2018-19
M. TECH. (AUTUMN SEMESTER) EXAMINATION
COMPUTER ENGINEERING
NUMERICAL AND STATISTICAL TECHNIQUES
AM661

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all questions. Notations and symbols used have their usual meaning. The normal distribution table is attached.

Q.No. Question CO M.M.
1(a) Approximate $y = x$ by a function of the form $y = ae^x + be^{-x}$ in $(0,1)$ in the least square sense. (CO1) [07]

1(b) For the initial value problem $y'' - y' - 1 = 0, y(0) = 0, y'(0) = 0$, find the values of $y(0.2)$ and $y(0.3)$, by Modified Euler's method. (CO1) [08]

2(a) Consider $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0, 0 \leq x \leq 3, 0 \leq y \leq 3$ with $u(x,0) = 1 + x$, $u(0,y) = 1 + y$, $u(1,y) = y$, $u(x,1) = x$. Solve it by applying three iterations of Liebmann's method with $h = 1$. (CO2) [08]

OR

2(a') Given $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}, 0 \leq x \leq 1, t \geq 0$, with $u(0,t) = 0, u(1,t) = 0$, $u(x,0) = \sin \pi x + \sin 2\pi x$, $\frac{\partial u}{\partial t}(x,0) = 0$. Solve it up to two time levels with $h = 1/4$. (CO2) [08]

2(b) Apply three iterations to find an approximate solution of the integral equation

$$y(x) = x + \int_0^x (t - x)y(t)dt, \quad y(0) = 0.$$ Can you predict the exact solution? (CO2) [07]

3 Attempt any two parts

(a) Let $X$ and $Y$ be two random variables having the joint density function (CO3) [7.5]

...
\[ f(x, y) = \frac{1}{27} (2x + y), \text{ where } x \text{ and } y \text{ can assume only the integer values 0, 1 and 2. Find the conditional distribution of } Y \text{ for } X = x. \]

(b) Suppose that the two dimensional random variables \((X, Y)\) is uniformly distributed over \(R\), where \(R\) is defined by \(((x, y): x^2 + y^2 \leq 1, y \geq 0)\). Evaluate \(\rho_{XY}\), the correlation coefficient.

(c) An Electronic device has a life length \(T\) which is exponentially distributed with parameter \(\alpha = 0.001\), that is probability distribution function is \(f(t) = 0.001e^{-0.001t}\). Suppose that 100 such devices are tested, yielding observed values \(T_1, T_2, ..., T_{100}\).

i. What is the probability that \(950 < \bar{T} < 1100\)?

ii. What is the probability that the largest observed value exceeds 7200 hours?

iii. What is the probability that the shortest time to failure in less than 10 hours?

4 Attempt any two parts

(a) In a telegraph signal the Stochastic process is defined as
\[ x(t) = 1, \text{ if the total number of points in } (0, t) \text{ is even,} \]
\[ x(t) = -1, \text{ if the total number of points in } (0, t) \text{ is odd.} \]
Let \(P(k)\) be the probability of getting \(k\) points in \((t_1, t_2)\) and
\[ P(k) = e^{-\lambda t} \frac{(\lambda t)^k}{k!}, k = 0, 1, 2, ... \text{where } t = t_2 - t_1. \]
Find auto-correlation \(R(t_1, t_2)\)

(b) Show that Random walk and Semi random binary transmission are stationary in the mean.

(c) Consider a wireless signal \(X(t)\) with auto-correlation function
\[ R_{XX}(\tau) = \frac{1}{2a} e^{-a|\tau|} \]

What is the power spectral density of the signal? Calculate the bandwidth which contains 90% of the signal power, given \(a = 5 \text{ kHz}\).
2018-19
B. TECH. (AUTUMN SEMESTER) EXAMINATION
COMPUTER ENGINEERING
SOFTWARE ENGINEERING-I
CO-601

Maximum Marks: 60 Credits: 04 Duration: Two Hours

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

1(a) Answer the following:
   i) Is software the only deliverable in a software project?
   ii) Can the software quality be assessed before the deployment?

1(b) Answer the following:
   i) How does the software development process differ from a manufacturing a product in factory?
   iii) Can we start with program construction phase in software development as soon as we get the requirements to ensure Time to delivery?

1(c) Briefly explain the Spiral model.

2(a) Should we get rid of all Software Processes in the organization if people find them an unnecessary hurdle? Explain.

OR

2(a') Describe the importance of People Management over Product, Process and Project Management in detail.

2(b) Discuss the pros and cons of Size Oriented Metrics over Function Oriented Metrics.

2(b') Explain how you can reconcile the approaches of Size Oriented Metrics and Function Oriented Metrics.

2(c) Explain with an example how to calculate Function Points.

3(a) Enumerate a few Software Design principles.

OR

3(a') Enumerate and Explain Mandel’s golden rule of UI Design.

3(b) Explain different sources that might cause defects in Software specifications.

3(b') Explain the different types of Requirement analysis models?

3(c) Explain in brief the broad design of a simple mobile messaging app (eg: Whatsapp)

4(a) Enumerate the differences between Verification and Validation.

4(b) Discuss the following with reference to integration Testing:
   i) Top Down Integration
   ii) Bottom Up Integration

4(c) Explain Regression Testing. Is Regression Testing White Box Testing or Black Box Testing.

4(c) Explain Unit Testing. Is Unit Testing still required even if we perform Systems Testing and test the Software as a whole?
1(a) Gaussian elimination, the classic algorithm for solving systems of $n$ linear equations in $n$ unknowns, requires about $\frac{1}{3}n^3$ multiplications, which is the algorithm’s basic operation.

i. How much longer should you expect Gaussian elimination to work on a system of 1000 equations versus a system of 500 equations?

ii. You are considering buying a computer that is 1000 times faster than the one you currently have. By what factor will the faster computer increase the sizes of systems solvable in the same amount of time as on the old computer?

1(b) Discuss in detail the concept of Abstract Data Types with suitable examples.

OR

1(b') Show how to implement an ADT for a Queue using two stacks $S_1$ and $S_2$. Analyse the running time of the Queue operations. What can you say about the amortized complexity?

2(a) The running time of quicksort depends on whether the partitioning is balanced or unbalanced. Suppose that the splits at every level of quicksort are in the proportion $(1 - \alpha)$ to $\alpha$ where $0 < \alpha \leq 1/2$ is a constant.

Show that the minimum depth of a leaf in the recursion tree is approximately $\frac{-\log n}{\log \alpha}$ and the maximum depth is approximately $\frac{-\log n}{\log (1-\alpha)}$

where $n$ is the number of elements to be sorted. (Ignore floor/ceiling)

2(b) With the help of suitable diagrams, explain the various rotations performed in order to maintain an AVL tree. Let $F(h)$ be the minimum number of nodes in an AVL tree of height $h$. Write a recurrence relation for $F(h)$. Find the minimum number of nodes in an AVL tree of height 3, 4 and 5 respectively.
Describe the Prim’s Minimum Spanning Tree algorithm with the help of a suitable example. Also write the pseudo code.

What is amortized analysis? How is it different from average case analysis? Suppose we perform a sequence of $n$ operations on a data structure in which the $i^{th}$ operation costs $i$ if $i$ is an exact power of 2, and 1 otherwise. Use aggregate analysis to determine the amortized cost per operation.

What are the similarities and differences between the greedy and dynamic programming approaches to solve optimization problems in general? Discuss with suitable example(s).

Describe the rod-cutting problem. Show that it satisfies the necessary conditions for applying dynamic programming and develop a solution (pseudo code) for the problem using bottom-up approach.

Suppose there is a data file of 100000 characters containing only the characters from the set \{a, b, c, d, e, f\} with frequency (in thousand) of each character as indicated below:

\[
\begin{align*}
  a &: 45, \\
  b &: 13, \\
  c &: 12, \\
  d &: 16, \\
  e &: 9, \\
  f &: 5
\end{align*}
\]

Represent the six characters using fixed length coding and Huffman coding techniques. Find the percentage reduction in the number of bits required to encode the file using Huffman coding as opposed to fixed length coding.

Discuss any three page replacement algorithms and their advantages and disadvantages.

Write a detailed note on deadlock prevention and deadlock avoidance.
2018-19  
M.TECH. (AUTUMN SEMESTER) EXAMINATION  
COMPUTER ENGINEERING  
INTERACTIVE COMPUTER GRAPHICS  
CO-609  

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours  

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

Q.No.  
1  Write very brief answers for any FIVE of the following:  
   i) Enumerate the differences between LED and AMOLED displays.  
   ii) What is Projected Capacitive Touch screen and how does it work?  
   iii) What is the role of LEDs in LED Monitors/Televisions?  
   iv) Define Field of view and depth of field of a camera.  
   v) What is the role of computer graphics in security?  
   vi) Demonstrate how a plane can be defined by a point and two vectors or by three points in Affine Space.  
   vii) Define Pixels Per Degree (PPD) and how is it related to Retina Display?  
   viii) Distinguish between 4K and 5K resolution.  

2(a) Give the taxonomy of Planer Geometric Projections and briefly describe each type of projection.  

2(b) Derive Perspective Transformation for an object at \((x, y, z)\) with view plane on x-y plane and observer at \((0, 0, -d)\). How should the perspective view be obtained if the observer moves around in space in front of the view plane?  

OR  

2'(a) Derive reflection of an arbitrary square positioned in positive octant about  
   (i) XZ Plane  
   (ii) A plane that passes through origin and makes an angle \(\theta\) with the XZ plane.  

contd... 2.
2'(b) Give a list of hidden surface removal algorithms. Apply Warnock's Area Coherence Algorithm for hidden surface removal to the given polygons in Figure 1, and illustrate the solution.

Figure 1.

3(a) Using four control points prove that De Casteljau's algorithm results in an expression that is same as that of a Bezier curve for same number of control points.

3(b) With the help of some control points explain how Bezier surfaces are modelled.

4(a) With suitable example explain Cohen Sutherland line clipping algorithm. How does Liang-Barsky Clipping algorithm accept or reject the line segments?

OR

4(a') Derive Mid-Point Circle algorithm. Suggest an efficient method for drawing circles with a thickness of 3 pixels.

4(b) What are specular highlights and how are they modelled? Explain Phong's Illumination model and list its limitations.
Answer all questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

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<th>Q.No.</th>
<th>Question</th>
<th>CO</th>
<th>M.M.</th>
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<tr>
<td>1(a)</td>
<td>Explain regularity and modularity in system design.</td>
<td>(CO1)</td>
<td>[04]</td>
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<td>1(b)</td>
<td>What are different design styles? Which design style gives the best performance of the system?</td>
<td>(CO1,CO2)</td>
<td>[06]</td>
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<td>1(c)</td>
<td>What are the factors considered for calculating and setting maximum clock frequency of a sequential system?</td>
<td>(CO2)</td>
<td>[05]</td>
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<td>2(a)</td>
<td>Generate minimized state diagram for a sequence detector that detect binary sequence “11011”. Transform the state diagram into VHDL code using algorithmic modelling style.</td>
<td>(CO2,CO3)</td>
<td>[09]</td>
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<td>OR</td>
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<tr>
<td>2(a')</td>
<td>What are the different levels of design abstraction in structural and behavioural domain? Arrange and explain them from highest to lowest level of abstraction.</td>
<td>(CO2)</td>
<td>[09]</td>
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<tr>
<td>2(b)</td>
<td>What are the uses of Attributes in VHDL? Give and explain three predefined signal attributes and four vector attributes.</td>
<td>(CO3)</td>
<td>[06]</td>
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<td>3</td>
<td>Write VHDL function for adding two bits along with a carry bit and store the function and its specification in a package. How that function is invoked in VHDL Program? Write VHDL code for invoking the</td>
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<td><strong>function.</strong></td>
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<td><strong>OR</strong></td>
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<td><strong>3'</strong> Write Resolution function for wired-OR logic; keep the function and its specification in a package. What is overloading of a function? Describe pure and impure functions.</td>
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<td><strong>4(a)</strong> Write VHDL code for 4:1 MUX and its test-bench, generate and apply stimulus for some input combination and all possible &quot;select&quot; inputs of the MUX.</td>
<td>(CO4) [10]</td>
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<td><strong>4(b)</strong> Write the user defined physical &quot;type&quot; for Capacitance and Resistance.</td>
<td>(CO4) [05]</td>
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<td><strong>OR</strong></td>
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<td><strong>4(b')</strong> What are different Delay models in VHDL, give the format of each.</td>
<td>(CO4) [05]</td>
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## Table 1

Values of the Standard Normal Distribution Function

\[ \Phi(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-t^2/2} dt = P(Z \leq z) \]

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