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Vellore Institute of Technology
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CHENNAI

Final Assessment Test(FAT) - Apr/May 2025

Programme	**B.Tech.**	Semester	**Winter Semester 2024-25**
Course Code	**BCSE401L**	Faculty Name	**Prof. Kabilan K**
Course Title	**Internet of Things**	Slot	**A2+TA2**
		Class Nbr	**CH2024250502006**
Time	**3 hours**	Max. Marks	**100**

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

CO1 : Describe layers of IoT and IoT devices used for various applications.
CO2 : Understand the standards, protocols and communication models of IoT.
CO3 : Comprehend advanced IoT applications and technologies from the basics of IoT.
CO4 : Understand working principles of various sensor for different IoT platforms.
CO5 : Understand the challenges of IoT using privacy and security metrics.
CO6 : Solve real-time problems and demonstrate IoT applications in various domains using prototype models.

Answer all Questions (10 × 10 Marks)

01. In the context of an IoT-based Smart City deployment where IPv4 is predominantly used, the system begins to experience performance degradation as the number of connected devices increases.

    i. Analyze the potential causes of network performance degradation associated with IPv4 in large-scale IoT environments. [4 Marks]

    ii. Evaluate how IPv6 can effectively resolve these limitations. Justify your answer with reference to addressing, scalability and efficiency in IoT networks. [6 Marks]

[10] (CO2/K1)

02. A hospital is deploying an IoT-based patient monitoring system using Wi-Fi enabled medical devices to track patients' vital signs in real-time. Given the critical nature of healthcare environments, any network failure can result in severe consequences.

    i. Identify the potential risks and limitations of relying exclusively on IEEE 802.11 for medical IoT applications in critical care environments.[3 Marks]

    ii. Design a fault-tolerant communication system that ensures real-time patient monitoring, even during primary network failures. Justify the technologies and methods used. [7 Marks]

[10] (CO2/K2)

03. Assume that you are tasked with designing a smart irrigation system for a remote farm with limited power supply and minimal internet connectivity.

    i. Explain the relevance of 6LoWPAN in this scenario and describe its core functionalities. [5 Marks]

    ii. Describe how 6LoWPAN enables energy efficient and scalable IoT-based solution suitable for such constrained environments. [5 Marks]

[10] (CO1/K2)

04. A retail company wants to analyze customer purchasing behaviour to improve product recommendations. The dataset contains thousands of customers with multiple purchasing features like total spending, frequency of purchases, product categories, seasonal trends, average discounts used, and online vs. offline shopping ratios. The marketing team struggles to interpret this high-dimensional data and identify patterns effectively. As a data scientist, apply unsupervised learning to simplify the dataset while retaining important information.

i. Explain a suitable method for transforming the dataset into a lower-dimensional form. Justify why this approach is effective for this problem. [5 Marks]

ii. Given the dataset below, perform the necessary steps to transform the high-dimensional data into a new one. [5 Marks]

Customer	Spending (₹)	Seasonal Trend	Avg Discount Used (%)	Online vs Offline Ratio
A	20000	5	15	0.8
B	50000	7	30	0.3
C	10000	2	10	0.9
D	30000	4	20	0.6
E	60000	8	35	0.2

[10] (CO3/K3)

05. A Chennai-based IoT startup deployed an ECC-based security system to protect patient data transmitted from wearable health monitors to a hospital server. The system uses the elliptic curve $y^2=x^3+x+1$ over a finite field F7(mod 7), with base point G=(2,3) and the doctor's private key n_A= 3*A. The patient's device sends an encrypted message to the doctor (heart rate = 5), whose public key is Q_A = n*G. Compute the doctor's public key Q_A, encrypt the message (heart rate = 5) using ECC with random integer k=2 and decrypt it back.

i. Compute the doctor's public key Q_A. [2 Marks]

ii. Encrypt the message (heart rate = 5) using ECC with k = 2. [4 Marks]

iii. Decrypt the message using the doctor's private key n_A = 3. [4 Marks]

[10] (CO5/K3)

06. A wildlife research organization plans to deploy a large-scale wireless sensor network in a dense forest to monitor environmental conditions and track animal movement. Due to poor GPS signal availability in such environments, the organization requires a GPS-free localization solution.

i. Discuss how MDS can be applied in such a scenario, specify its benefits and limitations in a forest environment. [4 Marks]

ii. Design and explain a localization strategy with illustration using the Multidimensional Scaling (MDS) technique to estimate sensor node positions based on inter-node distance measurements. [6 Marks]

[10] (CO4/K6)

07. John runs an online marketplace where sellers list and sell products. However, customers have complained about fake products being sold by fraudulent sellers. To solve this, John integrates Blockchain and Digital Signatures into his platform. Every seller registers their product on the blockchain with a unique digital signature. Buyers can verify the authenticity of the product by checking the blockchain record before purchasing. Once a sale happens, a smart contract automatically transfers ownership of the product to the buyer.

i. Explain how digital signatures help prevent counterfeit products in John's e-commerce platform. [5 Marks]

ii. How does a public and private key pair work in verifying digital signatures in blockchain transactions? [5 Marks]

[10] (CO5/K4)

08. Sophia is a data scientist working for a healthcare startup that develops an AI-based system to detect pneumonia from chest X-ray images. To evaluate the performance of her machine learning model, she collects a dataset containing 1000 labelled X-ray images (500 pneumonia-positive and 500 pneumonia-negative cases). After training the model, Sophia tests it on a set of 200 new images, where 100 images have pneumonia and 100 do not. The model's predictions result in the following confusion matrix:

Actual / Predicted	Pneumonia (Positive)	No Pneumonia (Negative)
Pneumonia (Positive)	80 (True Positives - TP)	20 (False Negatives - FN)
No Pneumonia (Negative)	10 (False Positives - FP)	90 (True Negatives - TN)

i. Calculate Accuracy, Precision, Recall and F1-score for Sophia's pneumonia detection model. [6 Marks]
ii. Analyze the significance of the Confusion Matrix in evaluating Sophia's model and explain how misclassifications impact real-world healthcare applications. [4 Marks]

[10] (CO2/K5)

09. A university is implementing a smart classroom system to enhance teaching and student engagement. Each classroom is equipped with interactive whiteboards, IoT-enabled attendance systems, student performance dashboards, and real-time feedback panels. These devices generate large volumes of data that must be processed instantly for real-time decision-making—such as auto-marking attendance, tracking student engagement, and adapting content delivery based on classroom responses.

i. Using the smart classroom scenario above, explain the difference between cloud computing and fog computing in terms of latency, data handling, and location of processing. Highlight why fog computing is preferred for real-time classroom interactions. [6 Marks]
ii. Mention any two fog computing technologies that can be used in this scenario with justification. [4 Marks]

[10] (CO4/K3)

10. Design an IoT-based waste management system for a smart city. Describe the sensors, communication technologies and data analytics components involved in optimizing waste collection.

[10] (CO6/K1)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)