Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Final Examination | **Fall 2021** | **3rd Year 2nd Semester**

Course Code: CSE 315 | **Course Title: Peripheral and Interfacing** | **Credits: 3**

Full Marks: 150 | **Duration: 3 Hours**

Instructions:

1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. a. Suppose you are working for Leads Corporation as an IoT engineer. Now, the project manager has assigned you to a project where you will have to measure the distance between A and B of their office, show it through Serial Communication. Please write the code for the above scenario with Arduino circuit design. **[25]**

OR

a. Design a reverse counter using Figure 1-A. The counter will count from 1000 to 0 automatically in the decreasing order.
As an instance- 1000, 999, 998, 997, …, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0. **[25]**

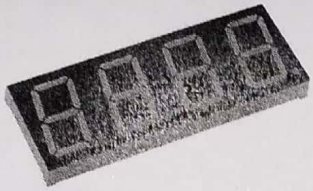
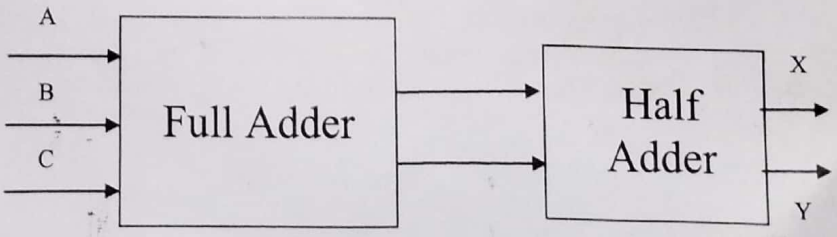


Figure 1-A: A Four-digit seven segment display

2. a. Take last three digits of your registration number and take the last bits of each number. Like, if your ID is 1720789 then last three digits are 7, 8, and 9 convert each number to its corresponding binaries and take last bits of each [7=0111, 8=1000, 9=1001] here, the last three bits are **1,0,1.** Now input the bits through A, B, C of the circuit and determine the output on X, Y.
Write the code for the above scenario with Arduino circuit design. **[25]**



OR

a. Design a Full adder and subtractor which will contain selector, and we will be able to select the operation through switch S. [S could be 0 or 1] If we input **0** it will perform Addition operation and if we input **1** it will perform Subtraction operation. **[25]**

3. a. Write the differences between scanner and camera. Discuss the anatomy of Flatbed scanner with proper operational description and diagram. **[05+20]**

4. a. What is the term IoT means? Explain the domains of IoT application given by Atrozi et al. Please provide some examples. **[25]**

5. a. How Edge Computing illustrate our vision of edge computing in Smart City and Smart Home? Explain your answer with logical explanation and/or with diagrams. **[25]**

6. a. Suppose, ABCD is a square in the Figure below. Here, you have a sensor at the center **O**, of the circle in ABCD. Now, you have to measure the Area of the square through Arduino Sketch. Please explain the calculation procedure of that sensor briefly. **[25]**
[Note: Area of a circle is measured by the formula πr^2. The figure is drawn to scale.]

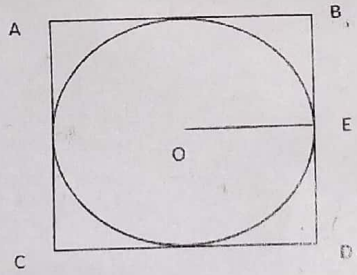


Figure: ABCD is a Square

Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Final Examination **Fall 2021** **3rd Year 2nd Semester**

Course Code: CSE 313 **Course Title: Numerical Methods** **Credits: 3**

Full Marks: 150 **Duration: 3 Hours**

Instructions:

1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

2.3482, 0.9762, −0.7796

1. (a) The relative approximate error at the end of an iteration to find the root of an equation is 0.004%. What is the least number of significant digits we can trust in the solution? Explain theoretically. [7]

(b) Using $[a, b, c] = [1,3,5]$ as the initial guess, find the values of $[a, b, c]$ after three iterations in the Gauss-Seidel method for $\begin{bmatrix} 12 & 6 & 5 \\ 2 & 5 & 3 \\ 2 & 8 & -11 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 2 \\ -5 \\ 6 \end{bmatrix}$ [18]

OR

a. The coefficient matrix A is given with an initial guess of $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$. Will the solution converge using the Gauss-Seidel method? Explain, how? [7]

b. Find the lower triangular matrix $[L]$ in the $[L][U]$ decomposition of the matrix given below [18]

$$\begin{bmatrix} 25 & 5 & 4 \\ 10 & 8 & 16 \\ 8 & 12 & 22 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix} \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}$$

2. (a) Write the algorithm of Bisection method step-by-step. [10]

b. The velocity of a body is given by $v(t) = 3t$ (when $1 \le t \le 7$) and $v(t) = 4t^2 + 5$ (when $7 \le t \le 21$), where t is given in seconds, and v is given in m/s. Find the distance covered by the body from $t = 3$ to $t = 12$ seconds by using two-segment trapezoidal rule. [15]

OR

a. Write the advantages and disadvantages of the Newton-Raphson method. [10]

b. Find the value of $\int_3^{19} f(x)dx$ by using two-point Gauss quadrature rule. [15]
Assume that the weighting factors and function argument values for the two point rule are: c1 = 1.000000000, x1 = − 0.577350269, c2 = 1.000000000, x2 = 0.577350269.

2nd
(3.4167, −4.4, 1.8182)

3. a. How will you achieve the best-fit $y = f(x)$ regression model to the given n data points? [5]

b. An instructor gives the same y vs. x data as given below to four students and asks them to regress the data with least squares regression to $y = a_0 + a_1 x$. [20]

x	1	15	22	31	42
y	1	98	350	570	960

They each come up with four different answers for the straight-line regression model among which only one is correct. Find the correct linear regression model.

4. a. Assuming an initial bracket of [0, 0.11], find the third (at the end of 3 iterations) iterative value of the root of $x^3 - 0.165x^2 + 3.993 \times 10^{-4} = 0$ using the bisection method. [15]

b. Find the absolute relative approximate error at the end of each iteration of the question 4(a), and the number of significant digits at least correct at the end of each iteration. [10]

5. a. Which numerical method will you choose to solve interpolation and why? [5]

b. The following data of the velocity of a body is given as a function of time. [20]

Time (s)	10	15	18	22	24
Velocity (m/s)	18	21	38	45	123

Find the velocity at t=19 seconds using the Lagrangian method for cubic interpolation.

6. a. Given $3\frac{dy}{dx} + 5y^2 = \sin x$, $y(0.3) = 5$ and using a step size of h = 0.3, find the most nearly value of y(0.9) using Euler's method. [Note: please do not forget to use radian while calculating sin x] [20]

b. How will you guarantee that the Gauss-Seidel method will converge for sure? [5]

$\theta_{i+1} = \theta_i + f(t_i, \theta_i) \times h$ $\quad t = t_1 = t_0 + h$

0.7071

0.9709

$30 - \frac{22}{1}\frac{22}{30}$

$20 - \frac{22 \times 20}{30}$

19.66

11.33

$\frac{b_i}{0.0577}$

0.04275

0.0686

33.3330

20.26230

$-3.4167, -4.4, 1.8182$

$1.6091, -0.7242, -4.3667$

$2.3482, 0.9762, -0.7796$

Department of Computer Science & Engineering
University of Asia Pacific (UAP)
Program: B.Sc. in Computer Science and Engineering

Final Examination	Fall 2021	3rd Year 2nd Semester
Course Code: CSE 319	Course Title: Computer Networks	Credits: 3.0
Full Marks: 150		Duration: 3:00 Hours

Instructions:

1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. a) Suppose a process in Host C has a UDP socket with port number 6789. Both Host A and Host B each send a UDP segment to Host C with destination port number 6789. Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts? Explain. 8

   b) Is it possible for an application to enjoy reliable data transfer even when the application runs over UDP? If so, how? Justify your answer. 7

   c) RDT 3.0 provides reliable data transmission between the sender and receiver. However, it cannot utilize the full channel capacity. Analyze how pipelining protocol will increase the channel performance. 10

OR

   a) Transmission Control Protocol (TCP) is a standard that defines how to establish and maintain a network conversation by which applications can exchange data. Assume that ***client A*** wants to provide the data reliability service to the application layer applications. However, client A must establish an end-to-end connection with the other party, i.e., the server. Moreover, it is also necessary to tear down the link when data sending is over by both parties. For the above scenario, develop the TCP connection establishment and connection closure procedure for *client A* and the server. 15

   b) UDP does not support data reliability services to lessen the communication overhead between sender and receiver. However, after receiving a successful UDP segment, a receiver needs to know the packet is intact. Develop an algorithm with an example to ensure that the received packet is error-free. 10

2. a) Apply the existing rules and convert the following IPv6 address to its most compressed format 2.5×4= 10

(i) ff00:0f0e:0000:3f00:0000:0000:0ef0:0000

(ii) 0001:0000:0000:0f08:0000:0000:0000:0000

(iii) ef08:0010:1000:0001:0f0f:0000:0000:0000

(iv) 0001:0000:0000:fe08:0000:0000:0000:000f

b) Consider the following network in Figure 1. The indicated link costs use Dijkstra's shortest-path algorithm to estimate the shortest path from ***O*** to all nodes. Use the following information to calculate the final cost of a particular link. 15

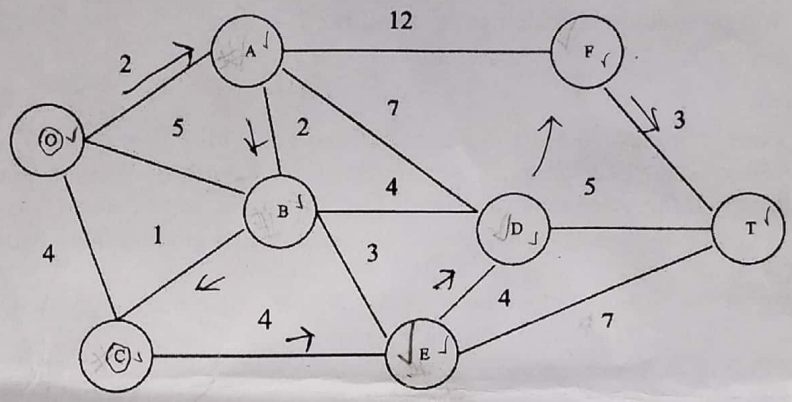


Figure 1: Core network topology

3. a) Let UAP wants to design its network as illustrated in Figure 2. As a network designer, you must complete the VLSM IP address calculation based on given IPV4 addresses. 15

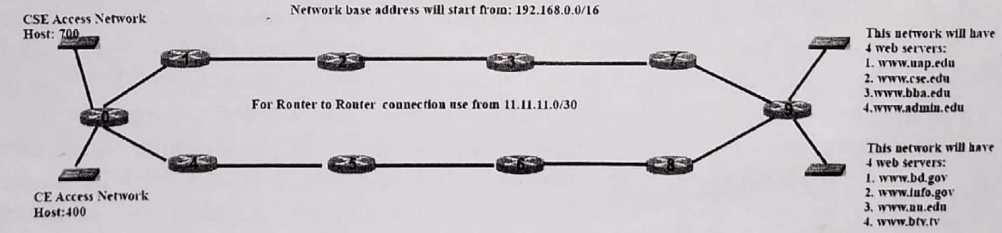


Figure 2: High-level design of UAP network

b) Compare and contrast link-state and distance-vector routing algorithms. 10

OR

a) Company D designs a network infrastructure with variable-length subnet masks (VLSM). The use of VLSM is a technique dividing an IP address space into a hierarchy of subnets of different sizes to reduce wasted IP addresses. 3×3=9

Company D uses a private IP address space 172.12.1.0/24 for its internal network. According to VLSM, Company D divides 172.12.1.0/24 into eight subnet masks 172.12.1.0/30, 172.12.1.4/30, 172.12.1.8/29, 172.12.1.16/28, 172.12.1.32/27, 172.12.1.64/27, 172.12.1.96/27, and 172.12.1.128/25.

Figure 3 shows the network configuration of Company D. Table 1 shows the IP address plan of the routers and PCs in the Admin Section. All departments of Company D need access to the Internet.

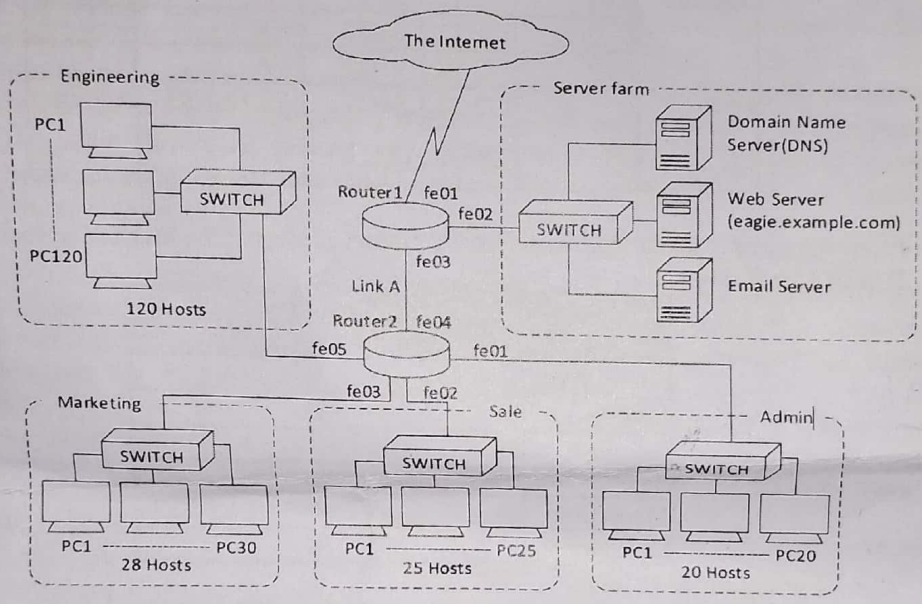


Figure 3: Network configuration of Company D

Table 1: IP address plan				
Device	Interface	IP address/mask	Gateway	Section
Router 1	fe01	202.20.120.95/30	N/A	
	fe02	172.12.1.9/29	N/A	
Router 2	fe01	172.12.1.33/27	N/A	
	fe02	172.12.1.65/27	N/A	
	fe03	172.12.1.97/27	N/A	
PC1 … PC20		172.12.1.34/27 … 172.12.1.53/27	172.12.1.33	Admin

From the answer group below, select the correct answer to be inserted in each blank **A, B, and C** in Table 2.

Table 2: Subnet addresses		
Section	Number of hosts	Subnet
Server farm	6	172.12.1.8/29
Link A	2	A
Admin	20	172.12.1.32/27
Sale	25	B
Marketing	28	172.12.1.96/27
Engineering	120	C

Answer group for A, B, and C

i) 172.12.1.0/30 ii) 172.12.1.8/29 iii) 172.12.1.16/28
iv) 172.12.1.32/27 v) 172.12.1.128/25 vi) 172.12.1.64/27

b) Suppose datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Assuming a 20-byte IP header, identify how many datagram's would be required to send an MP3 consisting of 10 Megabytes. 6

c) Network address translation (NAT) is a method of mapping an IP address space into another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device. The technique was initially used to avoid assigning a new address to every host when a network was moved, or when the upstream Internet service provider was replaced but could not route the network's address space. It has become a popular and essential tool in conserving global address space in the face of IPv4 address exhaustion. However, NAT has a traversal problem if a server resides in the private network. Formulate the solution mechanisms to solve the NAT traversal problems for the server in the private network. 10

$c = 5^7 \bmod 21$
$= 78125 \bmod 21$
$= 5$

$m = 5^3 \bmod 21$
$125 \bmod 21$

Cryptography is associated with the process of converting ordinary plain text into unintelligible text and vice-versa. It is a method of storing and transmitting data in a particular form so that only those for whom it is intended can read and process it. Cryptography not only protects data from theft or alteration but can also be used for user authentication.

Modern cryptography is concerned with:

Confidentiality - No one can understand information

Integrity - Information cannot be altered

Authentication - Sender and receiver can confirm each

Confidentiality, Integrity, and Authenticity (CIA) are the three most fundamental aspects of data communications. Cryptographic algorithms such as private key cryptography or public-key cryptography might solve the CIA issue. Moreover, we know that private key cryptography is much stronger and more efficient than public-key cryptography. However, private key cryptography faces challenges of secret key exchange between sender and receiver. As a data security expert, please complete the following issues.

a) RSA is well-known public-key cryptography that chooses big prime numbers and does mod operations. However, to illustrate the fundamental calculation, consider the following prime number sets **P** = **{3,5}**, and **Q={7,11}**. Now, calculate RSA, choosing ***p*** and ***q*** from the prime numbers set ***P*** and ***Q***, respectively. Using the prime number sets, identify all the necessary key pairs and encrypt the message ***m*** where ***m*** is your birthday (i.e., if January 14 is your birthday, you will encrypt 14) using the public key pair. Use the private key pair to get back message ***m*** from the ciphertext. 10

b) Formulate a cryptographic algorithm to solve the CIA issue where the sender and receiver reside in a different country. Make sure that your algorithm is free of man/woman-in-the-middle attacks. 15

5. Cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale. Cloud computing delivers on-demand computing services from applications to storage and processing power, typically over the internet and on a pay-as-you-go basis. Rather than owning computing infrastructure or data centers, companies can rent access to anything from applications to storage from a cloud service provider. One benefit of using cloud computing services is that firms can avoid the upfront cost and complexity of owning and maintaining their own IT infrastructure and instead pay for what they use when they use. In turn, providers of cloud computing services can benefit from significant economies of scale by delivering the same services to a wide range of customers. Cloud computing brings numerous possibilities for new startups.

$d = 7$
$e = 7$

$p, q, n = pq$
$\phi = (p-1)(q-1)$
public $= (n, e)$
private $= (n, d)$
encrypt $C = m^e \bmod n$
$m = c^d \bmod n$

$5^7 \bmod 21$
$= 78125 \bmod 21$
$= 5$

The Blockchain is an encrypted, distributed database that records data, or in other words, it is a digital ledger of any transactions and contracts that need to be independently recorded. One of the key features of Blockchain is that this digital ledger is accessible across several hundreds and thousands of computers and is not bound to be kept in a single place. Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible (a house, car, cash, and land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a Blockchain network, reducing risk and cutting costs for all involved.

a) There are various frictions in a business network, such as information friction, interaction friction, and innovation friction. For example, recently, Bangladeshi people have been overwhelmed by the price of soybean oil, and the authorities cannot trace the stocks of oils and its update in real-time. Therefore, propose a solution using distributed ledger technology, i.e., Blockchain, to achieve a friction-free business network where your proposal might solve the soybean oil issue. 15

b) Design a startup proposal for the above scenario and discuss your deployment mechanism with a detailed management plan that will be more efficient, environment-friendly, and cost-effective. 10

6. a) *Design a Finite State Machine (FSM) to satisfy the following requirements.* 5
   - It can handle bit errors.
   - It can identify packet losses.

b) IPv4 provides a maximum of 4.29 billion 32-bit addresses, which seemed like more than enough addresses when IPv4 became a standard in 1980. The number of IP addresses needed today far exceeds the world's population. First, IPv4 addresses are often allocated in groups, such as network addresses. Places such as companies, schools, homes, cafés, and airports are allocated network addresses for their users. As I go from my house to the café or college, I receive a different IP address to access each network. So, in most cases, I need a different IPv4 address wherever I go. But a much more significant reason we need so many more IP addresses is the number of devices per person connected to the Internet. Justify that IPV6 can solve the modern-day requirements for unique identification to connect to the Internet. 10

c) Choose and describe an alternative method for public key distribution other than Trusted Third Party (TTP). 5

d) Categorize the security aspects of cloud computing services. 5