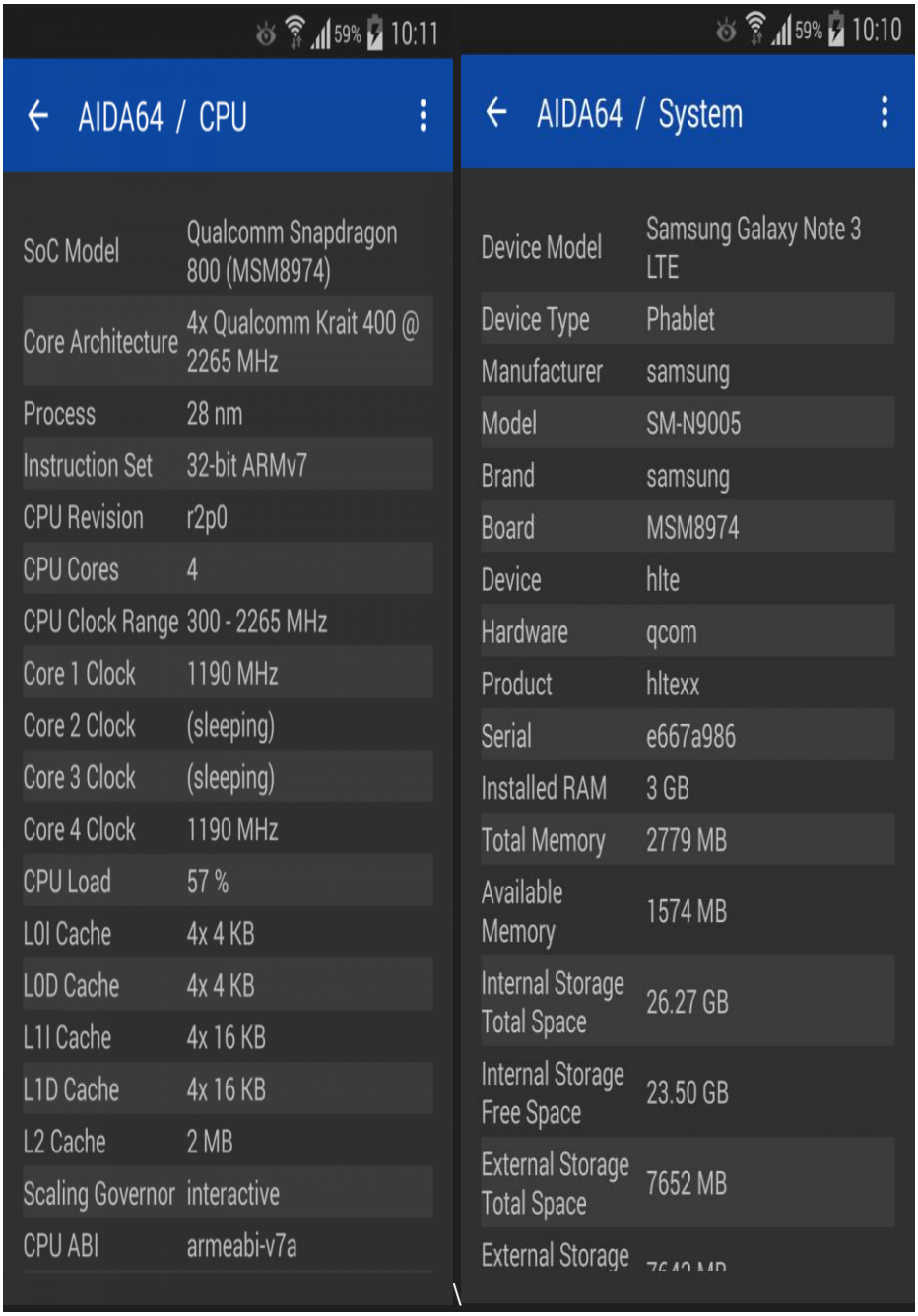

Fig 4.3: Screenshot 3

Fig 4.4: Screenshot 4

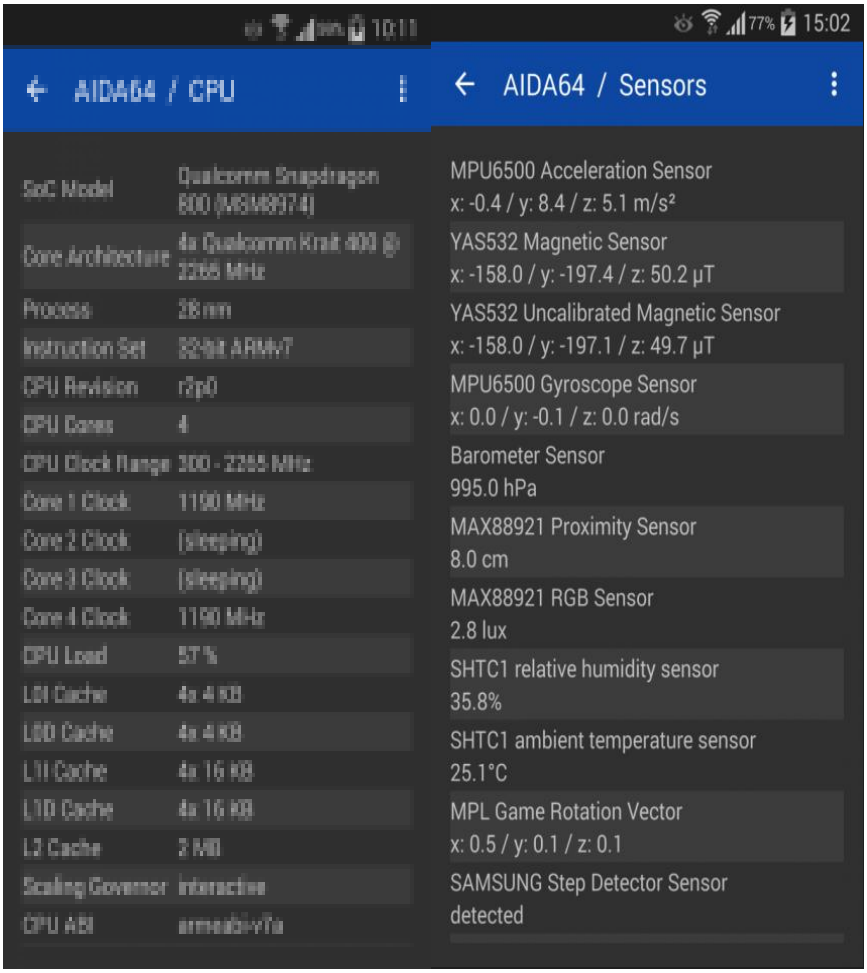

Fig 4.5: Screenshot 5 **Fig 4.6:Screenshot 6**

b. Actual Setup diagram

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/relevant software	Specification	Quantity
1	**Android Mobile Handset with installed AIDA-64 / CPU-Z**	-	1

IX Precautions to be followed

1. Use only trusted and secure apps like AIDA64 / CPU-Z from official app stores to avoid malware.
2. Do not modify any system settings through the app; use it for information only.
3. Avoid running multiple heavy applications during the experiment as it may affect the data (e.g., temperature, RAM usage).
4. Use a stable internet connection to download the app safely.

X Procedure

1. **Install the App:**

- Download and install a system information app like **AIDA64**, **CPU-Z**, **DevCheck**, or **Droid Info** from the Google Play Store or App Store.

2. **Open the Application:**

- Launch the installed app and allow any necessary permissions (e.g., access to device info, sensors, etc.).

3. **Explore Sections:**

- Navigate through various sections such as:
    - **System** – for device model, manufacturer, Android version.
    - **CPU** – for processor type, number of cores, and clock speed.
    - **Memory** – for RAM and internal storage details.
    - **Battery** – for capacity, health, temperature.
    - **Display** – for screen size and resolution.
    - **Sensors** – to list active sensors on the device.
    - **Network** – to view connectivity options.

4. **Record Observations:**

- Note down the information from each section into the **Observation Table** prepared.

5.**Analyze the Data:** Compare and interpret the specifications to understand the performance and capabilities of the device.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1		- -	1

XII Actual Procedure

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XIII Observation Table

Table 1: Information of Mobile

Sr. No.	Parameter Category	Parameter Name	Observed Value	Unit/Details
1	System Information	Device Model		
		Manufacturer		
		Android Version		
		API Level		
2	CPU	Processor Model		
		Cores		
		CPU Clock Speed		GHz
3	Memory	RAM		GB
		Internal Storage		GB
4	Battery	Capacity		mAh
		Battery Health Status		
5	Display	Screen Size		Inches
		Screen Resolution		Pixels
6	Sensors	Available Sensors		
7	Network	Connectivity		
8	Thermal	CPU Temperature		Degree Celsius

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. How does AIDA64 collect hardware and system information from a smartphone?
2. What is the battery capacity and current temperature of your phone?
3. What is the role of sensors in a smartphone? Name at least 10 sensors in your phone with its function.

[Space for Answers]

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XVIII References/Suggestions for further reading

1. https://www.aida64.com/user-manual/start-using-aida64
2. https://www.aida64.com/user-manual/start-using-aida64

XVIII Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Use of Relevant software in mobile phone	10%
2	Follow ethical practices	20%
3	Identifying the type information with its units and details	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Result	20%
6	Practical related questions	15%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 5: Installation of eSim on mobile handset

I Practical significance

The installation and activation of an **eSIM (embedded SIM)** represent a modern shift from traditional physical SIM cards to digital SIM profiles. This practica

l is highly significant for students and technicians because it develops essential skills required in next-generation mobile communication systems and mobile servicing. In this practical, students will be able to develop skills to install eSim on mobile handset.

II Industry / Employer Expected outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

"Maintain mobile and wireless communication system"

III Course Level Learning outcome(s)

Compare generations of mobile communication systems.

IV Laboratory Learning outcome(s)

Install and authenticate eSIM (virtual SIM) on mobile handset.

V Relevant Affective Domain related outcome(s)

- Display precision while following eSim activation procedures.
- Maintain patience and attention during error handling.
- Demonstrate working as a leader / a team member.
- Follow ethical practices and safety practices

VI Relevant Theoretical Background

An eSIM (Embedded Subscriber Identity Module) is a reprogrammable chip embedded in a mobile device. It allows users to activate cellular plans without needing to insert a physical SIM card. eSIM uses Remote SIM Provisioning (RSP) standards defined by GSMA. The installation is done via QR codes, carrier apps, or manual entry of SM-DP+ and activation codes.

eUICC (embedded Universal Integrated Circuit Card)

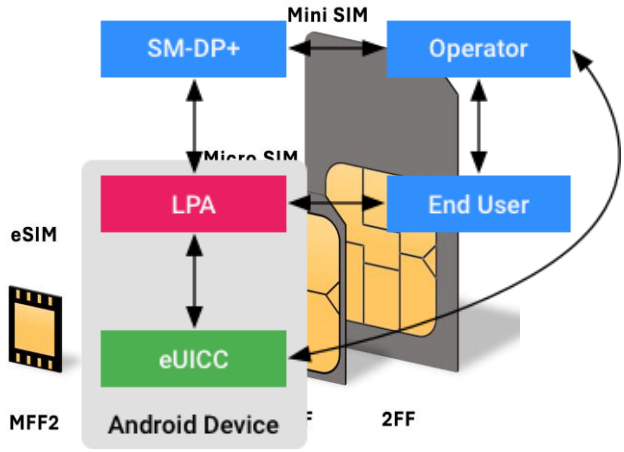

Fig 5.1Different types of SIM cards in smartphone

Fig 5.2 Implementation of eSIM in (Android-based) smartphone.

VII Actual Circuit diagram used in laboratory with equipment specifications/rating:

B) Sample Set up diagram:

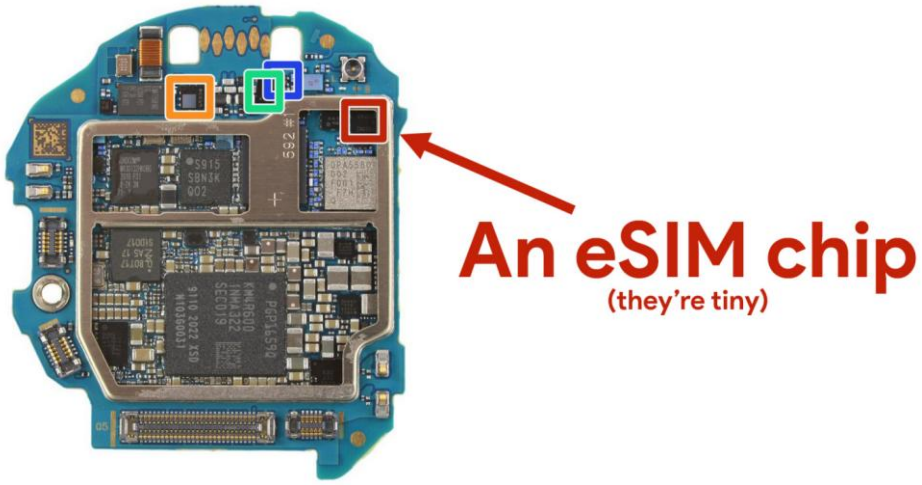

Fig 5.3 eSIM smartphone.

B) Actual Set up diagram:

VIII Required Resources/apparatus/equipment with specifications:

Sr. No.	Instrument / Relevant app	Specification	Quantity
1.	Smartphone	eSIM-compatible mobile phone (Android/iOS)	1
2.	Internet Connection	Stable Wi-Fi or Mobile Data Connection	1
3.	Carrier eSIM QR Code	Provided by the service provider (via email/SMS/web)	1
4.	Mobile Carrier Account	Active plan with eSIM support	1
5.	Carrier App (Optional)	App for downloading/managing eSIM profiles (e.g., Jio, Airtel….)	1

IX Precautions to be followed:

1. Ensure the device is connected to the internet throughout the activation.
2. Scan the correct and valid QR code linked to the user account.
3. Do not interrupt the device during installation.
4. Do not remove previously active SIMs unless necessary.
5. Confirm that the handset is unlocked and supports the selected carrier.

X Procedure:

1. Unlock the mobile handset and ensure it has battery and data access.
2. Navigate to **Settings > Network & Internet > Mobile Network > Add Carrier**.
3. Tap **Add eSIM** or **Use QR Code**.
4. Point the camera to the eSIM QR code provided by the carrier.
5. Wait for the plan to be recognized, then tap **Download**.
6. Accept terms and conditions and confirm the profile installation.
7. Choose SIM preference for calls, SMS, and data usage.
8. Restart the device if prompted.
9. Confirm signal registration and connectivity by making a call or browsing.
10. Verify registration on the carrier network (e.g. Jio, Airtel, vi., etc.)

XI Resources used:

Sr. No.	Name of the Resource	Specification	Quantity
1.			
2.			
3.			
4.			
5.			
6.			

XII Actual Procedure:

XIII Observation table:

Sr. No.	Step	Possible Observations	Observed Status
1.	QR Code Scan	Successful / Failed	
2.	Profile Download	Completed / Interrupted	
3.	Network Registration	Connected / Searching / Not Registered	
4.	Data Services	Enabled / Not Working	
5.	Dual SIM Behaviour	Working in parallel / Conflict	

XIV Result(s):

XV Interpretation of results:

XVI Conclusions and recommendation

XVII Practical related questions:

1. What is the function of SM-DP+ in eSIM provisioning?
2. Can you activate an eSIM without scanning a QR code?
3. What are the advantages of eSIM over physical SIM?
4. What factors affect successful eSIM authentication?
5. How do you reset or remove an eSIM profile from the device?

XVIII References:

1. **Jio (India):**https://www.jio.com/selfcare/esim Step-by-step guide for Android and iPhone.
2. **Airtel (India):**https://www.airtel.in/esim/ eSIM setup for Android, iOS – QR scan instructions.
3. **Vi (Vodafone Idea):** https://www.myvi.in/help-support/esim
4. **T-Mobile (US):** https://www.t-mobile.com/support/esim
5. **AT&T (US):** https://www.att.com/support/article/wireless/KM1262646

XIX Assessment scheme:

Performance Indicators		Weightage
Process Related : (15 Marks)		**60 %**
1	Installation of esim	20%
2	Authentication procedure	20%
3	Inserting SIM card properly	10%
4	working in team	10%
Product Related: (10 Marks)		**40%**
5	Result	20%
6	Practical related questions	10%
7	Submitting the journal in time	10%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No.6: Identification of different parts of smartphones using 4G or 5G experimental setup

I Practical Significance

To identify and analyze different hardware components of smartphones and observe their interaction and performance using a 4G or 5G communication network in an experimental setup. This practical helps student to identify different parts of smartphone.

II Industry/Employer Expected Outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

Maintain mobile and wireless communication system

III Course Level Learning Outcome(s)

Interpret 5G system architecture**.**

IV Laboratory Learning Outcome(s)

Identify Dual sim interface section, Touch screen display section, battery charging circuit, power management unit of 4G or 5G smartphone and test working.

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background

Smartphones are composed of multiple interconnected hardware parts such as:

- Modem/Chipset (handles 4G/5G connectivity)
- Antenna modules
- Motherboard
- Battery
- Screen (touchscreen and display)
- RF circuits (manage signal transmission and reception)
- Sensors (proximity, gyroscope, etc.)

4G and 5G communication technologies operate on different frequencies and involve distinct

signal processing mechanisms. This allows for analyzing how each hardware component behaves under different network conditions.

VII Actual Circuit diagram used in laboratory with related equipment rating.

a. Sample set up

Fig 6.1 5G Mobile Trainer kit

Fig 6.2 Smartphone

b. Actual setup diagram

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Specification	Quantity
1	Smartphones	(preferably both 4G and 5G enabled)	1
2	SIM cards	with active 4G/5G plans	1
3	Network testing tools	(e.g., NetMonster, Network Cell Info Lite)	1
4	Disassembling toolkit for smartphones	(for physical identification)	1
5	Laptop with data logging software	(e.g., Wireshark, QXDM for Qualcomm-based phones)	1

IX Precautions to be followed

1. Use dissembling kit to open back cover.
2. Use sim card with 4G/5G active network.

X Procedure

A. Identification of Physical Parts

1. Power off the smartphone.
2. Use a disassembling toolkit to open the back cover carefully.
3. Identify and label:
   - Motherboard
   - Battery
   - Antennas
   - Chipset (SoC – System on Chip)
   - Camera module
   - RF components
   - SIM and SD card slot
4. Record observations or take pictures of each component

B. Experimental Setup Using 4G/5G

1.Insert a SIM card with active 4G/5G services.
2.Power on the smartphone and enable mobile data.
3.Install network monitoring apps or connect the phone to a laptop with Wireshark/QXDM.
4.Run data-intensive applications (e.g., video streaming, downloads).
Monitor:

a. Signal strength

b. Data rates (upload/download)

c. Band switching (e.g., LTE to 5G NR)

d. Frequency bands used (using NetMonster)

5.Observe how the phone switches bands and what components are involved in the communication (e.g., modem activity).
6.Use thermal camera (if available) to detect which parts heat up during high data usage.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1		- -	1

XII Actual Procedure

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XIII Observation Table

Table 1: Testing of User Interface section

Sr. No.	Section Identified	Tool/Method Used	Physical Location in Device	Working Status	Remarks
1	Dual SIM Interface	Visual inspection, SIM card insertion test	Near SIM tray or internal SIM slot	Working / Not Working	SIM detection, signal status
2	Touchscreen Display Section	Touch test, multi-touch tester app	Front panel (digitizer + display)	Working / Not Working	Responsive / Lag observed
3	Battery Charging Circuit	USB power meter, voltage check via multimeter	Near charging port, battery connector	Working / Not Working	Fast charging supported?
4	Power Management Unit (PMU)	Voltage tracing, schematic diagram (if available)	Near battery and processor	Working / Not Working	Heating or voltage drop noted

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. How do the RAM and internal storage affect smartphone speed and multitasking?
2. How does the smartphone's battery performance change during 4G vs. 5G usage?
3. What are the major hardware components found in modern smartphones?

[Space for Answers]

XVIII References/Suggestions for further reading

1. https://scientechworld.com/wp- content/uploads/2024/10/Scientech-2140-5G.pdf?srsltid=AfmBOoolzors56CsfUx9leRjDJ5lIpiT3Gkf4caXgfh9imcmcXIr_5r7
2. https://www.kitektechnologies.com/images/prod/wc3.pdf

XVIII Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Proper Handling of the Equipment / Components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Results	20%
6	Practical related questions	15%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 7: Location of nearby tower and find internet connection strength

I Practical significance

This experiment helps students understand how mobile networks operate in real-world conditions. By using mobile apps, one can determine how strong the signal from the nearest cell tower is, and how it impacts internet speed. These insights are vital for improving coverage, optimizing performance, and understanding mobile network behaviour especially important in telecom careers. In this practical, students will be able to Location of nearby tower and find internet connection strength.

II Industry / Employer Expected outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

"Maintain mobile and wireless communication system"

III Course Level Learning outcome(s)

Interpret 5G system architecture.

IV Laboratory Learning outcome(s)

Using appropriate mobile app locate and find Internet signal strength of mobile tower.

V Relevant Affective Domain related outcome(s)

- Show curiosity and initiative in exploring wireless signal behaviour.
- Demonstrate attention to detail while recording signal data.
- Work responsibly, ensuring all measurements are accurate and safe.
- Follow ethical practices and safety practices.

VI Relevant Theoretical Background

Mobile phones communicate with nearby cellular towers via electromagnetic signals.

These signals are affected by distance, obstructions, and environmental conditions.

Important parameters that indicate signal quality include:

- **RSSI (Received Signal Strength Indicator):** This measures the power level being received by the phone from the tower, typically in dBm. Values closer to 0 indicate stronger signals, while more negative values indicate weaker signals.
- **RSRP (Reference Signal Received Power):** This provides more precise information about LTE/5G signal strength.
- **SINR (Signal-to-Interference-Plus-Noise Ratio):** This measures the signal quality relative to background noise and interference.

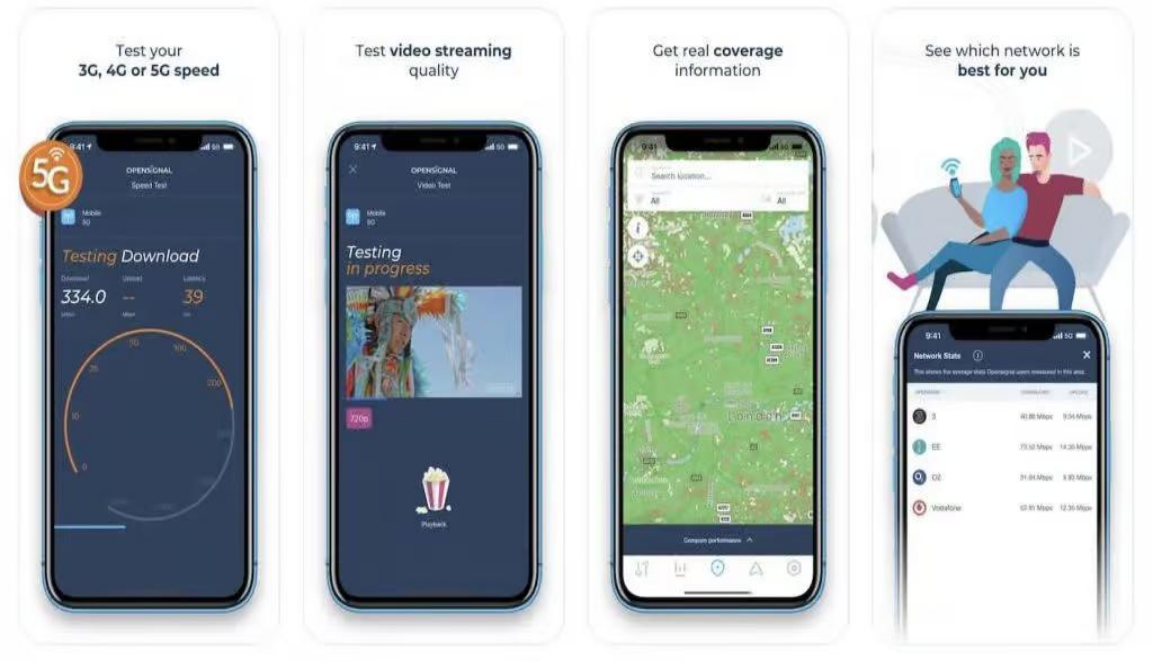

Fig 7.2 Testing of 3G/4G, Video Streaming, Real Coverage Using Open signal app

VII Actual Circuit diagram used in laboratory with equipment specifications/rating:

A) Sample android app diagram:

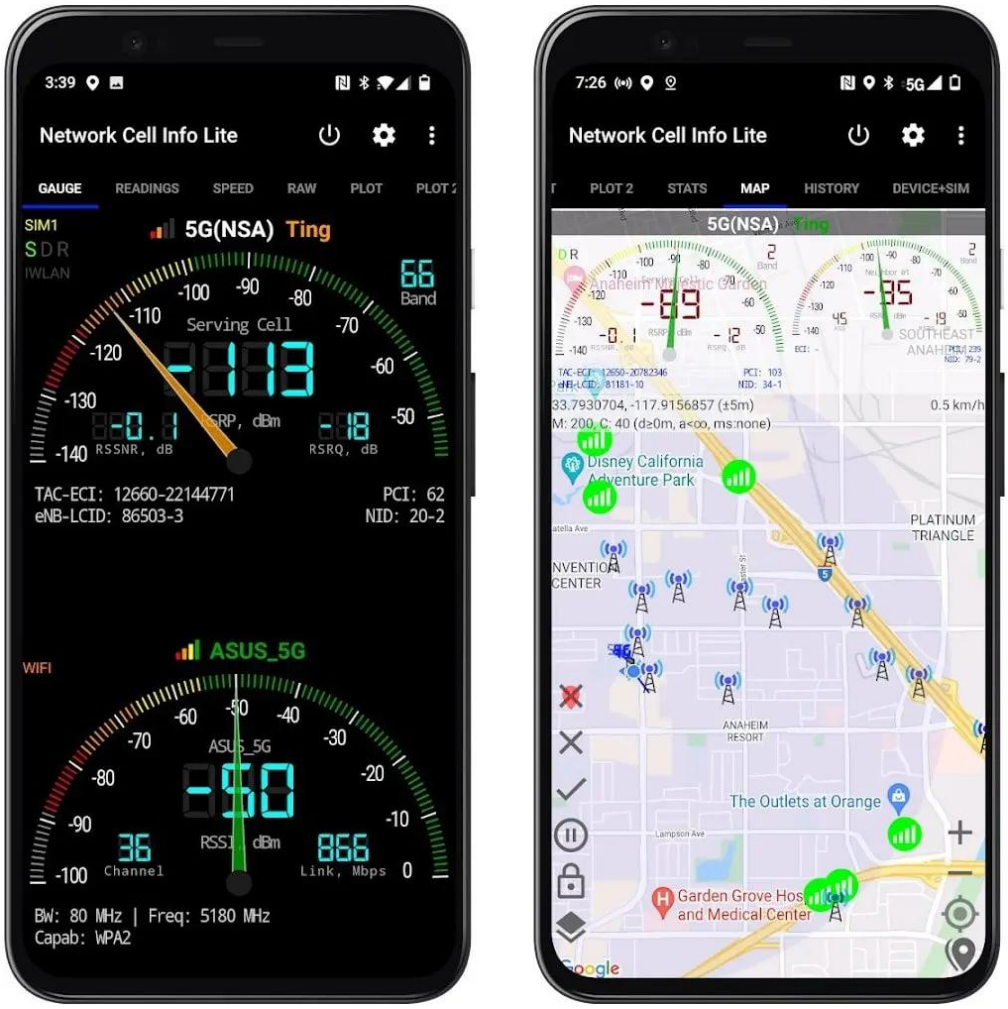

Fig7.2 Showing Network coverage using Cell info lite app display

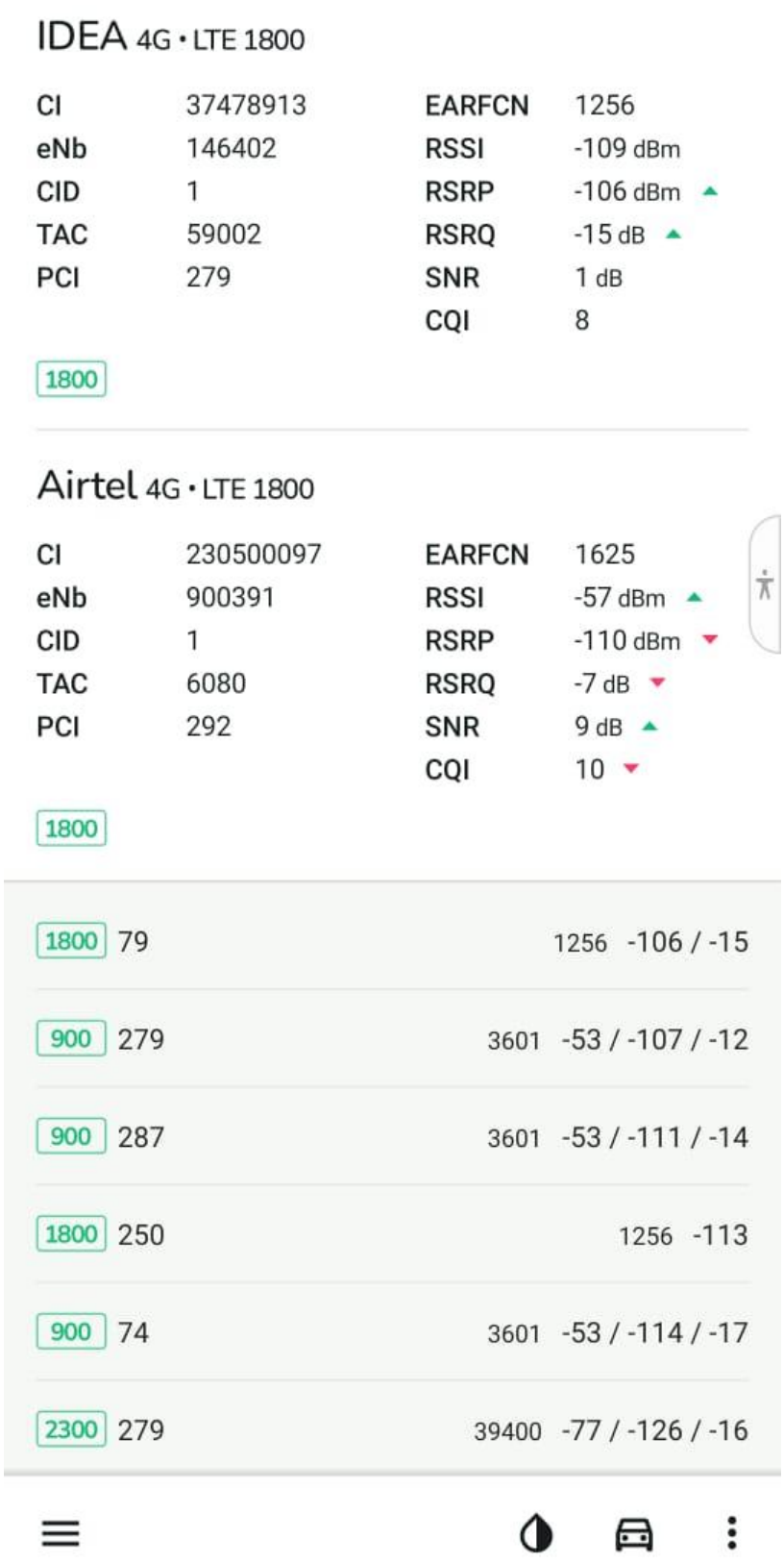

Fig7.3 Showing different parameters using NetMonster app display

B) Actual set up Diagram:

VIII Required Resources/apparatus/equipment with specifications:

Sr. No.	Instrument / Relevant app/software	Specification	Quantity
1.	Smartphone	Android-based, 4G/5G, GPS enabled	1
2.	NetMonster App/ any other relevant app	Free signal monitoring application	1
3.	Cell Mapper App	Cell tower mapping app	1
4.	Speed test App	Used to measure internet speed (download/upload)	1
5.	Notebook/Pen	For recording observations manually	1

IX Precautions to be followed:

1. Ensure the GPS is enabled on the smartphone before starting the experiment.
2. Only one network monitoring application should be active at a time to avoid data interference.
3. Move slowly between test locations to allow the app to collect accurate data.
4. Avoid testing near microwave ovens or metal structures that may distort signal measurements.
5. Do not perform tests during a phone call or hotspot usage, as it can affect data accuracy.

X Procedure:

1. Install the required app like NetMonster, Cell Mapper, and Speed test applications on the smartphone.
2. Enable both GPS and mobile data services.
3. Open the NetMonster application. Note down the following details: signal strength (RSSI, RSRP), signal quality (SINR), Cell ID, and the operator.
4. Perform this measurement in different areas: inside the lab, on the terrace, and near the parking lot.
5. Open the Speedtest application and run the speed test at each of these locations. Record both download and upload speeds.
6. Use the CellMapper app or visit https://www.cellmapper.net to identify the approximate location of the nearby tower based on the Cell ID.
7. Repeat the above steps at three or more locations around the campus or experimental area.

XI Resources used:

Sr. No.	Name of the Resource	Specification	Quantity
1.			
2.			
3.			
4.			
5.			
6.			

XII Actual Procedure:

XIII Observation table:

Sr. No.	Location	Cell ID	RSSI (dBm)	RSRP (dBm)	SINR (dB)	Download Speed	Upload Speed
1.	Department	138456	-57	-110	9	15 Mbps	5 Mbps
2.	Inside Lab						
3.	Terrace/ Place 1						
4.	Parking/ Place 2						

XIV Result(s):

XV Interpretation of results:

XVI Conclusions and recommendation

XVII Practical related questions:

1. What do the parameters RSSI, RSRP, and SINR represent, and how do they influence internet speed?
2. How can we estimate the location of a cell tower using only a mobile phone?
3. Why is signal strength better at elevated locations?
4. What environmental and structural factors affect mobile signal propagation?
5. Can a single phone connect to multiple towers at once?

XVIII References:

1.Network Cell Info App (Play Store)
2.NetMonster App (Play Store)
3.CellMapper
4.Speedtest by Ookla
5.Technical Literature:3GPP TS 36.331 – LTE RRC signal measurement standards
GSMA Mobile Connectivity Index Reports

XIX Assessment scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Installation of App	10%
2	Handling of smart phone App	20%
3	Measuring Different parameters using suitable app installed in smart phone	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Result	20%
6	Practical related questions	10%
7	Submitting the journal in time	10%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 8: Check performance of user interface section of smartphone(4G/5G)

I Practical Significance

To evaluate and compare the responsiveness, speed, and overall performance of the User Interface (UI) in smartphones when connected to 4G and 5G networks. This practical will enable students to check performance of user interface section of smartphone(4G/5G)

II Industry/Employer Expected Outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

Maintain mobile and wireless communication system

III Course Level Learning Outcome(s)

Interpret 5G system architecture.

IV Laboratory Learning Outcome(s)

Test functioning of various user interface section of smart phone: buzzer, vibrator, MIC/speaker, handsfree using 4G/5G Kit.

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background

The User Interface (UI) section of a smartphone refers to everything the user interacts

with on the screen to control the device and access its features. It includes visual

elements, touch gestures, and how information is displayed and organized.

UI features include graphical and interactive elements for user-device interaction,

covering menus, icons, buttons, notifications, and visuals on screen.

The key components of the smartphone UI:

1. Home Screen

Main screen that appears after unlocking the phone.

Contains **app icons**, **widgets** (like weather, clock), and **shortcuts**.

Typically includes **navigation bars** (e.g., Back, Home, Recent Apps).

2. Status Bar and Notification Panel

Status Bar (top edge of the screen):

Shows time, battery level, signal strength, Wi-Fi, notifications.

Notification Panel (pull-down menu):

Displays recent notifications.

Contains quick settings (Wi-Fi, Bluetooth, flashlight, etc.).

3. App Drawer (for Android)

A complete list of all installed apps.

Accessed usually by swiping up from the home screen.

4. Navigation

Gesture-based or **button-based**:

Gestures (swipe up to go home, swipe from edge to go back).

Buttons (Back, Home, Recent apps).

Varies between Android and iOS.

5. Touchscreen Controls

Tapping, swiping, pinching, long-pressing.

Used to open apps, zoom in/out, drag items, etc.

6. On-screen Keyboard

Pops up when text input is needed.

Includes predictive text, emoji, voice typing, etc.

7. App Interface

Each app has its own UI.

Consists of menus, buttons, images, text areas, etc.

Designed for ease of use and navigation.

8. Settings Menu

Allows customization of phone UI (themes, font size, display brightness, etc.).

Access system settings like Wi-Fi, Bluetooth, security, and more.

9. Multitasking Interface

Shows recent or currently running apps.

Allows switching between apps or closing them.

10. Voice Interface (optional UI component)

Assistants like **Siri**, **Google Assistant**, or **Bixby** allow voice control of phone functions.

VII Actual Circuit diagram used in laboratory with related equipment rating.

a. Sample set up

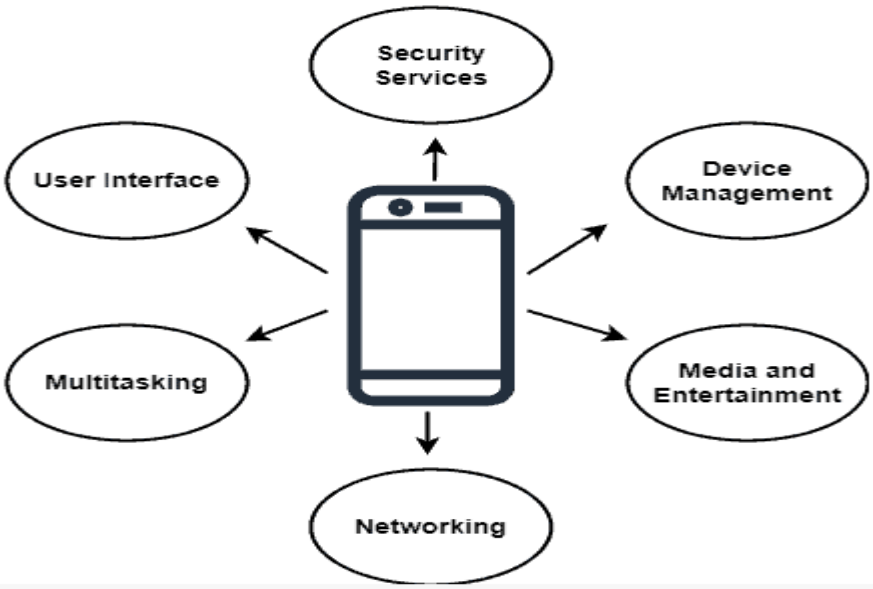

Fig 8.1: User interface of smartphone

b. Actual setup diagram

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument /relevant app/software	Specification	Quantity
1	Two smartphones	One with both 4G and 5G capabilities	2
2	SIM cards	with active 4G and 5G plans	2
3	List of UI operations (e.g., opening apps, scrolling, multitasking)		1

4	Screen recording app or tool		1
5	Network monitoring app	(e.g., NetMonster, Speedtest)	1

IX Precautions to be followed

1) Handle mobile with care
2) Close all recent applications

X Procedure

A. Preparation

1. Ensure the smartphone is fully charged and has similar app/data setup.
2. Insert a 4G SIM and boot the device.
3. Connect only to the mobile network (disable Wi-Fi).
4. Repeat the process with the same phone using 5G.

B. Define Test Tasks (UI Activities)

Perform each task under both network conditions:

Task Number	Task Description
1	Unlock phone and navigate to home screen
2	Launch a web-based app (e.g., YouTube, Instagram)
3	Scroll through content (feeds, images)
4	Open recent apps and switch between them
5	Use voice assistant (Google Assistant, Siri)
6	Open and search in app store
7	Launch camera and switch modes (photo to video)

C. Data Collection

For each task:

1. Measure response time (in seconds)
2. Note any lag/stutter
3. Record frame drops (if using Android Profiler)
4. Measure data loading time (for content-based apps)

Repeat each test 3 times and take the average**.**

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1			

XII Actual Procedure

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XIII Observation Table

Table 1: Checking of performance of User Interface

Sr. No.	Task /Feature Tested	Expected outcome	Actual outcome
1	Home screen Navigation	Smooth navigation between home screens	
2	App Opening Speed	App should open within 2 sec	

3	Touch Screen Responsiveness	Immediate response to touch	
4	Screen Rotation(Auto Rotate)	Screen should rotate smoothly with second	
5	Scrolling performance	Smooth Scrolling without lag	
6	Multitasking(switching apps)	Quick switching without crashing	
7	Keyboard responsiveness	Keyboard appears instantly an registers input	
8	Visual appearance & layout	Consistent font colors .	

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. How fast does the smartphone respond to touch inputs?
2. How effective are the accessibility settings for visually or hearing

impaired users?

3. What options are available for dark mode or reading mode?

[Space for Answers]

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XVIII References/Suggestions for further reading

1.https://www.aida64.com/user-manual/start-using-aida64

2. https://www.aida64.com/user-manual

XVIII Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Proper Handling of the Equipment	10%
2	Testing the functioning of User Interface Section	20%
3	Recording observation of UI section performance parameters	20%
4	working in teams	10%
Product Related: 10 Marks		**40%**
5	Result	20%
6	Practical related questions	15%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 9: Make Hotspot connection on Wi-Fi on any 2 devices

I Practical significance

Creating a mobile hotspot and connecting two devices over Wi-Fi is a basic yet essential practical in mobile networking. It introduces students to real-world applications of wireless communication and fosters an understanding of device-to-device networking, internet sharing, and mobile network tethering. In this practical, the student will be able to make hotspot connection on Wi-fi on any two device

II Industry / Employer Expected outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

"Maintain mobile and wireless communication system"

III Course Level Learning outcome(s)

Use relevant wireless technology suitable for various 5G applications.

IV Laboratory Learning outcome(s)

Test the hard reset function, hotspot and other networking functions of the given smart phone.

V Relevant Affective Domain related outcome(s)

- Operate devices responsibly, avoiding open hotspots and default passwords.
- Exhibit meticulous documentation and respect for the shared laboratory spectrum.
- Follow safety and ethical practices.

VI Relevant Theoretical Background

A mobile hotspot is a feature that allows a device, usually a smartphone, to share its cellular internet connection with other nearby devices through Wi-Fi. The smartphone acts as a wireless access point (AP) by using its internal wireless adapter to broadcast a Wi-Fi signal. Devices that connect to this hotspot are assigned IP addresses through DHCP (Dynamic Host Configuration Protocol).

The mobile device also performs Network Address Translation (NAT), allowing multiple devices to use one cellular IP address. For security, the hotspot typically uses WPA2-PSK or WPA3-SAE encryption. Hotspot performance depends on factors such as signal strength, distance from the client device, number of connected clients, and the data plan of the host device.

A smart phone (Host device) broadcasts a Wi-Fi network (Hotspot) . Two client devices connect to the hotspot over 2.5Ghz or 5Ghz. All network traffic flow from client-hotspot-cellular network.

VII Actual Circuit diagram used in laboratory with equipment specifications/rating

A) Sample Set up diagram:

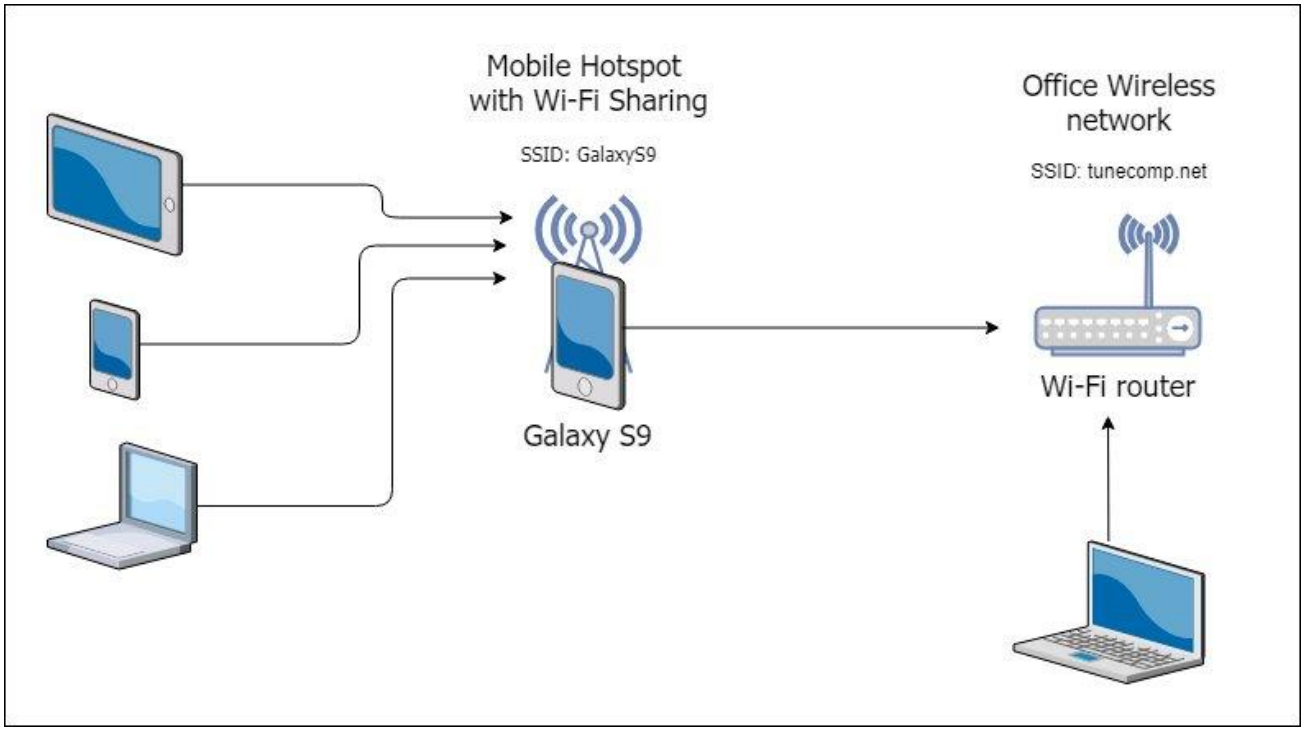

Fig 9.1 Hotspot Wi-Fi sharing

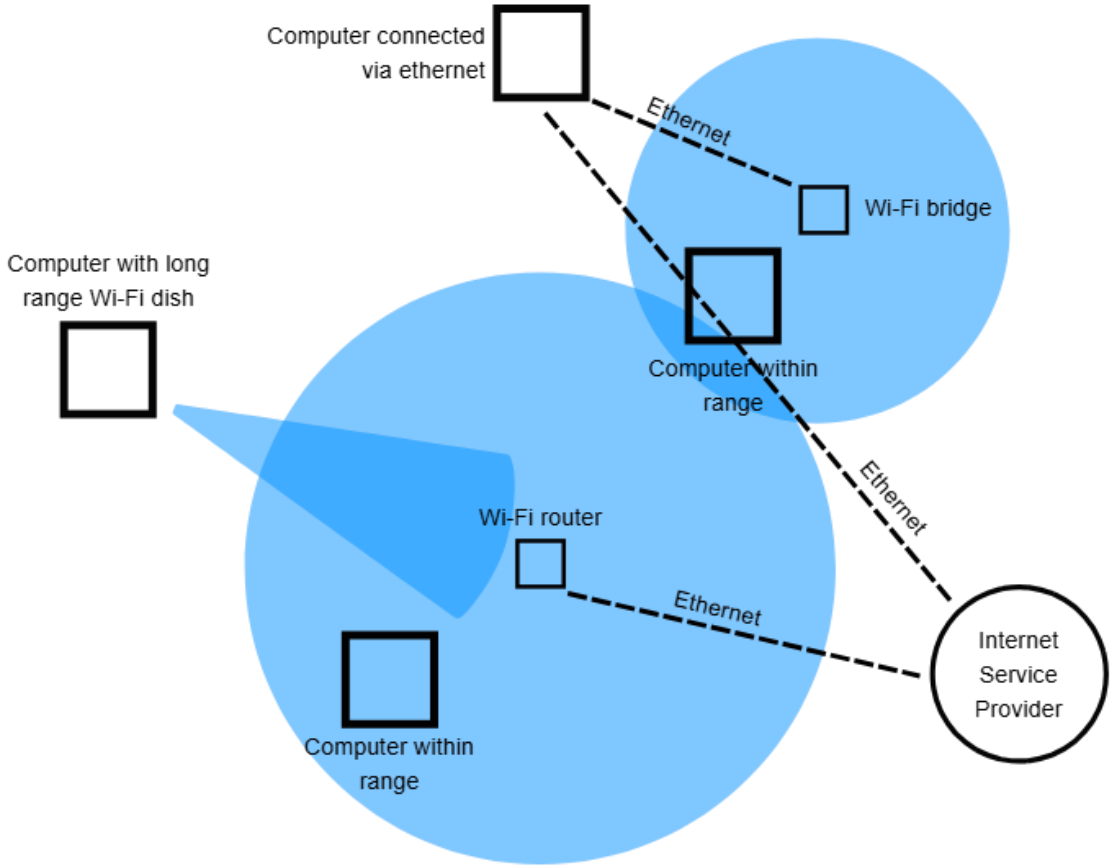

Fig 9.2 Hotspot router on computer

VIII Required Resources/apparatus/equipment with specifications:

Sr. No.	Instrument / Component	Specification	Quantity
1.	Smartphone	Android-based, 4G/5G, GPS enabled	1
2.	Client Device 1	Laptop or desktop with Wi-Fi capability	1
3.	Client Device 2	Tablet or another smartphone with Wi-Fi	1
4.	Optional Apps	Speed test by Ookla, Network Info, Ping Tools, Net Analyzer	1
5.	Internet Connection	Mobile data with 4G or 5G capability	1

IX Precautions to be followed:

1. Ensure the hotspot password is strong (minimum 12 characters) to prevent unauthorized access.
2. Avoid enabling the hotspot without security (never use open networks).
3. Maintain a close distance (less than 5 meters) between devices to ensure signal quality.
4. Monitor battery usage of the host device, as tethering increases power consumption.
5. Disconnect hotspot when not in use to conserve data and battery.

X Procedure:

1. On the host smartphone, open **Settings > Network & Internet > Hotspot & Tethering > Wi-Fi Hotspot**.
2. Turn on the hotspot and set the **SSID** (network name) and **password**.
3. On the first client device, enable Wi-Fi, search for the hotspot SSID, enter the password, and connect.
4. Repeat the same process for the second client device.
5. On both clients, test the internet connection using a browser or **Speedtest app**.
6. Record parameters like RSSI (signal strength), download/upload speed, and latency (ping).
7. Optionally, switch hotspot from 2.4 GHz to 5 GHz band and repeat steps 3–6.
8. Switch the host device from Android to iPhone (or vice versa) and repeat the full procedure.

XI Resources used:

Sr. No.	Name of the Resource	Specification	Quantity
1.			
2.			
3.			
4.			
5.			
6.			

XII Actual Procedure:

XIII Observation table:

Student can attach

1. Screenshot of hotspot settings on Android/iPhone.
2. Screenshot of Wi-Fi connected status on Laptop.
3. Screenshot of Speed test result on both clients.
4. Screenshot of signal info app showing RSSI and link speed.

Sr. No.	Test Parameter	Device 1 (Laptop)	Device 2 (Tablet)
1	Wi-Fi Signal Strength	Good	**Fair**
2.	Connection Speed		
3.	Download Speed		
4.	Upload Speed		

XIV Result(s):

XV Interpretation of results:

XVI Conclusions and recommendation

XVII Practical related questions:

1. What role does Network Address Translation (NAT) play in mobile hotspot sharing?
2. Why is WPA3 considered more secure than WPA2?
3. What are the advantages of using the 5 GHz band over 2.4 GHz in hotspot sharing?
4. How can excessive battery drain be prevented while using the hotspot?

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XVIII References:

1. Google Android Help – Set up mobile hotspot
2. Apple iPhone Support – Personal Hotspot
3. Motorola Mobile Hotspot Guide
4. SentinelOne: “Wi-Fi Security Best Practices for 2025”
5. Android Authority: “How to use mobile hotspot on Android phones”

XIX Assessment scheme:

Performance Indicators		Weightage
Process Related: 15 Marks		**60 %**
1	Connection procedure for setting up a Network	20%
2	Use of Wi-Fi Hotspot & Observation & recording of testing parameters.	20%
3	Follow Ethical Practices	20%
Product Related: 10 Marks		**40%**
4	Result	20%
5	Practical related questions	10%
6	Submitting the journal in time	10%
Total (25 Marks)		100 %

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No.10: *Establish Personal Area Network of at least two devices

I Practical Significance

To establish a Personal Area Network (PAN) between at least two devices using Bluetooth or Wi-Fi Direct and demonstrate file sharing, communication, or device control within the PAN. The PAN was successfully established using both Bluetooth and Wi-Fi Direct. Wi-Fi Direct provided significantly faster file transfers and is more suitable for larger data sharing. Bluetooth is reliable for low-data applications and peripheral connectivity. The students will be able to establish Personal Area Network of any two devices.

II Industry/Employer Expected Outcome(s)

This practical is expected to develop the following skills for the industry identified expected outcome.

Maintain mobile and wireless communication system

III Course Level Learning Outcome(s)

Use relevant wireless technology suitable for various 5G applications.

IV Laboratory Learning Outcome(s)

Build a Personal Area Network of mobile devices using Bluetooth.

V Relevant Affective Domain related outcome(s)

- Follow Safety practices
- Follow ethical practices
- Demonstrate working as a leader /team member

VI Relevant Theoretical Background

A Personal Area Network (PAN) is a short-range communication network (usually within 10 meters) used to connect devices like smartphones, laptops, and tablets. Technologies used:

- Bluetooth – low power, low data rate
- Wi-Fi Direct – higher speed, suitable for file sharing and streaming
- Infrared (IR) – legacy, line-of-sight communication

PANs are useful for tasks such as file transfer, peripheral communication (e.g., headphones), or device control.

Types of Personal Area Network (PAN) :

Personal Area Network can be of 2 types depending upon its connection i.e., Wireless PAN, and Wired PAN.

These are explained as following below.

Wireless PAN -

Wireless Personal Area Network (WPAN) is connected through signals such as infrared, ZigBee, Bluetooth and ultrawideband, etc.

Wired PAN -

Wired PAN is connected through cables/wires such as Firewire or USB (Universal Serial Bus).

VII Actual Circuit diagram used in laboratory with related equipment rating.

A) Sample set up

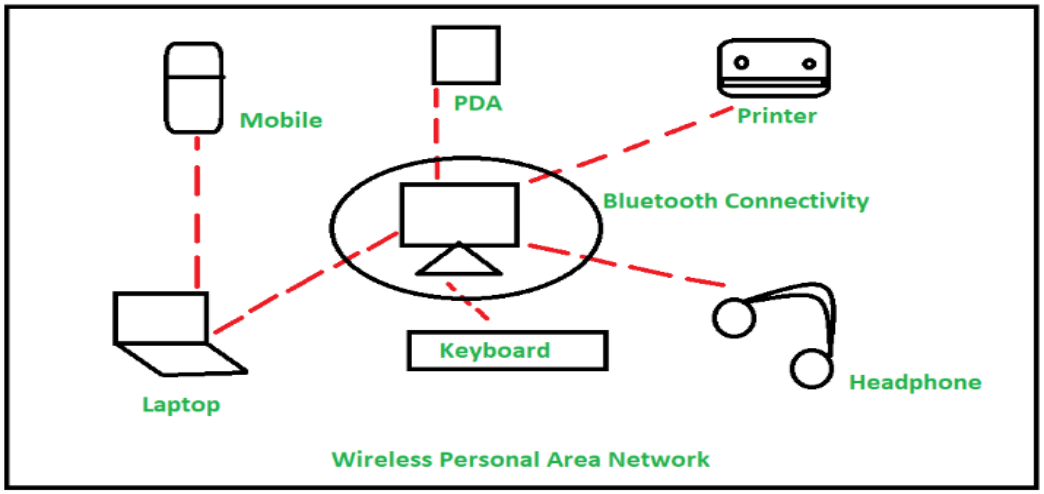

Fig 10.1: Bluetooth connection set up 1

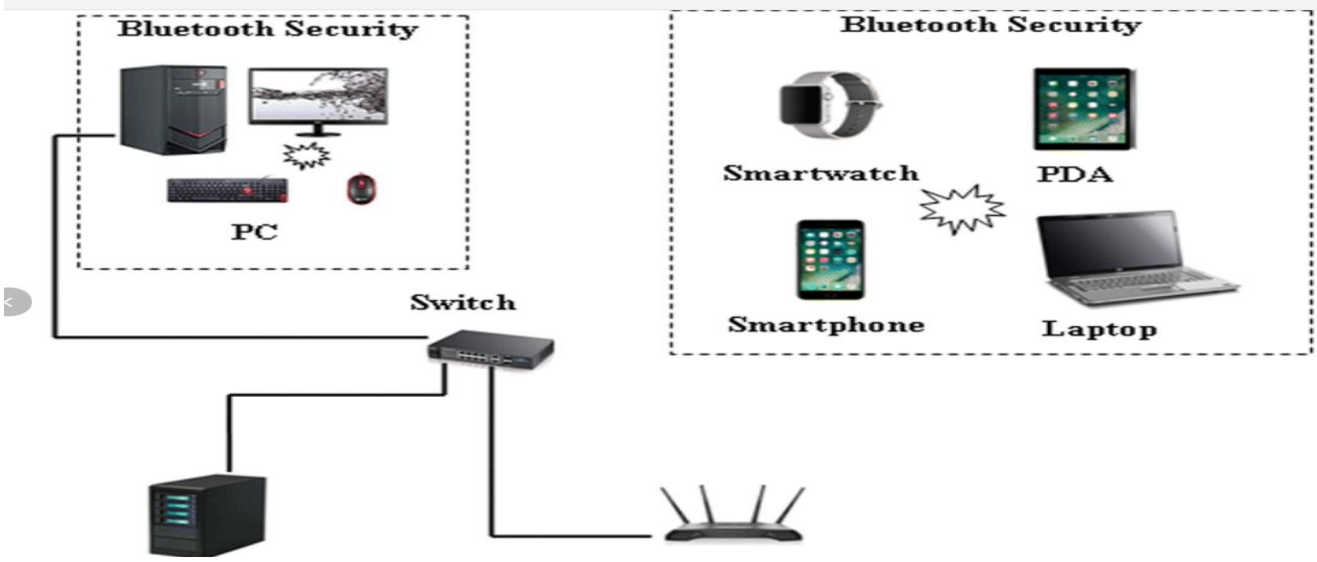

Fig 10.2: Bluetooth connection set up 2

B) Actual setup diagram

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/Relevant app/Software	Specification	Quantity
1	Two or more PAN-capable devices	(e.g., smartphones, laptops, tablets)	1
2	Bluetooth or Wi-Fi Direct functionality enabled		1
3	File sharing app	(e.g., SHAREit, Files by Google, or native OS tools)	1
4	Optional: Terminal apps for testing network connectivity		1
5	Power supply for devices	0-30V	1

XI Precautions to be followed

1) Check the battery status before connection and connect carefully
2) Enter Correct Password for Pairing
3) Don’t forget to switch off Bluetooth of your device when not in use.

X Procedure

A. Setup Using Bluetooth

1. Enable Bluetooth on both devices.
2. On Device A, go to Bluetooth settings and make it discoverable.
3. On Device B, scan and select Device A from available devices.
4. Pair the devices using the authentication key (if prompted).
5. Once paired, transfer a file from Device A to Device B.
6. Observe the file transfer status and time taken.

B. Setup Using Wi-Fi Direct (Alternative Method)

1. Enable Wi-Fi Direct on both devices (usually in Wi-Fi settings).
2. On Device A, initiate connection with Device B.
3. Accept the connection request on Device B.
4. Use a file sharing app that supports Wi-Fi Direct (e.g., SHAREit, Files by Google).
5. Transfer a large file (e.g., 100MB) and record the speed and time taken.
6. Optionally, use IP tools or ping apps to test direct connectivity between the devices.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1			

XII Actual Procedure

XIII Observation Table

Table 1: Observations for testing PAN network

Sr. No.	Device 1	Device2	Technique used	Files Transferred	Output
1	Phone 1	Phone2	Bluetooth	PDF file	
2	Laptop	Phone 1	Bluetooth	Image	
3	Phone2	Tablet	Wi-Fi	Video	
4	Phone	Speaker	Wi-Fi	Audio	

XIV Result(s)

XV Interpretation of results

XVI Conclusion and recommendation

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State any four features of Bluetooth technology.
2. Explain architecture of Bluetooth technology.
3. State the frequency band of Bluetooth technology and Name of spread spectrum used in Bluetooth.
4. List the applications of Bluetooth technology.

[Space for Answers]

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XVIII References/Suggestions for further reading

1. https://www.zenarmor.com/docs/network-basics/what-is-pan
2. https://www.geeksforgeeks.org/computer-networks/overview-of-personal-area-network-pan/

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Connection procedure for setting up a network	30%
2	Use of Bluetooth as PAN	20%
3	Follow ethical practices	10%
Product Related: 10 Marks		**40%**
4	Result	20%
5	Practical questions	10%
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	