



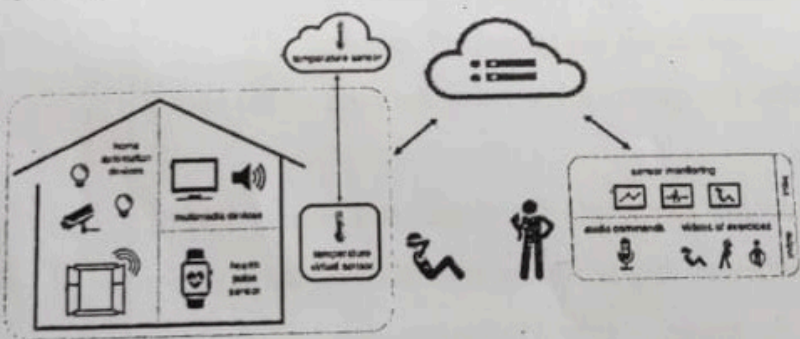
**Continuous Assessment Test(CAT) – I - February 2024**

Programme	: B.Tech CSE in specialization with CPS	Semester	: Winter-23-24
Course Code & Course Title	: BCSE429L & Cyber Physical System Design	Class Number	: CH2023240501524, CH2023240501528
Faculty	: Dr. R. Priyadarshini, Dr. D. Subitha	Slot	: C2
Duration	: 1½ Hours	Max. Mark	: 50

**General Instructions:**

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

**Answer all questions**

Q. No	Sub Sec.	Description	Marks
1.		<p>Investigate and elaborate on the specific challenges emerging from communication issues between the cyber and physical components in the Virtual Exercise Tutoring System's module for human-machine interaction during exercise routines. Envision a scenario where smart sensors capturing user movements and actuators delivering real-time feedback encounter delays in communication with the central tutoring system.</p>  <p>Analyse and assess the potential consequences of these communication lapses on the overall quality of virtual exercise sessions, the effectiveness of user-machine interaction, and the system's ability to engage user effectively. Illustrate the solution for the above issues in the scenario with the detailed flow diagram.</p>	10

2.	<p>Draw the open loop and closed loop feedback control system for a Modern Air conditioner for a car where the inside cooling and hotness can be adjusted by the outside temperature. If the outside temperature is too less, the temperature is high inside the car and vice versa. Identify the plant, controller, actuator/sensor, input and output.</p>	10
3.	<p>A music system that has the mixture of harmonics represented mathematically as</p> $x(t) = 9 \cos(2\pi 1000t + \pi) + \sin(1000t + \pi)$ <p>to be converted into a digital signal using ADC of 20-level quantizer. Suggest suitable parameters that facilitates the design of ADC that comprises the process of sampling, quantization and encoding. (2 marks each)</p> <ol style="list-style-type: none"> <li>In the context of sampling, explain the significance of determining the Nyquist sampling rate for this composite signal. What factors should be considered when deciding an appropriate sampling rate?</li> <li>Compute the first 6 samples of the audio analog signal and make a plot of them by considering Nyquist sampling rate as the sampling frequency of ADC.</li> <li>Quantize the above samples using the 20-level quantizer and sketch the quantized samples.</li> <li>Determine the quantization noise for each of the above samples.</li> <li>If you decide to sample the signal at a rate of 2 kHz, discuss whether this sampling rate satisfies the Nyquist theorem for accurate signal reconstruction.</li> </ol>	10
4	<p>Consider a complex industrial process where distributed sensors, actuators, and control units collaborate to monitor and control various aspects of the operation. Is there a critical need for synchronization in ensuring accurate data acquisition, decision-making, and coordinated actions? Discuss the</p>	10



	<p>challenges associated with maintaining synchronization in a distributed CPS, considering factors such as communication delays, network latency, and variations in device capabilities. Illustrate potential synchronization strategies that could be employed to address the challenges identified.</p> <p>Note : Consider aspects like time synchronization, data consistency, and coordination mechanisms.</p>	
5.	<p>Design a dynamic networked system for a sports event, integrating physical and cyber spaces and develop a communication infrastructure for real-time data exchange with low latency, and reliability. The component includes IoT sensors, ticketing systems, video surveillance, mobile apps, Augmented Reality installations, and interactive displays. While designing, consider the issues faced in implementation of the system like fluctuating crowd density, weather changes, and high network demand.</p>	10

\*\*\*\*\*All the best \*\*\*\*\*