Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course: Biomedical Assistive Devices **Semester:6**

Program: BT-BIOMEDICAL ENGINEERING

Duration: 3 Hours

Course Code: HSTX3002P **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	**Which device would most likely be used for a person with lower limb amputation?** a) Ankle-foot orthosis b) Visual prosthetic c) Lower-limb prosthesis d) Hearing aid	1.5	CO1
Q 2	**Which component is typically integrated into a smart assistive device for real-time feedback?** a) Passive resistor b) Motion sensor c) Static inductor d) AC motor	1.5	CO2
Q 3	**What type of assistive device is designed to support or align body segments?** a) Cognitive aid b) Orthotic device c) Prosthetic limb d) Visual display	1.5	CO1
Q 4	**The use of AI in hearing aids mainly contributes to:** a) Size reduction b) Cost reduction c) Noise cancellation and adaptive listening d) Battery backup	1.5	CO3
Q 5	**A powered exoskeleton is MOST beneficial to:** a) Increase blood flow b) Enhance mobility for spinal cord injury patients c) Monitor blood sugar d) Improve vision	1.5	CO3

Q 6	**Which feature ensures the long-term usability of a prosthetic limb?** a) Flexibility in color b) High cost c) Durability and user comfort d) Length adjustment	**1.5**	**CO5**
Q 7	**AAC systems are primarily used to support individuals with:** a) Vision loss b) Hearing impairment c) Cognitive disorders d) Speech and language disorders	**1.5**	**CO5**
Q 8	**What is the role of ISO/IEC standards in assistive device manufacturing?** a) Marketing b) Design aesthetics c) Safety, quality, and interoperability d) Branding	**1.5**	**CO2**
Q 9	**Which device translates written text into tactile Braille output?** a) Hearing aid b) Braille display c) Smart reader d) Exosuit	**1.5**	**CO2**
Q 10	**Which material is often used in prosthetics for its lightweight and durable nature?** a) Glass b) PVC c) Carbon fiber d) Steel	**1.5**	**CO1**
Q 11	**Which of the following assistive devices is non-wearable?** a) Robotic arm b) Exoskeleton c) Powered wheelchair d) Prosthetic leg	**1.5**	**CO1**
Q 12	**Somatic hybridization is to plant biology as _____ is to assistive technology.** a) Prosthetics b) Myoelectric interfacing c) Brain-computer interfacing (BCI) d) Biochips	**1.5**	**CO5**
Q 13	**Which application of tissue culture directly correlates with assistive device development?** a) Somaclonal variation b) In vitro conservation c) Custom biomaterial scaffolds d) Cryopreservation	**1.5**	**CO4**

Q 14	**The main challenge in designing AI-powered assistive wearables is:** a) Lack of funding b) Complexity in coding c) Maintaining real-time response and data privacy d) Battery installation	**1.5**	**CO5**
Q 15	**Which device aids individuals with both hearing and visual impairments in navigation?** a) Smart cane with GPS and haptic feedback b) Exoskeleton c) Magnifying lens d) Braille books	**1.5**	**CO2**
Q 16	**Which of the following would MOST benefit from personalized medicine in assistive tech?** a) Prosthetic limb user b) Individual with speech disability c) Chronic neurological patient using BCI d) Orthotic shoe user	**1.5**	**CO2**
Q 17	**Which is an example of a device used for auditory rehabilitation?** a) Braille reader b) Cochlear implant c) Smart cane d) AAC device	**1.5**	**CO3**
Q 18	**User-centric design primarily focuses on:** a) Cost-efficiency b) Visual appeal c) Safety, comfort, and usability d) Technical complexity	**1.5**	**CO3**
Q 19	**Which assistive technology uses muscle signal detection for operation?** a) Smart glasses b) Myoelectric prosthesis c) Cognitive aid d) Braille scanner	**1.5**	**CO5**
Q 20	**Which ethical aspect is critical in AI-integrated assistive technologies?** a) Weight control b) Signal processing c) Data privacy and informed consent d) Battery optimization	**1.5**	**CO1**
Section B **(4Qx5M=20 Marks)**			
Q 1	Discuss the concept of brain-computer interfaces (BCIs) and their potential applications in assistive technology.	**5**	**CO3**
Q 2	Explain the working principle of a digital hearing aid. How is it different from analog hearing aids?	**5**	**CO4**

Q 3	Write a short note on the significance of cognitive and speech assistive devices.	**5**	**CO5**
Q 4	What is the importance of genetic fidelity in plant tissue culture, and how can it be ensured?	**5**	**CO2**
Section C **(2Qx15M=30 Marks)**			
Q 1	**Interdisciplinary Approach: Designing a Smart Orthotic System for Postural Correction** You're part of a team tasked with designing a **smart orthotic device** to help office workers with poor posture and early signs of spinal misalignment. Your answer should address: • Concept of the device and its need in a sedentary workforce *(3 marks)* • Materials used for comfort and biomechanical support *(2 marks)* • Sensors and electronics for posture tracking and feedback *(3 marks)* • Integration with mobile apps or cloud for data logging *(2 marks)* • Ethical aspects like data collection and user dependency *(2 marks)* • Potential user feedback strategies for product refinement *(3 marks)*	**15**	**CO2**
Q 2	**Application-Based Question: Technology Roadmap for AI-based Visual Assistive Devices** Visual impairment affects millions globally. Draft a **technology roadmap** for developing an **AI-based wearable visual assistive system** (like smart glasses) that aids in navigation, object recognition, and reading. Your plan should include: • System architecture and core features *(2 marks)* • Use of AI/ML for object or text recognition *(3 marks)* • Audio/visual feedback mechanisms *(2 marks)* • Hardware and software integration *(3 marks)* • Cost, accessibility, and social acceptance *(2 marks)* • Challenges and future enhancements *(3 marks)*	**15**	**CO4**
Section D **(2Qx10M=20 Marks)**			
Q 1	**Could a Wheelchair Think for You? Imagine an AI-Powered Mobility Aid** With AI integration, assistive devices are becoming more intuitive. Imagine you're designing a **smart wheelchair** that can learn and adapt to the user's daily routine. In your answer, describe: • The core features of your AI-powered wheelchair *(2 marks)*	**10**	**CO5**

	• How it could assist differently in indoor vs outdoor environments *(2 marks)* • Role of **machine learning** in predicting user preferences *(3 marks)* • One major **ethical or safety concern** and how you'd address it *(3 marks)*		
Q 2	Design a **wearable assistive device** for visually impaired users that helps them navigate unfamiliar indoor environments like malls or hospitals. **Marking Scheme Suggestion (15 Marks):** • Problem definition & user needs (2) • Technical features (2) • Materials & power source (2) • Safety, comfort, and usability (2) • Future scope or limitations (2)	**10**	**CO2**