CHENNAI INSTITUTE OF TECHNOLOGY
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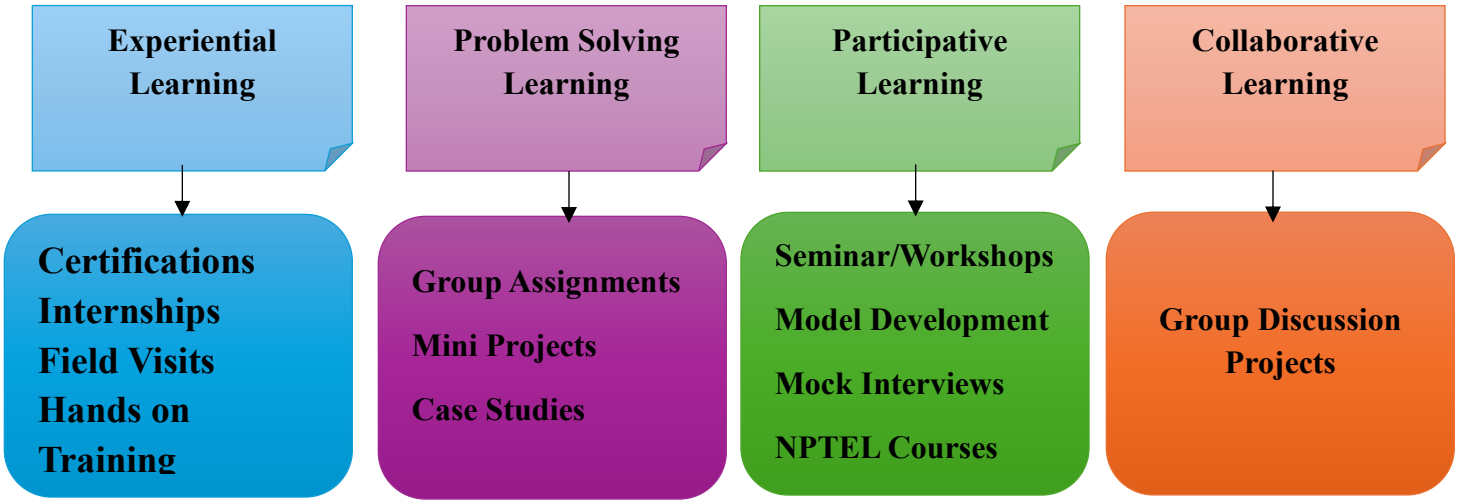
DEPARTMENT OF BIOMEDICAL ENGINEERING

TEACHING & LEARNING PROCESS

Introduction:

The objective of CIT's teaching-learning process is to give students a high-quality education that will advance their knowledge, develop their skills, give them more self-assurance, and transform their lives. Students are motivated to work together in a diverse and transdisciplinary setting to solve difficult engineering problems. Through a number of multimodal phases, students acquire a comprehensive education that includes things like:

- Project-based learning
- Internships
- Higher studies training
- Activity Based Learning
- Professional Skill Development



Innovative teaching-learning and assessment strategies are employed to link students with academic and professional careers. Every faculty member intends to use ICT-enabled tools for efficient course management, including Google Forms for MCQ-based assignments and quizzes, Google Classroom for online classes, recording lectures in addition to giving personality tests, quizzes and other interactive platforms for online group discussions.

To share resources with students, including modules, PowerPoint presentations, experiment procedures, etc., faculty members have developed websites. The teaching and learning

process (TLP) lies at the heart of any educational establishment. Faculty strive to innovate the teaching-learning process so that all parties involved benefit as much as possible.

All departments and students get the academic calendar prior to the commencement of the semester. Faculty members find it easier to organize their teaching load when semester events are calendar-based. It ensures that TLP runs smoothly and efficiently. Holistic education has been put into practice to enhance student performance, and all required steps have been done to independently curate the curriculum.

TLP policy choices are made at the departmental level by the faculty. By using innovative teaching strategies, instructors may deliver lectures more efficiently and rapidly, allowing students to keep up with technological advancements. Additionally, creative instructional techniques help students build self-sufficient mental processes and reasonable reasoning by encouraging them to take initiative.

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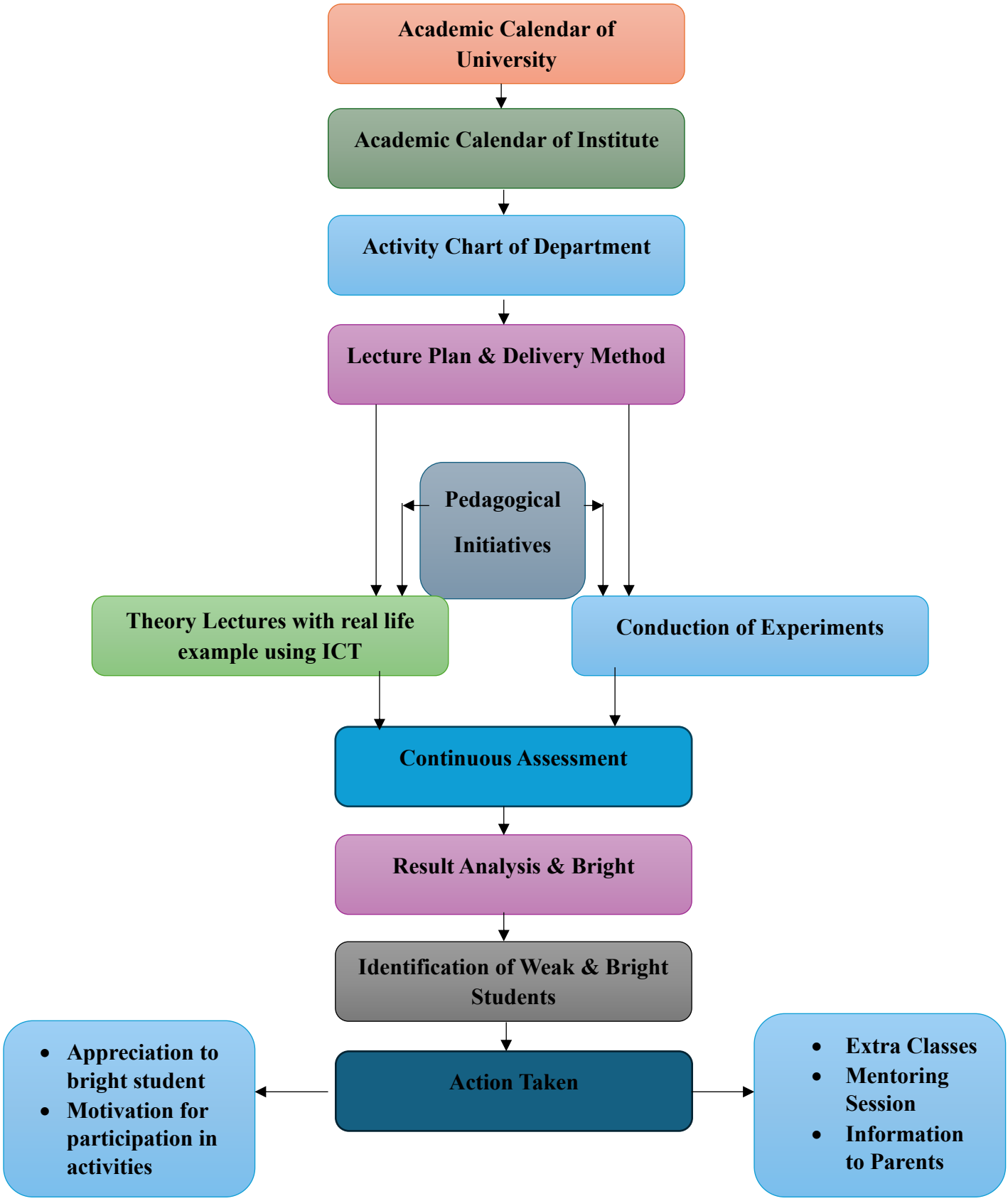

GATE Training:

Our faculty members who are expertise in their specialized domain, give mock tests referring to older GATE question papers and related materials. This is yielding improvement in increased number of ALL INDIA RANK students every year.

NPTEL Courses:

Both faculty members and students are encouraged to sign up for classes in the NPTEL online learning environment. Furthermore, it enhances comprehension when the instructor discusses topics while providing examples. The instructors will refer to these course materials in their regular classes as needed. Students are taking specialized courses from NPTEL if they sign up for them.

Blended learning:

E-learning and conventional face-to-face instruction are two examples of the several teaching approaches that are combined in blended learning. Effective student engagement is ensured via a mixed learning strategy. establishment of Google Classroom Sharing of electronic resources: Subject assignments can be distributed and graded electronically using Google Classrooms.

E-platform for study materials: Google Classrooms (GCR) is used to distribute instructional resources, and students are given G-Suit IDs. GCR is where assignments are posted and accessed. tests administered by Microsoft Forms and Google Forms. Additionally, interactive presentations and question banks are created and promptly sent to the students. Each subject-in-charge has produced notes and lab instructions for their specific subjects. The content is distributed to the class via Google Classroom.

Guest lectures and Seminars: Technical seminars and guest lectures are arranged to enhance understanding of the subject and make clear how ideas are used in real-world situations. Academics from different universities and industrialists are among the invited speakers.

Games, Role plays, and other activities: To enhance the teaching and learning process, faculty members are encouraged to employ games, role plays, and other activities that are relevant to the topic being discussed in class. It keeps the students interested in the material and helps them remember it for a longer amount of time.

ICT use: ICT-based education is widely acknowledged as the way of the future. Consequently, the faculty members make good use of ICT. The usage of internet resources, such as YouTube videos and Microsoft Office products like Word, Excel, and PowerPoint, improves the learning throughout the sessions.

Case Study: Students can identify typical real-world problems in specific managerial functional domains by using the Case Study Method. It is expected of students to study cases, comprehend the business context, analyze the problems, develop solutions, and then discuss the case in class.

To illustrate typical yet distinct problems that arise in business, domain-specific scenarios are explored. Occasionally, the case studies are used as a topic for group discussions to assist students develop their skills, test them, and use their analytical and communication abilities to come up with practical solutions.

Flipped classroom and Group discussions: Subject-specific GDs provide several benefits, such as improving students' articulation, improving topic research, improving students' understanding of a concept and its practical applications, decreasing students' shyness, and improving their communication abilities. GD also helps people gain jobs at reputable companies because it is one of the most popular interview-specific assignments.

Project based learning:

Project-based learning (PBL), a student-centered pedagogy that uses a dynamic classroom approach, is based on the notion that students learn more thoroughly by actively addressing challenges and problems from the real world. Students learn a subject by devoting a significant amount of time to investigating and resolving a difficult problem, question, or challenge. It is a method for active learning and inquiry-based learning. In contrast to paper-based, rote memorization or training that depicts these things, PBL replaces teacher-led teaching that provides known information or a clear path to knowledge with questions, issues, or scenarios.

Activity Based Learning:

Through practical exercises, students are encouraged to actively engage in a variety of activities, either individually or in groups. From semester one to semester four, ABL activities are carried out.

Research Based Learning:

The purpose of incorporating Research Based Learning (RBL) into the curriculum was to motivate students to work in groups on small projects related to their areas of interest. From semester five to semester eight, RBL events are conducted. Students participate in internships to expand their technical skills across a range of fields. Domains are chosen based on the curriculum and the interests of the students. Employability enhancement courses also students build skills that meet industry demands. Training on identified skills is being conducted by external industry specialists.

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Internal Assessment test:

At the conclusion of each day, a set of Formative Assessment tests is administered. These offer a chance to reflect on the subject matter and/or delve deeper into the information discussed in class. In order to give the students prompt feedback on what they have comprehended and what they have not, these are assessed and given back to them in the following class. This is the best kind of ongoing assessment and teaches students to be consistent and on time.

Sample pictures for project-based learning

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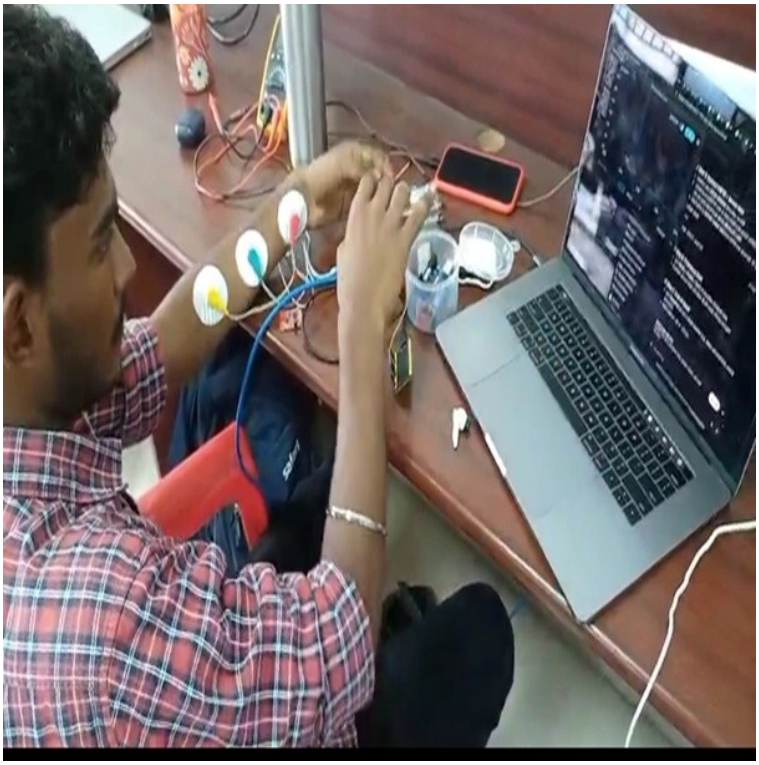
Sample pictures of students leaning from technical visits



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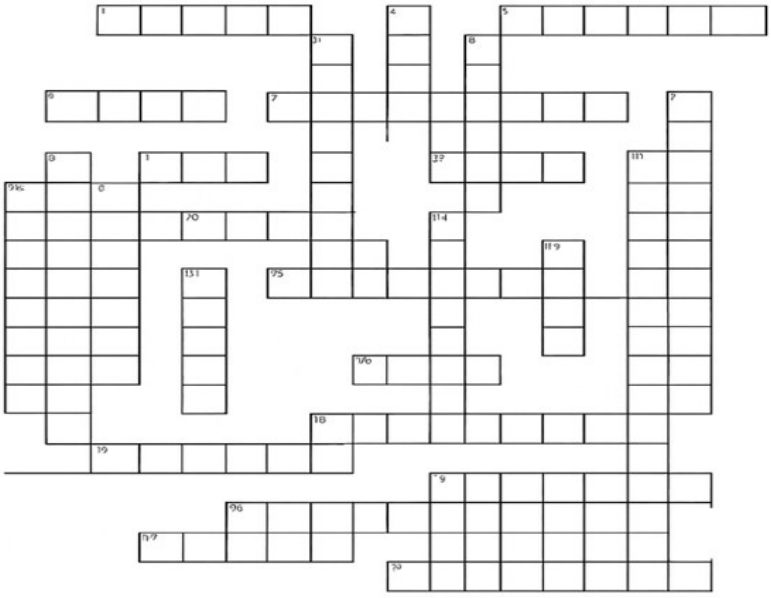
CROSSWORD

Objective: To enable students to apply and demonstrate biomedical engineering concepts through structured quiz-based learning. To strengthen their ability to analyze, interpret, and evaluate technical clues and problem scenarios with deeper understanding. To improve their capacity to articulate, justify, and communicate technical reasoning effectively during discussions and answer reviews.



Across

1. Device used to measure and record electrical activity of the heart.
2. Imaging technique that uses X-rays to produce detailed cross-sectional images of the body.
3. Study of the mechanics of human movement and body structure.
4. A wearable biomedical device that tracks vital parameters such as heart rate or temperature.
5. Artificial replacement for a missing body part.
6. Process of using computer algorithms to analyze medical images automatically.
7. The artificial organ used in dialysis to filter blood.
8. Computer programming platform used for simulation and signal processing in Biomedical Engineering.
9. An engineering field that combines biological science with electronics.

10. The use of mathematical models to understand physiological systems.
11. Non-invasive imaging technique that uses magnetic fields and radio waves.
12. The process of regenerating damaged tissues using cells and scaffolds.
13. A type of sensor used for detecting changes in body temperature.

Down

2. Electrical recording of muscle activity.
3. Discipline that integrates engineering principles with biological systems for healthcare applications.
4. Type of electrode commonly used in ECG measurements.
5. Technique for analyzing brain activity through scalp-recorded electrical signals.
6. Instrument used for measuring blood pressure.
7. An embedded microcontroller platform commonly used for prototyping biomedical devices.
8. Technology that uses intelligent algorithms to detect diseases or abnormalities in data.
9. Biomedical engineering area focusing on the design of assistive and rehabilitative devices.
10. Optical technique used to visualize internal structures through reflected light (used in ophthalmology).

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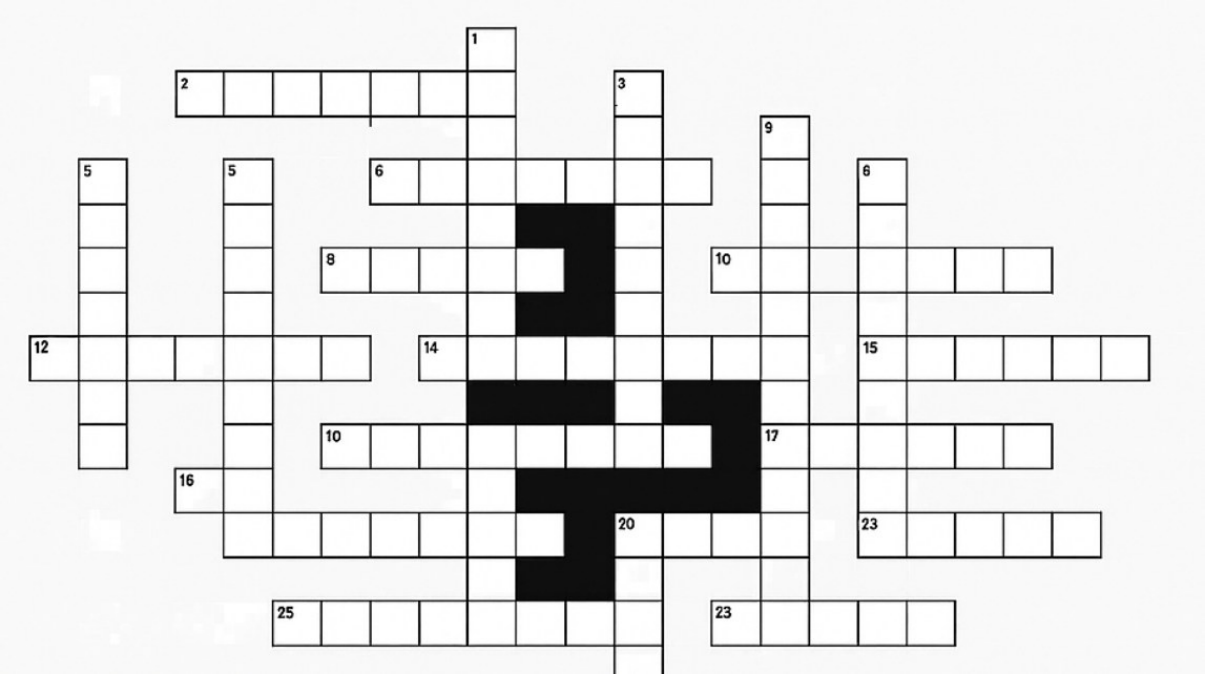

Across

1. Device that assists patients in standing and maintaining upright posture during therapy.
2. Wearable sensor system used to capture joint angles and body movements.
3. Artificial device that replaces a missing limb or body part.
4. Framework used to assess patients' ability to perform daily tasks, often measured in rehabilitation.
5. Robot-assisted therapy device used for gait training after stroke or spinal injury.
6. Electrical stimulation technique that activates nerves to restore voluntary muscle movement.
7. Structured program designed to improve functional mobility and strength after injury or surgery.
8. Brace used to support, align, or correct deformities of the musculoskeletal system.
9. Therapeutic device that uses resistance and vibration to improve motor function and balance.

10. Soft exoskeleton or wearable robotic suit used to assist disabled individuals in walking.
11. Assessment scale used to classify muscle strength from Grade 0 to Grade 5.
12. Equipment that measures hand grip force, commonly used for rehabilitation progress tracking.

Down

1. Technology using virtual environments for immersive rehabilitation exercises.
2. Sensor that detects electrical activity in muscles, useful for stroke rehabilitation assessment.
3. Assistive device that provides mobility support using wheels and a frame.
4. Therapeutic method involving water-based exercises for joint pain and injury recovery.
5. Quantitative test used to evaluate balance and fall risk in rehabilitation patients.
6. Rehabilitation specialist who focuses on restoring movement and physical function.
7. Device that improves communication for patients with speech impairment or neurological disorders.
8. Long-term assistive technology used to correct, compensate, or substitute for motor impairments.
9. Non-invasive brain–computer interface used to control assistive devices through neural signals.
10. Assessment used to measure gait speed, endurance, and walking capacity, often timed over 6 minutes.
11. Type of therapy using repetitive task practice to stimulate neuroplasticity in stroke patients.
12. Robot-assisted upper-limb rehabilitation device that trains reaching and grasping movements.

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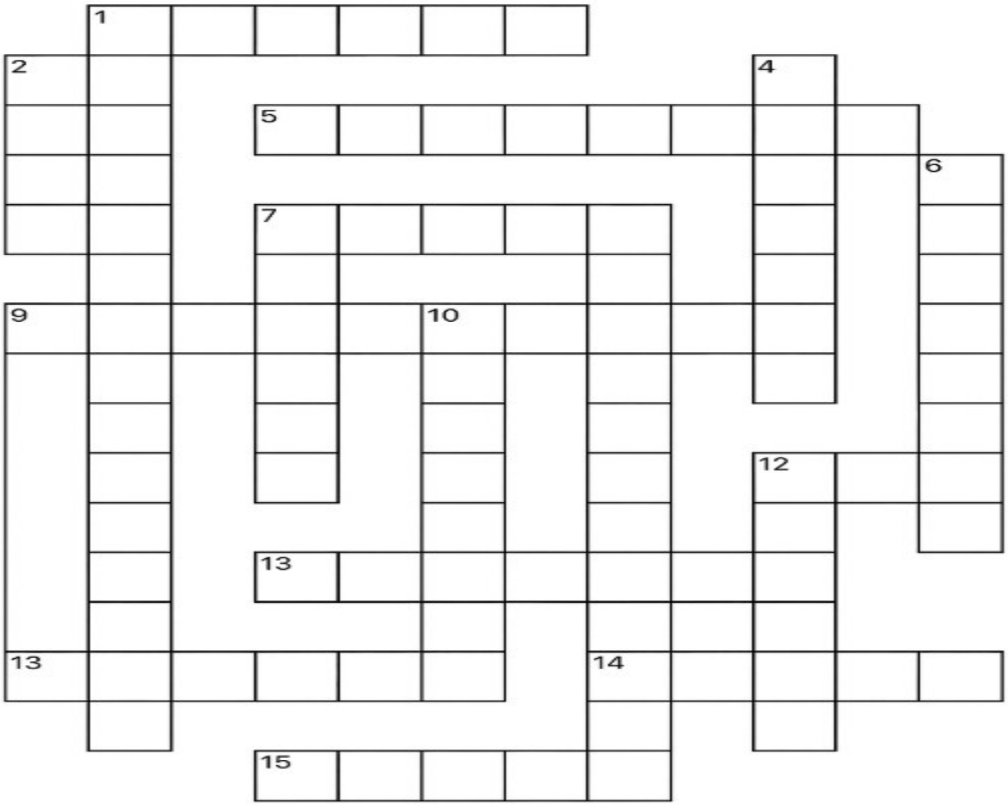

ACROSS

1. Beam used in radiography to create 2D projection images of internal structures.
2. Mathematical process used to reconstruct CT images from projection data.
3. Imaging modality based on proton alignment and relaxation in a magnetic field.
4. Device that converts X-rays into visible light or electronic signals in digital radiography.
5. Contrast agent used in MRI to enhance T1 relaxation.
6. Mode of ultrasound imaging that displays blood velocity using Doppler shift.
7. Camera used to detect gamma photons in nuclear medicine imaging.
8. High-frequency sound waves used for real-time imaging of soft tissues.
9. Technique used to acquire detailed cross-sectional images of the brain without ionizing radiation.

10. Imaging method that uses positron-emitting tracers to study metabolic activity.
11. Term for the brightness level of pixels in an image.
12. Detector technology widely used in digital mammography for high resolution.

DOWN

1. Unit used to measure CT attenuation values (CT number).
2. Phenomenon where ultrasound energy decreases as it travels through tissue.
3. Major safety concern associated with MRI due to strong magnetic fields.
4. Type of radiation used in PET imaging.
5. Artifact appearing as streaks in CT images due to highly dense materials like metal.
6. Primary piezoelectric material used inside ultrasound transducers.
7. Layer in ultrasound probes that reduces impedance mismatch with tissue.
8. Nuclear imaging technique that uses single-photon emitters.
9. Term describing random variations in pixel values that reduce image quality.
10. Algorithm used to reduce noise in MRI by repeatedly sampling k-space.
11. X-ray tube component where electrons strike to produce X-rays.

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QUIZ - MULTIPLE CHOICE QUESTIONS

Name of the Subject: Biomedical Instrumentation

Objective:

To enable students to effectively apply and demonstrate biomedical engineering concepts through an engaging and structured quiz activity. To enhance their ability to analyze, interpret, and evaluate technical questions and problem scenarios for deeper conceptual understanding. To improve their confidence in articulating and communicating accurate technical reasoning during discussions and answer reviews.

Outcome:

- Strengthened students' understanding of core biomedical engineering concepts through active participation and application-based questioning.
- Enhanced critical thinking and analytical reasoning skills relevant to real-world healthcare innovation challenges.
- Promoted interdisciplinary learning by linking engineering principles with medical and biological sciences.
- Encouraged teamwork, communication, and quick decision-making among participants during problem-solving rounds.
- Fostered creativity and innovation by motivating students to think beyond theoretical knowledge and explore modern healthcare technologies.

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BIOMEDICAL INSTRUMENTATON QUIZ

1. **The instrument used to record the electrical activity of the heart is called**
   (a) EEG
   (b) EMG
   (c) ECG
   (d) EOG

2. **The main transducer used in a blood pressure measurement system is a**
   (a) Thermistor
   (b) Strain gauge
   (c) Photodiode
   (d) Microphone

3. **The bioelectric potentials generated by the brain are measured using**
   (a) EMG
   (b) ECG
   (c) EEG
   (d) ERG

4. **The main purpose of a differential amplifier in biomedical instrumentation is to**
   (a) amplify all incoming signals equally
   (b) reduce noise and amplify small biopotentials
   (c) generate carrier waves
   (d) filter unwanted harmonics

5. **The sensing element used in a thermistor is sensitive to**
   (a) humidity
   (b) pressure
   (c) temperature
   (d) light

6. **Which of the following electrodes is most commonly used in ECG measurement?**
   (a) Calomel electrode
   (b) Silver-silver chloride electrode
   (c) Glass electrode
   (d) Hydrogen electrode

7. **The normal frequency range of an ECG signal is approximately**
   (a) 0.01 – 10 Hz
   (b) 0.05 – 100 Hz
   (c) 1 – 500 Hz
   (d) 10 – 1000 Hz

8. **A photoplethysmograph is used to measure**
   (a) Heart rate and blood flow
   (b) Temperature and pH
   (c) Brain activity
   (d) Lung volume

9. **The component in a biomedical amplifier that rejects common mode noise is the**
   (a) Coupling capacitor
   (b) Transformer
   (c) Differential input stage
   (d) Rectifier

10. **The signal from a pacemaker is primarily**
    (a) AC signal
    (b) DC signal
    (c) Pulsed DC signal
    (d) Sinusoidal signal

11. **In a spirometer, the physiological parameter measured is**
    (a) Blood pressure
    (b) Heart rate
    (c) Lung volume
    (d) Brain activity

12. **Which transducer converts physiological pressure into an electrical signal?**
    (a) Strain gauge transducer
    (b) Thermistor
    (c) Photodiode
    (d) Ultrasonic transducer

13. **The main advantage of using biomedical electrodes with gel is**
    (a) Reduced weight
    (b) Lower contact impedance
    (c) Increased electrode resistance
    (d) Improved durability

14. **A pulse oximeter measures**
    (a) Blood pressure and heart rate
    (b) Blood oxygen saturation and pulse rate
    (c) Blood glucose level
    (d) Body temperature

15. **The device that measures electrical activity of muscles is**
    (a) ECG (b) EEG (c) EMG (d) EOG

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BIOMECHANICS QUIZ

1. **Which of the following quantities is a vector?**
   A. Mass
   B. Speed
   C. Force
   D. Work

2. **The SI unit of stress is:**
   A. Joule
   B. Pascal
   C. Newton
   D. Watt

3. **Which tissue primarily resists tensile forces in the human body?**
   A. Bone
   B. Cartilage
   C. Ligament
   D. Adipose tissue

4. **The slope of the stress–strain curve in the elastic region represents:**
   A. Poisson's ratio
   B. Yield strength
   C. Young's modulus
   D. Toughness

5. **What type of joint is the knee joint?**
   A. Ball and socket
   B. Hinge joint
   C. Pivot joint
   D. Saddle joint

6. **Ground reaction force is generated due to:**
   A. Muscular contraction
   B. Gravity
   C. Newton's third law
   D. Friction only

7. **Which muscle contraction produces movement with constant velocity?**
   A. Isotonic
   B. Isokinetic
   C. Isometric
   D. Concentric

8. **Poisson's ratio is defined as the ratio of:**
   A. Shear strain to normal stress
   B. Transverse strain to longitudinal strain
   C. Stress to strain
   D. Elastic limit to yield point

9. **The primary function of synovial fluid is:**
   A. Bone formation
   B. Shock absorption and lubrication
   C. Muscle contraction
   D. Nerve conduction

10. **The gait cycle begins with:**
    A. Toe-off
    B. Heel-strike
    C. Mid-stance
    D. Mid-swing

11. **Which component of bone provides compressive strength?**
    A. Collagen
    B. Hydroxyapatite
    C. Elastin
    D. Proteoglycans

12. **The moment arm is defined as the:**
    A. Distance between two muscles
    B. Perpendicular distance from the force line to the axis of rotation
    C. Length of the bone
    D. Torque multiplied by velocity

13. **Torsion in long bones mainly produces:**
    A. Tensile stress only
    B. Shear stress
    C. Compressive stress
    D. Hydrostatic stress

14. **Muscles act as which class of lever most commonly in the human body?**
    A. First class
    B. Second class
    C. Third class
    D. Fourth class

15. **Which part of the spine allows the most rotation?**
    A. Cervical
    B. Thoracic
    C. Lumbar
    D. Sacral

16. **Which factor most strongly influences joint stability?**
    A. Muscle strength
    B. Skin elasticity
    C. Bone density
    D. Body temperature

17. **The viscoelastic behavior of biological tissues means they exhibit:**
    A. Only elastic behavior
    B. Only viscous behavior
    C. Time-dependent stress–strain response
    D. No deformation

18. **Which parameter is measured using a force plate?**
    A. Muscle EMG
    B. Ground reaction forces
    C. Body temperature
    D. Blood pressure

19. **Tendon primarily connects:**
    A. Bone to bone
    B. Muscle to bone
    C. Muscle to muscle
    D. Bone to cartilage
20. **Which type of loading commonly causes stress fractures in bones?**
    A. Compressive overload
    B. Tensile overload
    C. Repetitive cyclic loading
    D. Single high-impact load
21. **In biomechanics, kinematics deals with:**
    A. Forces causing motion
    B. Motion without considering forces
    C. Joint stability
    D. Muscle fatigue
22. **Center of mass in the human body is usually located at:**
    A. Head region
    B. Mid-thorax
    C. Anterior to S2 vertebra
    D. Near the knee joint
23. **Which law explains inertia of human movement?**
    A. Newton's 1st law
    B. Newton's 2nd law
    C. Newton's 3rd law
    D. Hooke's law
24. **What does EMG measure in muscles?**
    A. Force output
    B. Neural activation signals
    C. Blood flow
    D. Elasticity
25. **The maximum load a material can withstand without permanent deformation refers to:**
    A. Toughness
    B. Elastic limit
    C. Fatigue strength
    D. Ultimate strength

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TECHNICAL PAPER/POSTER PRESENTATION

Objective:

To enable students to apply and present technical concepts effectively by organizing their ideas into clear, structured, and research-based presentations. To strengthen their ability to analyze, interpret, and synthesize information from various sources, fostering deeper understanding and critical thinking. To enhance their capacity to articulate, justify, and communicate technical content with clarity and confidence during presentations and audience interactions.

OUTCOME:

- Develop the ability to plan and structure effective presentations by gathering relevant information, understanding audience requirements, and defining clear objectives.
- Organize content logically by identifying central themes, key points, and supporting ideas, while crafting impactful introductions and conclusions.
- Recognize the importance and effective use of visual aids to enhance audience engagement and comprehension.
- Select and apply appropriate media tools for data visualization and presentation enhancement.
  Demonstrate proficient verbal and non-verbal communication techniques for confident and professional delivery.
- Manage presentation-related stress through effective preparation and practice strategies.
  Handle audience questions and feedback with clarity, composure, and professionalism.

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PRE-READING MATERIAL

Topic: Brain Signal Acquisition Using Emotiv Epoc Flex EEG System

Objective: To enable students to build foundational understanding and apply key biomedical engineering concepts by engaging with structured pre-reading content before classroom instruction. To strengthen their ability to analyze, interpret, and connect theoretical information with practical applications for deeper conceptual clarity. To enhance their capacity to articulate, discuss, and effectively communicate their technical understanding during subsequent classroom activities and evaluations.

Description:

The Emotiv Epoc Flex EEG system is a high-performance, multi-channel electroencephalography (EEG) headset designed to measure electrical activity generated by the brain. It is widely used in biomedical research, cognitive studies, and neuro engineering applications.

Signal Acquisition:
The Epoc Flex uses 32 saline-based electrodes placed over the scalp according to the international 10–20 system. These electrodes detect minute voltage changes (in microvolts) caused by neuronal firing in the cerebral cortex.

Signal Amplification:

Since the EEG signals are very weak, an amplifier module boosts the signal strength while maintaining fidelity. The amplifier also ensures a high signal-to-noise ratio, minimizing motion and environmental interference.

Signal Processing:

The acquired EEG signals are transmitted wirelessly to a computer via Bluetooth. The EmotivPRO software filters out noise and artifacts (e.g., eye blinks or muscle movement) and converts raw data into readable waveforms, such as alpha, beta, delta, and theta bands.

Visualization and Analysis:

Processed data are visualized as real-time brain wave activity, allowing interpretation of cognitive states such as attention, relaxation, or stress. The recorded data can be exported for advanced analysis in MATLAB or Python for feature extraction and classification.

Outcome:

Students develop foundational knowledge of EEG-based biomedical signal acquisition and processing. They gain practical insight into how neural activity is captured, analyzed, and applied in brain–computer interface systems, cognitive neuroscience, and neuro-rehabilitation technologies.

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CONCEPT OF THE DAY

Year/Sem: All classes everyday 7.50 am to 8.00 am

Objective: To enable students to explore, understand, and demonstrate emerging biomedical engineering concepts through focused daily discussions and knowledge-sharing sessions. To strengthen their ability to analyze, interpret, and connect new technical ideas with real-world biomedical applications for deeper conceptual enrichment. To enhance their capacity to articulate, justify, and communicate innovative engineering concepts confidently during classroom interactions and peer discussions.

Outcomes: Students and faculties learnt more new trending concepts in and around in the area of Engineering.

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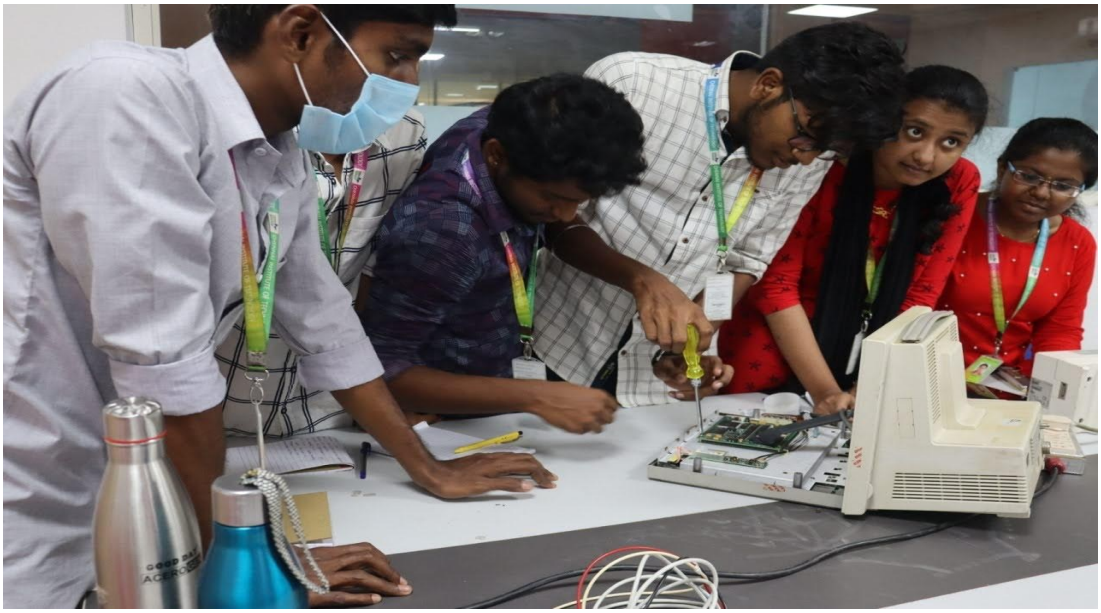
SELF LEARNING

Objective:

To enable students to independently explore and apply biomedical engineering concepts through structured self-learning activities that promote deeper subject understanding. To strengthen their ability to analyze, interpret, and evaluate technical content, research resources, and problem scenarios through guided self-study. To enhance their capacity to articulate, justify, and communicate their technical insights effectively during discussions, reflections, and assessments.



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CASE STUDY DISCUSSION

Objective:

To enable students to apply and demonstrate concepts related to smart healthcare technologies and biosensing systems through structured learning activities and practical exploration. To strengthen their ability to analyze, interpret, and evaluate real-time sensor data, biomedical signals, and healthcare problem scenarios with deeper technical understanding. To enhance their capacity to articulate, justify, and communicate their insights on smart diagnostics and biosensing innovations effectively during discussions and evaluations.

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Objective : To enable students to apply and demonstrate biomedical engineering concepts by critically examining real-world clinical and technical case scenarios. To strengthen their ability to analyze, interpret, and evaluate patient data, device performance issues, and healthcare challenges with deeper technical insight. To enhance their capacity to articulate, justify, and communicate evidence-based reasoning effectively during collaborative case discussions and reviews.