2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
NUMERICAL & STATISTICAL TECHNIQUES
(AM – 661)

Maximum Marks: 75

Note: (i) Answer five questions, selecting atleast two questions from each section.
(ii) The normal distribution table is provided with the question paper.

SECTION – A

1 (a) Obtain the least squares approximation of the form \( y = a e^{bx} \) to the data

<table>
<thead>
<tr>
<th>( x )</th>
<th>0.5</th>
<th>1.0</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>0.57</td>
<td>1.46</td>
<td>5.10</td>
<td>7.65</td>
<td>9.20</td>
</tr>
</tbody>
</table>

(b) Obtain the least squares approximation of the form \( y = a + bx + cx^3 \) for the function \( f(x) = \sqrt{x} \) on \([0,1]\). (7+8)

2 (a) Solve: \( \frac{dy}{dx} = yz + x, \quad \frac{dz}{dx} = xz + y \), given that \( y(0) = 1, z(0) = -1 \) to find the values of \( y \) and \( z \) at \( x = 0.2 \) by choosing \( h = 0.2 \) applying Modified Euler’s Method.

(b) Solve: \( y'' = xy' - y \), \( y(0) = 3, \ y'(0) = 0 \) to approximate \( y(0.2) \) by taking \( h = 0.2 \), applying Runge-Kutta method of order 4. (7+8)

3 (a) Solve: \( \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0 \) in \( 0 \leq x \leq 3, \ 0 \leq y \leq 3 \) given that \( u(0,y) = 0 \), \( u(x,0) = \frac{1}{2}x^2 \) and \( u(x,3) = x^2 \).

Chose \( k = h = 1 \).

(b) Using Crank-Nicholson’s scheme, solve

\[
\frac{\partial^2 u}{\partial x^2} = 16 \frac{\partial u}{\partial t}, \quad 0 < x < 1, \quad t > 0.
\]

Given \( u(x,0) = 0 = u(0,t) \)

\( u(1,t) = 50t \)

compute \( u \) for two steps in \( t \) direction taking \( h = 0.25 \). (7+8)

4 (a) Solve \( \frac{\partial^2 u}{\partial t^2} = 4 \frac{\partial^2 u}{\partial x^2} \) with the boundary conditions \( u(0,t) = 0 = u(4,t) = \frac{\partial u}{\partial x}(x,0) \)

and \( u(x,0) = x(4-x) \). Calculate \( u \) for two steps in \( t \) direction.

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

\[
y(x) = 1 + x + \int_0^x (x-s)y(s)ds, \ y(0) = 1.
\]

Is it possible to get the exact solution. (8+7)
SECTION - B

5 (a) For the following two dimensional discrete random variable distribution of 
      \((X,Y)\) find \(i) \ P(X \leq 1, \ Y = 3) \) \(ii) \ P(Y \leq 2) \) 
      \(iii) \ P(X \leq 1, \ Y = 2) \)

\[
\begin{array}{c|ccc}
X & 1 & 2 & 3 \\
\hline
1 & 1/12 & 1/6 & 0 \\
2 & 0 & 1/9 & 1/5 \\
3 & 1/18 & 1/4 & 2/15 \\
\end{array}
\]

(b) Let \((X,Y)\) be a two dimensional continuous random variable with probability 
    distribution function \(f(x, y) = K (xy + y^2), \ 0 \leq x \leq 1, \ 0 \leq y \leq 2.\)

Find \(i\) the value of \(K, \) \(ii) \ P (Y > 1), \) \(iii) \ P (X+Y) \leq 1 \)

6 (a) Let \(X\) and \(Y\) be independent random variables having pdf \(g(x) = e^{-x}, \ x \geq 0 \)

and \(h(y) = 2e^{-2y}, \ y \geq 0 \)

\(= 0, \ y < 0 \)

Find the pdf of \(U = X+Y\)

(b) Suppose that \(X\) and \(Y\) are independent random variables with pdf's 

\(g(x) = \frac{2}{x^2}, 1 \leq x \leq 2 \) and \(h = 2y \ 0 \leq y \leq 1 \)

Find the pdf of \(Z = XY.\)

7 Suppose that two dimensional random variable \((X,Y)\) has pdf given by 

\(f(x,y) = 2 \) for \(0 \leq y \leq x \leq 1 \)

(a) Show that the pdf of \(X\) is \(g(x) = 2x, \ 0 \leq x \leq 1 \)

(b) Show that the pdf of \(Y\) is \(h(y) = 2-2y, \ 0 \leq y \leq 1 \)

(c) Calculate \(E(X), \ E(Y)\) and \(E(XY).\)

(d) Calculate \(V(X)\) and \(V(Y)\)

(e) Calculate the correlation coefficient \(P.\)

8 (a) Let \(X\) be a random variable with \(E(X) = \mu\) and \(V(X) = \sigma^2.\) Let \(\bar{X}\) be the 
    sample mean of a sample \((X_1, X_2, \ldots, X_n)\) of size \(n.\)

Show that \(E(\bar{X}) = \mu\) and \(V(\bar{X}) = \sigma^2 / n.\)

(b) Let \(X\) be exponentially distributed with parameter \(\alpha\) is the pdf of \(X\) is 
    \(f(x) = \alpha e^{-\alpha x}.\) Find the pdf of \(K = \min \ (X_1, X_2, \ldots, X_n)\), where \((X_1, X_2, \ldots, X_n)\) 
    is a sample of size \(n,\) each \(X_i\) is having the same pdf as \(X,\) also calculate 
    \(E(X), \ V(X)\) and the cdf \(F(x)\) of \(X.\)

(c) A sample of size 10 is obtained from a random variable with distribution 
    \(N (20, 9).\) What is the probability that the sample mean exceeds 22?

****

(FIG. Enclosed)
Maximum Marks: 75

Duration: Three Hours

Note: (i) Answer all questions
     (ii) Make appropriate assumptions, if required
     (iii) Symbols and abbreviations have their usual meanings

1. (a) Differentiate between adaptive and corrective maintenance. (05)
     (b) What is typical distribution of effort across different phases of software development? (05)
     (c) Give list of intermediate products produced in Waterfall model. (05)

     OR

1’ (a) Capability Maturity Model (CMM) rates maturity of a process at one of five levels. Give names of these levels. (05)
     (b) Which software development process model would you be selecting for high risk projects and why? (05)
     (c) Discuss whether increasing the cost for enhancing the quality would reduce overall development cost and maintenance cost. (05)

2. (a) Consider that a set of Data Flow Diagrams (DFD) have to be reviewed. Prepare a checklist for review meeting. (05)
     (b) In many cases, throwaway prototypes are developed to gain better understanding of requirements. What is done to reduce the development cost of the prototype? (05)
     (c) How would you determine that majority of requirements have been understood and specified and therefore design can begin. (05)

3. (a) How is coupling between modules measured? Explain. (05)
     (b) Consider a module which searches a given integer in an array of integer. If it is found, it returns its position otherwise returns -1. Use Hoare method to specify the functionality of this module. (05)
     (c) Write a function in C which takes an array of integer as input and sorts the array in ascending order. Document your code and use good programming style. (05)

     OR

3’ (a) Specify the design of a GUI based calculator to be developed in the language of your choice. (05)
     (b) List levels of cohesion in order of their strength. (05)

Contd. ....2
(c) Write in brief about any three static analyses for verification of code which is performed by the tool.

4 (a) What is regression testing?  
(b) Give two examples of test selection and test generation criteria.  
(c) Consider a program which takes arithmetic expression as input (in string form). The expression contains integer/real constant as ops and following operators—+, -, *, / and mod. Generate test cases for testing this program.

5 (a) Why should the module with large number of parameters be carefully scrutinized?  
(b) Write short note on any two of following:  
   (i) Function Point vs KLOC  
   (ii) Software Configuration Item (SCI)  
   (iii) Halstead metric for length & volume
2010-11
M. TECH. (I SEMESTER) EXAMINATION
(COMPUTER SCIENCE & ENGINEERING)
SELECTED TOPICS IN COMPUTER SYSTEMS
(CO-602)

Maximum Marks: 75
Duration: Three Hours

Attempt any FIVE questions. Unless stated otherwise, all symbols and abbreviations have their conventional meanings. Use the C-like syntax for writing pseudocode, if needed.

1. (a) Explain the process of problem solving through step-wise refinement. With the help of an example explain the role of an ADT in problem solving. (8)

2. Give the complete description of an abstract data type QUEUE and its implementation using a circular array. (15)

3. (a) Explain the difference between abstract data types SET and DICTIONARY. (5)

(b) Write the implementation of the ADT DICTIONARY using open hashing mechanism. (10)

4. (a) Construct an NFA with $\epsilon$-moves for the regular expression $01^*+10$ and convert it into an equivalent NFA without $\epsilon$-moves and then to an equivalent DFA. (8)

(b) Convert the following $\epsilon$-NFA into a DFA and minimize the DFA. Also show the steps of conversion.

5. (a) Explain the push-down automaton. For a language $L = \{ x \mid x = ww^R \}$ the PDA is given as follows:

- $P = (\{ q_0, q_1, q_2 \}, \{ 0, 1 \}, \{ 0, 1, Z_0 \}, \delta, q_0, Z_0, \{ q_2 \})$

Write the transition function $\delta$ of the above PDA for the above language. Show the moves made by the PDA for the strings 1111, 1001, and 1110. (10)

(b) Given the following description of a Turing machine $M$, show the moves made by it for the strings 000111, 00011, 00111, 000, and 111.

$M = (\{ q_0, q_1, q_2, q_3, q_4 \}, \{ 0, 1 \}, \{ 0, 1, X, Y, B \}, \delta, q_0, B, \{ q_4 \})$

<table>
<thead>
<tr>
<th>State</th>
<th>0</th>
<th>1</th>
<th>X</th>
<th>Y</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_0$</td>
<td>$(q_1, X, R)$</td>
<td>--</td>
<td>--</td>
<td>$(q_3, Y, R)$</td>
<td>--</td>
</tr>
<tr>
<td>$q_1$</td>
<td>$(q_1, 0, R)$</td>
<td>$(q_2, Y, L)$</td>
<td>--</td>
<td>$(q_1, Y, R)$</td>
<td>--</td>
</tr>
<tr>
<td>$q_2$</td>
<td>$(q_2, 0, L)$</td>
<td>--</td>
<td>$(q_0, X, R)$</td>
<td>$(q_2, Y, L)$</td>
<td>--</td>
</tr>
<tr>
<td>$q_3$</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>$(q_3, Y, R)$</td>
<td>$(q_4, B, R)$</td>
</tr>
<tr>
<td>$q_4$</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

(Contd 2)
6. For the grammar below, attempt the following questions:
   \[
   S \rightarrow A+B \mid B \\
   B \rightarrow B\cdot C \mid C \\
   C \rightarrow aSb \mid d
   \]
   (a) Compute the sets FIRST(X) and FOLLOW(X) for each non-terminal X in the above grammar. (4)
   (b) Write the functions closure(I) and goto(I, X) where I is a set of LR(0) items and X is a grammar symbol (3)
   (c) Construct the canonical collection of LR(0) items for the above grammar. (4)
   (b) Construct the SLR parsing table for the above grammar. (4)

7. (a) What is meant by CPU scheduling? Theoretically, which is the best CPU scheduling algorithm in terms of minimum average waiting time and why it cannot be used in real scenarios? Discuss the approximation to be made for real scenarios. (8)
   (b) Explain the dining-philosophers problem and its solution. (7)
M.TECH (I SEMESTER) EXAMINATION
(COMPUTER SCIENCE & ENGINEERING)
INTERACTIVE COMPUTER GRAPHICS
(CO - 609)

Maximum Marks: 75
Duration: Three Hours

Attempt all questions. Make relevant assumptions wherever required.

1  (a) Describe **synthetic-camera** model. How is it different from pinhole camera in terms of projection? Explain using diagrams.

(b) Describe Application Programmer’s model of graphics system. What type of functions do we need in the API for computer graphics?

(c) Draw the block diagram of Graphics pipeline. Explain the components of graphics pipeline.

OR

1' (a) List and describe features of good interactive programs for computer graphics applications.

(b) Using OpenGL, write a C program to draw a triangle. Extend this program for generating the Sierpinski gasket by repeatedly subdividing the triangle into four smaller triangles by bisecting the sides and removing the middle triangle.

2 (a) What are the basic elements of viewing? With reference to OpenGL, answer the following:
   (i) What is the default view volume
   (ii) What is default model-view matrix?
   (iii) What is the default camera position?
   (iv) In what direction does the camera points?

(b) Differentiate between orthogonal projection and oblique projection.

(c) Differentiate between Specular surfaces and Diffuse Surfaces.

3 (a) Most of the geometric objects may be defined using three fundamental types: scalars, vectors, and points. How do we describe scalar, vector, and points? What's the difference between a point and a vector? Using affine space, define a line segment in parametric form. Define affine sum/addition and generalize it to include objects defined by \( n \) points \( P_1, P_2, ..., P_n \). Write the conditions under which the set of points formed by the affine sum of \( n \) points is called **convex hull**.

(b) What is homogenous co-ordinate representation? How does it avoid the difficulty in representation for points and vectors in three dimensions? Describe through examples. What is a frame?

OR

3' (a) What do you mean by rendering? What is the role of clipping during Rasterization part of graphics pipeline? Describe Cohen-Sutherland Clipping algorithm.

(b) Describe Liang-Barsky Clipping algorithm. Is it feasible to extend the Cohen-Sutherland, and Liang Barsky algorithm to three dimensions? If so, explain the extension in the conditions for these algorithms for three dimensions.
4. (a) Explain the following transformations using examples in homogenous coordinates representation.
   (i) Translation, (ii) Scaling (iii) Rotation (iv) Shear

(b) Derive the transformation matrix $M$ for the following cases
   (i) Rotation about a fixed point (ii) Rotation about an arbitrary axis.

5. (a) Explain cubic Bézier curve considering four control points: $p_0$, $p_1$, $p_2$, and $p_3$. Derive Bézier geometry matrix $M_B$. Define Blending functions and find out the blending functions for cubic Bézier curve using geometry matrix $M_B$. Discuss the suitability of Bézier curves in computer graphics as compared to Hermite curves.

(b) Explain any one of the followings:
   (i) Basic Illumination Models.
   (ii) Antialiasing of Rasterized Line segments.
2010-2011
M.TECH. (I Semester) Examination
WEB MINING AND SEARCHING
(CO-616)

Maximum Marks: 75

Duration: Three hours

Answer any five questions.

1.(a) Discuss Classification as a two step process. What is the benefit of attribute independence hypothesis in Naïve Bayesian classification? Classify the given unseen sample X= <rain, hot, high, false> in one of the class P (Play) or N (don’t play) for the data of Play-Tennis example given in Table 1 using Naïve Bayesian classification. 10

1.(b) Name some of the popular decision tree based classification algorithms. Also, mention some of the enhancements in basic decision tree induction. 05

2.(a) What is good clustering? Discuss different types of data in clustering analysis. 07

2.(b) List major clustering approaches. Write down the K-means clustering algorithm and discuss its strengths and weaknesses. 08

3.(a) What is association rule mining? List the different applications of association rule mining. Also, define support and confidence. 05

3.(b) Write down the Apriori algorithm for association rule mining. Apply the algorithm to find association rules for the data given in Table 2 with minimum support 2. 10

4.(a) What do you mean by Web content mining? Why Web content mining is sometimes called Web text mining? 05

4.(b) List different types of text data mining and discuss three in detail. 10

5.(a) Differentiate between Web text mining and Information access. What is the goal of a Web search? List the challenges of Web searching. 05

5.(b) What is a Web crawler? Write the basic crawler algorithm. What do you mean by a focused Web crawler. 05

Contd......2
5.(c) What do you mean by relevance and importance of a Web document in the Web search? How search engines rank document?

6.(a) What is PageRank of a Web page? What is the concept behind the PageRank algorithm? Write down the PageRank algorithm with damping.

6.(b) Name and discuss the difficulties of the keyword-based retrieval. Also, discuss the preprocessing tasks performed in the keyword-based retrieval systems.

7.(a) What do you mean by content-based image retrieval? What may be the possible types of queries in the content-based image retrieval? Also, discuss the concept-based approach of image retrieval.

7.(b) Name few commercial and academic CBIR systems. Draw the block diagram of a CBIR system and discuss.

### Table 1. Play-Tennis Example

<table>
<thead>
<tr>
<th>Outlook</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Windy</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
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<td>hot</td>
<td>high</td>
<td>false</td>
<td>N</td>
</tr>
<tr>
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<td>high</td>
<td>false</td>
<td>P</td>
</tr>
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<td>high</td>
<td>false</td>
<td>P</td>
</tr>
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<td>cool</td>
<td>normal</td>
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</table>

### Table 2. A Transaction Database

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<tr>
<th>Transaction ID</th>
<th>Itemsets</th>
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<tr>
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<td>A, B, D, E</td>
</tr>
<tr>
<td>20</td>
<td>A, C, D, G</td>
</tr>
<tr>
<td>30</td>
<td>A, C, D, E, F</td>
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<td>40</td>
<td>B, D, E, F, G</td>
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