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This question paper contains 6 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : 1375

Unique Paper Code : 2342011102

Name of the Paper : Computer System Architecture

Name of the Course : B.Sc. (H) Computer Science (NEP-UGCF)

Semester : I

Duration : 3 Hours Maximum Marks : 90

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory.

Attempt any 4 of Question Nos. 2 to 7.

Parts of a question must be answered together.

Section–A

1. (*a*) Define the following types of memories : 2

   (*i*) PROM

   (*ii*) EPROM

   (*b*) Differentiate between isolated and memory mapped I/O. 3

   (*c*) List any *three* characteristics of a GPU. 3

   (*d*) Show the 8-bit representation of -14 in 3

   (*i*) Signed magnitude representation

   (*ii*) Signed-1's complement representation

   (*iii*) Signed-2's complement representation

P.T.O.

(*e*) Describe the functions of the following registers : 3

(*i*) AR

(*ii*) AC

(*iii*) DR

(*f*) Given the Boolean function F = A'B + ABC' : 4

Derive the algebraic expression for F'. Also, show that F.F' = 0.

(*g*) Write the micro-operations for the following instructions : 4

(*i*) CIR

(*ii*) SNA

(*h*) Give the logic diagram and truth table of a 2-to-4 line decoder using NAND gates only. 4

(*i*) Represent the decimal numbers 184 and 576 in binary code and BCD form. 4

Section-B

2. (*a*) Determine the number of 1024 × 16 memory chips required to achieve the following memory capacities : 4

(*i*) 8192 K × 16

(*ii*) 4096 × 32

(*b*) Explain why each of the following register transfer language statements cannot be directly executed in a basic computer. Also specify the correct sequence of micro-operations required to perform these operations : 5

(*i*) IR ← M[PC]

(*ii*) AC ← AC + TR

(*c*) Design a combinational circuit with three binary inputs *a*, *b* and *c* and three binary outputs *x*, *y* and *z*. When the binary input has even number of 1's, then the output is one more than the input. When the binary input has odd number of 1's, then the output is one less than the input. The output remains the same if the input is zero. 6

3. (*a*) Draw the block diagram of a 4-to-1 line multiplexer and explain its operation by means of a function table. 4

(*b*) Define the Interrupt Cycle. Illustrate the process with a flowchart depicting the sequence of operations involved in the interrupt cycle. 5

(*c*) Given the Boolean function F = xy'z + x'y'z + w'xy + wx'y + wxy 6

(*i*) List the truth table of the given function.

(*ii*) Draw the logic diagram using the original Boolean expression.

(*iii*) Simplify the function using Boolean algebra.

4. (*a*) What mechanism can be used to detect overflow condition while performing arithmetic computations on binary numbers ? Explain the same with the help of an example. 4

(*b*) Draw a space-time diagram for a six-segment pipeline showing the time it takes to process eight tasks. 5

(*c*) The content of the AC in the basic computer is A937 (all numbers are in hexadecimal) and the initial value of E is 1. Determine the contents of AC, E, PC, AR and IR in hexadecimal after the execution of the CMA instruction. The initial value of PC is hexadecimal 021 and hexadecimal code of CMA is 7200. 6

5. (*a*) Assuming the three bit binary code for a register corresponds to the register number and the binary codes for the operations supported by the processor are listed in Table 1. Specify the 14-bit binary control words consisting of four fields SELA, SELB, SELD and OPR that must be applied to implement the following operations : 4

(*i*) $R_1 \leftarrow R_2 + R_3$

(*ii*) $R_1 \leftarrow R_2 \vee R_3$

OPR select	Operation
0000	Transfer
01011	OR
10010	ADD
10100	Complement

Table–1 : Encoding of ALU operations

(*b*) An instruction is stored at location 100 with its address field at location 101. The address field has the value 500. PC has the value 100. The content of a processor register R_1 is 200. Evaluate the effective address (EA) if the addressing mode of the instruction is (All values are in decimal) : 5

(*i*) Direct

(*ii*) Relative

(*iii*) Indirect

(*iv*) Register Indirect

(*v*) Immediate.

(*c*) Perform the arithmetic operations (+70) + (+80) and (–70) + (–80) in binary using signed-2's complement representation for negative numbers. Use eight bits to accommodate each number together with its sign. 6

6. (*a*) Perform the following conversions : 4

(*i*) Convert the hexadecimal number E7B2D.75 to octal

(*ii*) Convert $(3431)_5$ to decimal.

(*b*) Give characteristics table and excitation table of D flip-flop. What is the disadvantage of D flip-flop ? 5

(*c*) Simplify the following Boolean function F together with don't care conditions *d* in SOP (sum of products) form and draw the logic diagram for the simplified F. 6

$$F(x, y, z, w) = \Sigma(0, 1, 8, 14, 15)$$

$$d(x, y, z, w) = \Sigma (2, 5, 10).$$

7. (*a*) What is a binary adder-subtractor ? Draw a diagram of a 4-bit binary adder-subtractor and explain its functionality. 4

(*b*) Explain Direct Memory Access (DMA) in brief. Differentiate between Burst Transfer Mode and Cycle Stealing Mode in DMA. 5

(*c*) A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code a stored in one word of memory. The instruction has four parts : a mode field to specify one of the 16 addressing modes, an operation code, a register code part to specify one of 60 registers, and an address part :

(*i*) How many bits are there in the mode field, operation code, register code part, and the address part ?

(*ii*) Draw the instruction word format and indicate the number of bits in each part.

(*iii*) How many bits are there in the data and address inputs of the memory ? 6