Assignment 1

MCQ:

1. Which of the following is an example of an embedded system?
   A. Global Positioning System (GPS)
   B. Digital Camera
   C. Fitness tracker
   D. All of the above

Solution: Option D. All of the above.
Explanation: GPS system has multiple sensors embedded on a chip connected to navigation satellites. Digital Camera has embedded sensors to capture and process a photograph. Fitness tracker has embedded systems to track heart rate, body temperature, etc.

2. While designing a 2-bit adder, which gives the sum as output and discards the carry, which of the following is represented by the behavioural dimension of the Gajski's Y chart for the adder ? (a and b are the input bits.)
   A. a+b
   B. a^b ('^' represents XOR)
   C. a-b
   D. None of these

Solution: Option B. a^b ('^' represents XOR)
Explanation: The behavioural dimension of the Gajski's Y chart deals with the mathematical aspect of the hardware design to be built, which for the case of a 2-bit adder, will bear the output as the xor of the input bits.

3. Suppose we build an embedded system with a bus design so as to facilitate parallel access of instruction and data. Which architecture will be suitable for the design?
   A. Princeton architecture
   B. Von Neumann architecture
   C. Harvard architecture
   D. None of these

Solution: Option C. Harvard architecture
Explanation: The core principle of Harvard architecture is to provide two different sets of memory for instructions and data along with different sets of buses to access the instructions and data simultaneously and increase performance of the design.

4. Statement 1 : ASIC is hardwired and hence does not have the flexibility of being programmed.
Statement 2 : GPP can be used for several applications and hence is programmable.
   A. Both statements are true.
   B. Statement 1 is true but Statement 2 is false.
   C. Statement 1 is false but Statement 2 is true.
   D. Both statements are false.

Solution : Option A. Both statements are true.

Explanation : Definition of ASIC and GPP is the same as the statements.

5. Select the false statement:

A. Programmable Logic Devices(PLD) have a very low NRE cost.
B. Very Large Scale Integration(VLSI) devices have a very low NRE cost.
C. General Purpose Processors(GPP) have a higher NRE cost than PLDs.
D. All of the above.

Solution: Option B. Very Large Scale Integration(VLSI) devices have a very low NRE cost.
Explanation: In a full-custom IC technology(VLSI design), we optimize all layers for our particular embedded system's digital implementation, hence the high NRE cost and long turnaround times.

6. Which of the following statements about DSP(Digital Signal Processors) are false?

A. DSPs are optimized in signal processing tasks like signal filtering, transformation or combination.
B. DSPs use a Princeton architecture.
C. DSPs have special hardware to fetch large and sequential data memory locations.
D. DSPs have special purpose datapath components like multiply-accumulate unit which help to perform operations like FFT.

Solution: Option B. DSPs use a Princeton architecture.
Explanation: DSPs use a Harvard architecture. Rest are properties of DSPs.

7. Find the correct match:

1. ASIC	i. FPGA
2. ASIP	ii. IC of DVD player
3. GPP	iii. DSP
4. PLD	iv. Desktop computer

A. 1-iv;2-iii;3-ii;4-i
B. 1-ii;2iii;3-iv;4-i
C. 1-i;2-ii;3-iii;4-iv
D. 1-iii;2-iv;3-i;4-ii

Solution: Option B. 1-ii;2iii;3-iv;4-i
Explanation: 1. IC of a DVD player is very specific in its function, hence ASIC
2. DSP performs a lot of different mathematical operations on signals , hence is slightly programmable and hence ASIP 3. GPP powers most modern desktop computers 4. FPGA is an example of a complex PLD.

8. Suppose I want to build a processor to perform multiplication of unsigned 64-bit integers. To increase speed of the processor, I will prefer : (assume that I have sufficient funds to satisfy the NRE cost)

A. Software implementation of the multiplier.
B. Hardware implementation of the multiplier.
C. Both software and hardware implementation(separate not a co-design)
D. None of these

Solution: Option B. Hardware implementation of the multiplier.
Explanation: Hardware implementation of mathematical circuits increases the speed of the processor while having a noticeable overhead in space and price of the processor(Nre cost is satisfied, hence hardware is the correct alternative). The co-design of both hardware and software is still a debated topic.

9. Which kind of operating system can be used in embedded systems?

A. Real-time Operating Systems
B. Network Operating Systems
C. Batch Operating Systems
D. None of these

Solution: Option A. Real-time Operating Systems
Explanation: Real-time Operating Systems have a small response time and almost no virtual memory and hence can be used for task specific processors(embedded systems). Network OS is not viable due to the large size of their servers and costly maintenance. Batch OS is used for multiple tasks at once, hence a higher response time and also they are costly to implement and harder to debug.

10. The control unit of a processor can be

A. Hardwired
B. Microprogram controlled
C. Both A and B
D. None of these

Solution: Option C. Both A and B
Explanation: THe control unit of a processor can be designed completely by hardwiring the circuits or by using a microprogrammed setup where the control values are saved to and accessed directly from the memory. The hardware control unit is much faster than the microprogrammed control unit.

Short-Answer type(Alphanumeric answers only):

11. The NRE cost to design a processor is Rs. 5,00,000 and the unit cost of production is Rs. 2,000. Calculate the total cost to produce 100 such processors.
Solution: 7,00,000
Explanation:
Total cost = NRE cost + (unit cost * no of units) = 5,00,000 + 2,000*100 = 7,00,000.

12. A metro station gate is controlled by an embedded system. The gate opens when two tickets are delivered. Determine the least number of states in the FSMD of the embedded system.
Solution : 4
Explanation :