Dhirubhai Ambani Institute of Information & Communication Technology
Final Examination, Semester I 2018-19

Course Title	IT304 Computer Networks		**Max Marks**	35%
Date	28 November 2018	**CLOSED BOOK**	**Time**	2 Hours

Questions are worth 5 marks each.

1. What is the purpose of the flow ID field in IPv6 header? Explain how tunneling is used to allow incremental deployment of IPv6 and co-existence of IPv4 and IPv6?

2. A token bucket controller for bursty traffic can be designed by using different [A,B] values where A is the token generation rate and B is the token bucket size. An bursty source has a peak rate of 200 KB/sec, long term average of 100 KB per second and burst size of 500 KB.

   Compute the maximum delay suffered by packets for the values of A=100 KB/sec, A=150 KB/sec and A=200 KB/sec. What are the respective values of B so that there are no packet losses?

3. Briefly describe the operation of slotted ALOHA. For a system with N active nodes, find the relation between p and N that maximizes the system throughput.

4. In the context of IEEE 802.3 (Ethernet) LAN protocol, answer the following:
   a. Briefly describe the functioning of CSMA/CD protocol.
   b. In terms of the relevant LAN parameters (length L, packet size B, link capacity C etc.) derive an expression for the maximum time T_{ct} during which collision may take place.
   c. Explain the need of exponential back-off mechanism in 1-presistent CSMA/CD.

5. Clearly describe a reverse-path-forwarding based multicast protocol that is suitable for dense multicasting. Your answer should contain the following details:
   a. Multicast group creation
   b. Reverse Path Forwarding
   c. Multicast Tree management

6. Briefly describe the Token-ring protocol. Derive the expression for efficiency of the protocol as a function of active nodes N in terms of relevant MAC parameters (Lengh L, pkt size B, propagation speed V, capacity C, Token size b etc.)

7. Describe the functioning of a switched hub in a LAN and its impact on the system goodput. Explain the additional capabilities present in a port-based L3 switch and how it functions.

Dhirubhai Ambani Institute of Information & Communication Technology
Mid Semester Test-1, 1st Semester 2018- 19

Course Title	IT304 Computer Networks		**Max Marks**	20
Date	1 September 2018	**CLOSED BOOK**	**Time**	1 Hour

In protocol design problems,

- Give a brief description of how your protocol functions.
- Provide the details of the message structure, message sequence, timer functions (if needed), and other actions performed by the nodes.
- Give brief justification for each component of your design.

1. Write the pseudocode for a TCP client and server application where client sends a single "*whoami*" message to the server and the server responds with the message containing the "*IP address*" of the client. Your pseudocode should contain (a) the calls needed for establishing a connected socket, and (a) the logic for extracting the client IP address on the server side. You don't need to give the exact syntax of the library calls; however you should be aware of the arguments of the calls being used. [5]

2. Discuss the pros and cons of layered architecture. Be brief and precise. List the services offered by layers of Internet protocol stack. In particular, discuss the design choices made for the services that are offered in the Transport layer. [1+2+2]

3. In the context of the DNS protocol,
   a. Draw the DNS hierarchy, and list the DNS *messages* sent and received and *records* processed in obtaining the IP address corresponding to `server1.google.com`. Assume that the local resolving name-server is `ns1.daiict.ac.in` and all DNS servers performed iterated queries.
   b. Heavily loaded application servers are frequently replicated across multiple networks and machines. In these cases, all these replicated servers have different IP addresses but are mapped to same domain name entry. For example, www.google.com is mapped to a number of physically separated machines across networks. How can DNS be used to *balance load* and improve fault-tolerance on such replicated servers? [3+2]

4. An ack-based link protocol (waiting for ack before sending next packet) uses a timer to abort ack_wait function after the timeout period T and retransmits the same packet. This process continues till the packet is successfully transmitted before moving to a new packet.
   a. How would you define the efficiency of such a protocol.
   b. 10 packets are sent on a channel. Each packet takes 10ms to transmit. Acks take exactly 100ms to arrive after the transmission. Two of the ten packets got corrupted the first time they were sent (these needed to be retransmitted once). No other packets suffered corruption. Compute the efficiency of the protocol in each case when timeout value T is set to (i) 150ms, (ii) 120ms, and (iii) 80ms. [2+3]

Dhirubhai Ambani Institute of Information & Communication Technology
Mid Semester Test-2, 1st Semester 2018- 19

Course Title	IT304 Computer Networks	**Max Marks**	25
Date	16 October 2018 **CLOSED BOOK**	**Time**	90 min

1. Using clear examples, briefly explain the working of DHCP, NAT, and CIDR. Describe how these protocols help in more efficient use of the Internet address space. [5]

2. A router is said to be congested if its buffer and packet forwarding resources are inadequate to handle incoming flows for a sustained period. TCP has the mechanism to manage congestion. In this context,
   a. What is the effect of congestion on the TCP and UDP flows passing through the congested router?
   b. What is the effect of congestion on the two TCP flows with unequal round trip times passing through the congested router.
   c. How is TCP protocol ack-timeout calculated? Give justification.
   d. Briefly describe the connection establishment and termination mechanisms in TCP. Explain the rationale for using such a mechanism and the role of the initial sequence number.

   [4*2]

3. Draw the sort network, shuffle-exchange network, and the Banyan network for a 8x8 Batcher-Banyan switch. What additional modules/functionalities are needed to make this switch perform as an Internet router? [5]

4. Compute the average throughput of a TCP connection if the packet loss probability is p and the round trip time is T (constant). What would be the effect on throughput if the round trip time is not a constant but varies between $T - \Delta$ to $T + \Delta$. ($\Delta << T$) [4]

5. Estimating the correct buffer size is important as an overestimate makes the router unnecessarily costly and underestimate leads to frequent buffer overflow and packet loss. Assuming that the traffic is predominantly TCP, derive an expression for the *buffer size* as a function of relevant router and flow parameters. [3]

Registration Nos 201601128

READ THE INSTRUCTIONS CAREFULLY

DA-IICT, Gandhinagar
EL2xx: Embedded Hardware Design
Aug 31, 2018 (Friday)
Exam: Insem1
Duration: 60 minutes (Time: 1100hrs-1200hrs)
Total Marks: 50

Keep the rough workings along side your solution.
No Calculators allowed.
No extra sheet provided.

1. Show how a demultiplexer could be used to allow a microcontroller to control eight LEDs from three digital outputs. **(8 marks)**

2. Implement the function

$$f = \sum_{ABC}(1,3,4,7)$$

using a 4-1 line multiplexer and a NOT gate, and
using a 3-1 line decoder and an OR gate.
Describe the commonality between the two implementations. **(10 marks)**

3. Design a combinational logic circuit which subtracts 1 from the input. Given a 3-bit binary input ABC_2, design a circuit which provides a 3-bit binary output DEF_2. Where

$DEF_2 = ABC_2 - 1$ if $ABC_2 > 0$
$= 0$ if $ABC_2 = 0$ **(12 marks)**

4. Apply Quine McCluskey method on the following expression:

$$X = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}D + ABCD$$

And write the reduced solution.

(20 marks)

-END OF PAPER-

Registration Nos .....

DA-IICT, Gandhinagar
EL203: Embedded Hardware Design
Oct 15, 2018 (Monday)...Exam: Insem2
Duration: 60 minutes (Time: 1630hrs-1730hrs)
Total Marks: 50

No Calculators allowed.

1. Design a combinational network that finds the largest and the second largest of four nonnegative integers A, B, C, D. Each integer is represented by four bits. You may use one of the following module types: 4x2 input muxes and 4 bit comparators. The two bit output of the comparator is z = (z_1, z_0). If the first integer is larger than the second, the output is z= 10. If the second number is larger, the output is z=01 and if the numbers are equal, the output is z=00. Indicate all the inputs and connections and the modules being used.

[15 marks]

2. a. Complete the following table. If there is a problem completing the table, explain. All implicit and explicit values are given in the decimal number system. [6 marks]

Number System	Number of digits n	Signed integer x	Representation value x_R	Digit vector X
2's complement	7	-39		
1's complement	8		167	
2's complement				100100100
2's complement	6	-43		

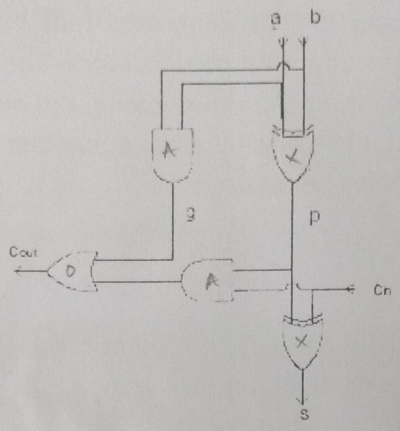
b. Compute $z=a+2b-c$ in 2's complement for $a=-7$, $b=12$, and $c=-97$. Perform calculations on bits representing a, b, and c and show every step of your work. How many bits should z have to represent the correct result? Check your work by showing, for each step, the corresponding values in decimal number system. [4 marks]

3. Design a 4-bit by 2-bit multiplier module. The operands are positive: the multiplicand X=(x_3, x_2, x_1, x_0), the multiplier Y= (y_1, y_0) and the product p = (p_5, p_4, p_3, p_2, p_1, p_0). You are allowed to use AND gates, full adders (FA) and half adders (HA) **only**.

[15 marks]

Registration Nos .....

4. Calculate the worst case delay of a Ripple carry adder consisting of the full adder blocks shown below. You can use t_p for the AND and OR functions and $2t_p$ for the XOR gates. Express your answer in terms of t_p.



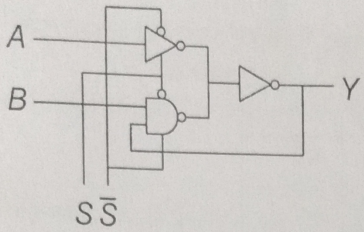
Repeat the same calculations for 32-bit adders. [10 marks]

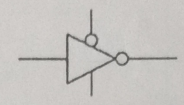
-END OF PAPER-

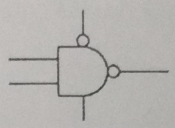
Registration Nos .....

EL203: Embedded Hardware Design
DA-IICT, Gandhinagar
Nov 30, 2018 (Friday)...Exam: Final
Duration: 120 minutes (Time: 1430hrs-1630hrs) Total Marks: 100

1. Identify the following circuits: [5 marks]







2. a. Provide a state diagram and state output table of the Mealy machine which implements the following behavior:

$$z(t) = \begin{cases} x'(t) & if\ x(t) = 0\ and\ x(k) = 0\ for\ all\ k < t \\ 0 & if\ x(t) = 1\ and\ x(k) = 0\ for\ all\ k < t \\ x(t) & otherwise \end{cases}$$

[10 marks]

b. Illustrate the time behavior for the input sequence shown below. [10 marks]

Assume $x(k) = 0\ for\ k < 0$

t	0	1	2	3	4	5	6
x(t)	0	0	1	0	1	1	0
z(t)							

3.

a. A modulo 6, synchronous binary counter cycles through the states 000_2 to 101_2 and then repeats the sequence. Design a synchronous sequential circuit that implements the counter, using D-type flip-flops and logic gates. [12 marks]

b. Show how the counter you designed can be used to write incoming synchronous data into a RAM device. Assume the RAM has 3 bits of address and is 1 byte per address. A clock signal on the input shows valid data on the rising edge. Your RAM should store the last 6 bytes of the data. [8 marks]

Registration Nos .....

4. Find an equivalent finite state machine with a minimum number of states. Show all the steps while reaching to the minimal state table. Design the circuit using appropriate combinational and sequential elements.

[20 marks]

PS	x=0	x=1
A	E,0	C,0
B	C,0	A,0
C	B,0	G,0
D	G,0	A,0
E	F,1	B,0
F	E,0	D,0
G	D,0	G,0

5. A synchronous counter has the following counting sequence

0→ 1→ 3 → 2 → 6 → 7 → 5 → 4→ 0

The outputs are interpreted as binary integers.

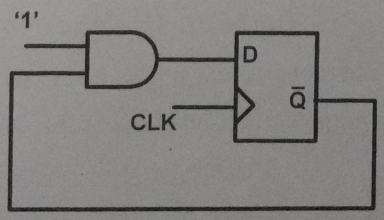
a. Produce the next state equations such that the counter is hazard-free. [6 marks]

b. Using positive-edge D-type bistables and only 2-input NAND gates, sketch the circuit diagram of the above counter. [4 marks]

c. Given that, a D-type bistable has T_{PHL}= *12 ns*, T_{PLH}= *10 ns*, T_{SU} = *2 ns*, and a 2-input NAND gate has propagation delay of *4 ns*, estimate the maximum clock frequency at which the above counter could operate. [6 marks]

d. Describe one way by which the counter could be initialized to count from a specified count value. [4 marks]

6. The following circuit aims to provide an output **Q** whose frequency is *15MHz* when the clock (CLK) frequency is *30 MHz*.



For a D-type bistable, T_{SU} = *10 ns*, T_H = *2 ns*, and T_{PHL} = T_{PLH} = *13 ns*. For the AND gate T_{PHL} = T_{PLH} = *12 ns*. Explain what happens in the clock cycle immediately following a rising edge. Will the circuit satisfy its aims? [15 marks]

-END OF PAPER-

Autumn Semester Roll No._____

Academic Year 2018-19

Computational and Numerical Methods (SC374)

First In-Semester Examination

Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar

Time: 1 Hour 45 Minutes Total Marks: 20

All questions are compulsory. Answer all the sub-parts of a question together. Marks for each question are indicated next to it. All terms and symbols carry their standard textbook meaning.

1. Prove that if $f(x) = 0$ is an n-degree polynomial equation with real coefficients, then it can have only n number of roots. **[2]**

2. Find the root of $f(x) = xe^x - 1 = 0$ by the secant method. Present your numerical steps clearly in a table, and provide the root correct up to 5 places of decimal. **[2]**

3. Plot $y = f(x) = (1 - x)/(1 + x)$ for all x. Provide various details like the quadrants in which $f(x)$ lies, its turning points (if any), the asymptotic behaviour of $f(x)$, etc. In the plot precisely indicate the coordinates where $f(x)$ shows important features. **[2.5]**

4. Produce the third-degree Taylor polynomial for $f(x) = \ln(1 + x)$ using $a = 0$ as the point of approximation. Plot this Taylor polynomial along with $f(x)$ within $-1 \leq x \leq 1$. **[2.5]**

5. Find the root of $f(x) = x^3 - \exp(-x^2) = 0$ by the bisection method. Apply an error tolerance of $\epsilon = 0.0010$ and provide the root correct up to 4 places of decimal. Present your numerical steps clearly in a table with full details. **[2.5]**

6. Find the non-zero root of $f(x) = x^2 - \sin x = 0$ by the Newton-Raphson method. Present your numerical steps clearly in a table, and provide the root correct up to 4 places of decimal. **[2.5]**

7. Find the roots of $x^3 + 21x + 342 = 0$ by Cardan's method. **[2.5]**

8. Find the roots of $x^4 - 10x^2 - 20x - 16 = 0$ by the Descartes method. **[3.5]**

Roll No._____

Autumn Semester

Academic Year 2018-19

Computational and Numerical Methods (SC374)

Second In-Semester Examination

Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar

Time: 2 Hours

Total Marks: 25

All questions are compulsory. Answer all the sub-parts of a question together. Marks for each question are indicated next to it. All terms and symbols carry their standard textbook meaning.

1. Given the points $x_0 = 0$, $x_1 = 1$ and $x_2 = 4$, obtain $f(x) = \sqrt{x}$ at every point. Using $(x_i, f(x_i))$, produce Newton's divided-difference interpolation polynomial of the quadratic order. **[3]**

2. Given $f(x) = x^2 e^{-x}$, find $S_n(f)$ for $n = 2$ and $n = 4$ over the interval $0 \leq x \leq 1$. **[3]**

3. Given $f(x) = \ln(1 + x)$,
   (a) Calculate the exact integral of $f(x)$ over the interval $0 \leq x \leq 1$.
   (b) Estimate $T_n(f)$ over the same interval for $n = 2$ and find the percentage error. **[1+2=3]**

4. For three data points $(0, 1)$, $(1, 2)$ and $(4, 2)$,
   (a) Perform a linear Lagrange interpolation at $x = 0.5$.
   (b) Find the quadratic Lagrange interpolation polynomial. Interpolate at $x = 2$. **[1.5+2.5=4]**

5. Interpolate $(1, -1)$, $(2, 3)$ and $(3, 15)$ with natural cubic spline functions. **[4]**

6. Evaluate the numerical derivative of $f(x) = e^{-x}$ by using both the forward difference and the central difference formulae, at $x = 1$ with $h = 1/16$. Provide your results correct up to five places of decimal, and evaluate the error in both the cases. **[4]**

7. Evaluate the following by Gaussian quadrature using the approximation with two nodes.

$$\int_1^2 (x^3 + 3x^2 + 2x + 1)\, dx$$

Also estimate the percentage error with respect to the exact integral. **[4]**

Autumn Semester Roll No. 201601129

Academic Year 2018-19

Computational and Numerical Methods (SC374)

End-Semester Examination

Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar

Time: 2 Hours 30 Minutes Total Marks: 25

All questions are compulsory. Answer all the sub-parts of a question together. Marks for each question are indicated next to it. All terms and symbols carry their standard textbook meaning.

1. Find the discriminant of $u_{xx} + 2u_{xy} + u_{yy} = 0$, and classify the partial differential equation. **[1]**

2. Convert the second-order equation $Y'' + 3Y' = 10\sin(x)$, $Y(0) = Y'(0) = 0$, to a system of first-order equations. **[1]**

3. Solve the following system by using an augmented matrix: **[3]**

$$\begin{aligned} 4x_1 - x_2 - x_3 &= 1 \\ -x_1 + 2x_2 - x_3 &= 1 \\ -2x_1 - 2x_2 + 13x_3 &= 2 \end{aligned}$$

4. Given $Y'(x) = Y(1 + e^{2x})$, $Y(0) = 1$, estimate $Y(0.5)$ with $h = 0.25$ by Heun's method. Clearly write the Heun formula that is relevant to this initial-value problem, and provide your result correct to 4 places of decimal. **[3]**

5. Given $Y'(x) = -Y + \sin(4\pi x)$, $Y(0) = 0.5$, integrate by the second-order Taylor method up to $n = 2$, with $h = 0.1$. Provide your result correct to 4 places of decimal. **[3]**

6. Consider the following system of nonlinear equations:

$$y\cos(xy) + 1 = 0\,, \qquad \sin(xy) + x - y = 0$$

Using initial guess values $(x_0, y_0) = (1, 2)$ estimate (x_1, y_1) by the Newton method. Provide your result correct to 3 places of decimal. **[4]**

7. Find the inverse of

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 3 & 3 & 4 \end{bmatrix}$$

by performing Gaussian elimination on an augmented matrix. **[5]**

8. Consider the initial-value problem $Y'(x) = 1 - 2Y$, $Y(0) = 2$. For $h = 0.1$ and $n = 3$,
A. Integrate by Euler's method. B. Integrate by the backward Euler method.
Provide your results correct to 3 places of decimal. **[2+3=5]**

0.3953