



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Engineering**

**Level: Diploma**

**Branch: Biomedical Engineering**

**Course / Subject Code: DI03003031**

**Subject Name: Principle of Telemedical Communication**

|                                |                 |
|--------------------------------|-----------------|
| <b>w. e. f. Academic Year:</b> | 2024-25         |
| <b>Semester:</b>               | 3 <sup>rd</sup> |
| <b>Category of the Course:</b> | PCC             |

|                      |   |
|----------------------|---|
| <b>Prerequisite:</b> | Basic knowledge of human biology, fundamentals of communication technology, computer literacy.  |
| <b>Rationale:</b>    | <p>Telemedicine is transforming healthcare delivery by enabling remote diagnosis, monitoring, and consultation through modern communication technologies. This course introduces diploma students to the fundamentals of Telemedical communication, preparing them to assist in telehealth operations and support digital healthcare services.</p> <p>With growing demand for telemedicine, students will gain essential technical, ethical, and practical skills to enhance their career prospects in healthcare and allied industries. Understanding Telemedical communication will enhance their employability in healthcare facilities, diagnostic centers, telemedicine startups, and public health initiatives.</p> |

## Course Outcome:

After Completion of the Course, Student will be able to:

| No.  | Course Outcomes  | RBT Level |
|------|--|-----------|
| CO-1 | Explain fundamental concepts of telemedicine, including telehealth, mHealth, eHealth, and their evolution.                               | R,U       |
| CO-2 | Identify and describe major components and technologies used in telemedicine systems   | R, U      |
| CO-3 | Compare different types of networking and wireless technologies used in healthcare communication systems.                                | R,U,A     |
| CO-4 | Recognize and apply ethical, legal, and data security principles in the design and operation of telemedicine systems.                    | R,U,A     |
| CO-5 | Demonstrate knowledge of practical applications of telemedicine such as Teleradiology, Telecardiology, Telepathology, and Tele-education | R,U,A     |

*\*Revised Bloom's Taxonomy (RBT)*



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| Teaching Scheme<br>(in Hours) |   |    | Total Credits<br>L+T+<br>(PR/2) | Assessment Pattern and Marks |        |        |                      | Total Marks |
|-------------------------------|---|----|---------------------------------|------------------------------|--------|--------|----------------------|-------------|
| L                             | T | PR |                                 | C                            | Theory |        | Tutorial / Practical |             |
|                               |   |    | ESE (E)                         |                              | PA (M) | PA (I) | ESE (V)              |             |
| 3                             | 0 | 2  | 4                               | 70                           | 30     | 20     | 30                   | 150         |

**Course Content:**

| Unit No. | Content   | No. Of Hours | % of Weight age |
|----------|---|--------------|-----------------|
| 1.       | <p><b>Unit 1. Fundamentals of Telemedicine</b></p> <p>1.1 Definitions: Telemedicine, Telehealth, mHealth, uHealth, eHealth</p> <p>1.2 Major areas of Telemedicine Technology</p> <p>1.3 Benefits of Telemedicine</p> <p>1.4 Challenges in implementing Telemedicine</p> <p>1.5 Block diagram –Telemedicine system</p> <p>1.6 Role of biomedical engineers in telemedicine systems</p> <p>1.7 Applications: rural healthcare, urban healthcare, home monitoring.</p>   | <b>08</b>    | <b>18%</b>      |
| 2.       | <p><b>Unit 2. Technology of Telemedicine system</b></p> <p>2.1 Types of information in telemedicine</p> <p>2.2 Basics of analog and digital communication</p> <p>2.3 Medical devices</p> <p style="padding-left: 20px;">2.3.1 Functions of - Digital electrocardiograph, electronic stethoscope, Digital spirometer, Ophthalmoscope, Digital Microscope, Dermoscope, Otoscope, Vital sign Monitors</p> <p>2.4 Videoconferencing equipment- Video camera, camcorder</p> <p>2.5 Connectivity and communication system</p> <p>2.6 Transmission media: satellite, internet, wireless, and mobile networks</p> <p>2.7 Delivery modes in Telemedicine</p> <p style="padding-left: 20px;">2.7.1 Store-and-forward Telemedicine</p> | <b>10</b>    | <b>22%</b>      |



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|    |   |           |             |
|----|---|-----------|-------------|
|    | 2.7.2 Real-time Telemedicine<br>2.7.3 Hybrid systems  |           |             |
| 3. | <b>Unit 3. Networking in Telemedicine</b><br>3.1 Computer networking in hospitals<br>3.2 Network Configuration:<br>3.2.1 Point-to-Point Connection, Local Area Network, Metropolitan Area Networks, Wide Area Network<br>3.3 Open system Interconnection Model<br>3.4 Types of wireless technologies-<br>3.4.1 Wi-Fi, WiMAX, Bluetooth, Zigbee<br>3.4.2 Cellular Networks (2G, 3G, 4G, 5G)<br>3.4.3 RFID (Radio-Frequency Identification) | <b>10</b> | <b>22%</b>  |
| 4. | <b>Ethics, Security and Legal issues in Telemedicine</b><br>4.1 Ethical Issues- Confidentiality, Professional standards, Authentication<br>4.2 Security in Telemedicine Systems<br>4.2.1 Access Controls and Firewalls<br>4.2.2 Encryption and Authentication<br>4.3 Legal Issues in Telemedicine<br>4.3.1 Doctor-Patient Relationship and Jurisdiction<br>4.3.2 Informed Consent and Licensing   | <b>07</b> | <b>16%</b>  |
| 5. | <b>Application of Telemedicine</b><br>5.1 Teleradiology<br>5.1.1 Components of Teleradiology system<br>5.2 Telecardiology<br>5.2.1 Equipment for Telecardiology<br>5.3 Telepathology<br>5.3.1 Types of Telepathology (Static, Dynamic, Hybrid)<br>5.3.2 Equipment for Telepathology<br>5.4 Telesurgery<br>5.4.1 Components of a Telerobotic system  | <b>10</b> | <b>22%</b>  |
|    | <b>Total</b>  | <b>45</b> | <b>100%</b> |

**Suggested Specification Table with Marks (Theory):**

| Distribution of Theory Marks (in %) |         |         |         |         |         |
|-------------------------------------|---------|---------|---------|---------|---------|
| R Level                             | U Level | A Level | N Level | E Level | C Level |
| 35%                                 | 42%     | 23%     | –       | –       | –       |

*Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)*



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## References/Suggested Learning Resources:

### (a) Books

- “Telemedicine: Technologies and Applications” *Author:* R.S. Khandpur  
*Publisher:* PHI Learning.
- “Handbook of Telemedicine” *Editors:* Olga Ferrer-Roca, M. Sosa-Iudicissa  
*Publisher:* IOS Press
- “Fundamentals of Telemedicine and Telehealth” *Author:* Shashi Gogia  
*Publisher:* Academic Press (Elsevier)

### (b) Open-source software and website:

- Telemedicine Practice Guidelines – India (2020)**  
*Publisher:* MoHFW, NITI Aayog, and Board of Governors MCI  
<https://www.mohfw.gov.in/pdf/Telemedicine.pdf>
- eSanjeevani Portal Documentation** <https://esanjeevani.in>
- WHO Telemedicine Reports and Toolkits** <https://www.who.int/health-topics/telemedicine>

## Suggested Course Practical List: If any

| Sr. No. | Practical Outcomes (PrOs)  | Unit No. | Approx. hours required |
|---------|--|----------|------------------------|
| 1.      | To understand and represent the major functional blocks of a telemedicine system.                                    | 1        | 2                      |
| 2.      | Identify the major application areas of telemedicine.  | 1        | 2                      |
| 3.      | Identify and discuss telemedicine benefits and challenges of different stakeholders (patients, doctors, government). | 1        | 2                      |
| 4.      | Understand the different types of information transmitted in telemedicine.   | 2        | 2                      |
| 5.      | Compare various communication technologies like satellite, internet, wireless, and mobile networks                   | 2        | 2                      |
| 6.      | To observe, differentiate, and analyze analog and digital signals using basic tools or simulations.                  | 2        | 2                      |
| 7.      | Set up a simple LAN using computers and networking equipment.  | 3        | 2                      |
| 8.      | Understanding and Implementing the OSI Model   | 3        | 2                      |
| 9.      | Test mobile data speeds on different network generations (2G, 3G, 4G, 5G) using speed testing apps.                  | 3        | 2                      |



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|              |   |   |           |
|--------------|---|---|-----------|
| 10.          | Demonstrate encryption and decryption techniques to secure patient data transmission in telemedicine.           | 4 | 2         |
| 11.          | Develop a prototype access control system using Arduino and RFID to simulate secure access to medical records.  | 4 | 2         |
| 12.          | Simulate firewall implementation using network simulation tools to evaluate security in telemedicine networks.  | 4 | 2         |
| 13.          | Demonstrate the working of a pulse sensor interfaced with Arduino to simulate telecardiology data transmission. | 5 | 2         |
| 14.          | Identify the components of a telesurgery system using diagrams, videos, or models.                              | 5 | 2         |
| 15.          | Identify the components of a teleradiology system using diagrams, videos, or models.                            | 5 | 2         |
| <b>Total</b> |   |   | <b>30</b> |

### List of Laboratory/Learning Resources Required:

| S.No | Equipment Name with Broad Specifications   | PrO. No.                   |
|------|--|----------------------------|
| 1    | Desktop Computers<br>Standard desktop computers with at least Intel Core i3 processor, 4GB RAM, and 500GB hard drive. Should support internet connectivity, have USB ports, and include a webcam and microphone for telemedicine demonstrations. | 1, 2, 3, 4, 5, 6, 7, 8, 15 |
| 2    | Arduino Uno<br>Microcontroller development boards with ATmega328P chip, 14 digital I/O pins, and USB interface. Used for prototyping telemedicine devices such as pulse sensors and access control systems.                                      | 11, 13                     |
| 3    | RFID Reader<br>RFID reader (13.56 MHz) with compatible passive tags or cards. Enables demonstration of secure access to medical records using Arduino.   | 11                         |
| 4    | Pulse Sensor<br>Analog pulse sensors that measure heart rate through fingertip detection. Easy to interface with Arduino for real-time telecardiology data simulation.   | 13                         |
| 5    | Smartphones/Tablets<br>Basic Android/iOS smartphones with GSM/3G/4G/5G connectivity and  | 6,9,15                     |



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|   |  |        |
|---|--|--------|
|   | camera/mic. Used for teleconsultation simulation and network speed testing.  |        |
| 6 | Video Conferencing Software<br>Free tools such as Zoom, Google Meet, or Jitsi Meet to demonstrate live doctor-patient consultations. Must support screen sharing and HD video/audio.               | 1,15   |
| 7 | Speed Testing App<br>Apps like Speedtest by Ookla or TRAI MySpeed for testing mobile data speeds in different network generations (2G to 5G).  | 9      |
| 8 | Digital Biomedical Instruments<br>Includes basic instruments like digital thermometer, pulse oximeter, and digital BP monitor. Used for demonstration of medical data collection and transmission. | 1,2,13 |
| 9 | External Webcam & Microphone<br>High-definition USB webcams and standalone microphones with noise cancellation. Useful for simulating remote diagnosis setups.                                     | 1,15   |

## Suggested Project List:

Projects allow students to apply theoretical concepts to real-world telemedicine problems, reinforcing their understanding, also encouraging students to design or simulate telehealth *solutions fosters innovation and creative thinking.*

1. **Mini Telemedicine Workstation Setup:** Set up a basic telemedicine unit using a webcam, mic, internet, and open-source video conferencing tools.
2. **EMR Design and Patient Record Management:** Create a simple EMR (Electronic Medical Record) system using Excel, Google Sheets, or basic database tools.
3. **Demo Using eSanjeevani or Similar Platform:** Navigate and demonstrate the use of eSanjeevani (without real patient data).
4. **Role-Play Project: Doctor-Patient Interaction in Telehealth:** Script and perform a recorded teleconsultation with simulated patients.
5. **Comparison of Wireless Technologies in Telemedicine:** Research and create a comparative study (Wi-Fi, Bluetooth, 4G/5G, VSAT, etc.)
6. **E-Waste Audit of an Institute's ICT Devices:** Survey computers, printers, scanners, and digital medical tools in your college or lab.
7. **Mini Telemedicine Workstation Setup:** Set up a basic telemedicine unit using a webcam, mic, internet, and open-source video conferencing tools.



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8. **Security in Telemedicine: A Case Study:** Study real-world security risks (data breaches, consent issues).
9. **Poster ethics in Telemedicine:** Create a digital or physical poster highlighting ethics (confidentiality, consent, professionalism).
10. **Case Study on Legal Issues:** Present a real-world case study of a legal issue in telemedicine (such as jurisdiction or doctor-patient relationships).
11. **Integration of AI in Telemedicine for Diagnostics:** explore the integration of AI-based diagnostic tools in telemedicine to enhance remote healthcare decision-making.

## **Suggested Activities for Students: If any**

In addition to classroom and laboratory learning, students are encouraged to engage in cocurricular activities that enhance their understanding and practical skills. These activities can be conducted in groups. It will give exposure to current tools, systems, and delivery modes that prepare students for roles in biomedical and telehealth industries.

1. Definition Card Sorting Game: Students match definitions to terms: Telemedicine, Telehealth, mHealth, etc.
2. Block Diagram Construction: Draw and explain the telemedicine system block diagram in groups.
3. Demonstration: Basic functioning of devices like ECG, digital stethoscope, or oximeters (if available).
4. Chart Making: Functions of diagnostic devices used in telemedicine in table/visual format.
5. Quiz / Crossword: Terms related to networking, legal & ethical aspects.
6. Telemedicine Application Presentations: Small groups present on Teleradiology, Telepathology, Telecardiology, Telesurgery, or Tele-education.
7. Reflection Journal: Students maintain a journal of what they learn weekly and how telemedicine could impact rural healthcare.

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