I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

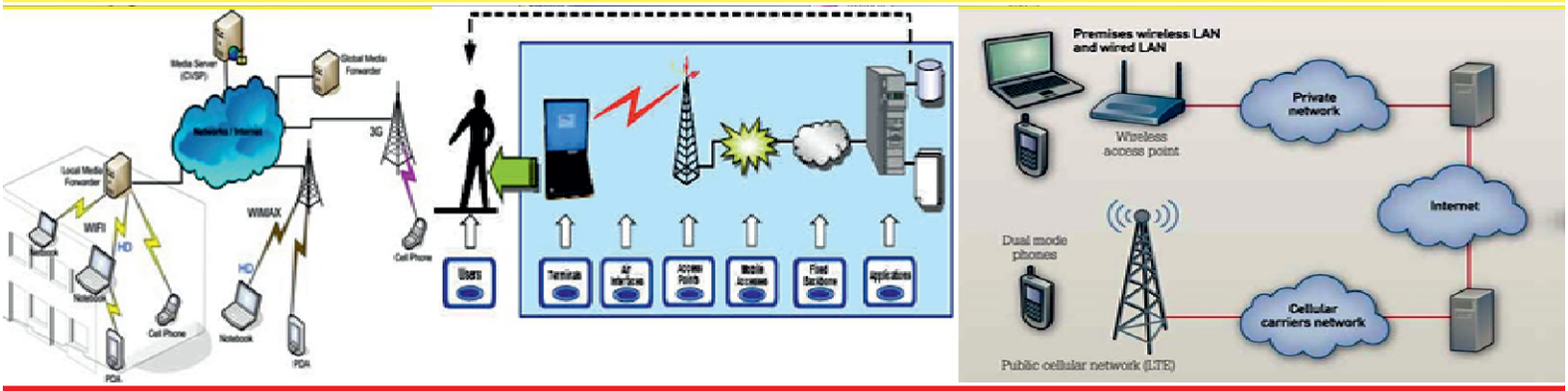
ELECTRONICS GROUP | SEMESTER - V | DIPLOMA IN ENGINEERING AND TECHNOLOGY

# A LABORATORY MANUAL

# FOR

# MOBILE AND WIRELESS COMMUNICATION

# (22533)




MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 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 changing technological and 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 followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual

for

# Mobile and Wireless Communication

## (22533)

## Semester-V

**(DE/EJ/ET/EN/EX/EQ)**

**Maharashtra State**
**Board of Technical Education, Mumbai**
**(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)**

Maharashtra State Board of Technical Education,
(Autonomous) (ISO:9001:2015 ) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra ( East ), Mumbai - 400051.
(Printed on May,2019)

# Maharashtra State
# Board of Technical Education

## Certificate

This is to certify that Mr. / Ms …….

Roll No……..of …… Semester of Diploma in ……of Institute……

(Code……..) has attained pre-defined practical outcomes(PROs) satisfactorily in course **Mobile and Wireless Communication (22533)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place …….  Enrollment No……

Date:…..  Exam Seat No. …….....

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

Seal of the Institute

# Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes 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 'I' scheme laboratory manual development team designed the practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals 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 at least 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.

In this world of connectivity and collaborative work environment, it is necessary to connect to the network from anywhere, with anybody, at any time. Wireless communication provides connectivity with mobility, flexibility and convenience. Wireless devices are used across the various industries like Healthcare, Education, Automation, Renewable energy sector, Automobile etc. Effective use of Social networking has become possible due to high end wireless devices. This course will help the students to develop skills to handle wireless and mobile communication systems.

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.

## Programme Outcomes (POs) to be achieved through Practical of this Course:

Following programme outcomes are expected to be achieved through the practical of the course

PO1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.

PO2. **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.

PO3. **Experiments and practice:** Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.

PO4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations

PO5. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electronics and Telecommunication engineering.

PO6. **Environment and sustainability:** Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts.

PO7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electronics and Telecommunication engineering.

PO8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO9. **Communication:** Communicate effectively in oral and written form.

PO10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**Program Specific Outcomes (PSO)**:-

**PSO1. Electronics and Telecommunication Systems:** Maintain various types of Electronics and Telecommunication systems.

**PSO2. EDA Tools Usage**: Use EDA tools to develop simple Electronics and Telecommunication engineering related circuits.

# List of Industry Relevant Skills

The following industry relevant skills of the competency 'Maintain mobile communication systems.' are expected to be developed in students by undertaking the practicals of this laboratory manual.

1. Identify the components of mobile phone
2. Identify the component of GSM Network.
3. Test electronic component
4. Test the various Input / Output devices of mobile phone.
5. Select the electronic component of proper value as per the requirement.
6. Identify the fault at different section and suggest suitable remedy.
7. Determine the channel efficiency of a cellular system and the methods for improving channel efficiency.
8. Execute various AT commands for a GSM modem.
9. Build a personal area Network.
10. Follow the procedural steps for hard reset function of a mobile phone.

## Practical- Course Outcome matrix

**Practical Course Outcomes (COs):**

- **a.** Troubleshoot mobile handsets.
- **b.** Assess cellular systems capacity.
- **c.** Assess performance of standards of different cellular mobile systems.
- **d.** Select relevant wireless technology suitable for various applications.
- **e.** Test the performance of various wireless protocols.

| Pro. No. | Practical Outcomes (PrO) | CO a. | CO b. | CO c. | CO d. | CO e. |
|---|---|---|---|---|---|---|
| 1. | Identify different sections and components of mobile phone such as ringer section, dialer section, receiver section and transmitter section, camera, microphone, speaker, flash light. | √ | - | - | - | - |
| 2. | Identify the inbuilt sensors of mobile handset and test their performance. | √ | - | - | - | - |
| 3. | Perform cold test of different sections of mobile phone unit. | √ | - | - | - | - |
| 4. | Test the supply of the Transmitter /Receiver section of mobile phone unit. | √ | - | - | - | - |
| 5. | Test the Battery charger section and power management unit of mobile phone unit. | √ | - | - | - | - |
| 6. | Test the LCD and SIM section of mobile phone unit. | √ | - | - | - | - |
| 7. | Test the user Interface section (Keyboard Buzzer, Vibrator, LED, Mike, and Speaker) of Mobile phone unit. | √ | - | - | - | - |
| 8. | Troubleshoot the Battery charger section, LCD section and SIM card section of the mobile handset. | √ | - | - | - | - |
| 9. | Troubleshoot the speaker problem, Ringer problem, Microphone problem, vibrator problem (User Interface section). | √ | - | - | - | - |
| 10. | Determine the coverage area of a split cell which has radius half the radius of original cell. | - | √ | - | - | - |

**Practical Course Outcomes (COs):**

**a.** Troubleshoot mobile handsets.
**b.** Assess cellular systems capacity.
**c.** Assess performance of standards of different cellular mobile systems.
**d.** Select relevant wireless technology suitable for various applications.
**e.** Test the performance of various wireless protocols.

| | | | | | | |
|---|---|---|---|---|---|---|
| **11.** | Determine the channel capacity of a cellular system service area comprised of 4/7/12 microcells with 8/12/16 channels per microcell. | - | √ | - | - | - |
| **12.** | Determine the channel capacity if each microcell in the above lab exercise split into 4 minicells and each minicell is further split into 4 microcells. | - | √ | - | - | - |
| **13.** | For the 7- cell cluster and 168-voice channels cellular system, determine the assignment of voice channel to each cell if Omni-directional antenna is used at the cell site. | - | √ | - | - | - |
| **14.** | For the 7- cell cluster, 168-voice channels cellular system, determine the assignment of voice channel to each sector if 3- sector $120^0$ and 6 -sector $60^0$ directional antenna are used at the cell site. | - | √ | - | - | - |
| **15.** | Perform installation, registration, activation and authentication of mobile applications on mobile handset. | - | - | √ | √ | - |
| **16.** | Read/Retrieve the contents of SIM card using relevant software. | - | - | √ | √ | - |
| **17.** | Execute call control commands using relevant software. | - | - | √ | √ | - |
| **18.** | Execute Network service commands using relevant software. | - | - | √ | √ | - |
| **19.** | Execute Security commands using relevant software. | - | - | √ | √ | - |
| **20.** | Execute Phone book commands using relevant software. | - | - | √ | √ | - |

**Practical Course Outcomes (COs):**

**a.** Troubleshoot mobile handsets.
**b.** Assess cellular systems capacity.
**c.** Assess performance of standards of different cellular mobile systems.
**d.** Select relevant wireless technology suitable for various applications.
**e.** Test the performance of various wireless protocols.

| | | | | | | |
|---|---|---|---|---|---|---|
| **21.** | Execute Short message commands using relevant software. | - | - | √ | √ | - |
| **22.** | Execute Data commands using relevant software. | - | - | √ | √ | - |
| **23.** | Execute Specific AT commands using relevant software. | - | - | √ | √ | - |
| **24.** | Execute AT commands for call control in 3G/4G network. | - | - | - | √ | - |
| **25.** | Execute AT commands for Video call and Phone camera related commands in 3G/4G network. | - | - | - | √ | - |
| **26.** | Execute AT commands for Microphone and Loudspeaker volume control related commands in 3G/4G network. | - | - | - | √ | - |
| **27.** | Build a Personal Area Network of mobile devices using Bluetooth. | - | - | - | - | √ |
| **28.** | Test the hard reset function, hotspot and other networking functions of the given smart phone. | - | - | - | - | √ |

## Guidelines to Teachers

1. Teacher is expected to refer complete curriculum document and follow guidelines for implementation
2. Teacher should provide the guideline with demonstration of practical to the students with all features.
3. Teacher shall explain prior concepts to the students before starting of each practical
4. Involve students in performance of each practical.
5. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
6. Teachers should give opportunity to students for hands on experience after the demonstration.
7. Teacher is expected to share the skills and competencies to be developed in the students.
8. 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.
9. Give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.
10. Assess the skill achievement of the students and COs of each unit.
11. At the beginning Teacher should make the students acquainted with any of the simulation software environment as few experiments are based on simulation.
12. It is desirable to paste the photo of actual experimental setup or draw block diagram of experimental setup.
13. Practical No.1 should not be consider for Practical (ESE-End Semester Exam).

## Instructions for Students

1. Listen carefully to the lecture given by teacher about course, curriculum, learning structure, skills to be developed.
2. Before performing the practical student shall read lab manual of related practical to be conducted.
3. For incidental writing on the day of each practical session every student should maintain a *dated log book* for the whole semester, apart from this laboratory manual which s/he has to *submit for assessment to the teacher*.
4. Organize the work in the group and make record of all observations.
5. Students shall develop maintenance skill as expected by industries.
6. Student shall attempt to develop related hand-on skills and gain confidence.
7. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
8. Student shall refer technical magazines, IS codes and data books.
9. Student should develop habit to submit the practical on date and time.
10. Student should well prepare while submitting write-up of exercise.

# Content Page

List of Practicals and Progressive Assessment Sheet

| Sr. No. | Title of the practical | Page No. | Date of perfor mance | Date of submis sion | Assessment marks (25) | Dated sign. of teache r | Remar ks (if any) |
|---|---|---|---|---|---|---|---|
| 18 | Execute Network service commands using relevant software. | 136 | | | | | |
| 19 | Execute Security commands using relevant software. | 145 | | | | | |
| 20* | Execute Phone book commands using relevant software. | 154 | | | | | |
| 21* | Execute Short message commands using relevant software. | 162 | | | | | |
| 22 | Execute Data commands using relevant software. | 170 | | | | | |
| 23 | Execute Specific AT commands using relevant software. | 179 | | | | | |
| 24* | Execute AT commands for call control in 3G/4G network. | 187 | | | | | |
| 25* | Execute AT commands for Video call and Phone camera related commands in 3G/4G network. | 195 | | | | | |
| 26* | Execute AT commands for Microphone and Loudspeaker volume control related commands in 3G/4G network. | 204 | | | | | |
| 27 | Build a Personal Area Network of mobile devices using Bluetooth. | 213 | | | | | |
| 28 | Test the hard reset function, hotspot and other networking functions of the given smart phone. | 219 | | | | | |
| **Total** | | | | | | | |

- *The practical marked as '*' are compulsory,*
- Column 6th marks to be transferred to Performa of CIAAN-2017.

# Practical No.1: Identify different sections and components of mobile Phone.

## I Practical Significance

Today we can connect to the network from anywhere, with anybody, at anytime. 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. This practical will help the student identify different sections of the mobile phone unit.

## II Relevant Program Outcomes (POs)

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

## III Competency and Practical skills

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the various sections of mobile handsets.
- Install the SIM card in the mobile phone.

## IV Relevant Course Outcome(s)

Troubleshoot mobile handsets

## V Practical Outcome

Identify different sections and components of mobile phone such as ringer section, dialer section, receiver section and transmitter section, camera, microphone, speaker, flash light. The student will be able to install the SIM card.

## VI Relevant Affective domain related Outcome(s)

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

## VII Minimum Theoretical Background

**A mobile phone** (also known as a **cellular phone**, **cell phone**, **hand phone**, or simply a (phone) is a phone that can make and receive telephone calls over a 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.

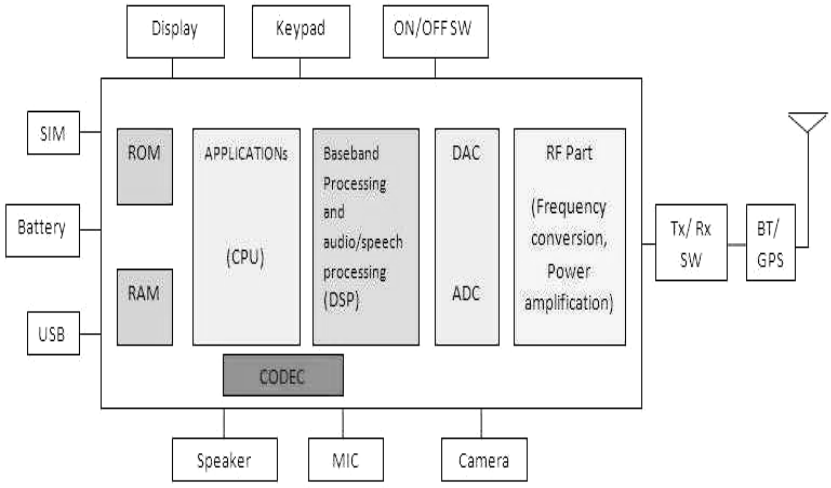



**Figure 1.1: Block diagram of Mobile Unit**

**RF section:**
RF signal is filtered and down converted to analog baseband signals in the RF section. The analog baseband signals are filtered and then up converted and amplified to RF. RF section consists of 2 main circuits: **Transmitter and Receiver**.

**Analog Baseband / Voice band Codec:**
Analog baseband signals from RF receiver section are filtered, sampled, and digitized before being fed to the DSP section. The coded speech digital information from DSP section are sampled and converted to analog baseband signals which is then fed to the RF transmitter section. The voice speech from the microphone is digitized and coded to a certain bit rate
(13kbps for GSM) using the appropriate coding scheme. The received voice call binary information are decoded and converted in the speaker.

**DSP / Microprocessor:**
The digital signal processor (DSP) is designed to perform signal manipulation calculations at high speed. The microprocessor handles all signaling for the keyboard and display; deals with command and control signaling with the base station and also coordinates the rest of the functions on the board.

**Flash Memory, ROM, SRAM (SIM card):**
The ROM, SRAM, and Flash memory chips provide storage for the phone's operating system and customizable features, such as the phone directory. The SIM card stores the subscriber's identification number and other network information.

**Power Management / DC- DC:**
This section regulates from the battery all the voltages required to the different phone sections.

## VIII

### a) Block Diagram

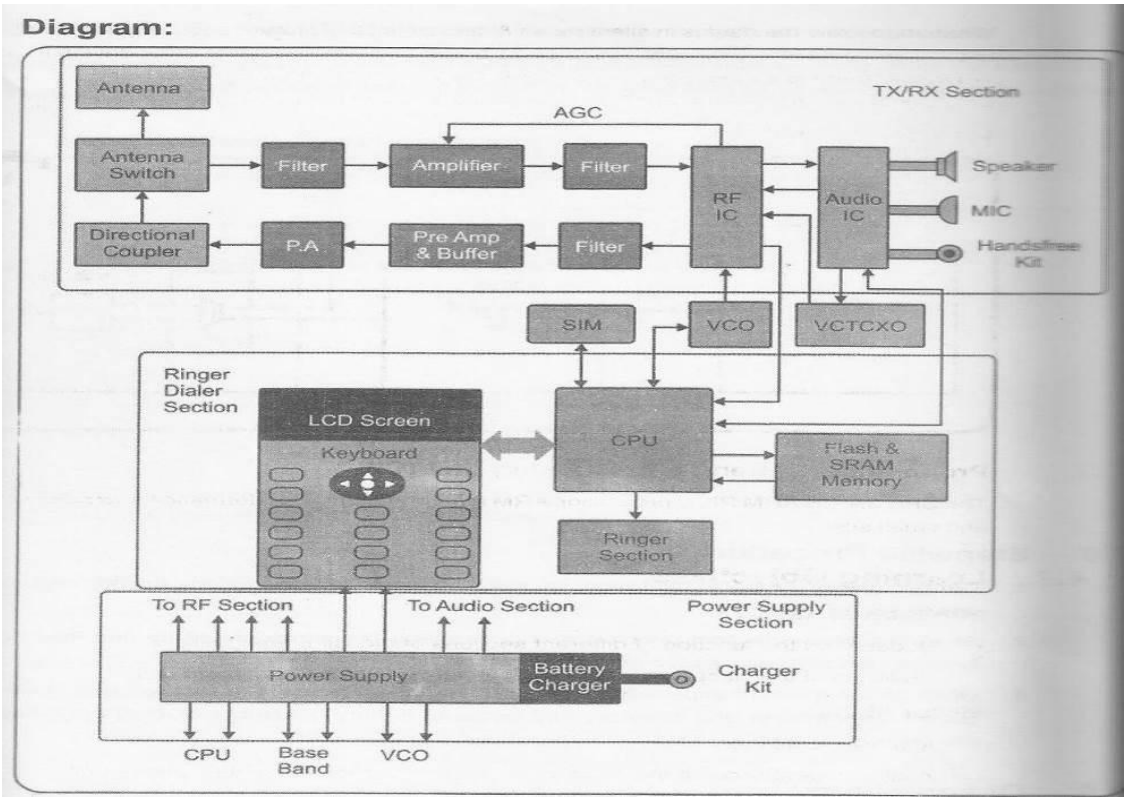



**Figure 1.2: Sections of Mobile phone Unit**

### (b) Actual Circuit used in laboratory

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | SIM card | Any type micro, Nano or Standard SIM | 1 No. |

## X Precautions to be Followed

- Read the instruction manual of the GSM trainer kit before applying power.
- Try to identify the SIM slot and the type of SIM to be inserted before purchase of SIM since there are 3 types of SIM in different sizes

## XI Procedure

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

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## XIII Actual procedure followed

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## XIV Precautions followed (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)

| Features | Availability in the trainer Kit |
|---|---|
| Name of the Blocks | |
| Hands free facility | |
| Antenna Used | |
| RF frequency band | |
| Number of SIM card slots available | |
| Type of SIM used | |
| ICs Used | |

**Note: Refer instruction manual for above observation**

**XVI Result**

The function of transmitter and receiver is ----------

The various blocks in a mobile phone unit are ----------

The different types of SIM are ----------

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**XVII Interpretation of Results**

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the frequency spectrum allocated for GSM and the bandwidth of each channel.
2. State the no of pins of SIM in a mobile phone.
3. Draw pin diagram of SIM card.

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**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=3ju9uXV-RJY
2. https://www.youtube.com/watch?v=fYRFelGABk8
3. www.mobilecellphone repairing.com

## XXI 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 the SIM card properly | 20% |
| **Product related (10 Marks)** | | **40%** |
| 4 | Results | 20% |
| 5 | Practical related questions | 10% |
| 6 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No.2: Identify the inbuilt sensors of mobile handset and test their performance.

## I Practical Significance

Service tests on any mobile handset are directly related to the phone's hardware. Service tests allow us to test the specific hardware component of an android phone (any mobile handset that runs on Android operating system). Service tests provides information about phone's hardware and whether it is working properly or not. These tests don't fix any error but they can report malfunction associated with phone's hardware. These tests are extremely useful when a fault is to be found on an android phone. By launching the service tests on that phone, touchscreen, bluetooth, Wi-Fi, SIM, sensors, camera, speakers and battery can be checked. The hardware component having a problem will not respond or work as expected. This practical will enable the student to test the inbuilt sensors in mobile handset.

## II Relevant Program Outcomes (POs)

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

## III Competency and Practical skills

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Use the relevant code for activating the service tests
- Check whether all the hardware components of mobile phone listed as "**Audio**", "**Imaging**", "**Sensors**", "**Hardware**", and "**Network**".are proper.

## IV Relevant Course Outcome

Troubleshoot mobile handsets .

## V Practical Outcome

Identify the inbuilt sensors of mobile handset and test their performance.

## VI Relevant Affective domain related Outcome(s)

- Handle equipment carefully.
- Follow safety practices.

## VII Minimum Theoretical Background

Most mobile devices have built-in sensors - accelerometers, gravity sensors, light sensors, magnetometers and others. Sensors provide various data about the environment. Different device models have a different set of sensors.

### Accelerometer

Accelerometers are vital sensors that are used to detect the orientation of the phone, primarily measuring linear acceleration of movement.

### Proximity Sensor

The proximity sensor is responsible for turning your screen off whenever your phone is against your face in a phone call to prevent accidental touches.

### Barometer

This sensor is primarily responsible for tracking altitude, and it aids in giving more accurate GPS readings.

### Light Sensor

This sensor is used for detecting ambient light.

### Gyroscope

The gyroscope measures the device's rotation and works alongside the accelerometer to give a complete picture of general movement.

### Magnetic Sensor

This sensor provides mobile phones with a simple orientation in relation to the Earth's magnetic field**.**

### HRM

Heart rate monitoring can be performed using this sensor.

### Fingerprint Sensor

This sensor is used for fingerprint scanning.

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Mobile handset | Any Android handset with basic specification | 01 |

## X Precautions to be Followed

- Read the instruction manual of the mobile handset in use.
- Perform all the tests with care

## XI Procedure

A. In Motorola Mobile handset the following procedure can be adopted
   1. Open the Moto Help app (It is the app which can be found in menu)
   2. Tap Hardware Tests.
   3. All test can be perform on this icon.
   4. Perform test by holding your hand over the phone. Note: The question mark should change to a green check mark once your hand is close enough to the front-facing camera.

B. Certain other mobiles the following procedure can be adopted
   1. Each mobile handset has a specific code for activating the service tests.

The codes are as follows:

| Sr. No. | Phone Manufacturer | Code |
|---|---|---|
| 1 | Samsung | *#*#0*#*# |
| 2 | Motorola | *#*#2486#*#* |
| 3 | REDMI | *#*#64663#*#* |
| 4 | HTC | *#*#3424#*#* |

Entering the code will invoke a set of menu.

Each model has a separate code that can be obtained from website.

1. Tapping on the "Sensor" button will yield a test page for a host of sensors — namely the accelerometer, proximity sensor, barometer, light sensor, gyroscope, magnetic sensor, HRM, and fingerprint scanner..
2. Observe the screen and note down the observations in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (Test any eight sensors available in the mobile handset)

| Sensor name | Observation on the screen |
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**XVI Result** (Activation of the code gives menu consisting of following tests )

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**XVII Interpretation of Results**

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the steps for testing the microphone – sound of the mobile phone
2. State the steps for testing the buzzer and vibrator of the mobile phone .
3. Compare the performance of 2 different handsets on the basis of accelerometer, Proximity sensor and light sensor.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=vjVibti8JRw
2. https://help.republicwireless.com/hc/en-us/articles/115013350428-How-to-Test the-Microphone-Sound-Hardware-on-Motorola-Phones

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Handling of the mobile phone for invoking the menu | 20% |
| 2 | Making observations | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Results | 20% |
| 2 | Practical related questions | 15% |
| 3 | Submission of report in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 3 : Perform cold test of different sections of mobile phone unit

**I Practical Significance**

A mobile phone consists of various sections that include transmitter / Receiver section, Buzzer and Vibrator section, Power supply section, Display section, SIM card section. To troubleshoot a mobile handset, it is necessary to perform cold test. This test is done without providing any power to the mobile unit. This practical will enable the student to unscrew the mobile phone/kit and measure resistance of the various sections.

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**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Measure resistance of various sections of the mobile phone

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

Perform cold test (measurement of resistance) of different sections of mobile phone unit

**VI Relevant Affective domain related Outcome(s)**

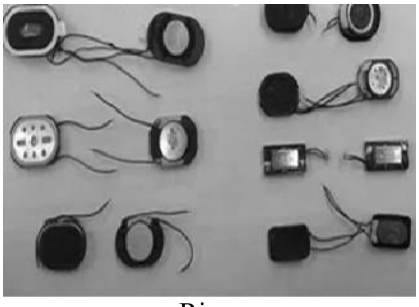
- Demonstrate working as a leader/a team member.
- Handle equipments carefully
- Follow safety practices

**VII Minimum Theoretical Background**

Faults in each part, component or section of a mobile cell phone can be repaired fast by using following 2 methods at the time of repairing mobile cell phone. These methods can also be used to find out faulty or damaged part or components inside a mobile cell phone. The various components are shown in the Figure

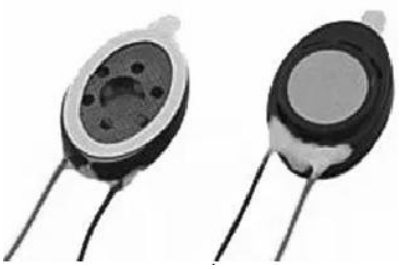
Front Facia


Back Facia



Ringer

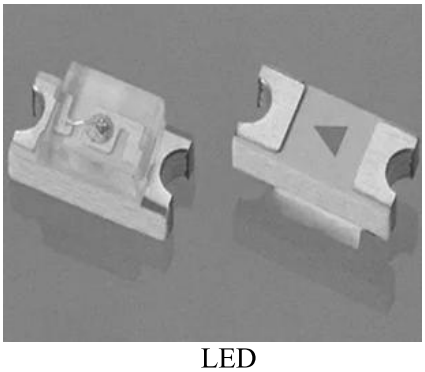
Internal Facia



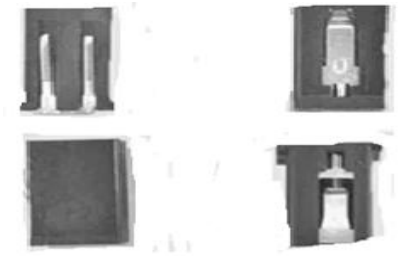
Speaker

Microphone

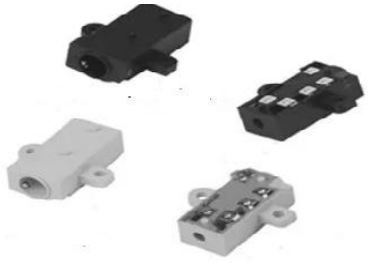
Vibrator



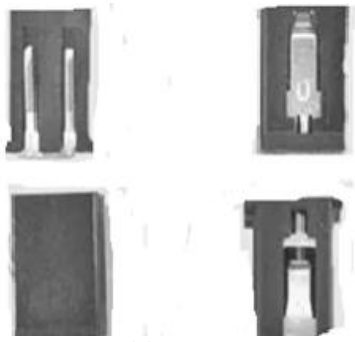
LED



Charging connector

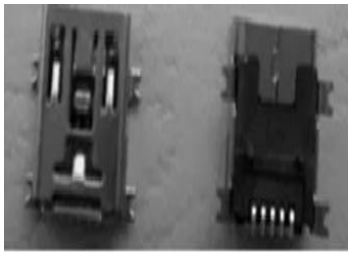


Headphone Connector



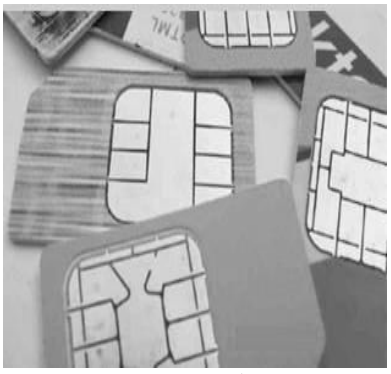
Data Cable Connector

Battery

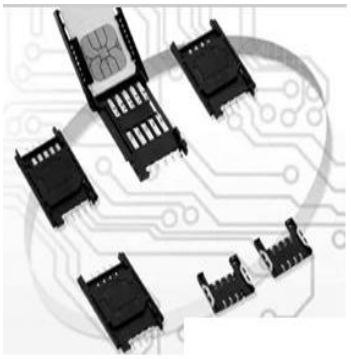


Battery Connector

Battery Connector



SIM Card



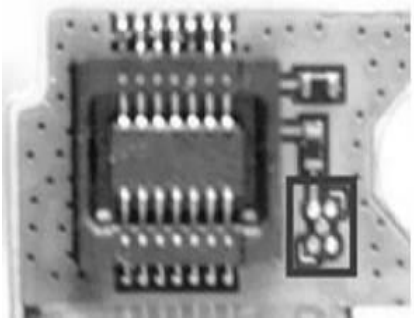
SIM Card Connector

Camera


Keypad Button

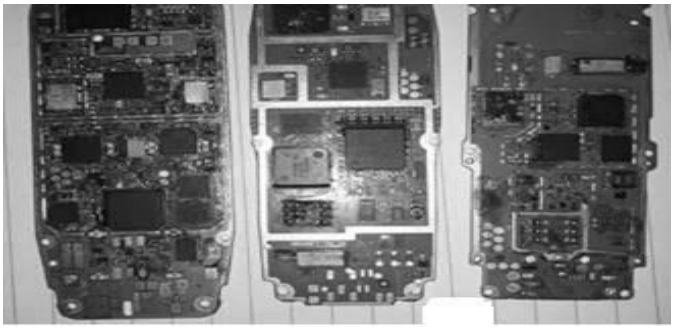
Keypad Carbon

ON / OFF Switch



Display Connector

Internal Antenna



PCB

**Figure 3.1: Components of Mobile phone**

**Front Facia or Facial**: This is the front cover or housing of any mobile phone. These are of different shapes and sizes depending upon brand and model.

**Back Facia or Facial**: This is the Back cover or housing of any mobile phone. These are of different shapes and sizes depending upon brand and model.

**Internal Facia or Facial**: This is the internal skeleton of a mobile phone.

**Ringer**: This part of component in a mobile phone is also called loudspeaker. It plays loud sound and music in mobile phone.

**Speaker**: This part or component is also called earpiece. It helps to listen to sound during phone call when the loudspeaker or headphone is NOT ON.

**Microphone**: It is also called Mic in short. It transmits sound of the speaker during phone call. It also helps to record sound in a mobile phone. It other words, microphone is a sound input device.

**Vibrator**: It is also called motor. It creates vibration in a cell phone when vibration mode setting is turned ON.

**LED**: Light Emitting Diode. These components produce light in a mobile cell phone

**Charging Connector**: It helps to connect the charger to the PCB of a mobile phone to charge or recharge the battery.

**Headphone Connector**: It is also called Earphone Connector. It helps to connect the headphone to the mobile phone via jack.

**Data Cable Connector**: It helps to connect the mobile to another device such as a computer, laptop, table etc using a data cable.

**Battery**: It supplies power or DC current to the mobile phone.

**Battery Connector**: It connects the battery to the internal circuit tracks of the PCB of a mobile phone

**SIM Card**: Subscriber Identification Module. This is a small rectangular chip with circuit and information of user of the card. A SIM card is necessary to make or receive phone calls with a mobile phone.

**SIM Card Connector**: It connects the SIM card to the Circuit or PCB of a mobile phone.

**Camera**: It is used to capture still images or record videos. These are available in different megapixel.

**Camera Connector**: It connects the camera to the PCB of the mobile phone.

**Keypad Button**: It is connected to the keypad carbon to enter numbers to make phone calls and other data.

**Keypad Carbon**: It is present in between keypad button and the PCB. It connects the keypad buttons to the PCB of a mobile phone.
**ON / OFF Switch**: It helps to switch the mobile phone ON or OFF.

**Display**: It is screen of the mobile phone.

**Display Connector**: It connects display of screen to the PCB of a Mobile Phone.

**Internal Antenna**: It helps to capture network frequency.

**PCB**: Printed Circuit Board of the Mobile Phone.

## IX Resources required

| Sr. No. | Instrument / Components | Specification | Quantity |
|---|---|---|---|
| 1. | Mobile phone (old/ non working) | Any android phone with basic specification | 1 No. |
| 2. | DMM | 3 ½ Digit | 1 No. |
| 3. | Connecting wires | Banana plugs | 4 No. |
| 4. | Toolkit | Consisting of screw driver, tweezers, opener | 1 no. each |

## X Precautions to be Followed

1. Handle all the components with care
2. Follow the instructions manual for opening the mobile phone

## XI Procedure

1. With the help of screw drivers , open the old mobile phone (non- working) or trainer kit
2. Remove the various components shown in the figure
3. With the help DMM measure the resistance at various test points given in the observation table
4. Note down the value of the resistance and compare with standard value

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## XIII Actual procedure followed

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**XIV** **Precautions followed** (use blank sheet provided if space not sufficient)

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**XV** **Observations** (use blank sheet if space not sufficient)

| Sr. No. | Component name | Standard value(k Ω) | Measured value (k Ω) |
|---|---|---|---|
| 1 | **Ear Phone Connector Tip (+ , -)** | 0.500 to 0.700 | |
| 2 | **Loud Speaker / Ringer Connector Tip (+,-)** | 0.300 to 0.600 | |
| 3 | **Battery Connector Tip (+)** | 0.400 to 0.500 | |
| 4 | **Battery Connector Tip (Sense)**: | above 0.800 | |
| 5 | **Display Connector Supply Pins**: | 0.250 to 0.400 | |
| 6 | **Display Connector Signal Pins**: . | 0.500 to 0.800 | |
| 7 | **Camera Connector Supply Pins**: | 0.250 to 0.400 | |
| 8 | **Camera Connector Signal Pins**: | 0.600 to 0.900 | |
| 9 | **Key Tip (Row and Column)**: | 0.400 to 0.800 | |
| 10 | **Charger Connector Tip** | 0.600 to 0.700 | |
| 11 | **Vibrator Motor Connector**: | 0.40 to 0.500 | |
| 12 | **Power ON / OFF Switch Point (+)**: | 0.600 to 0.900 | |
| 13 | **MIC Connector Tip (Analog MIC) (+,-)**: | 0.700 to 0.900 | |
| 14 | **Battery Charging Out Point (+,-)**: | 0.300 to 0.400 | |
| 15 | **SIM Card Connector Pin 1** | 0.500 to 0.700 | |

| Sr. No. | Component name | Standard value(k Ω) | Measured value (k Ω) |
|---|---|---|---|
| | **(VSim)**: | | |
| 16 | **SIM Card Connector Pin 2,3,6**: | 0.400 to 0.800 | |
| 17 | **SIM Card Connector Pin 4 (GND)** | 0.00 (Beep) | |
| 18 | **MIC Connector Tip (Analog MIC) (+,-)**: | 0.700 to 0.900 | |

**XVI Result**

The resistance measured and standard values (match/ do not match ) with the standard values

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**XVII Interpretation of Results**

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Describe difference between hot testing and cold testing method used in mobile.
2. State the procedure used to open the mobile phone / trainer kit.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. http://www.mobilecellphonerepairing.com/mobile-phone-repairing-testing-methods.html
3. Abhi Naha; Peter whale: Essentials of mobile handset design-Cambridge wireless essential series

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Proper handling of the equipment | 20% |
| 2 | Identifying the various components | 20% |
| 3 | Measuring resistance | 20% |
| **Product related (10 Marks)** | | **40%** |
| 4 | Results | 20% |
| 5 | Practical related questions | 10% |
| 6 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

## Practical No. 4: Test the supply of the transmitter /receiver section of mobile phone unit.

**I Practical Significance**

A mobile phone consists of various sections that include transmitter / receiver section, buzzer and vibrator section, power supply section, display section, SIM card section. To troubleshoot a mobile handset, it is necessary to understand the type of waveforms and the voltages and currents at the output of these sections. The practical will enable us to measure Input/ output voltages of transmitter receiver section.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Draw waveforms at the output of Transmitter/ Receiver sections of mobile handsets.
- Measure voltages at the output of Transmitter/ Receiver sections.

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

Test the supply of the Transmitter /Receiver section of mobile phone unit..

**VI Relevant Affective domain related Outcome(s)**

- Handle equipment carefully.
- Work in team
- Follow safety practices

**VII Minimum Theoretical Background**

**Transmitter and Receiver section**: Signal to the transmitter is the audio signal from the microphone of the mobile handset. This analog / audio signal is converted into

digital signal by the ADC. It is further modulated by the GMSK scheme and the modulated signal is transmitted through a transmitting antenna.
The signal to the receiver is the modulated signal which is demodulated into digital signal. This digital signal is converted into analog form with the help of DAC. The analog signal is then given to the speaker

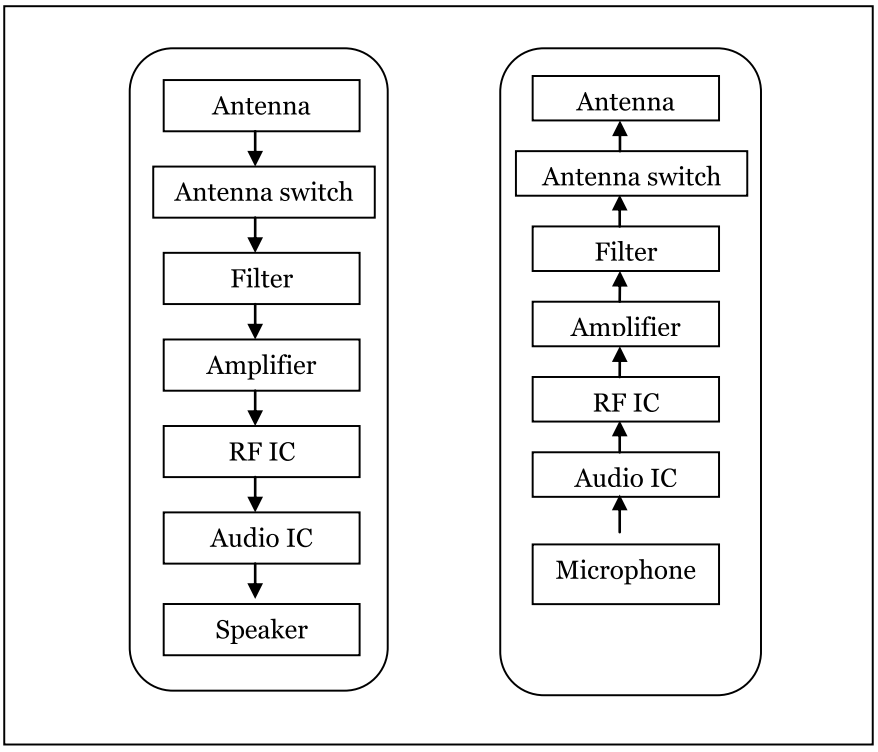


**Figure 4.1: Receiver and Transmitter sections**

## VIII

### (a) Circuit Diagram/ Block Diagram

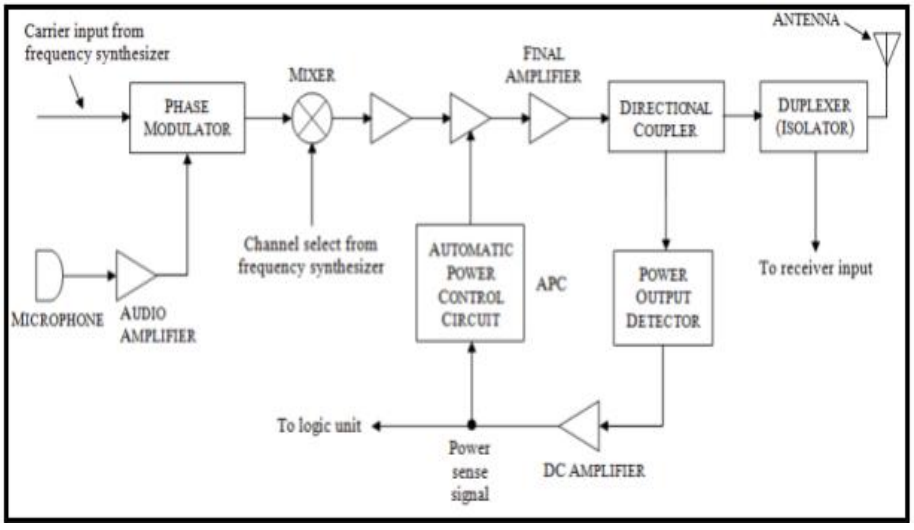


**Figure 4.2: Block schematic of Transmitter**

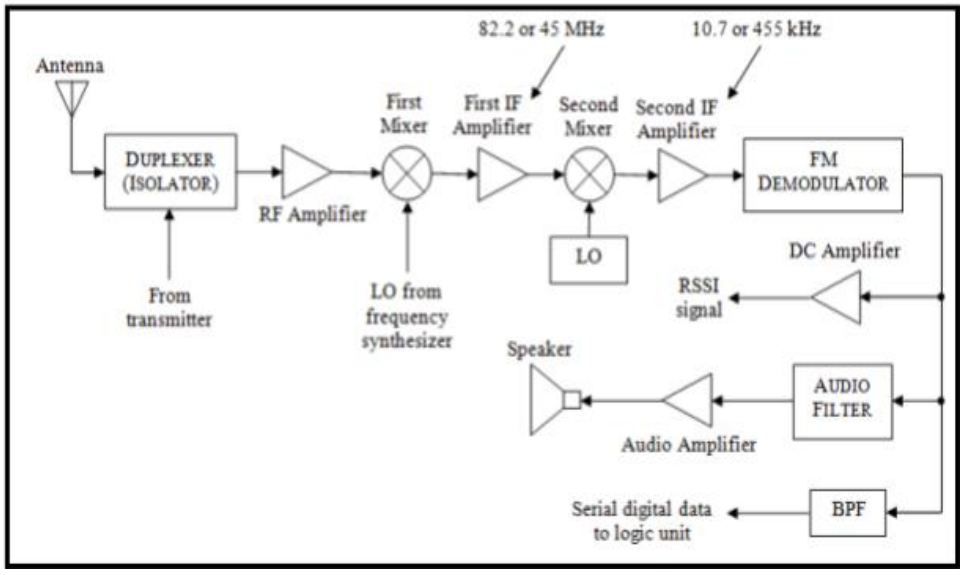


**Figure 4.3: Block schematic of Receiver**

## (b) Actual Circuit/ Trainer Kit diagram used in laboratory

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | CRO/DSO | 20MHz, dual trace, dual beam, | 1 No. |
| 3. | Spectrum analyser | 1 GHz | 1 No. |
| 4. | DMM | 3 ½ Digit | 1 No. |
| 5. | Connecting wires | Banana plugs | 4 No. |

## X Precautions to be Followed

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

## XI Procedure

1. Connect the power cord to the trainer kit. Insert the SIM card in the position provided and turn on the power supply
2. Make a call to the mobile trainer kit from any other mobile or landline number.
3. While the call is ON, observe the signal on the CRO/Spectrum analyzer and record the same.
4. Make a call from the mobile trainer kit to some mobile or land line.
5. While the call is ON, observe the signal on the CRO/Spectrum analyzer and record the same.

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)

**Transmitter Section**

| Test Points | Waveforms |
|---|---|
| **Audio Input** | |
| **Antenna Signal** | |

**Receiver Section**

| Test Points | Waveforms |
|---|---|
| **Audio Input** | |
| **Demodulated Output** | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Speaker output** | | | | | | | | | | |
| | | | | | | | | | | |
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## XVI Result

The voltage of the transmitting antenna is ----------V
The voltage of the receiving antenna----------V
The output of the speaker is ----------V

## XVII Interpretation of Results

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## XVIII Conclusions and Recommendations

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## XIX 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 identified CO.**

1. State the type of antenna used in a given mobile phone.
2. GMSK modulation technique is used in GSM mobile. Give reason
3. State the use of Hagar IC used in mobile.
4. From mobile settings, determine the operating system used.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=3ju9uXV-RJY
2. https://www.youtube.com/watch?v=fYRFelGABk8

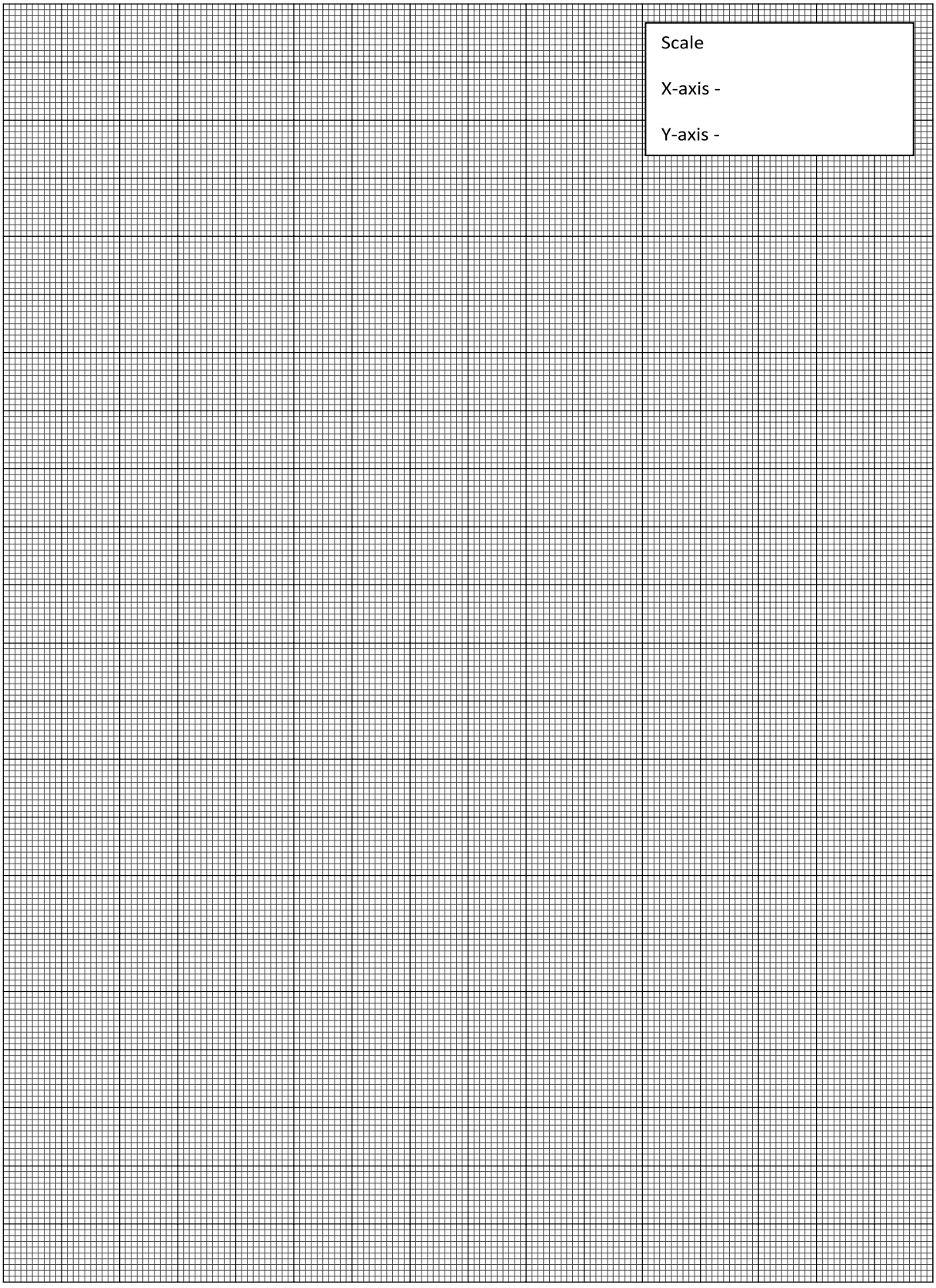
## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Proper handling of the equipment | 20% |
| 2 | Identifying the Test points | 20% |
| 3 | Measurement of voltage | 20% |
| **Product related ( 10 Marks)** | | **40%** |
| 4 | Results | 20% |
| 5 | Practical related questions | 10% |
| 6 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related (15)** | **Product Related (10)** | **Total (25)** | |
| | | | |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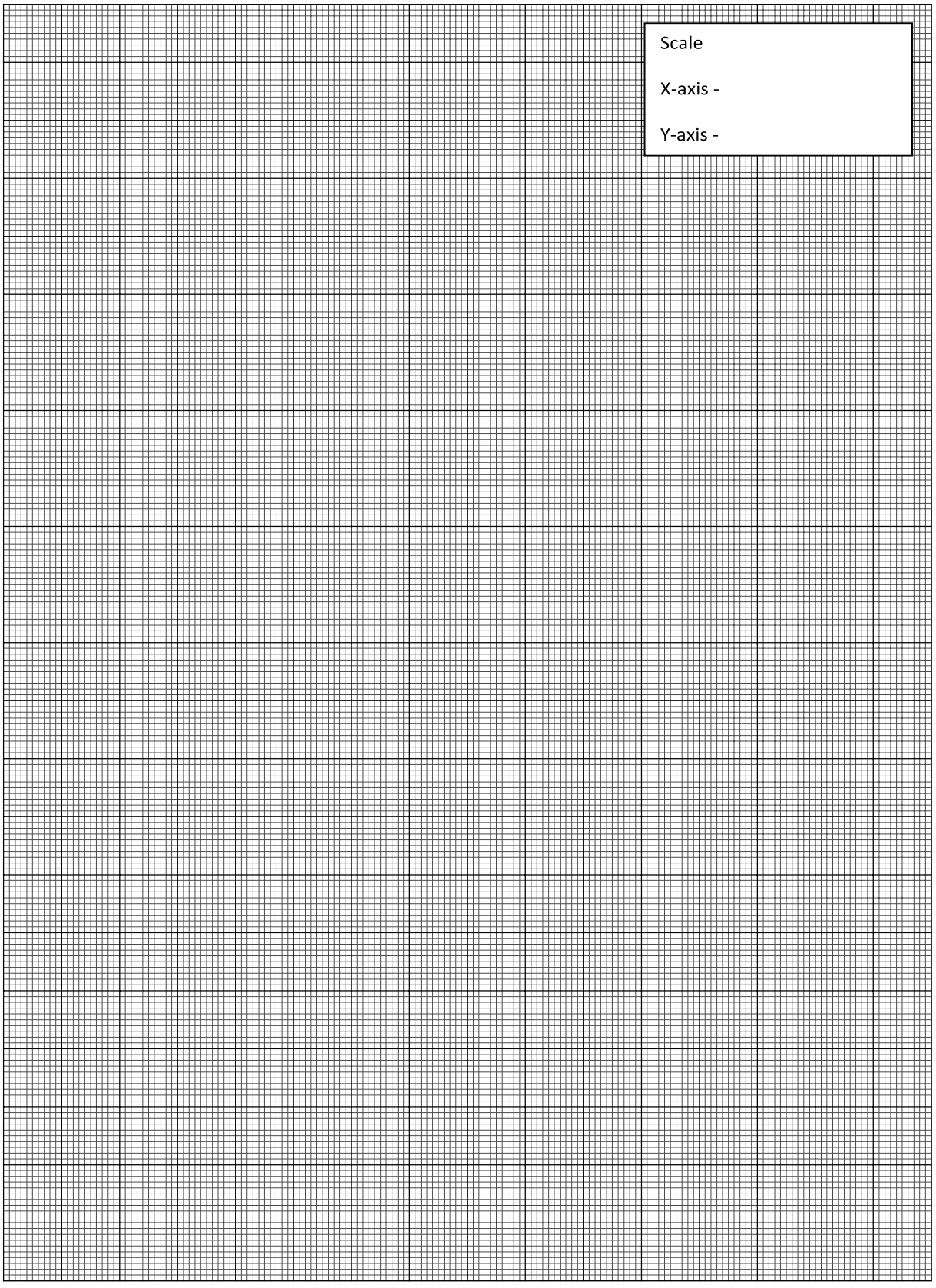
Scale
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# Practical No. 5: Test the Battery charger section and power management unit of mobile phone unit.

**I Practical Significance**

A mobile phone consists of various sections that include transmitter / Receiver section, Buzzer and Vibrator section, Power supply/ Battery charging section, Display section, SIM card section. To troubleshoot a mobile handset, it is necessary to be able to measure and record various charging signals in charging process. The practical will also enable students to observe and record the specifications of the battery

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **Environment and sustainability:** Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Measure Power supply section voltages
- Measure battery and battery charger section voltages

**IV Relevant Course Outcome(s)**

Troubleshoot mobile handsets.

**V Practical Outcome**

Test the Battery charger section and power management unit of mobile phone unit.

**VI Relevant Affective domain related Outcome(s)**

- Handle equipment carefully.
- Work in team
- Follow safety practices

**VII Minimum Theoretical Background**

Battery charger section accomplishes the charging phenomenon of battery by connecting a battery charger supply voltage to battery either when mobile is on or Off. There are six main components of Mobile charger circuit.

1. Charger
2. Charging Control circuit
3. Voltage rectifier

4. Power management/ Voltage Control circuit
5. Battery temperature detector
6. Battery

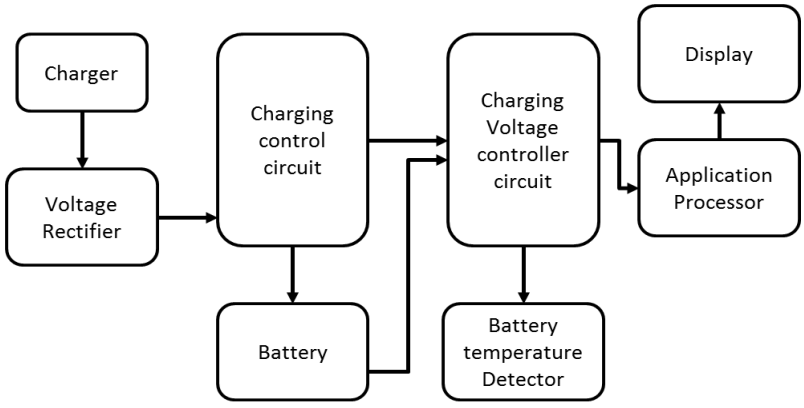


**Figure 5.1: Block Diagram of Battery Charging Circuit**

**Voltage Control Circuit -** This is the stage where the charger voltage and current is being stabilized, amplified, rectified, regulated and other voltage purification process is being held in this area before it feeds to the battery.

**Charging Control Circuit -** The charging process is monitored, and sends information to the application processor to start or stop the charging process. This area is part of Power **management circuit**

**Voltage Rectifier -** The 220 AC volts coming from the electrical outlet is converted to a desired DC voltage like 4.5 to 6 volt DC . The phone only accepts and can be operated in low DC voltage.

**Battery Temperature Detector**: The battery temperature is measured with a NTC inside the battery pack. The BTemp line voltage level decides level of the charging. If it is disconnected or improper, it leads to "Not Charging"

The power supply to various components of the mobile phone is provided by Battery. The figure 5.2 shows Power supply section which provides the power to audio section, CPU, Voltage controlled oscillator, RF section, Buzzer/ Vibrator sections.

**Application Processor:** It is used to start or stop the charging process. This area is part of **Power management circuit.**

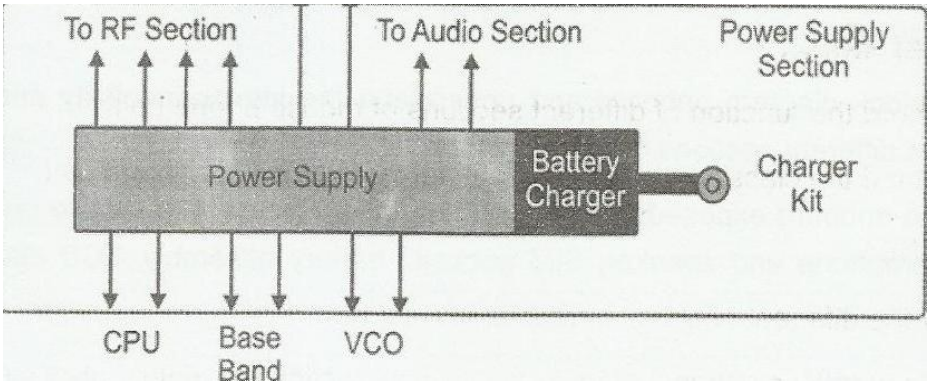


**Figure 5.2: Block Diagram of Power Supply Section**

The charging of mobile unit is carried out in two modes

1. **Startup Charging:** When the battery is empty, the startup current charges the battery until the voltage level reaches 3.0V. It is also called boost charging
2. **PWM Charging:** When battery voltage reaches 3.0V , Charging Control IC (CCONT) sends reset signal and PWM charging starts. In this charging, energy management software of CPU controls the charging current delivered from charger to battery

## VIII Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | DMM | 3 ½ Digit | 1 No. |
| 3. | Connecting wires | Banana plugs | 4 No. |
| 4. | CRO/ DSO | 20 MHz, Dual Trace | 1 No. |

## IX Precautions to be Followed

1. Read the instruction manual of the GSM trainer kit before applying power.
2. Install the SIM with care.
3. Measure the voltages at the test points on DMM/ CRO/DSO with proper range

## X Procedure

1. Connect the power cord to the trainer kit. Insert the SIM card in the position provided and turn on the power supply
2. Identify the test points in power supply section and measure the voltages
3. Record the Observations
4. Connect the battery charger unit to the trainer kit
5. Switch On the Charging
6. Observe charging indication on the display
7. Measure the voltage at the Test Point using DMM.
8. Observe the PWM signal on CRO / DSO at the same test point

## XI Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## XII Actual procedure followed

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**XIII Precautions followed** (use blank sheet provided if space not sufficient)

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**XIV Observations** (use blank sheet provided if space not sufficient)

**Table I . Power Supply Section voltages**

| Sr. No. | Test Point | Standard Voltage(V) | Observed Voltage(V) |
|---|---|---|---|
| 1 | Battery Voltage | 3.7 | |
| 2 | Battery Status Indicator (BSI)- When battery is discharged | 0 | |
| 3 | Battery Status Indicator (BSI)- When battery is charging | 0.5 | |
| 4 | Battery Ground | 0 | |
| 5 | Battery charger Supply | 6 | |
| 6 | Charger Voltage | 6 | |

**II PWM signal waveform**

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## XV Result

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## XVI Interpretation of Results

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## XVII Conclusions and Recommendations

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## XVIII 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 identified CO.**

1. Name the IC which controls the width of pulse.
2. Justify use of NTC inside battery pack.
3 Name the IC used for charging mobile phone.

**[Space for Answers]**

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**XX References / Suggestions for further Reading**

1. https://www.themobileindian.com/news/understanding-cell-phone-batteries-5168
2. https://www.youtube.com/watch?v=Ff4Wk-bIM8A

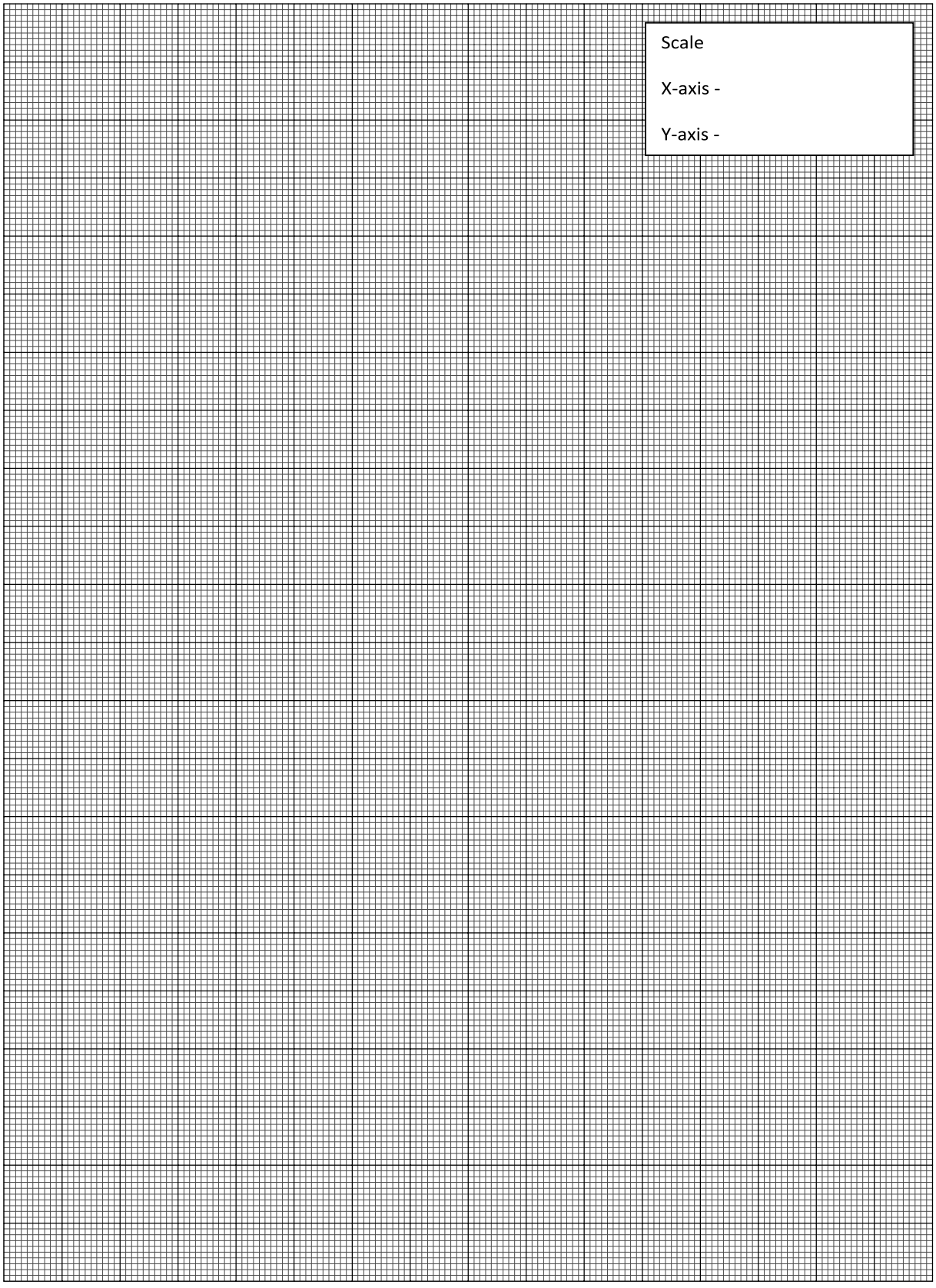
**XXI Assessment Scheme**

| Performance Indicators | | Weightage % |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Proper handling of the equipment | 30% |
| 2 | Measurement of voltages at various test points | 30% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Results | 20% |
| 2 | Practical related questions | 20% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

| **Marks Obtained** | | | **Dated signature of Teacher** |
|---|---|---|---|
| **Process Related (15)** | **Product Related (10)** | **Total (25)** | |
| | | | |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# Practical No. 6: Test the LCD and SIM section of mobile phone unit.

**I Practical Significance**

A mobile phone consists of various sections that include transmitter / Receiver section, Buzzer and Vibrator section, Power supply section, Display section, SIM card section.

SIM is the heart of the mobile. LCD is one of the user interface component. To troubleshoot a mobile handset, it is necessary to understand the type of waveforms and the voltages and currents at the output of these sections. The practical will enable students to measure Input/ output voltages of LCD display and SIM card

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **The engineer and society**: Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electronics and Telecommunication engineering

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the Display section and SIM section in a trainer kit.
- Measure the voltages with DMM at the relevant test points

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

Test the LCD and SIM section of mobile phone unit.

**VI Relevant Affective domain related Outcome(s)**

- Handle equipment carefully.
- Work in team
- Follow safety practices

**VII Minimum Theoretical Background**

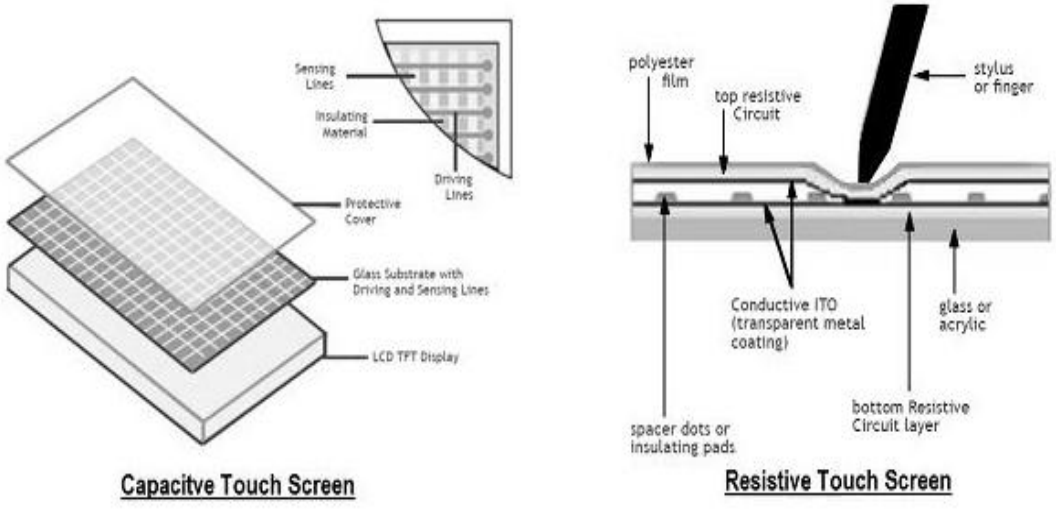
**Display**

Mobile phones may use two types of input devices. In regular mobile phones, a keypad type of device is used, which is mounted separately from the screen of the cellphone. Whereas in touch screen cellphones, a touch screen is a cellphone display screen that also acts as an input device. The touch screens are sensitive to pressure; a

user interacts with the mobile applications by touching pictures or words on the screen.

Touch screen technologies used in mobile phones include resistive and capacitive. The resistive system consists of a normal glass panel that is covered with conductive and resistive metallic layers. These two layers are held apart by spacers, and a scratch resistant layer is placed on top of the whole setup. An electrical current runs through the two layers while the monitor is operational. When a user touches the screen, the two layers make contact exactly at that spot. The change in the electrical field is noted and the coordinates of the point of contact are calculated by the processor. Once the coordinates are known, a special driver translates the touch into something that the operating system can understand, The change in the electrical current is registered as a touch event and sent to the controller for processing.

In the capacitive system, a layer of an electro-conductive material (most often indium tin-oxide) that stores an electrical charge is placed on the glass panel of the monitor. When a user touches the monitor with his finger, some of the charge is transferred to the user, so the charge on the capacitive layer decreases. This decrease is measured in circuits located at each corner of the monitor. The computer calculates, from the relative differences in charge at each corner, exactly where the touch event took place and then relays that information to the touch screen driver software.




*(Courtesy : https://discourse-cdn-sjc1.com/digikey/uploads/default/original/2X/6/6e0443ff7f710841d21ea7e3659696b2f6793c00.JPG)*

**Figure 6. 1: LCD Touchscreen Display**

### SIM Card

SIM card performs various functions and contains parameters such as IMSI , Network state information regarding location updates. The SIM card section requires different signals like data, reset, and clock. SIM card also stores the contact details and the SMS depending on storage capacity

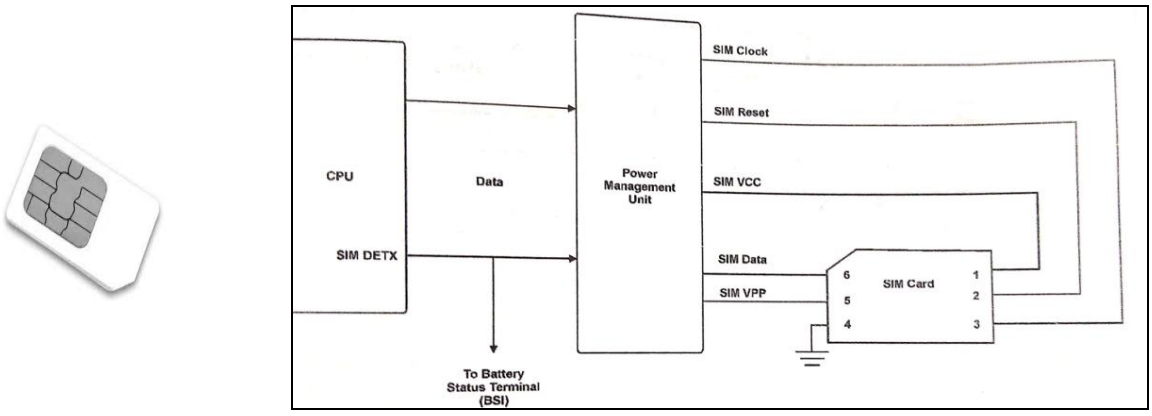



**Figure 6.3: SIM card Interface section**

## VIII Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | DMM | 3 ½ Digit , High resolution | 1 No. |
| 3. | SIM Card | Micro, nano or standard SIM | 1 No. |

## IX Precautions to be Followed

1. Read the instruction manual of the GSM trainer kit before applying power.
2. Install the SIM with care.
3. Measure the voltages at the test points on DMM with proper range

## X Procedure

1. Connect the power cord to the trainer kit. Insert the SIM card in the position provided and turn on the power supply
2. Observe the voltages at test points of LCD section of mobile phone on multimeter and record it
3. Observe the voltages at the different pins of SIM card on multimeter and record it

## XI Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
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## XII Actual procedure followed

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**XIII Precautions followed** (use blank sheet provided if space not sufficient)

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**XIV Observations** (use blank sheet provided if space not sufficient)

**LCD Section**

| Test Points | Standard Voltage(V) | Observed Voltage |
|---|---|---|
| LCD Reset | 6V | |
| LCD operating voltage | 3.8 V | |
| LED operating Volatage | 2V | |

**SIM Card Section**

| Test Points | Standard Voltage(V) | Observed Voltage |
|---|---|---|
| SIM Vcc | 2.8 V | |
| SIM Reset | 2- V | |
| SIM supply voltage | 2V | |
| SIM Data | 2.8 V | |

**XV Result**

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## XVI Interpretation of Results

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## XVII Conclusions and Recommendations

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## XVIII 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 identified CO.**

1. State different types of SIMs available.
2. State the type of SIM used in the trainer kit
3. Define IMSI. State the use of IMSI. State its significance.
4. State the difference between IMSI and IMEI.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

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

## XXI Assessment Scheme

| Performance Indicators | | Weightage % |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Proper handling of the equipment | 20% |
| 2 | Identifying the Test points | 20% |
| 3 | Measurement of voltage | 20% |
| **Product related: 10 Marks** | | **40%** |
| 4 | Results | 20% |
| 5 | Practical related questions | 10% |
| 6 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

## Practical No.7: Test the user Interface section (Keyboard Buzzer, Vibrator, LED, Mic, and Speaker) of Mobile phone unit.

**I Practical Significance**

User Interface Section of the mobile phone has the direct connection with the user of mobile phone. Hence it is called User Interface Section. Key-board, Screen Display Section, Background LED Section, Charging Circuit, State Instruction LED Circuit, Microphone Circuit, Speaker Circuit, etc. are the circuits that have direct connection with the user. This practical will enable the student to troubleshoot Keyboard Buzzer, Vibrator, LED, Mic, and Speaker

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **Environment and sustainability:** Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the User Interface section in a trainer kit.
- Measure the voltages with DMM at the relevant test points
- Observe the waveforms on the CRO.

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

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

**VI Relevant Affective domain related Outcome(s)**

- Handle equipment carefully.
- Work in team
- Follow safety practices

**VII Minimum Theoretical Background**

User Interface Section:

Key-board, Screen Display Section, Background LED Section, Charging Circuit, State Instruction LED Circuit, Microphone Circuit, Speaker Circuit, etc. are the

circuits that have direct connection with the user. Maximum User interface sections have direct connection with the Microprocessor unit and Memory section.

1. **Buzzer:** This is the circuit which informs the incoming call by ringing the bell or ringtone. This is also used to hear the other tones of the mobile phone like Key tone, alarm tone, alert tone etc. Ringer/ buzzer control circuit gets the signal form CPU at the time of incoming call. These control signals activate the ringer circuit to provide the pulses to buzzer and it starts ringing.

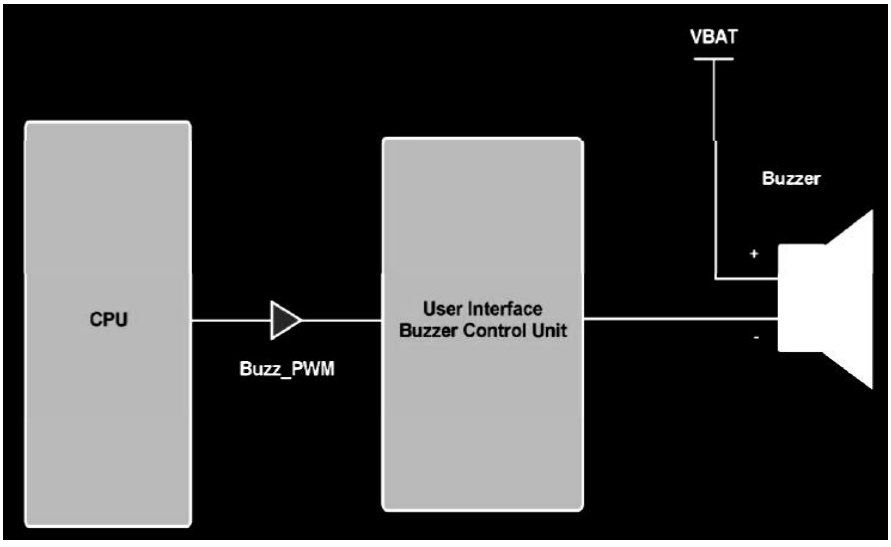


**Figure 7. 1: Block diagram of buzzer control circuit**

2. **Vibrator**: The function of the Vibrator section is to inform the user at the time of incoming call by vibrations. Vibrator control circuit receives the control signal from the CPU and activates the controlling circuit to provide the operating voltage to the vibrator and it starts to vibrate until it gets the signals from the CPU.

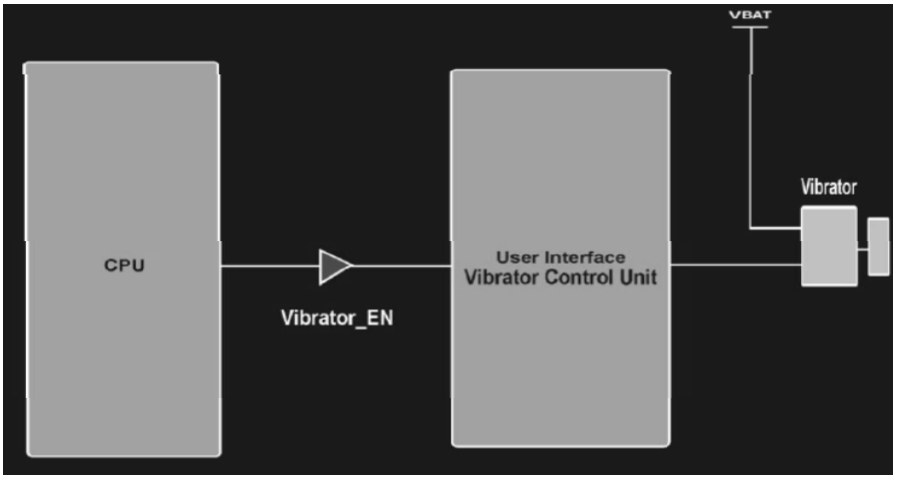


**Figure 7. 2: Block diagram of Vibrator control circuit**

1. **Microphone** : Microphone is for transmitting voice electronically through the call.

2. **Keyboard** : A **keypad** is a set of buttons or keys bearing digits, symbols and/or alphabetical letters placed in order on a pad, which can be used as an efficient input device.

3. **Speaker**.: The speaker is a small sound driver fitted within a mobile phone which is used to produce sound.

4. **LED** : Low power white LEDs of approximately 0.1W are used in backlighting LCD panels and keyboards. Multiple LEDs can be connected together to deliver higher brightness as with torch or flash light for illumination purpose. High-power LEDs of 1 W are used in camera phones with high resolution of 2M pixels or more to support photographing in dark environments

## VIII Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | DMM | 3 ½ Digit | 1 No. |
| 3. | SIM Card | Micro, nano or standard SIM | 1 No. |
| 4. | CRO Oscilloscope | 20 MHz, Dual Trace | 1 No. |

## IX Precautions to be Followed

1. Read the instruction manual of the GSM trainer kit before applying power.
2. Install the SIM with care.
3. Measure the voltages at the test points on DMM/ CRO/DSO with proper range

## X Procedure

1. Connect the power cord to the trainer kit. Insert the SIM card in the position provided and turn on the power supply

2. **Procedure for Buzzer**

   a) Press “Menu” button.
   b) Use scroll keys to get the option ‘Settings’.
   c) Select ‘Sound profiles’ using Up/Down key.
   d) Select ‘Normal’ and press ‘Edit’.
   e) Select ‘Call alert type’ and press ‘Change’.
   f) Select ‘Melody’ mode and save.
   g) Go back and select the ‘Voice call ring tone’.
   h) Press ’Change’ and select any ring tone.
   i) Make a Call to the the trainer kit.
   j) You will observe that the Buzzer starts to ring when trainer is called.
   k) Observe the Buzzer signal at test point in User Interface Section on CRO. It is a PWM signal which is converted to sound

3. **Procedure for Vibrator**

a) Press “Menu” button.
b) Use scroll keys to get the option ‘Settings’.
c) Select ‘Sound profiles’ using Up/Down key.
d) Select ‘Normal’ and press ‘Edit’.
e) Select ‘Call alert type’ and press ‘Change’. Select ‘Vibration’ mode and save. Go back to initial window.
f) Make a Call to the trainer.
g) Observe that the vibrator starts to vibrate when trainer is called.
h) Observe the Vibrator signal at test point in User Interface Section on CRO. It is a DC voltage which drives the vibrator to vibrate. It is approximately 1.5V to 3V.

**Similar procedures are followed for Microphone, Speaker and LED**

## XI Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## XII Actual procedure followed

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## XIII Precautions followed (use blank sheet provided if space not sufficient)

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**XIV Observations** (use blank sheet provided if space not sufficient)

| Sr. No. | Test Point | Observed voltage / waveform) |
|---|---|---|
| 1 | **Buzzer** | |
| 2 | **Vibrator** | |
| 3 | **LED ON & OFF** | |
| 4 | **Microphone(**Transmitted Audio**)** | |
| 5 | **Speaker (**Received Audio signal**)** | |

**XV Result**

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## XVI Interpretation of Results

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## XVII Conclusions and Recommendations

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## XVIII 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 identified CO.**

1. Give the method to determine whether speaker is faulty or proper.
2. Give the troubleshoot procedure for keyboard user interface device.
3. Name the types of mic and Speaker used in mobile phones.
4. Name the type of buzzer and vibrator used in mobile phone.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

- https://searchmobilecomputing.techtarget.com/.../mobile-UI-mobile-user-interface

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Proper handling of the equipment | 20% |
| 2 | Identifying the Test points | 20% |
| 3 | Measurement of voltage | 20% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related (15)** | **Product Related (10)** | **Total (25)** | |
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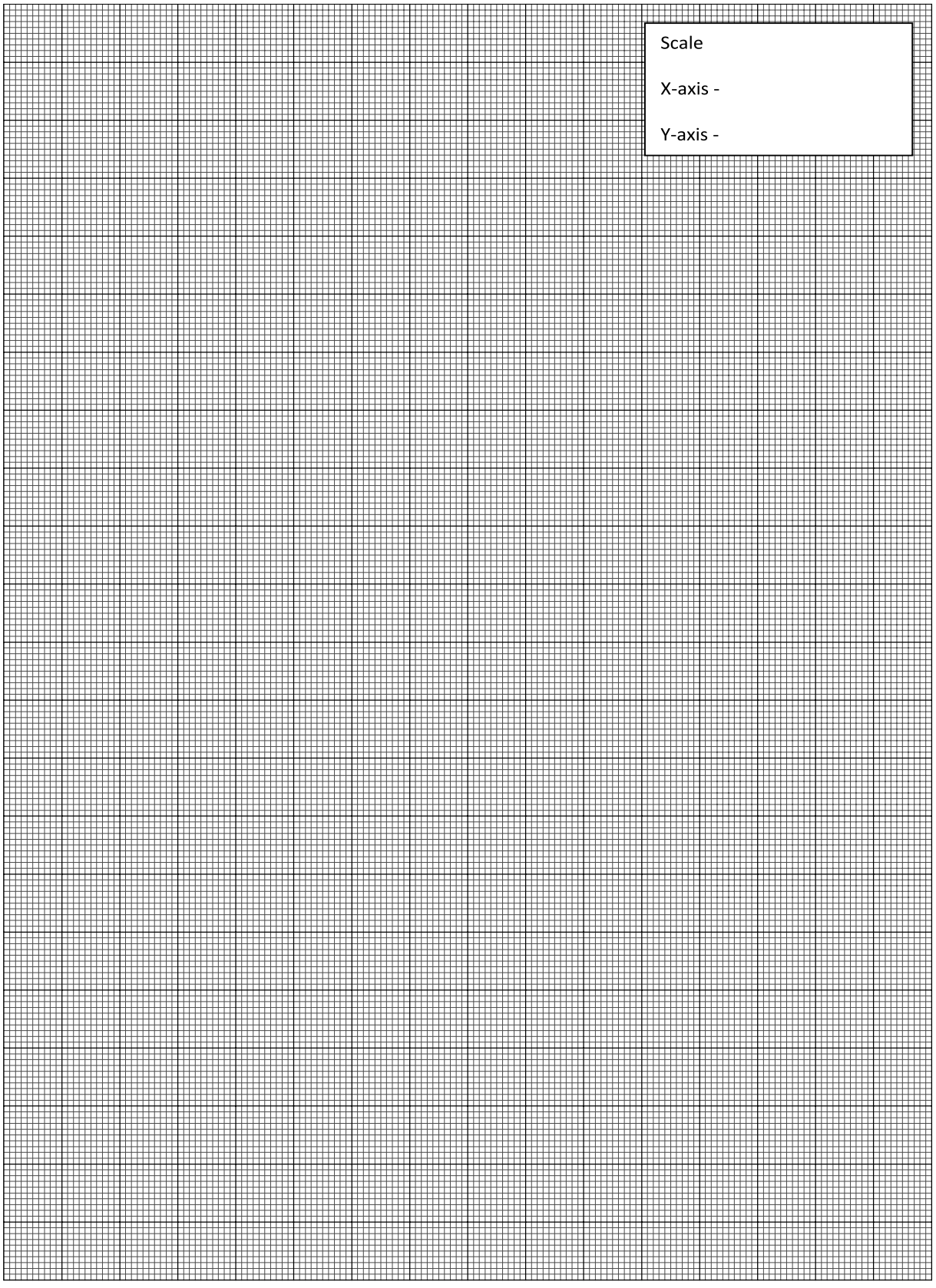
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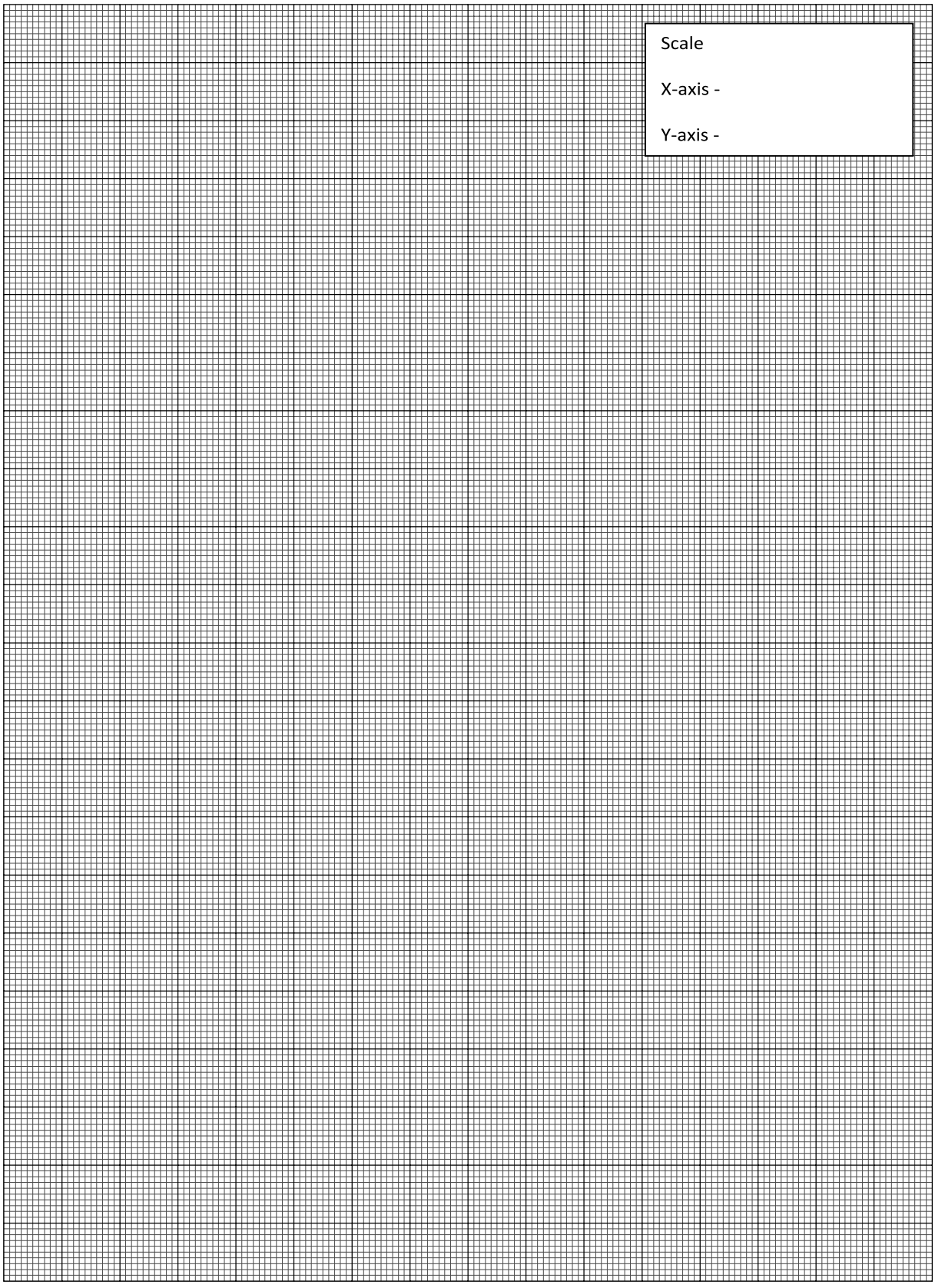
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## Practical No. 8: Troubleshoot the Battery charger section, LCD section and SIM card section of the mobile handset.

**I Practical Significance**

Mobile phones offer a set of capabilities, services and applications to their users. The user may come across problem in any of the above features. Troubleshooting is the process of diagnosing the source of a problem. It is used to fix problems with hardware, software, and many other products. In this practical, the student will be able to identify faults/ troubleshoot in battery section, display section and SIM card section.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electronics and Telecommunication engineering.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Testing of various faults in different sections of mobile phone.
- Compare the observed voltages with standard voltages

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

Troubleshoot the Battery charger section, LCD section and SIM card section of the mobile handset**.**

**VI Relevant Affective domain related Outcome(s)**

- Maintain tools and equipment
- Follow ethical practices

**VII Minimum Theoretical Background**

1. **Battery charger section:** Types of Faults or Problems with battery charging in any Mobile Cell Phone are as follows :
   a) Battery of the mobile phone is not charging at all.
   b) There is sign of battery charging but the battery is actually not getting charged.
   c) When the charger is inserted, it shows Not Charging.
   d) When the charger is connected it shows Bad Connecting Charging.
   e) When the charger is inserted the mobile phone gets hot.

2. **SIM Section:** Some of the problems with the SIM section may be as follows:

   a) SIM is inserted but still there is a message saying "Insert SIM".
   b) The Mobile Phone goes OFFLINE when the SIM Card is inserted.
   c) SIM works for some time and then it stops working.
   d) There is a message that says "Invalid SIM".

3. **LCD section:** Types of Faults or Problems with Display in any Mobile Cell Phone are as follows
   a) Display is blank.
   b) Display not working properly.
   c) Only Half Display Works.
   d) White Display.
   e) Display Upside Down.
   f) Display is Broken.
   g) When the Mobile Phone is Switched ON, the Logo Appears and then the Display Disappears.

## VIII Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Mobile phone Trainer kit | 2G/3G/4G GSM trainer kit | 1 |
| 2. | Power supply | 0-30 V single DC power supply | 1. |
| 3. | Oscilloscope | 20 MHz Dual trace | 1 |
| 4. | DMM | 31/2 Digit | 1 |
| 5. | Connecting wires/ probes | Banana plugs | 4 No. |

## IX Precautions to be Followed

1. Insert SIM card(s) before switching ON.
2. Handle the equipment with care

## X Procedure

**A Battery charger section :** To Solve battery charging Fault in any Mobile Cell Phone, following procedure is followed

1. Change the charger and check. Voltage must be 5 to 7 Volts.
2. Clean, Resolder or Change the Charger Connector.
3. If the problem is not solved then change the Battery and Check.
4. Check Voltage of the Battery Connector using a Multimeter. Voltage must be 1.5 to 3.7 DC Volts.
5. If there is no voltage in the connector then check track of the charging section.
6. If the problem still persists then check Fuse, Coil and Regulator one by one. Change if required.
7. If the problem is still not solved then Change the Charging IC.
8. Finally Change the Power IC.

**B SIM Section :** To Solve SIM Card Fault in any Mobile Phone, following procedure is followed

1. Check settings and see if the mobile phone is in Flight Mode or Not. If it is in "Flight Mode" then change the Mode to Normal.

2. Clean SIM Card Tips and SIM Connector.
3. If the problem is not solved then change the SIM Card and Check.
4. If the problem still persists then Change the SIM Connector.
5. If the problem is still not solved then Change the SIM IC.
6. Finally, if the problem persists, Change the Power IC.

**C LCD Section: To solve the problem of display, the following steps are followed**

1. Clean Display Tips and Display Connector.
2. Resolder the Display Connector.
3. Change the Display.
4. Check Display Track.
5. Change the Display IC.
6. Change the CPU.IC

## XI Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XII Actual procedure followed

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## XIII Precautions followed (use blank sheet provided if space not sufficient)

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## XIV Observations (use blank sheet provided if space not sufficient)

**Table No. 8.1: Faults in Battery section**

| Sr. No. | Fault | Possible response | Received Response |
|---|---|---|---|
| 1 | Insert fault such that there is no power supply to Mobile unit | The fault stops to supply battery voltage of 3.7 V | |

| Sr. No. | Fault | Possible response | Received Response |
|---|---|---|---|
| 2 | Disconnect battery status indicator pin | Battery does not start to charge and the mobile trainer kits continuously switches off and restarts | |
| 3 | Insert fault of improper grounding of the battery | Mobile unit stops charging | |
| 4 | Disconnect charger voltage from charging circuit | Mobile unit stops charging | |

**Table No. 8.2: Faults in SIM Section**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | Insert the fault of removing SIM $V_{CC}$. | Message " Insert SIM "on the display screen | |
| 2 | Remove SIM card | Message " Insert SIM "on the display screen | |
| 3. | Disconnect SIM reset connection | Message " Insert SIM "on the display screen | |

**Table No. 8.3: LCD section**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | Introduce fault in LCD reset voltage | Display light starts blinking | |
| 2 | Keep LCD supply off | No display | |
| 3. | Insert fault to keep the LCD supply not grounded | Display blurred | |
| 4. | Remove LCD clock signal | Display is hanged | |

## XV Result

| Sections | Voltages at Test Point | Possible fault |
|---|---|---|
| Battery charger | | |
| | | |
| | | |
| LCD | | |
| | | |
| | | |
| SIM | | |
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## XVI Interpretation of Results

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## XVII Conclusions and Recommendations

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## XVIII 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 identified CO.**

1. Explain method to do direct charging of the mobile phone if the charging circuit is non- functional
2. Name the test points whose fault insertion gives rise to fault in battery charging
3. List the possible messages when SIM card is faulty
4. State the meaning of the term “SIM card locked”
5. Name the signals required in the LCD section

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. http://www.mobilecellphonerepairing.com/mobile-cell-phone-display-not-working-problem-and-solution-how-to-solve-display-fault-in-any-mobile-cell-phone.html
2. http://www.mobilecellphonerepairing.com/mobile-cell-phone-battery-charging-problem-and-solution-how-to-solve-not-charging-problem-in-any-mobile-cell-phone.html
3. https://www.youtube.com/watch?v=tBrCzvWP8Qg

## XXI Assessment Scheme

| Performance Indicators | | Weightage % |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Handling of the components | 10 % |
| 2 | Identification of component | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related (10 Marks)** | | **40%** |
| 5 | Interpretation of result | 15 % |
| 6 | Conclusions | 05 % |
| 7 | Practical related questions | 15 % |
| 8 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 9: Troubleshoot User Interface section of mobile phone unit

**I Practical Significance**

The market size of mobile phones continues to expand every year. Particularly, the number of multifunctional mobile phones called smart phones equipped with high performance processors has been growing remarkably more than conventional mobile phones. The features of mobile phones are the set of capabilities, services and applications that they offer to their users. Troubleshooting is the process of diagnosing the source of a problem. The basic theory of troubleshooting is that we start with the most general possible problems, and then narrow it down to more specific issues. This practical will enable the student to identify and troubleshoot problems associated with User Interface section.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Testing of various faults in the different sections of mobile phone.
- Compare the observed voltages with standard voltages.

**IV Relevant Course Outcome**

Troubleshoot mobile handsets.

**V Practical Outcome**

Troubleshoot the speaker problem, Ringer problem, Microphone problem, vibrator problem (User Interface section).

**VI Relevant Affective domain related Outcome(s)**

- Maintain tools and equipment
- Follow ethical practices
- Follow safety practices

**VII Minimum Theoretical Background**

**A Microphone/ Speaker:** Types of Faults or Problems with Earpiece or Speaker in any Mobile Cell Phone are

a. No sound or Less Sound during phone call.
b. Sound with interruption or Changed sound.

**B Ringer/ vibrator section:** Types of Faults or Problems in Mobile Phone Ringer are

a. Vibrator not working.`
b. Vibration with interruption.
c. Vibration Hangs.

## VIII Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | GSM Trainer Kit | 2G/3G/4G GSM trainer kit | 1 No. |
| 2. | CRO/DSO | 20MHz, dual trace, dual beam, | 1 No. |
| 3. | DMM | 3 ½ Digit | 1 No. |
| 4. | Mobile repairing tool kit | Consisting of Screw driver, Tweezers and Opener | 1 No. |

## IX Precautions to be Followed

1. Insert SIM card(s) before switching ON.
2. Handle equipments with care

## X Procedure

### A. Troubleshoot Speaker:

1. Check Speaker Volume during Phone Call.
2. If speaker volume is not proper then Check Earpiece / Speaker by Keeping the Multimeter in Buzzer Mode. Value must be 25~35 Ohm. If the Value is not between 25~35 Ohm then change the Earpiece / Speaker.
3. If the problem is not solved then Check Circuit Track of Earpiece Section.
4. If the problem is not solved then Change the Audio IC.
5. If the problem is still not solved then Change the CPU.

   **Note: If there is less sound or sound is not clear during phone call then change the speaker.**

### B. Troubleshoot Microphone

1. Check Microphone setting.
2. If all settings are proper then, Check and clean Microphone Tips and Connector.
3. If the problem is not solved then Check Microphone by keeping the Multimeter in Buzzer Mode. Value must be 600~1800 Ohm. If the Value is not between 600~1800 Ohm then change the Microphone.

   **Note: Only one side will give value. The other side will not give any value.**
4. If the problem is not solved then Check Track of Microphone Section.
5. If the problem is not solved then Change Microphone IC.
6. If the problem is not solved then Change the Audio IC / Power IC.
7. If the problem is still not solved then Change CPU.

### C. Troubleshoot Ringer Section:

1. Check ringer settings in mobile phone. Check Ringer Volume and Silent Mode. Adjust or change volume and / or mode if required.
2. If the problem is not solved then open the mobile phone and clean ringer point and ringer connector.
3. If the problem is not solved then check ringer by keeping the multimeter in buzzer mode. Value must be 8 ~ 10 Ohm. If the Value is not between 8~10 Ohm then change the Ringer.
4. If the problem is not solved then check track of ringer section.

5. If the problem is not solved then check Ringer IC and change the IC if required.
6. If the problem is not solved then change Logic IC.
7. If the problem is still not solved then change the CPU.

**D. Troubleshoot Vibrator Section:**

1. Check Vibrator Settings in Mobile Phone. Check if Vibrator is ON or OFF.
2. If the problem is not solved then open the mobile cell phone and clean vibrator tips and connector.
3. If the problem is not solved then check vibrator by keeping the multimeter in Buzzer Mode. Value must be 8~16 Ohm. If the Value is not between 8~16 Ohm then change the Vibrator / Motor.
4. If the problem is not solved then check track of vibrator section.
5. If the problem is not solved then change Logic IC / Power IC.
6. If the problem is still not solved then change the CPU.

## XI Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XII Actual procedure followed

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## XIII **Precautions followed** (use blank sheet provided if space not sufficient)

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**XIV Observations** (use blank sheet provided if space not sufficient)

**Table No. 9.1: Faults in speaker**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | No sound during phone call | Not getting sound | |

**Table No. 9.2: Faults in Microphone**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | No sound or Less Sound during phone call. | No sound | |

**Table No. 9.3: Faults in Ringer**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | Ringer not working. | No sound | |
| 2 | Less sound from the Ringer. | Less sound | |
| 3 | Ringer Input OFF | PWM signal not present | |

**Table No. 9.4 :Faults in Vibrator**

| Sr. No. | Fault | Possible response | Response Received |
|---|---|---|---|
| 1 | Vibrator not working | No vibration | |
| 2 | Vibrator input off | PWM signal not present | |

**XV Result**

| Sections | Voltages at Test Point | Probable fault |
|---|---|---|
| Ringer | | |
| | | |
| Vibrator | | |
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## XVI Interpretation of Results

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## XVII Conclusions and Recommendations

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## XVIII 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 identified CO.**

1. State the function of Microphone.
2. State the function of vibrator.
3. State the fault associated with Ringer.
4. Name the test points where faults related to Ringer / vibrator can be found.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. http://www.mobilecellphonerepairing.com/mobile-cell-phone-microphone-mic-not-working-problem-and-solution-how-to-solve-microphone-fault-in-any-mobile-cell-phone.html
2. http://www.mobilecellphonerepairing.com/mobile-phone-vibrator-problem-and-solution-how-to-solve-vibrator-fault-in-any-mobile-cell-phone.html
3. https://www.youtube.com/watch?v=lSnVg0ohKPA

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Proper handling of the equipment | 20% |
| 2 | Identifying the Test points | 20% |
| 3 | Measurement of voltage | 20% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 10: Determine the coverage area of a split cell which has radius half the radius of original cell.

**I Practical Significance**

A cell is the geographical area covered by a cellular telephone transmitter. Cell splitting increases the capacity of the cellular system since it increases the number of times the channels are reused. In this practical the student will be able to study the effect of changing the radius of the cell.

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
- **Environment and sustainability:** Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

Calculate the coverage area of the cell

**IV Relevant Course Outcome**

Assess cellular systems capacity.

**V Practical Outcome**

Determine the coverage area of a split cell which has radius half the radius of original cell.

**VI Relevant Affective domain related Outcome(s)**

Ethical work practices

**VII Minimum Theoretical Background**

A cell is a geographical area covered by a cellular telephone transmitter. The radius of a cell varies from a few kilometers to several kilometers, depending on the terrain and the transmission power. As the demand for wireless service increases , the number of channels assigned to a cell eventually becomes insufficient to support required number of users. Cellular design techniques are required to provide more channels per unit coverage area. Techniques such as **cell splitting, Cell sectoring and coverage zone** approaches are used in the practice to expand the capacity of cellular systems. Cell splitting allows an orderly growth of cellular system. Cell sectoring uses directional antenna to further control the interference and frequency reuse of channels. The zone microcell concept distributes the coverage of the cell and extends the cell boundary to hard –to- reach places.

Cell splitting is the process of subdividing a congested cell into smaller cells, each with its own base station and a corresponding reduction in antenna height and transmitter power. Cell splitting improves the capacity of the cellular system since it increases the number of times the same frequency channels are reused. By defining new cells between the existing cells, capacity increases due to additional number of channels per unit area.

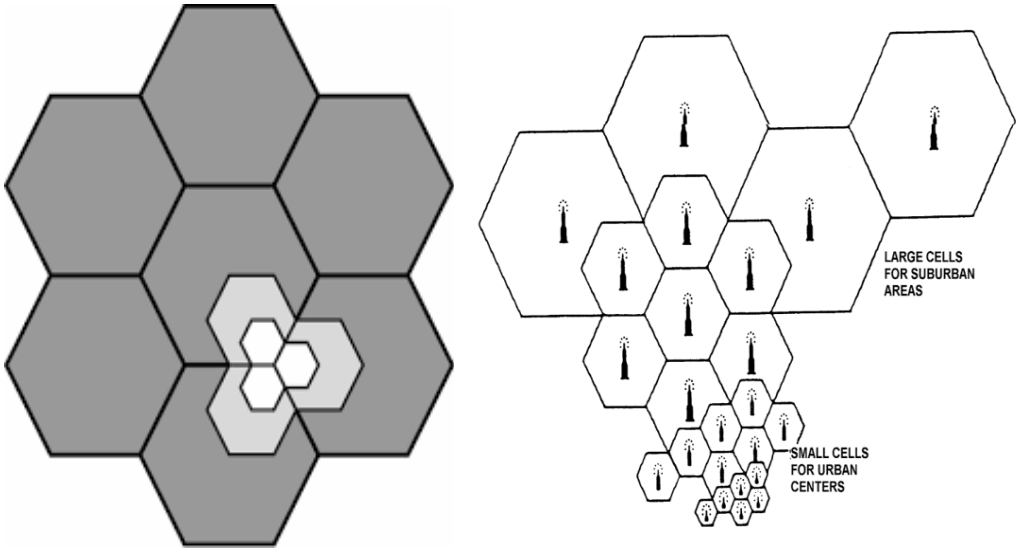


**Figure 10.1: Cell splitting**

## VIII Precautions to be Followed

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

## IX Procedure

1. Draw a 7 cell cluster in a graph paper with each segment of the hexagon to be 1 cm.
2. Mark them as A,B,C,D,E,F and G
3. Mark the centre point of each side of each hexagon
4. Draw all the possible smaller hexagons with half the length of the side within the cluster.
5. Count the number of such small hexagons formed
6. Compare the number with the theoretical value using the formula

## X Actual Procedure Followed

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**XI Precautions:**

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**XII Observations :**

| | hexagon side =1 cm | | hexagon side =1/2 cm | |
|---|---|---|---|---|
| **Number of cells in the cluster N=7** | | | | |
| **Area of the hexagon** | **Theoretical** | **Practical(from graph)** | **Theoretical** | **Practical (from graph)** |
| | | | | |

**XIII Calculation:**

Consider area covered by hexagon is equal to the area of a circle.
The area of circle with radius R is $\pi R^2$
If the radius id halved then the area covered will be $\pi(R/2)^2$
The area covered by the circle with half the radius is $\pi R^2/4$

**Calculations from graph**

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Consider the area of the regular hexagon

A= $3\sqrt{3}a^2$

Where a is the length of side. Calculate the area of the hexagon for a= 1 cm and a= ½ cm

**Calculation:**

**XIV Result**

Comment on the height of antenna and the power transmitted by large cell and small cell

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**XV Interpretation of Results**

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**XVI Conclusions and Recommendations**

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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 identified CO.**

1. State the effect of cell splitting on signal to inference ratio.
2. State the number of smaller cells of half the length of side in a cluster with size 12.
3 State the relationship between the transmit powers of large cell and small cell base stations.

**[Space for Answers]**

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## XVIII References / Suggestions for further Reading

1. Lee, C. Y. William, Mobile Cellular Telecommunications System, Mcgraw Hill Education, New Delhi, 2017, ISBN-13: 978-0070635999
2. Rappaport, S.Theodore, Wireless communication-Principles and practice, Pearson publication New Delhi, 2005, ISBN: 978-81-317-3186-4
3. http://www.pitt.edu/~dtipper/2720/2720

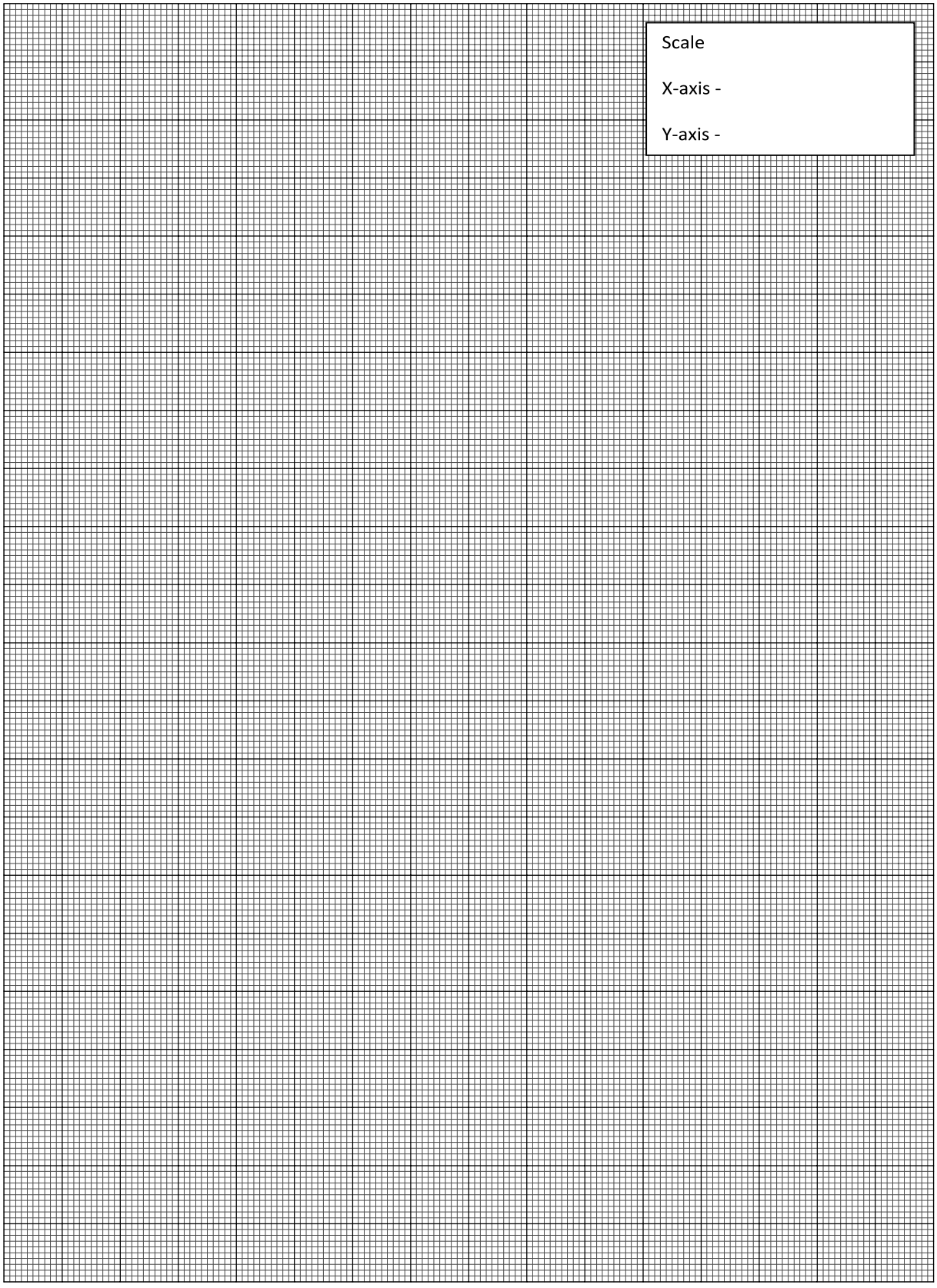
## XIX Assessment Scheme

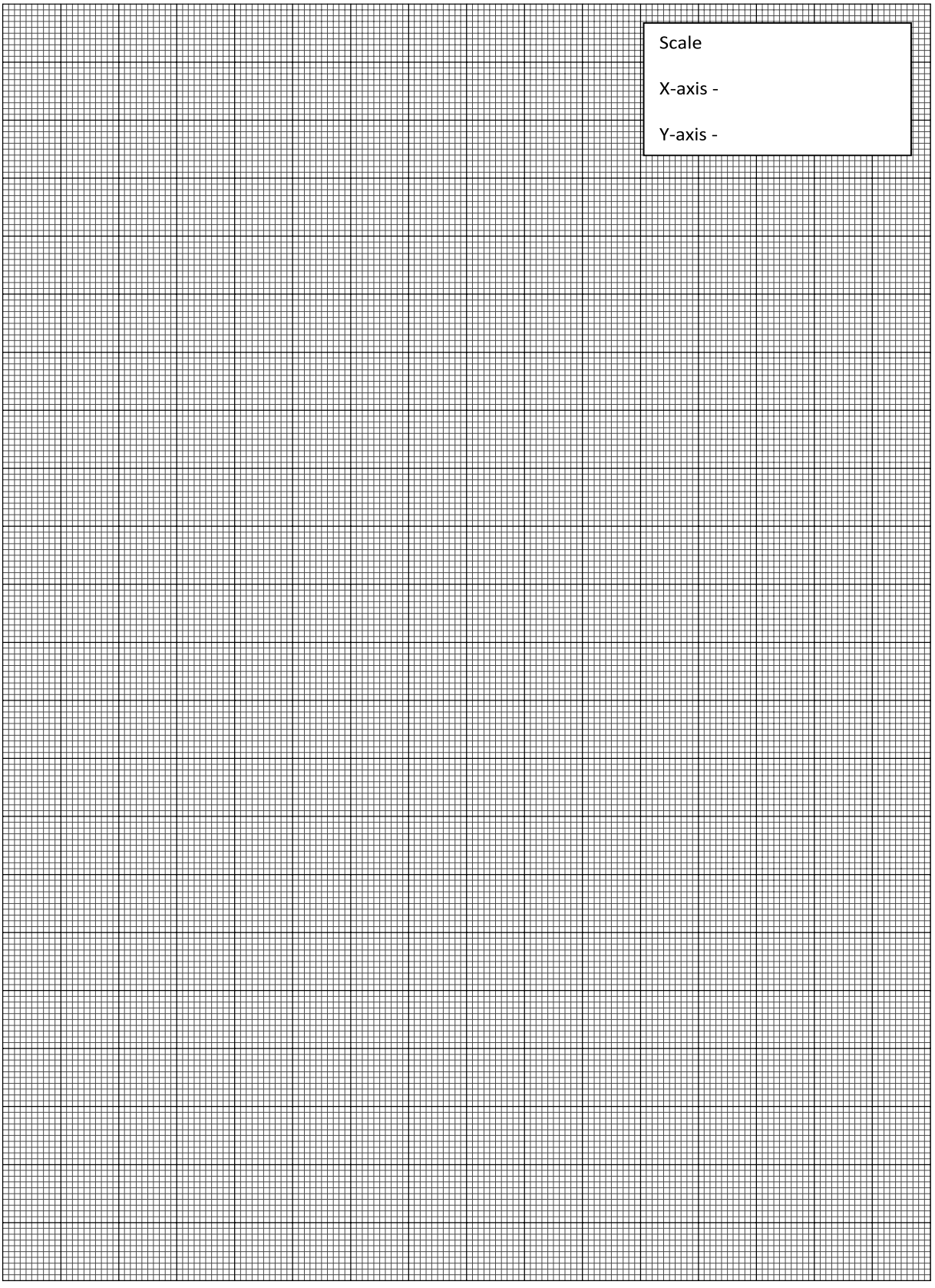
| Performance Indicators | | Weightage % |
|---|---|---|
| **Process related (15 Marks )** | | **60%** |
| 1 | Drawing proper graphs | 30% |
| 2 | calculations | 30% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks )** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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


Scale
X-axis -
Y-axis -


Scale
X-axis -
Y-axis -

# Practical No. 11: Determine the channel capacity of a cellular system service area comprised of 4/7/12 macrocells with 8/12/16 channels per macrocell

**I Practical Significance**

A cell is the geographical area covered by a cellular telephone transmitter. Cell splitting increases the capacity of the cellular system since it increases the number of times the channels are reused. In this practical the student will be able to study the effect of cell splitting on the channel capacity using the software SCILAB

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Life-long learning**: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

Use Scilab or equivalent software Calculate the channel capacity of cellular system

**IV Relevant Course Outcome**

Assess cellular systems capacity.

**V Practical Outcome**

Determine the channel capacity of a cellular system service area comprised of 4/7/12 macrocells with 8/12/16 channels per macrocell.

**VI Relevant Affective domain related Outcome(s)**

Ethical work practices

**VII Minimum Theoretical Background**

As the number of users in a cellular system increases , the traffic per unit time also increases. The allocated spectrum becomes gradually congested and eventually becomes used up. Congestion of the spectrum means that the call blocking probability increases which is not desired. Cell splitting is used as a technique to improve channel capacity in a cellular system. Frequency reuse concept enables a fix number of channels to serve an arbitrarily large number of users by reusing the channel throughout the coverage region.

Each cellular base station is allocated a group of radio channels within a small geographic area called a *cell*. Neighboring cells are assigned different channel groups. By limiting the coverage area to within the boundary of the cell, the channel groups

may be reused to cover different cells. The interference levels are to be kept within tolerable limits.

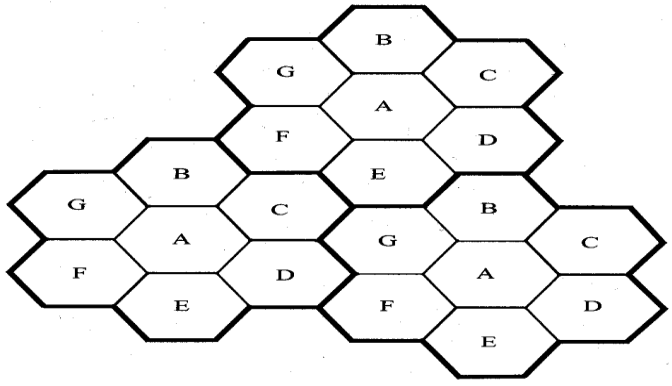



**Figure 11.1: Frequency Reuse concept**

Consider a cellular system which has a total of $S$ duplex channels. Each cell is allocated a group of $k$ channels. $S$ channels are divided among $N$ cells. The total number of available radio channels is $S = kN$

The $N$ cells which use the complete set of channels is called *cluster*. The cluster can be repeated $M$ times within the system. The total number of channels, $C$, is used as a measure of capacity $C = MkN = MS$

The capacity is directly proportional to the number of replication $M$. The cluster size, $N$, is typically equal to 4, 7, or 12.Small $N$ is desirable to maximize capacity.

The frequency reuse factor is given by $1 / N$

## VIII Precautions

1. Use proper syntax

## IX Procedure

**1.** Download the Scilab software using the link https://www.scilab.org/download/6.0.2

2. Click on Scilab software icon. The screen will appear as in figure 11.2

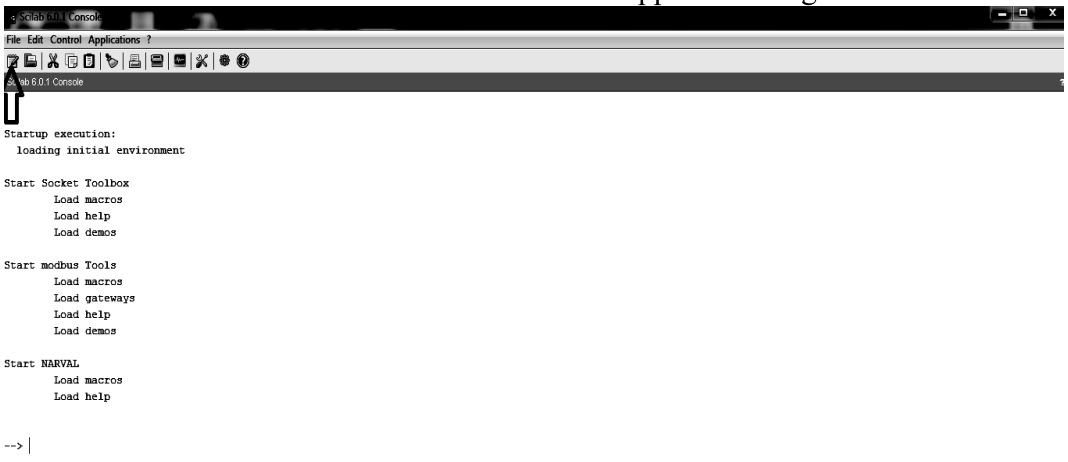


**Figure 11.2: SCILAB screen**

3. Open a scinotes by clicking the icon shown

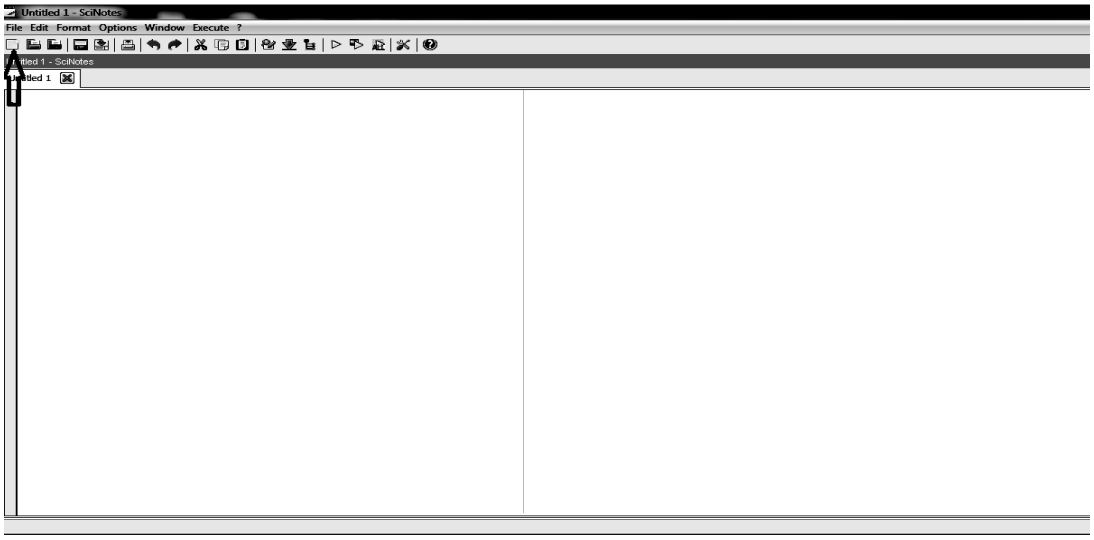



**Figure 11.3: SCILAB screen**

4. Click on “File” >“New” to create new scinote
5. Build a code for calculation of channel capacity

   **Code for Calculation of Channel Capacity:**

```
clc;
clear all;
M=input("enter the number of cluster: ");
k=input("enter the Number of channels per cells: ");
N=input("enter the number of cells in a cluster: ");
y = k*M*N;
disp(y);
```

6. Save the document.
7. Click on “Execute “ button

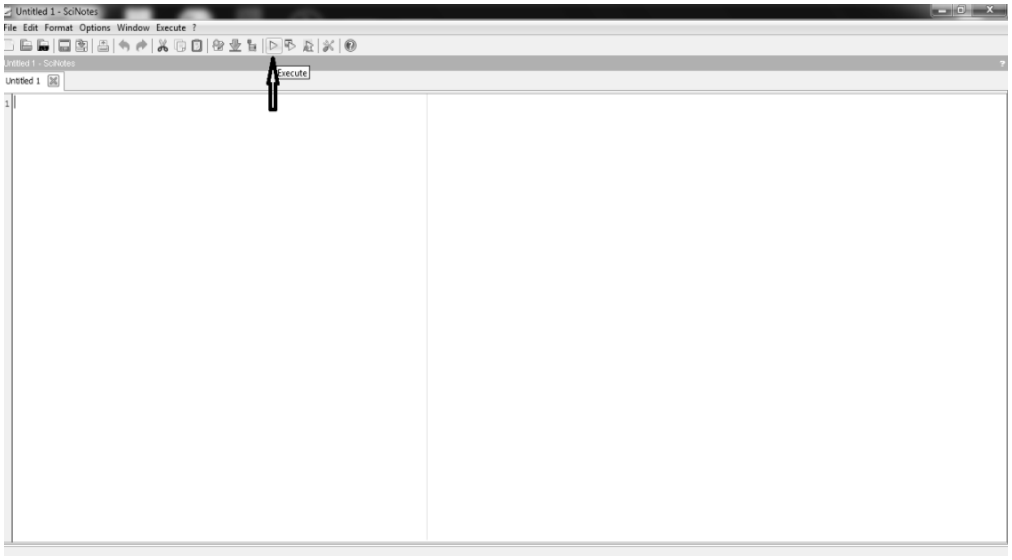



**Figure 11.4: SCILAB screen**

8. Observe the result on the screen in Fig 11.2
9. Change the value of M,N and k as given in the observation table and note down the outputs. Tabulate the results obtained

**Note: The teacher may give an overview of SCILAB software for understanding the software environment**

**X Actual Procedure Followed**

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**XI Precautions:**

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**XII Observations** (use blank sheet provided if space not sufficient)
**For M=1**

| Cluster Size | 8 Channels per macrocell | 12 channels per macrocell | 16 Channels per macrocell |
|---|---|---|---|
| 4 | | | |
| 7 | | | |
| 12 | | | |

**XIII Result**

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**XVII Interpretation of Results**

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## XVIII Conclusions and Recommendations

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## XIX 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 identified CO.**

1. Perform the above experiment for M=2
2. Is it possible to keep reducing the cell size. Is there any optimization?

**[Space for Answers]**

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## XX References / Suggestions for further Reading


1. Lee, C. Y. William, Mobile Cellular Telecommunications System, Mcgraw Hill Education, New Delhi, 2017, ISBN-13: 978-0070635999
2. Rappaport, S.Theodore, Wireless communication-Principles and practice, Pearson publication New Delhi, 2005, ISBN: 978-81-317-3186-4
3. https://www.youtube.com/watch?v=z_v96-ppe6U
4. https://www.scilab.org/download/6.0.2


## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Writing the code | 30% |
| 2 | Execution | 30% |
| **Product related: 10 Marks** | | **40%** |
| 1 | Interpretation of Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| | **Total** | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 12: Effect of Cell splitting on Channel capacity

**I Practical Significance**

A cell is the geographical area covered by a cellular telephone transmitter. Cell splitting increases the capacity of the cellular system since it increases the number of times the channels are reused. A macro cell can be divided into microcells. In this practical the student will be able to study the effect cell splitting on the channel capacity using the software SCILAB

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Life-long learning**: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

Use of Scilab or Equivalent software to Calculate the channel capacity of a macrocell divided into minicell and then into microcell

**IV Relevant Course Outcome**

Assess cellular systems capacity.

**V Practical Outcome**

Determine the channel capacity a cellular system service area comprised of 4/7/12 macrocells with 8/12/16 channels per macrocell. if each macrocell in is split into 4 minicells and each minicell is further split into 4 microcells.

**VI Relevant Affective domain related Outcome(s)**

- Ethical work practices
- Proper use of software

**VII Minimum Theoretical Background**

As the number of users in a cellular system increases , the traffic per unit time also increases. The allocated spectrum becomes gradually congested and eventually becomes used up. Congestion of the spectrum means that the call blocking probability increases which is not desired. Cell splitting is used as a technique to improve channel capacity in a cellular system.

Number of Macrocells per system = 7

Number of channels per macrocell = 16

Number of channels per macrocell system =7x16 = 112 channels

Channel capacity of macrocell system is 112 channels
Number of minicells in a macrocell =4
Number of channels per minicell system = 4x7x 16 = 448 channels
C-hannel capacity of minicell system is 448 channels
Number of microcell a minicell =4
Number of microcell in a macrocell is 4x4 =16
Number channels per microcell system = 16x7x16= 1792 channels
Channel capacity of micro cell system is 1792 channels

## VIII Precautions

1. Use proper syntax

## IX Procedure

1. Download the Scilab software using the link https://www.scilab.org/download/6.0.2
2. Click on SCILAB software icon.
3. Open a scinotes by clicking the icon “File”
4. Click on “File” >“New” to create new scinote
5. Build a code for calculation of channel capacity

   **Code for Calculation of Channel Capacity:**

```
clc;
clear all;
M=input("enter the number of cluster: ");
k=input("enter the Number of channels per cells: ");
N=input("enter the number of cells in a cluster: ");
a= input("enter the Number of mini cells per Macro cells: ");
b= input("enter the Number of Micro cells per Mini cells: ");
   y = k*M*N*a;
disp('Channel Capacity considering Minicells:' );
disp (y);

z= y*b;
disp('Channel Capacity considering Microcells:' );
disp (z);
```

6. Save the document.
7. Click on “Execute “ button
8. Observe the result in screen shown in fig 11.2
9. Similarly build the code by changing the number of channels per cell to 8 and 12

**Note: The teacher may give an overview of SCILAB software for understanding the software environment**

## X Actual Procedure Followed

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**XI Precautions:**

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**XII Observations** (use blank sheet provided if space not sufficient)
Cluster size = 7

| | Channel capacity | | |
|---|---|---|---|
| | **8 channel per cell** | **12 channel per cell** | **16 channel per cell** |
| **Macrocell** | | | |
| **Mini cell** | | | |
| **Microcell** | | | |

**XIII Result**

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**XVII Interpretation of Results**

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**XVIII Conclusions and Recommendations**

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**XIX 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 identified CO.**

1. Perform the above experiment for a cluster size of 4
2. Perform the above experiment for a cluster size of 12

**[Space for Answers]**

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**XX References / Suggestions for further Reading**

1. Lee, C. Y. William, Mobile Cellular Telecommunications System, Mcgraw Hill Education, New Delhi, 2017, ISBN-13: 978-0070635999
2. Rappaport, S.Theodore, Wireless communication-Principles and practice, Pearson publication New Delhi, 2005, ISBN: 978-81-317-3186-4
3. https://www.scilab.org/download/6.0.2

**XXI Assessment Scheme**

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Writing the code | 30% |
| 2 | Execution | 30% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Interpretation of Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 13: Fixed assignment of voice channels

**I Practical Significance**

The assignment of certain sets of voice channels in each cell is based on the aspect that it causes minimum co channel interference and adjacent channel interference. The criteria of frequency planning in cellular systems includes assignment of channels to each cell and maintain the desired signal quality In this practical the student will be able to study the assignment of voice channel to each cell if Omni-directional antenna is used at the cell site using the software SCILAB

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Life-long learning**: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

Use of Scilab or Equivalent software to Calculate the number of voice channels in each cell in a cell site using omni directional antenna

**IV Relevant Course Outcome**

Assess cellular systems capacity.

**V Practical Outcome**

For the 7- cell cluster and 168-voice channels cellular system, determine the assignment of voice channel to each cell if Omni-directional antenna is used at the cell site.

**VI Relevant Affective domain related Outcome(s)**

- Ethical work practices
- Proper use of software

**VII Minimum Theoretical Background**

Each cell is allocated a portion of the total frequency spectrum. As users move into a given cell, they are then permitted to utilize the channel allocated to that cell. The virtue of the cellular system is that different cells can use the same channel given that

the cells are separated by a minimum distance according to the system propagation characteristics; otherwise, intercellular or co-channel interference occurs. Channel allocation deals with the allocation of channels to cells in a cellular network. Once the channels are allocated, cells may then allow users within the cell to communicate via the available channels. There are three major categories for assigning these channels to cells (or base-stations). They are

- Fixed Channel Allocation,
- Dynamic Channel Allocation and
- Hybrid Channel Allocation which is a combination of the first two methods.

**VIII Precautions**

1. Use proper syntax

**IX Procedure**

1. Click on Scilab software Icon.
2. Open a scinotes by clicking the icon “File”
3. Click on “File” >“New” to create new scinote
4. Build a code for calculation of number of voice channels keeping the number of voice channels as 168 and cluster size as 7

   **Code for Calculation number of voice channels:**

```
clc;
clear all;

k=input("enter the Number of channels: ");
n=input("enter the number of cells in a cluster: ");


b= k/n;
disp('Number of Voice channels available in a cell when omni directional antenna is used:' );
disp (b);
```

5. Save the document.
6. Click on “Execute “ button
7. Observe the result
8. Perform the same for cluster size of 4 and 12 respectively

**Note: The teacher may give an overview of SCILAB software for understanding the software environment**

**X Actual Procedure Followed**

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**XI Precautions:**

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**XII Observations** (use blank sheet provided if space not sufficient)\

| Cluster size | Number of voice channel per cell |
|---|---|
| **7** | |
| **4** | |
| **12** | |

**XIII Result**

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**XVII Interpretation of Results**

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**XVIII Conclusions and Recommendations**

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## XIX 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 identified CO.**

1. State the essential advantages of dynamic channel assignment method to fixed channel assignment
2. Perform the above experiment if the number of voice channels in a cellular system is 385 and the cluster size is 7.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. Lee, C. Y. William, Mobile Cellular Telecommunications System, Mcgraw Hill Education, New Delhi, 2017, ISBN-13: 978-0070635999
2. Rappaport, S.Theodore, Wireless communication-Principles and practice, Pearson publication New Delhi, 2005, ISBN: 978-81-317-3186-4
3. https://www.scilab.org/download/6.0.2

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Writing the code | 30% |
| 2 | Execution | 30% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Interpretation of Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No. 14: To assign voice channels in Cell sectoring

**I Practical Significance**

The assignment of certain sets of voice channels in each cell is based on the aspect that it causes minimum co channel interference and adjacent channel interference. Cell splitting achieves capacity improvement by essentially rescaling the system., thus increasing the number of channels per unit area. Cell sectoring is another method of improving the cell capacity. It also increases the SIR (Signal to Interference Ratio). In this practical the student will be able to build a code in SCILAB for voice channel assignment using directional antenna for 3- sector $120^0$ and 6 -sector $60^0$ at the cell site

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Life-long learning**: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

Use of Scilab or Equivalent software to Calculate the number of voice channels in each sector if 3- sector $120^0$ and 6 -sector $60^0$ directional antenna are used at the cell site.

**IV Relevant Course Outcome**

Assess cellular systems capacity.

**V Practical Outcome**

For the 7- cell cluster, 168-voice channels cellular system, determine the assignment of voice channel to each sector if 3- sector $120^0$ and 6 -sector $60^0$ directional antenna are used at the cell site.

**VI Relevant Affective domain related Outcome(s)**

- Ethical work practices
- Proper use of software

## VII Minimum Theoretical Background

The co channel interference in a cellular system may be decreased by replacing a single omni directional antenna at the base station by several directional antenna, each radiating in a specified sector. By using directional antenna, a given cell will receive interference and transmit with only a fraction of the available co- channel cells. Sectoring increases system performance by decreasing co channel interference

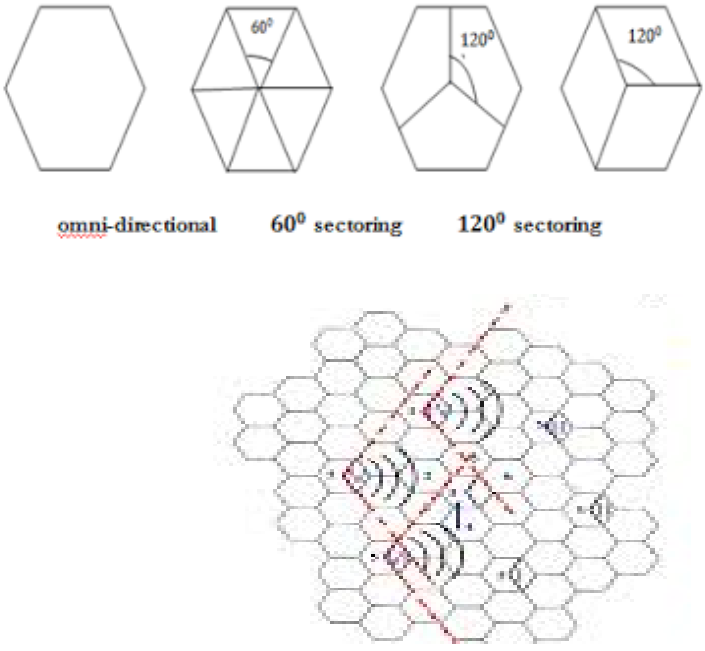


**Figure 14.1: Cell sectoring and use of directional antenna**

## VIII Precautions

1. Use proper syntax

## IX Procedure

1. Click on Scilab software icon.
2. Open a scinotes by clicking the icon “File”
3. Click on “File” >“New” to create new scinote
4. Build a code for calculation of number of voice channels keeping the number of channels as 168 and cluster size as 7

   **Code for Calculation number of voice channels:**

```
clc;
clear all;

k=input("enter the Number of channels: ");
n=input("enter the number of cells in a cluster: ");
a= input("enter the Number of sectors cells: ");

x= n*a;
disp('The total sectors in a given region:' );
disp (x);
```

```
z= k/x;
disp('Number of Voice channels available in a cell when directional antenna is
used:');
disp (z);
```

5. Save the document.
6. Click on “Execute “ button
7. Observe the result
8. Execute the program for 120° sectors and 60° sectors

## X Actual Procedure Followed

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## XI Precautions:

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## XII Observations (use blank sheet provided if space not sufficient)

| Cluster size | Number of voice channel per cell for 120° sector | Number of voice channel per cell for 60° sector |
|---|---|---|
| 7 | | |

## XIII Result

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## XVII Interpretation of Results

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## XVIII Conclusions and Recommendations

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## XIX 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 identified CO.**

1. Perform the above experiment for a cluster size of 4
2. Perform the experiment for a cluster size of 12

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. Lee, C. Y. William, Mobile Cellular Telecommunications System, Mcgraw Hill Education, New Delhi, 2017, ISBN-13: 978-0070635999
2. Rappaport, S.Theodore, Wireless communication-Principles and practice, Pearson publication New Delhi, 2005, ISBN: 978-81-317-3186-4
3. https://www.scilab.org/download/6.0.2

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Writing the code | 30% |
| 2 | Execution | 30% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Interpretation of Results | 20% |
| 2 | Practical related questions | 10% |
| 3 | Submission of report in time | 10% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No.15: Perform installation of mobile phone registration, activation and authentication of mobile handset.

**I Practical Significance**

Initially when SIM (Subscriber Identity Module) is purchased, the SIM along with the mobile phones IMEI (International Mobile Equipment Identity) is transmitted in a network, and network will register the SIM details after verifying it. Mobile phones are efficient communication devices and make life easier. Mobile authentication is the verification of a user's identity through the use a mobile device and one or more authentication methods for secure access. Mobile authentication may be used to authorize the mobile device itself or as a part of a multifactor authentication scheme for logging into secure locations and resources. This practical will help the students to configure the GSM module for communication.

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for executing Installation and activation..
- Use GSM modem and identify various Activation and registration AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Perform installation of mobile phone registration, activation and authentication of mobile handset.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

## VII Minimum Theoretical Background

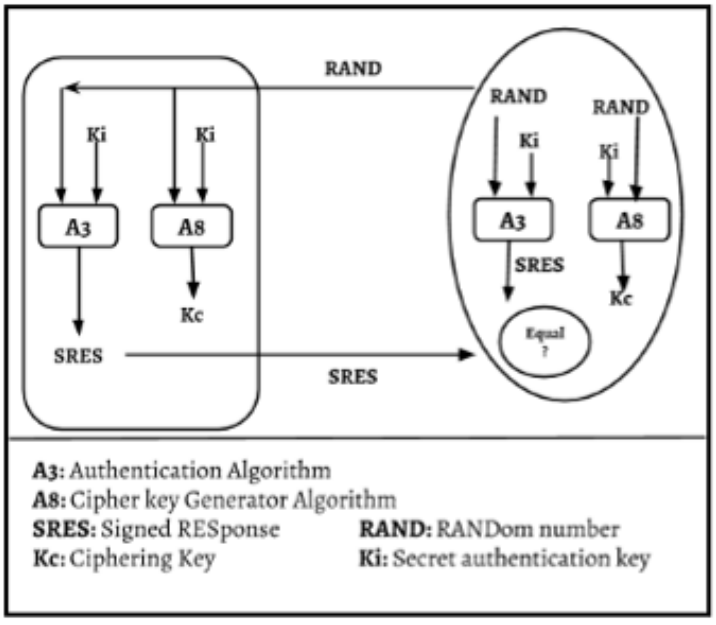


**Figure: 15.1 Security Aspects of GSM**

- The security procedure in GSM are aimed at protecting the network against unauthorized access and protecting the privacy of the mobile subscribers against eavesdropping on their communications. The security procedures also prevent unauthorized parties from tracing the identity and location of the subscribers as they roam within or outside the home network.
- At the time of service provisioning the IMSI, the individual subscriber authentication key (Ki), the authentication algorithm (A3), the cipher key generation algorithm (A8), and the encryption algorithm (A5) is unique and needs to be used across all GSM network operators.

**Commands:**

To control the GSM Module, there is an advance set of AT Commands according to GSM ETSI standards. These Commands are:

- Command concerning modem and SIM Card hardware.
- Network Registration Commands.
- Call Control Commands.
- Call Setting Commands
- Phone book commands.
- Message handling commands
- Message setting commands.
- Functionality commands.

**Mobile equipment error result code: +CME ERROR: <err>**

**<err> is defined as below :**

**3** Operation not allowed
**4** Operation not supported
**5** PH-SIM PIN required (SIM lock)

**10** SIM not inserted
**11** SIM PIN required
**12** SIM PUK required
**13** SIM failure
**16** Incorrect password
**17** SIM PIN2 required
**18** SIMPUK2 required
**20** Memory full
**21** Invalid index
**22** Not found
**24** Text string too long
**26** Dial string too long
**30** No network service
**32** Network not allowed – emergency calls only
**40** Network personalization PIN required (Network lock)

**Message service failure result code: +CMS ERROR: <err>**

**<err> is defined as below :**

**1 to 127** Error cause values from the GSM recommendation**.**
**301** SMS service of ME reserved
**302** Operation not allowed
**303** Operation not supported
**304** Invalid PDU mode parameter
**305** Invalid text mode parameter
**310** SIM not inserted
**311** SIM PIN required
**312** PH-SIM PIN required
**313** SIM failure
**316** SIM PUK required
**317** SIM PIN2 required
**318** SIM PUK2 required
**321** Invalid memory index
**322** SIM memory full
**330** SC address unknown

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM.** (This could be one of the reasons for getting this kind of error)

**Network Registration commands:**

**1. AT+CPIN:**

This Command is used to check the SIM status.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **AT + CPIN** | **OK** | **ERROR** |
| **AT+CPIN?** | **+CPIN: READY** | |

**2. AT+CREG:**

This command is used to show the network registration status and to control the presentation of an unsolicited result code +CREG: <stat> when there is a change in the network registration status.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **+CREG=<n>** | **OK** | |
| **Unsolicited Result codes:**<br>**+CREG: <stat>** **if <n> equals 1**<br>**+CREG: <stat>, <lac>, <ci>** **if <n> equals 2** | | |
| **AT+CREG?** | **+CREG: <n>,<stat> (n=1)**<br>**+CREG: <n>,<stat>, <lac>, <ci> (n=2)** | **+CME ERROR: <err>** |
| **AT+CREG=?** | **OK** | |

**Defined Values:**

**<n>:**

**0** Disable network registration unsolicited result code

**1** Enables network registration code result code +CREG: <stat>

**2** Enables network registration and location information unsolicited result code with
+CREG:<stat>,<lac>, <ci>

Where **<stat>:**

**0** Not registered, ME is not currently searching a new operator

**1** Registered, Home Network

**2** Not Registered, but ME is currently searching a new operator.

**3** Registration denied

**4** Unknown

**5** Registered, Roaming

**<lac>:** String type: two byte location area code in hexadecimal format (e.g. **"00C3"** equals **193** in decimal)

**<ci>:** String type: two byte cell ID in Hexadecimal format

Source: GSM 07.07/7.2

Implementation: Complete

**3. AT+CFUN:**

Command is used to set the functionality of the modem. It switches between two power consumption levels.

**Concept Structure:**

| **Command** | **Possible Response** |
|---|---|
| **AT+CFUN?**<br>**Note: Ask for current functionality Level** | **+CFUN:1**<br>**Note: Full Functionality** |
| **AT+CFUN=0**<br>**Note: Set Minimum Functionality** | **OK**<br>**Note: Command Valid** |
| **AT+CFUN=1**<br>**Note: Set the Full Functionality mode with a complete software reset** | **OK**<br>**Note: Command Valid** |

**Defined values:**
**<fun>:**
**0** Minimum functionality
**1** Full functionality

**<rst>:**
**0** Do not reset the ME before setting it to power level
**1** Reset the ME before setting it to power level

**Remarks:** AT+CFUN=1,1 is used to reset the GSM software. (Any special remarks to be observed for the particular AT command)
**Source:** GSM 07.07/8.2 (This is the **Source** of AT Commands and it's Standard for GSM AT Commands)
**Implementation:** complete (The **Implementation** for the command is completed; no modification or any versions are available)

**4. AT+CPOF:**
Command is used to switch off the module. The modem will perform an IMSI detach procedure before switching off all the internal circuitry. This is highly recommended, because of possible problems at the next registration attempt of a module that was never de-registered.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CPOF<CR> | OK |

**Remarks:** None
**Source:** factory default
**Implementation:** complete

**5. AT+CICB:**
Command is used to set the bearer type if no bearer is transmitted on an incoming call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CICB=<n> | OK |
| AT+CICB? | +CICB: <n> |
| AT+CICB=? | +CICB: list of supported <n>s |

**Defined values:**
**<n>** Simulated incoming bearer.
0 Data
1 Fax
2 Voice
**Remarks:** If a wrong bearer is transmitted, the CICB setting has no effect.
**Source:** factory default
**Implementation:** complete

**6. AT+CPAS:**

Command is used to request the phone activity status.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CPAS | +CPAS:0 |
| AT+CPAS=? | +CPAS: (0-5) |

**Defined values:**

**<pas>:**

**0** Ready (ME allows commands from TA/TE)
**1** Unavailable (ME does not allow commands from TA/TE)
**2** Unknown (ME is not guaranteed to respond to instructions)
**3** Ringing (ME is ready for commands from TA/TE, but the ringer is active)
**4** Call in progress (ME is ready for commands from TA/TE, but a call is in progress)
**5** Asleep (ME is unable to process commands from TA/TE because it is in a low functionality state)

**Remarks:** none
**Source:** GSM 07.07/8.1
**Implementation:** complete

## VIII Setup Diagram

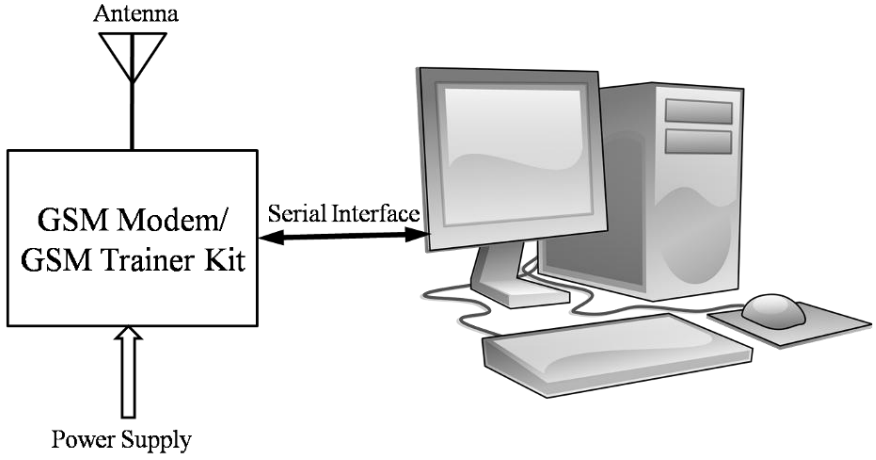


**Figure 15.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be Followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps to install Hyper terminal software:**

1. Download HyperTerminal Private Edition Installer
2. Run the installer
3. If using Windows 7 or Vista click “Yes” on the User Account Control prompt
4. Click next
5. Agree to the terms of the license agreement, click next
6. Select the default location or specify a location, click next
7. Click proceed to start the isntallation
8. Click Finish

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given below
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure15.3 Screenshot of hyper terminal software.**

5. Set the COM1 properties with default values as:
   - Speed/ Baud rate: 9600

- Date Bits: 8
- Parity: None
- Stop Bit: 1
- Flow Control: None.

6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

**XII Resources used**

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

**XIII Actual procedure followed**

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.....

**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**XVI Result** (Responses of various AT Commands )

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Using GSM AT Commands Set the modem/ Trainers functionality to Full Functionality.
2. Change the data rate of GSM modem to 4800/1200 bps, and comment on the result obtain using AT commands.
3. State the data rate of GSM modem used in the Laboratory.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. www.gsmworld.com
3. www.communica.se/multitec/gprs_at.pdf
4. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
5. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf.

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (15 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No.16: Read/Retrieve the contents of SIM card using relevant Software.

**I Practical Significance**

Today, SIM cards are ubiquitous, allowing over 7 billion devices to connect to cellular networks around the world. According to the International Card Manufacturers Association (ICMA), there were 5.4 billion SIM cards manufactured globally in 2016. The rise of cellular IoT and 5G networks is predicted to drive the growth of the addressable market for SIM card manufacturers to over 20 billion cellular devices by 2020. The introduction of Embedded SIM (eSIM) and Remote SIM Provisioning (RSP) from the GSM may disrupt the traditional SIM card ecosystem with the entrance of new players specializing in "digital" SIM card provisioning and other value-added services for mobile network operators. This Practical will help the students to read and write the contents of SIM (Subscriber Identity Module).

**II Relevant Program Outcomes (POs)**

1. **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
3. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
4. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for executing SIM read write operation.
- Use GSM modem and identify various SIM related AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Read/ Retrieve the contents of SIM card using relevant software

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

## VII Minimum Theoretical Background

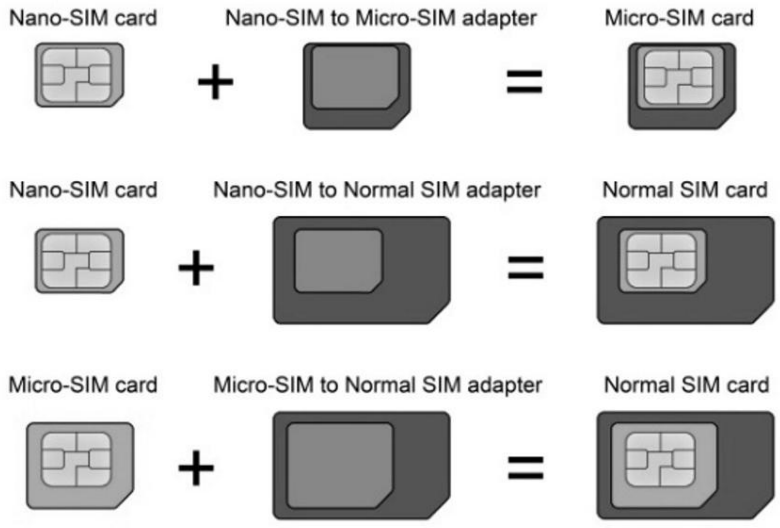


**Figure 16.1: Different types of SIM card.**

A subscriber identity module or subscriber identification module (SIM), widely known as a SIM card, is an integrated circuit that is intended to securely store the international mobile subscriber identity (IMSI) number and its related key, which are used to identify and authenticate subscribers on mobile telephony devices (such as mobile phones and computers). It is also possible to store contact information on many SIM cards. SIM cards are always used on GSM phones; for CDMA phones, they are only needed for newer LTE-capable handsets. SIM cards can also be used in satellite phones, smart watches, computers, or cameras.

A SIM card contains its unique serial number (ICCID), international mobile subscriber identity (IMSI) number, security authentication and ciphering information, temporary information related to the local network, a list of the services the user has access to, and two passwords: a personal identification number (PIN) for ordinary use, and a personal unblocking code (PUC) for PIN unlocking.

**The International Mobile Equipment Identity or IMEI** is a number, usually unique, to identify 3GPP mobile phones, as well as some satellite phones. It is usually found printed inside the battery compartment of the phone, but can also be displayed on-screen on most phones by entering *#06# on the dial pad, or alongside other system information in the settings menu on smartphone operating systems.

**The international mobile subscriber identity or IMSI** is used to identify the user of a cellular network and is a unique identification associated with all cellular networks. It is stored as a 64 bit field and is sent by the phone to the network. It is also used for acquiring other details of the mobile in the home location register (HLR) or as locally copied in the visitor location register. To prevent eavesdroppers identifying and tracking the subscriber on the radio interface, the IMSI is sent as rarely as possible and a randomly generated TMSI is sent instead.

**SIM read/ write Commands:**

**1. AT+CIMI:**

This Command is used to check read and identify the IMSI (international Mobile Subscriber Identity) of the SIM card.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT +CIMI | <IMSI> (15 DIGIT) |
| AT+ CIMI=? | OK |

**Remarks:** None.

**Source:** GSM 07.07/5.6

**Implementation:** complete

**2. AT+CCID:**

Command gives EF-CCID file information

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CCID | +CCID: <id> |
| AT+ CCID =? | OK |

**Defined values**

**<id>:** EF-CCID file in hexadecimal format

**Remarks:** none

**Source:** factory default

**3. AT+CPBS:**

Command selects phonebook memory storage. The SIM card is the only storage in the A2D module

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| AT+ CPBS=<storage> | OK | +CME ERROR: <err> |
| AT +CPBS? | +CPBS: <storage>[,<used>,<total>] | +CME ERROR: <err> |
| AT +CPBS=? | +CPBS: (list of supported <storage>s) | |

**Defined values:**

**<storage>:**

**"SM"** SIM abbrev. dialing phonebook

**"FD"** SIM fixed dialing phonebook

**"ON"** SIM own numbers phonebook

**<used>:** Integer type value indicating the number of used locations in selected memory.

**<total>:** Integer type value indicating the total number of locations in selected memory.

**Remarks:** none
**Source:** GSM 07.07/8.11
**Implementation:** complete

### 4. AT+CPBR:

Command is used to read a special entry or a range of entries from the phonebook memory storage.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+CPBR=<index1>[, <index2>]** | **+CPBR: <index1>,<number>,<type>,<text> <CR><LF> +CPBR: <index2>,<number>,<type>,<text>]** | **+CME ERROR: <err>** |
| **AT+CPBR=?** | **+CPBR: (list of supported <index>s),<nlength>,<tlength>** | **+CME ERROR: <err>** |
| **AT+CPBR=1** | **+CPBR: 1, "09869308311", 129 ,"Tejas"** | |

**Defined values:**

**<index1>, <index2>, <index>:** Integer type values in the range of location numbers of phonebook memory.
**<number>:** String type phone number of format <type>.
**<type>:** Type of address octet in integer format.
**<text>:** String type field of maximum length <tlength>; character set as specified by command Select TE Character Set +CSCS.
**<nlength>:** Integer type value indicating the maximum length of field <number>.
**<tlength>:** Integer type value indicating the maximum length of field <text>.

**Remarks:** none (Any special remarks to be observed for the particular AT command)
**Source:** GSM 07.07/8.12 *(*This is the **Source** of AT Commands and it's Standard for GSM AT Commands)
**Implementation:** complete (The **Implementation** for the command is completed; no modification or any versions are available*)*

**5. AT+CPBF:**

Command is used to set the bearer type if no bearer is transmitted on an incoming call.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+ +CPBF=<findtext>** | **+CPBF: <index1>,<number>,<type>,<text> <CR><LF>+CPBF: <index2>,<number>,<type>,<text>]** | **+CME ERROR: <err>** |
| **AT +CPBF=?** | **+CPBF: <nlength>,<tlength>** | **+CME ERROR: <err>** |

**Defined values:**

**<index1>, <index2>:** Integer type values in the range of location numbers of phonebook memory.

**<number>:** String type phone number of format <type>.

**<type>:** Type of address octet in integer format.

**<findtext>,<text>:** String type field of maximum length <tlength>; character set as specified by command Select TE Character Set +CSCS.

**<nlength>:** Integer type value indicating the maximum length of field <number>.

**<tlength>:** Integer type value indicating the maximum length of field <text>.

**Remarks:** none

**Source:** GSM 07.07/8.13

**Implementation:** complete

**6. AT+CPBW:**

Command is used to write a phonebook entry to a special place in the phonebook memory storage.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+CPBW=? NOTE: Test Command** | **+CPBW: (list of supported <index>s), <nlength>, (list of supported <type>s),<tlength>** | **+CME ERROR: <err>** |
| **AT +CPBW=[<index>] [,<number> [,<type>[,<text>]]]** | **OK** | **+CME ERROR: <err>** |

**Defined values:**

**<index>:** Integer type values in the range of location numbers of phonebook memory.

**<number>:** String type phone number of format <type>.

**<type>:** Type of address octet in integer format.
**<text>:** String type field of maximum length <tlength>; character set as specified by command Select TE Character Set +CSCS.
**<nlength>:** Integer type value indicating the maximum length of field <number>.
**<tlength>:** Integer type value indicating the maximum length of field <text>.
**Remarks:** none
**Source:** GSM 07.07/8.14
**Implementation:** complete

### 7. AT+CMGR:

Command is used to read one messages from the SIM card storage.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **AT+CMGR=<index>** | **+CMGR: <stat>,,<length><CR><LF><pdu>** | **+CME ERROR: <err>** |
| **AT +CMGR=?** | **OK** | |

**Defined values:**

**<stat>** Integer type (default 0) indicates the status of message in memory:
- **0** Received unread message (i.e. new message)
- **1** Received read message
- **2** Stored unsent message
- **3** Stored sent message
- **4** All messages

**<index>** See text mode
**<length>** Integer type value the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length);
**<pdu>** GSM 04.11 SC address followed by GSM 03.40 TPDU in hexadecimal format

**Remarks:** none
**Source:** GSM 07.05/3.4.3,4.2
**Implementation:** complete

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM.** (This could be one of the reasons for getting this kind of error)

## VIII Setup Diagram:

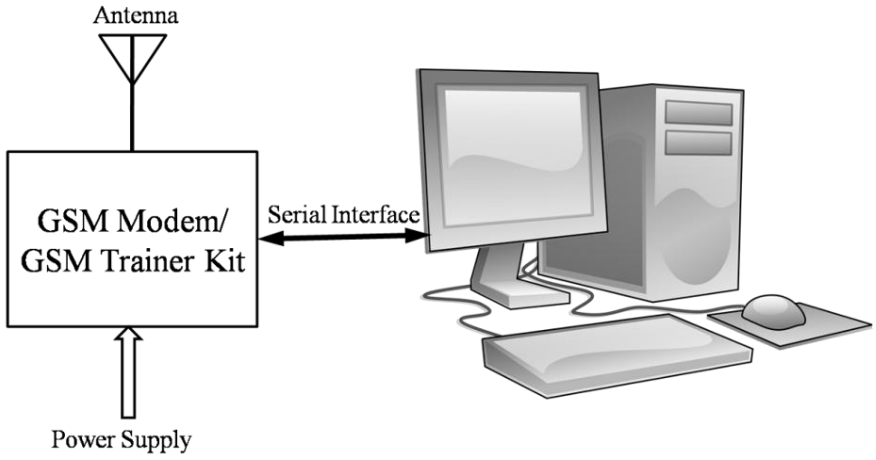


**Figure16.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given below.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure16.3 Screenshot of hyper terminal software.**

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. List different procedure to obtain IMEI number of the mobile?
2. Write the AT command for reading 2nd message on SIM memory, also write its response.
3. Can SMS stored on SIM? If yes, explain the procedure.
4. Is SIM required in CDMA phone? If no, justify.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. www.gsmworld.com
3. www.communica.se/multitec/gprs_at.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

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

# Practical No.17: Execute call control commands using relevant software.

**I Practical Significance**

The command set consists of a series of short text strings which can be combined to produce commands for operations such as dialing, managing SMS functions, and changing the parameters of the connection. Many of the commands that are used to control wired dial-up modems, such as ATD (Dial), ATA (Answer), ATH (Hook control) and ATO (Return to online data state), are also supported by GSM/GPRS modems and mobile phones. This practical will help the students to execute call control functionality of a GSM module. The AT is an ATTENTION command and is used as a prefix to other parameters in a string. The AT command combined with other parameters can be set up in the communications package or typed in manually as a command line instruction. This practical enables student to execute call control commands.

**II Relevant Program Outcomes (POs)**

1 **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.

2 **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.

3 **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations

4 **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

1 Identify the components on GSM modem and identify the commands for executing Call control commands

2 Use GSM modem and identify various call control AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute call control commands using relevant software

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

## VII Minimum Theoretical Background

### Mobile call origination in GSM:

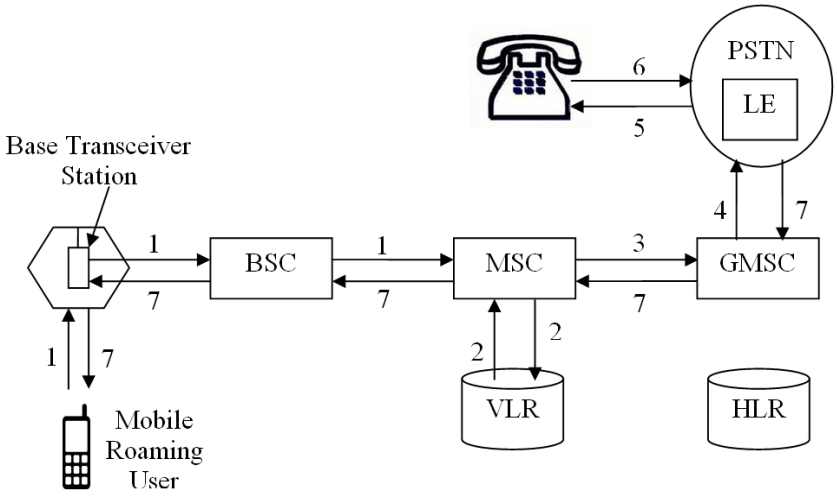


**Figure 17.1: Mobile call Origination**

1. The MS sends the dialed number indicating service requested to the MSC(via BSS)
2. The MSC checks from the VLR if the MS is allowed the requested service. If so, MSC asks BSS to allocate necessary resources for the call.
3. If the call is allowed, the MSC routes the call to GMSC.
4. The GMSC routes the call to the local exchange of called user.
5. The LE alerts (applies ringing) the called terminal.
6. Answer back (ring back tone) from the called terminal to LE.
7. Answer back signal is routed back to the MS through the serving MSC which also completes the speech path to the MS.

### Mobile call termination:

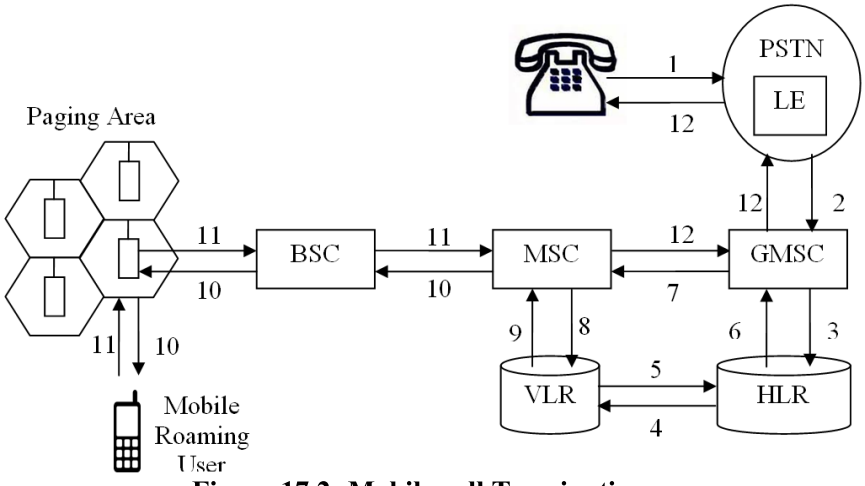


**Figure 17.2: Mobile call Termination**

1. The PSTN user dials the MSISDN of the called user in GSM.
2. The LE routes the call to the GMSC of the called GSM user.
3. The GMSC uses the dialed MSISDN to determine the serving HLR for the GSM user and interrogates it to obtain the required routing number.

4. The HLR requests the current serving VLR for the called MS for a MSRN(MS roaming number) so that the call can be routed to the correct MSC.
5. The VLR passes the MSRN to the HLR.
6. The HLR passes the MSRN to the GMSC.
7. Using the MSRN, the GMSC routes the call to the serving MSC.
8. The MSC interrogates the VLR for the current location area identity (LAI) for the MS.
9. The VLR provides the current location for the MS.
10. The MSC pages MS via the appropriate BSS. The MS responds to the page and sets up the necessary signaling links.
11. When the BSS has established the necessary radio links, the MSC is informed an the call is delivered to the MS.
12. When the MS answers the call, the connection is completed to the calling PSTN user.

**Call Control Commands:**

**1. ATD:**

This Command is used to establish a voice call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| ATD<number> | CONNECT <speed> If call is Established |
| | BUSY if Called party is on another call. |
| | NO ANSWER if called party does not receive a call |
| | NO CARRIER If there is a problem in establishing a call. |

**2. ATA:**

Command is used to accept an incoming call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| ATA | OK If incoming call is a voice call. |

**3. ATD<n>**

This command dials the phone number with accordance to the modifiers of n.

**Defined values:**

**<n>**

| | |
|---|---|
| **L** | Redial the last dialed number |
| **P** | Pulse dial |
| **R** | Enable answer mode |
| **S=x** | Dial the stored telephone number in x |
| **T** | Tone dials |
| **W** | Resume dialing after dial tone is detected |
| **,** | Pause before dial |

| | |
|---|---|
| **"555-4NET"** | Letters enclosed in quotes will be dialed as their corresponding numbers on the dialpad. |
| **!** | Enable "flash". (Modem can go off hook for a specified amount of time before returning on hook) |
| **@** | Modem will wait for a quiet answer before dialing the rest of the dial string |

**4. ATH**

This command is used to end the call.

**5. AT+CCFC:**

Command is used to set the call forwarding service.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **AT +CCFC =<reason>,<mode> [,<number>]** | **OK**<br>**When <mode>=2:**<br>**+CCFC: <status>,<class>** | **+CME ERROR: <err>** |
| **AT+CCFC=?** | **+CCFC: (list of supported <reason>s)** | **+CME ERROR: <err>** |

**Defined values:**

**<reason>:**

| | |
|---|---|
| **0** | Unconditional |
| **1** | Mobile busy |
| **2** | No reply |
| **3** | Not reachable |
| **4** | All call forwarding |
| **5** | All conditional call forwarding |

**<mode>**

| | |
|---|---|
| **0** | Disable |
| **1** | Enable |
| **2** | Query status |
| **3** | Registration |
| **4** | Erasure |

**<number>** Telephone number to forward to.

**<class>** Is a sum of integers each representing a class of information (default 7 equals to all classes):

| | |
|---|---|
| **1** | Voice |
| **2** | Data |
| **4** | Fax |

**<status>:**

| | |
|---|---|
| **0** | Not active |
| **1** | Active |

**Remarks:** none

**Source:** GSM 07.07/7.10

**Implementation:** complete

**6. AT+CLIP:**

Command is used to set and request the status of the calling line identification presentation service. Depending on the setting the number of the calling party will be shown as result code +CLIP: <number>,<type> on incoming calls (after every RING).

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+ +CLIP=[<n>] | OK |
| AT+CLIP? | +CLIP=<n>,<m> |
| AT+CLIP=? | +CLIP: (list of supported <n>s) |

**Defined values:**

**<n>** (Parameter sets/shows the result code presentation status):
- **0** Disable
- **1** Enable

**<m>** (Parameter shows the subscriber CLIP service status in the network):
- **0** CLIP not provisioned
- **1** CLIP provisioned
- **2** Unknown (e.g. no network, etc.)

**<number>** String type phone number of format specified by <type>.

**<type>** Type of address octet in integer format.

**Remarks:** none

**Source:** GSM 07.07/7.6

**Implementation:** complete

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

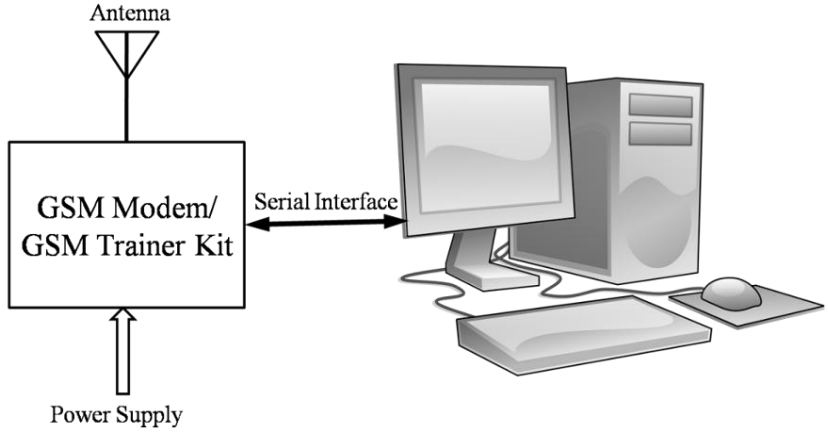


**Figure 17.3: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given below.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure17.4 Screenshot of hyper terminal software**.

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.

6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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## XIV **Precautions followed** (use blank sheet provided if space not sufficient)

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## XV **Observations** (use blank sheet provided if space not sufficient)

Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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| | | |
| | | |

**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the band of frequency used for 3G mobile system.
2. Using AT command try to call a specific number, write the response.
3. List Network Service types.
4. Write the AT command to alert the user for the incoming call.

**[Space for Answers]**

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**XX References / Suggestions for further Reading**

1. www.mobilecomms-technology.com
2. www.gsmworld.com
3. www.communica.se/multitec/gprs_at.pdf

**XXI Assessment Scheme**

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

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

# Practical No.18: Execute Network service commands using relevant software.

**I Practical Significance**

The Network services are important in GSM communication for handling functionality of a Mobile phone. Also to increase the functionality it may needed to see what all functionalities can be accessed by the network related commands. This practical will help the students to execute network service command, to communicate with the network components

**II Relevant Program Outcomes (POs)**

1 **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2 **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3 **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4 **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

1 Identify the components on GSM modem and identify the commands for Communicating with the network components.
2 Use GSM modem and identify various Network control AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute Network service commands using relevant software

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber.

These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signaling between functional entities in the Network Subsystem uses Signaling System Number 7 (SS7), used for trunk signaling in ISDN and widely used in current public networks.

**Network Control Commands:**

**1. AT+CNUM:**

Action command returns the MSISDNs related to the subscriber (this information can be stored in the SIM or in the ME). If subscriber has different MSISDN for different services, each MSISDN is returned in a separate line.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+ CNUM** | **+CNUM: [<alpha1>],<number1>,<type1>[,<speed>,<service>[,<itc>]] [<CR><LF>+CNUM: [<alpha2>],<number2>,<type2>[,<speed>,<service> [,<itc>]]** | **+CME ERROR: <err>** |
| **AT+CNUM =?** | **OK** | **+CME ERROR: <err>** |

**Defined values**

**<alphax>** optional alphanumeric string associated with <numberx>; used character set should be the one selected with command Select TE Character Set +CSCS

**<numberx>** string type phone number of format specified by <typex>

**<typex>** type of address octet in integer format

**<service>** (service related to the phone number):

**0** asynchronous modem
**1** synchronous modem
**2** PAD Access (asynchronous)
**3** Packet Access (synchronous)
**4** voice
**5** fax

also all other values below 128 are reserved by this ETS

**<itc>** (information transfer capability):

**0** 3.1 kHz

3 UDI

**1. AT+COPS:**

Set command forces an attempt to select and register the GSM network operator.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+COPS=[<mode>[,<format>[,<oper>]]]** | **+CME ERROR: <err>** | |
| AT +COPS? | +COPS: <mode>[,<format>,<oper>] | +CME ERROR: <err> |

| | | |
|---|---|---|
| AT+COPS=? | +COPS: list of supported (<stat>,long alphanumeric <oper>,short alphanumeric <oper>,numeric <oper>)s | +CME ERROR: <err> |

**Defined values**

**<mode>**

**0** automatic (<oper> field is ignored)

**1** manual (<oper> field shall be present)

**2** deregister from network

**3** set only <format> (for read command +COPS?), do not attempt registration/ deregistration (<oper> field is ignored); this value is not applicable in read command response

**4** manual/automatic (<oper> field shall be present); if manual selection fails, automatic mode (<mode>=0) is entered

**<format>**

**0** long format alphanumeric <oper>

**1** short format alphanumeric <oper>

**2** numeric <oper>

**<oper>** string type; <format> indicates if the format is alphanumeric or numeric

**<stat>**

**0** unknown

**1** available

**2** current

**3** forbidden

**2. AT+ CLIR**

This command refers to CLIR-service that allows a calling subscriber to enable or disable the presentation of the CLI to the called party when originating a call.

**Concept Structure:**

| **Command** | **Possible Response** |
|---|---|
| **AT+CLIR=[<n>]** | **OK** |
| **AT +CLIR?** | **+CLIR: <n>,<m>** |
| **AT +CLIR=?** | **+CLIR: (list of supported <n>s)** |

**Defined values:**

**<n>** (parameter sets the adjustment for outgoing calls)

**0** presentation indicator is used according to the subscription of the CLIR service

**1** CLIR invocation

**2** CLIR suppression

**<m>** (parameter shows the subscriber CLIR service status in the network)

**0** CLIR not provisioned

**1** CLIR provisioned in permanent mode

**2** unknown (e.g. no network, etc.)

**3** CLIR temporary mode presentation restricted
**4** CLIR temporary mode presentation allowed

**3. AT+COLP:**

This command refers to the GSM supplementary service COLP (Connected Line Identification Presentation) that enables a calling subscriber to get the connected line identity (COL) of the called party after setting up a mobile originated call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +COLP=[<n>]** | **OK** |
| **AT +COLP?** | **+COLP: <n>,<m>** |
| **AT +COLP=?** | **+COLP: (list of supported <n>s)** |

**Defined values:**

**<n>** (parameter sets/shows the result code presentation status in the TA)
**0** disable
**1** enable
**<m>** (parameter shows the subscriber COLP service status in the network)
**0** COLP not provisioned
**1** COLP provisioned
**2** unknown (e.g. no network, etc.)

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

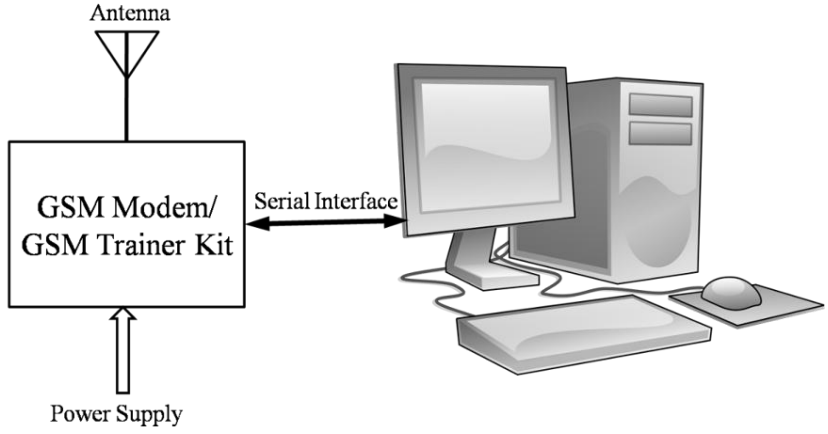


**Figure 18.1: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


Figure18.2 Screenshot of hyper terminal software.

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.

6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

**XII Resources used**

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
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| 3. | | | |
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**XIII Actual procedure followed**

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Check signal strength of the mobile phone available in the lab.
2. If signal strength is reduced beyond certain minimum value, state its effects on network.
3. Write down different mobile codes for checking the signal related information on different mobile phones.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.communica.se/multitec/gprs_at.pdf
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

3 ……

4 ……

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

# Practical No.19: Execute Security commands using relevant software.

**I Practical Significance**

Security of a mobile phone is the one of the important aspect where now day's service providers are looking. The security includes the algorithms and codes which cannot be easily decoded by a hacker. So to protect the SIM certain AT commands are used. This Practical will help the students to execute Security commands of GSM network such as setting password, changing the Password etc.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for Security provided by GSM network
- Use GSM modem and identify various Network control AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute Security commands using relevant software.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

At terminal location update, VLR sends IMSI to the HLR.
HLR returns security triplets (RAND, SRES, Kc) to the VLR.
For authentication and ciphering the VLR sends RAND to the MS.
Using stored A3 algorithm and secret key Ki stored in the SIM, and RAND provided by the VLR, the MS calculates the SRES and returns it to the VLR. Using the A8 algorithm and Ki, the MS also calculates the cipher key Kc.
If the SRES returned by the MS matches with the stored SRES in the VLR, the VLR sends the cipher key Kc to the BTS which uses Kc for ciphering the radio path (downlink).
The MS uses its Kc to cipher the radio path (uplink) using encryption algorithm A5

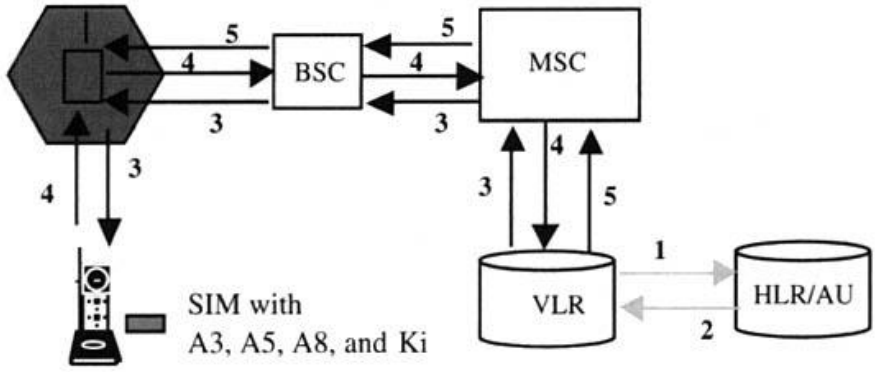


**Figure 19.1: General Authentication process**

**Security Commands:**

**1. AT+CLCK**

Execute command is used to lock, unlock or interrogate a ME or a network facility <fac>. Password is normally needed to do such actions.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **AT+CLCK=<fac>,<mode>[,<passwd>[ ,<class>]]** | **when <mode>=2 and command successful: +CLCK: <status>[,<class1> [<CR><LF>+CLCK: <status>,<class2> [...]]** | **+CME ERROR: <err>** |
| **AT+CLCK=?** | **+CLCK: (list of supported <fac>s)** | **+CME ERROR: <err>** |

**Defined values:**

**<fac>** values reserved by this ETS:
**"CS"** CNTRL (lock Control surface (e.g. phone keyboard))
**"PS"** PH-SIM (lock Phone to SIM card) (ME asks password when other than current SIM card inserted)
**"SC"** SIM (lock SIM card) (SIM asks password in ME power-up and when this lock command issued)
**"AO"** BAOC (Barr All Outgoing Calls)
**"OI"** BOIC (Barr Outgoing International Calls)
**"OX"** BOIC-exHC (Barr Outgoing International Calls except to Home Country)
**"AI"** BAIC (Barr All Incoming Calls)
**"IR"** BIC-Roam (Barr Incoming Calls when Roaming outside the home country)
**"NT"** barr incoming calls from numbers Not stored to TA memory
**"NM"** barr incoming calls from numbers Not stored to ME memory
**"NS"** barr incoming calls from numbers Not stored to SIM memory
**"NA"** barr incoming calls from numbers Not stored in Any memory
**"AB"** All Barring services
**"AG"** All outGoing barring services

**"AC"** All inComing barring services
**"FD"** SIM fixed dialling memory feature (if PIN2 authentication has not been done during the current session, PIN2 is required as <passwd>)

**<mode>**
**0** unlock
**1** lock
**2** query status
**<status>**
**0** not active
**1** active
**<passwd>** string type; shall be the same as password specified for the facility from the ME user interface or with command Change Password +CPWD
**<classx>** is a sum of integers each representing a class of information (default 7 equals to all classes):
**1** voice
**2** data
**4** fax

**2. AT+CPWD:**

Action command sets a new password for the facility lock function defined by command Facility Lock

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT +CPWD=<fac>,<oldpwd>, <newpwd>** | | **+CME ERROR: <err>** |
| **AT+CPWD=?** | **+CPWD: list of supported (<fac>,<pwdlength>)s** | **+CME ERROR: <err>** |

**Defined values:**

**<fac>**
**"P2"** SIM PIN2
**<oldpwd>, <newpwd>** string type; <oldpwd> shall be the same as password specified for the facility from the ME user interface or with command Change Password +CPWD and <newpwd> is the new password; maximum length of password can be determined with <pwdlength>
**<pwdlength>** integer type maximum length of the password for the facility

**(Note: Teacher can give more commands related to experiment)**
**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

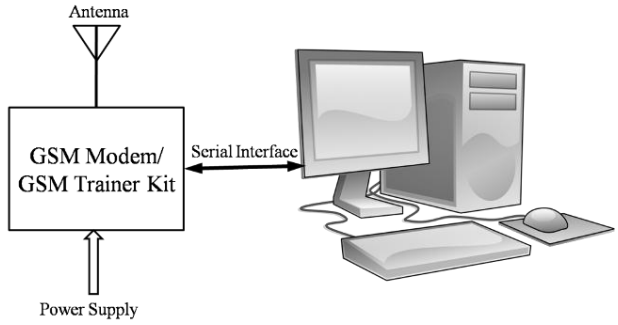


**Figure 19.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure19.3 Screenshot of hyper terminal software.**

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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## XIV **Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Interpret the figure19.4, figure19.5, figure19.6.

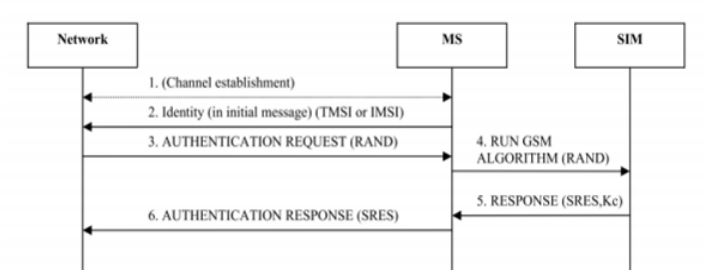


**Figure 19.4**

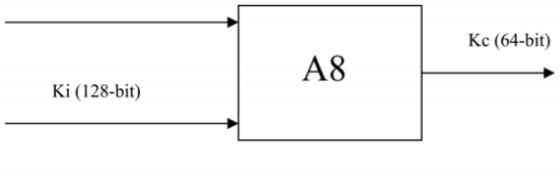


**Figure 19.5**

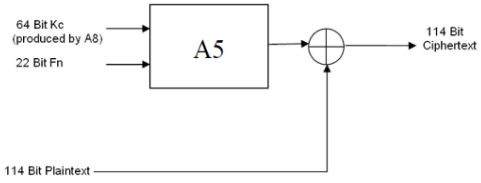


**Figure 19.6**

2. State the full forms of the given terms, AUC, DES, Kc, Ki, LAI, LFSR, TMSI.
3. State the significance of Signed Response in GSM network.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%(15)** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%(10)** |
| 4 | Observations and recording | 20% |
| 5 | Answer to sample questions. | 15% |
| 6 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %(25)** |

***Names of Student Team Member***

1 ……

2 ……

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4 ……

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

# Practical No.20: Execute Phone book commands using relevant software.

**I Practical Significance**

GSM network has a mobile unit as its component. The Mobile unit consists of a SIM and a Handset. To store the contacts and other information, the modem is connected to memories. So as to save, read; write the data from a phone book memory, AT commands can be used. This practical will help the students to learn how to get access to a phone memory and use it.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

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**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for Phone memory related commands.
- Use GSM modem and identify various Phonebook AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute Phone book commands using relevant software.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

The logic unit is made up of an embedded microprocessor with both ROM & RAM plus additional circuitry used for interpreting signals from MTSO and cell site & generating control signal for the transmitter & receiver.

A cellular radio contains a programmable read only memory chip called "Number Assignment Module (NAM)". The NAM contains the Mobile Identification Number (MIN), which is the telephone number assigned to the unit. The NAM PROM is 'burned' when the Cellular Radio is purchased & the MIN is assigned.

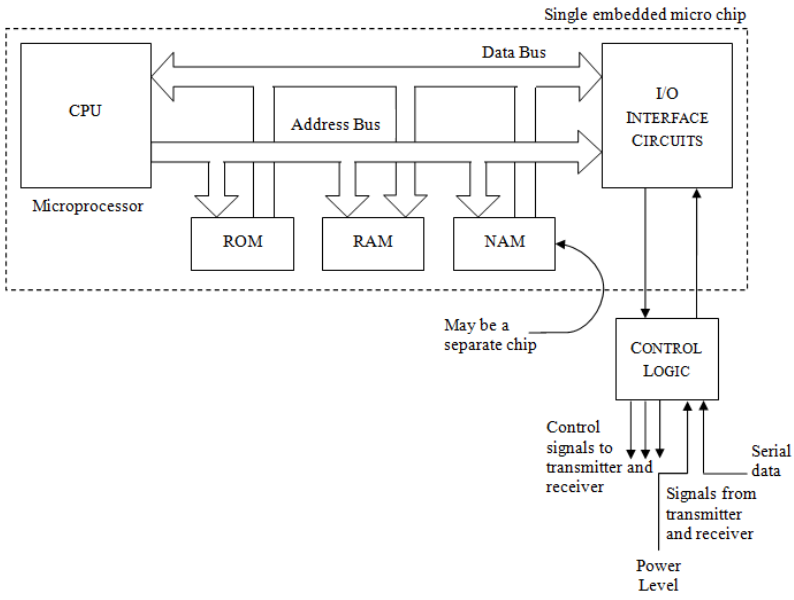


**Figure 20.1: Block diagram of Logic Unit of mobile unit**

This chip allows the radio to identify it when a call is initiated or when the radio is interrogated by the MTSO. All cellular mobile radios are fully under control of the MTSO through the cell site. The MTSO sends a serial data stream at 10 kbps through the cell site to the radio to control the transmitter & receiver frequency & transmitter power.
The MTSO monitors the received cell signal strength at the cellular radio by way of RSSI signal & it monitors the transmitter power level. These are transmitted back to the cell site & MTSO. Audio tones are also used for signaling purpose.

**Phonebook Commands:**

**1. AT+CPBS**

Command selects phonebook memory storage. The SIM card is the only storage in the module.

**Concept Structure:**

| **Command** | **Possible Response** | |
|---|---|---|
| **AT+CPBS=** | **OK** | **+CME ERROR: <err>** |
| **AT +CPBS?** | **+CPBS: <storage>[,<used>,<total>]** | **+CME ERROR: <err>** |
| **AT+CPBS=?** | **+CPBS: (list of supported <storage>s)** | |

**Defined values:**

**<storage>**

**"SM"** SIM abbrev. dialing phonebook
**"FD"** SIM fixed dialing phonebook
**"ON"** SIM own numbers phonebook

**<used> Integer type value indicating the number of used locations in selected memory.**
**<total>Integer type value indicating the total number of locations in selected memory.**

**Remarks:** none
**Source:** GSM 07.07/8.11
**Implementation:** complete

**2. AT+CPBR:**

Command is used to read a special entry or a range of entries from the phonebook memory storage.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT +CPBR=<index1> [,<index2>]** | **+CPBR: <index1>,<number>,<type>,<text> <CR><LF> +CPBR: <index2>,<number>,<type>,<text>]** | **+CME ERROR: <err>** |
| **AT +CPBR=?** | **+CPBR: (list of supported <index>s),<nlength>,<tlength>** | **+CME ERROR: <err>** |

**Defined values:**

**<index1>, <index2>, <index>** Integer type values in the range of location numbers of phonebook memory.
**<number>** String type phone number of format <type>.
**<type>** Type of address octet in integer format.
**<text>** String type field of maximum length <tlength>; character set as specified by command Select TE(Terminal Equipment) Character Set +CSCS.
**<nlength>** Integer type value indicating the maximum length of field <number>.
**<tlength>** Integer type value indicating the maximum length of field <text>.
**Remarks** none
**Source** GSM 07.07/8.12
**Implementation** complete

**3. AT+CPBF:**

Command is used to find a phonebook entry using a search-string.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT +CPBF= <findtext>** | **+CPBF: <index1>,<number>,<type>,<text> <CR><LF>+CPBF: <index2>,<number>,<type>,<text>]** | **+CME ERROR: <err>** |
| **AT +CPBF=?** | **+CPBF: <nlength>,<tlength>** | **+CME ERROR: <err>** |

**Defined values:**

**<index1>, <index2>** Integer type values in the range of location numbers of phonebook memory.
**<number>** String type phone number of format <type>.

| | |
|---|---|
| **<type>** | Type of address octet in integer format. |
| **<findtext>,<text>** | String type field of maximum length <tlength>; character set as specified by command Select TE Character Set +CSCS. |
| **<nlength>** | Integer type value indicating the maximum length of field <number>. |

**(Note: Teacher can give more commands related to experiment)**
**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

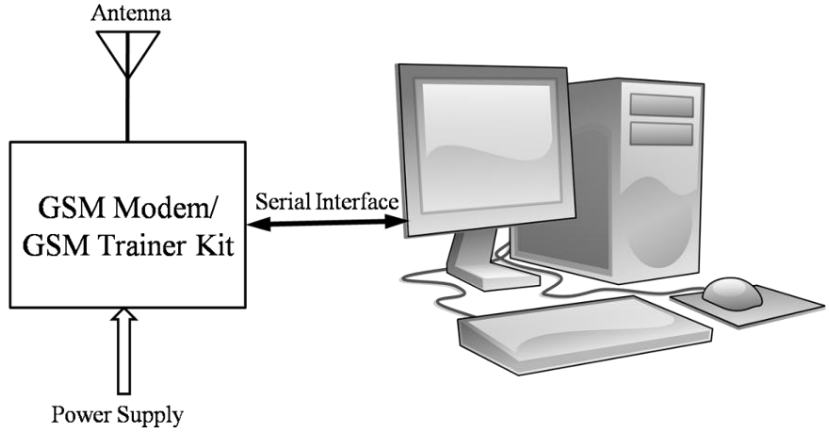


**Figure 20.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure20.3 Screenshot of hyper terminal software**.

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
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| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
| | | |
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| | | |

**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. List different types of memory available in mobile unit
2. State the significance of NAM.
3. Compare memories used in mobile phone.

4. Read the 4th memory location available in mobile phone using AT command, write the output obtain.
5. Identify the figure 20.4 And state its significance.


**Figure 20.4**

6. List the mobile phone which allows expanded memory using micro SD card.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

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

# Practical No.21: Execute short message commands using relevant software.

**I Practical Significance**

To interface a GSM modem with any embedded system, the microcontroller should have the control of SMS memory. The Message commands are used for that. The commands which can be used to read write the memory is the Short message commands. This can be used in 2 modes. This practical will help the students to execute Message related commands and how message will be transmitted.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for accessing messages of a mobile phone unit..
- Use GSM modem and identify various Message Handling and Message setting AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute short message commands using relevant software.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

SMS (short message service) is a text messaging service component of most telephone, internet, and mobile-device systems. It uses standardized communication protocols to enable mobile devices to exchange short text messages. An intermediary service can facilitate a text-to-voice conversion to be sent to landlines. SMS was the most widely used data application, with an estimated 3.5 billion active users, or about 80% of all mobile subscribers, at the end of 2010.

SMS, as used on modern devices, originated from radio telegraphy in radio memo pagers that used standardized phone protocols. These were defined in 1985 as part of the Global System for Mobile Communications (GSM) series of standards. The first SMS message was sent in 1992. The protocols allowed users to send and receive messages of up to 160 alpha-numeric characters to and from GSM mobiles. Although most SMS messages are mobile-to-mobile text messages, support for the service has expanded to include other mobile technologies, such as ANSI CDMA networks and Digital AMPS.

**Message handling Commands:**

**1. AT+CSCA**

Command is used to set the service center address. Mobile originated messages are transmitted through these service centers.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CSCA=<sca>[,<tosca>] | OK |
| AT +CSCA? | +CSCA: <sca>,<tosca> |
| AT+CSCA=? | OK |

**Defined values:**

**<sca>** service center address Value field in string format
**<tosca>** service center address Type-of Address octet in integer format

**Remarks:** In PDU mode (at+cmgf=0) this command is needed only when the length of the SMSC address coded into <pdu> parameter equals zero.
**Source:** GSM 07.05/3.3.1
**Implementation:** complete

**2. AT+CMGS:**

Command is used to send a message to the service center.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| AT +CMGS =<length><CR> PDU is given <ctrl-Z/ESC> | +CMGS: <mr> | +CME ERROR: <err> |
| AT +CMGS=? | OK | |

**Defined values:**

**<length>** Integer type value the length of the actual TP data unit in octets .
**<pdu>** Address followed by GSM TPDU in hexadecimal format
**<mr>** See text mode
**Remarks** When the length octet of the SMSC address equals zero, the SMSC address set with command Service Centre Address +CSCA is used.
**Source** 07.05/3.5.1,4.3
**Implementation** complete

**3. AT+CMGW:**

Command is used to write a message to the SIM card storage.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+CMGW<length>[,<stat>]<CR> PDU is given <ctrl-Z/ESC>** | **+CMGW: <index>** | **+CME ERROR: <err>** |
| **AT +CMGW=?** | **OK** | |

**Defined values:**

**<length>** Integer type value the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length);

**<stat>** Integer type (default 0) indicates the status of message in memory:

- **0** Received unread message (i.e. new msg.)
- **1** Received read message
- **2** Stored unsent message
- **3** Stored sent message
- **5** All messages

**<index>** Used to See text mode

**Remarks:** When the length octet of the SMSC address equals zero, the SMSC address set with command Service Centre Address +CSCA is used.

**Source:** GSM 07.05/3.5.3,4.4

**Implementation:** complete

**4. AT+CMGD**

Command is used to delete a message from the SIM card storage.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+CMGD=<index>** | **OK** | **+CME ERROR: <err>** |
| **AT +CMGD=?** | **OK** | |

**Defined values:**

**<index>** integer type; value in the range of location numbers supported by SIM memory

**Remarks:** none

**Source:** GSM 07.05/3.5.4

**Implementation:** complete

**5. AT+CMGF**

Command is used to select format for incoming and outgoing messages.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +CMGF=[<mode>]** | **OK** |
| **AT+ +CMGF?** | **+CMGF: <mode>** |
| **AT +CMGF=?** | **+CMGF: (list of supported <mode>s)** |

**Defined values:**
**<mode>**
**0** PDU modes
**1** Text mode

**Remarks:** none
**Source:** GSM 07.05/3.5.4
**Implementation:** complete

**NOTE*:* In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error*)***

## VIII Setup Diagram

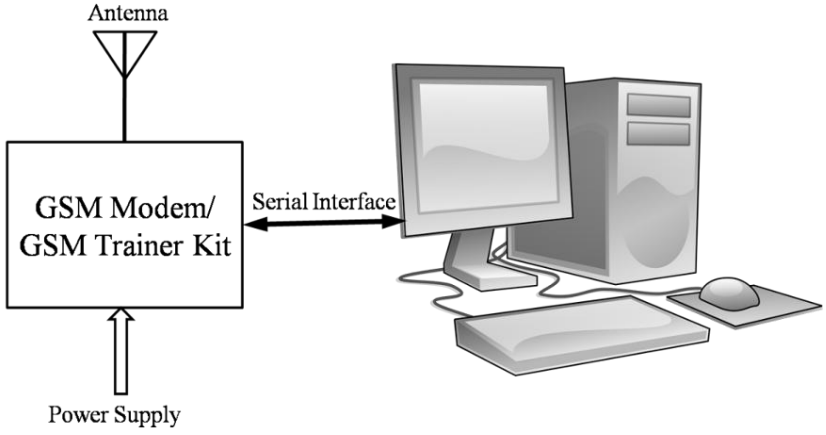


**Figure 21.1: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure21.2 Screenshot of hyper terminal software.**

5. Set the COM1 properties with default values as:
   - Speed/ Baud rate: 9600
   - Date Bits: 8
   - Parity: None
   - Stop Bit: 1
   - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
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## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the difference between flash message and chat message.
2. Find the Message size in GSM.
3. Send 3 messages to a friend and ask him to delete 2nd Message from the storage using AT commands. Write the procedure and response obtained.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.communica.se/multitec/gprs_at.pdf
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related: 10 Marks** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

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

# Practical No.22: Execute Data commands using relevant software.

**I Practical Significance**

Data communication plays very important role in Mobile communication. The data can be sent using various commands and using various methods. In GSM, Data related commands are also used to switch the data type/ Format. This practical will help the students to execute Data related commands and manage data.

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for accessing the data of a mobile phone unit..
- Use GSM modem and identify various data handling AT commands.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute Data commands using relevant software.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

The SMS specification has defined two modes in which a GSM/GPRS modem or mobile phone can operate. They are called SMS text mode and SMS PDU mode. (PDU stands for Protocol Data Unit.) The mode that a GSM/GPRS modem or mobile phone is operating in determines the syntax of some SMS AT commands and the format of the responses returned after execution.

When a modem is in data mode, any characters sent to the modem are intended to be transmitted to the remote party. The modem enters data mode immediately after it makes a connection. For example, if ATDT5551212 resulted in a phone call that was answered by another computer modem, the modem would report the word "CONNECT" and then switch to data mode.

Any further characters received over the serial link are deemed to be from the remote party, and any characters sent are transmitted to the remote party.
When a voice-capable modem is in "voice data" mode, any data sent to the modem is interpreted as audio data to be played over the phone line, rather than character bytes to be transmitted digitally to the other party.

**Data Handling Commands:**

**1.** +++

Sequence is used to switch from on-line data mode to on-line command mode while in a data call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| +++ | **OK** |

**Remarks:** No <CR> is needed after the sequence. For another way to disconnect see AT&D command.
**Source:** factory default
**Implementation:** complete

**2.** **ATO:**
Command is used to switch back from on-line command mode to on-line command data while in a data call.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **ATO** | **CONNECT <speed>** | **ERROR** |

**Remarks:** none
**Source:** GSM 07.07/V.25ter/6.3.7
**Implementation:** complete

**3.** **AT+CBST:**
Command is used to select the bearer service type and the transparent or non-transparent mode for a data connection.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +CBST =[<speed>,0,[,<ce>]]** | **OK** |
| **AT+CBST?** | **+CBST: <speed>,0,<ce>** |
| **AT+CBST=?** | **+CBST: (list of supported <speed>s),0,(list of supported <ce>s)** |

**Defined values:**

**<speed>**

| | |
|---|---|
| **0** | Autobauding (automatic selection of the speed) |
| **1** | 300 bps (V.21) |
| **2** | 1200 bps (V.22) |
| **4** | 2400 bps (V.22bis) |
| **6** | 4800 bps (V.32) |
| **7** | 9600 bps (V.32) |
| **8** | specific |
| **12** | 9600 bps (V.34) |
| **14** | 14400 bps (V.34) |
| **65** | 300 bps (V.110) |
| **66** | 1200 bps (V.110) |
| **68** | 2400 bps (V.110) |
| **70** | 4800 bps (V.110) |
| **71** | 9600 bps (V.110) |
| **75** | 14400 bps (V.110**)** |

**<ce>**

| | |
|---|---|
| **0** | Transparent |
| **1** | Non-transparent |
| **2** | Transparent preferred |
| **3** | Non-transparent preferred |

**Remarks:** none
**Source:** GSM 07.07/6.7
**Implementation:** complete

**4. AT+DS**

This command enables or disables V.42 data compression

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+DS=<dir>,<neg>,<P1>,<P2>** | **OK** |
| **AT+DS?** | **+DS: <dir>,<neg>,<P1>,<P2>** |
| **AT+DS=?** | **+DS: list of supported <dir>s,<neg>s,<P1>s,<P2>s** |

**Defined values:**

**<dir>** Specifies the desired direction(s) of operation of the data compression function; from the DTE point of view, (default is 3),

| | |
|---|---|
| **0** | Negotiated ... no compression |
| **1** | Transmit only |
| **2** | Receive only |
| **3** | Both directions, accept any direction |

**<neg>** Specifies whether or not the DCE should continue to operate if the desired result is not obtained, (default is 0)

| | |
|---|---|
| **0** | Do not disconnect if V.42bis is not negotiated by the remote DCE as specified in <dir> |

| | |
|---|---|
| **1** | Disconnect if V.42bis is not negotiated by the remote DCE as specified in <dir> |
| **<P1>** | specifies the maximum number of dictionary entries which should be negotiated, range 512- 4096, (default is 4096) |
| **<P2>** | specifies the maximum string length to be negotiated, range 6-250, (default is 250) |

**Remarks:** none
**Source:** factory default
**Implementation:** complete

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

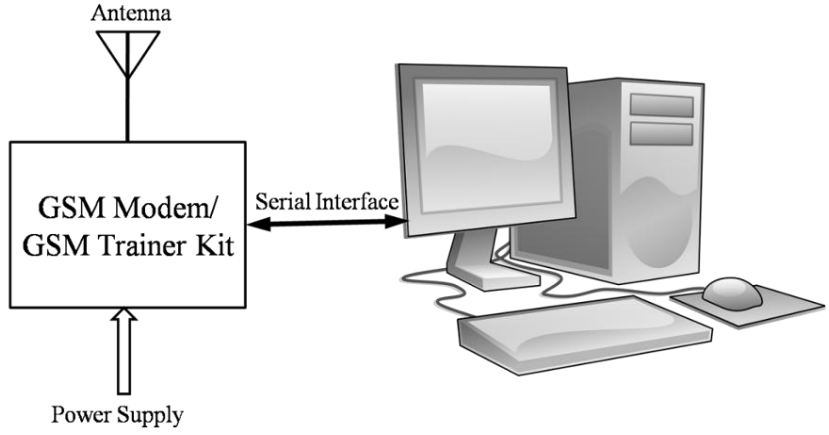


**Figure 22.1: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure your SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format your SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure 22.2: Screenshot of hyper terminal software**

5. Set the COM1 properties with default values as:
   - Speed/ Baud rate: 9600
   - Date Bits: 8
   - Parity: None
   - Stop Bit: 1
   - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
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| 3. | | | |
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| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the significance of **"V" and "Subsequent Number"** (V.703, V.35 modem).
2. Find the output of AT+CMGF=<mode><CR> in PDU mode.
   Parameters
   <mode>: 0 = PDU Mode, 1 = Text Mode
   <CR> = ASCII character 13
3. Draw the block diagram of basic MODEM

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. www.mobilecomms-technology.com
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 4 | Observations and recording | 20% |
| 5 | Answer to sample questions. | 15% |
| 6 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

3 ……

4 ……

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

# Practical No.23: Execute Specific AT commands using relevant software.

**I Practical Significance**

The AT command set is a command language with a series of short text strings, which combine together to output complete commands for different operations such as hanging up, dialing and changing connection parameters for modems. A majority of personal computer modems follow the AT command set specifications. This practical will help the students to execute recent AT commands to communicate with different networking components..

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **Communication:** Communicate effectively in oral and written form.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for accessing the various features of a mobile phone unit.
- Use GSM modem and identify various AT commands for different functions of GSM MODEM.

**IV Relevant Course Outcome(s)**

- Assess performance of standards of different cellular mobile systems.
- Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute Specific AT commands using relevant software.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

AT commands are commands which are used to control the modems where AT stands for Attention. These commands were derived from Hayes commands which were used by the Hayes smart modems. Every wireless, as well as the dial up modems, requires an AT command to interact with a computer machine. These AT commands along with other extended commands also require Hayes command set as a subset.

**Usage**

The AT commands can be used with GSM module and GPRS MODEMs or phone to access these services and information:

- SMS
- MMS
- Fax
- Voice link and other data over mobile network
- Information and configuration concerning the mobile devices or MODEM and SIM card.

**Types of AT Command**

There are 4 basic types of AT commands:

- **Test:** The test command is utilised to check the compatibility of a command by a modem.
- **Read:** Read command is used for extracting the mobile or modem settings required for operations.
- **Set:** This command is used to make changes into mobile phone or modem settings required for the operation.
- **Execution:** As the name suggests, this command is used to execute the said operation.

**Serial link control commands:**

**1. ATE**

The setting of this parameter determines whether or not the DCE echoes characters received from the DTE during command state and online command state

**Concept Structure:**

| Command | Possible Response |
|---|---|
| ATE[<value>] | OK |

**Defined values:**

**<value>**

**0** DCE does not echo characters during command state and online command state.

**1** DCE echoes characters during command state and online command state.

**Remarks** none

**Source** V.25ter/6.2.4

**Implementation** complete

**2. ATQ:**

The setting of this parameter determines whether or not the DCE transmits result codes to the DTE. When result codes are being suppressed, no portion of any intermediate, final, or unsolicited result code – header, result text, line terminator, or trailer – is transmitted. Information text transmitted in response to commands is not affected by the setting of this parameter.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| ATQ[<value>] | OK |

**Defined values:**
**<value>**

| | |
|---|---|
| **0** | DCE transmits result codes. |
| **1** | Result codes are suppressed and not transmitted. |
| **Remarks** | none |
| **Source** | V.25ter/6.2.5 |
| **Implementation** | complete |

**3. AT+IPR:**

This numeric extended-format parameter specifies the data rate at which the DCE will accept commands.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +IPR=<rate>** | **OK** |
| **AT+IPR?** | **+IPR:<rate>** |
| **AT+IPR=?** | **+IPR: [list of auto-bauding-capable <rate> values],[list of fixedonly <rate> values]** |

**Defined values:**

**<rate>** **Value specified shall be the rate in bits per second. A value of 0 switches into auto-bauding mode.**

**Remarks** The auto-bauding mode needs to have the characters in capital letters, otherwise they could not be recognized.
**Source** V.25ter/6.2.10
**Implementation** complete

**4. AT+CSAS**

Command is used to save special SMS settings.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| **AT+CSAS** | **OK** | **+CME ERROR: <err>** |
| **AT+CSAS=?** | **OK** | |

**Remarks:** none
**Source:** GSM 07.05/3.3.5
**Implementation:** complete

**(Note: Teacher can give more commands related to experiment)**
**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

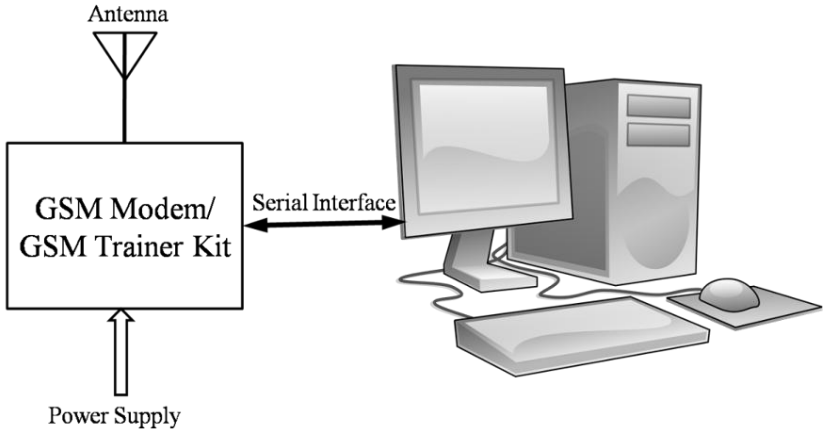


**Figure 23.1: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Fig 23.2 Screenshot of hyper terminal software**

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1
    - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations :**Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. AT commands are used only in GSM Modem, Justify.

2. State the different GSM modems available in the market. Write specification of any one GSM modem.
3. State technical specifications of modem used for this practical.
4. Write the AT commands used to change the SMS settings.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://electronicsforu.com/resources/cool-stuff-misc/gsm-at-commands
2. www.gsmworld.com
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

3 ……

4 ……

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

# Practical No.24: Execute AT commands for call control in 3G/4G network.

**I Practical Significance**

3G, short for third generation, is the third generation of wireless mobile telecommunications technology. It is the upgrade for 2G and 2.5G GPRS networks, for faster internet speed. This is based on a set of standards used for mobile devices and mobile telecommunications use services and networks that comply with the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. 3G finds application in wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV. This practical will help the students to learn 3G/4G networks call control AT commands.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for call control features of a 3G/4G mobile phone unit.
- Use GSM modem and identify various AT commands for different functions of 3G/4G GSM Mobile unit.

**IV Relevant Course Outcome**

Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute AT commands for call control in 3G/4G network.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

The 3G (UMTS and CDMA2000) research and development projects started in 1992. In 1999, ITU approved five radio interfaces for IMT-2000 as a part of the ITU-R M.1457 Recommendation; WiMAX was added in 2007.

There are evolutionary standards (EDGE and CDMA) that are backward-compatible extensions to pre-existing 2G networks as well as revolutionary standards that require all-new network hardware and frequency allocations. The cell phones use UMTS in combination with 2G GSM standards and bandwidths, but do not support EDGE. The latter group is the UMTS family, which consists of standards developed for IMT-2000, as well as the independently developed standards DECT and WiMAX, which were included because they fit the IMT-2000 definition.
While EDGE fulfills the 3G specifications, most GSM/UMTS phones report EDGE ("2.75G") and UMTS ("3G") functionality.
The following standards are typically branded 3G:
The UMTS (Universal Mobile Telecommunications Service) system, first offered in 2001, standardized by 3GPP, used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by GSM (Global Systems for Mobile) 2G system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure:
The following common standards comply with the IMT2000/3G standard:
EDGE, a revision by the 3GPP organization to the older 2G GSM based transmission methods, utilizing the same switching nodes, base station sites and frequencies as GPRS, but new base station and cellphone RF circuits. It is based on the three times as efficient 8PSK modulation scheme as supplement to the original GMSK modulation scheme. EDGE is still used extensively due to its ease of upgrade from existing 2G GSM infrastructure and cell-phones.
The Universal Mobile Telecommunications System, created and revised by the 3GPP. The family is a full revision from GSM in terms of encoding methods and hardware, although some GSM sites can be retrofitted to broadcast in the UMTS/W-CDMA format.
The CDMA2000 system, or IS-2000, including CDMA2000 1x and CDMA2000 High Rate Packet Data (or EVDO), standardized by 3GPP2 (differing from the 3GPP), evolving from the original IS-95 CDMA system, is used especially in North America, China, India, Pakistan, Japan, South Korea, Southeast Asia, Europe and Africa.

**Serial link control commands:**

**1. ATS0**

The S0 parameter controls the automatic answering of an incoming call.

**Concept Structure:**

| **Command** | **Possible Response** |
|---|---|
| **ATS0=<n>** | **OK** |
| **ATS0?** | **<n>** |

**Defined values:**

| | |
|---|---|
| **<n>** | Automatic answer after <n> rings. A value of 0 disables automatic answering. |
| **Remarks** | none. |
| **Source** | GSM 07.07/V.25ter/6.3.5 |
| **Implementation:** | complete |

**2. AT+CR:**

Command controls whether or not intermediate result code +CR: <serv> is returned from the modem during connect negotiation of a data call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +CR=[<mode>]** | **OK** |
| **AT+CR?** | **+CR: <mode>** |
| **AT+CR=?** | **+CR: (list of <modes>s)** |

**Defined values:**

**<mode>**

**0** Disables reporting

**1** Enables reporting

**<serv> ASYNC** Asynchronous transparent

**REL ASYNC** Asynchronous non-transparent

**Remarks** none

**Source** GSM 07.07/6.9

**Implementation** complete

**3. AT+CRC:**

Command controls whether or not the normal RING message of an incoming call is replaced by an extended call indication using unsolicited result code +CRING: <type>.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT +CRC=[<mode>]** | **OK** |
| **AT+CRC?** | **+CRC: <mode>** |
| **AT+CRC=?** | **+CRC: (list of <modes>s)** |

**Defined values:**

**<mode>**

**0** Disables reporting

**1** Enables reporting

**<type>**

**ASYNC** Asynchronous transparent

**REL ASYNC** Asynchronous non-transparent

**VOICE** Normal voice

**Remarks** none

**Source** GSM 07.07/6.11

**Implementation** complete

**4. AT+CCFC**

Command is used to set the call forwarding service.

**Concept Structure:**

| Command | Possible Response | |
|---|---|---|
| AT+CSAS | OK | +CME ERROR: <err> |
| AT+CSAS=? | OK | |

**Remarks:** none
**Source:** GSM 07.05/3.3.5
**Implementation:** complete
**(Note: Teacher can give more commands related to experiment)**
**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

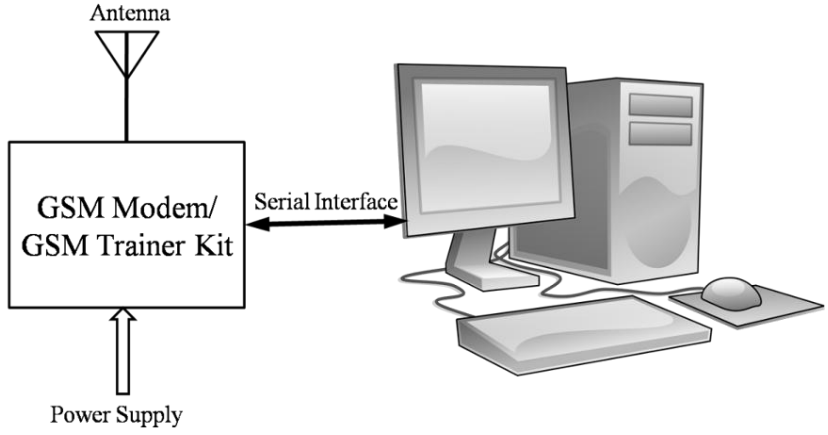


**Figure 24.1: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure 24.2 Screenshot of hyper terminal software**

5. Set the COM1 properties with default values as:
   - Speed/ Baud rate: 9600
   - Date Bits: 8
   - Parity: None
   - Stop Bit: 1
   - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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## XIX 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 identified CO.**

1. State different frequency bands used in GSM.
2. Compare GSM and GPRS based on their data rates
3. Specify the AT command is used to save special SMS settings.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://electronicsforu.com/resources/cool-stuff-misc/gsm-at-commands
2. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
3. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related ( 10 Marks)** | | **40%** |
| 4 | Observations and recording | 20% |
| 5 | Answer to sample questions. | 15% |
| 6 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

3 ……

4 ……

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

# Practical No.25: Execute AT commands for video call and phone Camera related commands in 3G/4G networks.

**I Practical Significance**

The mobile phone now a days become a necessity for an individual. The mobile now a days becoming smarter and the interface with all other services and internet is become necessary. The increased Data rates in GSM network, allows the user to use video calling, conferencing, camera related applications. This has now become integral part of mobile. To get acquainted with these features GSM AT commands are used. This practical will help the students to execute Advance features of 3G/4G networks like Video call and Phone camera commands

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for Advance features such as video call and phone camera of a 3G/4G mobile phone unit.
- Use GSM modem and identify various AT commands for different functions of 3G/4G GSM Mobile unit.

**IV Relevant Course Outcome(s)**

Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute AT commands for Video call and Phone camera related commands in 3G/4G networks.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

## VII Minimum Theoretical Background

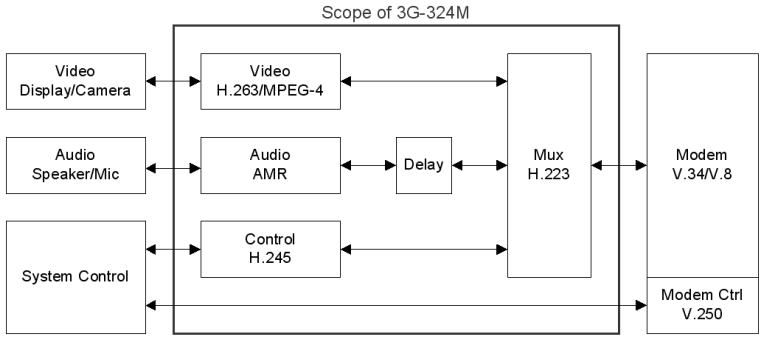


**Figure 25.1 Block diagram of Video call in 3G Mobile phone**
(courtesy: https://en.wikipedia.org/wiki/3G-324M)

The 3G-324M protocol operates over an established circuit switched connection between two communicating peers. 3G-324M is an umbrella specification to enable conversational multimedia communication over Circuit Switched (CS) networks and has been adopted by the 3GPP. 3G-324M is based on the ITU-T H.324 specification for multimedia conferencing over Circuit switched networks.
The 3G-324M specification using the Circuit switched network allows delay sensitive conversational multimedia services such as:

- Videoconferencing for personal and business use
- Multimedia entertainment services
- Telemedicine
- Surveillance
- Live Video Broadcasting– Cable TV On-the-Go
- Video-on-demand (movies, news clips)

MOBILE COMMUNICATION HISTORY AND STATUS

| Property | 1G | 2G | 2.5G | 3G |
|---|---|---|---|---|
| Starting Time | 1985 | 1992 | 1995 | 2002 |
| Driven Technique | Analogue signal processing | Digital signal processing | Packet switching | Intelligent signal processing |
| Representative Standard | AMPS, TACS, NMT | GSM, TDMA | GPRS, I-Mode, HSCSD, EDGE | IMT-2000 (UMTS, WCDMA, CDMA2000) |
| Service Type | Voice<br>Mono-service<br>Person-to-person | Voice, SMS<br>Mono-media<br>Person-to-person | Data service | Voice, Data<br>Some Multimedia<br>Person-to-machine |
| Bandwidth (bps) | 2.4K-30K | 9.6K-14.4K | 171K-384K | 2M-5M |
| Radio Frequency (HZ) | 400M-800M | 800M-900M, 1800M-1900M | | 2G |
| Multi-address Technique | FDMA | TDMA, CDMA | | CDMA |
| Cellular Coverage | Large area | Medium area | | Small area |
| Core Networks | Telecom networks | Telecom networks | | Telecom networks, Some IP networks |

**Figure 25.2 Comparison of 1G,2G,3G,4G networks | (Courtesy: https://www.researchgate.net/)**

**Video call and Phone camera Related commands:**

**1. AT+VPMAKE**

The command is used to originate a video call. Before issue the command, user can select video call TX source by AT+VPSOURCE, and select whether record video after video call is connected or not by AT+VPRECORD

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+VPMAKE=<num> | If connecting:<br>VPACCEPT<br>OK<br>VPRINGBACK, VPSETUP, VPCONNECTED |
| ATS0? | If not connecting:<br>VPACCEPT<br>OK<br>VPEND |

**Defined values:**

**<num>** Dialing number, which must less than 32 bytes

**2. AT+VPANSWER:**

The command is used to answer an incoming video call. If there is no incoming video call, OK response is given only.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+VPANSWER | OK<br>VPSETUP<br>VPCONNECTED |
| | No incoming video call:<br>OK |

**3. AT+VPEND:**

The command is used to end a video call. If recording video is ongoing, the command will stop recording and end video call. In addition, the command can be used to reject an incoming video call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+VPEND | Video call is connected:<br>OK<br>VPEND[: <seconds>] |
| | Video call is not connected:<br>OK |

**Defined values:**

**<seconds>** The duration of video call, from VPCONNECTED to VPEND and the unit is in second.

**4. AT+VPDTMF:**

The command is used to send DTMF tone during a connected video call, and it is sent as an H.245 user-input indication (basic string) to the other side.
**NOTE** The maximal length of DTMF string is 127.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+VPDTMF=?** | **+VPDTMF:(list of supported <vpdtmf>s)**<br>**OK** |
| **AT+VPDTMF=<vpdtmf>** | **OK** |

**Defined values:**

**<vpdtmf>** DTMF string consisted of ( 0–9, *, #).

**5. AT+VPSOURCE:**

The command is used to select video TX source which provides video frames to transmit to remote party. If select video TX source before video call is connected, the Module will get video frames from specified TX source when video call is connected. The command is only effective on current or next video call.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+VPSOURCE=?** | **OK** |
| **AT+VPSOURCE=<src>[, <fname>]** | **OK** |

**Defined values:**

**<src>** The Module supports three TX sources – CAMERA, STATIC IMAGE, and FILE SOURCE. In spite of which TX source is used, the size of video frames must be 176* 144(pixel).

- **0** Send none image, video or video capture from camera
- **1** Capture video from camera. (Default value)
- **2** Send a static image, support JPEG and BMP format.
- **3** Send video frames from file, support MP4 and 3GP format.
- **4** Reserved.
- **5** Reserved.

**<fname>** Image or video file which is existed in current directory [refer to AT+FSCD], and it includes extension name.

**6. AT+CCAMS:**

The command is used to start camera. Make sure the sensor is existent and connect well. Camera must be started before taking picture or recording video.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CCAMS | OK |
| | If have no sensor:<br>CAMERA NO SENSOR<br>ERROR |
| | If camera has started:<br>CAMERA INVALID STATE<br>ERROR |

**7. AT+CCAME:**

The command is used to stop camera.

If AT+CCAMTP has executed to take a picture and the picture is not saved by AT+CCAMEP, the picture will not be saved after AT+CCAME execution. If AT+CCAMRS has executed to record video and that is not ended by AT+CCAMRE, the video file will be stopped recording and saved after AT+CCAME execution.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| AT+CCAME | OK |
| | If camera has stopped:<br>CAMERA NOT START<br>ERROR |

**(Note: Teacher can give more commands related to experiment)**

**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

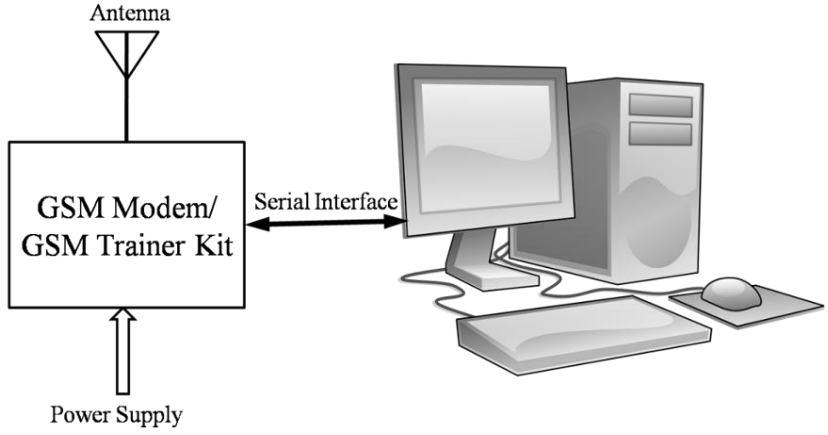


**Figure 25.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure 25.3 Screenshot of hyper terminal software**

5. Set the COM1 properties with default values as:
    - Speed/ Baud rate: 9600
    - Date Bits: 8
    - Parity: None
    - Stop Bit: 1

- Flow Control: None.

6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

**XII Resources used**

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

**XIII Actual procedure followed**

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
| | | |
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Establish a video call between 2 phones, and write the steps of video call process.
2. Write Specifications of Camera available in the phone.
3. Explain process of capturing an image in Mobile Phone Camera.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://www.falcom.de/uploads/media/A2D_hardware_description.pdf
2. https://www.etsi.org/deliver/etsi_gts/07/0707/05.00.00_60/gsmts_0707v050000p.pdf

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of student Team Member***

1. ……..
2. ……..
3. ……..
4. ……..

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

# Practical No.26: Execute AT commands for Microphone and Loudspeaker Volume control related commands in 3G/4G networks.

**I Practical Significance**

Smart phones will become even more user friendly mobile phones along with the high functionalization. On the other hand, there are problems currently occurring, such as noise coupled from the baseband circuit, due to the built-in multiple wireless communication functions, and the design changes to solve the reception sensitivity deterioration caused by this noise coupling, takes a lot of time and manpower for the mobile phone manufacturers to solve these problems. The different types of Microphones and speakers will help to communicate efficiently. This experiment will help the students to execute Controlling Loudspeaker and Microphone of the Mobile phone

**II Relevant Program Outcomes (POs)**

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Identify the components on GSM modem and identify the commands for Microphone and Loudspeaker volume control of a 3G/4G mobile phone unit.
- Use GSM modem and identify various AT commands for different functions of 3G/4G GSM Mobile unit.

**IV Relevant Course Outcome(s)**

Select relevant wireless technology suitable for various applications.

**V Practical Outcome**

Execute AT commands for Microphone and Loudspeaker volume control related commands in 3G/4G networks.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

**Loud Speaker:**

The loudspeaker is a small sound driver fitted within a mobile phone, or other communication device, which is used to produce sound. Traditionally, loudspeakers

on mobile phones are used to produce sound alerts for events such as incoming calls, incoming messages and alarms. Three different tests need to be done. For each test several consecutive measurements is taken and usually the highest and the lowest readings are discarded and the average value of the rest is taken.

The three tests are as follows:

1) A phone ringing (Calling a phone from another number to check the ringing). An old-school ringtone is used, resembling the ringing of an old phone. It seems that most phones do well when it is used.
2) Pink noise (a signal or process with a frequency spectrum such that the power spectral density (energy or power per frequency interval) is inversely proportional to the frequency of the signal.). Readings with it are pretty indicative on how well the handset loudspeaker would fare with standard music. Teenagers definitely appreciate a handset that will allow them to crank up the volume as high as possible.
3) Human voice, male. This is an important test, since if the use of loudspeaker for speakerphone purposes is more, loudness is really important, regardless of whether phone is in a conference room or in a car.

**Microphone:**

Microphones on various models of phones vary quite a bit. Newer phones have two or three microphones, but differ quite a bit in their sound recording abilities. Especially problematic seems to be recording loud sounds, such as concerts, although even those capabilities are improving.

Important things to look for in microphone related interfacing are the ability to:

1) Adjust gain levels;
2) change sampling rates;
3) Display the recording levels on the screen, so necessary adjustments can be done, and perhaps not as important,
4) Save the files to multiple formats.

Also very handy is the ability to email the recording, or save it to cloud storage, such as Drop box.

**Video call and Phone camera Related commands:**

**1. AT+CLVL:**

This command is used to select the volume of the internal loudspeaker audio output of the device. Test command returns supported values as compound value.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+CLVL=?** | **+CLVL: (list of supported <level>s)**<br>**OK** |
| **AT+CLVL?** | **+CLVL: <level>**<br>**OK** |
| **AT+CLVL=<level>** | **OK** |

**Defined values:**

**<level>** Integer type value which represents loudspeaker volume level. The range is from 0 to 8, and 0 represents the lowest loudspeaker volume level, 2 is default factory value.

NOTE <level> is nonvolatile, and it is stored when restart

**2. AT+VMUTE:**

The command is used to control the loudspeaker to mute and unmute during a voice call or a video call which is connected. If there is not a connected call, write command can't be used. When all calls are disconnected, the Module sets the sub parameter as 0 automatically.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+VMUTE=?** | **+VMUTE: (list of supported <mode>s)**<br>**OK** |
| **AT+VMUTE?** | **+VMUTE: <mode>**<br>**OK** |
| **AT+VMUTE=<mode>** | **OK**<br>**ERROR** |

**Defined values**

**<mode>**

**0** mute off

**1** mute on

**3. AT+CMUT:**

The command is used to enable and disable the uplink voice muting during a voice call or a video call which is connected. If there is not a connected call, write command can't be used. When all calls are disconnected, the Module sets the sub parameter as 0 automatically

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+CMUT=?** | **+CMUT: (list of supported <mode>s)**<br>**OK** |
| **AT+CMUT?** | **+CMUT: <mode>**<br>**OK** |
| **AT+CMUT=<mode>** | **OK**<br>**ERROR** |

**Defined values:**

**<mode>**

**0** mute off

**1** mute on.

**4. AT+CRSL:**

The command is used to select the incoming call ringer sound level of the device. The value of <level> will be saved to nonvolatile memory after write command is executed.

**Concept Structure:**

| Command | Possible Response |
|---|---|
| **AT+CRSL=?** | **+CRSL: (list of supported <level>s)**<br>**OK** |

| | |
|---|---|
| **AT+CRSL?** | **+CRSL: <level>**<br>**OK** |
| **AT+CRSL=<level>** | **OK** |

**Defined values:**

**<level>** Integer type value which represents the incoming call ringer sound level. The range is from 0 to 4, and 0 represents the lowest level, 2 is default factory value.

NOTE <level> is nonvolatile, and it is stored when restart.

**(Note: Teacher can give more commands related to experiment)**
**NOTE: In any of the practical related to AT command this "ERROR" can be the possible response which means: The device is not interfaced or available in MODEM. (This could be one of the reasons for getting this kind of error)**

## VIII Setup Diagram

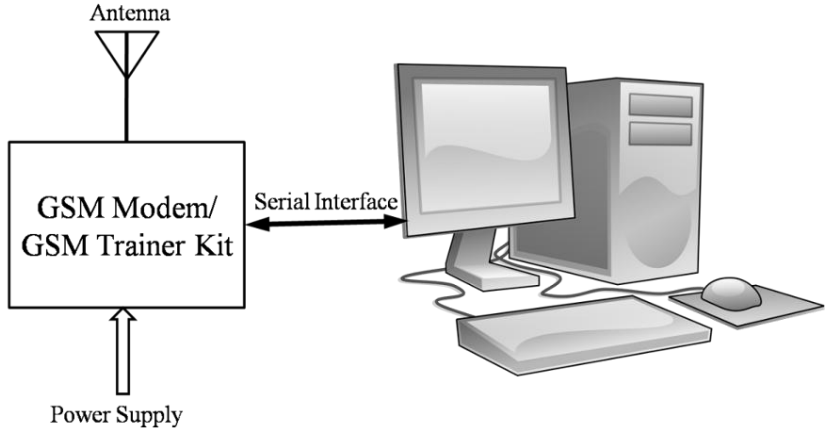


**Figure .26.2: Interfacing diagram of GSM modem and computer.**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Computer system | A basic computer system with Minimum Configuration and operating system like Windows 2000/ xp/ vista/ 2007/2010 | 01 |
| 2. | GSM Modem | SIM 300 or higher | 01 |
| 3. | SIM Card | Any 3G network SIM card | 01 |
| 4. | Serial Cable | DB-9 serial connector | 01 |
| 5. | Adapter | 12V DC | 01 |

## X Precautions to be followed

- Insert SIM Card Properly.
- Make sure the SIM is having network coverage
- Type the AT Commands after reading their use, as it might reset / Format the SIM Data.

## XI Procedure

**Steps for Connecting GSM Modem with Hyper terminal software:**

1. Connect the setup as shown in the block diagram given.
2. Start the PC and load the required software for GSM modem/Trainer.
3. Start the Hyper terminal Software
4. Open File-> New Connection


**Figure 26.3 Screenshot of hyper terminal software**

5. Set the COM1 properties with default values as:
   - Speed/ Baud rate: 9600
   - Date Bits: 8
   - Parity: None
   - Stop Bit: 1
   - Flow Control: None.
6. Type **"AT"** on the Screen(Command line ) and detect connection by receiving response **"OK"**
7. Type the various commands and check their responses
8. Record the responses of given various commands in the observation table

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

## XIII Actual procedure followed

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations** (use blank sheet provided if space not sufficient)
Observe Command response and write their Responses.

| Sr. No. | Command | Response |
|---|---|---|
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**XVI Result** (Responses of various AT Commands)

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**XVII Interpretation of Results (**Responses of AT Commands with their functionality)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. Find the IC used to process Audio signal in trainer kit from the instructional manual.
2. State the function of HAGGER and COBBA IC.
3. Test the micro phone and speaker of the phone available in lab, using specific Code. (Search for code to diagnose the phone).

**[Space for Answers]**

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**XX References / Suggestions for further Reading**

1. https://electronicsforu.com/resources/cool-stuff-misc/gsm-at-commands
2. https://en.wikipedia.org/wiki/3G-324M
3. http://www.mt-system.ru/sites/default/files/docs/simcom/docs/sim5215-16/simcom_sim5215_sim5216_atc_en_v1.21.pdf

**XXI Assessment Scheme**

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Use of GSM Modem with Hyper terminal Software | 20% |
| 2 | Identifying AT Commands for an experiment | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 4 | Observations and recording | 20% |
| 5 | Answer to sample questions. | 15% |
| 6 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

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4 ……

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

# Practical No.27: Build a Personal Area Network of mobile devices Using Bluetooth.

**I Practical Significance**

Bluetooth is a wireless technology standard for exchanging data over short distances using short-wavelength UHF radio waves in the ISM band from 2.400 to 2.485 GHz from fixed and mobile devices, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables. One thing keeps skipping people's attention is Bluetooth. Before portable hotspot and Wi-Fi tethering was a thing, which is shared in phone internet using Personal Area Networks, also called Bluetooth Tethering. This experiment will help the students to setup Personal Area Network, Bluetooth.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Use Bluetooth device to create a small network.
- Identify the various settings require for creating a network.

**IV Relevant Course Outcome**

Test the performance of various wireless protocols.

**V Practical Outcome**

Build a Personal Area Network of mobile devices using Bluetooth.

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

A personal area network (PAN) is a computer network for interconnecting devices centered on an individual person's workspace. A PAN provides data transmission amongst devices such as computers, smartphones, tablets and personal digital assistants. PANs can be used for communication amongst the personal devices

themselves, or for connecting to a higher level network and the Internet where one master device takes up the role as gateway. A PAN may be wireless or carried over wired interfaces such as USB.

A wireless personal area network (WPAN) is a PAN carried over a low-powered, short-distance wireless network technology such as IrDA, Wireless USB, Bluetooth or ZigBee. The reach of a WPAN varies from a few centimeters to a few meters

Today, smartphone penetration is higher than it's ever been. These devices now offer a lot of functionality, border-line phasing out certain gadgets altogether. For instance, a phone now stream music, meaning MP3 players and iPods no longer have a place. More relevant to today's topic, Cellular dongles, popularly referred to as modems are quickly becoming a thing of the past.

The main challenge of Bluetooth tethering, like with USB tethering, is that it only supports one device at a time. That is the device that's connected to the Android via Bluetooth. But if needed more users to share phone's internet, then it can enable the wireless hotspot as well. It turns Android supports USB tethering and wireless Hotspot to run at the same time. This might put a huge strain battery and data on phone.

## VIII Setup Diagram: (Refer Figure 27.1 for Setup Diagram)

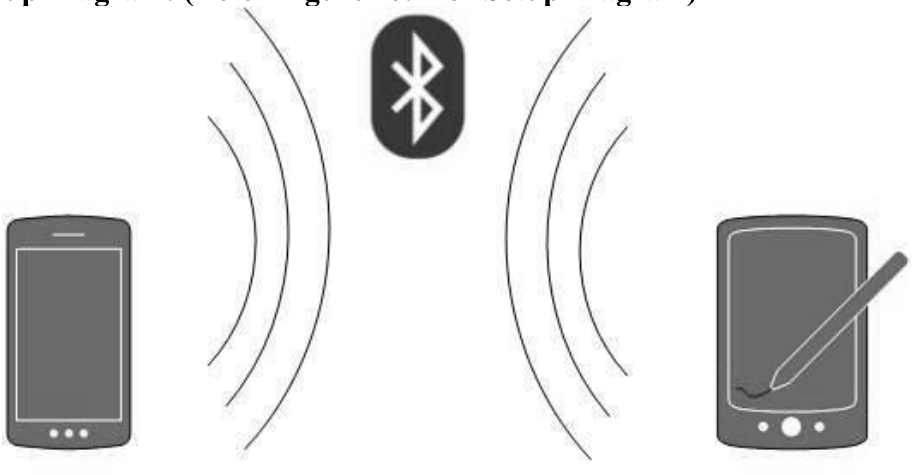

**Figure 27.1 Personal Area Network using Bluetooth technology**

*(Courtesy: https://www.tutorialspoint.com/data_communication_computer_network/computer_network_types.htm)*

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Mobile phone with Bluetooth device | Any basic phone having Bluetooth device | 02 |

## X Precautions to be followed

- Check the battery status before connecting..
- Enter correct password for pairing
- Disconnect the connection after usage.

## XI Procedure

**(Note: This procedure may vary phone to phone)**

**(On the phone from where a person wants to transfer a file)**

1. Go to Settings
2. Go to More
3. Select Tethering & Portable hotspot option
4. Select Bluetooth Tethering.
5. Wait for the receiver to connect to network.
6. The file will automatically transfer to another phone.


**Figure 27.2: Screenshot of settings in a smart phone**

**(Courtesy: https://www.dignited.com/31936/how-to-create-a-bluetooth-pan-personal-area-network-on-android/)**

**(On Receivers Phone)**

- Go to Settings
- Go to More
- Turn on the Bluetooth
- Select the transmitters MAC(Physical address / Name)
- Insert correct password
- Wait for connection to be complete

## XII Resources used

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |

**XIII Actual procedure followed**

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations:**
**Observe the following Setting and attach the screenshots of the mobile phone.**

1. Setting menu
2. Turning on the Bluetooth Tethering
3. Available Bluetooth devices.
4. Successful Tethering Connection

**XVI Result** (Successful/ Failure in the connection establishment)

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**XVII Interpretation of Results (**Remedies for creating proper Bluetooth connection )

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State the frequency of Bluetooth technology.

2. State the spread spectrum used in Bluetooth
3. Make 3 slides in the android phone and send the Presentation to course co-coordinator. Also write steps involved in it.
4. List various Personal Area Network devices and also list how many devices can be connected in a network.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. https://electronicsforu.com/resources/cool-stuff-misc/gsm-at-commands
2. https://www.dignited.com/31936/how-to-create-a-bluetooth-pan-personal-area-network-on-android/
3. https://en.wikipedia.org/wiki/Personal_area_network

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Connection procedure for setting up a network. | 20% |
| 2 | Use of Bluetooth as a Personal area Network | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

2 ……

3 ……

4 ……

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

# Practical No.28: Test the hard reset function, hotspot and other Networking functions of the given smart phone.

**I Practical Significance**

When the Android Smartphone slows, freezing, not responsive, responding incorrectly, or can't remember the phones password? There is still a pretty powerful option available, and that is to perform a hard reset, also known as an alternate reset, on the device. The hard rest helps the phone to revert the default settings and remove all the forgotten passwords. Also the Hotspots are the new personal wireless networks comes in a latest smart phones. The Hotspot helps a phone to get internet connectivity in the device where internet is not connected.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations
- **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

**III Competency and Practical skills**

This practical is expected to develop the following skills for the industry identified competency **'Maintain mobile communication systems':**

- Learn Procedure for Hard reset of a mobile phone.
- Identify the various settings require for creating a network.

**IV Relevant Course Outcome(s)**

Test the performance of various wireless protocols.

**V Practical Outcome**

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

**VI Relevant Affective domain related Outcome(s)**

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

**VII Minimum Theoretical Background**

**Hard Reset:**

A Hard reset, also known as master reset, is software restore of an electronic device to its original system state by erasing all of the information stored on the device in an attempt to restore the device to its original manufacturer settings. Doing so will effectively erase all of the data, settings, and applications that were previously on the

device. This is often done to fix an issue with a device, but it could also be done to restore the device to its original settings. Such electronic devices include smartphones. Since a factory reset entails deleting all information stored in the device, it is essentially the same concept as reformatting a hard drive. Pre-Installed applications and data on the card's storage card (such as a Micro SD card) will not be erased. A factory reset should be performed with caution, as it effectively destroys all data stored in the unit. Factory resets can fix many chronic performance issues such as freezing and will not remove the device's operating system.

**HOT SPOT:**

A hotspot is a physical location where people may obtain Internet access, typically using Wi-Fi technology, via a wireless local area network (WLAN) using a router connected to an internet service provider.

Public hotspots may be created by a business for use by customers, such as coffee shops or hotels. Public hotspots are typically created from wireless access points configured to provide Internet access, controlled to some degree by the venue. In its simplest form, venues that have broadband Internet access can create public wireless access by configuring an access point (AP), in conjunction with a router and connecting the AP to the Internet connection. A single wireless router combining these functions may suffice.

Private hotspots may be configured on a smartphone or tablet with a mobile network data plan to allow Internet access to other devices via Bluetooth pairing or if both the hotspot device and the device/s accessing it are connected to the same Wi-Fi network.

## VIII Setup Diagram:

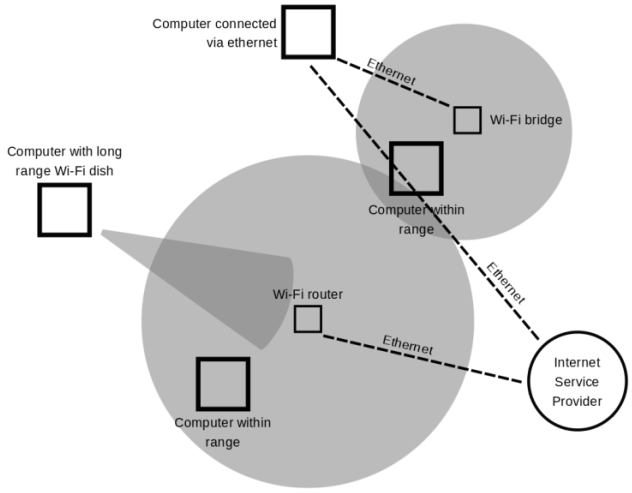


**Figure 28.1: Hotspot**

## IX Resources required

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | Mobile phone with Wi-Fi / Hotspot Connection | Any basic phone having Wi-Fi / Hotspot Connection | 01 |
| 2. | Simple Smart phone | A basic Smart phone (Preferably Android) | 01 |

## X Precautions to be followed

- Check the battery status before connecting.
- Enter correct password for pairing
- Read proper procedure before starting hard reset.

## XI Procedure

**(Note: This procedure may vary phone to phone)**

**Procedure for HARD RESET of a Smart Phone.**

- **Method 1:**
  1. When the phone is powered off, press and hold the **Volume Up** and the **Volume Down** keys both at the same time.
  2. Then press and hold the **Power** key until a test screen that shows some available options appears3
  3. Usually takes about 15-20 seconds.
  4. When that screen pops up let go of the keys.
  5. Press the **Volume Down** key to navigate down through the options until it highlights **FACTORY RESE.**
  6. Then press the **Power** key to select it.
- **Method 2:**
  1. Power the phone off all the way.
  2. Press and hold the **Volume Down** key and press than release the **Power** key, still holding the volume down key for about 10-15 seconds.
  3. When phone shows some additional options pop up on the screen, let go of the keys.
  4. Press the **Volume Down** key to navigate down through the options until it highlights the reset option.
  5. It usually says **FACTORY RESET.**
  6. Then press the **Power** key to make the selection.

**Note: http://www.smartmobilephonesolutions.com/content/how-to-hard-reset-an- android phone is the website, where can fine more, hard reset procedure for various phones**

**Procedure for WI-FI / Hotspot:**

1. Open the settings from the menu.
2. Open Wi-Fi/ Hotspot Option
3. The various Wi-Fi/ Hotspot networks available now can be seen.

4. Select the appropriate Wi-Fi/Hotspot device.
5. Enter the password.
6. After authentication, phone will be redirected and internet will get connected.

**XII Resources used**

| Sr. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| 1. | | | |
| 2. | | | |

**XIII Actual procedure followed** (use blank sheet provided if space not sufficient)

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**XIV Precautions followed** (use blank sheet provided if space not sufficient)

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**XV Observations:**

**Observe the following Setting and attach the screenshots of the mobile phone.(Hot spot/ Wi-Fi)**

1. Setting menu
2. Turning on the Hotspot/ Wi-Fi.
3. Available Hotspot/ Wi-Fi devices.
4. Successful Tethering Connection

**Observe the following Setting and attach the Photos of the mobile phone.(Hard reset)**

1. Factory reset options
2. Factory reset process
3. Successful Factory reset

**XVI Result** (Successful/ Failure in the connection or hard reset procedure)

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**XVII Interpretation of Results (**Remedies for creating proper Wi-Fi/ Hotspot connection and proper Hard reset Procedure.)

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**XVIII Conclusions and Recommendations (**Actions/decisions to be taken based on the interpretation of results).

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**XIX 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 identified CO.**

1. State in which situation the hard Reset becomes necessary.
2. Configure a Wi-Fi router and write the steps followed to configure and also state how many devices can be connected using single router.
3. List the precautions to be followed when hard reset is done.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

1. http://www.smartmobilephonesolutions.com/content/how-to-hard-reset-an-android-phone
2. https://en.wikipedia.org/wiki/Factory_reset
3. https://en.wikipedia.org/wiki/Personal_area_network
4. https://en.wikipedia.org/wiki/Hotspot_(Wi-Fi)

## XXI Assessment Scheme

| Performance Indicators | | Weightage |
|---|---|---|
| **Process related (15 Marks)** | | **60%** |
| 1 | Connection procedure for setting up a network. | 20% |
| 2 | Hard reset procedure and successful completion. | 30% |
| 3 | Follow ethical practices. | 10% |
| **Product related (10 Marks)** | | **40%** |
| 1 | Observations and recording | 20% |
| 2 | Answer to sample questions. | 15% |
| 3 | Timely Submission of report. | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Member***

1 ……

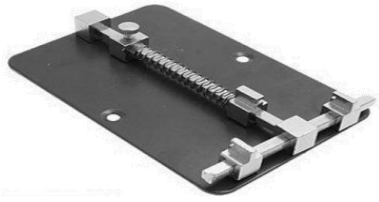
2 ……

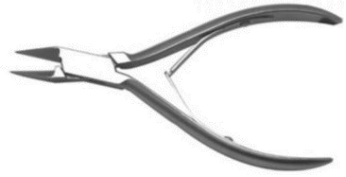
3 ……

4 ……

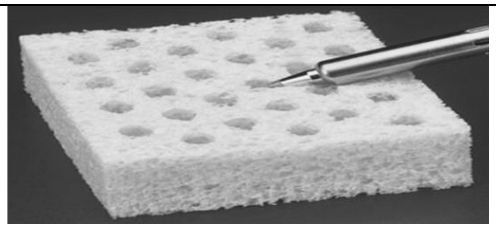
| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related (15)** | **Product Related (10)** | **Total (25)** | |
| | | | |

## Tools for mobile handset repair

| Sr No. | Tool | Use | Diagram |
|---|---|---|---|
| 1 | Soldering Iron or Soldering Station | Used to solder the component in PCB. |   |
| 2 | Soldering Wire | Used along with Soldering Iron to solder the components |  |
| 3 | PCB Stand | Used to Hold the PCB |  |
| 4 | PCB Cleaner | Used to Clean PCB. Mostly thinner is used. |   |
| 5 | Jumper Wire | Used to connect one point on PCB with another |  |
| 6 | Blade Cutter | Used to Cut & Remove Lamination |  |

| Sr No. | Tool | Use | Diagram |
|---|---|---|---|
| 7 | Point Cutter | Used to Cut Wires. |  |
| 8 | Nose Cutter | Used to Cut Wires. |  |
| 9 | Screwdriver Set | Use to Remove and Tighten screws from Mobile Phone. (T3,T4,T5,T6,+,-,*) |  |
| 10 | Tweezers | Used to Hold Wire and Components |  |
| 11 | EST – Brush | For Cleaning PCB |  |
| 12 | Multimeter | Used to Check PCB track and Electronic Components |  |

| Sr No. | Tool | Use | Diagram |
|---|---|---|---|
| 13 | Hot Air Gun | To Remove and solder SMD / Chip components |   |
| 14 | Battery Booster | Used to Boost Voltage of Battery |   |
| 15 | Ultrasonic Cleaner | Advance technique to clean PCB and Electronic components |  |
| 16 | BGA Kit | Used to Reball and Repair Ball-Type IC |  |
| 17 | Magnifying Lamp | To Get Magnified View of PCB and Components. |  |
| 18 | Case and Screen Opener | To Open the Screen and Case of a Mobile Phone. |  |

| Sr No. | Tool | Use | Diagram |
|---|---|---|---|
| 19 | Regulated DC Power Supply | To Supply DC Voltage |  |
| 20 | Liquid Flux/ Paste Flux | To Clean PCB Track and Legs of Electronic Components while Soldering. |   |
| 21 | Solder Paste | Solder in Semi-Solid Form. Used to Solder |  |
| 22 | File / Cleaning Sponge | To Clean Tip of Soldering Iron |  |
| 23 | Desoldering Wire | To Desolder Electronic Components and To Remove Excess Solder from PCB Track |   |

**Source**: https://www.pdfdrive.com/mobile-phone-repairing-course-e18663794.html

# List Of Laboratory Manuals Developed by MSBTE

## First Semester:

| | | |
|---|---|---|
| 1 | Fundamentals of ICT | 22001 |
| 2 | English | 22101 |
| 3 | English Work Book | 22101 |
| 4 | Basic Science (Chemistry) | 22102 |
| 5 | Basic Science (Physics) | 22102 |

## Second Semester:

| | | |
|---|---|---|
| 1 | Bussiness Communication Using Computers | 22009 |
| 2 | Computer Peripherals & Hardware Maintenace | 22013 |
| 3 | Web Page Design with HTML | 22014 |
| 4 | Applied Science (Chemistry) | 22202 |
| 5 | Applied Science (Physics) | 22202 |
| 6 | Applied Machines | 22203 |
| 7 | Basic Surveying | 22205 |
| 8 | Applied Science (Chemistry) | 22211 |
| 9 | Applied Science (Physics) | 22211 |
| 10 | Fundamental of Electrical Engineering | 22212 |
| 11 | Elements of Electronics | 22213 |
| 12 | Elements of Electrical Engineering | 22215 |
| 13 | Basic Electronics | 22216 |
| 14 | 'C' programming Language | 22218 |
| 15 | Basic Electronics | 22225 |
| 16 | Programming in "C" | 22226 |
| 17 | Fundamentals of Chemical Engineering | 22231 |

## Third Semester:

| | | |
|---|---|---|
| 1 | Applied Multimedia Techniques | 22024 |
| 2 | Advanced Serveying | 22301 |
| 3 | Highway Engineering | 22302 |
| 4 | Mechanics of Structures | 22303 |
| 5 | Building Construction | 22304 |
| 6 | Concrete Technology | 22305 |
| 7 | Strength Of Materials | 22306 |
| 8 | Automobile Engines | 22308 |
| 9 | Automobile Transmission System | 22309 |
| 10 | Mechanical Operations | 22313 |
| 11 | Technology Of Inorganic Chemicals | 22314 |
| 12 | Object Oriented Programming Using C++ | 22316 |
| 13 | Data Structure Using 'C' | 22317 |
| 14 | Computer Graphics | 22318 |
| 15 | Database Management System | 22319 |
| 16 | Digital Techniques | 22320 |
| 17 | Principles Of Database | 22321 |
| 18 | Digital Techniques & Microprocessor | 22323 |
| 19 | Electrical Circuits | 22324 |
| 20 | Electrical & Electronic Measurment | 22325 |
| 21 | Fundamental Of Power Electronics | 22326 |
| 22 | Electrical Materials & Wiring Practice | 22328 |
| 23 | Applied Electronics | 22329 |
| 24 | Electrical Circuits & Networks | 22330 |
| 25 | Electronic Measurments & Instrumentation | 22333 |
| 26 | Principles Of Electronics Communication | 22334 |
| 27 | Thermal Engineering | 22337 |
| 28 | Engineering Matrology | 22342 |
| 29 | Mechanical Engineering Materials | 22343 |
| 30 | Theory Of Machines | 22344 |

## Fourth Semester:

| | | |
|---|---|---|
| 1 | Hydraulics | 22401 |
| 2 | Geo Technical Engineering | 22404 |
| 3 | Chemical Process Instrumentation & Control | 22407 |
| 4 | Fluid Flow Operation | 22409 |
| 5 | Technology Of Organic Chemicals | 22410 |
| 6 | Java Programming | 22412 |
| 7 | GUI Application Development Using VB.net | 22034 |
| 8 | Microprocessor | 22415 |
| 9 | Database Managment | 22416 |
| 10 | Electric Motors And Transformers | 22418 |
| 11 | Industrial Measurements | 22420 |
| 12 | Digital Electronics And Microcontroller Applications | 22421 |
| 13 | Linear Integrated Circuits | 22423 |
| 14 | Microcontroller & Applications | 22426 |
| 15 | Basic Power Electronics | 22427 |
| 16 | Digital Communication Systems | 22428 |
| 17 | Mechanical Engineering Measurments | 22443 |
| 18 | Fluid Mechanics and Machinery | 22445 |
| 19 | Fundamentals Of Mechatronics | 22048 |

## Fifth Semester:

| | | |
|---|---|---|
| 1 | Design of Steel and RCC Structures | 22502 |
| 2 | Public Health Engineering | 22504 |
| 3 | Heat Transfer Operation | 22510 |
| 4 | Environmental Technology | 22511 |
| 5 | Operating Systems | 22516 |
| 6 | Advanced Java Programming | 22517 |
| 7 | Software Testing | 22518 |
| 8 | Control Systems and PLC's | 22531 |
| 9 | Embedded Systems | 22532 |
| 10 | Mobile and Wireless Communication | 22533 |
| 11 | Industrial Machines | 22523 |
| 12 | Switchgear and Protection | 22524 |
| 13 | Energy Conservation and Audit | 22525 |
| 14 | Power Engineering and Refrigeration | 22562 |
| 15 | Solid Modeling and Additive Manufacturing | 22053 |
| 16 | Guidelines & Assessment Manual for Micro Projects & Industrial Training | 22057 |

## Sixth Semester:

| | | |
|---|---|---|
| 1 | Solid Modeling | 17063 |
| 2 | Highway Engineering | 17602 |
| 3 | Contracts & Accounts | 17603 |
| 4 | Design of R.C.C. Structures | 17604 |
| 5 | Industrial Fluid Power | 17608 |
| 6 | Design of Machine Elements | 17610 |
| 7 | Automotive Electrical and Electronic Systems | 17617 |
| 8 | Vehicle Systems Maintenance | 17618 |
| 9 | Software Testing | 17624 |
| 10 | Advanced Java Programming | 17625 |
| 11 | Mobile Computing | 17632 |
| 12 | System Programing | 17634 |
| 13 | Testing & Maintenance of Electrical Equipments | 17637 |
| 14 | Power Electronics | 17638 |
| 15 | Illumination Engineering | 17639 |
| 16 | Power System Operation & Control | 17643 |
| 17 | Environmental Technology | 17646 |
| 18 | Mass Transfer Operation | 17648 |
| 19 | Advanced Communication System | 17656 |
| 20 | Mobile Communication | 17657 |
| 21 | Embedded System | 17658 |
| 22 | Process Control System | 17663 |
| 23 | Industrial Automation | 17664 |
| 24 | Industrial Drives | 17667 |
| 25 | Video Engineering | 17668 |
| 26 | Optical Fiber & Mobile Communication | 17669 |
| 27 | Therapeutic Equipment | 17671 |
| 28 | Intensive Care Equipment | 17672 |
| 29 | Medical Imaging Equipment | 17673 |

## Pharmacy Lab Manual

## First Year:

| | | |
|---|---|---|
| 1 | Pharmaceutics - I | 0805 |
| 2 | Pharmaceutical Chemistry - I | 0806 |
| 3 | Pharmacognosy | 0807 |
| 4 | Biochemistry and Clinical Pathology | 0808 |
| 5 | Human Anatomy and Physiology | 0809 |

## Second Year:

| | | |
|---|---|---|
| 1 | Pharmaceutics - II | 0811 |
| 2 | Pharmaceutical Chemistry - II | 0812 |
| 3 | Pharmacology & Toxicology | 0813 |
| 4 | Hospital and Clinical Pharmacy | 0816 |

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