2013-14
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
COMPUTER GRAPHICS
CO-404

Maximum Marks: 60
Credits: 05
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.                  Question                                  M.M.  

1(a). With the help of a diagram, explain the functioning of an interactive graphics system. Will a graphics package be considered to be a part of this system? If no, why? [06]

1(b). Why is programming with GLUT termed as event driven? Has it got anything to do with the GLUT API being a state machine? If yes, justify [06]

2. Derive the decision parameter \( p_k \) and the initial condition \( p_0 \) for the Bresenham’s line algorithm for lines with \( |m| < 1 \). Use the algorithm to find \( p_k \) and the corresponding intermediate pixel values, given endpoints (10,10) and (20,18). [12]

OR

2'(a). Explain the data structures used within the Scan-Line Polygon Fill algorithm. For the polygon given in Fig.1, what would be the edge table (ET) and the active edge list (AEL) entries for scan line S? [06]

![Fig.1](scan_line_S.png)
2(b) Explain antialiasing. Differentiate between pre-filtering and post-filtering antialiasing techniques.

3(a). Derive the composite matrix representation for general scaling by a factor $S_x$ and $S_y$ along any direction $u$ and $v$ about a fixed point $(x', y')$. Clearly indicate the matrices for individual transformations.

3(b). Derive the transformation matrix for reflection about a line $y = mx + b$ using the basic transformation functions.

4(a). Consider a view window, the contents of which are to be mapped onto a viewport as shown in Fig.2. Derive the viewing transformation matrix and use it to map the endpoints of the given line.

![View Window Diagram]

Fig.2

4(b). Derive the transformation matrix for oblique projection of a 3-D object onto the view plane. Can the same matrix be utilised to perform orthographic projection? If yes, how?

OR

4'(a). How are the viewing coordinates derived from world coordinates when generating a 2-D scene from a 3-D worldview? Clearly differentiate between view reference point and "look-at" point.

4'(b). Apply the Liang-Barsky line-clipping algorithm on the line shown in Fig.3. Calculate the parametric value $u$ at the intersections with the clipping window and use it to obtain the endpoint coordinate values of the clipped line.
5(a). Consider a flat polygon represented as $Ax + By + Cz + D = 0$ used to render a surface. Explain the procedure applied on the above representation in order to obtain the spatial orientation of the polygon face and to determine its outside face.

5(b). What is Lambert's Cosine Law? Explain how is it used to obtain the illumination model for diffuse reflection off a surface illuminated by a point light source. Does the optical property of the surface have an effect on diffuse reflection?

OR

5'(a). Write the general representation of a blending function for a Bézier curve and apply it to a curve having 5 control points. Calculate the values of the blending function at each control point and use it to obtain the parametric representation of the curve.

5'(b). Write the depth-buffer algorithm for visible surface detection. How is the coherence property exploited within the algorithm in order to successively calculate the value of $z$ (depth)?
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
DISTRIBUTED & PARALLEL SYSTEMS
CO-405

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. Question M.M.
1(a) What do you mean by parallel overhead? What are the reasons behind it? [03]
1(b) How are the efficiency and speed-up of a multiprocessor system calculated? Explain Amdahl’s law in this regard. [06]
1(c) Briefly describe about the Flynn’s classification scheme. [06]

OR

1’(c) What are the differences between parallel systems and distributed systems? [06]

2(a) What are the drawbacks of memory interleaving? [03]
2(b) Write an algorithm of odd-even transposition sorting on SIMD model. [06]
2(c) Give a comparative analysis of mesh network, tree network and pyramid network. [06]

OR

2’(c) Briefly discuss about the factors which are used to measure the performance of an interconnection network. [06]

3(a) How is the load imbalance factor of a multi-processor system calculated? [03]
3(b) Compare the working procedure of snoopy cache and directory scheme protocols. [06]
3(c) Discuss all the routing and scheduling techniques used in multi-processor systems? [06]

OR

3’(c) What is a vector computer? Give an example with full specification. [06]

4(a) What is the main difference between parallel algorithm and sequential algorithm? What do you mean by a cost optimal parallel algorithm? [03]
4(b) What is cloud computing? “Cloud computing is a high level grid computing.” Justify the statement. [06]
4(c) How is the BSP model used to overcome the drawbacks of PRAM model? [06]

OR

4’(c) Write an algorithm to calculate the prefix sum of an array on PRAM model. [06]
2013-14
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
SOFT COMPUTING
CO-444

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions. Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.
1(a) Draw the McCulloch-Pitts' network for the following expression: [03]
    \[ N_3(t) = N_1(t-1) \lor \neg(\neg N_2(t-3) \land N_2(t-2)) \]
1(b) Describe ADALINE and MADALINE networks with suitable diagrams. How it can solve non-linearly separable tasks (e.g. XOR problem), explain. [03]
1(c) Draw and give the mathematical expressions for different possible transfer functions used in Artificial Neural Network. [03]
1(d) Derive Back Propagation Learning Algorithm. [06]

OR

1(d') Explain different types of neural network learning methods, also show classification diagram. [06]

2(a) Define a fuzzy set A on universe of discourse (UoD), X when the UoD is [02]
    (i) Discrete and finite
    (ii) Continuous and infinite

2(b) (i) Let the fuzzy sets \( A = \frac{0.3}{x_1} + \frac{0.9}{x_2} + \frac{0.1}{x_3} \) and \( B = \frac{0.2}{y_1} + \frac{0.3}{y_2} + \frac{0.4}{y_3} \) be defined on universe of discourse \( X = \{x_1, x_2, x_3\} \) and \( Y = \{y_1, y_2, y_3\} \) respectively. Find \( R \) for the relation: "If \( x \) is \( A \) then \( y \) is \( B \)" i.e. \( R = (A \times B) \cup (\overline{A} \times Y) \). [08]
    (ii) Using fuzzy relation \( R \) computed in section (i), infer (compute) \( B' \) based on (a) max-min (b) max-product compositions given \( A' = \frac{0.7}{x_1} + \frac{1.0}{x_2} + \frac{0.3}{x_3} \).

2(c) Describe defuzzification techniques to derive crisp output from fuzzy input. [05]
3(a) Discuss the issues, benefits and use of Genetic Algorithms. [05]

3(b) Apply Genetic Algorithm for the objective function;

\[ z = f(x_1, x_2) = (x_1^2 + x_2 - 11) + (x_1 + x_2^2 - 7)^2 \]

as minimization problem, for at least one generation cycle. Assume random initialization, 4-bit binary representation, population size = 4, Roulette Wheel selection, 1 point crossover and bitwise mutation, take fitness function as: \[ f = \frac{1}{1 + z} \]

3(c) Explain Swarm Intelligence. List few engineering applications of swarm intelligence. [05]

OR

3'(a) Explain Rank Selection and Elitism in Genetic Algorithms. [05]

3'(b) Why Mutation is applied in Genetic Algorithms? [05]

3'(c) Write notes on the following:

(i) Ant Colony Optimization (ACO)
(ii) Simulated Annealing [05]

4(a) Briefly describe Hybrid Systems; also explain the classification in hybridization. [05]

4(b) Write the characteristics of the following:

(i) Neuro-Fuzzy Hybrids
(ii) Neuro-Genetic Hybrids
(iii) Fuzzy Genetic Hybrids [10]

OR

4(b') Explain any one of the following in detail with its implementation steps and representation scheme. Use diagrams/flow charts/graph for the support.

(i) Genetic Algorithm Based Backpropagation Networks
(ii) Evolutionary Fuzzy Inference Systems. [10]
1. Attempt any three:
   a) Illustrate and differentiate between hard real time and soft real time system.
      Give an example of each system. Which of the two systems is harder to design? Justify your answer.
   b) How an embedded system differs from other computing systems? What are the challenges in designing such systems?
   c) In what respect a real-time operating system differs from the conventional operating system.
   d) Explain the inheritance, generalization and specialization in the aspect of UML.

2(a) Differentiate between
    i. RISC and CISC architecture
    ii. Von-Neumann and Harvard architecture

2(b) Write an assembly code for PIC 16F877 to read 2 bit input from PORTA.
     If it is 01 then perform a bitwise OR on PORTB and PORTC and show the result on PORTD.
     If it is 10 then perform a bitwise AND on PORTB and PORTC and show the result on PORTD.
     If it is 11 then perform a bitwise XOR on PORTB and PORTC and show the result on PORTD.
     If it is 00 then toggle PORTD repeatedly with some delay.

     OR

2'(a) Explain the architecture of PIC 16F877. Describe its different components like
     (memory, I/O ports, timers, ADC, Interrupt control).

2'(b) What is the size of instruction set of PIC 16F877. Classify this instruction and give a brief description of any 10 instructions.
2(c) Explain Byte-oriented instructions with two suitable examples.

3(a) Draw a control data flow graph and write ARM7 assembly code for the following code segment.
   if (a+b > 0)
     x = 5;
   else
     x = 7;

   OR

3(a') Draw a control data flow graph and write ARM7 assembly code for the following code segment.
   a*b + 5*(c-d)

3(b) Describe the ARM architecture. Explain the Thumb instruction set of ARM.

3(c) Describe different Addressing modes in ARM7. Explain the following mnemonic.

   LDR r0,[r1]
   LDR r0,[r1,-r2]
   LDR r0,[r1,#4]

4(a) Draw a control data flow graph for the following segment of code.

   if (condx) bbx();
   else bby();
   bbz();
   switch (testx) {
     case c1: bbu(); break;
     case c2: bbv(); break;
     case c3: bbw(); break;
   }

   OR

4(a') What problem might occur in a shared memory process communication? How can you overcome that problem? Illustrate your answer with an example.

4(b) Explain Priority-driven scheduling in embedded system.

4(c) Explain working of I^2C Bus in embedded system.
As a network designer, consider the following two scenarios S1 and S2.

S1
Suppose users share a 1Mbps link. Also, suppose that each user alternates between periods of activity, when the user generates data at a constant rate of 100 Kbps, and the periods of inactivity when the user generates no data. Suppose further that the user is active only 10 percent of the time.

S2
Suppose there are 10 users and that one user suddenly generates one thousand packets each of 1000 bits in length while other users remain quiescent and do not generate packets.

Now, answer the following questions.

(i) For scenario S1, how many users can be supported using circuit switching? Given that the probability that out of 35 users more than 10 users are active at the same time is 0.0004. Write a mathematical expression for this probability. How many users can be supported using packet switching?

(ii) Discuss whether one should prefer circuit switching or packet switching for the above two scenarios. Justify your answer.

OR

Suppose two hosts, A and B, are separated by 10000 kilometers and are connected by a direct link of \( R = 1 \) Mbps. Suppose the propagation speed over the link is \( 2.5 \times 10^8 \) meters/sec.

(i) Calculate the bandwidth-delay product, \( R \cdot t_{\text{prop}} \).
(ii) Consider sending a file of 400,000 bits from Host A to Host B. Suppose the file is sent as one big message. What is the maximum number of bits that will be in the link at any given time?

(iii) Provide an interpretation of the bandwidth-delay product.

(iv) What is the width (in meters) of a bit in the link?

(v) Derive an expression for the width of a bit in terms of the propagation speed \( s \), the transmission rate \( R \), and the length of the link \( m \).

1(b) Consider sending a large file of \( F \) bits from Host A to Host B. There are two links (and one switch) between A and B, and the links are uncongested (that is, no queuing delays). Host A segments the file into segments of \( S \) bits each and adds \( h \) bits of header to each segment, forming packets of \( L = (S+h) \) bits. Each link has a transmission rate of \( R \) bps. Let \( S_{opt} \) be the value of \( S \) that minimizes the delay of moving the file from Host A to Host B. Show that \( S_{opt} = \sqrt{hF} \). Disregard propagation delay.

2(a) What are the services provided by Domain Name System (DNS)? A simple design for the DNS would have one DNS server that contains all the mappings. In this centralized design, clients simply direct all queries to the single DNS server, and the DNS server responds to the querying clients. What are the problems with this centralized design of DNS? Describe the distributed design of DNS. Also, with the help of suitable diagrams, describe how the DNS queries are resolved using iterated queries and recursive queries.

OR

2(a') With the help of suitable diagrams, describe the differences in the design of the following P2P file sharing systems: Napster, Gnutella, and KaZaA.

2(b) Consider an institutional network connected to the Internet. It consists of a Local Area Network (LAN) with a link bandwidth of 10 Mbps, and an access link between the institution router to the rest of the Internet of 1.5 Mbps. Suppose that the average object size is 900,000 bits and that the average request rate from the institution’s...
browsers to the origin server is 1.5 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response in two seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from the Internet router to institution router) and the average Internet delay. For the average access delay, use \( \frac{A}{1-2\lambda} \), where \( \lambda \) is the average time required to send an object over the access link and \( \lambda \) is the arrival rate of objects to the access link.

(i) Find the total average response time.

(ii) Now suppose a cache is installed in the institutional LAN. Suppose the hit ratio is 0.4. Find the total response time.

3(a) With the help of suitable diagrams, describe the design of Go-Back-N (GBN) protocol.

3(b) Consider the idealized model for the steady-state dynamics of TCP. In the period of time from when the connection's window size varies from \( W/(2\text{RTT}) \) to \( W/\text{RTT} \), only one packet is lost (at the very end of the period).

(i) Show that the loss rate, \( L \), is given by

\[
L = \frac{8}{3W(W+2)}
\]

(ii) Use the result above to show that if a connection has loss rate \( L \), then its average bandwidth is approximately given by

\[
\tau \approx \frac{MSS}{\text{RTT}} \sqrt{\frac{3}{2L}}
\]

where MSS is Maximum Segment Size.

OR

3'(a) With the help of suitable diagrams, describe the mechanism of TCP congestion control
3'(b) Consider the TCP procedure for estimating RTT. Suppose that $\alpha = 0.1$. Let $\text{SampleRTT}_1$ be the most recent sample RTT, let $\text{SampleRTT}_2$ be the next most recent sample RTT, and so on.

(i) For a given TCP connection, suppose four acknowledgements have been returned with corresponding sample RTTs $\text{SampleRTT}_1, \text{SampleRTT}_2, \text{SampleRTT}_3, \text{SampleRTT}_4$. Express $\text{EstimatedRTT}$ in terms of the four sample RTTs.

(ii) Generalize your formula for $n$ sample RTTs.

(iii) For the formula in part (ii) let $n$ approach infinity. Comment on why this averaging procedure is called an exponential moving average.

4(a) Suppose as a network designer you need to consider the pros and cons of virtual circuit (VC) and datagram networks so as to decide which one to choose for the following situations.

(i) Suppose that at the network layer, routers were subjected to stressful conditions that might cause them to fail fairly often. At a high level, what actions would need to be taken on such router failures? Does this argue in favor of VC or datagram architecture?

(ii) Suppose that in order to provide a guarantee regarding the level of performance (for example, delay) that would be seen along a source-to-destination path, the network requires a sender to declare its peak traffic rate. If the declared peak traffic rate and the existing declared traffic rates are such that there is no way to get traffic from the source to the destination that meets the required delay requirements, the source is not allowed access to the network. Would such an approach be more easily accomplished within a VC or a datagram architecture?
4(b) Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

<table>
<thead>
<tr>
<th>Destination Address Range</th>
<th>Link Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>11100000 00000000 00000000 00000000 through 11100000 11111111 11111111 11111111</td>
<td>0</td>
</tr>
<tr>
<td>11100001 00000000 00000000 00000000 through 11100001 00000000 11111111 11111111</td>
<td>1</td>
</tr>
<tr>
<td>11100001 00000001 00000000 00000000 through 11100001 11111111 11111111 11111111</td>
<td>2</td>
</tr>
<tr>
<td>otherwise</td>
<td>3</td>
</tr>
</tbody>
</table>

(i) Provide a forwarding table that has four entries, uses longest-prefix matching, and forwards packets to the correct link interfaces.

(ii) Describe how your forwarding table determines the appropriate link interface for datagrams with destination addresses:

11001000 10010001 01010001 01010101
11100001 00000000 11000011 00111100
11100001 10000000 00010001 01110111

OR

4(b') Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet 1 is required to support up to 125 interfaces, and Subnets 2 and 3 are each required to support up to 60 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints. Also provide the range of addresses for each of the three subnets.

5(a) Describe a high-level view of a generic router architecture. With the help of appropriate diagrams describe the components of a router in detail.
5(b) Describe the link-state routing algorithm and show its working for the network of Figure 1. Discuss the problem with the link-state routing algorithm with the help of a suitable example.

Figure 1: The given network for Q5 (b).