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**PRESIDENCY UNIVERSITY
BENGALURU**

SET B

**SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024**

Semester : Semester V - 2021

Course Code : ECE3063

Course Name :Wearable Devices and Its Applications

Program : B.Tech.

Date : 10-JAN-2024

Time : 9:30AM - 12:30 PM

Max Marks : 100

Weightage : 50%

Instructions:

- (i) Read all questions carefully and answer accordingly.*
 - (ii) Question paper consists of 3 parts.*
 - (iii) Scientific and non-programmable calculator are permitted.*
 - (iv) Do not write any information on the question paper other than Roll Number.*
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PART A

ANSWER ALL THE QUESTIONS

5 X 2M = 10M

1. Steve Mann is considered as the father of wearable technologies. Give the definition given by him. List at least three important properties of a Wearable Computer.
(CO1) [Knowledge]
2. The blood pressure is an indication of sudden stress, anxiety and other fatigue related parameters which is harmful if not controlled. Differentiate between Systolic and Diastolic blood pressure measurements.
(CO2) [Knowledge]
3. The amount of work performed during a particular activity is considered as the energy expenditure (EE). Expand the terms used BMR and TEE,.
(CO2) [Knowledge]
4. Wearable microphones are used to capture acoustic signals. Differentiate between internal and external by listing at least two examples.
(CO3) [Knowledge]
5. It is suggested that for future extravehicular activity (EVA) locomotion in space, moon or mars Wearables Sensors are useful. Why? Give at least two justifications.
(CO4) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS

5 X 10M = 50M

6. Human body could also act as a communication medium. What do you understand by Human Body Communication (HBC)? Compare the features of HBC with that of the Wired and Wireless communication technologies.
(CO3) [Comprehension]
7. Design of a wearable computing systems poses a number of challenges to designers. Discuss at least seven challenges of Wearable Computing by giving at least one sentence justification.
(CO3) [Comprehension]
8. A Wireless Body Area Network (WBAN) is a special purpose sensor network designed to operate autonomously to connect various medical sensors and appliances, located inside and outside of a human body.
List at least three characteristics of WBAN and discuss the requirements of WBAN with respect to energy consumption and quality of service and reliability
(CO4) [Comprehension]
9. Wearable Medical Monitoring or Wearable Health Monitoring finds applications in early disease detection, continuous health monitoring as well as suggesting immediate care with the help of various stakeholders. Discuss at least 6 diseases that could be treated when wearable health monitoring could be employed. You need to identify the problem and the solutions that are possible in each case.
(CO2) [Comprehension]
10. In order to estimate the fall risk of elderly people, it is suggested to use wearable inertial sensors and other devices. You have been given a task to do the following:
1. Identify the sensing systems for such scenarios other than inertial sensors, if any.
- Design the protocol for data collection assuming that the system has been designed.
(CO3) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

2 X 20M = 40M

11. (A) An inertial system attached to a car starts moving with a non-constant velocity of $v_x(t) = 2\text{m/s}$ in X direction and $v_y(t) = 3t - 4\text{m/s}$ in Y direction, where t is time. What is the car's location with respect to the origin ($X=0, Y=0$ i.e. from origin in both directions) after 5 seconds? (10 MARKS)
- (B) In order to analyze the gait patterns of an elderly group a research team has collected accelerometer based data which indicate that for a about 70 minutes duration one of the subject set his right foot and the left foot 48 times each (equally spaced). What would be the number of gait step and average step of the elderly person respectively? (5 MARKS)
- (C) If a person lifts a 7 kg of weight for about 2 meters. What would be the amount of energy expended in Joules? In order to perform some work, we perform certain physical activities. List the factors which characterize such physical activities. (5 MARKS)
(CO3) [Application]

12. **Scenario:** An elderly person with a history of stroke has been paralyzed due to spinal cord injury (SCI) is trying to navigate through a supermarket. The person is able to navigate through a special powered wheelchair designed to assist. A wearable computer monitors the vital health parameters and a laptop helps the person by providing the route map as well as helps in computing complex health related parameters and could be used to inform caregivers/family members in emergency situation. Your WIoT architecture should be designed considering its acceptance by many other such elderly populations in order to provide a successful business model.

A complete WIoT architecture needs to be developed for the following requirements (without using any commercially available devices, **main focus of design should be person's wearable computer**):

- (i) Sensing Elements, their placement location and type of device (wrist-worn, body-hugging, ear-worn, head-mounted etc.)
- (ii) Communication Elements (short range, medium range, long range)
- (iii) Decision Making Algorithms: supervised / unsupervised classifier
- (iv) Actuation and Command as well as Control center: based on requirement (15 MARKS)

Tasks to do:

- (a) List all the required elements selected by you (from (i) to (iv)) for the current scenario by giving proper justification.
- (b) Represent the sequence of activities by using either a sequence chart or flow chart, which will be performed by each element (including the medical algorithms) in order to achieve the tasks visualized for the given scenario. (5 MARKS)

Note: Suitable assumptions are allowed based on the scenario and / or need (however, specify them clearly).

(CO2) [Application]