Department of Mathematics
National Institute of Technology Srinagar

Examination: End Term
Subject: Introduction to Probability and Statistics
Course Code: MAT-301
Date: 10/12/2022

Semester: B. Tech 5^{th} Semester/IT
Max. Marks: 60
Time: 3 hours

NOTE: Attempt All Questions. Marks Are Indicated Against Each Question.

1. **CO1.** (a) A continuous random variable X has the following probability density function,

$$f(x) = \begin{cases} kx & \text{for } 0 \le x < 2 \\ 2k & \text{for } 2 \le x < 4 \\ -kx + 6k & \text{for } 4 \le x < 6 \\ 0 & \text{elsewhere} \end{cases}$$

Find k and mean of the density function. (8)

(b) A sales tax officer reported that the average sales of 500 business establishment in a year is Rs 36,000 and a standard deviation of Rs 10,000. Assuming the sales in these businesses are suitably distributed. Find (i) the number of businesses the sales of which are more than Rs 40,000 (ii) the percentage of businesses the sales of which are likely to range between 30,000 and 40,000. (2, 2, 3)

2. **CO2.** (a) Two discrete random variables X and Y have the joint probability density function as,

$$p(x, y) = \frac{\lambda^x e^{-\lambda} p^y (1-p)^{x-y}}{y!(x-y)!}, \quad y = 0, 1, 2, \cdots, x \; ; \; x = 0, 1, 2, \ldots$$

where λ and p are constants with $\lambda > 0$ and $0 < p < 1$. Find (i) The marginal probability density functions of X and Y (ii) The conditional distribution of Y for a given X and of X for a given Y. (4, 4)

(b) Obtain a regression plane by using multiple linear regression to fit the data given as, $x : 1, 2, 3, 4$; $z : 0, 1, 2, 3$; $y : 12, 18, 24, 30$. (7)

3. **CO2.** (a) A study of prices of a certain commodity at Srinagar and Delhi yields the following data,

Average price/kilo in rupees : 2.463, 2.797, *Standard Deviation* : 0.326, 0.207.

Correlation coefficient between prices at Srinagar and Delhi is 0.774. Estimate from the above data, the most likely price at Srinagar corresponding to the price of Rs 3.052 per kilo at Delhi. (7)

(b) Fit a polynomial (degree 2) of regression of y on x to the data given as, $x : 1, 1.5, 2, 2.5, 3, 3.5, 4$; $y : 1.1, 1.3, 1.6, 2, 2.7, 3.4, 4.1$. (8)

4. **CO3.** (a) The mean life of a random sample of 10 light bulbs was found to be 1456 hrs with a S. D. of 423 hrs. A second sample of 17 bulbs chosen at random from a different batch showed mean life of 1280 hrs with a S. D. of 398 hrs. Is there significant difference between the mean life of the two batches at 0.05 level of significance? (8)

(b) The research investigator was interested in studying whether there is a significant difference in the salaries of B.tech graduates in two metropolitan cities. A random sample of 100 from Mumbai yields an average income of Rs 20,150. Another random sample of 60 from Chennai results in an average income of Rs 20,250. The variances for both the populations are Rs 40,000 and Rs 32,400 respectively. (7)

5. **CO3.** (a) A normal population has a mean of 0.1 and standard deviation of 2.1. Find the probability that mean of a sample of size 900 will be negative. (8)

(b) Twenty people were attacked by a coronavirus disease and only 18 survived. Will you reject the hypothesis that the survival rate, if attacked by this disease is 85 percent in favour of the hypothesis that it is more, at 0.05 level of significance. (7)

National Institute of Technology, Srinagar
Department of Information Technology
Mid-Term Examination Autumn 2022

Course code: IT301
Course name: Design & Analysis of Algorithms
Max marks: 30

Date: 29/09/2022
Time: 10:00-11:30 AM

Course Outcome [CO's]

CO1: Understand basics of algorithm efficiency and asymptotic notations.
CO2: Study various divide & conquer and greedy algorithms.
CO3: Understand the concept of dynamic programming with applications.
CO4: Study various graph searching and traversal algorithms.
CO5: Understand various computational complexity measures.

Q1.

a) [CO1, 2 Marks] Sort all the functions below in increasing order of asymptotic (big-O) growth. If some have the same asymptotic growth, then be sure to indicate that. As usual, lg means base 2

1. 5n
2. 4lg n
3. 4 lg lg n
4. $n^{1/2} \lg^4 n$
5. $(\lg n)^{5 \lg n'}$
6. $n^{\lg n}$
7. 5^n
8. 5^{5n}

b) [CO1, 3 Marks] Give asymptotic upper and lower bounds for T(n) in each of the following recurrences. Assume that T(n) is constant for $n \leq 2$. Make your bounds as tight as possible, and justify your answers.

1. $T(n) = 5T(n/4) + 4n$
2. $T(n) = 25T(n/5) + n^2$

c) [CO1, 3 Marks] Analyse the running time of the following recursive pseudo-code as a function of *n*.

```
void function (int n) {
        if (n<2) return;
         else counter=0;
        for i = 1 to 8 do
                function (n/2);
       for i =1 to n^3 do
              counter = counter + 1;
}
```

d) [CO1, 3 Marks] Write a recursion formula for the running time $T(n)$ of the function whose code is below.

```
Function (int n) {
        if (n<=1) return;
        for (int i=1; i<n; i++)
            printf(" * ");
        function ( 0.8n );
}
```

Q2.

a) [CO2, Marks 5] Write an algorithm for Longest Common Subsequence (LCS). Given two sub sequences as shown below:

X= < A C A D B >
Y= < C B D A >

Find the longest common subsequence between "X" and "Y"

b) [CO2, Marks 6] Write an algorithm for Randomized Quick Sort using given Partition Algorithm. Let X be the number of comparisons performed in line 4 of Partition over the entire execution of Randomized Quick Sort on an n-element array. Prove the running time of Quick Sort is O(n+x).

```
PARTITION(A, p, r)
1  x = A[r]
2  i = p − 1
3  for j = p to r − 1
4      if A[j] ≤ x
5          i = i + 1
6          exchange A[i] with A[j]
7  exchange A[i + 1] with A[r]
8  return i + 1
```

Q3.

a) [CO3, Marks 2] Tabulate the difference between Greedy Approach and Dynamic Programming.

b) [CO3, Marks 6] Convert the following recurrence to code.

$$T(0) = T(1) = 2$$

$$T(n) = \sum_{i=1}^{n-1} 2 \times T(i) \times T(i-1), \text{for } n > 1$$

Can we improve the solution of above problem using memoization of DP? If "Yes" then can we improve the further complexity of the problem.

(a) $T(n) = T\left(\frac{n}{5/4}\right) + \Theta(n)$ → chooses best case at every step.

$\log_{5/4}^{1} = 0$; $n = 1$ → It doesn't use the concept of memoization

case - III ; so $\Theta(n^1 \log^0 n) = \Theta(n)$.

→ In DP we have choices

→ It uses

$\Theta(n^3 \log n)$

Department of Information Technology

National Institute of Technology, Srinagar

Mid-Term Examination

Course: Microprocessor
Branch: Information Technology
Maximum marks: 30
Date: 28/09/22

Couse Code: ITT302
Semester: 5th
Duration: 1 hrs. 30 min.

Note: Attempt all questions.

Q1[CO1]. *What will be output of the following [without explanation zero marks will be given]*

a. The subroutine SBX given below is executed by an 8085 processor. The value in the accumulator immediately after the execution of the subroutine will be [2]

```
SBX: MVI A, 99H
     ADI 11H
     MOV C, A
     RET
```

b. In an 8085 microprocessor, the value of the Stack Pointer (SP) is 2010 H and that of DE register pair is 1234 H before the following code is executed. What will be the value of DE register pair after the following code? [2]

```
LXI H, 0000H
PUSH H
PUSH H
POP B
DAD SP
XCHG
```

c. What will be the value of flag register after executing CMP instruction [2]

```
MVI A, 09H
MVI B, 09 H
CMP B
```

d. In an 8085 microprocessor, the content of accumulator and carry flag are A7(in hex) and 0 respectively. If the instruction RLC is executed four times, then what will be the content of accumulator (in hex) and carry flag. [2]

e. Which status pins are available in 8085 microprocessor? Describe the objectives of these pins. [1+2]

f. Explain the instructions used for peripheral interfacing [Explanation should cover machine cycles] and draw the timing diagram for any one of them. [2+2]

Q2.[CO3]

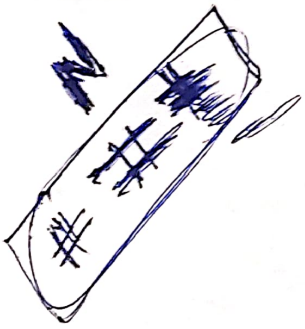
a. An 8085 assembly language program is given as follows. Assume the MPU is working on 6 MHz clock frequency. Calculate the execution time or delay of this program. [3]

	Instruction	T-State
	MVI B,0AH	7T
LOOP:	MVI C,05H	7T
	DCR C	4T
	DCR B	4T
	JNZ LOOP	10T/7T

a. Prepare the look-up table for seven segments LED display using common anode method. Write a code to display a BCD number by using this table. [1+3]

d. Define subroutine. How does MPU manage to call a subroutine? Explain machine cycle wise. [1+3]

e. Write the machine cycles used for STA instruction and draw the timing diagram for it. [1+3]



Department of Information Technology

National Institute of Technology, Srinagar

End-Term Examination

Course: Microprocessor
Branch: **Information Technology**
Maximum marks: 60
Date:

Couse Code: ITT302
Semester: 5th
Duration: 3 hrs.

Note: All questions carry equal marks. Attempt any four.

Q1.[CO1] a. Draw and explain the basic architecture of 8085 microprocessor. [3]

b. Illustrate all the pins of 8086 microprocessor. [4]

c. Suppose the instruction code 4FH stored in 2005H memory location. Illustrate the data flow and list the sequence of events when the instruction code is fetched by the microprocessor unit. [2+2]

d. What is monitor program? [1]

e. Assume the accumulator holds the data bytes FFH. Illustrate the differences in the flags set by adding 01H and the accumulator content. [3]

Q2.[CO2] a. Data byte 28H stored in register B and data byte 97H is stored in accumulator. Show the content of register B,C and accumulator after execution of the following two instructions: [2]

```
MOV A,B
MOV C,A
```

b. Write the assembly language programming for the following

Perform the addition of two hexadecimal numbers A2H and 18H. Save both the numbers for future use and store the sum in the accumulator. [2]

c. Two machine codes 0011 1110 (3EH) and 0011 0010 (32H) are stored in memory location 2000H and 2001H respectively. The first machine code 3EH represents the opcode to load the data byte in the accumulator and second code is data byte to be loaded in the accumulator. Illustrate the bus timing diagram as these machine codes are executed. Calculate the time required to execute Opcode Fetch and Memory Read cycles and entire instruction cycle if the clock frequency is 2MHz. [2+1+1+1]

d. Draw the timing diagram for IN and OUT instruction. [2+2]

e. Specify the register content and flag status as the following instructions are executed

```
MVI A,5EH
ADI A2H
MOV C,A
HLT
```

Assume initially all flags are set to zero. [2]

Q3.[CO3] a. Write a program to count in hexadecimal from FFH to 00H in a system with 0.5μs clock period. Use register C to set up a one millisecond (ms) delay between each count and display the numbers at one of the output port. [5]

b. Illustrate the CALL and RET instruction with the help of data transfer during the execution of these instructions. [3+3]

c. Write the short notes on the following [2+2]

1. RST 2. Conditional Call and Return Instruction

Q4.[CO4] a. Sixteen bytes of data are stored in memory location at XX50H to XX5FH. Transfer the entire block of data to new memory locations starting at XX70H. Write the assembly language program. [2]

b. Briefly explain the working of SIM and RIM instruction. [3+3]

c. Explain the handshaking mechanism between Programmable Interface Device (8155), peripheral device and microprocessor unit. Draw the timing diagram for it. [4+3]

Q5.[CO5] a. Calculate the address line required for 8K- byte memory chip. Calculate the number of memory chip needed to design 8K-byte memory if the memory chip size is 1024 X 1. [1+1]

b. Specify the contents of registers A,D& HL after execution of the following instructions [3]

```
    LXI H, XX90H
    SUB A
    MVI D, 0FH
LOOP: MOV M, A
    INX H
    DCR D
    JNZ LOOP
    HLT
```

c. Illustrate the various pins of different sections of 8279. [5]

d. Assume the accumulator content is AAH and CY=0. Illustrate the accumulator contents after the execution of the instruction RAL twice. [2]

e. Assume register B holds 93H and accumulator holds 15H. Illustrate the results of the instructions ORA B, XRA B and CMA. [3]

Department of Computer Science & Engineering
National Institute of Technology Srinagar

Major Examination (Autumn 2022)

Course: Microprocessor | **No. of credits: 04**
Max Marks: 90 | **Time allotted: 03 hours**
Sem: 5th | **Course code: CSE 503**

Course Outcomes (CO)

CO1	**Understand the architecture and memory organization of microprocessors 8085 and 8086.**
CO2	**Apply the programming (assembly level language) in 8085 microprocessor for simple arithmetic, logical and real time applications.**
CO3	**Identify the different ways of interfacing memory and I/O with microprocessors.**
CO4	**Apply and analyze the interfacing concept of different programmable interfacing modules with microprocessors and controllers for real time applications.**

Note:
1. **Solve only 04 questions.**
2. **Programs must be complete with memory-address, label, mnemonics and comments.**
3. **Assume a frequency of 2 MHz wherever needed.**

Q1. (a) Draw a block diagram to show the 8085 bus structure and explain how a Memory Write Operation takes place.

(b) Write an assembly language program to perform the following operations:
(i) To clear the accumulator
(ii) Add 25 H
(iii) Subtract 80H
(iv) Display the result on a port
Specify the answer that you would expect at the port.

CO1, CO2 (8, 7)

Q2. (a) Draw timing diagrams for the following instructions:
(i) IN port #
(ii) MVI B, 20H
(b) With the help of a suitable diagram explain the de-multiplexing of the data bus.

CO1, CO2 (5 x 2, 5)

Q3. (a) If the memory chip size is 2048 x 8, how many chips are required to make up 16-K memory? If the address of the last location is FFFFH, find the starting address?

(b) What is the significance of counters and time delays? Write an assembly language program to create a time delay of 1millisecond.

(c) Explain the PUSH and POP instructions with the help of a suitable example.

CO2, CO3 (4, 7, 4)

Q4. (a) What are the various interrupts available in 8085 and what is their significance?

(b) Draw the block diagram of an 8155 programmable device. Explain how we can set the addresses of control/status register.

(c) Explain briefly the architecture of 8086.

CO3, CO4 (4, 6, 5)

Q5. (a) Draw the block diagram of 8255A chip and describe the BSR mode in detail. Write a subroutine to set bits PC_3 and PC_7 and reset them after 10 ms.

(b) A bar code scanner scans boxes being shipped from the loading dock and records all the codes in computer memory; the end of the data is indicated by the byte 00. The code (A3H) is assigned to 19" television sets. Write a program to count the number of 19" television sets that were shipped from the following data set:

Data (H): FA, 67, A3, 24, A3, A3, DA, 00

CO3, CO4 (8, 7)

END OF PAPER

सूचान प्रौद्योगिकी विभाग
Department of Information Technology Engineering

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Hazratbal, Srinagar Jammu and Kashmir, 190006, INDIA

Subject: **Theory of Computation (ITT 304)**

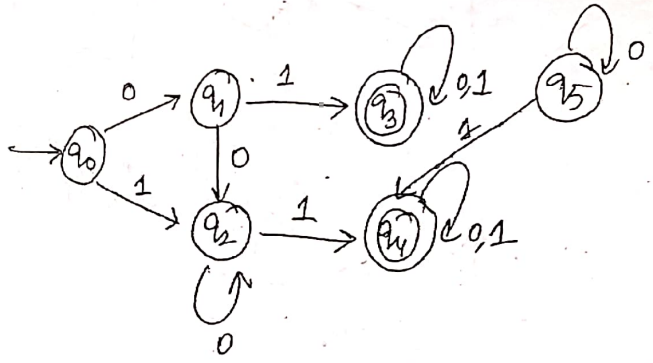
Mid-Term 5th Sem (Autumn 2022) **Time: 1hour 30 min**

All questions are compulsory.

1. [CO1, CO2] a) Find minimal DFA for the following languages on $\sum$={a,b}
   i) L= { w / $(n_a(w)+2n_b(w))$mod3 < 2}
   ii) Atmost two "a" and exactly 2 "b". (6 marks)

   b) Using closure properties of languages, find $L_1 \cup (L_2 - L_3)$ if
   L_1= {$a^m b^n$ / m, n≥ 1}
   L_2= {$a^n b^n$ / n≥ 0}
   L_3= {w w^R / w ∈ {a,b}*} (4 marks)

2. [CO1] a) Convert the following DFA to minimal DFA (4 marks)



   b) Explain the concept of pumping lemma for regular languages, by showing L= {ww / w in {0,1}*} is not regular. (6 marks)

3. [CO1, CO2] a) Design a Moore machine for ∑={0,1} over the output alphabet {0,1,2,3} for divisibility by four test. {e.g., binary 100 equivalent decimal is 4 , so should be divisible by 4} (4 marks)
   b) Write the regular expression for the following: (6 marks)

   i) L = {w/ |w| mod 100≤5}

   ii) for ∑={a,b} first and last symbols are same.

   iii) for ∑={0,1} neither two consecutive 0's nor two consecutive 1's.

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Hazratbal, Srinagar Jammu and Kashmir ,190006, INDIA

Course code: **ITT304** Date: 6/12/2022

Course name: **Theory of Computation (End Term)** **(5th SEMESTER IT)** Time: 10:00 AM - 01:00 PM

Course Outcomes (CO's)

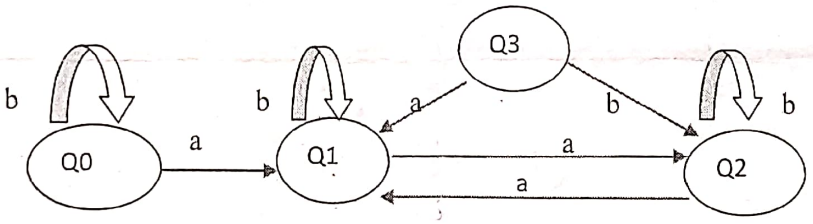
- To identify different formal language classes and their relationships
- Classify machines by their power to recognize languages.
- Employ different machines to solve problems in computing.
- To design grammars and recognizers for different formal languages.

Note: Attempt any four questions.

Q1. [CO1, Marks 15] a) Write the regular grammar for the language L= $\{a^n b^m / n+m \text{ is even}\}$. (4 marks)

b) Let ∑={a,b} and language L={aa,bb}. Then write the complement of L in simplest form. Also draw the DFA for its complement. (3 marks)

c) Minimize the following DFA, for ∑={a,b}. Here Q1 and Q2 are final states. (4marks)



d) Consider the following languages: $L_1=\{0^p1^q0^r/p,q,r\geq 0\}$ and $L_2=\{0^p1^q0^r/p,q,r\geq 0, p\neq r\}$
Find $L_1 \cap L_2$ and complement of L_2 using closure properties. (4 marks)

Q2. [CO3, Marks 15] a) Design a Mealy machine for the binary full adder. (5 marks)

b) Design a minimal DFA over ∑={a,b} , in which $|3| = 1$ mod 3

$$L = \{w \in \{a, b\}^* / |n_a(w) - n_b(w)| = 1\}.$$ (5 marks)

c) Design a PDA, for the language $L = \{a^n b^m c^n / n, m \geq 1\}$. (5 marks)

Q3. [CO4, Marks 15] a) Explain pumping lemma for context free languages? With the help of this, show that $L = \{a^n b^n c^n / n \geq 1\}$ is not context free language. (4 marks)

b) Apply tuning machine programming to design, $L = \{a^n b^n c^n d^n / n \geq 1\}$ (6 marks)

c) Find the Greibach normal form for the following grammar:

$S \rightarrow AA/0$

$A \rightarrow SS/1$ (5 marks)

Q4. [CO2, Marks 15] a) What do you mean by polynomial time reduction and how NP-hard problems are different from NP class problems? Apply the reduction theorem to find class for L_1 and L_3, given that $L_1 \leq_p L_2$ and $L_2 \leq_p L_3$ (L2 belongs to 3-SAT problem). (7 marks)

b) How Rice theorem is applied in undecidable problems. Explain with proof? (5 marks)

c) Explain the L and L̄ theorem of recursive and recursive enumerable languages? (3 marks)

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Q5. [CO1 and CO4, 15 marks] a) Eliminate left-recursion (from 1) and left factoring (from 2) in the following grammar:

1. S→Aa/b
   A→ Ac/Sd/€

2. S→a/ab/abc/abcd/abcde

(6 marks)

b) Write the regular expression for the following, ∑={a,b}:

i) All odd length strings

ii) No consecutive b's. (4 marks)

c) How we remove null-production, unit and useless production from a grammar? Explain the concept with the help of example. (5 marks)

DEPARTMENT OF INFORMATION TECHNOLOGY

NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Mid-Term Examination

Course: Data Communication
Branch: Information Technology
Maximum marks: 30
Date: 26 September 2022

Course code: ITT 305
Semester: 5th
Duration: 1 hour 30 min.

Please be specific in your answers. Attempt all questions.

Q.1. Data Network basics. (CO1, CO3, CO4, CO6) **(10)**

A. **Network Topologies.** Draw a hybrid topology consisting of three-star networks connected with the backbone network based on

i. Multi-point connections

ii. Point-point connections with two neighboring devices (3*2)

B. **Addressing.** A user wants to establish communication with another user. Identify the type of address, and the associated TCP/IP layer, if the address given is

i. 23 Port No

ii. 00-18-CE-C7-F3-FE : Mac

iii. 101.10.30.42 IPv4

iv. AE12::9AFBC:A123:2612 - IPv6 (4)

Q.2. Transmission media and layered architecture. (CO2, CO4) **(10)**

A. **Layered Architecture.** A Network planner wants to plan a network using OSI model, help him to identify the layer responsible for each case and its smallest data unit:

Session i. He needs to ensure that for the transmission of a long message, link breakage doesn't force retransmission from the beginning.

Prog. ii. He needs to transmit a secret message and hence needs to ensure that no third party can read the message.

Phy. iii. He needs to fix the topology of the network.

iv. He needs to broadcast a message on his LAN. (4)

C. **Transmission Media.** Suggest the transmission medium which would be the **best** choice in the following cases and briefly write the reason:

a. If you are only equipped with a transmitter and not a receiver and require to transmit data securely over very high data rate over long distance.

b. If you want to setup a network in the open, high up in the mountains where wired setup is not possible but require an isolated communication setup.

c. If you want to setup a network for a temporary event at a open place where ~~reachability~~ reachibility is of utmost priority. (6)

Q.3. Signal parameters and impairments and channel capacity. (CO4, CO6) (10)

A. Attenuation. A composite signal consisting of two frequency components with frequencies 50 Hz and 100 Hz travels a distance of 10 km over the transmission medium. (2+1+1+2)

a. What is the attenuation in decibels for the first component (f = 50 Hz), if its power reduces by 1/5th of original power after the given distance is covered?

b. Second component (f = 100 Hz) has an attenuation of -0.3 dB/km.

i. What is the final attenuation after the given distance is covered?

ii. Is the final attenuation different for two frequencies? Yes/No. Give reason.

iii. If the second component had a power of 2 mW, what is the power at the end of 10 km? $P_2 = 1mV$

B. Channel capacity. (2+2)

a. We have a channel with 4 kHz bandwidth. If we want to send data at 100 Kbps, what is the minimum SNR_{dB}?

b. A signal with 200 milliwatts power passes through 10 devices, each with an average noise of 2 microwatts. What is the SNR_{dB}?

********** End of Paper **********

DEPARTMENT OF INFORMATION TECHNOLOGY

NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Major Examination

Course: Data Communication | **Course code: ITT 305**
Branch: Information Technology | **Semester: 5th**
Maximum marks: 60 | **Duration: 3 hours**
Date: 28 November 2022

Please be specific in your answers. Attempt any four questions.

Q1. Data and Signal basics. (CO3) **(15)**

A. A telecom company has two antennas of equal height. They need to establish LOS communication using those. The maximum distance achieved between two antennas is 500 m, what is the height of the antenna? (4)

B. We measure the performance of a telephone line (4 KHz of bandwidth). When the signal is 10 V, the noise is 5 mV. What is the maximum data rate supported by this telephone line? (4)

C. If the peak voltage value of a signal is 20 times the peak voltage value of the noise, what is the SNR and the SNR_{dB} of the signal (4)

D. Suggest the transport layer protocol to be used for a financial application? Give a reason for our answer. (2)

Q2. Digital Transmission. (CO1, CO2, CO4, CO5) **(15)**

A. Suggest the **best-suited** line encoding scheme for the following and give a reason for the same. (4)

a. LAN with fiber optic backend

b. WAN covering the entire country

B. Pulse Code Modulation (PCM). (2+2+1)

a. Given a composite analog signal as follows:
$s(t) = \sin 2\pi ft + 1/3 \sin 6\pi ft + 1/6 \cos 4\pi ft$. Find the frequency at which the signal should be sampled to avoid aliasing.

b. Given that signal $s(t)$ has power 10 mW and contains noise of power $1\mu W$, find the number of quantization levels required for such a signal.

c. Given $f = 2\ kHz$ for signal $s(t)$, find its bit rate.

C. Given a data stream 110000000010. Encode it using Differential Manchester. (3,

D. A system uses NRZ-I to transfer 10 kbps data. What are the average signal rate, minimum bandwidth and minimum SNR_{dB}? (3)

Q3. Analog Transmission. (CO1, CO2, CO4, CO5) **(15)**

A. Given a system using 4-level multiple ASK. Give the resultant analog signal if the data is 11011001. (4)

B. Name the resulting process when a signal is fed to a voltage-controlled oscillator (VCO) and the signal is (3)

a. An analog signal

b. Time-derivative of analog signal

c. Unipolar NRZ signal

C. Given an analog signal with bit rate of 16 kbps and a baud rate of 2 kbaud, how many signal elements do we need for analog transmission? (2)

D. Given a data stream 001011, give the resulting analog signal if the following techniques are used (2*3)

a. BPSK (Binary Phase Shift Keying)

b. DPSK (Differential Phase Shift Keying)

Also plot the constellation diagrams of the two techniques.

Q4. Bandwidth utilization techniques. (CO1, CO5) **(15)**

A. Four channels, two with a bit rate of 200 kbps and two with a bit rate of 150 kbps, are to be multiplexed using multiple slot TDM with no synchronization bits. Answer the following questions: (4)

a. What is the size of the output frame in bits?

b. What is the frame rate?

c. What is the duration of frame?

d. What is the output data rate?

B. Show the contents of the output frames for a statistical TDM multiplexer. The multiplexer combines four sources transmitting data at specific data rates and sending following characters and the characters are sent in the same order as they are typed. (4)

a. Source 1 (20 Kbps): HE

b. Source 2 (10 Kbps): IS

c. Source 3 (10 Kbps): THE

d. Source 4 (10 Kbps): KINGG

C. A device needs to send 010 using DSSS with Barker sequence (10110111000), encode the resulting signal after spreading process using AMI line coding scheme. (3)

D. Given three stations using a channel with 600 kHz bandwidth and frequencies ranging from 100 to 700 kHz, show the bandwidth sharing using frequency-time plots in case of FDM and FHSS. (4)

Q5. Error control. (CO3, CO5) **(15)**

A. A sender has two data items to send: $(2456)_8$ and $(3321)_8$. What is the value of the checksum? (3)

B. Using 7-bit Hamming code, receiver received a codeword of 1101101, assume even parity and identify whether the codeword is corrupted or not. If Yes, correct it and give the error location. (4)

C. Message received by a receiver is $x^7 + x^5 + x^4 + x^2$. Using $x^3 + 1$ as the generator polynomial. Check if the message is error-free. If Yes, then extract the resulting dataword and if No, then give the reason for the same. Can the given generator detect all odd numbers of errors? Give a reason. (5)

D. An error-correcting code has the following codewords: 0000, 0111, 1011,1010. How many errors are guaranteed to be detected and corrected? (3)

End of paper

NIT NATIONAL INSTITUTE OF TECHNOLOGY
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DEPARTMENT OF INFORMATION TECHNOLOGY
Midterm Examination

Course: Computer Organization and Architecture
Semester: 5th
Date: 27/09/22

Time: 90 Minutes
Max. Marks: 30
Code: ITT 303

Instructions:

- Attempt all questions.
- All questions carry equal marks.
- If you need to make any assumptions, state them clearly.
- Unnecessarily lengthy solutions will be penalized.
- Results/proofs covered in various sessions/assignments may simply be cited, unless specifically asked for.

Course Outcomes:

CO1: Understand the basics of computer architecture and how it interacts with the software. Understand how computers represent and manipulate data. Understand computer arithmetic.

CO2: Understand the basics of instruction set architecture (ISA).

CO3: Understand how to assemble a simple computer with hardware design including instruction format, instruction set, memory, arithmetic and logical unit, control unit and data.

CO4: Understand the basis of the computer pipeline. Learn the different kinds of techniques to reduce the various kinds of hazards in the computer pipeline.

CO5: Understand the basics of the memory hierarchy in high-performance computers and the numerous techniques to improve the efficiency of the memory system.

Start of Paper

Problem 1. Data Representation, Combinational Circuit Design (CO1). [10]

Part 1A) Most of the time, a carry does not propagate till the end. In such cases, the correct output isavailable much before the worst case delay. Modify a ripple carry adder to consider such cases and set an output line to high as soon as the correct output is available.

Part 1B) Let us define sign contraction to be the reverse of sign extension. What are the rules for converting a 32-bit number to a 16-bit number by using sign contraction? Can we do this conversion all the time without losing information?

Problem 2. Instruction Set Architecture (CO2). [10]

Consider a hypothetical machine called SIC, for Single Instruction Computer. As its name implies, SIC has only one instruction: subtract and branch if negative, or sbn for short. The sbn instruction has three operands, each consisting of the address of a word in memory:

sbn a, b, c, #Mem[a] = Mem[a] – Mem[b]; if (Mem[a] < 0) go to c

The instruction will subtract the number in memory location b from the number in location a and place the result back in a, overwriting the previous value. If the result is greater than or equal to 0, the computer will take its instruction just after the current instruction. If the result is less than 0, the next instruction is taken from memory location c. SIC has no registers and no instructions other than sbn.

(a) Identify what the following does:

```
start: sbn temp, temp, .+1
       sbn temp, a, .+1
       sbn b, b, .+1
       sbn b, temp, .+1
```

In the above program .+1 means "the address after this one."

(b) Write a SIC program to add a and b, leaving the result in a and leaving b unmodified.

Problem 3. Processor Design (CO3). [10]

Design a (very) simple CPU for an instruction set that contains only the following four instructions: lw (load word), sw (store word), add, and jump (unconditional

branch). Assume that the instruction formats are similar to the RISC V architecture. If you assume a different format, state the instruction formats. Show all the components, all the links, and all the control signals in the datapath. You must show only the minimal hardware required to implement these four instructions. For each instruction show the steps involved and the values of the control signals for a single cycle implementation.

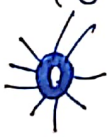
End of Paper

But the disadvantage

2. If the most significant

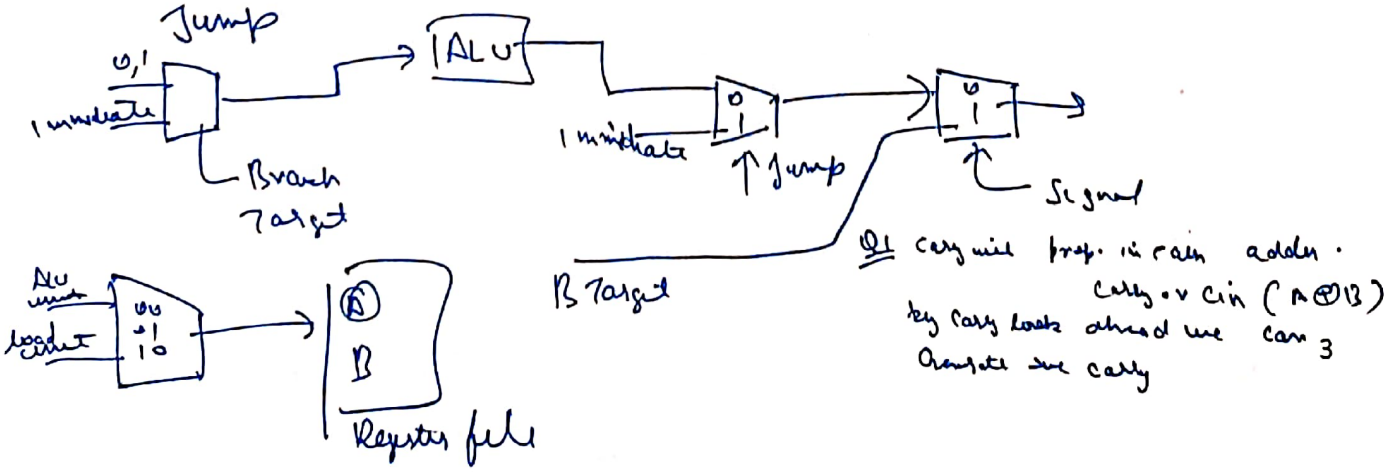
1111111000 00000 → Contains

0101101 1010111 → not applicable



Q3

lw (load word)
sw (store word)
add
Jump



Q1 carry will propagate in ripple adder.
Carry = Cin (A⊕B)
by carry looks ahead we can 3
compute the carry