Computer Organization and Architecture (CS203)
Mid Semester Exam (25-02-2019)

Time: 02 hours **Max. Marks: 20**

Note: Attempt all questions.

Q.1. A CPU which address the data though its 6 registers in one of 12 different modes, is to be designed to support 10 arithmetic instructions, 15 logic instructions, 24 data moving instructions, 6 branch instructions and 5 control instructions. Of these instructions 20%, 60%, 50%, 50% and 60% are no-operand instructions, respectively. Rest all are double operands type. What should be the minimum size of CPU instruction word? **4**

Q.2. Prove with sketch that Processor is a state machine. **4**

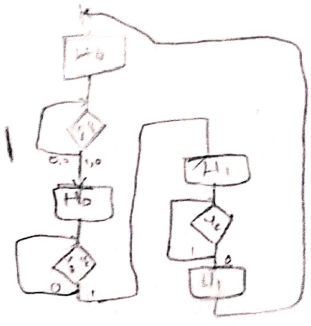
Q.3. Let us assume that the ALU present in my CPU can perform 18 arithmetic operations, 15 Logic operations, 20 Memory displacement operations and 10 other operations. Design a Datapath architecture which will have a control unit and 5 registers including PC, IR, MAR, MDR etc and explain it. **4**

Q.4. Let us assume that we are having 63 states of CPU. Also assume that we are using *J-K* flip flops in our implementation. Provide a Firmware design of a Controller which should be capable to perform the aforesaid tasks. **4**

Q.5. For the Datapath designed in question 3 and controller designed in question 4, write the respective machine code which should be generated by Controller for the following Micro-Instructions: **4**

(a) Address ← PC
(b) PC ← PC + 1
(c) MDR1 ← Data.IN
(d) MDR1 ←MDR1 + MDR2

You can assume the respective code for ALU and other Multiplexers.



Computer Organization and Architecture (CS203)
End Semester Examination (30-04-2019)

Time: 3 Hours **Max. Marks: 40**

Note: Attempt all questions.

Q.1. Let us assume that the ALU present in my CPU can perform 18 arithmetic operations, 15 Logical operations, 40 Memory displacement operations and 30 other operations. Design a Datapath architecture which will have a control unit and 5 registers including PC, IR, MAR, MDR etc and explain it. **2**

Q.2. Let us assume that we are having 103 states of CPU. Also assume that we are using J-K flip flops in our implementation. Provide a Firmware design of a Controller which should be capable to perform the aforesaid tasks. **2**

Q.3. Write the register transfer activity (Micro-Instructions) for the following code. **4**

```
IF ( i == j)
{
   a = b + c;
}
Else
{
   d = b – c;
}
```

Q.4. Write the respective machine code which should be generated by Controller used in question (1) for the Micro-Instructions derived in question (3). You can assume the respective code for ALU and other Multiplexers. **4**

Q.5. What are different modes of addressing data in Datapath architecture? Explain. **2**

Q.6. A block set associative cache consists of a total of 64 blocks divided into 4-block sets. The main memory contains 4096 blocks, each consisting of 128 words. **4**

(a) How many bits are there in a main memory address?

(b) How many bits are there in each of the TAG, SET and WORD field?

Q.7. When a program generates a reference to a page that does not reside in the physical main memory, execution of the program is suspended until the requested page is loaded into the main memory. What difficulties might arise when n instruction in one page has an **5**

P.T.O.

operand in a different page? What capabilities must the processor have to handle this situation?

Q.8. Suppose that a machine has 64-bit virtual addresses and 64-bit physical addresses.
(a) What is the main advantage of a multilevel page table over a single –level one? **3**
(b) With a two-level page table, 16 KB pages and 4-byte entries, how many bits should be allocated for the top level page table field and how many for the next-level page table field? Explain. **3**

Q.9.
(a) What are different modes of I/O? Explain each of them in detail with sketch. **3**
(b) What is difference between Memory mapped I/O and I/O mapped I/O? Explain. **1**
(c) What do you mean by Exceptions? What are different hardware solutions to handle them? **2**

Q.10. The address bus of a computer has 16 address lines, A_{15-0}. If the address assigned to one device is $7CA4_{16}$ and the address decoder for that device ignores lines A_8 and A_9, what are all the addresses to which this device will respond? **5**

Roll No. 2017336

Midsem Examination (February 2019)

Course Name: Data Communications
Course Code: CS205

Maximum Marks – 50
Total Time: 02:00 Hour

Note: Attempt all questions.

Q.1 a) Explain the various functions of Network Layer in detail . **(06 Marks)**

b) Five routers are to be connected in a point-to-point subnet. Between each pair of routers, the designers may put a high-speed line, a medium-speed line, a low-speed line, or no line. If it takes 100 ms of computer time to generate and inspect each topology, how long will it take to inspect all of them? **(04 marks)** 2s

Q.2 a) If 8492Kb data is transmitted at the rate of 1.544Mbps from the one end of the cable and if the propagation speed of the cable of is 2 x 10^7 m/sec, What should be the cable length so that by the time of reaching the first bit on the other end, the transmitter may finish the transmission of whole data.? **(05 marks)** 11×10^7 m

b) Suppose symbols are sent on a noiseless 4-k Hz channel at rate of one symbol every 0.50 msec. If the symbols each encode 4 bits, what is the maximum data rate for this channel? What if the symbols each encode 8 bits? What is the upper limit on the data rate for this (noiseless) channel? **(05 marks)** 36.04 kbps, 45.67 kbps

Q.3 a) List out the advantages and drawbacks of mesh topology, and star topology? **(06 marks)**

b) Given a channel with an intended capacity of 20 Kbps, the bandwidth of the channel is 6MHz. Assuming white thermal noise, what signal-to-noise ratio is required to achieve this capacity? **(04 marks)** 7.705×10^{-3}

Q.4 a) Explain the Fourier's Analysis, and its inferences for periodic and non-periodic signals. **(06 marks)**

b) What do you mean by transmission impairment, discuss various type of transmission impairments in detail? **(04 marks)** Attenuation, Distortion, Noise

Q.5 a) Show the NRZ, Manchester, and NRZI encodings for the bit pattern shown below. Assume that the NRZI signal starts out low.? **(03 marks)**

1110 0101 0000 0011

b) Show the 4B/5B encoding, and the resulting NRZI signal, for the above-mentioned bit sequence. Assume that the NRZI signal starts out low. **(03 marks)**

c) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers? **(04 marks)**

Roll No. 2017336...

Session 2018-19 Sem II

Endsem Examination April 2019

Course Name: Data Communication
Course Code: CS205

Maximum Marks – 75
Total Time: 03:00 Hour

Note: Attempt all questions.

Q.1. a.) Compare the ISO OSI reference model with TCP/IP model in detail. **(06 Marks)**

b.) A TCP segment consisting of 2048 bits of data and 160 bits of header is sent to the IP layer, which appends another 240 bits of header. This is then transmitted through two networks, each of which uses a 24-bit packet header. The destination network has a maximum packet size of 800 bits. How many bits, including headers, are delivered to the network layer protocol at the destination? **(04 Marks)**

c.) Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white thermal noise, what signal-to-noise ratio is required to achieve this capacity? **(05 Marks)** $20 = 3 \times \log_2(1+x)$

Q.2 a.) Three packet-switching networks each contain n nodes. The first network has a star topology with a central switch, the second is a (bidirectional) ring, and the third is fully interconnected, with a wire from every node to every other node. What are the best-case, average-case, and worst-case transmission paths in hops? **(06 Marks)** 3, 1, 2

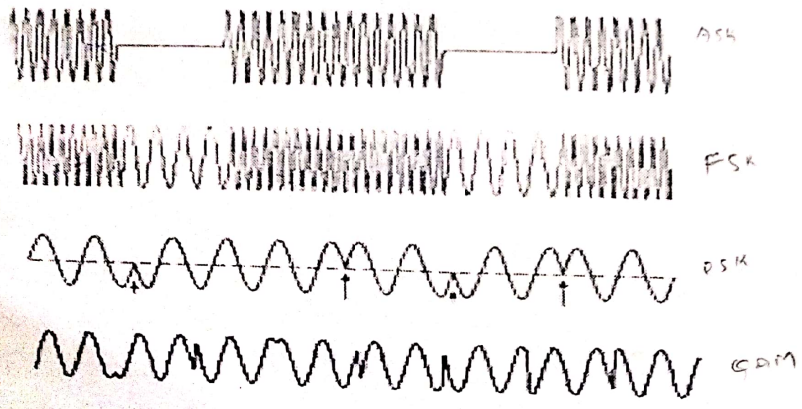
b.) The distance from earth to a distant planet is approximately 9×10^{10} m. What is the channel utilization if a stop-and-wait protocol is used for frame transmission on a 64 Mbps point-to-point link? Assume that the frame size is 32 KB and the speed of light is 3×10^8 m/s. **(04 Marks)**

c.) Prove that utilization of sliding window protocol for error free channel is $U = W/(1 + 2a)$, where 'W' is window size and 'a' is ratio of propagation time to transmission time. **(05 Marks)**

Q.3 a.) A modem constellation diagram has data points at the following coordinates: (1,0)(1, 1), (1, −1), (0,-1), (−1, 1),(-1,0), (−1, −1), and (0,1). How many bps can a modem with these parameters achieve at 1600 symbols/second? **(03 Marks)**

b.) If the data link layer can detect error between hops, why do you think we need another checking mechanism at the transport layer? **(03 Marks)**

c.) Name the modulation schemes used in the below given four signals **(04 marks)**



$2 \times 10^3 \times \log_2(1+x)$

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d.) Compare QPSK and QAM modulation techniques and what limits us to use the higher order modulat to increase the data rate. **(05 Marks)**

Q.4 a) Explain the frame structure of HDLC protocol in detail with description of each field for various mode **(06 marks)**

b) Compute the hamming code for the Message M=101100010 using even parity. **(05 Marks)**

c) FDM (Frequency Division Multiplexing) splits a channel up among each of its users. If the users sending encoded video signals, and each requires a bandwidth of 2MHz. If a guard band between the is 200 KHz, how many of these can fit into a data channel of 100 MHz bandwidth? **(04 Marks)**

Q.5 a) In a CRC error-detecting scheme, choose $G(x) = X^4 + X + 1$.

i.) Encode the bits 10010011011. **(03 marks)**

ii.) Suppose the channel introduces an error pattern 100010000000000 (i.e., a flip from 1 to 0 or from to 1 in position 1 and 5). What is received? Can the error be detected? **(03 marks)**

b) List the characteristics of a good generator polynomial in CRC? **(04 marks)**

c) Suppose a data channel can send data at 10 Mbps, and the channel has a signal/noise ratio of 1000. If bandwidth cannot be changed, how much improvement in signal/noise ratio is required to get this channe to send at the rate 100Mbps? Equivalently, assuming the noise is unchanged, how much more signa power is required to get the rate to 100Mbps using the same bandwidth? **(05 marks)**

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Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
Quiz 1: Design and Analysis of Algorithms (CS204)

Marks: 10 Time: 40 mins Date: February 03, 2019

There are 10 MCQs in the question booklet each carries 1 mark. Please pick the correct answer from the alternatives with proper justification in order to get full mark for each question.

1. Consider the following segment of C-code

```
int j, n;
j=1;
while(j<=n)
j=j*2;
```

The number of comparisons made in the execution of the loop for nay n>0 is:

a. $\lceil \log_2 n \rceil + 1$ b. n c. $\lceil \log_2 n \rceil$ d. $\lfloor \log_2 n \rfloor + 1$

2. The running time of an algorithm T(n), where n is the input size, is given by

$$T(n) = \begin{cases} 8T\left(\frac{n}{2}\right) + qn, & \text{if } n > 1 \\ p, & \text{in } n = 1 \end{cases}$$

Where, p, q are constants. The order of this algorithm is

a. n^2 b. n^n c. n^3 d. n

3. An algorithm is made up of 2 modules M1 and M2. If order of M1 is f(n) and M2 is g(n) then the order of the algorithm is

a. max(f(n),g(n)) b. min(f(n),g(n)) c. f(n)+g(n) d. f(n)×g(n)

4. The running time T(n), where n is the input size, of a recursive algorithm is given as follows.

T(n)=c+T(n-1), if n>1
=d, if n<=1

The order of this algorithm is

a. n^2 b. n c. n^3 d. n^n

5. The running time T(n), where n is the input size, of a recursive algorithm is given as follows.

$$T(n) = \begin{cases} T(n-1) + \frac{1}{n}, & if\ n > 1 \\ 1, & \text{otherwise} \end{cases}$$

The order of this algorithm is

a. $\log_2 n$ b. n c. n^2 d. n^n

6. The running time of an algorithm is given by

T(n)=T(n-1)+T(n-2)-T(n-3), if n>3
=n, otherwise

The order of this algorithm is

a. n b. $\log_2 n$ c. n^n d. n^2

7. Let W(n) and A(n) denote respectively, the worst case and average case running time of an algorithm executed on an input of size n. which of the following is ALWAYS TRUE?

a. $A(n)=\Omega(W(n))$ b. $A(n)=\theta(W(n))$ c. $A(n)=O(W(n))$ d. $A(n)=o(W(n))$

8. A list of n strings, each of length n, is stored into lexicographic order using the merge-sort algorithm. The worst case running time of this computation is

a. $O(\log_2 n)$ b. $O(n^2 \log_2 n)$ c. $O(n^2 + \log_2 n)$ d. $O(n^2)$

9. What is the time complexity of the following recursive algorithm?

```
int DoSomething(int n){
    if(n<=2)
        return 1;
    else
        return(DoSomething(floor(sqrt(n))+n));
}
```

a. $\theta(n^2)$ b. $\theta(n \log_2 n)$ c. $\theta(\log_2 n)$ d. $\theta(\log_2 \log_2 n)$

10. *Consider the following C code segement*

```
int IsPrime(n){
    int I,n;
    for(i=2;i<=sqrt(n);i++)
        if(n%i==0){
            printf("Not Prime");
            return 0;
        }
    return 1;
}
```

Let T(n) denotes the number of times the for loop is executed by the program on input n, which of the following is TRUE?

a. $T(n) = O(\sqrt{n})$ and $\Omega(\sqrt{n})$

b. $T(n) = O(\sqrt{n})$ and $T(n) = \Omega(1)$

c. $T(n) = O(n)$ and $\Omega(\sqrt{n})$

d. None of these

Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
End Semester, Friday, April 26, 2019
Design and Analysis of Algorithms (CS204)

Marks: 55 **Time: 3 hours**

[Note: Please show each and every step clearly to get full marks]

1. [**Marks** 5] Show that the Clique Decision problem is NP-hard.

2. [**Marks** 4] Find out strongly connected components using Kosaraju's algorithm for the following adjacency matrix:

	A	B	C	D	E	F	G	H	I	J	K
A	0	1	∞	∞	∞	∞	∞	∞	∞	∞	∞
B	∞	0	1	1	∞	∞	∞	∞	∞	∞	∞
C	1	∞	0	∞	∞	∞	∞	∞	∞	∞	∞
D	∞	∞	∞	0	1	∞	∞	∞	∞	∞	∞
E	∞	∞	∞	∞	0	1	∞	∞	∞	∞	∞
F	∞	∞	∞	1	∞	0	∞	∞	∞	∞	∞
G	∞	∞	∞	∞	∞	1	0	1	∞	∞	∞
H	∞	∞	∞	∞	∞	∞	∞	0	1	∞	∞
I	∞	∞	∞	∞	∞	∞	∞	∞	0	1	∞
J	∞	∞	∞	∞	∞	∞	1	∞	∞	0	1
K	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	0

3. [**Marks** 4] With the help of state space tree, solve the Travelling Salesperson Problem of the *following cost matrix using least cost branch and bound approach.*

	A	B	C	D	E
A	0	3	1	5	8
B	3	0	6	7	9
C	1	6	0	4	2
D	5	7	4	0	3
E	8	9	2	3	0

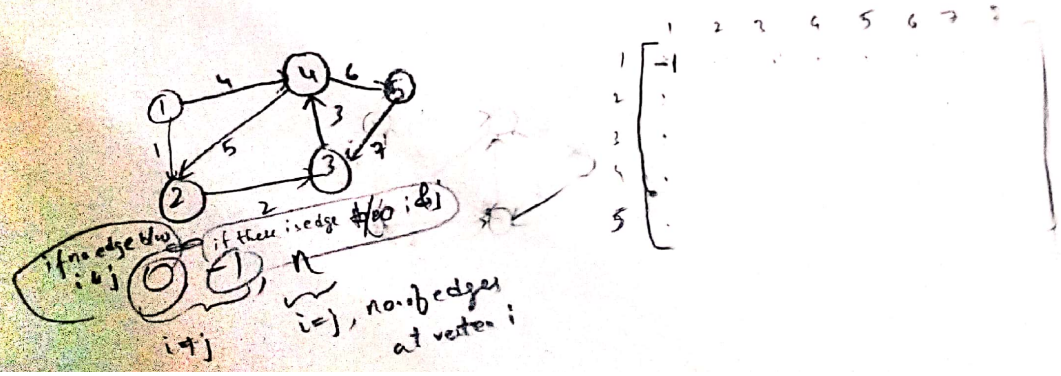
4. [**Marks** 4] Show that the fractional knapsack problem exhibits the greedy-choice property.

5. [**Marks** 4] Give a dynamic-programming solution to the 0-1 knapsack problem that runs in O(n.W) time, where n is the number of items and W is the maximum weight of items that the thief can put in his knapsack.

6. [**Marks** 3] The **incidence matrix** of a directed graph G=(V, E) with no self-loops is a $|V| \times |E|$ matrix B=(b_{ij}) such that

$$b_{ij} = \begin{cases} -1 & \text{if edge } j \text{ leaves vertex } i, \\ 1 & \text{if edge } j \text{ enters vertex } i, \\ 0 & \text{otherwise.} \end{cases}$$

Describe what the entries of the matrix product BB^T represent, where B^T is the transpose of B.



7. [**Marks** 5] We have a connected graph G = (V, E), and a specific vertex u ∈ V. Suppose we compute a depth-first search tree rooted at u, and obtain a tree T that includes all nodes of G. Suppose we then compute a breadth-first search tree rooted at u, and obtain the same tree T. Prove that G = T. (In other words, if T is both a depth-first search tree and a breadth-first search tree rooted at u, then G cannot contain any edges that do not belong to T.).

8. [**Marks** 5] Suppose you are given a connected graph G, with edge costs that are all distinct. Prove that G has a unique minimum spanning tree.

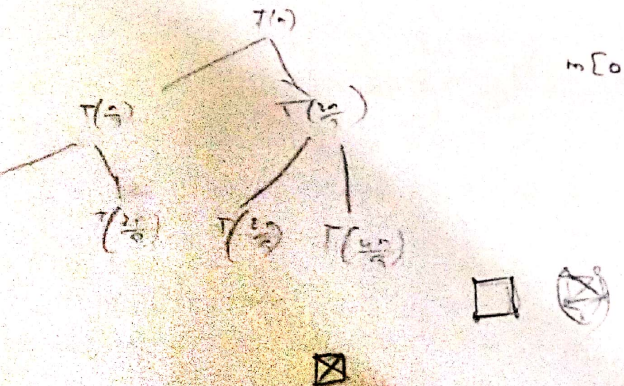
9. [**Marks** 3] Argue that the solution to the recurrence $T(n) = T\left(\frac{n}{3}\right) + T\left(\frac{2n}{3}\right) + cn$, where c is a constant, is Ω(nlogn) by appealing to a recursion tree.

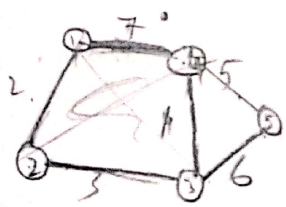
10. [**Marks** 5+1=6] What do you mean by **memorization**? Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5, 10, 3, 12, 5, 50, 6).

11. [**Marks** 5] If G has a topological ordering, then prove that G is a directed acyclic graph.

12. [**Marks** 4] If G has no negative cycles, then prove that there is a shortest path from u to v that is simple (i.e., does not repeat nodes), and hence has at most n − 1 edges.

13. [**Marks** 3] Show that the Shortest-Path method can be implemented in O(mn) time, where n and m are the number of nodes and edges of a graph respectively.





Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
Mid Semester: Design and Analysis of Algorithms (CS204)

Marks: 30 **Time: 2 hours** **Date: February 22, 2019**

1. Write an algorithm to merge two Binomial Heaps. Derive the time complexity of the algorithm. 4+2=6

2. Consider the following two matrices and multiply tem using Strassen's algorithm. Derive the time complexity of that algorithm. 6+2=8

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 6 & 5 & 4 \\ 7 & 8 & 9 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

3. Write a short note on RAM model. 4

4. Let f(n) and g(n0 be asymptotically nonnegative functions. Using the basic definition of ,θ-notation, prove that max(f(n), g(n))= θ (f(n)+g(n)). 3

5. Prove Master Theorem. Mention two cases, where you can not apply Master Theorem in order to find the time complexity. 5 +2=7

6. *Show that for any real constants a and b, where b > 0,* $(n + a)^b = \theta(n^b)$. 2