BT/K/TX

Reg. No:

Final Assessment Test – November 2024

VIT
Vellore Institute of Technology

Course: **BCSE401L - Internet of Things**

Class NBR(s): **2070/2075/2077/2079/2081/2082/2085 /2090/2091/2093/2094/2095**

Slot: **C1+TC1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

(10 X 10 = 100 Marks)

1. What are the advantages and disadvantages of IPv6?

   Categorize the given list of components into sensors or actuators, identifying their respective roles and typical applications through prescribed table.

Name	Sensor/ Actuator	Function	Application
Hydrophone			
Selsmometer			
Microphone			
Blind spot monitor			
Curb feeler			
Hall effect device			
Frequency Domain			
Hydrometer			
Pyrgeometer			

2. List four temperature sensor types and map each with their corresponding temperature measurement range.

Temperature measurement range	Temperature Sensor
−100°C to 500°C	
−260°C to 2300°C	
−55°C to 200°C	
-200°C to +850°C	

   In IPV4, given a Class C network ID 200.10.20.0/24 with a subnet mask of 255.255.255.0, create subnets that can support at least 40 hosts each. Calculate required host bits and determine Subnet Mask.

3. Write brief note on RSSI (Received Signal Strength Indicator), Receiver Sensitivity, Link Margin, SNR (Signal-to-Noise Ratio), and Maximum Link Budget within the context of the LoRaWAN Protocol;

   Given a LoRaWAN configuration with a Spreading Factor (SF) of 7 and a Bandwidth (BW) of 250 kHz, determine the following parameters: chip rate, chip duration, symbol rate, symbol duration, and data rate for a code rate (CR) of 1.

4. Provide a list of application protocols in IoT and explain one in detail;
Map appropriate protocol to the following given scenarios and justify.

Scenario 1:

A VIT community radio broadcasted exciting news at 90.8 MHz about affordable online courses for students eager to learn. VIT students who have tuned to that specific frequency on the radio were able to catch the broadcast. This broadcast caught the student's attention, motivated them to check out the platform for educational opportunities. This enabled them to improve their learning through the low cost online courses.

Scenario 2:

A student team named as "InnovateTech" from an IoT course in VIT encountered a problem with their project. They sent their query to the course professor through the online portal. Impressed by the InnovateTech team, the professor promptly replied with a detailed solution. The InnovateTech team was grateful for the help and went on to successfully complete their project, inspired by the support they received from their mentor.

Scenario 3:

In a progressive step, the esteemed Prime Minister of India Shri Narendra Modi's post about the National Education Policy on X platform (previously called Twitter) quickly became a sensation. This policy is designed to propel India to the forefront as a hub of research and innovation. Those who showed interest in the subject were promptly informed. The message swiftly captured the attention of academicians and experts, sparking widespread interest and discussion within educational circles. Eagerly engaging with the content, academicians expressed hope for the positive impact the policy could have on the nation's education landscape, emphasizing the significance of such initiatives in shaping the future of research and innovation in the country.

Provide your answer using the following table:

Scenario	Application layer protocol	Justification
Scenario – 1		
Scenario – 2		
Scenario – 3		

5. Write about Bias and Variance in the context of IoT (Internet of Things) applications.

Perform kNN (k-Nearest Neighbour) classification on the given raw dataset of a smart home as shown in Table. Determine the class for **Temperature = 4** and **Humidity = 8** with **kn = 3**

Sample	Temperature	Humidity	Class
a	8	8	Warm
b	8	5	Warm
c	4	5	Cool
d	2	5	Cool
e	9	9	Warm

6. What are the drawbacks of l-diversity Anonymization technique in the data privacy and explain with an example.

Write about generalization of data for k-anonymity and apply full domain generalization for the following table

Gender	Zip Code	Education
M	560001	Doctorate
M	560045	Masters
F	560033	Bachelors
F	560041	Doctorate
F	560003	Bachelors
M	560002	Masters
F	560044	Masters
M	560001	Bachelors
M	560042	Doctorate
F	560031	Masters
M	560035	Masters
M	560033	Doctorate

7. List the various distance-based localization methods used for estimating the position of an object. Explain any two of these methods in detail, highlighting their working principles and potential applications.

Consider three targets $T_1, T_2,$ and T_3 detected by two sensors. The posterior probabilities at the zeroth iteration for each sensor are:

- **Sensor 1:**

$$P(x = T_1 \mid Y_0^1) = 0.5, \quad P(x = T_2 \mid Y_0^1) = 0.3, \quad P(x = T_3 | Y_0^1) = 0.2$$

Sensor 2:

$$P(x = T_1 \mid Y_0^2) = 0.6, \quad P(x = T_2 \mid Y_0^2) = 0.2, \quad P(x = T_3 | Y_0^2) = 0.2$$

At the fusion center, the combined prior probabilities are:

- $P(x = T_1 \mid Y_0^1, Y_0^2) = 0.6$
- $P(x = T_2 \mid Y_0^1, Y_0^2) = 0.3$
- $P(x = T_3 \mid Y_0^1, Y_0^2) = 0.1$

The updated posterior probabilities at the first iteration are:

Sensor 1:

$$P(x = T_1 \mid Y_1^1) = 0.7, \quad P(x = T_2 \mid Y_1^1) = 0.3, \quad P(x = T_3 | Y_1^1) = 0.1$$

- **Sensor 2:**

$$P(x = T_1 \mid Y_1^2) = 0.8, \quad P(x = T_2 \mid Y_1^2) = 0.1, \quad P(x = T_3 | Y_1^2) = 0.2$$

Using Bayesian data fusion, calculate the combined posterior probabilities for each target at the first iteration.

8. Compare cloud computing and fog computing for various characteristics. Describe the role of virtualization technology in fog computing and explain how it enables efficient resource management in this environment. Discuss virtualization at various levels, including CPU instruction level, hardware abstraction level, and operating system level.

9.a) List types of machine leaning techniques and write about one any of them.

In the process of reduction of dimension using Principal Component Analysis (PCA), compute Covariance matrix from below data table

X= Moisture	2	1	0	-1
Y= Leaf Wetness	4	3	1	0.5

OR

9.b) In Elliptic Curve Cryptosystem (ECC) Encryption and Decryption, list formulas for the encryption process, and decryption process for given private keys of sender(s_{priv}) , receiver (r_{priv}), generator or base point (g), public key of sender (s_{pub}), receiver (r_{pub}), secret keys of sender (s_{key}), receiver (r_{key}) and message(M).

Consider the elliptic curve $y^2 = (x^3 + ax + b)\ mod\ p_r$ for a=1, b=0, and $p_r = 7$ with generator point $g \equiv (x_g, y_g) = (3, 3)$ and encoded message on the curve, $Message \equiv (x_M, y_M) = (3, 4)$. Assume that private key of sender is 3, private key of receiver is 2, public key of sender is (5, 5) and public key of receiver is (1,4)

Value of 5λ mod 7		
λ	1	2
5λ	5	10
5λ mod 7	5	3

Compute secret key of the receiver (r_{key}).

10.a) On the sprawling campus of VIT, nestled among the busy buildings and vibrant life, the hostels faced a growing issue: water scarcity. The unpredictable rainfall and excessive use of water resources by the students had created a dire need for conservation. In the midst of this, a group of B.Tech CSE students, known for their innovative spirit, observed the worsening situation. One evening, as they discussed the problem over a cup of chai in the hostel common room, they decided to take action. Their mission: to design a smart IoT system for conserving water in the VIT hostels, ensuring sustainability for future generations. The students decided to design an IoT system that included a variety of sensors, actuators, and other peripherals to monitor and manage the water usage efficiently.

Based on this scenario, you are asked to design an IoT system for water conservation tailored for the VIT hostels. Specify the types of sensors, actuators, and application protocols you would use, and justify your choices by highlighting the features and benefits of your design.

OR

10.b) In the ever-evolving field of healthcare, technology plays a crucial role in improving patient care and management. At Vellore Institute of Technology (VIT), a group of B.Tech CSE students were inspired to address the challenges faced by patients with chronic conditions. They decided to design an IoT-based health monitoring system, named "HealthConnect," to assist both patients and healthcare providers. HealthConnect aims to continuously monitor patients' vital signs, such as heart rate, blood pressure, and blood glucose levels, using IoT sensors. This data is then transmitted to a cloud-based platform where healthcare providers can access it in real-time. The system also includes features to alert both patients and doctors if any irregularities are detected, ensuring prompt medical intervention.

With this context in mind, Design an IoT-based health monitoring system called 'HealthConnect' for patients with chronic conditions. Specify the types of sensors, communication modules, actuators, and application protocols you would use. Justify your recommendations by highlighting the features and benefits of your design.

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