B. Tech.
(SEM. VIII) EXAMINATION. 2006-07
REAL TIME SYSTEMS

Time : 3 Hours] [Total Marks : 100

Note:   
(1) Attempt all questions.
(2) All questions carry equal marks.
(3) Symbols occurring in this paper have their meanings based on Real Time Systems by Krishna and Shin.

1 Attempt any four parts of the following:
(a) What is a real time system? Explain its various components with a suitable block diagram.
(b) What is an embedded system? Differentiate between embedded system and real time system.
(c) Explain the following terms with a suitable example.
   (i) Periodic task
   (ii) Sporadic task
(d) Explain the most important issues in Real-Time computing.
(e) Explain why predictability is an important requirement of a real time system? Discuss different techniques to enforce this requirement.
(f) What do you mean by temporal constraints? List possible task timing constraints.

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2 Attempt any **four** parts of the following:
   (a) Differentiate between firm real time systems and hard real time systems.
   (b) What is a real time operating system? How it is different from general purpose operating system?
   (c) Why task synchronization is required in real time operating systems? Explain.
   (d) Name two commercial RTOS other than Maruti, HART and VRTX. Discuss their capabilities/requirements.
   (e) Compare the design approach of Maruti II RTOS with VRTX real time operating system.
   (f) Describe the architecture and functions of I/O sub system of HART OS.

3 Attempt any **two** parts of the following:
   (a) What is rate monotonic scheduling algorithm? What are various assumption in this algorithm? Explain rate monotonic scheduling algorithm with a suitable example.
   (b) Prove that if there are two tasks \( T_1, T_2 \) and
   \[
   \frac{e_1}{p_1} + \frac{e_2}{p_2} \leq 2 \left( \sqrt{2} - 1 \right)
   \]
   then the tasks are rate monotonic schedulable.
(c) Differentiate between fixed priority and dynamic priority scheduling algorithms. Construct a set of periodic tasks (with release times, execution times, and periods) which can be scheduled feasibly by the EDF algorithm, but not by the RM algorithm.

4 Attempt any two parts of the following:
(a) Discuss various approaches used for real-time software specification and verification and then discuss the duration calculus approach in brief.
(b) Define real-time communication. Explain VTCSMA (virtual time carrier-sensed multiple access) protocol with a suitable example.
(c) Consider the use of the timed-taken protocol in the following situation. We have five nodes in the system. The real-time requirement is that node $ni$ be able to put out upto $bi$ bits over each period of duration $Pi$, where $bi$ and $Pi$ are as given in the following table:

<table>
<thead>
<tr>
<th>node</th>
<th>bi</th>
<th>Pi</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h_1$</td>
<td>1K</td>
<td>10000</td>
</tr>
<tr>
<td>$h_2$</td>
<td>4K</td>
<td>50000</td>
</tr>
<tr>
<td>$h_3$</td>
<td>16K</td>
<td>90000</td>
</tr>
<tr>
<td>$h_4$</td>
<td>16K</td>
<td>90000</td>
</tr>
</tbody>
</table>

The overhead is negligible, and the system bandwidth is 1K/unit time. (This is, it takes one unit time to transmit 1 kB of data). Choose an appropriate TTRT and obtain suitable values of $fi$. 

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5 Attempt any two parts of the following:

(a) What do you mean by fault tolerance? How faults are classified according to their temporal behaviour and output behaviour? Discuss various types of redundancies required to design a fault tolerant system.

(b) Define notion of clock and clock synchronization in context of real time systems. Explain non fault tolerant synchronization algorithm.

(c) Discuss the most important issues in Real time software design. Explain how the principles of object oriented paradigm may be applied in large dynamic real time systems.