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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKEUP EXAMINATION – JULY 2024

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| **Semester :** V Sem (AY 2021-2025) | **Date :** 10/07/2024 |
| **Course Code :** ECE3063 | **Time :** 9:30 AM to 12:30 PM |
| **Course Name :** Wearable Devices and its Applications | **Max Marks :** 100 |
| **Program :** B. Tech. (ECE), 8th Semester | **Weightage :** 50% |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 9M=45M** | | | |
| 1 | Steve Mann is considered as the father of wearable technologies. Give the definition of wearables given by him. Why do we use wearable computers, justify by giving at least five points? | (CO 1) | [Remember] |
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| 2 | Killer Applications are those which are frequently used by a mass population across boundaries. List at least five such applications in your opinion by giving at least a single sentence justification for your selections. | (CO 1) | [Remember] |
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| 3 | In Big Data Performance Testing, we use various types of classifiers for classification tasks. Considering a binary classifier, give the confusion matrix and at least 5 formulae obtained from the confusion matrix. | (CO2) | [Understand] |
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| 4 | One of the major applications of wearables have been in sports. However, designing such devices require a proper research roadmap. Discuss at least five research roadmaps. You should not write more than three sentences for each of the roadmaps. | (CO1) | [Understand] |
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| 5 | You are working in a company which design wearables. The project manager has got an assignment for your team to design a system which will be used by male college students (aged: 18 – 21 years). He considers the requirements with respect to design, wearability, usage etc. The device should not be a traditional health monitoring device (like jacket, wrist-worn), rather it should consider (i) fashion, (ii) function, (iii) wearability (placement location and comfort), and (iv) usage and technological aspects.  Do the following:  1.  What kind of device you will design? List out the features and functions of the device that your group is designing.  2.  List the sensors and their utility you are going to have in your design based on the attributes listed from (i) – (iv)  3.  Comment on any specific issues, biases in your opinion which will either help to decrease the marketability or decrease its acceptance if any. | (CO1) | [Apply] |
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| 6 | 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, Create) | (CO4) | [Create] |
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| 7 | In order to develop a new wearable device and validate it’s utility by recruiting a number of subjects, raw data is collected by designing a scenario and following a data collection protocol. List the scenario under which you will collect your data for performing studies on elderly people who are suffering from forgetfulness (kind of dementia) and what protocol steps you will follow? | (CO1- CO3) | [Apply] |
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| **PART B** | | | |
| **Answer the following Question. The question carries 30 marks. 1Q X 30M=30M** | | | |
| 8 | A typical architecture of a WIoT is shown below.    **Scenario:** Consider the scenario near the Line of Control (LoC) which is a military control line between two nations — a line which does not constitute a legally recognized international boundary, but serves as the de facto border. Reinforced sandbagged and concrete posts and bunkers are among the first line of defence along the LoC. Armed soldiers man these positions with enough supplies for at least a week. The posts and bunkers allow soldiers to sleep, cook, and keep a watch on enemy positions round the clock. Some posts are located in remote locations and animals are sometimes used to help transport loads. Soldiers deployed on these posts communicate to their command centers through a data-radio set (looks like a smart-phone) which transmits on Very High Frequency (VHF) or Ultra High Frequency (UHF) and is configured to prevent enemy intercepts, using Army's own secure Mobile Cellular Communications Systems. The data-radio has other uses as well and can transmit audio, video, location coordinates etc.  You have been assigned to design a wearable device for soldiers having necessary capabilities for monitoring their vital parameters, detection of abnormalities, providing communication etc. Additionally, the system should be capable of monitoring soldier’s activities when they enter enemy’s areas for any emergency operations and inside bunkers. Under movement situations the system should have a provision to inform the soldiers locally and to those who are in bunkers, about their whereabouts and health status. The raw data which needs to be processed later should be delivered to an Army Command Center and/or Hospital, exploiting the WIoT architecture. It should be noted that the WIoT architecture should be designed considering its acceptance by a larger soldier community.  A complete WIoT architecture needs to be developed for the following requirements (without using any commercially available devices):   1. Sensing Elements, their placement location and type of device (wrist-worn, body-hugging, ear-worn, head-mounted etc.) 2. Communication Elements (short range, medium range, long range) 3. Decision Making Algorithms: supervised / unsupervised classifier 4. Actuation and Command as well as Control center: based on requirement   **Tasks to do:**   1. List all the required elements selected by you (from (i) to (iv)) for the given scenario by giving proper justification. 2. 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.   **Note:** Suitable assumptions are allowed based on the scenario and / or need (however, specify them clearly). | (CO1-CO4)  20+10=30M | [Apply] |

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| **PART C** | | | |
| **Answer the following Question. The question carries 30 marks. 1Q X 25M=25M** | | | |
| 9 (A) | 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. | (CO2)  7 M | [Apply] |
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| 9 (B) | An inertial system attached to a car starts moving with a non-constant velocity of vx(t) = 4 m/s in X direction and vy(t) = 7t - 3m/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 7 seconds? | (CO2)  10 M | [Apply] |
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| 9 (C) | In order to analyze the gait patterns of an elderly group a research team has collected accelerometer based data which indicate that for about one and half hour duration one of the subject set his right foot and the left foot 56 times each (equally spaced). What would be the number of gait step, number of gait stride, average step and average stride of the elderly person respectively? | (CO2)  8 M | [Apply] |