VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

Winter Semester 2023-24

Continuous Assessment Test – I1

SLOT: A1+TA1

Programme Name & Branch:B.Tech (CSE)

Course Name & Code: Embedded Systems – BCSE305L

Class Number (s): **Faculty Name (s): All** **Exam Duration: 90 Min.**
Maximum Marks: 50

<table>
<tr><th>Q.No.</th><th>Question</th><th>Max Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>Using relevant real life examples, investigate how events or signals could be classified as per the following criteria and provide sufficient justifications:-
a. Arrival
b. Form or Structure
c. Type (hint: what it conveys?)</td><td>10</td><td>CO4</td><td>BL4</td></tr>
<tr><td>2.</td><td>Discover and discuss in details regarding the requirements of real-time embedded systems. Design and demonstrate a hybrid scheduler for an embedded system governed by the real time requirements.

Note: Hybrid scheduler must be illustrated using sample dataset of your choice, Task-Time line graph, and the necessary as well as sufficient conditions.</td><td>10</td><td>CO4</td><td>BL3</td></tr>
<tr><td>3.</td><td>For the given datasets, prove that EDF gives feasible schedule. Illustrate task time-line graph for at least three cycles.

<table><tr><th>Task</th><th>Execution Time</th><th>Period</th></tr><tr><td>T1</td><td>5</td><td>15</td></tr><tr><td>T2</td><td>7</td><td>10</td></tr><tr><td>T3</td><td>10</td><td>20</td></tr></table>
Compute the utilization percentage for the following data set using EDF technique and identify the parameters required to be manipulated for better utilization and schedulability with proper justifications.

<table><tr><th>Task</th><th>Arrival Time</th><th>Execution Time</th><th>Period</th><th>Deadline</th></tr><tr><td>T1</td><td>0</td><td>5</td><td>20</td><td>20</td></tr><tr><td>T2</td><td>5</td><td>10</td><td>15</td><td>15</td></tr><tr><td>T3</td><td>10</td><td>15</td><td>10</td><td>10</td></tr></table></td><td>10</td><td>CO4</td><td>BL3</td></tr>
<tr><td>4.</td><td>Construct FSM model for the given scenario: -</td><td>10</td><td>CO3</td><td>BL4</td></tr>
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	➢ ***"Fruit Classifier"*** **Specification:** 1. **Ambience:-**Agro market with fruit sorting, pricing and packing using multiple robots 2. Baskets of different types 3. Different types of fruits such as watermelon, apple, pomegranate, grapes etc. 4. Mobile robot with 360^0 rotational arm capability **Requirements:** 1. Fruits need to be **sorted** based on type, size, quality and weight 2. **Collision avoidance** to be incorporated 3. Relevant **states, events and actions** to be considered **Illustrate** the CDFG for the above scenario.			
5.	**Identify as well as analyse** the requirements of code optimization in embedded system design. **Apply** your findings on the given code snippet to get the optimized code with relevant validations *int p;* *int q=50;* *int r=100;* *for (inti=0; i<200; i++)* *{* *int w = 25 + 35;* *p = q + r;* *for (inti=0; i<200; i++)* *Temperature[i] = i * 2;* *for (inti=0; i<200; i++)* *Moisture[i] = i * 3;* *}*	10	CO3	BL2

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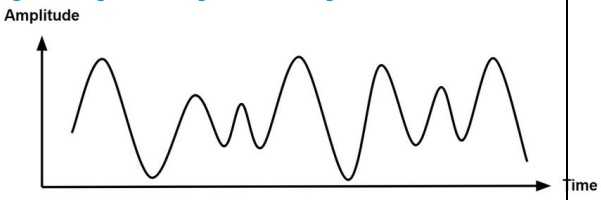
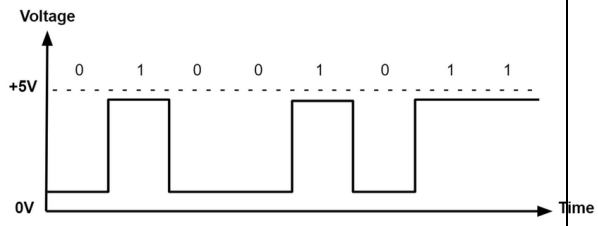
Class Number (s): **Faculty Name (s): All**
Exam Duration: 90 Min. **Maximum Marks: 50**

Q. No.	Note: The evaluation must be based on the individual answers. The keys are provided just for the reference	
	Questions	**Keys**
1.	**Using** relevant **real life examples**, **investigate** how events or signals could be classified as per the following criteria and **provide** sufficient justifications:- a. Arrival b. Form or Structure c. Type (**hint:** what it conveys?)	a. Arrival – • Periodic – ex: Time Table, Flickering of a fluorescent light, etc. • Aperiodic – ex: Activation of a door bell • Sporadic – ex: Government town bus in a remote village b. Form / Structure – Analog – Systems for communicating voice, data, picture, signal, and video information frequently use analog signal which is provide continuous transmissions. Any physical phenomena - sound, light, temperature, position, or pressure  Digital - All digital electronics, including computer hardware and data transfer devices, rely on digital signals. Ex: Voltage, current, magnetic field and any physical quantity  c. Type (What it conveys…) – • Text / Message – Remote water pump control via mobile device • Audio – Ex: Voice signal – voice operated ATM • Video / image – Ex: Attendance system using facial recognition

<table>
<tr>
<td>2.</td>
<td>Discover and discuss in details regarding the requirements of real-time embedded systems. Design and demonstrate a hybrid scheduler for an embedded system governed by the real time requirements.

Note: Hybrid scheduler must be illustrated using sample dataset of your choice, Task-Time line graph, and the necessary as well as sufficient conditions.</td>
<td>Requirements of a real time embedded systems:
• Functional correctness - Producing correct computational output
• Timeliness – meeting time deadline
• Scalability – consistent behavior of the system irrespective of scale
• Cost effectiveness – loss of life or property or performance
Note: apply and discuss in detail these factors for a real life example such as – Anti-Missile Launching System, Nuclear Reactor Power Control, Driverless Automobile, and Smart Class Room etc.

Hybrid Scheduler:
Event Driven Scheduler – Minimum Laxity/Slack First using relative deadline and remaining execution to calculate the priority for tasks</td>
</tr>
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<td>3.</td>
<td>For the given datasets, prove that EDF gives feasible schedule. Illustrate task time-line graph for at least three cycles.

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Compute the utilization percentage for the following data set using EDF technique and identify the parameters required to be manipulated for better utilization and schedulability with proper justifications.

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</td>
<td>Apply EDF schedulability check

First tasks set – schedulability fails and Illustrate time line graph
Note: Analysis of cases based on user assumed arrival time of tasks for schedulability, may be considered

Second tasks set – schedulability fails
Analysis of correct parameters for feasible schedule with justifications and illustration
Example:
• Manipulation (increment or decrement) of execution time of a task - Execution time of tasks T2 and T3 can be reduced
Note: manipulation of execution time can be achieved by applying optimization in code, increasing cache and faster communication buses
• Since arrival time and period of tasks purely depends on scenario and natural phenomena, they should not be modified
• Since deadline is user defined, it may be modified.</td>
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<td>4.</td>
<td>Construct FSM model for the given scenario: -
➢ “Fruit Classifier”
Specification:
1. Ambience:-Agro market with fruit sorting, pricing and packing using multiple robots
2. Baskets of different types
3. Different types of fruits such as watermelon, apple, pomegranate, grapes etc.
4. Mobile robot with 360^0 rotational arm capability
Requirements:
1. Fruits need to be sorted based on type, size, quality and weight
2. Collision avoidance to be incorporated
3. Relevant states, events and actions to be considered

Illustrate the CDFG for the above scenario.</td>
<td>Entity
• Agro Market
• types of fruits and baskets
• mobile robots

Fruits
• number of fruits
• types
• price-tag
• size
• weight
• quality

Basket
• Empty
• Large
• Medium
• small
• full</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>
Robot

idle
move-forward
move-backward
turn-left
turn-right
arm-rotate(360^0)
pick
sort
place
halt

<table>
<tr><th>From State</th><th>Event</th><th>To State</th></tr>
<tr><td>Idle</td><td>Pick basket/fruit/sort/ place/ basket-empty/ basket-full/obstacle-true/obstacle-false or any other</td><td>Move-forward/ Move-backward / Turn-left/ Turn-right</td></tr>
<tr><td>Move-forward/ Move-backward / Turn-left/ Turn-right</td><td>sort/ price-tag/place</td><td>Halt</td></tr>
</table>
Note: Consider all possible states and events and draw the FSM
</td>
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<td>5.</td>
<td>Identify as well as analyse the requirements of code optimization in embedded system design.

Apply your findings on the given code snippet to get the optimized code with relevant validations

int p;
int q=50;
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int w = 25 + 35;
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Temperature[i] = i * 2;

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Moisture[i] = i * 3;
}</td>
<td>
Requirements of code optimization

Constrained resources
<ol type="a">
Memory
Processing
Power

Design Challenges
<ol type="a">
Time and space complexity
Scalability – features
Cost optimization
Time to market – customization, faster portability, backward compatibility

Optimization Techniques:

Constant folding
Code motion
Sub expression evaluation
Loop fusion
Strength reduction
Replacing array access using pointer

</td>
</tr>
</table>