20% 1. Identify the letter of the choice that best completes the statement or answers the question.

   (1) Most businesses use a standard, such as ______, that defines how data transmits across telephone lines or other means.
      a. PCS    b. EFT    c. XML    d. EDI

   (2) The degree of a relation is the number of ______ in the relation database.
      a. attributes  b. tuples  c. unions  d. attitudes

   (3) When a hashing algorithm produces an address for an insertion key and that address is already occupied, it is called a ______.
      a. collisions  b. buckets  c. synonyms  d. linked lists

   (4) In an inorder traversal, the root is processed ______.
      a. first  b. second  c. last  d. a or b

   (5) All the members of a record must be ______.
      a. integer type  b. different types  c. the same type  d. character type

   (6) Defining the users, needs, requirements, and methods is part of the ______ phase.
      a. design  b. analysis  c. implementation  d. testing

   (7) A process in the ready state goes to the running state when ______.
      a. it enters memory  b. it requests I/O  c. it gets access to the CPU  d. it finishes running

   (8) A ______ is a connecting device that acts as a protocol converter.
      a. repeater  b. bridge  c. router  d. gateway

   (9) If the memory address space is 16 MB and word size is 8 bits, then ______ bits are needed to access each word.
      a. 8  b. 16  c. 24  d. 32

   (10) According to the von Neumann model, ______ stored in memory.
      a. data and programs are  b. only data are  c. only programs are  d. non of the above

8% 2. Show the following numbers in 32-bit IEEE format.

   (1) $-2^6 \times 1.10001$

   (2) $+2^7 \times 1.11111$

   (3) $+2^4 \times 1.01110011$

   (4) $-2^5 \times 1.01101000$

9% 3. What are the three fundamental features of an object-oriented programming language?

12% 4. A multiprogramming operating system uses an apportioning scheme and divides the 60 MB of available memory into four partitions of 10 MB, 12 MB, 18 MB, and 20 MB. The first program to be run needs 17 MB and occupies the third partition. The second program needs 8 MB and occupies the first partition. The third program needs 10.5 MB and occupies the second partition. Finally, the fourth program needs 20 MB and occupies the fourth partition. What is the total memory used? What is the total memory wasted? What percentage of memory is wasted?

5% 5. Write a recursive algorithm by C++ pseudocode to find the greatest common divisor (gcd) of two integers using the following definition.

   \[
   \text{gcd}(x, y) = \begin{cases} 
   \text{gcd}(y, x) & \text{if } x < y \\
   x & \text{if } y = 0 \\
   \text{gcd}(y, x \mod y) & \text{otherwise} 
   \end{cases}
   \]
6% 6. What are some differences between a transport layer based on the TCP (Transmission Control Protocol) protocol and another based on the UDP (User Datagram Protocol) protocol in computer network?

12% 7. In the following graph, please find:
   (1) All nodes adjacent to Node A, Node F, and Node G.
   (2) The degree of vertices A, E, F, G, and H.
   (3) Give the depth-first traversal of the graph by ascending order as shown in follows, starting from vertex A.
   (4) Furthermore, give the adjacency matrix representation of the graph.

6% 8. What is Database? What is Database Management System (DBMS)? What is Database System?

10% 9. You have a relation STUDENT as shown in follows.

<table>
<thead>
<tr>
<th>SID</th>
<th>Name</th>
<th>Major</th>
<th>GradeLevel</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Jake</td>
<td>Computer</td>
<td>GR</td>
<td>21</td>
</tr>
<tr>
<td>150</td>
<td>David</td>
<td>History</td>
<td>SO</td>
<td>19</td>
</tr>
<tr>
<td>200</td>
<td>Jelly</td>
<td>Mathematics</td>
<td>GR</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>Linda</td>
<td>Computer</td>
<td>SN</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>Jelly</td>
<td>History</td>
<td>SN</td>
<td>41</td>
</tr>
<tr>
<td>350</td>
<td>Winnie</td>
<td>Mathematics</td>
<td>JR</td>
<td>20</td>
</tr>
<tr>
<td>400</td>
<td>Rye</td>
<td>History</td>
<td>FR</td>
<td>18</td>
</tr>
<tr>
<td>450</td>
<td>Amy</td>
<td>Computer</td>
<td>SN</td>
<td>24</td>
</tr>
</tbody>
</table>

Show the SQL statements if you need to obtain the following resulting relations:

(1) Jake 21

(2) Computer

History

Mathematics

12% 10. Which of the OSI layers is (are) involved in each of the following activities:
   (1) Sending a frame to the next station
   (2) Sending a packet from the source to the destination
   (3) Sending a long message from the source to the destination
   (4) Logging into a remote computer
   (5) Encrypting and decrypting data
   (6) Changing the data from the machine code to Unicode