AAVARTAN'25-26

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VIGYAAN

DEPARTMENT OF BIOMEDICAL ENGINEERING

PROBLEM STATEMENTS

BME01: Develop specific ECG electrodes for Pulmonary Edema

Pulmonary edema distorts ECG signals due to fluid-induced electrical interference, delaying timely diagnosis. The challenge is to engineer specific ECG electrodes that capture clean, reliable signals even under fluid-compromised conditions. The team must deliver a robust, patient-safe, low-cost electrode design optimized for real-world clinical deployment.

BME02: AI-powered microscope to check cancer margins

Surgeons lack rapid, precise tools to assess tumor margins during surgery, leading to incomplete excisions or complications. The task is to build an AI-powered microscope capable of real-time margin detection. The team must deliver a fast, accurate, standardized optical-AI pipeline for intraoperative decision support.

BME03: Modified AMBU Bag with Pressure Feedback (Level 2)

Manual ventilation often risks lung injury due to the absence of real-time pressure cues. The challenge is to design a modified AMBU bag with integrated pressure feedback to guide safe ventilation. Teams must deliver a reliable, easy-to-use, and low-resource-compatible monitoring-enabled AMBU prototype.

BME04: <u>Long-Acting Insulin Forms (Level 3)</u>

Frequent insulin dosing burdens patients and reduces therapy adherence. The problem is to develop long-acting insulin forms that ensure stable glucose control with minimal dosing frequency. Teams must produce a scientifically sound model/formulation concept with demonstrable pharmacokinetic advantages.

BME05: <u>Reverse Engineering Costly Medical Equipment (Level 3)</u>

High-end diagnostic devices remain inaccessible in rural centers due to prohibitive costs. The challenge is to reverse engineer costly medical equipment to create affordable, functional equivalents. Teams must deliver a validated design pathway, functional prototype concept, and cost-reduction strategy.

BME06: <u>Endangered Medicinal Plants & Lack of Cultivation Support</u>

Deforestation and weak cultivation ecosystems threaten key medicinal plants essential to AYUSH and tribal healthcare. The task is to design a model that safeguards these plants through sustainable cultivation and digital support systems. Teams must deliver a conservation-tech roadmap and cultivation-support solution

BME07: <u>Malnutrition – SAM, MAM, Micronutrient Deficiencies</u>

Delayed identification of SAM/MAM cases leads to preventable complications in children. The task is to create a model to detect malnutrition accurately using digital or biomedical tools. Teams must provide an early-screening, low-cost, field-ready assessment solution.

BME08: <u>Respiratory Infections (Pneumonia)</u>

Pneumonia detection remains limited in rural settings due to poor screening tools. The goal is to build a model to detect respiratory infections like pneumonia rapidly and accurately. Teams must deliver a scalable detection solution integrating biomedical sensing or AI-based triage.

BME09: <u>Non-Communicable Diseases (Diabetes, Hypertension, CVDs, Cancer)</u>

NCDs remain the leading global killers due to delayed detection and inefficient screening systems. The challenge is to design a model that detects **non-communicable diseases** early and reliably. Teams must deliver a multi-parameter, scalable diagnostic/monitoring framework suited for low-resource settings.

BME10: <u>Delayed Identification of High-Risk Individuals</u>

Frontline workers frequently miss early signs of high-risk conditions due to lack of digital assessment tools. The challenge is to design a model enabling rapid identification of high-risk individuals. Teams must deliver a smart, automated risk-scoring and referral-support system.

BME11: <u>Stock-outs and Inventory Gaps</u>

Manual supply tracking in health facilities leads to stock-outs and delayed patient care. The task is to design a model that detects **stock-outs and inventory gaps** with automated forecasting. Teams must deliver a real-time inventory intelligence system tailored for public-health environments.