

Roll Number: \_\_\_\_\_

**Thapar Institute of Engineering & Technology, Patiala**

Department of Computer Science & Engineering

**END SEMESTER EXAMINATION (Dec 2023)**

B. E.(COE) (Final Year): Semester-VII December 12, 2023

Course Code: UCS704

Course Name: Embedded System Design

Time: 3 Hours, M. Marks: 35

Tuesday, 02:00 PM – 05:00 PM

Faculty: Dr. Ranjeet Kumar Ranjan, Dr. Nitin Saxena, Dr. Deepshikha Tiwari

**Note:** Attempt Any Seven questions. All parts of a question must be answered in order. Assume missing data, if any, suitably.

- Q.1** Draw the Flow chart of Application Specific Integrated Circuit (ASIC) design process. Explain DFT and DRC tests conducted during ASIC design process. (5)
- Q.2** Explain characteristic (i.e. speed, torque and direction) of DC motor. Which stepper motor (half stepping or full stepping) is required for following applications? Justify your answer. (5)
- i. Application-required maximum torque.
  - ii. Application require fine resolution.
- Q.3** a) Why is the non-invasive method of reading the brain signals not very effective? Give the example of one invasive and non-invasive method for reading the brain signals. (3)
- b) To develop a smart watch, whether you will choose Microprocessor or Microcontroller as the processing unit? Justify your answer. (2)
- Q.4** a) Draw a diagram for SRAM cell which can store one bit of data and explain how it stores 0 and 1. (2)
- b) Differentiate: (3)
- i. Synchronous vs Asynchronous DRAM
  - ii. NAND-Flash vs NOR-Flash memory structure
- Q.5** Explain Rate Monotonic Theory. For the task set given in the following table, find the CPU utilization. Check whether the given tasks are schedulable or not using the Rate Monotonic Algorithm. Show the Gantt chart for the schedule. (5)

Task	Period (msec)	CPU burst (msec)
T1	10	5
T2	12	2
T3	15	3
T4	24	6

- Q.6** DSP processors can employ Instruction level parallelism, Data level parallelism or both to achieve high throughput. Give one use case for each to justify the statement. (5)

**Q.7** The cruise control system in modern cars entirely relies on electronics. The system communicates with the throttle via various sensors connected to Electronic Control Unit. Cruise Control allows driver to set a speed to be maintained without his/her intervention (e.g. 80 Km/h down a long straight motorway). There is no need to keep accelerator pressed (less driver fatigue). Design a Finite State Machine model with the following requirement specifications: **(5)**

- Driver can request the system to maintain the current speed and can always turn it off.
- System should not operate after braking.
- System should allow the driver to travel faster than the set speed.

Clearly specify the inputs (Driver and Sensor), outputs (Control) and the required states with transitions.

**Q.8** Environment monitoring has become crucial to ensure healthy living. Enterprises are focusing on green technology by capitalizing on state-of-the-art environment monitoring systems. IOT based environmental monitoring systems allow supervisors and managers to monitor current / remote sites for conditions such as rain, temperature, humidity, harmful gases etc. **(5)**

Air pollution harms human cognition and productivity, drains motivation, and leads to damage health and costs lives. No one doubts the importance of air pollution monitoring systems. The problem is their cost. A price tag deters enthusiasts and prevents the expansion of an air quality network. A most dynamic city X manages fast urban sprawls in near real time but at the cost of poor air quality. To improve the situation, the authorities decided to install environmental monitoring and control systems. The difficulty was that the city didn't have a network of air pollution monitoring stations to rely on. But a bit of creativity helped the city council to find a solution. They bought low cost air quality sensors and placed them in the public cabs of city's popular cab chain. This way, they've turned a cab into a mobile platform that captures data as it travels through the city. Low upfront cost and scalability are key benefits of the solution. Design and discuss the structure of Internet of Things (IoT) based Air Quality Monitoring System which can incorporate the proposed solution.

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